

RESOURCES ON OPERATIONS RESEARCH (OR) IN HEALTHCARE

1. [Classification of OR in Healthcare applications](#)
2. [OR Tools Used in Healthcare Applications](#)
3. [Surveys and Websites](#)
4. [Specific OR in Healthcare Applications](#)
5. [Journals and Conferences](#)
6. [OR in Health Care programs](#)

1. CLASSIFICATION OF HEALTHCARE APPLICATIONS

- Prevention
 - [Vaccine selection](#)
 - [Social distancing](#)
 - [Wellness](#)
- Diagnosis
 - [Classification problems](#)
- Treatment
 - [Radiation therapy](#)
 - [Minimization of treatment time](#)
- Scheduling and planning healthcare operations
 - [Nurse scheduling](#)
 - [Appointment scheduling](#)
 - [Surgery scheduling](#)
 - [Hospital layout, capacity planning](#)
 - Patient Transportation
 - [Forecasting demand](#)

2. WIDELY-USED OR TOOLS TO ADDRESS HEALTHCARE PROBLEMS

- Optimization

References:

- i. [EK Lee, G Limo. *Optimization in Medicine and Biology*. Boca FL: Taylor and Francis Auerbach Publications 2008](#)
- ii. “Optimization Problems in Healthcare”, presentation by Martin Puterman
<http://co-at-work.zib.de/berlin2009/downloads/2009-10-07/2009-10-07-1330-MP-Health-Care-OR-1.pdf>

- Simulation
- Statistical Methods
- Queuing Models
- Dynamic Programming

3. SURVEYS AND WEBSITES

3.1. General Surveys

- INFORMS Healthcare Website: includes history and references
<https://www.informs.org/Explore/History-of-O.R.-Excellence/O.R.-Application-Areas/Health-Care>
- [EK Lee, G Lim. *Optimization in Medicine and Biology*. Boca FL: Taylor and Francis Auerbach Publications 2008](#)
- ‘Operations Research in Healthcare: A Review’ by S. Priyan
<https://juniperpublishers.com/jojph/pdf/JOJPH.MS.ID.555561.pdf>
- ‘Operations Research in Healthcare: A Survey’ by A. Rais and A. Viana
<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-3995.2010.00767.x>
- ‘Optimization Problems in Healthcare’, by Martin Puterman
<http://co-at-work.zib.de/berlin2009/downloads/2009-10-07/2009-10-07-1330-MP-Health-Care-OR-1.pdf>
- ‘Mathematical Programming Models for Optimization of Medical Decision Making’, by Brian Denton
<http://btdenton.engin.umich.edu/wp-content/uploads/sites/138/2019/06/Vietnam-2019.pdf>

3.2. Scheduling and planning healthcare operations

- ‘The state of the art of **nurse rostering**’ by E. Burke, P. De Causmaecker , G. Vanden Berghe, H. Van Landeghem (2004). Journal of Scheduling 7: 441-499.
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.2058&rep=rep1&type=pdf>
- ‘**Nurse scheduling**’ by G. Lim (2012). In R. Hall, editor, Handbook of Health Care System Scheduling, Springer International Series in Operations Research & Management Science, Springer, New York, USA pp. 31-64.

- ‘**Appointment scheduling** in health care: Challenges and opportunities’ by D. Gupta and B. Denton. <https://btdenton.engin.umich.edu/wp-content/uploads/sites/138/2015/08/Gupta-2008.pdf>
- ‘**Operating room planning and scheduling**: A literature review’ by B. Cardoen, E. Demeulemeester, J. Belien (2010). European Journal of Operational Research 201(3): 921-932.
- ‘A note on challenges and opportunities for Operations Research in **hospital logistics**’ by T. Melo, [Technical Reports on Logistics of the Saarland Business School](#).
- ‘Four methodologies to improve healthcare **demand forecasting**’ by MJ Côté and SL Tucker. <https://pubmed.ncbi.nlm.nih.gov/11351811/>

4. OR IN HEALTH CARE APPLICATION EXAMPLES

- Radiation Therapy.** An important application of optimization in medicine. The goal is to determine a set of directions and intensities of radiation beamlets such that a sufficiently large dose is delivered to tumor cells and a sufficiently small dose to healthy areas.

