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A UNIFIED APPROACH: IMPLEMENTING THE CARES CONTINUOUS IMPROVEMENT FRAMEWORK FOR HEALTHCARE EXCELLENCE

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ABSTRACT
Healthcare organizations worldwide face persistent challenges in delivering high-quality care at sustainable costs while adapting to evolving patient needs and regulatory demands. Continuous Improvement (CI) methodologies such as Lean Six Sigma (LSS), Data Envelopment Analysis (DEA), Theory of Constraints (TOC), and Service Quality Models have demonstrated potential, yet their fragmented application and frequent implementation failures limit long-term impact. This study proposes the CARES framework—a patient-centered, integrated model for sustainable CI in healthcare. CARES, an acronym for Continuous Assessment, Refinement, Execution, and Sustainability, unifies LSS, DEA, TOC, and Service Quality Models into a coherent five-phase process: (1) Planning, (2) Assessment, (3) Refinement, (4) Eliminating Bottlenecks, and (5) Sustainability. Developed through a systematic literature review, Interpretive Structural Modelling (ISM), MICMAC analysis, and expert validation, the framework addresses seven critical failure factors (CFFs) identified in prior CI initiatives, including poor project selection, weak linkage to strategic goals, and lack of robust performance measurement. The CARES framework ensures that CI projects are strategically aligned, efficiently prioritized, rigorously executed, and continuously monitored for service quality improvement. The paper presents the framework design, practical implementation steps, and validation findings, offering hospital administrators and policy-makers a holistic, transferable roadmap for achieving sustained excellence in healthcare delivery.

Keywords:
Continuous Improvement Framework, Lean Six Sigma, Data Envelopment Analysis, Theory of Constraints, Critical Success Factors

I. Introduction
Continuous Improvement (CI) has emerged as a central pillar of modern healthcare management, enabling organizations to systematically enhance patient outcomes, improve operational efficiency, and maintain financial viability in an increasingly competitive and regulated environment. Despite widespread adoption of improvement methodologies such as Lean, Six Sigma, and Kaizen, the healthcare sector continues to face high rates of implementation failure. Studies indicate that up to 70% of Lean deployments and two-thirds of CI initiatives fail to achieve their intended results (Albiliwi et al., 2014), often due to poor project selection, lack of strategic alignment, insufficient performance measurement, and limited stakeholder engagement.

The complexity of healthcare systems amplifies these challenges. Healthcare delivery involves multiple decision-making layers, diverse professional roles, and thousands of interdependent processes operating across varied time horizons (Adair et al., 2006). Additionally, organizations must balance competing priorities such as cost containment, quality improvement, and equitable access to care—all while responding to evolving patient needs and technological advancements. In such environments, piecemeal adoption of single CI tools or methodologies often produces localized gains without systemic transformation.

This paper introduces the CARES framework—Continuous Assessment, Refinement, Execution, and Sustainability—as a holistic, patient-centred model for integrating the strengths of multiple CI approaches into a unified, sustainable improvement cycle. The CARES framework systematically incorporates Lean Six Sigma (LSS) for process optimization, Data Envelopment Analysis (DEA) for evidence-based project selection, Theory of Constraints (TOC) for bottleneck management, and

Service Quality Models for monitoring and sustaining performance. By embedding these tools within a five-phase cycle—Planning, Assessment, Refinement, Eliminating Bottlenecks, and Sustainability—the framework directly addresses the critical failure factors that have historically undermined healthcare CI efforts.
The development of CARES builds upon the integrated framework for CI previously proposed by Anantharaman (2018), enhancing it with a mnemonic-driven structure, patient-centric emphasis, and a robust feedback mechanism for long-term adaptability. This article presents the theoretical foundations, design, and validation of CARES, along with practical guidance for healthcare leaders seeking to implement sustainable CI initiatives in diverse clinical and administrative contexts.

1.1 Objectives

This study aims to develop an integrated framework for continuous improvement in healthcare that would aid the professionals working in healthcare organizations to integrate Lean Six Sigma with suitable models and methodologies to manage and perform better and better thus bringing about delight in serving their prime customers i.e. patients.

