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Digital Transformation & Interoperability

ANALYSIS - EVALUATION - OPPORTUNITIES - KEY DEVELOPMENTS

How Interoperability and Automation Are Reshaping Medication Management in European Hospital Pharmacies

European hospital pharmacies are undergoing digital transformation to enhance efficiency, patient safety and clinical outcomes. However, fragmented systems and a lack of interoperability hinder progress. The EAHP's Special Interest Group unites pharmacists and vendors to standardise data exchange, inspired by the DICOM model. This collaborative, phased effort aims to achieve vendor-neutral, plug-and-play automation and improve medication management across Europe.

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key points

- Hospital pharmacies face major challenges due to fragmented digital and automation systems.
- Interoperability is vital to improve efficiency, safety and staff productivity in pharmacies.
- The EAHP formed a Special Interest Group to drive standardisation and system integration.
- Experts propose a vendor-neutral model inspired by the DICOM standard in medical imaging.
- Collaboration among pharmacists, vendors and regulators is key to achieving seamless workflows.

When I was asked to write an article about Interoperability in hospital settings, I immediately thought about hospital pharmacies. Indeed, I could see firsthand the pain of lack of standardised interoperability in that domain during my collaboration with French e-health company Eurekam on chemotherapy monitoring solutions.

Digital transformation in hospital settings comes with its own unique organisational, change management and technological hurdles, so adding the resource- and time-consuming interoperability of digital solutions on top of these can be overwhelming.

There is no denying that the digital transformation of hospital pharmacies is accelerating, driven by the imperative to improve efficiency, enhance patient safety and optimise resource allocation. As in most hospital departments, pharmacies lack personnel. Digitisation and automation may be critical to alleviating this issue. However, this transformation is often hindered by fragmented software and automation systems that fail to communicate effectively, leading to inefficiencies, operational bottlenecks and increased risks.

During an EAHP (European Association of Hospital Pharmacists) conference in Florence last year, I was introduced to a newly formed Special Interest Group that aims to tackle the very issue of interoperability of digital systems in their working environment.

This Special Interest Group, organised by the EAHP and led by experts in hospital pharmacy, including Patrick Koch and Francine de Stoppelaar, has been actively working to address these challenges

by advocating for greater interoperability and standardisation in hospital pharmacy automation.

Francine and Patrick's insights on the one hand, combined with the perspective of solution vendors they put me in touch with, have provided a roadmap for a more connected, efficient and patient-centric hospital pharmacy system in Europe and beyond.

The Three Pillars of a Modern Hospital Pharmacy

Louis Bertin is a hospital pharmacist and Board Member of the European Association of Hospital Pharmacists (EAHP) and helped set up the EAHP's Special Interest Group (SIG) on digital solutions interoperability. Louis walked me through the overall context of hospital pharmacies' digital transformation to put the interoperability effort in perspective.

Louis identifies three fundamental pillars of hospital pharmacy: logistics, treatment preparation and clinical pharmacy. Each of these pillars plays a crucial role in ensuring patient safety and the effective delivery of pharmaceutical care. As Louis described it, the pyramid works somewhat like Maslow's pyramid of needs: it is easier to tackle the next level of the pyramid if you have covered the foundational levels below.

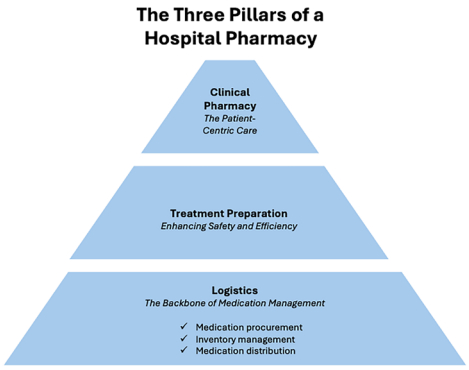

Figure 1. The Three Pillars of a Hospital Pharmacy. Source: Author's own work, based on the interview with Louis Bertin

