

Assessing alignment of organizational practices with operational excellence principles: evidence from an eye hospital setting

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Abstract

Purpose – Health-care systems are increasingly challenged by chronic diseases, rising costs and aging populations. To improve efficiency, many organizations have adopted methodologies from manufacturing, such as Lean and Six Sigma, yet sustaining such initiatives remains difficult. In contrast, practices that evolve organically within organizations often prove more sustainable. This study aims to assess the alignment of organizational practices with principles of operational excellence (OE) and examine their association with key performance outcomes in a hospital setting.

Design/methodology/approach – A structured questionnaire was developed to assess adherence to operational practices based on the continuous process improvement (CPI) dimension in Shingo's model of OE. A survey was conducted among 62 professionals across 16 departments, including clinical and administrative



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roles, in a large eye hospital. Outcome data including patient satisfaction, patient safety (near misses), outpatients cycle time, process efficiency and capacity utilization were collected. Descriptive statistics, Pearson correlations and Kruskal–Wallis tests were used to analyse relationships between adherence and outcomes.

Findings – Correlation coefficients ranged from -0.33 to 0.62 , with 33 of 45 coefficients being positive. Departments with higher adherence (upper tercile) had better outcomes, particularly in process efficiency and patient satisfaction

Research limitations/implications – The questionnaire used in this study was newly developed; although it was tested for feasibility, it should be considered a preliminary framework that requires further review, refinement and validation before being applied in diverse settings. In addition, as a cross-sectional study, the findings reflect associations rather than causal relationships.

Practical implications – The findings provide actionable insights for hospital leaders and quality improvement teams seeking to enhance performance without adopting formal excellence frameworks. The structured self-assessment tool can help identify areas of alignment with CPI principles as well as gaps requiring attention. The positive association between stronger alignment and better departmental outcomes highlights the potential of addressing such gaps to drive consistent, high-quality service delivery. Importantly, the results also underscore the systemic nature of health-care delivery, where standardized processes and a culture of continuous improvement – actively involving frontline staff – are essential for sustaining outcomes.

Originality/value – This study demonstrates the feasibility of assessing alignment between existing organizational practices and concepts of OE. It highlights the value of embedding structured practices into daily workflows to sustain improved outcomes, even when an organization has not formally adopted specific methods. The findings also support using periodic assessments to guide targeted improvements. Future research should explore the role of organizational culture, team engagement, customer value and goal alignment in sustaining excellence.

Keywords Operational practices, Process optimization, Operational outcomes, Continuous process improvement, Operational excellence

Paper type Research paper

Introduction

Globally, health-care systems continue to grapple with the dual challenges of rising costs and inconsistent quality, despite the dedicated efforts of skilled professionals. For example, the US health-care system experiences significant waste – estimated to constitute approximately 25% of total health-care expenditures – arising from failures in care delivery and coordination, overtreatment and administrative complexity (Shrank *et al.*, 2019). In response, leaders and policymakers have pursued various incremental solutions, including the implementation of clinical practice guidelines, fraud prevention measures, error reduction initiatives and strategies to enhance patient engagement. Yet, these approaches have not led to substantial improvements, indicating the need for a fundamentally different strategy (Porter and Lee, 2013).

Over the past four decades, industries – especially manufacturing – have implemented a range of methodologies aimed at enhancing the quality of their products, services and processes, collectively known as “operational excellence” (OE). Notably, methodologies such as Lean, Six Sigma, ISO 9001 and Total Quality Management (TQM) have gained prominence. These methodologies emphasize a commitment to continuous improvement, waste reduction and the pursuit of high-quality outcomes, all with a focus on satisfying customer needs. Their adoption has played a pivotal role in driving organizational success and maintaining competitiveness across diverse industries (Park *et al.*, 2001; Coronado and Antony, 2002; Sony and Naik, 2011). However, the long-term sustainability of these efforts remains a challenge, even though OE programmes have shown initial success (Carvalho *et al.*, 2017).

In recent years, health-care organizations have adopted a range of methodologies derived from industrial engineering and manufacturing – such as business process redesign, the Toyota Production System (TPS), TQM, Continuous Quality Improvement, Value-Based Health care, Lean and Six Sigma. These approaches have contributed to measurable improvements in operational efficiency, waste reduction, quality enhancement, fewer medical errors, better clinical outcomes and increased safety and satisfaction for both patients and staff. However, recognizing the unique characteristics of the health-care setting is central for successful implementation. Unlike manufacturing, health-care delivery involves real-time, person-centred service provision rather than the production and storage of goods. Patients often present with complex and multiple chronic conditions (Mahajan *et al.*, 2017; Boersma *et al.*, 2018). Moreover, each patient is an individual with unique and evolving needs, making personalization and adaptability essential. Therefore, tailoring industrial methodologies to the realities of health-care dynamics is critical for achieving and maintaining OE.

Patient care can be conceptualized as a systematic process, characterized by a methodical sequence of activities executed by health-care professionals (Vijverberg *et al.*, 2023). The inherent complexity of the health-care sector – characterized by a wide range of service providers and multiple interdependent departments and staff – means that any breakdown in the care loop can adversely affect the entire continuum of patient care and lead to unnecessary costs (Rathi *et al.*, 2022). OE in health care involves streamlining and optimising the care loop to reduce the likelihood of medical errors and improve patient satisfaction and outcomes. A well-formulated strategy for OE – supported by competent implementation – can relieve management from the need to frequently intervene in daily operations. Instead, empowered staff, actively engaged in care delivery, can detect deviations from optimal performance and use standardized procedures to address and correct issues in real time (Welch *et al.*, 2016). In a system of horizontal coordination, all the staff develops comprehensive understanding of the entire work process and a shared understanding and commitment to organizational goals (Aoki, 1986).

Interestingly, organizations – including hospitals – may demonstrate strong performance outcomes despite not formally adopting established OE models. However, many of their organically developed operational practices appear inherently aligned with principles from one or more of these OE models, suggesting an implicit application of core concepts. However, the absence of formal structures may lead to practice variations across departments as these practices evolve over time, potentially influencing performance consistency. This observation informed this study's central inquiry: how can existing hospital practices be systematically assessed for alignment with established OE models, and how does such alignment relate to performance outcomes across hospital departments?

OE methodologies and frameworks commonly emphasize key dimensions such as organizational culture, continuous process improvement, enterprise alignment and performance outcomes (Rusev and Saloniitis, 2016). Among these, the continuous improvement of systems and processes is widely recognized as a cornerstone of OE (Detwal *et al.*, 2023). The Shingo Model: *The Shingo Model for Organizational Excellence* (2025) encompasses these core dimensions while placing particular emphasis on respect for individuals and the critical role of people in driving sustained improvement. This human-centred approach to OE has guided the selection of the Shingo Model as the conceptual framework for this study.

This study aimed to develop and pilot a structured instrument – adapted from the Shingo Model – to assess the degree of alignment between hospital operational practices and the continuous process improvement (CPI) principles. We also wanted to understand the role of

feedback from performance outcomes, and the influence of variation in adherence to effective practices, on ongoing refinement of processes for sustaining operational outcomes.

Conceptual framework

To illustrate these relationships, we developed a conceptual framework (Figure 1) – “An Extended Shingo-Based Framework for Operational Excellence in Healthcare”, to illustrate the relationship between effective practices for CPI and the attainment of better outcomes, ultimately driving OE. The CPI parameters are based on the Shingo model of OE ([The Shingo Model for Organizational Excellence, 2025](#)). Outcome indicators are selected to reflect the efficiency and effectiveness of processes within the hospital setting. The proposed framework postulates that OE can be achieved when effective processes and practices designed for continuous improvement are consistently followed and refined over time based on the feedback. The degree of adherence to these practices moderates the impact on outcomes variations. Feedback based on outcome and adherence level of practices drives continuous improvement.

