

Smart Anesthesia Workflow Optimization: Enhancing Operating Room Safety and Efficiency Through Digital Decision Support Systems**

****Daifallah Nasser AlDibsh^{1*}, Mansour Yahya Alkhallaf², Abdulrahman Ahmed Almalki³, Yahya Ali Otai⁴, Mohammed Yahya Almalki^{5**}**

¹ Department of Anesthesia Technology, Saudi Arabia

² Operating Room Department, Saudi Arabia

³ Department of Surgical Services, Saudi Arabia

Corresponding Author: Daifallah Nasser AlDibsh

Email: (dnd_reem@hotmail.com)

DOI: 10.29322/IJSRP.16.03.2026.p17112

<https://dx.doi.org/10.29322/IJSRP.16.03.2026.p17112>

Paper Received Date: 18th February 2026

Paper Acceptance Date: 14th March 2026

Paper Publication Date: 20th March 2026

Abstract: Operating rooms (ORs) represent complex clinical environments requiring continuous monitoring, rapid decision-making, and coordinated teamwork. Despite technological advances, workflow inefficiencies and human-factor errors remain major contributors to perioperative complications. Digital decision support systems have emerged as innovative tools capable of improving anesthesia workflow and enhancing patient safety.

This narrative review evaluates the role of smart anesthesia workflow optimization through digital decision support systems in improving operating room efficiency, clinical performance, and perioperative safety. Literature published between 2020 and 2025 addressing anesthesia informatics, workflow automation, and clinical decision support technologies was analyzed.

Digital anesthesia systems demonstrated improvements in workflow coordination, reduction of procedural omissions, enhanced team communication, and early detection of physiological deterioration through predictive analytics. Automated safety verification and integrated monitoring platforms improved operational efficiency and patient safety indicators.

Smart anesthesia workflow optimization represents a transformative approach in perioperative medicine by supporting data-driven decision-making and reducing preventable clinical errors.

Index Terms: Anesthesia workflow, operating room efficiency, clinical decision support, digital health, patient safety, perioperative management.

I. INTRODUCTION

The operating room is among the most resource-intensive and high-risk environments within healthcare systems. Successful surgical outcomes depend not only on surgical expertise but also on efficient anesthesia management and coordinated interdisciplinary teamwork. Anesthesia providers maintain physiological stability, anticipate complications, and ensure perioperative safety.

Increasing surgical complexity, aging populations, and technological expansion have introduced new workflow challenges. Traditional anesthesia workflows rely heavily on manual documentation and memory-based verification processes, increasing vulnerability to preventable adverse events.

Digital transformation has introduced clinical decision support systems (CDSS), electronic anesthesia records, and intelligent monitoring technologies designed to enhance workflow efficiency and clinical performance. Smart anesthesia workflow optimization integrates these technologies into unified perioperative systems supporting real-time decision-making.

II. DIGITAL TRANSFORMATION IN ANESTHESIA PRACTICE

Digital healthcare technologies have reshaped perioperative medicine. Electronic anesthesia information management systems automatically capture physiological parameters, reducing documentation errors and improving clinical accuracy.

Integration between monitoring devices and electronic medical records enables continuous data exchange across perioperative stages, improving continuity of care. Digital solutions reduce administrative workload and allow anesthesia professionals to focus on patient monitoring and clinical management.

III. SMART WORKFLOW OPTIMIZATION IN OPERATING ROOMS

Workflow inefficiencies contribute to surgical delays and increased healthcare costs. Smart workflow optimization applies digital tools to coordinate perioperative processes through automated scheduling, digital pre-induction checklists, real-time dashboards, and task coordination platforms.

Standardized digital protocols improve consistency of care and reduce variability in clinical practice while enhancing operating room utilization.

IV. CLINICAL DECISION SUPPORT SYSTEMS IN ANESTHESIA

Clinical decision support systems assist anesthesia providers by analyzing patient data in real time. Applications include drug dosing guidance, airway risk prediction, hemodynamic alerts, and perioperative risk assessment.

Predictive analytics identify early physiological trends, enabling preventive intervention before deterioration occurs. These systems enhance clinician situational awareness while preserving professional judgment.

V. IMPROVING PATIENT SAFETY THROUGH DIGITAL SYSTEMS

Digital workflow systems enhance patient safety through automated verification processes, medication alerts, allergy warnings, and intelligent alarm prioritization.

Digital checklists ensure completion of critical safety steps and reduce omission errors, contributing to improved perioperative outcomes.

VI. TEAM COMMUNICATION AND COORDINATION

Digital platforms provide centralized dashboards accessible to all operating room team members. Real-time updates improve communication, reduce misunderstandings, and enhance coordination among anesthesia providers, surgeons, and nursing staff.

VII. TRAINING AND EDUCATION BENEFITS

Digital simulation platforms enable anesthesia training using realistic clinical scenarios with objective feedback. Procedural data may support quality improvement programs and professional development initiatives.

VIII. CHALLENGES AND IMPLEMENTATION BARRIERS

Implementation challenges include financial investment, staff adaptation, training requirements, cybersecurity considerations, and integration with legacy hospital systems. Structured implementation strategies are essential for successful adoption.

IX. FUTURE DIRECTIONS

Future operating rooms are expected to incorporate predictive analytics, augmented reality guidance, voice-controlled documentation, and personalized anesthesia planning supported by large clinical datasets.

X. DISCUSSION

Smart anesthesia workflow optimization represents a transition from reactive clinical management toward predictive perioperative care. Digital systems augment clinician cognitive capacity by reducing routine verification workload and improving situational awareness.

Workflow intelligence may provide greater safety improvements than isolated technological innovations, supporting safer patient centered care.

XI. CONCLUSION

Digital decision support systems are transforming anesthesia practice by improving workflow efficiency, enhancing patient safety, and supporting clinical decision-making. Adoption of smart anesthesia workflow models is expected to become a core component of future operating room environments.

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