1. Logistics: The Backbone of Medication Management

The logistical aspect of hospital pharmacies encompasses procurement, inventory management and medication distribution. Hospitals must maintain precise control over their medication stocks to prevent shortages or overstocking, both of which can have severe consequences. Digital inventory management systems have already revolutionised logistics by improving tracking accuracy and minimising waste. However, a lack of interoperability between hospital inventory systems and automated dispensing units, for example, often results in inefficiencies that could be avoided through better integration. Hospital pharmacists and technicians spend a sizeable amount of time and energy compensating for this, time that comes at the expense of their dedication to the next levels of the pyramid.

2. Treatment Preparation: Enhancing Safety and Efficiency

The preparation of treatments, particularly chemotherapy drugs and customised pediatric medications, requires extreme precision. Implementation of automation solutions has proved to improve safety by reducing human errors in compounding and dose calculation. For example, robotic systems and other monitoring systems for chemotherapy preparation are now being widely adopted to ensure the correct formulation and to protect pharmacists from hazardous exposure.

Nevertheless, without a standardised data exchange framework, communication between robotic systems and electronic health records (EHR) remains inconsistent, limiting their full potential.

> "What DICOM achieved in imaging, we must now achieve in pharmacy automation. We need the same level of vendor-neutral, plug-and-play interoperability."

3. Clinical Pharmacy: The Patient-Centric Care

The role of the hospital pharmacist is continuously evolving. Beyond dispensing medications, pharmacists are increasingly involved in direct patient care, collaborating with physicians to optimise prescriptions, identify drug interactions and adjust treatments based on laboratory results.

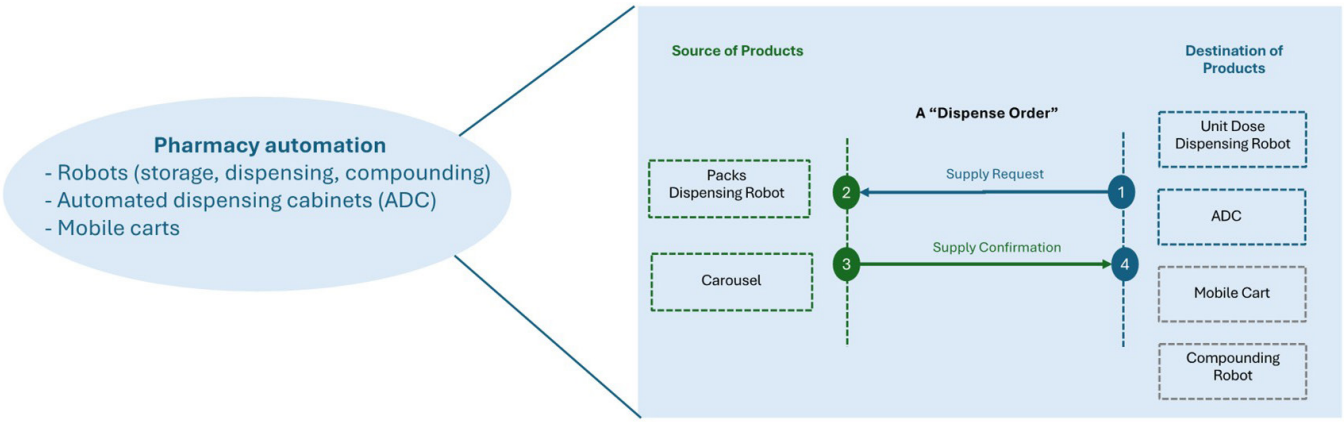

Figure 2. Hospital Pharmacy Interoperability Need: Interoperability amongst Pharmacy Systems. Source: European Association of Hospital Pharmacists (EAHP) – Special Interest Group on Interoperability. Reproduced with permission.

