A Critical Analysis of Infection Control Management in the Ophthalmology Department and its Impact on Patient Care at Tertiary Care Corporate Hospital, Mumbai, Maharashtra, India

Akifa Mariyam Abdur Rehman[1], Dr. Saurav Bhowmik[2]

[1]Optometrist, Mumbai and M.Optom, MBA Sem IV, Hospital Administration and Healthcare Management, Dr. D. Y. Patil Vidyapeeth, Pune, Maharashtra Indi

[2]Professor, Center for Online Learning, Dr. D. Y. Patil Vidyapeeth, Pune, Maharashtra India
Email: *saurav.bhowmik.col[at]dpu.edu.in*

Abstract: ***The control of infections is a primary factor contributing to safety in patients. It is In particular crucial in places like high-volume ophthalmic surgery settings where post-operative endophthalmitis often means profound visual loss. To that end, we reviewed infection control management system at a corporate tertiary hospital in Maharashtra and pointed out structural, behavioral and compliance deficits. We further tried to establish if these deficits affect patient outcomes. Method: Under the guidance of the Hospital Infection Control Committee (HICC) and Infection Control Team (ICT), we carried out a cross-sectional mixed-methods study. We got the data Mostly through: (1) a Knowledge, Attitude, and Practice (KAP) survey of 50 health-care staff over six months i.e. September 2025, February 2026; (2) direct observational audits of 10 randomized surgical cases mainly targeting operation and sterilization practices in the theatre; and (3) retrospectively checking 250 patient records from February 2025 to January 2026. Results: Rate of postsurgical infection was 4.0 per 1,000 operations against a global benchmark of <1.0 per 1,000. Even though HCW's showed quite good theoretical knowledge (89%), their practical adherence was only 64% with hand hygiene practice being at 61%. Majority participants considered that very stringent protocols impede patient flow (78%; average Likert score 4.2/5), pointing out another significant behavioral challenge. It was found that the process audiology did not meet the standard for sterilization papers (only 75% compliants), and PPE was a bit of a problem too (81%). Just one out of five identified issues on non-compliance were followed-up with documentation. Conclusion: Really the hospital is dedicated to the prevention of hospital-acquired infections is encouraging; Still, there remain some operational issues that interfere with the full implementation of the infection prevention programs. It appears necessary to introduce digital tracking of sterilization, make workflow more efficient, and set up a Closed-Loop Corrective Action system, thereby ensuring better adherence and reducing the number of infections following surgery.***

Keywords: Infection Control, Ophthalmic Surgery, Endophthalmitis, Compliance Deficits KAP Survey, Quality Improvement

1. Introduction

Infection Control Management, or ICM, is an integral part of contemporary healthcare, combining clinical and hospital operations practices with the quality assurance aspect of these activities and using them together to help reduce the risk of Healthcare-Associated Infections or HAIs. A well-implemented infection control policy will not only lead to safer healthcare and better medical results, but it also ensures that the hospital meets all its institutional targets and standards like Joint Commission International (JCI) and the National Accreditation Board for Hospitals and Healthcare Providers (NABH). In ophthalmology, since the eye is a very special organ immunologically that very poorly defends itself from microbial invasions, prevention of such an infection has to be really important. Post-operative endophthalmitis is an intraocular infection that can cause vision loss irreversible to as early as 24-48 hours and even a very small microbial contamination during the surgical procedure can result in such an infection.To get a high volume of ophthalmic procedures done per day, a hospital might be required to do more than one surgery per a patient and also need a short waiting period between two surgeries, i.e. turn the patient around very quickly. But this, in turn, demands the operation theatre workflows to be extremely well managed besides placing significant stress on the Central Sterile Services Department (CSSD) reprocessing systems. This way, one big problem in infection control arises due to the need to maintain surgical efficiency on one hand and strict adherence to hygiene rules on the other. The moment medical personnel consider these guidelines as hindering work flow they will find less reason to follow these protocols and thereby exposing patients to higher risk of infection. This study aims at understanding how the Infection Control Management system at a tertiary level corporate hospital in Maharashtra got affected by operational pressures like low traceability and poor corrective action mechanisms at a sterilization facility resulting in a 4.0 post-operative infection rates per 1,000 surgical procedures, which is way above and beyond the internationally accepted benchmarks.