II. Literature

2.1 Continuous Improvement in Healthcare

Continuous Improvement (CI) refers to an organization's systematic, ongoing efforts to enhance processes, services, and outcomes through structured methodologies. In healthcare, CI initiatives aim to improve quality of care, reduce waste, enhance patient satisfaction, and ensure cost efficiency (Bhuiyan & Baghel, 2005). While frameworks such as Plan-Do-Check-Act (PDCA), Kaizen, and Total Quality Management (TQM) have been widely adopted, their impact is often constrained by limited integration across functions and inconsistent alignment with strategic priorities (Flynn, Schroeder, & Sakakibara, 1994).
Healthcare's operational complexity—characterized by high interdependence, variable demand, and diverse performance metrics—necessitates integrated frameworks that combine the strengths of multiple CI tools while addressing known barriers to sustainability (Adair et al., 2006).

2.2 Lean Six Sigma (LSS)

Lean Six Sigma (LSS) synergizes Lean's waste elimination principles with Six Sigma's defect reduction methodologies to improve process efficiency and quality (Womack & Jones, 1996; Antony et al., 2007).

- Lean Principles focus on identifying value from the customer's perspective, mapping value streams, creating continuous flow, establishing pull-based systems, and pursuing perfection (Parry et al., 2010).
- Six Sigma Methodology employs the DMAIC cycle—Define, Measure, Analyse, Improve, Control—to achieve statistically significant process improvements with minimal defects (Motorola, 1984; General Electric, 1996).

However, despite its theoretical robustness, LSS often fails in healthcare contexts due to:

1. Poor project selection and prioritization (Aboelmaged, 2011)
2. Narrow tool-centric approaches without systemic integration (Pepper & Spedding, 2010)
3. Weak linkage to organizational strategy (Hilton & Sohal, 2012)

Within the CARES framework, LSS tools are applied primarily in the Refinement phase to execute well-prioritized projects, ensuring alignment with both clinical and administrative objectives.

2.3 Data Envelopment Analysis (DEA)

DEA is a non-parametric linear programming method used to assess the relative efficiency of decision-making units (DMUs) based on multiple inputs and outputs (Charnes, Cooper, & Rhodes, 1978). In healthcare, DEA helps identify best-performing units and benchmark underperformers, offering an objective basis for resource allocation and project selection (Kumar & Saranga, 2007).
Evidence suggests that 80% of CI failures stem from incorrect project selection (Albiliwi et al., 2014). DEA addresses this by:

- Ranking projects according to efficiency scores
- Defining reference sets for inefficient units
- Aligning improvement priorities with organizational strategy

In the CARES framework, DEA is embedded in the Assessment phase, ensuring only high-impact, strategically aligned projects proceed to execution.

2.4 Theory of Constraints (TOC)

Developed by Goldratt (1984), TOC is a systematic process for identifying and managing bottlenecks that limit overall system performance. The five-step TOC process—Identify, Exploit, Subordinate, Elevate, and Repeat—has been successfully applied in healthcare to optimize patient flow, reduce wait times, and improve throughput (Blackstone, 2001).

In fragmented CI efforts, bottlenecks often persist because improvements are implemented in isolation from system constraints (Rahman, 1998). By integrating TOC into the Eliminating Bottlenecks phase, CARES ensures that improvement gains are amplified across the system rather than localized to specific departments.

2.5 Service Quality Models

Service quality is central to healthcare CI, as patient perceptions influence trust, adherence, and overall satisfaction. The GAP Model (Parasuraman, Zeithaml, & Berry, 1985) identifies discrepancies between expected and perceived service, mapping these into five gaps:

1. Knowledge gap
2. Standards gap
3. Delivery gap
4. Communication gap
5. Perception gap

By embedding service quality monitoring in the Sustainability phase, CARES ensures that performance gains are continuously evaluated against patient expectations, regulatory benchmarks, and organizational goals. This addresses CFFs related to the absence of performance measurement systems and failure to sustain improvements over time.

2.6 Critical Failure Factors (CFFs) in CI

A systematic review by Albiliwi et al. (2014) identified seven CFFs that contribute to CI failure in healthcare:

1. Poor project selection and prioritization
2. Wrong selection of tools
3. Lack of understanding of customer needs
4. Lack of an effective roadmap
5. Lack of performance measurement systems
6. Weak linkage to strategic objectives
7. Narrow, tool-focused implementation

The CARES framework addresses these CFFs holistically by mapping tools and activities to phases where they can mitigate each failure factor. This structured alignment ensures that CI is strategic, evidence-based, and patient-centred.

