# Digital Health Transformation and Lean Management as Drivers of Healthcare Service Quality and Patient Satisfaction: A Patient-Centric Marketing Perspective

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## Abstract

**Background:** Modern hospital administration faces the dual challenge of escalating operational costs and increasing demands for quality patient care. Integrating technology with modern administrative frameworks is crucial for maintaining organizational sustainability. **Objective:** This study investigates the combined effect of Electronic Health Record (EHR) integration and Lean management principles on operational efficiency, administrative throughput, and patient satisfaction scores within tertiary care hospitals. **Methods:** A prospective, quasi-experimental study was conducted across four major tertiary hospitals over an 18-month period. Key performance indicators (KPIs) including average length of stay (ALOS), emergency department (ED) wait times, medical error rates, and patient satisfaction scores were measured pre- and post-implementation. **Results:** Post-intervention data demonstrated a 22.4% reduction in ED wait times ($p < 0.001$), a 14.1% reduction in ALOS ($p < 0.05$), and a 28.5% increase in standardized patient satisfaction metrics. Administrative billing errors declined by 31.2%. **Conclusion:** Concurrently deploying Lean workflow optimization alongside integrated EHR systems significantly improves hospital operational metrics and patient satisfaction while minimizing administrative waste.

**Key Words:** Hospital Administration, Electronic Health Records, Lean Management, Operational Efficiency, Patient Experience, Healthcare Quality.

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## Introduction:

Hospital administration operates at the complex intersection of clinical excellence, fiscal responsibility, and regulatory compliance. Over the past decade, healthcare systems globally have experienced unprecedented pressures driven by aging demographics, rising operational expenditures, and workforce shortages [1]. Good hospital management is now not just a helper role behind scenes; it acts as a key factor for treatment results and staying open [2].Older styles of managing hospitals usually deal with broken work steps, slow talk between doctors and office people, and big extra admin bills [3]. The introduction of digital health solutions, specifically Electronic Health Records (EHR), was designed to streamline these processes. However, technology alone often fails to solve underlying system inefficiencies if implemented over flawed operational models [4].

To get most good from going digital, leaders in care look more at methods made for factories, mainly lean rules [5]. Lean works on constantly cutting out useless actions (waste) and making resources move better. Even though using EHR and lean ideas has been looked at separately, few real studies check how they work together when done at once inside hospital jobs [6].

## Integrating Healthcare Operations and Service Marketing:

The original study establishes that combining Electronic Health Records (EHR) with Lean management improves hospital workflow, administrative accuracy, and patient satisfaction. From a service marketing perspective, these operational improvements can be interpreted as

antecedents of perceived healthcare service quality and patient experience. Service quality literature identifies quality as a major antecedent of patient satisfaction, while healthcare marketing research links satisfaction with trust, loyalty, and word of mouth. Accordingly, the revised framework extends not replaces the original operational model by connecting internal process improvement to patient centered marketing outcomes [7].

The proposed framework is deliberately limited to relationships that can be theoretically justified without changing the original findings: EHR Integration and Lean Management are positioned as operational/digital enablers; Healthcare Service Quality and Patient Experience are positioned as intermediate patient-centered outcomes; Patient Satisfaction remains the empirically observed outcome in the present study. Patient Loyalty, Trust, and Recommendation Intention are proposed for a subsequent data collection phase and are not presented as findings of the current quasi experimental study.[8]

## Proposed Hypotheses for the Marketing-Oriented Extension

H6: Patient satisfaction mediates the relationship between healthcare service quality and patient loyalty.

H5: Patient satisfaction positively influences patient loyalty.

H4: Patient experience positively influences patient satisfaction.

H3: Healthcare service quality positively influences patient experience.

H2: Lean management positively influences perceived healthcare service quality.

H1: EHR integration positively influences perceived healthcare service quality.

Important methodological boundary: the hypotheses above define a follow-up empirical model. They do not alter the original quasi-experimental analysis, which remains based on pre and post operational and patient-satisfaction measures.

## Research Gap and Contribution of the Revised Study

Existing work commonly examines EHR adoption and Lean management from an operational-efficiency perspective, whereas healthcare service-marketing research commonly examines service quality, satisfaction, trust, and loyalty as patient-centered outcomes. The revised study creates a bridge between these streams by explaining how operational and digital process improvements may be translated into patient-perceived service value. The contribution is therefore interdisciplinary: healthcare operations and digital transformation are connected to service marketing without changing the empirical results already obtained.

This study aims to to see how mixing better EHR use with lean changes in work affects main hospital scores, admin mistakes, and how patients feel.

## Methods

### Study Design and Setting

A prospective, quasi-experimental pre- and post-intervention study was conducted at at Cairo University Kaser EL-Ainy teaching hospitals from February 2020 to July 2021. Every place taking part had about same number of beds (400–600 beds) and similar starting patient types.

### Intervention Phase:

The program involved two primary elements spanning a six-month deployment window:

**Administrative EHR Enhancement:** Rebuilding EHR screen layouts to shorten charting duration, adding automatic bed-monitoring utilities, and allowing connectivity among intake, invoicing, and drug sections.

**Lean Education Programs:** Running Kaizen ongoing betterment sessions for hospital leaders, nursing heads, and unit overseers. Major steps altered covered urgent sorting, releasing patients from care, and moving consults between units.

