White Paper

Before the First Fill

The Data-Driven Approach to Central Fill Pharmacy

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About the Author

Pablo Arias is VP, Strategic Solutions & Integration at Capsa. In that role, he leads the Solution Design team, bringing 24 years of Engineering, New Product Development, Product Management, and Solutions Design expertise in Pharmacy Automation.

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Before the First Fill

How Design Expertise Determines Central Fill ROI

Central fill pharmacy automation is among the most consequential capital investments a health system or pharmacy network will make. The decisions made during the design phase determine the system's performance ceiling for years, making design methodology the highest-leverage factor in the entire project.

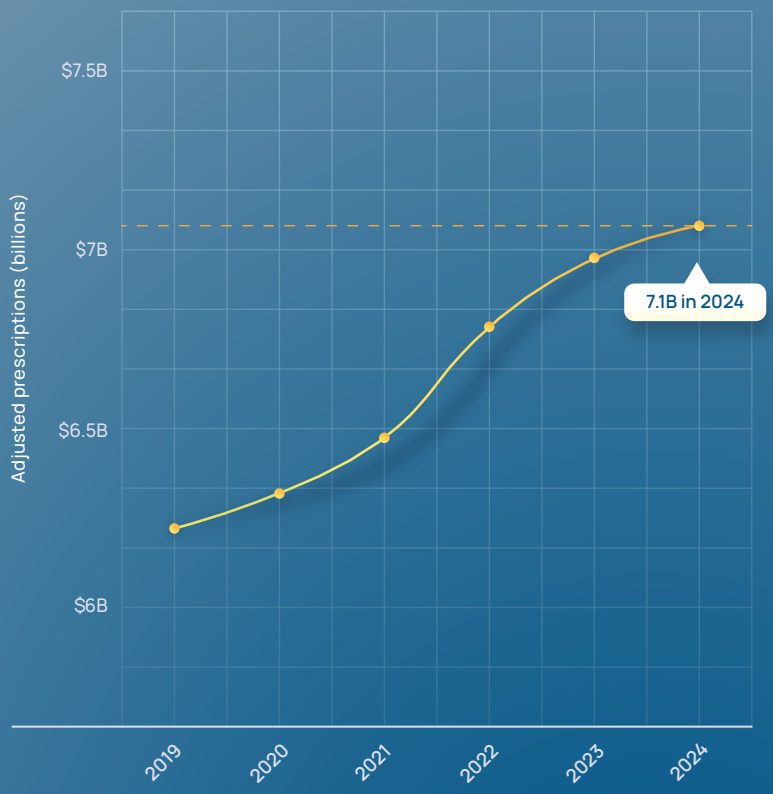
This paper describes Capsa Healthcare's data-driven approach to central fill design: a structured methodology, developed by a team with more than a century of combined experience across high-volume dispensing operations, that begins with operational data and ends with a system engineered for a specific facility, workflow, and growth trajectory. The paper outlines the three foundational artifacts that initiate every design engagement, the engineering principles that govern capacity planning and equipment allocation, and the partnership model that sustains the system through implementation and beyond.

THE CENTRAL FILL IMPERATIVE

The math facing pharmacy operations is familiar to healthcare leaders, but the scale bears quantifying. U.S. retail, mail, and long-term care prescription volume reached more than 7.1 billion in 2024, growing 2.5% over 2023 and adding roughly 170 million prescriptions in a single year. The workforce has not kept pace: pharmacy technician job postings have increased 5% year over year, the majority of pharmacy executives report technician turnover between 21% and 30%, and BLS projects roughly 14,200 pharmacist openings annually through 2034. Meanwhile, gross profit per prescription dropped $0.84 in the first half of 2024 alone, a trend accelerated by the rapid growth of high-cost, low-margin medication classes. GLP-1 prescriptions have more than tripled since 2020, accounted for 29% of drug spending growth in 2024, and 95% of pharmacists who dispense them report losing money on every fill. More volume, fewer people, thinner margins. Central fill automation addresses