To validate the framework, we applied it at Aravind Eye Hospital (AEH) in Madurai, India, which is acknowledged worldwide for its efficiency, high patient volume, quality of service and financial sustainability.

Methodology

Design

We conducted a survey among hospital personnel to examine current operational practices in patient care departments and their association with CPI and OE.

Study setting

AEH, established in 1976 in Madurai, India, is part of the larger Aravind Eye Care System, which operates a vast network comprising eight tertiary hospitals, eight secondary hospitals, eight community centres, and over 119 primary eye care centres across Tamil Nadu, Andhra Pradesh and Pondicherry (Aravind.org). AEH Madurai implemented an online Hospital Management System (HMS) as early as 1991 to automate patient care functions, capture clinical and operational data, and enable real-time monitoring, planning and

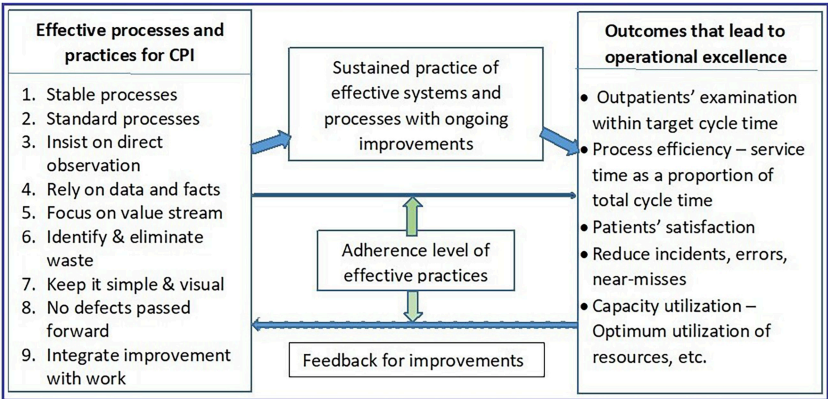


Figure 1. Extended Shingo-based framework for operational excellence in health care

decision-making. Case studies ([Rangan, 1993](#); [Manikutty and Vohra, 2003](#); [Shah and Murty, 2004](#); [Bhupinder et al., 2012](#); [Joshi, 2014](#); [Sharma \(2014\)](#); [Shaw and Hathiari, 2020](#); [Merode et al., 2024](#)) highlight AEH's operational efficiency – surgeon productivity surpassing the national average five-fold, a surgical complication rate comparable to international benchmarks and financial surplus enabling cross-subsidization and internal financing for new initiatives. Its operating room system minimizes downtime and enhances productivity. A comparative analysis with internationally recognized eye hospitals ([Table 1](#)), previously compared in 2009 ([Molema, 2009](#)), further underscores AEH's efficiency and high volume, particularly in outpatient care and surgeries per senior doctor, attributed to its effective operations management practices.

In 2016, AEH introduced a comprehensive electronic medical records (EMR) system known as eyeNotes, developed in-house using Microsoft .NET and Google Angular technologies, with a Microsoft SQL Server database backend. Reporting and dashboard functionalities are supported through HTML, SQL Server Reporting Services and Google Charts. eyeNotes enables structured documentation of all clinical findings and investigations as an integral part of the examination workflow.

AEH has institutionalized a wide range of practices aimed at identifying problems and driving continuous improvement. The eyeNotes system incorporates decision-support features that alert users to data entry errors or clinical inconsistencies based on pre-defined rules. Staff can also report events, near misses and operational issues through a dedicated tool integrated into the hospital's intranet.

The organization has embedded systems for continuous quality enhancement, real-time operational monitoring and knowledge-sharing across departments ([Ravindran et al., 2021](#); [Ganesh-Babu et al., 2023](#)). AEH has adapted lessons from high-performing organizations, including those outside the health-care domain. Practices such as 5S ([Liker and Meier 2005](#)) and daily stand-up meeting ([Stray et al., 2016](#)) were piloted in some departments over a decade ago. Regular departmental and interdepartmental meetings have been held for years to discuss challenging issues following structured problem-solving processes ([Brooks, 2022](#)), patient feedback and performance evaluations. Annual and mid-year reviews are conducted at the departmental level, involving all staff in performance assessments and goal setting. These practices have become an integral part of the work culture and systems. In recent years, AEH has initiated efforts to implement TQM ([Samson and Terziovski, 1999](#)). However, the implementation of these practices remains at an early stage and is not yet consistent across the organization.

Shingo model for operational excellence

The Shingo Model is a framework for achieving OE through the elimination of waste, the pursuit of perfection and the promotion of a culture of continuous improvement, which encompasses Lean six sigma principles. It emphasizes tenets such as respect for people, the pursuit of OE as a cultural norm and the relentless pursuit of perfection in processes. Named after Japanese industrial engineer Shigeo Shingo, this model has been widely adopted by organizations seeking to improve their operational efficiency and effectiveness. A key strength of the Shingo Model lies in its comprehensive scope, which integrates respect for individuals, a clear organizational vision and cultural transformation as foundational elements for sustained excellence ([Jiang, 2010](#); [Rusev and Salonitis, 2016](#)). By prioritizing long-term organizational outcomes and systemic improvement, the model provides a structured yet adaptable approach for embedding OE as a cultural norm ([The Shingo Model for Organizational Excellence, 2025](#)).

The model is organised into four overarching dimensions:

Table 1. Performance of eye hospitals during 2023

Details	Moorfields Eye Hospital, the UK ²	Johns Hopkins Wilmer Eye Institute, the USA ²	Royal Victorian Eye and Ear Hospital, Australia ¹	The Rotterdam Eye Hospital, the Netherlands ¹	Singapore National Eye Centre ¹	Sagamatha Choudhary Eye Hospital, Lahan, Nepal ²	Aravind Eye Hospital, Madurai ²
Total staff	2,349	470	577	545	1,107	999	1,595
Senior doctors	389	127	49	45	95	39	113
Nurses	893	33	179	52	327	151	584
Others*	903	159	349	448	685	809	680
Outpatients examined	671,542	274,121	178,490	150,000	430,000	1,054,346	1,512,032
Surgeries	37,755	14,968	9,971	14,000	27,000	127,294	193,522
Outpatients examined per senior doctor	1,726	2,158	3,643	3,333	4,526	27,034	13,871
Surgeries per senior doctor	97	118	203	311	284	3,264	1,775

Note(s): *Others Includes postgraduates, residents, postgraduate fellows, nursing trainees, administrative staff, etc, ¹Data received from the chief executive officers of these hospitals upon the authors' request, ²Data collected from published reports and websites of these hospitals

- (1) cultural enablers;
- (2) CPI;
- (3) enterprise alignment; and
- (4) results.

Given our study's emphasis on processes and the evaluation of current operational practices, we confined our assessment to the CPI dimension. This dimension includes nine supporting concepts that collectively guide process excellence:

- (1) stabilise processes – creating consistency and repeatability in the process;
- (2) reliance on data and facts – being data-driven in the pursuit of continuous improvement;
- (3) standardise processes – building control into process for maintaining improvement;
- (4) insistence on direct observation – truly understanding the process being studied;
- (5) focus on value stream – defining what customers' value;
- (6) keeping it simple and visual – solving information deficits by making them visible and simple;
- (7) identifying and eliminating waste – driving behaviour of identifying anything that slow down or interrupts the continuous flow of value to customers;
- (8) no defects passed forward – stop the process to understand the root cause and take counter measures to prevent recurring; and
- (9) integrating improvement with work – migrating towards principle-based culture to drive activities and approaches for continuous improvement become a part of everyday work.