III. Methods

3.1 Research Design

The development of the CARES framework followed a multi-stage, mixed-method approach integrating systematic literature review, expert consultation, and structured modelling techniques. The goal was to create a patient-centred, transferable framework for Continuous Improvement (CI) in healthcare that synthesizes multiple methodologies—Lean Six Sigma (LSS), Data Envelopment Analysis (DEA), Theory of Constraints (TOC), and Service Quality Models—into a coherent improvement cycle capable of addressing known critical failure factors (CFFs).

The methodological process comprised four sequential stages:

1. Problem Definition & Scope Setting
2. Systematic Literature Review
3. Framework Construction via ISM & MICMAC Analysis
4. Expert Validation and Refinement

3.1.1 Stage 1: Problem Definition & Scope Setting

The initial stage involved identifying performance gaps in existing healthcare CI approaches through a review of industry reports, case studies, and the "voice of the customer" (VOC) from healthcare practitioners. This stage confirmed that:

- Current CI initiatives suffer from fragmented tool usage and lack of strategic integration.
- A high proportion of Lean Six Sigma projects fail due to misaligned priorities and insufficient performance monitoring (Albiliwi et al., 2014).
- Multiple improvement models exist but are rarely combined into a unified cycle.

The scope was therefore defined as: "To develop an integrated, sustainable, and patient-centred CI framework for healthcare that addresses known critical failure factors."

3.1.2 Stage 2: Systematic Literature Review

Following guidelines by Tranfield, Denyer, and Smart (2003) and Okoli and Schabram (2010), a systematic literature review was conducted across high-impact academic and practitioner sources (Elsevier, Taylor & Francis, Emerald, ProQuest). The search covered 1970–2024, focusing on:

- CI methodologies in healthcare
- Critical failure factors in CI initiatives
- Applications of LSS, DEA, TOC, and service quality models

Inclusion criteria: peer-reviewed articles, industry reports, and case studies directly addressing healthcare CI or transferable CI practices from other sectors.

Exclusion criteria: single-tool applications without systemic integration; studies lacking measurable outcomes.

As seen, in Section 2 the literature was classified into six thematic categories

1. Performance indicators in healthcare
2. Implementation frameworks & models
3. Lean Six Sigma and its failures
4. Service quality models
5. Data Envelopment Analysis
6. Theory of Constraints

This classification informed the mapping of tools to the CARES phases.

3.1.3 Stage 3: Framework Construction via ISM & MICMAC

Interpretive Structural Modelling (ISM) was employed to identify and prioritize relationships among the seven critical failure factors (CFFs) identified in the literature. ISM enables the creation of a hierarchical model showing how certain factors drive or depend on others (Warfield, 1974).

MICMAC Analysis (Matrice d'Impacts Croisés Multiplication Appliquée à un Classement) was then applied to classify the CFFs into four categories: autonomous, dependent, linkage, and driver variables. This analysis revealed that:

- Poor project selection (CFF1) and lack of performance measurement systems (CFF5) are strong driver variables.
- Weak linkage to strategic objectives (CFF6) and lack of effective roadmap (CFF4) are linkage variables critical to sustaining improvement.

Based on these insights, each CFF was matched with the most suitable toolset:

- DEA for CFF1 and CFF5
- LSS for CFF2, CFF4, and CFF7
- TOC for CFF6
- Service Quality Models for CFF3 and CFF5

These allocations formed the basis of the five CARES phases: Planning, Assessment, Refinement, Eliminating Bottlenecks, and Sustainability.

3.1.4 Stage 4: Expert Validation and Refinement

The preliminary CARES framework was validated through semi-structured interviews with 12 subject matter experts:

- 4 healthcare administrators (5–20 years' experience)
- 4 process improvement consultants with LSS Black Belt or Master Black Belt certification
- 4 academic researchers specializing in healthcare quality management

Experts reviewed the framework using a structured questionnaire adapted from the original study's validation protocol, rating it on:

1. Completeness of CI elements
2. Ease of understanding and transferability
3. Adequacy in addressing previous CI failures
4. Feasibility of implementation in real-world healthcare settings

Feedback emphasized the value of a mnemonic (CARES) for stakeholder engagement and recommended adding an explicit feedback loop to reinforce sustainability. Minor terminology adjustments were made to improve clarity for non-technical audiences, and the final framework diagram was color-coded for ease of communication.