2. Literature Review

Infectious complications of post-operative inflammation affecting both the uvea and retina, a condition commonly described as post-operative endophthalmitis, are among the most devastating outcomes after an ophthalmic surgery as it can very quickly lead to irreversible loss of eyesight if prevention is not possible via rigorous infection controls measures. In fact, the very nature, structure and defenses of the eye render all intraocular manipulations so very easily susceptible to contamination that exceptional standards of surgical field sterility are required. Besides being responsible for rigorous environmental hygiene and providing sterile microsurgical instrumentation, a necessity underlined by Baudin et al (2022), the All India Ophthalmological Society (AIOS) Task Force (2023) is of the opinion that infection rates will stay below the international benchmark of one case per 1,000 procedures if one sticks with preoperative antisepsis, proper operation theatre maintenance as well as validated sterilization practices. Despite In reality healthcare personnel are equipped with solid theoretical knowledge, there is always a gap in practice and the theory that is often not recognized as a knowledge-to-practice gap between theory and practice. Based on the Knowledge, Attitude, and Practice (KAP) based research, knowledge about infection control goes above 80 % most of the cases yet for example, during busy periods at work, people fail to comply with recommended hand hygiene. While the World Health Organization promotes 100% compliance with hand hygiene at the moment of aseptic procedures, in practice, people's adherence can be affected by workloads. Besides, efficient sterilization also needs proper reprocessing of the tools and a traceability system. Rutala et al (2023) explained that manual documentation can introduce several error points. Whereas digital sterilization tracking systems are the means of the recommended CDC and Tuttle (2019) strategies, they enhance accountability, ensure full compliance with the requirements and also reinforce the QA in the surgical departments.

3. Structural Paradigms

This paper combines the concepts of Donabedian Triad and PDCA Cycle to identify the factors that influence infection control outcomes. As one of the leading infection control models, the Donabedian Quality Model proposes a structured way of assessing infection control performance through three interconnected dimensions: structure, which includes evaluating the availability of disinfectants consumables staffing, and standard operating procedures; process, which focuses on infection prevention practices, hand hygiene, sterilization, and document; and outcome, which evaluates the post-operative endophthalmitis rate and patient satisfaction as measures of quality and safety of healthcare(Figure 1).The Closed-Loop Corrective Action system (CLCA) supports improvement of the infection control system as through a cycle of audit that ends in root-cause analysis and takes it further through accountability, corrective action, re-audit, and documentary closure, etc.

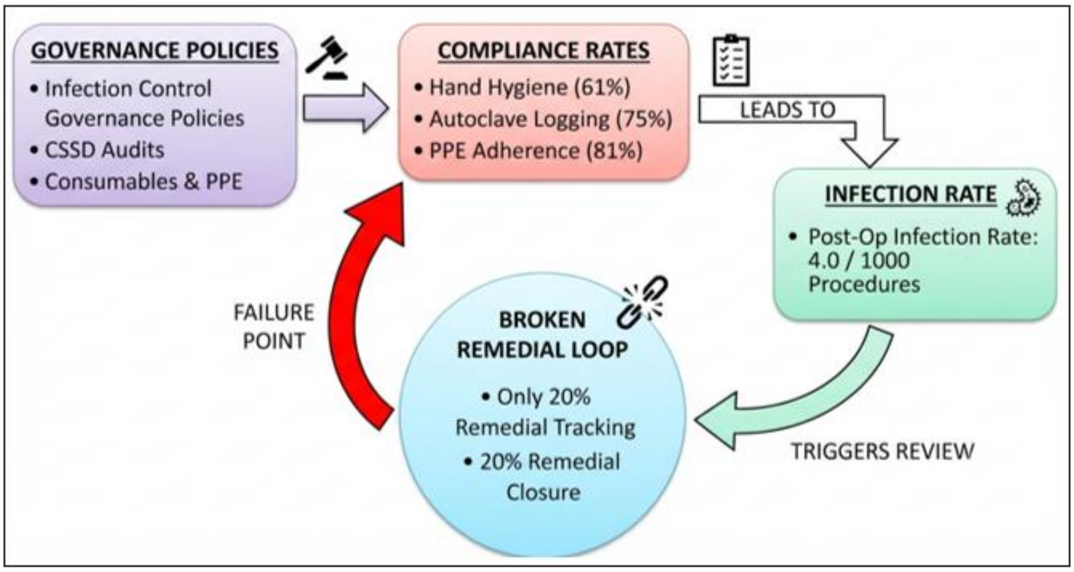

Figure 1: The Donabedian Quality Model Framework.

