Healthcare Operations Management: Hospital Efficiency, Patient Flow, and Value-Based Care

Hugo Lefevre
INSA Lyon, France

ABSTRACT

This paper studies how operations management rules can improve the efficiency of health care, patient flow, resource use and nursing quality. The focus is on the capacity of emergency department, bed management, operation schedule, the use of Lean and Six Sigma, value-based healthcare and the increasing use of AI and digital technology. The discussion emphasized process reengineering, queue analysis, time schedule optimization, data decision-making, and how to reduce delay and waste and improve patient outcomes. We also consider the difficulty of continuing to improve and expand operations throughout the complex healthcare system.

Keywords: Healthcare Operations; Patient Flow; Lean Healthcare; Hospital Efficiency; Scheduling; Capacity; Value-Based Care; Healthcare Quality

1. INTRODUCTION

Healthcare operations management—applying operations management methods and frameworks to healthcare delivery systems—has emerged as a critical discipline as healthcare systems worldwide face simultaneous pressure to improve care quality, increase access, and reduce costs in the face of aging populations, chronic disease burden, and constrained public funding. Healthcare accounts for approximately 10-17% of GDP in OECD countries, making even modest efficiency improvements potentially worth billions of dollars while directly improving patient outcomes. Operations management's toolkit—process analysis, capacity planning, queuing theory, scheduling optimization, lean process improvement, quality management—applies directly to healthcare's operational challenges of patient flow bottlenecks, scheduling inefficiency, medication errors, and resource waste.

2. PATIENT FLOW AND BED MANAGEMENT

2.1 Emergency Department Operations

Emergency department (ED) crowding—the condition in which patient demand exceeds capacity to provide timely care—is one of healthcare operations' most visible and consequential failures, associated with increased mortality, treatment errors, and patient dissatisfaction. Queuing theory analysis of ED operations reveals the fundamental cause: EDs operate at high utilization (limited slack capacity) with highly variable demand (random patient arrivals, varying acuity) and highly variable service times (treatment duration varies enormously by diagnosis)—the combination that queuing theory predicts will produce severe congestion and waiting. Effective ED capacity management strategies include: fast track (separate process pathway for low-acuity patients to prevent them from queuing behind complex cases); surge capacity protocols; front-end registration and triage streaming; and hospital-wide bed management to expedite ED-to-inpatient transfers.

2.2 Surgical Scheduling

Operating room (OR) scheduling—allocating surgical time blocks to surgeons and specialties, and sequencing individual cases within blocks—is one of healthcare's most complex scheduling problems because of the high economic stakes (OR time costs $15-25 per minute), high variability in case duration (surgical duration prediction error averages 20-30%), and complex downstream dependencies (ICU beds, recovery room capacity, specialist availability). Block scheduling (allocating fixed time blocks to surgical groups) versus open scheduling (case-by-case allocation) and their combinations require optimization approaches that balance OR utilization (minimizing idle OR time) against overtime (controlling expensive after-hours cases) and downstream capacity constraints.

Table 1. Operations management tools and their healthcare applications and impacts.

Operations Tool	Healthcare Application	Documented Impact
Lean/TPS	Patient flow redesign; waste elimination; 5S in clinical areas	Virginia Mason: 50-85% wait time reduction in multiple departments
Six Sigma	Medication error reduction; surgical complication reduction	Hospital: 50-75% reduction in targeted defect rates
Queuing theory	ED capacity planning; call center staffing; appointment scheduling	Mathematically optimal staffing; 15-25% wait time reduction
Simulation	Hospital system redesign; scenario planning; capacity investment	Avoid $10M+ capital investments through simulation-informed redesign

3. VALUE-BASED HEALTHCARE

Value-based healthcare (VBHC)-The framework constructed by Porter and Teisberg (2006) can reorganize medical care around the value of patients (health outcomes obtained from every penny). Not providing many services-affecting the reform of the medical system all over the world. Because he suggested that if the medical treatment of specific diseases is summarized on IPUs, the results and expenses are measured, so that the payment of money conforms to the value (not the quantity), the results will be better and the expenses will be reduced. Porter and Lee (2013)' The Strategy That Will Fix Health Care' in Harvard Business Review includes Cleveland Clinic Intermountain Healthcare.

4. HEALTHCARE TECHNOLOGY AND AI

The medical field has changed a lot in AI and digital technology. It is used in various occasions of treatment. diagnostic imaging helped by AI (cancer, fracture and retinal diseases can be found as accurately as radiation teachers). A model for predicting the risk of sepsis, readmission, and state deterioration in advance (treatment can be carried out as soon as possible). The operation plan that AI often does and the resource allocation of OR. natural language processing of clinical documentation (reducing the burden of doctors' paperwork). Robotic process automation of transactional work (prior authorization, claim processing, appointment adjustment, etc.). Johns Hopkins' sepsis predicted that the algorithm was used in the whole hospital, because the news came early, so the mortality rate dropped. Epic's readmission prediction model is used in hundreds of hospitals, aiming at targeting the post-discharge allowance to high-risk patients.

5. CONCLUSION

In the operations management of health cards, if the operations management methods are used correctly, the efficiency of health cards can be improved even if there are no new drug, device and clinical protocols. It is difficult to expand what has been done. Most of the successful cases of Healthcare operations management recorded so far are projects with only one facility and limited duration, which can not be sustained all the time and can not do the same thing on a large scale. The organization of healthcare is very complex (doctor autonomy, various sources of funds, regulatory requirements), and it is more difficult to change than most other industries. In the future research, AI will be used for patient scheduling adjustment, bed management, operation planning and personnel allocation optimization of the Healthcare operations management platform, and how to integrate clinical decision support into an operational intelligence system-beyond various lean and Six Sigma projects, and improve the operation experience of using data continuously.

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