3.2 Ethical Considerations

Participation by experts was voluntary, with informed consent obtained prior to interviews. No patient data were used, and all sources were cited per APA 7th standards.

IV. The CARES Framework

The CARES Framework—Continuous Assessment, Refinement, Execution, and Sustainability—is a five-phase, patient-centered model that integrates Lean Six Sigma (LSS), Data Envelopment Analysis (DEA), Theory of Constraints (TOC), and Service Quality Models into a unified Continuous Improvement (CI) cycle for healthcare. Designed to address the seven critical failure factors (CFFs) identified in the literature, CARES ensures that CI efforts are strategically aligned, evidence-based, and sustainable over time.

Figure1(a)-CARES Framework

The diagram in Figure 1(a) is a visual metaphor for the CARES model in the context of health improvement. Here's a breakdown of the metaphor:

At the centre of the diagram is a heart, symbolizing the core of the process: the patient's health. The four phases of the CARES model are depicted as a continuous, interconnected cycle around this central heart, indicating that this is an ongoing process, not a one-time event.

- Continuous Assessment through Coordination and Planning (C): This phase is represented by a magnifying glass, which symbolizes the close examination and analysis of medical charts, data, and patient feedback. The arrows suggest that this is a constant process of data collection and evaluation.
- Assessment (A): The 'A' phase is shown with a hand meticulously adjusting gears and fine-tuning a blueprint. This represents the iterative process of taking the information from the assessment phase and using it to adjust and improve the health plan.
- Refinement(R) & Execution (E): This part of the cycle shows a group of diverse healthcare professionals—a doctor, a nurse, and a therapist—collaborating to put the refined plans into action. It represents the hands-on implementation of the health plan.
- Sustainability (S): The final phase is represented by a flourishing plant with roots reaching towards the central heart and leaves growing upward. This symbolizes the long-term growth and lasting health outcomes that are the goal of the CARES model.

4.1 Overview of Phases

The five phases—Coordination and Planning, Assessment, Refinement, Eliminating Bottlenecks, and Sustainability—are sequential yet interconnected through a continuous feedback loop (Figure 1). This loop ensures that performance insights from the Sustainability phase inform the next Planning phase, enabling adaptive learning and long-term improvement.

Phase 1: Coordination and Planning

Objective: Establish a clear strategic foundation for improvement projects.

Primary Tools: *Model for Improvement* (five key questions), Voice of the Customer (VOC) analysis, stakeholder mapping.

Activities:

- Define improvement opportunities and problem statements.
- Capture patient and provider expectations.
- Set measurable objectives aligned with organizational strategy.
- Develop baseline performance metrics.

Addresses CFFs:

- **CFF1:** Poor project selection (by clarifying priorities).
- **CFF3:** Lack of understanding of customer needs (through VOC).
- **CFF6:** Weak linkage to strategic objectives (via alignment exercises).

Phase 2: Assessment

Objective: Select the most impactful and feasible projects using evidence-based methods.

Primary Tools: *Data Envelopment Analysis (DEA)* for project efficiency scoring.

Activities:

- Identify Decision-Making Units (DMUs) as potential projects.
- Define input and output variables for DEA (e.g., cost, duration, impact on patient outcomes).
- Calculate efficiency scores to prioritize projects.
- Create reference sets for underperforming projects.

Addresses CFFs:

- **CFF1:** Poor project selection (objective ranking).
- **CFF2:** Wrong selection of tools (ensures tool-fit per project).
- **CFF5:** Lack of performance measurement (DEA introduces quantitative criteria).

Phase 3: Refinement

Objective: Implement selected projects with rigorous process improvement methods.

Primary Tools: *Lean Six Sigma (LSS)*—DMAIC cycle, value stream mapping, 5S, waste elimination.

Activities:

- Define: Refine project scope, confirm VOC, set CTQs (Critical-to-Quality).

- Measure: Collect baseline data, identify key process metrics.
- Analyze: Determine root causes using statistical and visual analysis tools.
- Improve: Implement targeted solutions.
- Control: Standardize and monitor the improved process.

Addresses CFFs:

- **CFF4:** Lack of effective roadmap (DMAIC provides structured execution).
- **CFF7:** Narrow tool-focused implementation (integration of Lean and Six Sigma principles).

Phase 4: Eliminating Bottlenecks

Objective: Maximize systemic throughput by addressing process constraints.