This is what some hospital pharmacists aspire to spend most of their time doing and the reason why they pursued this career. So, the more interoperability there is, the smoother and expedited the first two levels of the pyramid will be; the more hospital pharmacists will have time to dedicate to the high-added-value activities of clinical pharmacy.

And at this level again, the integration of AI-driven clinical decision support tools has the potential to significantly enhance these activities. However, for these tools to be truly effective, they also must be seamlessly integrated into hospital IT systems, enabling real-time data sharing and decision-making.

The Interoperability Challenge in Pharmacy Automation

Francine de Stoppelaar, Associate at Deloitte UK and Associate Professor at the University of Leicester, brings a wealth of experience in implementing fully digitalised hospital pharmacy models. Francine explained to me how her work at the Cleveland Clinic London revealed that whilst automation can bring significant benefits, the lack of interoperability between systems often diminishes their effectiveness. Francine is an expert in hospital digital transformation and its practical challenges. This made her particularly well suited to attack the next frontier of interoperability when joining the SIG project for hospital pharmacies as Co-Chair.

Breaking Down Silos in Hospital Automation

As Francine describes, in many hospitals, automated systems operate in isolation. Robotic dispensing units, unit-dose packaging machines and automated medication storage systems often function independently, requiring manual interventions to transfer medications between them. This fragmentation leads to delays, increased labour costs and a higher likelihood of errors. A unified digital framework that links these systems could eliminate redundant tasks and significantly improve operational efficiency.

Vendor Collaboration: A New Paradigm

When prompted to explain the absence of a unified framework, Francine points out that one of the key obstacles to achieving interoperability is the historical reluctance of automation vendors to collaborate.

This was not for bad intentions, but traditionally, each vendor has developed proprietary systems optimised for their own ecosystem, making cross-platform integration difficult as a consequence.

This is the reason why the EAHP formed this Special Interest Group (SIG) on interoperability. An overseeing group was needed to change this dynamic. By bringing together hospital pharmacists and automation vendors, the SIG is fostering dialogue aimed at developing universal standards for pharmacy automation.

Francine also notes that a significant breakthrough in this initiative has been twofold. Firstly, this is the first vendor-neutral collaborative platform of its kind, and secondly, each participating vendor has contributed financially, which has incentivised them to actively contribute to interoperability solutions. Nine leading vendors have currently joined the effort, marking a shift towards a more collaborative industry approach.

Adopting a pragmatic, phased approach, the EAHP Special Interest Group on Interoperability has chosen to focus first on resolving interoperability challenges within the hospital pharmacy's automation systems (as

illustrated in Figure 2). This initial step aims to ensure seamless communication between automated devices operating within the pharmacy perimeter. Once this internal interoperability is achieved, the group will turn to the next phase: integrating these systems with the broader hospital IT ecosystem (as shown in Figure 4).

To move from strategy to implementation, the SIG is working on clearly defined, real-world use cases—such as the interoperability between automated dispensing cabinets (ADCs) and pharmacy robots. These concrete scenarios form the basis for practical frameworks supporting seamless automation, as we will discover in the contribution from Patrick Koch.

> "Our goal is to deliver a vendor-neutral communication mechanism that any hospital in Europe can adopt."

Lessons from Other Sectors: Can DICOM Inspire Pharmacy Automation?

Patrick Koch, founder and CEO of Peka Consulting, is an independent consultant specialising in the digital transformation of medication management and the automation of hospital pharmacies. He brings his expertise in healthcare interoperability and co-leads the Special Interest Group (SIG) on Interoperability launched by EAHP in 2024.

With a background in medical imaging IT, including a tenure at Carestream, Patrick believes that hospital pharmacy automation can learn valuable lessons from the success of the DICOM (Digital Imaging and Communications in Medicine) standard. DICOM has enabled seamless communication between imaging devices and software from different vendors, reducing integration complexity and costs.

"What DICOM achieved in imaging, we must now achieve in pharmacy automation," Patrick explains. "We need the same level of vendor-neutral, plug-and-play interoperability."