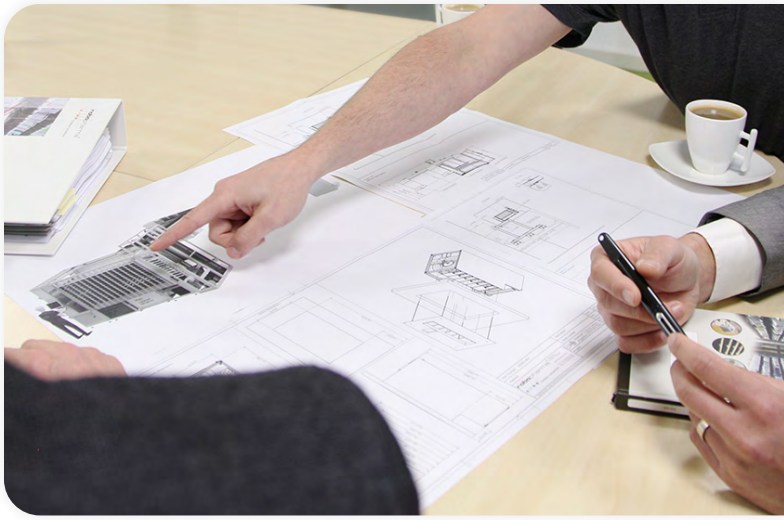
Total dispensed prescriptions in the U.S., 2019–2024

(retail, mail, and long-term care), adjusted for prescription length.



all three by consolidating high-volume dispensing into a purpose-built facility, freeing pharmacists to focus on clinical services and patient care.

But central fill is also one of the most complex capital projects a pharmacy operation will undertake. It touches dispensing workflows, facility infrastructure, IT systems, staffing models, and vendor relationships simultaneously. The stakes are high because the decisions made during the design phase lock in the system's performance ceiling for years. **A well-designed system compounds value as volume grows. A poorly designed one compounds cost.**



Why Design Methodology Matters

Central fill design is an engineering discipline. Building a fully optimized central fill operation requires more than selecting equipment from a catalog. As an engineering-first company, Capsa designs and manufactures its central fill automation platform in-house, and these components power some of the world's largest central fill operations. Behind the platform is a dedicated R&D team actively developing new automation capabilities to meet the market where it is and understand where it is going so that our solutions continue to lead the industry. That same expertise backs up design team engagements with nimble engineering capabilities to solve unique challenges.

We don't shoehorn one-size-fits-all products into a customer's operation. Our design process maps the operational workflow and selects and configures modular components to create a system engineered for the facility's unique environment, current needs, and growth goals.

> "Design decisions are driven by data, not assumptions."

The Solution Design team leverages deep experience in central fill automation, conveyor systems, pharmacy IT architecture, and enterprise software integration to understand the customer's needs and challenges, translating operational goals into measurable KPIs before any equipment enters the conversation. And they remain actively involved throughout the design process, bringing their knowledge of how dispensing patterns, physical infrastructure, and technology integration interact. Based on their knowledge and experience, the design team identifies issues that often derail projects: unverified ceiling clearance, PMS integrations assumed to be plug-and-play, or volume projections built on aspiration instead of data.

Every design decision is driven by verified dispensing patterns, not assumptions or industry rules of thumb. This reshapes the conversation. Instead of *"how many counting cells do you need?"* we ask, *"what does your dispensing velocity data tell us about the capacity you actually need?"* Instead of *"here's our floor plan,"* we ask, *"let's look at your facility drawings together, and schedule a site visit, to understand what the space will and will not support."*

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Common Assumptions, Real Consequences

"We want to go live at 2,500 scripts per shift and scale to 10,000." That's a reasonable starting point, but it leaves most of the design work ahead of it. It says nothing about dispensing velocity, SKU distribution, facility constraints, or integration requirements. Other common assumptions are equally misleading: that more machines automatically mean higher throughput, that automation alone will fix broken workflows, that all equipment fits any space, or that pharmacy management system integrations are straightforward. Each of these, left unexamined, creates decisions that are expensive to reverse once implementation begins.

The analogy the design team uses is that of a general contractor building a house. A general contractor does not start by ordering materials. They start with an architectural plan, identify the subcontractors and specialists needed, coordinate the sequence of work, and manage the build against the plan. **Central fill design works the same way: Capsa serves as the single point of coordination across technology, integration, facility preparation, and operational workflow,** managing complexity so the customer's team can focus on their core operations.