Given its structured yet flexible approach, the Shingo Model – particularly its CPI dimension – was regarded as a robust foundation for assessing operational practices in the hospital setting. It enabled a focused examination of how routine practices align with the principles of continuous improvement and how this alignment relates to performance outcomes.

Survey instrument

We developed a questionnaire to assess the current practices associated with the nine supporting concepts of the Shingo model's CPI dimension. Each concept was measured with a set of four to six questions, resulting in a total of 43 questions ([Appendix 1](#)). In each individual department we aimed to survey a senior medical officer, a senior and a junior nursing staff member and managers or supervisors. To accommodate language preferences, the questionnaire was available in both English and Tamil. Participants could choose either version based on their comfort.

Pilot study

We piloted the survey instrument by collecting data from 12 respondents. We also obtained respondents' experiences and challenges related to understanding of questions or response categories. Respondents were also advised to identify any questions they found ambiguous or confusing, allowing for these issues to be addressed when they returned the completed survey and for the clarity of those questions to be improved.

Validity and reliability of the survey instrument

The Cronbach's alpha coefficient for each question, using an individual participant as the unit of analysis, ranged between 0.74 and 0.78. The pilot data showed that the overall instrument had acceptably high reliability (Cronbach's alpha ≥ 0.70). In response to the feedback of the pilot group, the questionnaire was refined to enhance its face validity and content validity.

Sampling for the main study and selection of participants

We included 16 patient care departments in the main study. We used convenience sampling, creating a list of potential participants who met our selection criteria and approaching them individually. If an individual was unavailable or declined to participate, the next person on the list was approached. We selected key personnel from each of the 16 patient care departments; in each department, we included a senior ophthalmologist, a manager or supervisor and a senior and a junior mid-level ophthalmic nurse. Trainees were excluded from the sample. This mix of staff levels was chosen to account for the contributions of all staff levels to the overall departmental outcomes. In total, we included 62 staff members representing the 16 departments in the sample.

Data collection

The principal investigator handed the questionnaire to each selected participant in an in-person meeting and explained its contents and the approximate time needed for completion. Participants were assured that their responses would only be used for aggregate analysis, without identifying them individually. In addition, they were instructed to not answer any questions they found unclear and mark them for clarification. Participants were given two days to return the completed questionnaire. During the collection of the completed forms, participants' doubts were addressed and the completeness of the forms was ensured.

Scoring

Each question was scored as "1" if the preferred practice was followed and "0" if it was not. In cases where multiple preferred practices were listed as options for a question, selecting any one of those options was scored as "1". After assigning scores to each question, we calculated the total score for each supporting concept of CPI for each participant, and then calculated the department-level average score.

As an example, [Table 2](#) we show below the average score calculation of two concepts – stabilise processes and standardise processes – for the cataract department:

The Cronbach's alpha coefficient of the scores for each question, using individual participants as the unit of analysis, ranged between 0.68 and 0.73 with an overall score of 0.73, which shows acceptably high reliability (Cronbach's alpha ≥ 0.70).

Outcome variables

We selected five outcome variables that are relevant to all 16 departments and reflect OE. The reports for these outcome variables were collected from the EMR system, incident reporting system and patient feedback system for the six-month period January 2023 to June 2023:

- *Patient satisfaction mean score:* The patient feedback team at AEH, Madurai, collects survey data every day from a sample of patients about their satisfaction with various service stations of the hospital. On an average 45 outpatients and 6 inpatients complete the survey daily, from a randomly selected list of patients

Table 2. Example calculation of average scores for stabilise and standardise process concepts (cataract department)

#	Respondent ID	#	Department	Stabilise processes (five questions)					Standardise processes (six questions)					
				SPQ1	SPQ2	SPQ3	SPQ4	SPQ5	STQ1	STQ2	STQ3	STQ4	STQ5	STQ6
22			Cataract	0	1	1	1	1	1	0	1	1	1	1
48			Cataract	0	1	1	1	1	1	0	1	1	1	1
39			Cataract	1	1	0	1	1	1	1	1	1	0	1
37			Cataract	1	1	1	1	1	1	1	0	1	1	1
25			Cataract	1	1	1	1	1	1	1	1	1	0	0
			Score	3	5	4	5	5	5	3	4	5	3	4
			Supporting concept level score	22					24					
			Average score per question	22/5 = 4.4					24/6 = 4.0					

registered and contacted for feedback. These sample sizes constitute 2% and 3% of the respective patient populations. Data is collected via in-person interview, website, kiosks or telephone interview. The four points on the satisfaction scale are labelled excellent, good, average and poor. In our analysis we computed a weighted mean score based on weights 100, 66.66, 33.33 and 0 for the four points, respectively (Press Ganey Association Scoring System). For this study, we analysed the responses to the overall patient satisfaction question: “How do you rate the overall experience of your visit”.

Table 3 illustrates an example of the calculation of the mean score based on the distribution of number of respondents on the satisfaction scale:

- Patient safety score: AEH has an online reporting system where anybody in the organization can access the site and register an incident, near misses or error and choose to remain anonymous or not. For example, a case where a patient is prescribed incorrect refraction values and spectacles are delivered with the wrong values is considered an incident. However, a case where the incorrect refraction value is detected when the spectacle order is booked at the optical shop (i.e. before delivery of spectacles), is classified as a near-miss. Reported problems are reviewed and a solution is developed by addressing the root cause. The solution is implemented to prevent such incidents in the future.

As a measure of patient safety, in each department we calculated a near-miss score per 10,000 outpatients examined as follows. Actual number of reported near-misses was divided by the number of outpatients handled by the clinic and then multiplied by 10,000.

Example: Total number of outpatients handled – 59,673, number of near-misses reported – 9. Safety score = $9/59,673 * 10,000 = 1.5$ per 10,000 outpatients:

- % achieved against target cycle time: each department has established specific target cycle times to track and ensure timely examinations for patients. We considered the percentage of patients who complete the examination within the target time.

Example: General ophthalmology clinics aim to complete the examination of each patient within two hours, while subspecialty clinics have a three-hour target cycle time:

- *Process cycle efficiency %*: Defined as the ratio of service time (sum of times taken to deliver services across all stations) to cycle time (total duration between the time a patient registers and the time an examiner selects “patient can go home” in the system after the visit has been completed) for a given patient. This was calculated for each patient in each department and averaged across patients. A high process cycle efficiency % indicates that a larger portion of the cycle time is spent on value-added activities, making the process more efficient.

Table 3. Methodological example illustrating the calculation of the mean score from satisfaction scale responses

Month	Excellent	Good	Average	Poor	Mean score
January’23	13	36	1	1	$((13 \times 100) + (36 \times 66.66) + (1 \times 33.33) + (1 \times 0))/51 = 73.2$

Example: A patient spent 120 min overall from registration to completion of the visit and was examined by three doctors/technicians who together spent 40 min. Therefore, the patient was waiting for service for the remaining 80 min. The process cycle efficiency is $40/120 = 33\%$:

- *Capacity utilization %*: Patients interact with multiple touch points based on their medical condition and needs. We calculated the capacity utilization of medical officers or consultants who serve as the final touch point in the patient encounter and prescribe treatments. AEH management has set the target average service time for the final doctor examination at 10 minutes per patient based on analysis of historical EMR data. This translates to a capacity to examine six patients per hour per consultant. The capacity utilization percentage was calculated based on the number of patients examined relative to the estimated capacity. In this metric we included only those days of consultants when they spent the entire day in the outpatient clinic.

Example: Target average service time for a consultant in glaucoma clinic is 10 min per patient, which translates to 42 patients per 7-hour day (after excluding breaks). If a consultant examines 30 patients in a day, capacity utilization % = $(30/42) \times 100 = 71\%$.

