Digital Visibility is the Foundation for **Autonomy and Intelligence in Pharmacy**

By Douglas Descalzi

Co-authors: James Stevenson, Mohamed Magoury

Thiopoly

1 You Cannot Manage **What You Cannot See**

Its 2024, and what can pharmacy see? In almost any industry, seeing the full picture, the entire enterprise, produces faster, more informed decisions and stronger results. The pharmacy enterprise in any health system has grown immensely in strategic importance, critical to achieving health and financial goals for any provider. Yet, health system pharmacy continues to be a very manual juggling act, especially in managing medications across increasingly numerous, varied and disperse care settings. Even with all the technology and tools available today, recent research has found that 65% of medication inventory in US health systems lacks digital visibility.[1]

> **The foundational problem in operational pharmacy is that the full medication inventory picture is not available.**

Regardless of the sizable visibility challenge, the pharmacy profession has aspirations for powerful AI tools and the fully autonomous pharmacy[2], the zero-error, automated operation that produces the ideal state of medication use outcomes. But, the lack of visibility significantly hampers the forward progress of pharmacy, including application of automation technology, artificial intelligence (AI), and advanced analytics. Digital visibility provides the core data for operational pharmacy. Without this data, the full potential of technology and AI cannot be realized.

We believe that **full digital visibility** in medication management is the key to achieving the autonomous pharmacy vision and **meeting the needs of healthcare in the future.**

2 RX **Challenges**

Pharmacists in health systems face a never-ending list of care, cost, workforce, regulation, and scale challenges.[3] As healthcare evolves, pharmacy staff are balancing a larger and more influential role in patient care with the responsibility of ensuring the supply chain of medications within increasingly complex and disperse health systems. It's a juggling act on a treadmill, where more balls must be kept in the air and the speed of the treadmill is getting faster.

In medication management, the goal is to purchase and position medications to ensure care while minimizing costs. Considering the thousands of medication line items, hundreds of storage locations, and dozens of facilities in the modern health system, this is a daunting task even when things go exactly right. Yet, in daily operations, medication management can get nearly chaotic with the unpredictable daily events that imperil drug availability to patients and the chronic challenges that affect health system economics.

Unpredictable Events **The 'Crisis'**	Chronic Challenges **The 'Curses'**
Recall	Diversion/Shrinkage
Stockout	Overstock
Shortage	Waste

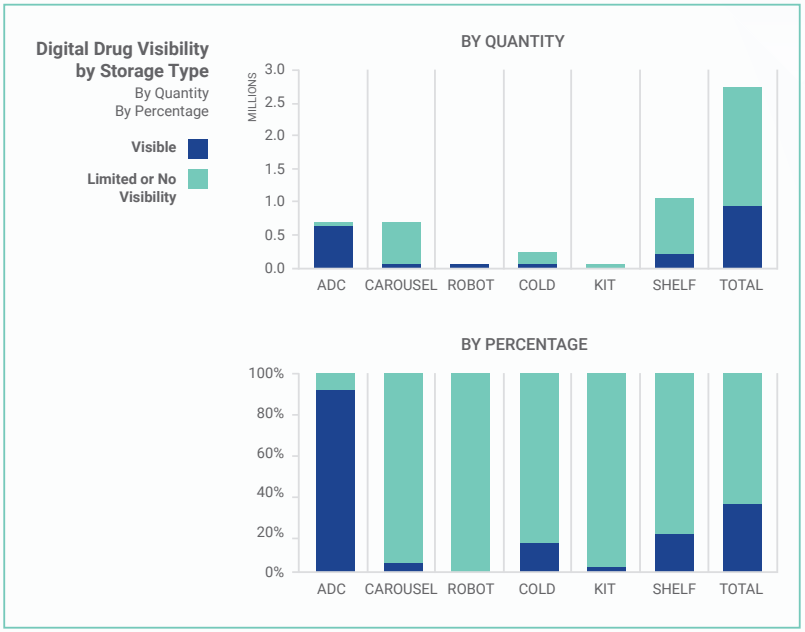
The lack of digital visibility exacerbates these crises and curses, and also limits the ability to respond to them efficiently and effectively.

3 Where **Digital Visibility is Lacking.**

Digital visibility of medications in a health system is provided through the storage solutions and systems available. Physical storage solutions for medication management include automated dispensing cabinets (ADC's), medication carousels, and dispensing robots; virtual storage solutions include 'scan-in, scan-out' and perpetual inventory management systems. Health systems may use one or all of these solutions to manage medication inventory. Often, these solutions are stitched together, via numerous integrations, to provide a consolidated view of medication inventory throughout the health system.