Applying the DICOM Model to Pharmacy Automation

Patrick envisions a similar approach to drive integration across automated pharmacy equipment and pharmacy IT systems. This would require a close collaboration between vendors and hospital pharmacists, just as it happened in radiology during the development of DICOM:

- Standardised communication protocols between automation devices (robots, dispensing cabinets) and pharmacy IT systems, which not only enable system integration but also promote more standardised workflows within hospital pharmacy operations.
- A common data structure for medication records and prescriptions, based on existing healthcare standards like HL7, FHIR and IHE.

The Future of Pharmacy: Plug-and-Play Automation

To fully harness the benefits of automation, hospital pharmacies need a plug-and-play ecosystem – one where various systems and devices from different vendors can interoperate without custom development efforts for each project.

Patrick outlines a few key priorities to get there:

- **Standardising communication protocols across the board.** Just as DICOM structured data exchange in imaging, hospital pharmacies need a unified technical framework that dictates how data should be formatted, shared and interpreted.
- **Greater regulatory and policy support for interoperability.** Public authorities can act as catalysts by incentivising or mandating vendor-neutral approaches in procurement and regulation.
- **Shifting from siloed product offerings to vendor-neutral workflow integration.** Instead of promoting seamless integration only within their own product portfolios, vendors must align with a common, vendor-neutral communication protocol. This approach ensures that automation solutions can be integrated into broader hospital workflows, regardless of brand, enabling hospitals to build best-of-breed systems without being locked into a single vendor.

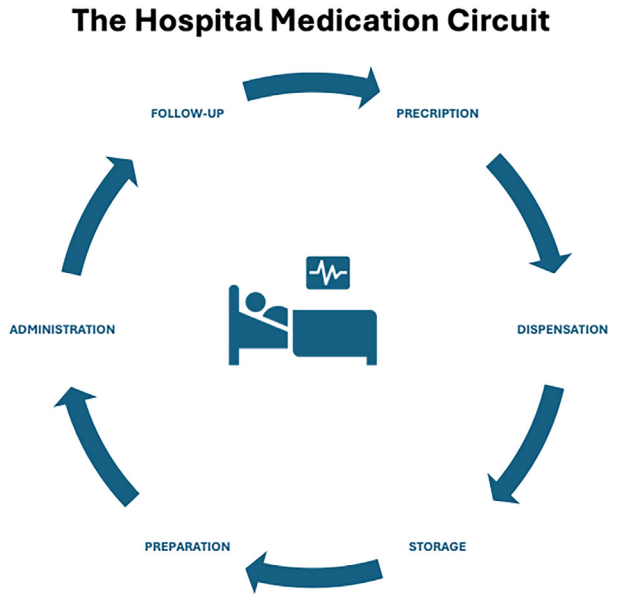

Figure 3. The Hospital Medication Circuit. Source: Author's own work

A European Initiative to Make It Happen

Through the EAHP Interoperability SIG, Patrick and a group of 12 hospital pharmacists and nine major automation vendors across Europe are taking action. Their mission is to define and test a standard communication protocol for the most common use cases, such as replenishing automated dispensing cabinets and producing unit doses.

"Our goal is to deliver a vendor-neutral communication mechanism that any hospital in Europe can adopt," Patrick concludes. "It's time to make medication management as seamless and safe as modern imaging has become."

The Vendor's Perspective: Opportunities, Hurdles and Strategic Directions

As hospital pharmacists navigate the real-world challenges of digital transformation, solution vendors are simultaneously grappling with the complexities of integration, regulation and fragmented market dynamics. As the task of creating new interoperability conditions is going to eventually fall on their shoulders, hearing about their perspective sheds additional light on the problem the group is trying to solve.