4. Research Methodology

4.1 Research Design & Sampling Strategy

A descriptive cross-sectional mixed-methods study included 50 ophthalmology healthcare professionals selected through convenience sampling to evaluate infection control practices.

4.2Data Collection Components

Data were collected between September 2025 and February 2026 and integrated with a retrospective review of patient records from February 2025 to January 2026. A validated 24-item Knowledge, Attitude, and Practice (KAP) questionnaire was administered to healthcare workers to assess infection control knowledge, perceptions, and practices. Direct non-participatory observational audits of 10 randomized ophthalmic surgical cases evaluated compliance with hand hygiene, sterilization procedures, PPE use, environmental controls, and waste management. A retrospective review of 250 patient records was conducted to determine the baseline post-operative infection rate. Additionally, governance practices were assessed through semi-structured interviews and document reviews with the Infection Control Team (ICT), focusing on standard operating procedure revisions, infection surveillance activities, and corrective action monitoring to evaluate the effectiveness of the hospital's infection control management system.

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5. Results and Data Analysis

5.1 Knowledge-Attitude-Practice (KAP) Diagnostic Alignment

The quantitative analysis (Table 1) of the survey administered to the 50 healthcare workers demonstrated an acute misalignment between clinical comprehension and behavioral execution.

Table 1: Quantitative Analysis

KAP Parameter	Metric Value	Operational Insight & Statistical Significance
Average Knowledge Score	89%	High level of theoretical training; staff understand sterilization principles, autoclave thresholds (>121°C), and basic sterile barriers.
Attitude Barrier ("Slows Patient Flow")	78% Agreement (Mean: 4.2 / 5.0)	Statistically significant cultural consensus that strict protocol adherence serves as a core bottleneck to operational turnaround time.
Overall Practice Score	64%	Severe behavioral drop-off from knowledge baseline, demonstrating a significant implementation gap driven by efficiency pressures.
Observed Hand Hygiene Compliance	61%	The lowest personnel execution score, particularly deficient during critical pre- and post-aseptic procedure intervals.

5.2 Operating Theatre and CSSD Process Compliance Audits

The objective observational process (Figure 2) audits (N=10) confirmed that the self-reported practice deficits were mirrored by systemic operational failures in critical reprocessing and safety verification areas (Table 2).

Table 2: Observational Process Audits

Process Audit Area	Observed Compliance	Deficit Contribution	Primary Gaps Observation
Autoclave Logs & Documentation	75%	42.40%	Blank fields, missing supervisor signature, lack of biological indicator logs.
Appropriate PPE Usage	81%	32.20%	Improper doffing sequences and unauthorized reuse of single-use devices.
Biomedical Waste Segregation	85%	25.40%	Cross-contamination between sharp and non-sharp infectious streams.

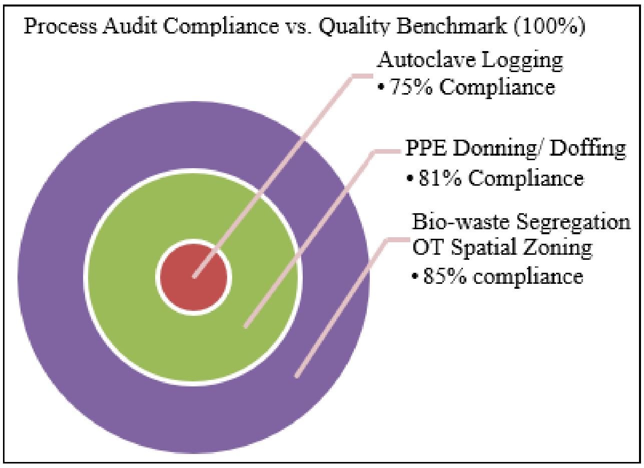

Figure 2: Concentric Mapping of Process Compliance Audits

The diagram represents infection control performance among different audit areas. Autoclave logging had the lowest compliance (75%) and Because of this was most vulnerable, which was closely followed by PPE adherens (81%). But, Bio-waste segregation and operation theatre spatial zoning showed good compliance levels with 85% indicating that in these areas infection control was better followed. A secondary analysis was implemented on the data to determine the relative contributions of each failure process to the overall observed non-compliance shortfall. Here is the formula used: Relative Deficit Contribution =100 -[observed compliance/ ((100 - observed compliance) 100)]