References:

- [EK Lee, G Lim. *Optimization in Medicine and Biology*. Boca FL: Taylor and Francis Auerbach Publications 2008](#), Chapters 7-10
- ‘Radiotherapy Treatment Design and Linear Programming’ by Allen Holder, in [Operations Research and Health Care: A Handbook of Methods and Applications](#), pp 741-774.
- ‘Mathematical Programming Models for Optimization of Medical Decision Making’, by Brian Denton (slides 7-11) <http://btdenton.engin.umich.edu/wp-content/uploads/sites/138/2019/06/Vietnam-2019.pdf>

- Surgery Scheduling** can be solved as an application of a discrete optimization problem, Extensible Bin Packing. The bins are operating rooms, and the items are the operations to be performed on patients.

Reference:

B.T. Denton, A.J. Miller, H.J. Balasubramanian, and T.R. Huschka. [Optimal allocation of surgery blocks to operating rooms under uncertainty](#). Operations research, 58(4-part-1): 802–816, 2010.

- Optimization of Kidney Transplants** can be formulated and solved as a Matching problem using integer programming or combinatorial algorithms.

References:

- ‘Mathematical Programming Models for Optimization of Medical Decision Making’, by Brian Denton (slides 16-23)
<http://btdenton.engin.umich.edu/wp-content/uploads/sites/138/2019/06/Vietnam-2019.pdf>
- [EK Lee, G Limo. *Optimization in Medicine and Biology*. Boca FL: Taylor and Francis Auerbach Publications 2008](#), Chapter 6: Optimization over Graphs for Kidney Paired Donation.

iv. **Classification and Disease Prediction** via Mathematical Programming. Linear programming is used for solving the problem.

Reference:

[EK Lee, G Limo. *Optimization in Medicine and Biology*. Boca FL: Taylor and Francis Auerbach Publications 2008](#), Chapter 1.

v. **Minimization of total treatment time.** Integer programming solution is given for a specific application.

Reference:

G. Wake, N. Boland, and L. Jennings. Mixed integer programming approaches to exact minimization of total treatment time in cancer radiotherapy using multileaf collimators. *Computers and Operations Research*, 36(3) 2009, pages 795-810.

vi. **Vaccine selection problem.**

Important direction in problems related to the prevention of diseases. The problem has been extensively studied. Integer programming and stochastic dynamic programming have been developed for the following specific applications: vaccine procurement and delivery for childhood immunization; resource allocation problem for HIV prevention; optimization of influenza vaccine selections.

References:

- JT Wu, LM Wein, AS Perelson (2005) Optimization of influenza vaccine selection. *Operations Research* 53: 456-476.
- SR Earnshaw, K Hicks, A Richter, A Honeycutt (2007) A linear programming model for allocating HIV prevention funds with state agencies: A pilot study. *Health Care Management Science* 10: 239-252.

vii. **Exercise scheduling.**

Reference:

V. Melkonian, ["An Optimization Model for Exercise Scheduling"](#)
American Journal of Operations Research, Vol. 9(1), 1-14, 2019.

viii. **Applications in social distancing.**

Reference:

V. Melkonian, ["Mathematical Models for a Social Partitioning Problem"](#)

5. JOURNALS AND CONFERENCES

INFORMS Healthcare Conference

<https://www.informs.org/Meetings-Conferences/INFORMS-Conference-Calendar/INFORMS-Healthcare-Conference-2021>

Healthcare Management Science

<https://www.springer.com/journal/10729>

Operations Research for Healthcare

<https://www.journals.elsevier.com/operations-research-for-health-care>

IIE Transactions on Healthcare Systems Engineering

<https://www.tandfonline.com/toc/uhse21/current>

6. OPERATIONS RESEARCH IN HEALTHCARE PROGRAMS

Georgia Institute of Technology

Center for Operations Research in Medicine and Healthcare

<https://www2.isye.gatech.edu/~evakylee/medicalor/index.htm>

North Carolina State University

Health Systems Engineering Certificate Program

<https://www.ise.ncsu.edu/current-students/hsecp/>