

From OR to ICU: A New Era in Hemodynamic Performance Improvement

Executive Summary

As health systems face mounting ICU capacity challenges due to staffing constraints, rising acuity and limited capital for expansion, the reduction of avoidable ICU days has never been more critical. The demand for ICU utilization is projected to grow significantly over the next decade, even as the number of ICU beds declines. Adult critical care days are expected to increase by 13%, with the similar growth anticipated at children's hospitals in the next 5 years. For both pediatric and adult critical care, growth is not uniform across acuity groups—medical ICU days make up a significant and growing portion of ICU care.

Additionally, hospitals will increasingly compete for high-margin elective surgeries to balance inpatient revenue. Advanced hemodynamic monitoring supports earlier extubation, fewer complications and shorter recovery time, each of which contributes to relieving pressure on limited ICU resources.

Vizient®/Sg2 collaborates with innovative life sciences firms to improve surgical outcomes through data-driven insights and performance optimization. Over the past three years, Becton Dickinson (BD), a global health care technology company, in partnership with leading health systems and supported by Sg2 analytics, has conducted a series of prospective observational studies using an advanced, minimally invasive continuous hemodynamic monitoring system. The results demonstrate not only that intraoperative hypotension (IOH) is preventable with early AI-enabled detection but also that its mitigation leads to significant improvements in clinical outcomes, reduced complications, shorter lengths of stay and substantial cost savings. These findings offer a compelling case for hospital leaders to adopt advanced patient monitoring technologies and protocols to optimize clinical, operational and financial performance across the perioperative spectrum while also decreasing the workforce burden.

Evolving Monitoring Methods

Intraoperative hypotension remains a persistent challenge in surgical care, often contributing to increased rates of postoperative complications such as acute kidney injury (AKI), prolonged mechanical ventilation, surgical site infections and prolonged inpatient care. Hemodynamic monitoring in surgery has evolved from invasive methods, such as pulmonary artery catheterization for direct measurements, and less reliable periodic snapshots using intermittent blood pressure cuff measurements, to advanced monitoring using cardiac output monitors, dynamic preload indicators and real-time perfusion monitoring. Moreover, advancements include validated predictive hemodynamic monitoring, using minimally invasive methods. This shift represents a broader trend

toward individualized, goal-directed care aimed at reducing complications related to intermittent, undetected intraoperative hypotension. Furthermore, being able to monitor IOH non-invasively from the OR to ICU will support the continuum of care as part of a broader care redesign strategy.

Despite growing awareness, few health systems have systematically adopted real-time solutions and care protocols to detect and respond to IOH at scale. BD's on-site clinical teams partnered with a broad network of hospitals to implement minimally invasive continuous hemodynamic technology and care protocols across key surgical service lines, including cardiac, spine, abdominal, colorectal and obstetrics. The monitoring technology used was BD's Acumen IQ cuff, which offers rapid access to continuous blood pressure and advanced hemodynamic monitoring. A self-coiling cuff wraps around the patient's finger for consistent snugness to decrease variability in application; and it integrates with the Acumen Hypotension Prediction Index (HPI) system, a software tool that monitors and predicts hypotension during surgery. Acumen HPI utilizes a machine learning algorithm that analyzes high-fidelity arterial pressure waveform data from the cuff to identify patients trending toward hypotension.

Encouraged by the early-stage results and future potential, BD engaged Sg2 to independently analyze the results of additional prospective observations using the Vizient® Clinical Data Base, a comprehensive database that allows hospital leadership and clinicians to measure and benchmark quality and financial performance. This white paper summarizes the results and impact of these interventions.

Quality Improvement Methodology

BD initially evaluated noninvasive continuous hemodynamic monitoring at more than 50 hospitals nationwide, encompassing thousands of patient cases. The project was supported by a dedicated clinical team focused on optimizing care delivery. After engaging Sg2, health system prospective project outcomes were analyzed using data from the Vizient® Clinical Data Base (CDB). All findings were reviewed by Sg2 clinical and analytics experts, with summaries prepared for hospital executives and clinical leadership.

Comparative Outcomes Analysis Across Surgical Service Lines

The results reported by BD consistently show that hemodynamic instability detected by AI reduce intraoperative hypotension (IOH) and measurable improvements across multiple clinical domains. Figure 1 provides a summary of the most prominent outcomes by service line, based on data from multiple pilots.