From large players like Becton Dickinson to niche specialists like Triatech specialising in Automated Dispensing Cabinets and Alphatron focused on the digitisation of the dispensing leg of the hospital medication circuit, vendors look at the problem from different angles but with a common motivation to turn interoperability from a constraint to an opportunity.

Interoperability—the seamless integration of different technologies and systems within a healthcare environment—emerges for these vendors as both a business imperative and a collaborative challenge, requiring not only technical solutions but also alignment across the entire ecosystem.

Three leading voices in the pharmacy automation space—Hakan Aya, CTO of Triatech; Stefan Soloman, Interoperability Lead at Becton Dickinson (BD); and Harald Verloop, CEO of Alphatron Medical—offered me their respective and valuable insights into how vendors are addressing the hurdles of interoperability and shaping strategic responses to unlock the full potential of automation in hospital pharmacies settings and beyond.

1. Hakan Aya: The Challenge of Interoperability in Pharmacy Automation

Hakan Aya's company, Triatech, specialises in automated dispensing cabinets (ADCs) for hospital pharmacies. Originally an electronics engineer with experience in medical devices, Hakan joined Simeks in 2004 as a partner, initially distributing ADCs in Turkey before developing their own line of systems in 2015 with the co-founded company Triatech under Stockart brand. Triatech now operates in 33 countries and is preparing to expand into North America. Aya's company focuses primarily on ADCs, with plans to explore other areas of pharmacy automation in the future.

Interoperability Challenges. Hakan explained to me the critical role of interoperability in the success of hospital pharmacy automation from his perspective as an ADC vendor. The integration of ADCs with hospital information systems (HIS), material management systems and billing systems is particularly challenging, as these systems often come from different vendors. In Turkey, where these systems are typically integrated into a single software, interoperability is less of an issue. However, in Europe and the US, the fragmented nature of hospital systems makes integration both complex and costly.

Hakan underlines that the integration of ADCs with other hospital systems is typically expensive and time-consuming, taking around 2 to 3 weeks per site. This process can account for 5 to 10% of the total project cost for small-sized projects, with hospitals bearing the brunt of the financial burden in many cases. The lack of standardised interoperability is therefore costing time and money on most projects, when these resources