Data analysis

Microsoft Excel was used to record the survey data and Stata was used for data processing and analysis. Frequencies means and Pearson correlation coefficients were computed and non-parametric Kruskal–Wallis tests were performed for each concept at the department level.

Ethics approval and consent to participate

The study was performed with adherence to the tenets of the Declaration of Helsinki. Ethical clearance was obtained from the institutional ethics committee (reference number: RET202100350). The use of oral consent was deemed suitable as study participants filled the survey themselves, with measures taken to ensure participant understanding, voluntariness and confidentiality of their data. Participants were informed about data privacy and given the opportunity to ask questions before providing consent.

Results

Sample description

A total of 62 participants from 16 departments were included in the study (Table 4). The number of participants interviewed per department ranged from three to five, and the percentage of department staff interviewed ranged from 12% to 50%. Mean age of the participants is 39.6 years (range 27.8–51.5 years). The mean experience is 12.9 years (range 2.8–23.4 years). Paying General Unit-1 has the youngest team and the least average experience. Seventy-nine percent of participants were female (range from 50% to 100%).

Compliance with preferred operational practices

In Table 5, we present the mean scores of the nine supporting concepts for each department. The Kruskal–Wallis test showed that for each concept the median rank was not different between departments ($p > 0.05$ for each concept), indicating that variations between departments are not large. Overall, compliance scores for all preferred practices range from 59.4% to 81.9%.

Practice-level ranking. Practices were ranked and grouped into three terciles. The most consistently followed practices across the departments – insisting on direct observation,

Table 4. Demographic details of participants

Department	Number of staff interviewed	Number of staff in department	% of staff interviewed (%)	Mean age in years	Mean experience in years	Females (%)
Cataract clinic	5	23	22	37.0	11.1	60
Cornea clinic	4	22	18	36.8	12.9	75
Day care ward	4	8	50	42.8	23.4	100
Free new	3	11	27	38.7	15.5	100
Free review	4	10	40	51.5	10.5	50
Glaucoma clinic	5	26	19	44.0	17.0	60
Insurance	3	6	50	46.0	13.8	100
Medical records	4	16	25	42.3	10.9	75
Neuro clinic	3	7	43	44.5	17.7	67
Orbit clinic	4	10	40	32.5	9.9	100
Paediatric clinic	4	24	17	39.3	8.9	75
Preoperative clinic	4	12	33	36.0	10.8	75
Retina clinic	5	41	12	45.0	18.5	80
Paying General Unit-1	4	15	27	27.8	2.8	75
Paying General Unit-3	3	13	23	35.0	14.5	100
Uvea clinic	3	9	33	35.7	10.1	100
Total or average	62	253	25	39.6	12.9	79

Table 5. Department-level mean scores of compliances with preferred practices for the Nine supporting concepts of continuous process improvement

Departments	Stabilise processes	Standardise processes	Insist on direct observation	Focus on value stream	Keep it simple and visual	Identify and eliminate waste	No defects passed forward	Integrate improvement with work	Rely on data and facts	Total adherence score
Cataract clinic	4.4	4.0	3.0	3.4	2.0	4.2	3.6	4.2	3.0	31.8
Cornea clinic	3.8	3.6	2.4	2.8	1.8	4.0	3.4	3.6	2.6	28.0
Day care ward	3.8	3.8	3.8	2.5	1.8	4.8	2.8	4.3	2.8	30.4
Free new outpatients	3.7	4.3	3.3	3.0	3.0	4.7	4.0	4.7	3.0	33.0
Free review outpatients	2.8	3.5	3.3	2.8	1.8	2.5	2.3	3.3	2.0	24.3
Glaucoma clinic	4.8	4.2	3.2	3.8	2.4	3.6	4.4	4.0	3.2	33.6
Insurance	4.0	4.3	3.7	3.3	3.3	5.3	3.7	4.0	2.3	33.9
Medical records	3.8	3.0	3.8	3.8	2.8	4.0	3.0	4.3	2.5	31.0
Neuro clinic	3.5	4.0	3.0	3.0	2.5	4.5	2.5	5.0	3.0	31.0
Orbit clinic	4.3	3.5	3.5	3.3	2.8	3.0	4.0	3.3	1.8	29.5
Paediatric clinic	3.8	4.0	3.0	2.8	2.0	3.3	2.0	3.3	2.5	26.7
Preoperative clinic	3.5	4.0	3.3	2.8	1.8	3.0	3.3	4.0	2.5	28.2
Retina clinic	3.2	3.0	3.4	2.6	2.8	4.0	3.4	4.4	2.8	29.6
Paying general outpatients Unit-1	4.3	4.5	3.3	2.8	2.5	4.0	3.3	4.8	2.8	32.3
Paying general outpatients Unit-3	4.0	4.0	3.7	3.3	2.0	5.0	3.3	3.7	2.0	31.0
Uvea clinic	2.7	3.3	2.7	2.3	2.7	3.7	3.3	4.0	2.3	27.0
P-value (Kruskal–Wallis test) ⁺	0.784	0.221	0.267	0.739	0.376	0.314	0.382	0.502	0.622	
Number of questions (=maximum possible score)	5	6	4	5	4	5	5	5	4	43
Mean compliance score	3.78	3.81	3.28	3.02	2.38	3.98	3.27	4.01	2.57	
Mean compliance score relative to maximum possible score, expressed as a %	75.5	63.5	81.9	60.4	59.4	79.5	65.4	80.3	64.2	70.0
Std dev of compliance score	0.56	0.45	0.39	0.43	0.49	0.78	0.64	0.50	0.41	

Notes(s): ⁺ Since compliance scores are unlikely to be normally distributed, we conducted the nonparametric Kruskal–Wallis test to assess differences in median ranks between departments

integrating improvement with work and identifying and eliminating waste – were ranked in the upper tercile. Stabilise processes, no defects passed forward and rely on data and facts were ranked in the middle tercile. Standardising processes, focusing on value stream and keeping practices simple and visual were ranked in the lowest tercile.

Department-level ranking. Departments were also ranked based on compliance with preferred practices (last column of [Table 5](#)) and grouped into three terciles consisting of 5, 6 and 5 departments, respectively. Insurance, glaucoma clinic, free new outpatient units, paying general outpatient unit-1 and cataract clinic, were ranked in the upper tercile. Medical records department, neuro clinic, paying general outpatients unit-3, day-care ward, retina clinic and orbit clinic are ranked in the middle tercile. Preoperative clinic, cornea clinic, uvea clinic, paediatric clinic and free review outpatients are in the lowest tercile.

Departments in the lowest tercile consistently showed low compliance to preferred practices, particularly in keeping process simple and visual, passing no defects forward and relying on data and facts.

Outcomes across departmental terciles of adherence to operational practices

In [Table 6](#) we show the mean values of the five outcomes for each of the three terciles of departments ranked according to their level of adherence to effective operational practices. Departments with lower adherence (lower tercile) exhibited poorer outcomes. Outcomes of both upper and middle tercile departments were higher in all five parameters compared with outcomes of lower tercile departments, with the exception of patient safety (near misses). Process efficiency and capacity utilization are highest in the upper tercile. Departments within the medium tercile scored higher score in percentage of patients examined within target cycle time and patient satisfaction. While patient safety scores were lowest in the lower tercile, the maximum score is highest in this cohort.

Association between preferred operational practices and outcomes

We present the correlation coefficients between the scores of compliances with preferred practices for each supporting concept and the key outcomes in [Table 7](#). Each correlation coefficient is computed across the 16 departments.

Overall, the correlations between the adherence scores for operational practices and outcomes tend to be positive, with 12 of the 45 coefficients indicating weak negative effects and one moderate negative effect ([Table 7](#)).