FIGURE 1. OUTCOMES ANALYSIS OF ADVANCED PATIENT MONITORING BY SERVICE LINE, 2022–2025, US MARKET, MULTIPLE HOSPITAL SITES

Service Line (hospitals)	IOH Reduction	AKI Reduction	LOS Decrease	Cost Savings (per case)
Cardiac (n=14)	38.4%	49.0%	1.1 days (12.2%)	\$1,592
Abdominal (n=7)	39.8%	73.0%	0.1 days (3.4%)	\$3,602
Spine (n=5)	47.8%	53.0%	1.0 days (15.9%)	\$982
Colorectal (n=3)	42.4%	N/A	0.8 days (18%)	\$1,100
Bariatric (n=2)	51.0%	N/A	0 days (0%)	\$132
Surgical Oncology (n=1)	66.0%	N/A	0 days (0%)	N/A
Transplant (n=1)	48.0 %	N/A	N/A	N/A

Note: Findings based on Sg2 review of the clinical pilot data across multiple health systems and service lines. N-value represents number of unique hospitals. Not all hospitals reported on all outcomes measures. Additional outcomes measures are available upon request (Sg2 data on file). N/A = not assessed.
Sources: BD Advanced Patient Monitoring (Sg2 data on file), 2025; Sg2 Analysis, 2025.

Deep Dive: Meta-analysis of Impact on Cardiac Valve Procedures

To assess the potential impact of noninvasive continuous hemodynamic monitoring across all major US hospitals and to validate the findings, Sg2 completed a prospective meta-analysis using the Vizient® CDB and focusing on 263 elective or urgent cardiac valve procedure outcomes for hospitals in different markets. This analysis and the engagement of clinical and administrative leadership at each site highlight several key benefits of Acumen IQ use and care protocol optimization in cardiac valve surgery, including reduced mean LOS, direct cost and ICU days and a reduction of complications (Figure 2).

FIGURE 2. META ANALYSIS OF ADVANCED PATIENT MONITORING IN CARDIAC VALVE ELECTIVE AND URGENT SURGICAL CASES, 2023–2024, US MARKET, FOUR HOSPITAL SITES

	Cases	↓IOH (%)	↓AKI (%)	↓LOS	↓LOS Index	↓ICU LOS	↓Cost	↓Cost Index
Baseline	110	17.27	15.45	8.17	0.93	2.95	\$30,005	0.88
Intervention	153	11.76	9.80	7.25	0.82	2.42	\$28,483	0.85

Notes: LOS overall and ICU LOS show average length of stay in days. Cost shows average direct costs as defined by Vizient® CDB. LOS and cost indexes utilize the Vizient® risk-adjusted index which is a benchmarking tool used by hospitals to evaluate performance and compare observed outcomes to expected outcomes, adjusting for patient-specific risk factors. Sources: Data from the Vizient® Clinical Data Base used with permission of Vizient, Inc. All rights reserved. 2023–2024; Sg2 Analysis, 2025.

Case Study: Protocolized Hemodynamic Monitoring Improves Cardiac Surgical Outcomes at AdventHealth Celebration

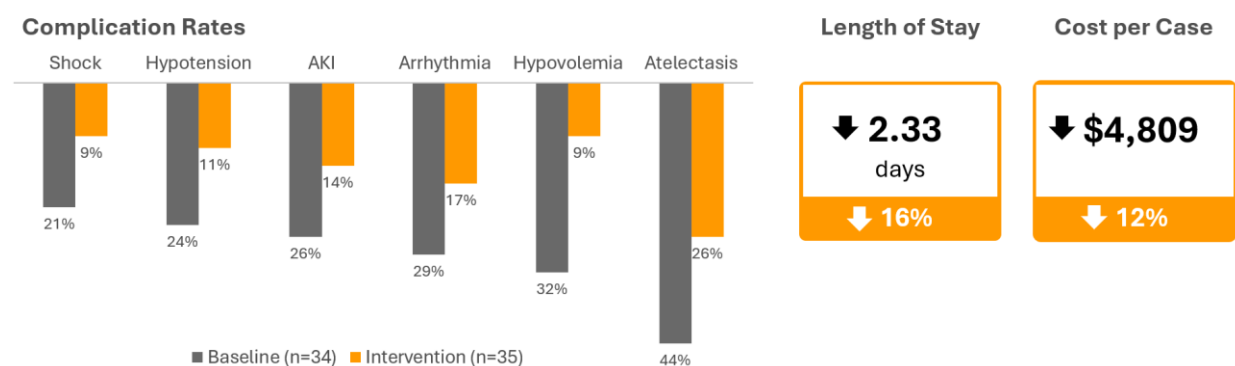
AdventHealth Celebration sought to address intraoperative hypotension and its associated complications in cardiac surgery patients. The AdventHealth Celebration Innovation Team and clinical leadership implemented Acumen IQ and the integrated Acumen HPI software as part of protocol-based care in both the cardiovascular operating room (CVOR) and the cardiovascular intensive care unit (CVICU).