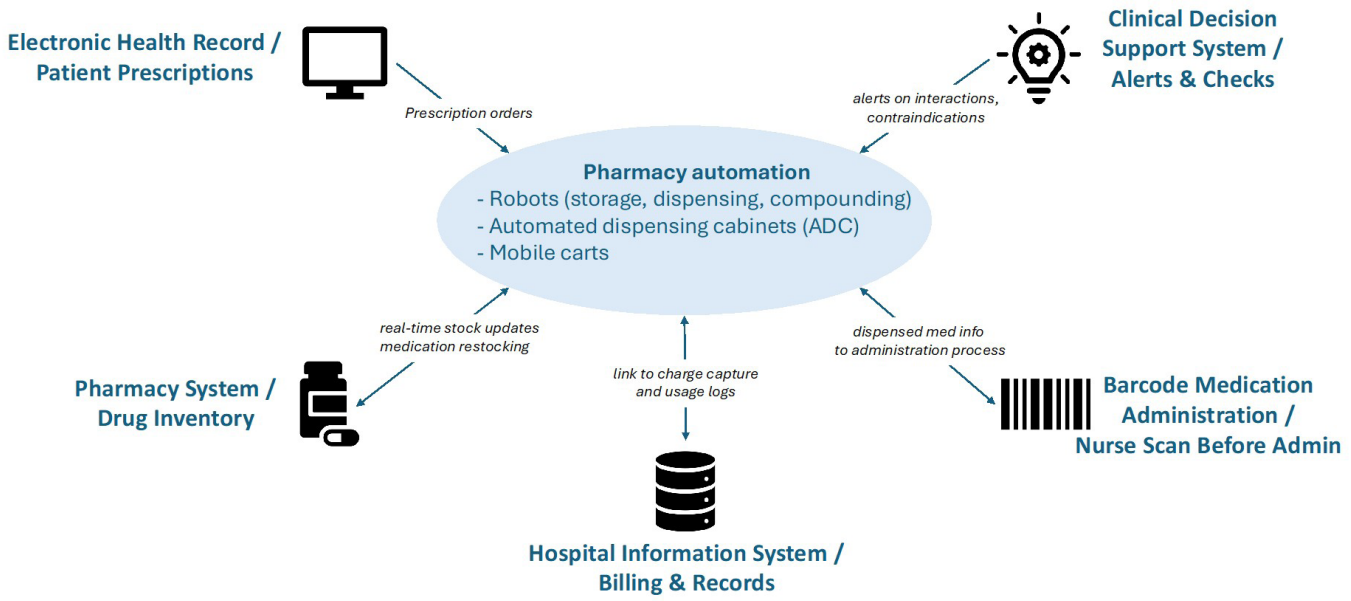

Figure 4. Hospital Pharmacy Interoperability Need: Pharmacy Systems Interoperability with Hospital IT Systems. Source: Author's own work

could have been utilised for innovation by vendors and for more equipment by hospitals instead.

The Future of Interoperability. Despite these challenges, Hakan shared with me his optimism about the future of interoperability, placing his hopes on the SIG where he is particularly active and invested.

Hakan believes that the industry's focus on improving interoperability will lead to smoother integration of different systems. With pre-designed interfaces for different devices, his company Triatech aims to reduce the complexity and cost of integration, making it easier for hospitals to adopt ADCs and other automated solutions.

Despite the slow progress in standardisation, Hakan is confident that the SIG initiative will provide a boost. He believes this industry-wide European initiative will ultimately foster a more interoperable healthcare ecosystem, enabling vendors and hospitals to achieve greater efficiency and lower costs. This effort is particularly important as Triatech looks to expand into the North American market, where interoperability is a critical consideration.

2. Stefan Soloman: Navigating the Fragmented Landscape of Medication Management

Regulatory and Technological Challenges. Stefan Soloman is the interoperability lead for medication management devices at Becton Dickinson (BD). Stefan provides another perspective on the challenges of interoperability in hospital pharmacies. Indeed, BD offers a wide range of devices, such as dispensing robots and infusion pumps, that play a central role in medication management. However, these devices cannot function effectively in isolation. They require integration with other hospital IT systems, such as Pharmacy Information Systems (PIS), Electronic Health Records (EHRs) and Electronic Medication Administration Records (EMARs).

Stefan emphasises that one of the primary challenges is the regulatory fragmentation across different countries. Unlike the telecom industry, where Stefan used to work and where global standards ensure seamless communication, healthcare systems have developed in a way that varies significantly by country. This has led to a situation where hospital systems and their accompanying technologies are highly fragmented, making interoperability a complex and expensive endeavour.

The lack of EU-wide regulations for interoperability means, in particular, that vendors must create solutions tailored to specific countries or hospitals. This has led to the development of "islands of innovation," where different systems work in isolation but do not communicate effectively with others. As a result, Stefan argues, the broader adoption of hospital automation technologies has been slower than expected.

BD's Role in Overcoming Fragmentation. BD recognises the importance of interoperability in enabling fully automated hospital workflows. However, achieving this goal requires collaboration between multiple stakeholders, including other medical device

vendors and healthcare IT companies. The challenge is compounded by competing vendor interests, as each company aims to maintain its competitive edge in the marketplace.

In this context, Stefan sees potential in early-stage collaboration among vendors to demonstrate that interoperability is a shared goal. Phase 1 of this effort, as he describes it, focuses on bringing together medical device vendors to agree on the importance of interoperability. This is what the SIG is currently realising through the building of a common understanding and goals.

> "Interoperability is not a luxury; it is a prerequisite for realising the full promise of automation."