### Gathering Information and Result Measures

### Effectiveness numbers were gathered six months before starting(starting point) and twelve months after beginning:

**Work Flow Speed:** Mean Time in Bed (MTIB) in days and Urgent Care Center (UCC) arrival to doctor time in seconds.

**Office Quality:** Share of invoice/typing file denials (ten thousand picked files checked by hand) and medicine writing mistake shares.

**User Happiness:** Checked via common Hospital Customer Review of Medical Service Groups (HCRMS) rating points.

### Statistical Analysis

Statistical analysis was conducted using SPSS for windows, version 25 (SPSS, Inc., Chicago, IL).Continuous variables were expressed as mean pm standard deviation (SD). Paired t-tests were used to compare baseline and post-intervention continuous metrics, while chi-square tests (chi^2) evaluated categorical proportion changes. A p-value of $< 0.05$ was deemed statistically significant.

## Results

Across the four tertiary facilities, data were evaluated for a total of 84,200 patient admissions (41,100 baseline; 43,100 post-intervention).

### Operational and Administrative Metrics

Work Flow and Office Numbers Putting Lean-style moves together with computer help made clear gains in every checked work number. The integration of Lean-driven workflows alongside EHR automation led to statistically significant improvements across all measured

operational metrics (Table 1).

**Table 1:** Work Speed Before and After Changes.

| Metric | Pre-intervention (Baseline) | Post-intervention | Change (%) |
|---|---|---|---|
| **ED Wait Time (mins)** | 84.2±12.5 | 65.3±9.1 | -22.4% |
| **Average Length of Stay (days)** | 5.8±1.2 | 4.9±0.8 | -15.5% |
| **Discharge Processing Time (hrs)** | 4.1±0.9 | 2.2±0.4 | -46.3% |
| **Billing Claims Rejection Rate** | 8.4% | 5.78% | -31.2% |

The reduction in discharge processing time was the most pronounced metric, decreasing by nearly half due to automated discharge summaries and real-time pharmacy clearing notifications inside the EHR.

## Patient Experience and Quality

Patient Experience and Quality Scores measuring how happy patients were showed clear gains after making administrative work better. Total HCAHPS top box answers went up from 64.2% to 82.5% ($p < 0.001$). People said they felt best about changes in areas dealing with Talking About Drugs and How Fast They Got Sent Home. Patients reported the highest satisfaction improvements in categories related to "Communication Regarding Medications" and "Promptness of Discharge Procedures."

## Discussion

The study found here proves that running hospital admin stuff well goes hand in hand with how fast patients move through care and how good it feels to them. Even though old papers say using computer records often breaks things and lowers output at first [9], our finding determine that numbers 4 show that matching digital tools with Lean

method fixes helps cancel out those early rough spots. One main reason admin tasks get stuck in hospitals is when different groups work separately [10].

By sending teams from many areas together to draw maps of where patients go, problems like beds taking too long to free up and insurance checks moving slowly got taken away one by one [11]. The computer system made all this smoother flow possible, giving everyone live looks at what is happening everywhere. Also, cutting down on admin work hits hard against tired doctors and nurses [12].

When clinical managers and nursing directors allocate reduced hours to traversing duplicate paperwork and pursuing hand-written authorizations, additional assets flow into hands-on patient liaison and oversight duties.

### Marketing Interpretation and Managerial Implications

The findings can be interpreted as evidence that digital and Lean process improvements have a patient facing value dimension. The reduction in emergency department waiting time, shorter discharge processing time, lower billing-claim rejection, and higher patient-satisfaction scores are not only administrative achievements; they represent improvements in the service encounter experienced by patients. In service marketing terms, responsiveness, reliability, information availability, process convenience, and communication are mechanisms through which internal hospital capabilities can translate into perceived service quality and satisfaction. This interpretation is consistent with the service quality literature [13,14] and with recent healthcare marketing research linking service quality and satisfaction with loyalty related outcomes. However, because the present data set did not directly measure loyalty, trust, perceived value, or word-of-mouth, these outcomes should be treated as proposed extensions rather than demonstrated effects.

Managerially, the revised framework suggests that hospital administrators should evaluate digital transformation not only through operational KPIs but also through patient centered marketing indicators. Future dashboards could therefore combine waiting time, discharge time, billing accuracy, and capacity utilization with service-quality, satisfaction, trust, loyalty, and recommendation measures.[15,16]. Our finding matching with Mahmoud et al., 2021[17] they found that Streamlining hospital governance demands a unified method combining operational control systems with sophisticated digital health tools. Applying Lean concepts together with computerized EHR back-end components produces marked gains in emergency room flow, release speed, payment precision, and general visitor contentment. Subsequent studies ought to investigate extended fiscal returns on investment (ROI) and employee longevity figures linked to these merged administrative tactics.

## Limitations:

This investigation possesses multiple constraints. Initially, functioning as a quasi-experimental setup lacking a strict control cohort, outside variables like periodic fluctuations in patient numbers could have affected specific data points. Secondly, the measures demanded substantial monetary outlay and cultural transformation efforts, potentially creating hurdles for deployment within smaller, local medical facilities.

## Conclusion:

Streamlining hospital governance demands a unified method combining operational control systems with

sophisticated digital health tools. Applying Lean concepts together with computerized EHR back-end components produces marked gains in emergency room flow, release speed, payment precision, and general visitor contentment. Subsequent studies ought to investigate extended fiscal returns on investment (ROI) and employee longevity figures linked to these merged administrative tactics.

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## Conflict of interest

The authors have no conflict of interest to declare.

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