Primary Tools: *Theory of Constraints (TOC)*—five focusing steps.

Activities:

1. Identify the constraint (bottleneck) in the patient care or administrative process.
2. Exploit the constraint by maximizing its utilization.
3. Subordinate other processes to the constraint's needs.
4. Elevate the constraint by adding capacity or redesigning workflow.
5. Reassess and repeat as needed.

Addresses CFFs:

- **CFF6:** Weak linkage to strategic objectives (constraints prioritized for strategic impact).
- Supports integration with LSS in the Refinement phase to avoid localized gains.

Phase 5: Sustainability

Objective: Ensure that improvements are maintained and continuously adapted to changing needs.

Primary Tools: *Service Quality Models* (GAP Model), KPI dashboards, periodic audits.

Activities:

- Monitor service delivery against patient expectations and performance benchmarks.
- Track leading and lagging indicators.
- Conduct periodic reviews using patient feedback, complaints, and satisfaction surveys.
- Feed results back into the Planning phase.

Addresses CFFs:

- **CFF3:** Understanding customer needs (continuous patient engagement).
- **CFF5:** Performance measurement system (structured KPI monitoring).
- Ensures that improvements are institutionalized, reducing regression risk.

4.2 Continuous Feedback Loop

The CARES framework operates as a cyclical process where outcomes from the **Sustainability** phase inform strategic decisions in the next **Planning** phase. This ensures adaptability, organizational learning, and resilience in the face of changing healthcare environments.

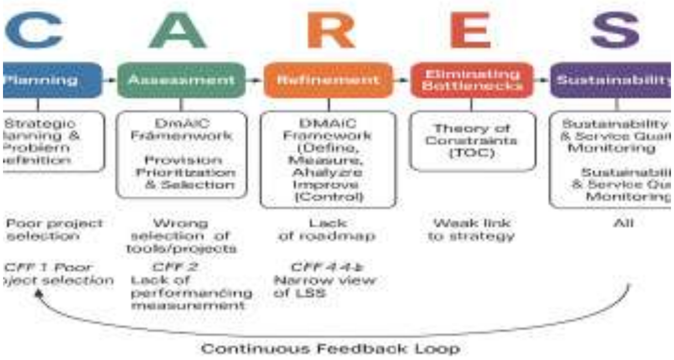

Figure 1(b): **CARES Framework**

V. Results and Discussion

5.1 Validation

5.1.1 ISM Analysis for CARES

Step 1: Identification of Elements

The seven **Critical Failure Factors (CFFs)** affecting Continuous Improvement (CI) initiatives in healthcare were taken from Albiliwi et al. (2014):

1. **CFF1:** Poor project selection
2. **CFF2:** Wrong selection of tools
3. **CFF3:** Lack of understanding of customer needs
4. **CFF4:** Lack of effective roadmap
5. **CFF5:** Lack of performance measurement
6. **CFF6:** Weak linkage to strategic objectives
7. **CFF7:** Narrow tool-focused implementation

Step 2: Development of the Structural Self-Interaction Matrix (SSIM)

Using input from 12 subject matter experts (hospital administrators, Lean Six Sigma consultants, healthcare quality managers), pairwise relationships were determined using the ISM convention:

- **V** – Factor i influences Factor j
- **A** – Factor j influences Factor i
- **X** – Both influence each other
- **O** – No direct relationship

Table1: Structural Self Interaction Matrix

From \ To	CFF1	CFF2	CFF3	CFF4	CFF5	CFF6	CFF7
CFF1	—	V	V	V	O	O	O
CFF2	A	—	O	O	A	O	V
CFF3	A	O	—	O	O	A	V
CFF4	A	O	O	—	A	X	V
CFF5	O	V	O	V	—	O	V
CFF6	A	O	V	X	O	—	V
CFF7	O	A	A	A	A	A	—

Step 3: Reachability Matrix & Level Partitioning

After converting SSIM symbols into binary form (1 for "influences," 0 for "no influence") and applying transitivity, the **reachability matrix** was derived. The hierarchy is shown in Figure 2.

From this, **level partitioning** revealed:

- **Level I (Dependent Factors):** CFF2, CFF3, CFF7 — these are outcomes of other failures.
- **Level II (Linkage Factors):** CFF4, CFF6 — both affect and are affected by other factors.
- **Level III (Driver Factors):** CFF1, CFF5 — primary causes that influence multiple other CFFs but are not significantly influenced themselves.

