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EDITORIAL

Enhancing Patient Safety and Reducing Costs: Artificial Intelligence-Driven Virtual Observation in Healthcare

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Abstract

Rising healthcare costs and an aging population demand innovative approaches to patient safety and operational efficiency. Artificial intelligence-driven virtual observation (AI-VO) offers a scalable, cost-effective alternative to traditional one-to-one patient sitters. By combining real-time video monitoring with machine learning, AI-VO systems enable a single observer to safely monitor multiple high-risk patients—such as those with delirium, dementia, or suicidal ideation—reducing falls and optimizing staff resources. Institutions implementing AI-VO have reported significant benefits, including reduced inpatient falls, improved patient safety, and substantial cost savings. One hospital achieved a 15% fall reduction and projected annual cost avoidance exceeding $2 million. These systems also alleviate nursing strain and support workforce retention, especially amid growing shortages. Challenges remain, including setup costs, integration with electronic health records, cybersecurity, and staff adoption. Success depends on comprehensive training, interdisciplinary collaboration, and cultural change. Looking forward, AI-VO technologies are expanding beyond inpatient care into long-term and home health settings. Features such as predictive analytics, voice recognition, and wearable device integration are enhancing system capabilities. As healthcare shifts toward value-based care, AI-VO stands out as a key innovation—improving safety, reducing costs, and supporting the future of digital, patient-centered healthcare.

Plain Language Summary

Hospitals are facing growing challenges, including rising costs, staff shortages, and an aging population that needs more care. One common issue is patients falling while in the hospital, which can cause injuries and increase hospital stays and expenses. To help solve this, some hospitals are using virtual observation (VO) powered by artificial intelligence. Instead of having a staff member sit in a patient's room all the time, VO allows one trained observer to watch several patients at once using video cameras and smart software that can recognize risky behavior—like trying to get out of bed unsafely. This system has many benefits. It helps prevent falls, saves money, and frees up nurses and other staff to focus on patient care. For example, one hospital saw a big drop in patient falls and saved over $2 million a year. There are some challenges, such as buying the equipment, making sure patient privacy is protected, and training staff to use the system. But with the right support and planning, these systems can work well.

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Why Do We Need Virtual Observation?

In 2022, U.S. healthcare spending reached $4.5 trillion, a 4.1% increase from the previous year.[1,2] At only 17% of the population, adults over 65 years account for 37% of healthcare spending.[3] By 2040, adults over 65 years will account for 22% of the population, leading to a further rise in potential healthcare costs.[4] One significant contributor to hospital expenses is falls by inpatients—an issue both preventable and costly. Each fall can prolong hospitalization by an average of 8 days and add approximately $62,500 in hospital costs per incident.[5] At our major level one trauma center and its affiliated sites,

over 6,500 inpatient falls occurred over just 30 months. Of these, 16% led to injuries, creating not only health risks for patients but also financial and legal liabilities for institutions.[6]

Traditionally, fall-risk patients are assigned a one-to-one staff member tasked with patient observation to promote safety. While this method can reduce adverse events, it comes with a high labor cost that is not reimbursed by insurers. This results in a significant and often unsustainable financial burden for hospitals. Virtual observation (VO) presents a tech-driven solution to this dilemma, combining remote monitoring capabilities with intelligent alert systems to enhance patient safety at a lower cost.[7]

Virtual observation utilizes real-time video surveillance, often paired with artificial intelligence-driven virtual observation (AI-VO), to monitor patients remotely. Patients at high risk—those with dementia, delirium, substance use disorders, suicidal ideation, or the propensity to remove medical devices—can be watched continuously without requiring a physical one-to-one staff member at the bedside.[7] One observer, aided by AI, can monitor multiple patients simultaneously, making the system scalable and cost-effective.

The Benefits of VO

The benefits of VO are multifaceted, combining clinical improvements, economic advantages, and workflow efficiencies. The return on investment for VO is well-documented. For instance, a 300-bed hospital saved over $400,000 within its first year of implementation.[8] At our trauma center, a reduction of 917 overtime staff hours in just 1 month led to an annualized savings of $270,000. These savings are crucial in an industry where profit margins are often slim and operational expenses continue to rise.

Patient safety outcomes are also significantly improved. Our same trauma center observed a 15% reduction in falls over a 6-month period following VO implementation. This translated into an estimated cost avoidance of $2.4 million—savings that can be reinvested into staffing, equipment, or other patient care initiatives.

Beyond cost and safety, VO alleviates staffing strain. Nursing shortages were exacerbated by the COVID-19 pandemic, and burnout rates are climbing.[9] The availability of VO reduces the need for one-on-one staff members, allowing nursing staff to focus on clinical tasks rather than surveillance, which may lead to improved job satisfaction and help hospitals retain experienced personnel.

Artificial Intelligence Utilization in VO

An AI-powered VO leverages cutting-edge technology to enhance monitoring capabilities. Systems equipped with image- and sensor-based technologies can detect patient movements, bed exits, or abnormal behaviors in real time.[10,11] These systems use machine learning algorithms trained on large datasets to predict and identify dangerous behaviors before they escalate. One Italian group analyzed 1,400 images to provide an AI model with a data set capable of detecting several types of falls.[12] Potentially, AI could be trained to triage alert severity and prioritize interventions, minimizing false alarms and enhancing staff response time.

The COVID-19 pandemic further underscored the value of VO. In many cases, social distancing requirements and infection control protocols made in-person sitting impractical. VO provided a safe, contactless alternative, allowing for continuous patient monitoring while protecting both patients and staff from unnecessary exposure.