A collaborative multidisciplinary team of anesthesiologists, nurses, intensivists and surgeons designed CVOR and CVICU algorithms to guide timely interventions based on real-time monitoring. These protocols used a mean arterial pressure of less than 65 mmHg as a hypotension trigger and incorporated advanced hemodynamic parameters (e.g., cardiac index, systemic vascular resistance, and dP/dt) for decision-making. Staff received dedicated training to ensure consistency and compliance with the new clinical pathways.

This observational, comparative cohort study evaluated 72 consecutive cardiac valve and coronary artery bypass graft procedures (April to June 2023). Patients were divided into two cohorts: 35 were monitored with a continuous noninvasive system (intervention), while 37 followed traditional monitoring (comparator). Baseline characteristics, including case mix index, procedure type and age distribution, were statistically similar.

Key results, shown in Figure 3, include a reduction in various complications, ICU LOS (44%; 2.3 days) and overall LOS. Additionally, there was a reduction in cost per case of \$4,809.

FIGURE 3. OUTCOMES ANALYSIS OF ADVANCED PATIENT MONITORING PILOT, ADVENTHEALTH CELEBRATION, 2023



Sources: Data provided by AdventHealth Celebration; Sg2 Analysis, 2025.

Modeling Cost Savings From Improved Outcomes

When combined, the findings depicted in Figure 1 and Figure 2 present a compelling case for advanced AI-enabled monitoring of surgical and critical care patients to reduce complications, improve outcomes and realize cost savings. Beyond the clinical and cost-savings benefits, health system leaders will need to evaluate and plan for the potential benefits of operational performance and additional capacity to grow surgical services.

For an average US hospital performing around 170 annual cardiac surgeries, implementing advanced patient monitoring in the cardiac service line alone could save up to 98 ICU and 160 hospital days with potential cost savings of around \$250,000 (Figure 4). System-wide adoption and standardization of protocols across multiple service lines (Figure 1) would therefore be expected to generate significant improvements in overall clinical, operational and economic performance for hospitals. Furthermore, it would support a clinical and economic use case for a focused AI initiative in clinical practice.

FIGURE 4. MODELING POTENTIAL ANNUAL BENEFITS FROM IMPROVED PERFORMANCE IN CARDIAC SURGERY CASES, VIZIENT DATA BASE, 367 HOSPITALS, CY 2024



Notes: MS-DRGs 216-221 and 231-236 were included in the analysis for elective and urgent admissions. Potential impact modeled based on average AKI rate, LOS and direct costs from cardiac surgical cases in the Vizient® Clinical Data Base. Estimated savings calculated were based on a prospective meta-analysis of 169 elective cardiac valve procedure outcomes for hospitals in different markets. The percentage difference was applied from the meta-analysis to the average performance of the CY 2024 retrospective CDB analysis (Figure 2). Sources: BD Advanced Patient Monitoring Outcomes, 2025; Vizient® Clinical Data Base used with permission of Vizient, Inc. All rights reserved. Data from CY2024; Sg2 Analysis, 2025.

Strategic Implications for Health Systems

The findings from these analyses demonstrate that adoption of AI-enabled advanced patient monitoring could significantly benefit hospitals' performance. Furthermore, intermittent intraoperative hypotension is not a fixed inevitability—it is a modifiable risk factor that could be addressed with advanced hemodynamic monitoring paired with targeted intraoperative management protocols.

This work sets a precedent for scaling AI technology-enabled, goal-directed therapy and early recovery after surgery protocols across service lines. Institutions can now benchmark expected returns—both clinical and financial—when considering investment in noninvasive continuous monitoring technologies.

The findings from observations and outcomes of advanced patient monitoring across different service lines, departments and markets create a compelling case for hospital and health system leaders to take action. The consistent clinical and economic improvements observed underscore improved patient outcomes and key opportunities:

STRATEGIC

- Adoption of AI-enabled care through the use of predictive algorithms
- Reduction of total cost of care to support value-based care initiatives
- Engagement and education of the workforce in new, innovative care models

CLINICAL

- Standardization of care across anesthesia providers and surgeons
- Adoption and optimization of surgical pathways
- Enablement of multidisciplinary protocol adherence

OPERATIONAL

- Reduction in ICU and overall lengths of stay
- Improved clinical decision-making and transparency
- Capacity generation through reduced resource utilization

FINANCIAL

- Economies of scale through expansion of use across service lines and facilities
- Expanded capacity to perform additional surgical procedures
- Use of real-world evidence to evaluate and justify cost of adopting new technology

As hospitals continue to adapt to evolving clinical, operational and financial pressures, investments in proven, real-time advanced patient monitoring and protocol optimization offer a scalable, evidence-based solution. The insights outlined in this paper provide an important insight into a new era for advanced patient monitoring with potential systemwide benefits.