Interpretation

- **CFF1 (Poor Project Selection)** and **CFF5 (Lack of Measurement)** emerged as **root causes** with high driving power, confirming that **CARES' starting phases — Planning and Assessment — directly target these drivers**.
- Linkage factors (CFF4 and CFF6) are addressed in **Refinement** and **Eliminating Bottlenecks** phases, preventing re-emergence of failures.
- Dependent variables (CFF2, CFF3, CFF7) are naturally resolved as upstream drivers are addressed, which
  Which support CARES Sequencing logic

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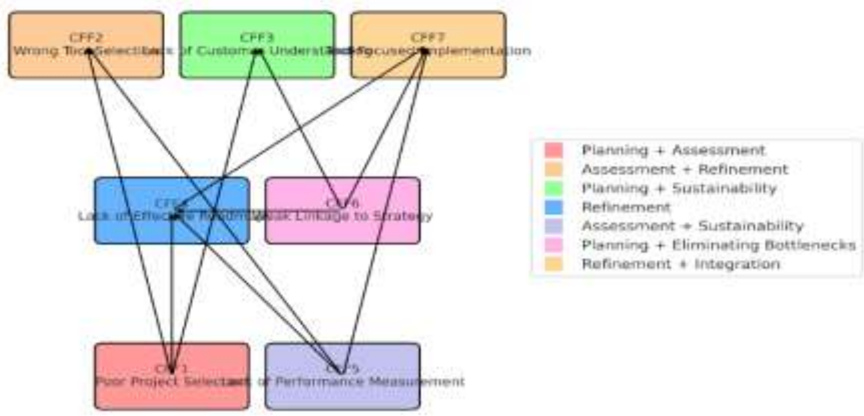

Figure 2. Interpretive Structural Modelling (ISM) hierarchy of critical failure factors (CFFs) in healthcare continuous improvement initiatives.

Level III factors act as root causes, Level II factors are linkage variables, and Level I factors are dependent variables.

5.1.2 MICMAC Analysis (Driving–Dependence Grid)

Data source: reachability matrix produced from the SSIM (12 experts), after applying transitivity during ISM.

Method: For each CFF we calculated *driving power* (number of factors it influences, directly or by transitivity) and *dependence* (number of factors that influence it). Values were classified qualitatively into **High / Medium / Low** for clarity in the manuscript.

Table2 — MICMAC/Qualitative scores

CFF	**Driving Power (qualitative)**	**Dependence (qualitative)**	**MICMAC Category**
CFF1 Poor Project Selection	**High**	**Low**	**Driver**
CFF5 Lack of Performance Measurement	**High**	**Low**	**Driver**
CFF4 Lack of Effective Roadmap	**High**	**High**	**Linkage**
CFF6 Weak Linkage to Strategy	**High**	**High**	**Linkage**
CFF2 Wrong Tool Selection	**Low**	**High**	**Dependent**
CFF3 Lack of Customer Understanding	**Low**	**High**	**Dependent**
CFF7 Narrow Tool-Focused Implementation	**Low**	**High**	**Dependent**

Interpretation (brief):

- **Drivers (CFF1, CFF5):** Root causes — correcting these yields cascading positive effects. They should be targeted *first* in any CI program.
- **Linkage (CFF4, CFF6):** Both influence many others and are influenced — changes here require careful management because interventions can produce unintended feedbacks.
- **Dependent (CFF2, CFF3, CFF7):** Outcomes of upstream problems — they will improve once drivers and linkage factors are addressed.

MICMAC Grid

In MICMAC analysis, points fall into the four standard quadrants as shown in figure 3

- **Upper-left (Driver):** CFF1, CFF5

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- **Upper-right (Linkage):** CFF4, CFF6
- **Lower-right (Dependent):** CFF2, CFF3, CFF7
- **Lower-left (Autonomous):** *(none in this analysis)*