Virtual observation also has the potential to expand beyond inpatient settings. In long-term care facilities, VO could monitor residents with cognitive impairments who are prone to wandering. In outpatient or home settings, it could provide post-discharge monitoring for high-risk individuals, reducing readmissions and enhancing recovery outcomes. These possible extensions of VO reflect the growing emphasis on continuity of care and proactive intervention in modern healthcare.

The Challenges of AI-VO

Despite the compelling benefits, VO implementation comes with notable challenges. The initial setup cost—though lower than long-term one-to-one staff member expenses—can be a barrier for smaller institutions. These costs include purchasing cameras and hardware, integrating software with existing electronic health record (EHR) systems, and training personnel.

Technical expertise is also required to launch and maintain the system. Smaller hospitals might lack the necessary information technology infrastructure or personnel to manage complex integrations or respond to technical issues. Larger systems face logistical hurdles in standardizing VO across multiple units and facilities, each with their workflows and patient populations.

Patient privacy is another concern. Although VO systems typically use live video feeds that are not recorded, any digital transmission presents the possibility of a data breach. Ensuring compliance with regulations such as the Health Insurance Portability and Accountability Act (HIPPA) requires robust cybersecurity protocols and frequent IT updates.[13] Institutions must also develop clear policies outlining what is monitored, who has access, and how data is protected.

Staff adoption and culture change are critical (Table 1). Successful programs prioritize education and include staff in planning and decision-making.[14] Demonstrating the effectiveness of VO through pilot programs, sharing success stories, and providing hands-on training can help ease resistance.

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Table 1. Challenges in the adoption of virtual observation.

Challenges	Risks
Skepticism of VO	Affects nurses, aides, and other frontline staff, especially if they feel the system undermines their judgment or increases their workload.
False alarms	Repetitive and futile bedside evaluation can lead to alarm fatigue and distrust in the system.
Operating additional advanced technical equipment	Reduced time available to be directed towards patient care.

VO: virtual observation.

Training programs should cover both the technical and ethical aspects of VO. Observers must be skilled in using the platform and in communicating effectively with clinical teams. Clear communication protocols—such as when to escalate an alert—must be established and practiced. Regular drills and refreshers, including falls, out of bed, and device removal, ensure the system runs smoothly and remains compliant with safety standards.

Implementation Success

Effective implementation of VO requires a coordinated strategy involving clinical, technical, and administrative stakeholders. Providers and nursing informaticists have been and will continue to be the primary driving leaders behind this change. Clinical informaticists must be able to critically analyze the needs of a hospital system and patient care units while working with administration and clinical staff to implement these models. Many hospitals choose to partner with third-party vendors who offer turnkey solutions, including hardware, software, training, and support. This reduces the burden on internal teams and accelerates deployment.[15]

Integrating VO systems with EHR platforms offers additional efficiencies. Observers can access patient histories, risk profiles, and medication lists, allowing them to provide context-rich alerts. Integration also enables automated documentation and improved data accuracy.

Some hospitals are developing command centers staffed with multidisciplinary teams that include virtual observers, care coordinators, and data analysts. These centralized hubs allow for cross-functional collaboration, real-time patient surveillance, and faster response times. The success of these models underscores the potential of VO to be more than a stopgap—it is becoming an integral part of patient care delivery.

Future Outlook

Looking to the future, AI-VO is poised to evolve rapidly. Predictive analytics will enable systems to identify trends and forecast risk levels before adverse events occur. Natural language processing may allow observers to issue voice commands or interpret patient speech for signs of distress. Wearable devices and remote monitoring tools will likely become interoperable with VO platforms, creating a comprehensive digital ecosystem for continuous care.

Domestically, AI & VO will likely continue to infiltrate many aspects of patient care in the U.S. The ability of AI-VO to provide remote surveillance may pair well with the hospital care at home programs currently being rolled out across the nation in response to the COVID-19 pandemic. The combination of these programs could ease the growing shortage of inpatient beds in the US.

Internationally, VO adoption is gaining momentum. In the United Kingdom, the National Health Service has begun exploring VO to support overburdened wards.[16] In Canada and Australia, pilot programs have shown promise in elder care and mental health settings.[17,18] These developments indicate that VO is not just a U.S.-based trend but a global solution to common healthcare challenges.

As AI regulation matures, VO systems will need to adhere to evolving legal and ethical standards. Transparent algorithm design, bias mitigation, and patient consent will become central concerns. Healthcare leaders must stay informed of these developments to ensure ethical and compliant use of AI in observation technologies.

Conclusion

Virtual observation represents a transformative step forward in healthcare—enhancing patient safety, reducing costs, and modernizing care delivery through AI and technology. While challenges exist in implementation, privacy, and culture change, the benefits far outweigh the drawbacks. As the healthcare industry continues to embrace innovation, VO stands out as a scalable, sustainable solution that aligns with value-based care, workforce optimization, and evolving patient needs.

Whether used in hospitals, long-term care facilities, or home settings, VO empowers care teams to work smarter, not harder. With the integration of AI and continuous advancements in technology, VO is set to become a cornerstone of 21st-century healthcare.

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Conflicts of Interest

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Author Contributions

Dr. Wandling drafted the manuscript and revised important intellectual content. Dr. Marburger supervised the

project, revised it, and approved the final version to be published.

Data Availability Statement (DAS), Data Sharing, Reproducibility, and Data Repositories

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Application of AI-Generated Text or Related Technology

ChatGPT was utilized for the Plain Language Summary. All content has been reviewed by the authors for content.

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