Patient satisfaction demonstrated a moderate positive correlation with practices that emphasize direct observation, a low positive correlation with waste identification and elimination practices and a negligible negative correlation with practices related to no defects passing forward and reliance on data and facts.

Patient safety (near-misses) was positively associated with practices that emphasized keeping processes simple and visual, which were associated with lower near-misses. Associations of other practices with patient-safety were negligible but negative.

Patients' examination within target cycle time showed low positive correlation with stabilise processes and standardise processes and negative correlation with keeping process visual and simple.

Process efficiency showed a moderate positive correlation with standardising processes and low positive correlation with identify and eliminate waste, indicating that higher process discipline was linked to more efficient performance.

Capacity utilization demonstrated moderate positive correlation with insist on direct observation and low positive correlation with a focus on the value stream, suggesting that departments emphasising these practices tended to operate at higher utilization levels.

Table 6. Adherence to effective operational practices and outcome parameters

Outcome parameters	Adherence to effective operational practices		
	Lower Tercile Mean (SD) (Minimum-Max)	Middle Tercile Mean (SD) (Minimum-Max)	Upper Tercile Mean (SD) (Minimum-Max)
Number of departments	5	6	5
Patient satisfaction %	79.2 (5.4)(71.9–87.1)	81.9 (5.3)(76.4–88.2)	80.3 (7.0)(73.3–92.0)
Patient safety score per 10,000 patients	0.65 ⁺ (0–19)	2.97 ⁺ (0–14.3)	2.64 ⁺ (0–15.1)
Patients examined within target cycle time %	84.6 (10.7)(71–97)	89.7 (6.7)(78–96)	86.2 (9.0)(72–96)
Process efficiency %	20.0 (5.8)(15–30)	20.5 (8.3)(13–33)	31.8 (14.3)(11–47)
Capacity utilization %	72.8 (21.6)(50–99)	74.7 (13.6)(56–95)	82.6 (4.5)(75–86)
Note(s): ⁺ The standard deviations for these scores were higher than the mean, so median is presented			

Table 7. Correlations between preferred operational practices and key outcome parameters

Operational practices for continuous process improvement	Outcome variables			
	Patient satisfaction	Patient Safety-near misses per 10,000 patients [^]	Patients examined within target cycle time	Process efficiency
Stabilise processes	0.19	-0.17	0.44	-0.01
Standardise processes	0.09	-0.23	0.30	0.51*
Insist on direct observation	0.50*	-0.24	0.23	0.09
Focus on value stream	0.18	-0.07	0.29	0.62*
Keep it simple and visual	0.08	0.43	-0.33	0.12
Identify and eliminate waste	0.43	-0.06	0.28	0.23
No defects passed forward	-0.04	-0.14	-0.21	0.48
Integrate improvement with work	0.21	0.02	0.21	0.02
Rely on data and facts	-0.08	0.05	-0.01	0.15
				0.01

Note(s): Coefficients smaller than 0.3 in magnitude are considered negligible, those larger than 0.30 in magnitude but smaller than 0.50 indicate a low correlation (italic), and coefficients larger than 0.5 in magnitude signify a moderate correlation (italic and *) (Schober and Schwarte, 2018). [^] Higher scores on patient safety-near misses indicate poorer outcomes, unlike the other Four outcome variables, where higher scores indicate better outcomes. Accordingly, for ease of interpretation, we have multiplied the correlation coefficients in this column by -1

Correlation among outcomes

We found that five outcome variables were correlated as well. Patient satisfaction has moderate correlation with patients examined within target cycle time. Near misses has low moderate positive correlation with patients examined within cycle time. In addition, there are positive correlations between the practices of supporting concepts. We present a full report of the correlation analysis of practices and outcomes in Supplementary Table 1.

Evidence from an eye hospital Qualitative analysis of responses to five open-ended questions is presented in [Appendix 2](#). The findings indicate that human factors, process-related issues, staffing constraints, patient-related factors and resource limitations contribute to process instability, which, in turn, may lead to errors or suboptimal outcomes. Variations in patient load, shortages of manpower, software-related challenges, lack of process coordination, patient-related issues and delays in investigation reports were commonly reported as factors affecting adherence to standard processes.

Open-ended comments and responses

Most respondents indicated that vulnerable patients are managed through prioritisation, fast-tracking and escorting. In addition, respondents identified several process steps that do not add value and highlighted opportunities for simplification and improvement across clinical, administrative and workflow-related activities.

Discussion

Overview of key findings

In the ever-evolving business environment today, a dedicated commitment to enhancing operational processes is crucial to organizational success, particularly in service-intensive sectors such as health care. In prior research both product and process innovation are widely recognized as essential drivers for achieving success in the challenging operating environment ([Anand et al., 2009](#); [Lee et al., 2011](#); [Tett, 2016](#)). CPI lies at the heart of OE and is critical for achieving optimal outcomes and meeting customer expectations. Engaging frontline workers in the innovation process enables organizations to harness their tacit knowledge and address local challenges effectively ([Castells, 2009](#)). Research underscores the importance of adopting and implementing the right practices for achieving world-class performance ([Timenes Laugen et al., 2005](#); [Brown et al., 2007](#)). Building on these literatures, our study examined how departmental level operational practices at AEH align with the Shingo Model's CPI principles and examine how such alignment correlates with operational outcomes. The following key findings emerged:

- Departmental adherence to preferred operational practices varied, revealing areas of strength and opportunities for improvement.

We observed variability in adherence to OE practices across departments. While interdepartmental score differences were relatively minor, five of the 16 departments in the lower tercile exhibited limited focus on value stream management and lacked process simplicity and visual control. These findings align with findings by [Sadun et al.](#), who observed that even leading organizations struggle to implement best practices uniformly ([Sadun et al., 2017](#)).

Lower scores in standardized processes may reflect a need for flexibility, especially in specialties like uvea and paediatrics, where case variability limits standardization. Low scores in value stream focus and visual simplicity point to improvement areas, possibly linked to limited visual tools – such as dash boards, charts and waiting list – following the shift from the earlier HMS. Likewise, challenges in relying on data may be linked to limited

familiarity with newer system. Departments with the lowest overall scores were mainly challenged in maintaining visual clarity and using data effectively – areas that could be strengthened by fully leveraging the EMR system. Currently, defects are caught downstream; pre-transfer alerts embedded in the EMR could improve this process:

- Better adherence to operational practices was associated with stronger departmental outcomes.

The outcomes of departments in the middle and upper terciles are superior to those in the lower tercile, indicating that better adherence to operational practices may lead to improved outcomes. Higher process efficiency and capacity utilization were especially notable among upper tercile departments, underscoring the importance of adhering to better practices for enhanced efficiency. Interestingly, there were higher rate of near-misses than the lower tercile departments in these groups, possibly due to factors such as the handling of larger volumes, the proactive reporting of near-misses ([Hudson, 2007](#); [Kaya et al., 2023](#)) and inherent risk of errors resulting from an increased focus on efficiency:

- Correlational patterns highlight important interdependencies between operational practices and outcomes.

Operational practices aligned with the supporting concepts of stabilise processes, emphasizing direct observation, waste identification and elimination and integrating improvement with work have been effectively practiced, yielding higher scores. Overall, there is a positive, but varying correlation between the practices, highlighting their interdependency. The significant correlation between the concepts of standardise processes and stabilise processes underscores the equal importance of building control and creating flow and improvement. The stronger association between stabilise processes and focus on value stream practices indicates that stabilising the process involves eliminating waste with the necessary tools to identify and eliminate inefficiencies in the process. Following a stabilised process substantially reduces the chance that defects are passed to the next station, exhibiting a significant association in addition to the focus on the value stream. The stronger association between integrating improvement with work and relying on data and facts emphasizes the need for reconciliation between predicted results and actual results, making the improvement process truly data-driven ([The Shingo Model for Organizational Excellence, 2025](#)).