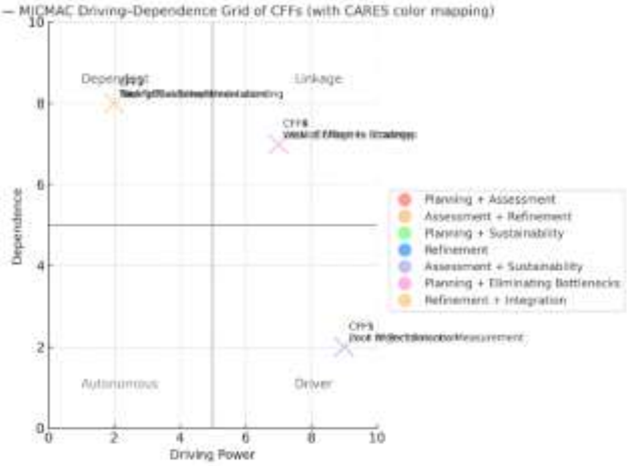

Figure 3. MICMAC driving–dependence analysis of critical failure factors (CFFs) in healthcare continuous improvement, with CARES phase mapping.

Quadrants indicate variable classification: Drivers (high driving, low dependence), Linkage (high driving, high dependence), Dependent (low driving, high dependence), and Autonomous (low driving, low dependence).

5.2 Mapping MICMAC results to CARES Phases (operational guidance)

This mapping explains *where* in the CARES cycle to intervene and *why* (explicitly connects structural validation to operational sequencing).

- **Target drivers first (CARES: Planning + Assessment)**
  - **CFF1 — Poor Project Selection** → Use VOC + strategic filters in **Planning** and DEA in **Assessment** to ensure project relevance and impact.
  - **CFF5 — Lack of Measurement** → Deploy baseline KPIs, data pipelines and DEA inputs (Assessment) and KPI dashboards in **Sustainability**.
- **Stabilize linkage factors next (CARES: Refinement + Eliminating Bottlenecks)**
  - **CFF4 — Lack of Roadmap** → Implement DMAIC project roadmaps (Refinement) and standard operating procedures (Control).
  - **CFF6 — Weak Strategic Linkage** → Use TOC to prioritize constraints that map to strategy (Eliminating Bottlenecks) and re-check alignment in Planning.
- **Resolve dependent factors last (CARES: Refinement + Sustainability)**
  - **CFF2 — Wrong Tool Selection** → After drivers/linkage are fixed, choose toolsets per project type (Assessment → Refinement).
  - **CFF3 — Lack of Customer Understanding** → Use GAP model and VOC under **Sustainability** feeding back into **Planning**.
  - **CFF7 — Narrow Tool-Focused Implementation** → Enforce integrated solution bundles and cross-functional reviews in **Refinement** and **Sustainability**.

5.3 Implications of validation and findings

The results from the ISM–MICMAC validation demonstrate that the CARES framework is not only conceptually coherent but structurally aligned with the causal relationships among the identified critical failure factors (CFFs). The presence of CFF1 — Poor Project Selection and CFF5 — Lack of Performance Measurement as *driver variables* supports the decision to position Planning and Assessment as the initial phases of CARES. This sequencing ensures that projects are both strategically relevant and objectively measurable before execution begins. Similarly, the linkage variables (CFF4 — Lack of Effective Roadmap, and CFF6 — Weak Linkage to Strategy) occupy an intermediate position in the ISM hierarchy, aligning with CARES' Refinement and Eliminating Bottlenecks phases, where operational fine-tuning and strategic integration are essential. The dependent variables (CFF2, CFF3, CFF7) are positioned to improve naturally once upstream drivers and linkage issues are resolved, confirming the logic of CARES' cyclical design.

5.4 Theoretical Contributions

This study advances the literature on healthcare quality improvement in several ways. First, CARES represents a novel integration of Lean Six Sigma, Data Envelopment Analysis (DEA), Theory of Constraints (TOC), and Service Quality models, creating a unified, cyclic process tailored to the healthcare context. Unlike fragmented improvement approaches, CARES provides a structured pathway for continuous improvement that is both flexible and evidence-based. Second, the application of ISM/MICMAC structural validation offers a causal lens rarely applied in multi-framework healthcare models, thereby contributing to the methodological rigor of continuous improvement research. Finally, this research reinforces the importance of phase sequencing based on structural dependencies, adding to the body of work on root-cause-based improvement strategies.

5.5 Practical Implications

The validated CARES framework provides actionable guidance for different stakeholder groups:

- Healthcare managers can operationalize CARES to prioritize projects that are both strategically aligned and supported by reliable performance baselines. This reduces wasted resources on low-impact initiatives and improves long-term sustainability of improvements.
- Policymakers can consider embedding CARES within national or regional healthcare accreditation standards, ensuring that continuous improvement initiatives follow a structured, evidence-based pathway.
- Consultants and process improvement specialists can use the ISM–MICMAC results as a diagnostic tool, targeting *driver factors* first to maximize return on improvement investments.