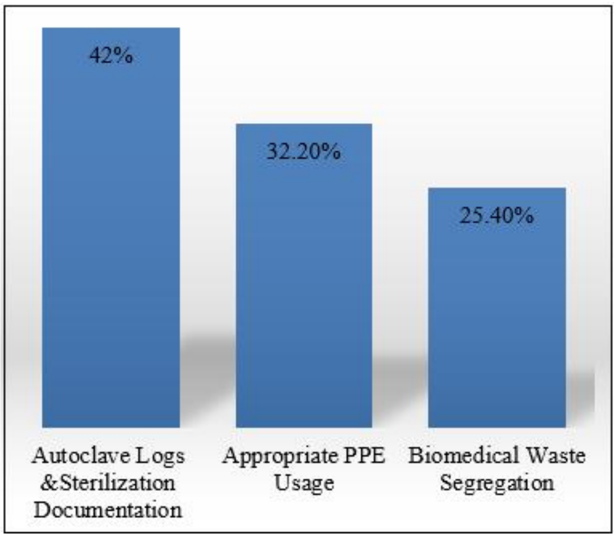

Figure 3: Relative Contribution to Systemic Infection Control Deficit

The third figure demonstrates the pattern of systemic quality failures for the surgical non-compliance events observed (N=10 cases). Main weaknesses in autoclave logs and verification of disinfection have been pointed out as a big issue causing 42.4% of the overall shortfall in compliance. Autoclave records came out to be the weakest with the lowest compliance rate (75%) and they were missing both the documents and the validation. The wearing of PPE was 81%, but there were cases of improper removal and disposable items being used repeatedly by some staff. The segregation of biomedical waste resulted in 85% compliance, the errors in the waste segregation were quite

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small and they appeared to be recurring Most of all with the separation of sharps and non-sharp infectious waste.

5.3 Quality Governance & Systemic Vulnerabilities

The structural evaluation indicated that even though 90% of the departmental standard procedures had been reviewed in the last year infection control governance still was mostly reactive. 40% of surveillance activities were directed at proactive monitoring whereas 60% targeted containment and eradication. In addition, only 20% of the non-compliance issues detected were documented corrective actions, follow-up, and formal administrative closure (Figure 4).

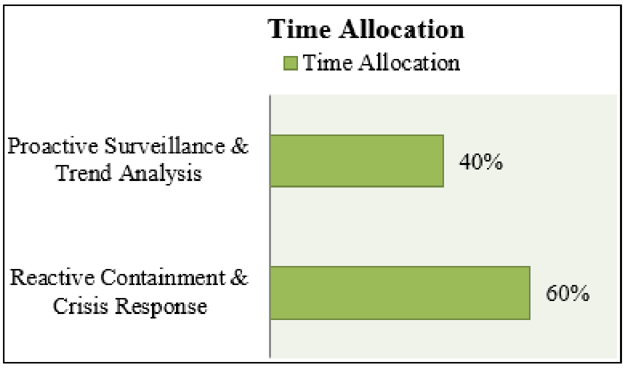

Figure 4: Allocation of Active Operational Hours by the Infection Control Team

Figure 4 graphically portrays how operational hours are divided among the institutional Infection Control Team (ICT). As the result indicates, the major portion of the team's workload (60.0%) is devoted to containment measures that are only initiated when an outbreak is detected, which means a significant portion of the team's activity is focused on fighting the fires rather than preventing the wildfires. This finding So stresses the importance of the ICT shifting to an automated and a more proactive micro-cluster detection system.

5.4 Root Cause Analysis (Ishikawa Diagnostics)

A Root Cause Analysis was conducted across six key areas to identify system-level causes rather than individual mistakes (Figure 5).