Most key outcomes showed positive correlations with departments' adherence to better operational practices. Patient satisfaction improves when patients receive attention during their wait and timely examinations. These aspects show a moderate correlation with departments that practice direct observation and eliminate unnecessary steps for certain conditions. Near-miss identification is more likely when stabilised and standardised processes are in place, although this was not reflected in the analysis. Keeping processes simple and visible is essential for highlighting the errors in real-time, and minimizing near misses. Improving patient waiting times is linked to stabilising processes, eliminating non-value-added activities and directly observing patient flow, all of which are positively correlated with departments practicing these aspects. However, keeping processes simple and visual showed a negative correlation, possibly due to challenges in easy access to details or lack of recognition for visibility. Process efficiency is improved with better processes and eliminating non-value-added activities, which moderately correlates with departments practicing these aspects. Patients are unique, and factors such as conditions, patient cooperation and

clarifications needed can affect examination time. Efficient clinician utilization involves closely observing patient flow and crowd levels, assigning patients timely and to the right clinicians, avoiding repetition of examinations. Capacity utilization showed a negative correlation with waste elimination practices, although a direct connection between them was not expected:

- Inter-outcome correlations reveal important operational dynamics.

Correlations among outcomes also yielded notable insights. Patient satisfaction tended to rise when examinations occurred within the target cycle time, underscoring the value of timely service delivery (Pandit, 2016; Xie and Or, 2017). However, an increased number of incidents were noted in departments handling more patients within the cycle time, highlighting the risk of errors when speed becomes the focus. Paradoxically, higher process efficiency was associated with slightly lower patient satisfaction, possibly due to reduced patient-provider interaction or process repetition.

Overall, the study highlights meaningful variation in OE practice adherence among departments at AEH. Identifying and addressing these differences – particularly in areas with lower performance – can further the hospital's progress towards OE. The low positive correlation between attention to process efficiency and identifying and eliminating waste, might be signal to further integrate OE practices.

It is also important to acknowledge that excessive focus on standardization, efficiency or key performance indicators can have unintended consequences. These may include reduced innovation, diminished staff morale, compromised well-being and weakened interdepartmental collaboration (Womack *et al.*, 1990). Thus, achieving OE requires balancing efficiency with broader strategic priorities, including innovation, patient-centredness and employee engagement.

Insights from frontline perspectives

The open-ended responses also suggest a high level of situational awareness among staff regarding potential sources of error and inefficiency in their daily work. The ability of respondents to identify specific human, process and system-related factors, as well as non-value-adding steps and opportunities for simplification, indicates that frontline staff are actively observing their work environment and recognising risks before they translate into adverse outcomes. This awareness is critical for sustaining continuous process improvement, as it reflects a proactive approach to error prevention rather than reactive problem-solving, and supports the role of frontline engagement in achieving more reliable and safer operational performance.

Theoretical contribution

This study contributes to the operations management literature by showing that OE can be achieved without explicitly adopting formal models such as Shingo, Lean or TPS. By developing and applying a structured instrument to assess the alignment of hospital practices with the Shingo Model's CPI principles, this research demonstrates how abstract theoretical constructs can be translated into measurable indicators. The observed interdepartmental variation in alignment also suggests that OE principles must be adapted to specific organizational and contextual realities, especially in health-care settings in low- and middle-income countries (LMICs). This work thus provides a pathway for operationalizing OE theory in environments where formal management models are not explicitly implemented.

Practical implication

The findings provide actionable insights for hospital leaders and quality improvement teams seeking to enhance performance without adopting formal excellence frameworks. The structured self-assessment tool can help identify areas of alignment with CPI principles as well as gaps requiring attention. The positive association between stronger alignment and better departmental outcomes highlights the potential of addressing such gaps to drive consistent, high-quality service delivery. For high-performing hospitals in LMICs, this framework offers a scalable and evidence-informed approach to institutionalizing excellence by making tacit practices explicit, measurable and improvable. Importantly, the results also underscore the systemic nature of health-care delivery, where standardized processes and a culture of continuous improvement – actively involving frontline staff – are essential for sustaining outcomes.

Our study underscores the systemic nature of a hospital, where effective health-care delivery hinges on the seamless collaboration of various elements. Implementing standardised systems and processes, alongside fostering a culture of continual improvement that actively engages daily operations staff, holds the potential to consistently elevate outcomes, thereby propelling the achievement of OE.

Strengths and limitations

Strengths of this study include the objective measurement of operational practices across multiple departments, engagement with diverse participants and its implementation in a high-performing hospital renowned for its productivity, quality and financial performance. Consequently, the study was able to identify specific operational practices associated with improved outcomes, supporting the case for broader adoption of CPI principles.

However, this study has some limitations. Firstly, the questionnaire was newly developed; although it was tested for feasibility, it should be considered a preliminary framework that requires further review, refinement and validation before being applied in diverse settings. Secondly, as a cross-sectional study, our findings reflect associations rather than causal relationships. Thirdly, the operational practice scores are relative and specific to AEH. The departmental differences observed reflect variation within a single high-performing institution and cannot be directly compared with those of other eye hospitals. It is possible that the magnitude of variation between departments elsewhere may be greater or follow different patterns. Comparisons across multiple eye hospitals at the departmental level would help determine how practices differ in other contexts and enhance the generalizability of these findings, which could be a further research.

Future studies should repeat the assessment after implementing appropriate actions to address the identified gaps and compare the outcomes. Further research should also explore how organizational culture, leadership commitment and staff engagement mediate the relationship between practice alignment and performance, thereby strengthening the link between OE theory and health-care management practice.

Conclusion

OE is an overarching vision that requires effective systems, processes and their continuous refinement. Embedding improvement into daily routines fosters shared responsibility, making practices more sustainable when they evolve organically and are supported by ongoing learning. Measuring and addressing defects in current practices is central to sustaining improvement and achieving better outcomes.

This study demonstrated the feasibility of assessing organizational adherence to principles of OE models and examining their association with key outcomes in a high-volume hospital

setting. The findings highlight the value of aligning daily practices with OE concepts, while also emphasizing the need to empower individuals, engage staff and connect team efforts with organizational goals. Continuous measurement, analysis of performance variation and alignment of both people and processes remain vital to sustaining OE. By linking organizational practices to OE principles, health-care leaders can embed sustainable improvement into daily work and achieve better outcomes.

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Appendix 1. Research on effective management practices

Annexure I: Research on effective management practices

To:
We are conducting a study to assess the practices followed for executing the work, your opinion about the process involved, identifying and fixing the problems in the process and work on the improvements. I hereby request you to share your views and fill in your response. **Please select one option for each question** and also fill in the details for a few questions. It takes approximately 30 minutes to complete the form. Please contact 98949XXXXX for any clarification. We assure that your identity will remain confidential and will not be shared. Thank you so much for your support.