However, as already stated, these technologies and solutions are only providing part of the picture. In a recent study of six large, academic medical centers, only 35% of drug inventory was deemed to have accurate digital visibility.[1] A separate, self-assessment survey was recently conducted, whereby health systems could individually and independently evaluate digital visibility within their operations. Analysis of survey results largely corroborate the initial findings, and suggest that more than half of respondents only have digital visibility into 50% of their drug inventory.[4]

When analyzed by storage solution, it becomes more apparent where the digital visibility challenges are. The most common types of medication storage solutions for health systems are ADC's, carousels, and robots. Yet, a large number of medications are stored outside these systems in refrigerators, freezers, or open shelves. All of these drug storage types create a wide range of digital visibility to the health system.[1]



Clearly, ADC's and robots provide high levels of digital visibility – in excess of 90% of the items stored in them.

> **Medication carousels, cold storage (refrigerators and freezers), and open shelving are the primary culprits in the digital visibility problem. And, due to the large number of medications stored in carousels, refrigerators, freezers and shelving, they have a large influence on the total digital visibility in a health system.**

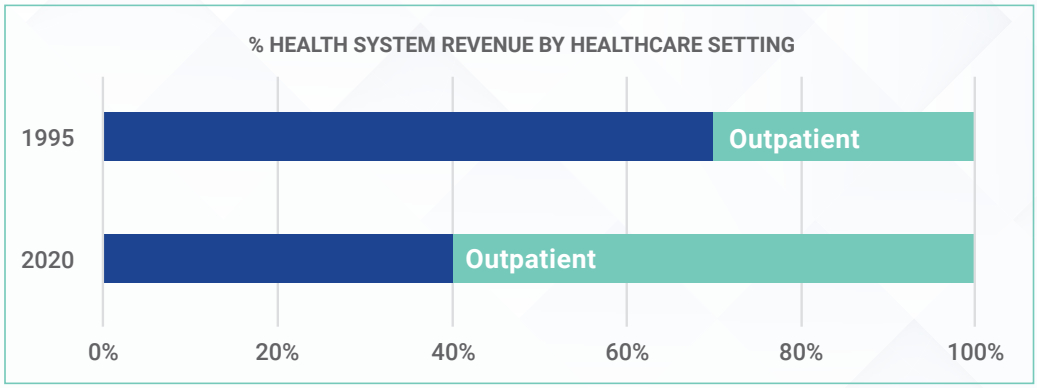
While alarming to those who may be unaware of the current state of medication management, most pharmacy leaders are not surprised. Somewhat numb to the problem, and without a means to address, they simply do the best they can with the tools and technologies available. Stop gap measures, such as cycle counting, are used to ensure some level of accuracy, but they are manual, time consuming, and also prone to error.

4 Why **Digital Visibility Has Become a Problem**

There are two primary reasons why digital visibility of medications in health systems has become such a problem:

1. Healthcare delivery has long been migrating from inpatient, acute, hospital settings to outpatient, ambulatory, clinic settings.
2. Technical innovation has not kept pace with the needs of pharmacy.

For the past 25 years, healthcare delivery has been moving to outpatient settings. According to the American Hospital Association, 70% of health system revenue was from inpatient services in 1995. In 2019, just prior to the Covid-19 pandemic, inpatient revenue was down to 40% of total health system revenue.[5]



The outpatient trend in care is due to many factors, including less invasive clinical therapies, demographics and chronic disease management, and healthcare policy & economics.

Regardless of causes, outpatient and ambulatory settings now greatly outnumber acute care hospitals. A large health system may now have tens of hospitals, but several hundred ambulatory centers and clinics. The medication management technologies that fit large, inpatient facilities are not well suited to outpatient, ambulatory settings. ADC's, carousels, and robots are expensive, require extensive support, and provide the greatest value when care is very concentrated.

> **While healthcare delivery has evolved and migrated, the new models and settings for care often do not have the size or scale, nor the staffing or financial resources, to deploy these legacy technologies.**

The second reason for lack of digital visibility is a lack of innovation. Technology adoption is accelerating in every industry, putting adoption laggards at a significant competitive disadvantage. Pharmacy, in particular, has experienced few transformative innovations in the last 20 years. ADC's, carousels, and robots were developed in the 1990's. Since that time, medication management technology has evolved and improved marginally, but few new technologies have been leveraged, utilized, or deployed to address the rapidly evolving needs of pharmacy.

Given the current complex needs of medication management, it is hard to envision how legacy technologies can fully resolve the digital visibility gap that exists today.

5

The Importance of **Full Visibility**

The importance of digital visibility can be seen through the costs of its absence and the benefits of its attainment. In the United States, healthcare costs due to the lack of full visibility include billions of dollars in additional labor and drug spend. Poor digital visibility also adversely impacts patient care and compliance risk.[6,7,8,9,10]

The Costs Due to **Lack of Drug Visibility**	
Direct Labor and drug costs associated with 'crises & curses' in pharmacy	$70b
Impacted care due to availability of drugs	>80 on-going drug shortages
Compliance risk in medication management	#3 finding from Joint Commission audits is medication management

Without visibility into what drugs are in stock, how much is on hand, and where it is stored, inventory management is suboptimal and inefficient. The direct drug costs, due to waste, diversion, and shrinkage, reach billions of dollars per year. The cost of labor, in the form of additional manual tasks associated with managing inventory, as well as recalls, shortages, and stockouts, adds billions more. Shortages, which require more detailed and accurate inventory management to ensure patient care, can affect treatment regimens for patients. Finally, medication management is a focus area for auditing bodies, causing findings and implications for the health system.