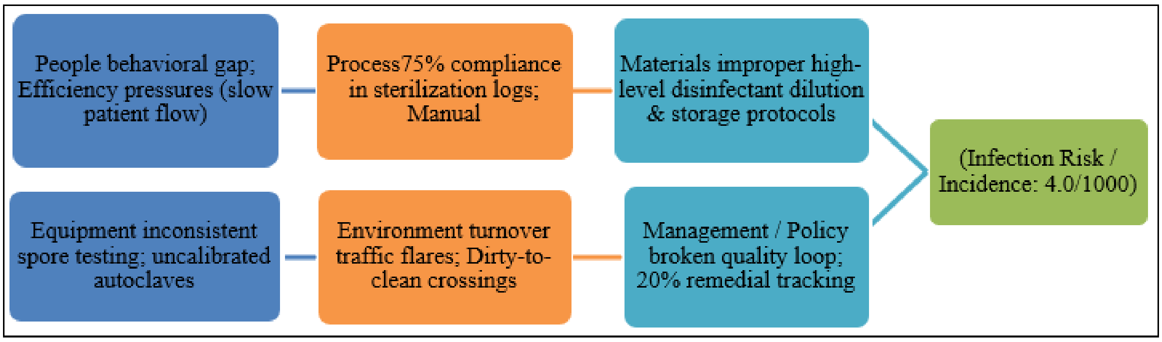

Figure 5: Ishikawa (Fishbone) Diagnostic Diagram of Systemic Infection Gaps

5.5 Categorical Breakdown of Systemic Failures

Table 2: Root Cause Analysis

Category	Root Cause Identified
People (Staff Factors)	Heavy workload and pressure to complete surgeries quickly lead staff to skip or shorten infection control practices, such as proper hand hygiene.
Processes (Reprocessing Workflows)	Manual paper-based sterilization records increase the risk of incomplete entries, documentation errors, and delayed verification during busy schedules.
Materials (Chemical & Consumable Controls)	Lack of routine verification of disinfectant concentration and contact time reduces the effectiveness of high-level disinfection.
Equipment (Sterilization Infrastructure)	Inconsistent recording of biological indicator (spore test) results allows sterilized instrument batches to be released without complete validation.
Environment (Operating Theatre Dynamics)	Rapid operating theatre turnover reduces adequate disinfectant contact time between surgical procedures.
Management / Policy	Absence of a Closed-Loop Corrective Action (CLCA) system results in audit findings being recorded without proper corrective action, follow-up, or closure.

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6. Discussion

6.1 Linking Management Failures to Clinical Outcomes

The empirical results support the main assumption of the study: those substandard patient safety outcomes are due to behavioral and process failures resulting from administrative quality governance gaps. And, cluster details are well explained.

6.2 The Disconnect Between Perception and Clinical Reality

An interesting point is the difference between how things seem from the outside versus what the actual medical indicators tell us. Surgeons returning to the ward for recovery rated the cleanliness of the facility very highly at a 4 out of 5. This high mark from the surgeons suggests that they were content with the cleanliness they experienced. But, such perceptions may not be reflective of the real clinical hazards. It was revealed that the real infection rate was 4.0 cases for every 2500 procedures which is quite a low number. We understand this discrepancy because infection threats are more to do with how certain back office operations like sterilization checks and employee hygiene are handled rather than how clean the surroundings look.

6.3 The Traceability Risk Multiplier

A 75% autoclave documentation compliance rate poses an unmeasurable risk to both the clinical and legal fronts. In surgical quality assurance, a sterilization cycle missing any documentation will be considered as an unsterile one. Suppose an endophthalmitis cluster happens and besides the manual log the data on the instrument tracking is missing, then the hospital would not have time to figure out which is the contaminated instrument batch or to do the root-cause analysis. This structural flaw actually damages the delivery of patient care.

6.4 Strategic Financial Implications

The healthcare economics approach shows that passive quality governance is very wasteful. Managing one case of post-operative endophthalmitis through a series of therapeutic interventions such as secondary pars plana vitrectomy, repeated intravitreal antibiotic injections, and prolonged hospital care will cost 10 to 20 times that of carrying out the operational aspects of the primary prevention protocols. Initiating a proactive quality structure operates as a strategy for cost-avoidance at the same time as a protection for both, financial aspects of an institution, as well as its clinical reputation.