-BS Ganesh Babu, Central Operations, LAICO

Name:	Department:	Option-1	Option-2	Option-3	Option-4
Questions					
Stability of the process (SPQ)					
SPQ1. What is your assessment of the consistency of your workstation's examination process and results accuracy? (eg. Correct data captured, right investigations are done, correct results of investigations, right diagnosis, assigning the patient to the next station, etc)	1.Always (100%)	2. 96%-99% of patients	3. 91-95% of patients	4. 90% of patients or below	
SPQ2. What factors or issues do you believe could contribute to inconsistent or incorrect results at your workstation (Please list top 4 reasons)	1. at least one reason is given	2	3	4	
SPQ3. How do you confirm that the process at your station is consistently executed correctly?	1. Not possible to confirm	2. I check on my own directly	3. Errors are identified at next station or final exam	4. The system alerts when there is any errors	
SPQ4. When you notice a problem or inconsistency during a patient's examination at your station, what actions do you take?	1. I learn from the problem and correct my side to avoid it in the future	2. I discuss with seniors/colleagues to learn and avoid errors	3. The errors/deviations are documented and discussed in the department meeting for implementing the necessary solution	4. Management will fix the problem and share the solution	
SPQ5. What are the primary reasons that frequently affect patient flow or movement at your station? (Please list top 4 reasons)	1 at least one reason is given	2	3	4	
Standardisation of the process (STQ)					
STQ1. How do you typically carry out the steps of the overall process at your station?	1. I execute a series of steps in the order I want, to complete the process	2. I execute various steps based on the seniors instruction	3. I execute various steps based on the training given as per the protocol/guideline	4. There is no specific order or steps suggested to complete the process	
STQ2. Is it possible to carry out certain steps in the process differently, add extra steps, or skip some steps at your workstation?	1. No, I can not do other than the defined way	2. I do very rarely (<5% of patients)	3. I do frequently (5 to 10% of patients)	4. I do very frequently (>10% of patients)	
STQ3. Do you believe that not following the steps in order affects the output or outcome of the process?	1. No, the results will be the same even if we don't follow the order	2. Yes, but the affect is negligible	3. Yes, it will affect the patient care		
Questions					
Option-1					
Option-2					
Option-3					
Option-4					
STQ4. How do you ensure that you complete all steps in the process accurately and without any omissions or errors?	1. I check for completeness myself	2. The system generates an alert if I missed any steps	3.Next station/supervisor will identify the error and let me know	4. It is not possible to check the completeness	
STQ5. What actions do you take when you discover that certain steps in a process are not being followed?	1. I directly advise the concerned staff to follow the steps	2. Complaint to seniors about the problem	3.I make sure that the concerned staff take the issue to the department meeting for discussing such deviations and take appropriate decision	4. I usually ignore them or do not pay attention for such things	
STQ6. What is the process for handling a vulnerable patient at your station?	1 one or more correct steps are listed	2	3	4	
Understanding the problem (UTP)					
UTP1. How do you typically find solutions to problems in the process that are reported or suggested?	1. Discuss with the staff who reported the error	2. I use my previous experience in such a problem	3. Visit to site to understand the problem in detail for a solution	4.I discuss with seniors to get their opinion/views	
UTP2. Does your team use a specific method or process when addressing problems or opportunities for improvement?	1. I am not exposed/aware of any improvement method	2. Yes. We follow a process systematically for all the problems	3. Yes. We follow but rarely		
UTP3. Please select the method or framework your team uses for continuous improvement?	1. IHI/PDSA	2. DMAIC/PDCA	3. Other Methods	4. I do not know if we are following anything	
UTP4. What do you consider as a major source of information for identifying a problem?	1. Patients' suggestions/complaints	2. Identifying problems by monitoring patient flow in real-time	3. Staff complaints or suggestions	4. Seniors/management's complaint	
Value of process (VAP)					
VAP1. How would you describe the waiting time at your station?	1. Higher than standard or target	2. Reasonable / acceptable	3. There are opportunities for improvement (to reduce)	4	
VAP2. What steps in the current process at your department do you think don't add value for the patients? (Please list the top four.)	1 one or more steps is listed	2	3	4	

(continued)

Questions	Option-1	Option-2	Option-3	Option-4
VAP3. When you encounter steps that aren't necessary or don't add value, what actions do you take?	1. I skip them always	2. I skip them during the crowd or peak hours	3. I discuss in the meeting to understand the necessity	4. I try to learn from my colleagues / senior
VAP4. How do you ensure that patients understand the reasons or benefits of the investigations, examinations, or coordination you're performing for them?	1. Details of why we do, are displayed in the poster	2. Patients believe in Aravind's service	3. I always explain to the patient before I start the test	4. I explain to the patient if they ask
VAP5. How do you determine if patients are happy or satisfied with the service they receive in your department?	1. I can assess the feelings/expressions of the patient	2. Based on Patients satisfaction survey results	3. By reviewing complaints from patients if any	4. It is difficult for me to know
Details of the Process (DOP)				
DOP1. How would you assess the level of details for the process you're involved in?	1. Well-defined and easy for anyone to execute	2. Well-defined but require support from seniors to execute	3. There are no guidelines, just follow the seniors' instructions	4. Complex process and only selected people can do
DOP2. Can you easily access the required information when you need it, and is it readily visible?	1. No, it is difficult to get the information that I want to see	2. Yes, I can access but it takes time	3. Yes, it is visible and accessible in real-time	4. Yes, but not all the information are readily available
DOP3. Do you identify any steps at your station that are unnecessarily complex and could be simplified?	1. No, all are simple and easy	2. Yes: (please specify):		
DOP4. How do you determine if patients are experiencing longer wait times at your station?	1. Using my dashboard, I can keep track of patients waiting for examinations in real-time	2. I review the records of the patients waiting to find out the waiting time	3. My colleague gives the information about the waiting	4. It is difficult for me to know how many patients are waiting for how long
Dealing with Waste (DWW)				
DWW1. How do you recognize waste or unnecessary activities within the process you're involved in?	1. I can't do this myself, I can know only if others point out	2. I can know from the waiting time report	3. I can know by observing the patient flow	4. I do not know how to identify
DWW2. How often do you and your team discuss opportunities for improving the process?	1. Very rarely (once a year or in two years)	2. Atleast once a month	3. Once a Quarter	4. As and when we find any challenges
DWW3. Who within your department is authorized to report or raise concerns about waste or unnecessary activities?	1. Senior staff	2. Managers / Supervisor	3. Head of the department (doctor)	4. Anybody in the department
Questions	Option-1	Option-2	Option-3	Option-4
DWW4. How do you act on eliminating unnecessary activities in the process?	1. I just implement the suggested solution	2. I consult with seniors about the proposed solution before implementing them	3. I follow a method for detailed understanding, planning, implementation and follow-up on the outcome	4. I don't do anything
DWW5. What steps do you take to welcome ideas for eliminating waste or making improvements in the process?	1. Encouraging everyone to give Suggestions for improvement	2. Senior leaders suggest areas for improvement	3. Onsite visits in person to observe and identify opportunities for improvement	4. No specific way is followed
Dealing with Defects (DWD)				
DWD1. What do you do when you find an error, incident or nearmiss in the examination process?	1. I just correct it myself immediately if it is my error and continue to exam the next patient	2. I document the error and discuss in the meeting to follow a process to find solution	3. It is not possible to find any error, near-miss or incidents	4. I inform the concerned who caused the error and ensure it is corrected
DWD2. When you discover an error, incident, or near-miss in the examination process, what steps do you take to address it?	1. Train the concerned person to correct him	2. Immediately fix the system or process or software	3. Do the root -cause analysis and fix the system and processes	4. Implement what is suggested by the senior/management
DWD3. How do you typically identify errors that have occurred either with a patient or within the process itself?	1. The system alerts the inconsistencies or errors in the process/findings	2. When patient complaints about errors or service	3. I check if everything is alright	4. Usually, the error committed at my station is observed in the next station
DWD4. When you realize that an error has been made, what steps do you take to address the situation?	1. I document the error and register it into the system immediately	2. If it is not affecting the patient, I will just ignore	3. Will inform the seniors and let them decide	
DWD5. Do you receive any alerts or notifications when the results or findings from a patient's examination differ from the standard or routine?	1. No, there are no provisions to know	2. Yes, the system always alerts when the result deviates	3. Yes, the system alerts but not all the errors/deviations	
Working on Improvements (WOI)				
WOI1. What do you know about the work that you do?	1. I know why I do or the purpose	2. I know how it should be done	3. I know what should be done	4. I know why, how and what should be done
WOI2. How frequently does your department have formal meetings or discussions to brainstorm ideas for process improvements?	1. It is part of the agenda of the weekly meeting	2. Only when there is a problem or required	3. We discuss atleast once a month	4. It is usually done by external group / other department staff
WOI3. Has anyone in your department ever proposed ideas for improving the process of patient examination or enhancing patient satisfaction?	1. No, I do not remember so	2. Yes, during this month	3. Yes, it is about 3 months back	4. Yes, occasionally