Conversely, with full digital visibility, exciting new opportunities and pathways are unlocked to make meaningful improvements. Visibility generates the core data for operational pharmacy, and with rich, comprehensive, high quality data comes improved automation and intelligence, lower costs, and better care.

Fortunately, the creators of The Autonomous Pharmacy Framework recognized the need to see the full picture in pharmacy.[2] Based on their framework, automation technology and AI cannot meet its full potential, delivering meaningful benefits in medication use, safety, and efficiency, without full digital visibility.

Autonomous Pharmacy Framework **& Visibility Requirement**		
Level		**Data Management & Visibility Attainment**
Level 1	Non-Autonomous Pharmacy	Data primarily managed on paper or in disparate spreadsheets
Level 2	Limited Autonomous Pharmacy	Data managed disparately across sites with some visibility
Level 3	Intermediate Autonomous Pharmacy	Data integrated across enterprise and mostly visible
Level 4	Highly Autonomous Pharmacy	Near complete data visibility, offering workflow optimization and real-time insights
Level 5	Fully Autonomous Pharmacy	Complete data visibility, real-time workflow optimization, and predictive intelligence

With consolidated, accurate, full digital visibility of medication inventory across the health system enterprise, new, advanced AI models could be deployed that can optimize drug purchasing, storage, and positioning. Automation tools could be designed to support the full medication use process, from wholesale purchasing to patient administration, whether that be in the hospital or in the home. Standardization in data schemes and sharing could mitigate impacts of recalls and shortages on patients, reduce drug waste and diversion, and improve the overall efficiency of pharmacy operations.

Full visibility is the foundation for the Autonomous Pharmacy vision and meaningful improvement in medication use safety, efficacy, and efficiency.

6 Innovation: **The Path Forward to Full Visibility**

For any industry, the trajectory of productivity, improvement, or growth is rarely smooth or linear. A new paradigm, called the Pharmacy 5.0 Framework[11], was recently shared by several pharmacy leaders eager to accelerate change and innovation. In the discussion and description of Pharmacy 5.0, the authors compare pharmacy evolution to the industrial revolution. We believe this comparison is useful, in that innovation and technology disruption is often necessary to make meaningful progress.

The industrial revolution included complete technology transformations in means of power, information sharing, and process capabilities.

> **Likewise, in pharmacy, we will have to transform to reach full visibility. We will need to pivot from legacy solutions to next generation technology, including sensing, Internet-of-Things (IoT), mobile infrastructure, and modern data tools.**

These technologies can help add the missing pieces to the medication inventory picture. And, seeing this full picture is essential to harnessing the potential of autonomy and intelligence in pharmacy and achieving optimal outcomes in healthcare.

[1] Ashemore, A.W.., et. al., "Understanding the problem of digital medication inventory visibility in health-systems", AJHP, June 2023, https://doi.org/10.1093/ajhp/zxad130
[2] Flynn, AJ, et. al., "A strategic approach to improving pharmacy enterprise automation: Development and initial application of the Autonomous Pharmacy Framework", Am J Health Syst Pharm, 2021 Mar 18;78(7):636-645. doi: 10.1093/ajhp/zxab001
[3] Jorgensen, J, "Visante's Top 10 Issues Facing Health System Pharmacy for 2024", 340B Report, https://340breport.com/visantes-top-10-issues-facing-health-system-pharmacy-for-2024/, accessed Jan 2024
[4] Goldsmith, N., et. al., "A facility-level self-assessment of Autonomous Pharmacy Framework levels", Am J Health Syst Pharm, 2024, https://doi.org/10.1093/ajhp/zxad329
[5] Bates, M., "Why the physician's office, not the ED, is a health system's true front door", Healthcare Financial Management Association, June 25, 2021.
[6] Allen, M., "A Prescription for Reducing Wasted Health Care Spending", ProPublica, 17 Dec 2017
[7] Total doses lost in 2019 due to publicly reported diversion incidents, "2020 Diversion Digest", Protenus, Inc
[8] "Porter Research Study 2020: A Comprehensive Look At Drug Diversion From The View Of Healthcare Executives", Invistics
[9] "Drug Shortages for the Calendar Year 2021", Report to Congress, Food & Drug Administration
[10] "Top 5 Most Challenging Requirements for 2021", Joint Commission Online – May 11, 2022, https://www.jointcommission.org/resources/news-and-multimedia/newsletters/newsletters/joint-commission-online/may-11-2022/#.ZDA-KuzMIV8
[11] Lin, AC, et. al., "The Pharmacy 5.0 framework: A new paradigm to accelerate innovation for large-scale personalized pharmacy care", Am J Health-Syst Pharm, https://doi.org/10.1093/ajhp/zxad212.