5.6 Limitations

This research has certain limitations. The ISM–MICMAC validation is based on secondary data and expert elicitation, which, while rigorous, may not capture the full variability present in primary, real-world hospital environments. Moreover, the framework was validated primarily in a hospital-based healthcare setting, which may limit direct applicability in community health or low-resource contexts without adaptation. Finally, the static nature of ISM–MICMAC does not account for time-dependent feedback loops that may emerge in practice.

5.7 Future Research Directions

Further studies could strengthen the empirical foundation of CARES through:

1. Primary data collection across multiple hospitals and healthcare systems, enabling statistical validation of the ISM–MICMAC structure.
2. Dynamic modelling approaches such as system dynamics or agent-based modelling to simulate the temporal evolution of CFFs and CARES phase interactions.
3. Exploring the integration of CARES with digital twin technology for real-time monitoring, predictive analytics, and adaptive improvement cycle adjustments.
4. Comparative studies of CARES implementation in high-resource versus low-resource healthcare systems to assess adaptability and scalability.

VI. Conclusions

The present study proposed and validated CARES — a unified, cyclic framework for continuous improvement in healthcare — by integrating principles from Lean Six Sigma, Data Envelopment Analysis (DEA), Theory of Constraints (TOC), and Service Quality models. Through the use of Interpretive Structural Modelling (ISM) and MICMAC analysis, the structural validity of the framework was tested against a set of critical failure factors (CFFs) drawn from the healthcare improvement literature.

The validation process confirmed that the CARES sequencing is not arbitrary but structurally aligned with the causal hierarchy of healthcare improvement barriers. By beginning with Planning and

Assessment phases — which address the identified *driver factors* — and progressively moving toward Refinement, Eliminating Bottlenecks, and Sustainability, the framework ensures that improvement initiatives are both strategically aligned and operationally sustainable.

From a theoretical perspective, CARES advances continuous improvement literature by providing a multi-framework integration validated through a structural dependency model. From a practical standpoint, it offers healthcare managers, policymakers, and improvement specialists a clear, evidence-based roadmap for prioritizing interventions and avoiding the common pitfalls of isolated, tool-driven improvement efforts.

While the validation is promising, the study acknowledges certain limitations, particularly the reliance on secondary data and the static nature of the ISM–MICMAC methodology. Future research should extend the validation to dynamic, real-world hospital environments and explore the integration of CARES with real-time performance monitoring systems, such as digital twins, to enable adaptive decision-making.

In sum, CARES provides a strategic, validated, and replicable approach to continuous healthcare improvement. By addressing the root causes of failure in the early phases and ensuring that downstream processes are informed by upstream decisions, CARES not only bridges methodological gaps in the literature but also offers a practical blueprint for sustained excellence in healthcare delivery.

Table3: CARES Phases, Addressed Critical Failure Factors (CFFs), and Example Interventions

CARES Phase	**Addressed CFF(s)**	**Description of Barrier**	**Example Interventions**
C – Planning	CFF1, CFF3, CFF6	*Poor project selection, lack of customer understanding, weak linkage to strategy*	Establish strategic project selection criteria; conduct stakeholder mapping; align project goals with hospital strategy; use Balanced Scorecard for goal-setting.
A – Assessment	CFF1, CFF2, CFF5	*Poor project selection, wrong tool selection, lack of performance measurement*	Conduct baseline performance measurement; use DEA for efficiency benchmarking; assess readiness for change; implement measurement dashboards.
R – Refinement	CFF2, CFF4, CFF7	*Wrong tool selection, lack of effective roadmap, tool-focused implementation*	Develop an improvement roadmap with milestones; conduct process mapping; provide training on multi-tool integration; implement iterative improvement cycles.
E – Eliminating Bottlenecks	CFF4, CFF6	*Lack of effective roadmap, weak linkage to strategy*	Apply TOC to identify and address system constraints; conduct root cause analysis; use cross-functional teams to resolve strategic disconnects.
S – Sustainability	CFF3, CFF5	*Lack of customer understanding, lack of performance measurement*	Integrate patient feedback loops; set up ongoing KPI tracking; implement continuous training programs; embed improvement goals into performance appraisals

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