However, the collaboration among medical device vendors is not enough to solve the problem entirely. As the next step, Stefan advocates for the inclusion of healthcare IT vendors (systems like Electronic Health Records, prescription software etc.), whose systems need to integrate with medical devices for effective medication management.

Long-Term Vision for Regulatory Standardisation. In the long term, Stefan believes that regulatory standardisation will be essential to achieving widespread interoperability. Keeping drawing on the analogy with the telecom and payments industries, Stefan envisions a future where EU-wide standards for interoperability are mandated, making it easier for new vendors to enter the market and ensure that their products are compatible with existing systems. This regulatory framework would reduce fragmentation and accelerate the adoption of new technologies across healthcare systems.

We should not reinvent the wheel: interoperability standards like HL7 and IHE already exist; they just need to be adopted and enforced by European regulatory authorities.

3. Harald Verloop: The Role of Pharmacy in Digital Transformation

Alphatron Medical and the Shift Toward Automation. Harald Verloop's company, Alphatron Medical, has been involved in medical technology for over 25 years, with a focus on imaging systems and medical IT. Alphatron's platform, which initially targeted nursing workflows, now includes pharmacy systems as part of the broader effort to automate hospital workflows.

During our discussion, Harald shared that while radiology and other hospital departments have made significant strides in digital transformation, pharmacy departments have been slower in adopting automation and interoperability solutions.

Barriers to Pharmacy's Digital Transformation. As I asked him the reasons for this delay, Harald shared the interesting insight that the pharmacy's slower involvement in interoperability efforts is due in part to the lack of a clear feedback loop. In fields like radiology, where immediate feedback on image quality is provided to the radiology department, integration into hospital workflows happens more quickly. However, pharmacy departments are focused on the clinical aspects of medication (personalising prescriptions, avoiding iatrogenesis etc.) with less emphasis on medication verification and administration, which are critical to ensuring patient safety. Indeed, pharmacists are responsible for the delivery of medications but not for their administration to patients, which is the responsibility of nurses. Therefore, multiple actors along the medication chain are in charge of the process steps under their watch without clear ownership of the final patient outcome.

Medication Errors and the Need for Closing the Loop. Harald highlights that a significant percentage of medication errors (around 38%) occur during the administration phase – the one where his company, Alphatron, is focused – often due to fragmented responsibilities between doctors, nurses and pharmacists. He argues that closing this loop by ensuring that pharmacists are integrated into the entire end-to-end medication process—from prescription to administration—can significantly reduce medication errors and improve patient care.

Vendor Perspectives and Standardised Frameworks. Alphatron, like other vendors, faces challenges in ensuring interoperability due to the fragmented nature of hospital systems and the need for collaboration with other stakeholders. Harald supports initiatives like the Integrating Healthcare Enterprise (IHE) framework, which provides a standardised approach to testing and certifying the interoperability of medical devices. By adhering to such frameworks, vendors can ensure

that their products communicate effectively with other systems, which is crucial for enabling integrated workflows.

Conclusion: Toward an Interoperable Future in Hospital Pharmacy

The convergence of insights from hospital stakeholders and solution vendors paints a detailed picture of the current state of hospital pharmacy automation. While hospitals highlight integration gaps and the resulting operational inefficiencies, vendors acknowledge these pain points and reveal the underlying structural and market-level constraints.

Interoperability is not a luxury; it is a prerequisite for realising the full promise of automation in healthcare. Addressing this challenge will require coordinated action across the ecosystem. Hospitals must insist on integration-ready technologies and invest in internal governance for digital transformation. Vendors must prioritise open standards and actively contribute to initiatives like this SIG and IHE. Policymakers and regulators should support the development of EU-wide interoperability mandates and certification frameworks.

Only through this shared commitment can automation efforts evolve from isolated successes into system-wide improvements in patient safety, operational efficiency and staff satisfaction, giving birth to much wider innovation and patient outcome improvement in the process.

Conflict of Interest

None

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