7. Future Research Directions & Recommendations

Prior work suggested that an ongoing 12, 18-month follow-up study should measure the long-term effectiveness of Closed-Loop Corrective Action (CLCA) system (Figure 6), compare its implementation across other high-risk surgical specialties, and examine how behavioral interventions improve hand hygiene compliance without increasing staff workload. To reach the international level goal of 1.0 postoperative infections per 1000 surgical treatments or less, the hospital should introduce a mandatory CLCA structure, upgrade its digital sterilization & traceability systems, do continuous enhancement in monitoring, raise staff compliance through periodical training, and make sure that corrective measures have documented follow-up and administrator's accountability.

Figure 6: Closed-Loop Governance Escalation Flowchart

7.2 Operational Process and Traceability Enhancements (0–3 Months)

The hospital can do away with the manual system of keeping sterilization records and adopt a digital tracking system that is part of the Hospital Information System (HIS). This will ensure that all records are made available electronically before instruments being released. To further ensure that the activities done in sterilization are correctly documented, a full-time sterile processing quality engineer who works independently from others can also be appointed. This person will not have to rely on work from clinical staff for the work they do, and compliance will greatly improve because of that. As an additional support to ensure hand hygiene remains a top priority, alcohol-based hand sanitizers should be stationed at strategic locations in wards and other departments as well as in areas where staff tend to travel. By having hand sanitizers easily accessible at those spots, hand hygiene becomes a hassle-free practice, work interruptions are minimized, and more important, infection control measures become a part of the staffs' regular activity.

7.3 Behavioral and Cultural Interventions (3–6 Months)

The hospital should redesign workflows by introducing pre-packaged sterile surgical kits to minimize unwarranted staff movement and boost aseptic practice standards. Routine lectures should be replaced with quarterly simulation-based training. Through this method staff could be exposed to situations and be able to practice their hand hygiene,

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sterilization steps and chemical disinfection methods skills. Another non-punitive recognition program that appreciates teams who regularly show high surgical efficiency and infection control compliance must also be set up. This will definitely make the workforce more engaged, foster a culture of patient safety, and encourage behavioral changes that last over a lifetime. These suggestions, if well implemented, will definitely be the hospital's best asset.

7.4 Strategic Quality Governance Enhancements (6–12 Months)

The hospital needs to introduce a mandatory Closed-Loop Corrective Action (CLCA) procedure that mandates quick findings recognition, action, and confirmation. Activities for infection control must change from only reacting to problems to predicting ones and doing things in anticipation by enhancing regular check-ups and identifying trends to uncover possible infection risk factors in good time. A secret, unpenalizing online system for reporting near-miss events should also be designed to involve staff as contributors and, Because of this, uncover gaps in the processes that result in harm to patients before such harm happens and continuous quality enhancement by acting on and taking preventative measures in a timely manner.

8. Conclusion

This ground-breaking study proves that to successfully lower post-operative infections in units with high case-load doing complex operations, apart from knowledge level of medical personnel being high enough, one must tackle a more structural approach towards quality and behavioral integration. Results of the quality audit at the Tertiary Care Corporate Hospital highlight that, despite 89% of employees have very deep knowledge, 4.0 per 1,000 infection cases occur when processes barriers and quality tracking loops are left uncorrected. Main risk factors from the ward's point of view are lack of traceability due to errors (i.e. only 75% of the records are properly filled) and human errors in operations stemming from the idea that safety protocols are a constraint for getting the flow of operations right. That means, to be compliant with standards of an international safety benchmark and to improve patient outcomes by protecting them we need to adopt an approach which not only monitors through checking but is driven by closing the loops of governance that is assisted digitally by logging systems together with improving workflow and implementing enforced corrective cycles.

Declarations

1) Conflicts of Interest: The authors confirm having no financial or personal relationships which potentially could have influenced this paper's research in the way it was reported.
2) Supporting Funds: The research was self-funded as it did not include a specific funding grant issued by any institution belonging to public, commercial, or not-for-profit sectors.
3) Ethics Clearance: This paper strictly anonymized the data collected to safeguard institution and patient privacy in line with standard healthcare quality research ethics.

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