(continued)

Questions	Option-1	Option-2	Option-3	Option-4
WO14. How do you recognize when the current process is unsatisfactory or presents an opportunity for improvement?	1. My seniors come and encourage improvement	2. Our management suggests improvement	3. We review the reports to find if there are any deviations from the goal to focus on the improvement	4. Other department staff comment on our performance
WO15. Do you have defined metrics to measure the progress of your goals and strategies for improvement?	1. Yes, but not for all the strategies	2. Yes, for all the strategies	3. No, There are no such metrics available	
Use of Information (UOI)				
UOI1. Do you have access to information that allows you to evaluate how the process is executed or to assess the performance of your department?	1. Yes, all are available always	2. Yes, available on request	3. Yes, but not all the information available	4. No, performance is managed by seniors/ leaders only
UOI2. How do you determine that your department is performing well?	1. I can understand based on the improved patients load	2. By comparing the performance against the target	3. From my colleagues who talk about the improvement seen in my department	4. I will know about the progress end of the year
UOI3. What is your assessment of the quality of the reports provided to you?	1. The reports give the correct details	2. There are negligible amount of errors in the data	3. The reports are not reliable or usable	
UOI4. What actions do you take when the expected results, such as the number of patients or target waiting time, are not met?	1. I focus on doing correctly for improving	2. I / We work on Improving the way we work	3. We try to understand the reasons for poor performance and fix them	4. We approach and seek help from seniors

Note: Cells highlighted with green are preferred responses

Appendix 2. Insights from frontline perspectives

Table A1. What factors or issues do you believe could contribute to inconsistent or incorrect results at your workstation? (Question: SPQ2)

Theme	Responses	N (%)
Human factors	Lack of attention or inadequate focus, poor coordination among staff, failure to validate patient identity using check digits, missing clinical findings during examination, previous findings not reviewed before seeing the patient, incomplete or incorrect information exchange, registering an old patient as a new patient, missing or incomplete documentation, reviewing or documenting the findings in the wrong patient's medical record, incorrect documentation of clinical findings, deviation from established clinical protocols, billing for wrong procedure	32 (52)
Process issues	Delays in receiving investigation reports, performing refraction when the patient has ocular redness, incomplete investigations conducted, incomplete clinical examinations, change in planned procedures after obtaining insurance approval, insurance approval not granted in time, delays in investigation due to workflow bottlenecks	8 (13)
Staffing issues	Sudden staff posting changes affecting workflow, insufficient training or inadequate skill level among staff, examinations conducted by junior staff without adequate supervision, shortage of manpower affecting process quality	7 (11)
Patient factors	High patient load/uneven arrival leading to rushed examinations, language barriers between patients and staff, patients arriving with incomplete or missing documents, patients who are uncooperative during the examination, patients who make frequent visits and become confused with instructions, patients not providing complete or accurate medical history, patients arriving without an attender to support them	10 (16)
Resource issues	Non-availability or delay in obtaining special supplies that are ordered on demand, lack of space	2 (3)

Table A2. What are the primary reasons that frequently affect patient flow or movement at your station? (Question: SPQ5)

Theme	Responses	N (%)
Patient load	High patient volume, long waiting times, crowding, uneven arrival patterns	15 (24)
Manpower	Manpower shortages, inadequate staffing, improper planning or allocation	6 (10)
EMR issues	EMR running slow, EMR downtime, IT system failures	9 (15)
Process and coordination	Wrong route slip issued, lack of coordination, assigning the same flow for all patients, unnecessary referrals from other clinics, patients waiting long at specific stations (e.g. investigations), repeated investigations due to errors, medical record closed by mistake, patient sent to next station without completing required investigations (e.g. without dilatation)	7 (11)
Patient-related factors	Patients arriving with incomplete documents, uncooperative behaviour, inaccurate or incomplete history leading to wrong investigations or routing, complicated conditions, multiple attenders causing crowd, confusion or delays	10 (16)
Investigation/equipment delays	Waiting for investigations to be performed, equipment not ready, delays in receiving investigation reports, readiness of instrument	7 (11)
Space/infrastructure constraints	Inadequate physical space contributing to crowding and delays	4 (6)

Table A3. What is the process for handling a vulnerable patient at your station? (Question: STQ6)

Theme	Responses	N (%)
Priority handling	Prioritizing the patient, fast-tracking their movement and reducing waiting time	52 (84)
Escorting and assistance	Escorting the patient to the next station, providing wheelchair support and ensuring guided movement	26 (42)
Communication and information	Explaining procedures clearly, informing other staff and communicating expected waiting time	7 (11)
Comfort and special care	Offering comfortable seating, providing additional attention or support	3 (5)
Identification and safety measures	Using wristbands for identification, alerting staff about patient needs	6 (10)

Table A4. What steps in the current process at your department do you think do not add value for the patients? (Question: VAP2)

Theme	Responses	N (%)
Repetition or duplication of work	Patients returning with medicines for confirmation; rechecking glass prescriptions; unnecessary or repeated referrals; repeating investigations due to errors; repeated preliminary and final examinations by different doctors; doctor examining without available investigation results; duplicate documentation in both case sheet and EMR	9 (15)
Unnecessary or poorly sequenced investigations	Routine pre-operative ECG when not clinically required; performing IOP, BP and dilated fundus exam unnecessarily; dilatation not appropriately tracked; performing examinations before receiving investigation results	7 (11)
Documentation burden	Duplicate entry in case sheet and EMR; tallying glass prescriptions with optical shop records; “0 @ 10 performance” documentation requirements	6 (10)
Process flow inefficiencies	Reliance on patient route slips; responding without understanding patient needs; scheduling more patients for surgery per hour than the capacity; preliminary and final exams conducted by different clinicians; unnecessary opinion cases	4 (7)
System or structural issues	Lack of a proper system for tracking dilatation; delays in retrieving documents; admission initiated before physician fitness is confirmed	2 (3)

Table A5. Do you identify any steps at your station that are unnecessarily complex and could be simplified? (Question: DOP3)

Theme	Responses	N (%)
Clinical examination steps that could be simplified	Applanation and gonioscopy taking longer than necessary; dilated refraction adding complexity; avoiding dilatation for routine check-ups; performing blood sugar testing at OPD; lack of standardized protocols for specific diseases	6 (10)
Workflow and routing inefficiencies	Complexity in printing diagnosis and next station on route slips; appointment patients not consistently fast-tracked; lack of uniformity in grouping cases and advising surgery; delays related to room requests	4 (7)
Administrative and documentation burden	Need for digitisation of documentation; manual insurance billing processes; complex surgery admission processes (scan-to-admit); Unified Payment Interface (UPI) refund procedures	5 (8)
Registration and identification challenges	Absence of a barcode-based patient registration and identification system	2 (3)
Investigation and medication logistics	Handling of dilatation drops within cubicles; blood sugar testing workflow at OPD	2 (3)

Supplementary material

The supplementary material for this article can be found online.

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