Successful design methodology surfaces and resolves assumptions before they become commitments. In practice, the design team sizes systems to verified data rather than estimates, identifies facility constraints before equipment is ordered, engages IT and pharmacy management system vendors early enough to prevent integration delays, and plans capacity for growth from the outset rather than retrofitting after the fact.

The Three Pillars of Data-Driven Design

The design process begins with three foundational artifacts that together define the scope, constraints, and requirements of the project before design work starts.

Pillar 1: Structured Intake

The intake process captures the operational, financial, regulatory, and facility context of the project through a structured requirements checklist: current staffing models, pharmacy management system configurations, compliance requirements, budget constraints, packaging preferences, and operational workflows. It also surfaces integration complexity early, including PMS and wholesaler dependencies, IT infrastructure (cloud vs. on-premises), and data flow between systems. These are addressed in the first or second discovery session specifically because they are risk items. Engaging IT and PMS vendors early, rather than after design is locked, prevents the most common project delays.

INTAKE CHECKLIST

A structured requirements checklist used to capture the operational, technical, regulatory, and facility context of the project. It surfaces key risk factors early—such as system integrations, IT infrastructure, and workflow constraints—so they can be addressed before design is finalized.

Pillar 2: Dispensing Velocity Analysis

Velocity data is the engine of the design process. Historical dispensing patterns (which medications are filled, in what quantities, at what frequency, across what time periods) determine how capacity is allocated across the system.

The velocity report analyzes prescription mix by medication type, SKU distribution across the formulary, daily and seasonal volume patterns, and the ratio of oral solid doses to unit-of-use and specialty medications. This data reveals the operation's actual dispensing profile, which can differ from initial estimates. The analysis identifies which medications drive the highest volume, where automation will have the greatest impact, and where manual intervention will still be required.

Velocity data is not a one-time input. As the design evolves through iterative reviews, the data may be re-examined, reformatted, or supplemented with additional periods to validate assumptions about peak loads and growth trends. The goal is to design to verified patterns, not estimates.

For new facilities without historical dispensing data, the intake process places greater emphasis on business case projections and comparable-facility benchmarks that inform capacity planning, reinforcing the principle that design decisions should be grounded in the best available data, not high-level assumptions.

DISPENSING VELOCITY REPORT

A report that summarizes historical dispensing volumes by medication type and time period, including mix, run rates, and peak demand patterns. It provides the factual volume inputs that drive capacity allocation and inform downstream system design decisions.

Pillar 3: Facility Modeling

Physical constraints shape design as fundamentally as volume data. Facility modeling begins with AutoCAD drawings or equivalent documentation of the space. Not rough sketches, but dimensioned plans that capture ceiling heights, structural elements, utility locations, and access paths.

Physical environments produce surprises that are expensive to discover late. Ceiling clearance is a common example: equipment that fits within a standard floor footprint may require height clearance that a given facility cannot provide. Load-bearing walls, walkway width requirements, staging space for materials and packaging, and utility access points all impose constraints that must be accounted for in the design, not worked around after installation begins.

Facility modeling also addresses a forward-looking question: not just what the space can support today, but what infrastructure decisions made now will enable or constrain future expansion. Conveyance infrastructure is a particularly important consideration. Planning conveyance paths during initial design is significantly less expensive than retrofitting them after the facility is operational.

FACILITY DRAWINGS

Dimensioned facility plans that document ceiling heights, structural elements, utilities, and access paths within the pharmacy space. These drawings allow Solution Design teams to validate equipment fit, plan layouts, and account for physical constraints and future expansion during design.

Design Principles

With the three foundational artifacts in hand, design work is governed by a set of engineering principles that balance current needs against future requirements.

Modular Design: The Building Block Approach

Modular design builds complete solutions using standardized, interchangeable components. Vial filling technologies, conveyance segments, unit-of-use automation, and packaging stations are discrete modules that can be combined, reconfigured, and expanded as an operation's needs evolve. This is the building block approach to central fill: each component is purpose-built and proven, but the way they come together is unique to the operation.

Modularity is what makes scalability practical rather than theoretical. When growth is planned into the original design, adding capacity means adding modules, not redesigning the system. Capsa's in-house engineering group can also quickly respond to new challenges with engineered solutions that leverage vast experience in central fill automation.

Velocity-Driven Equipment Allocation

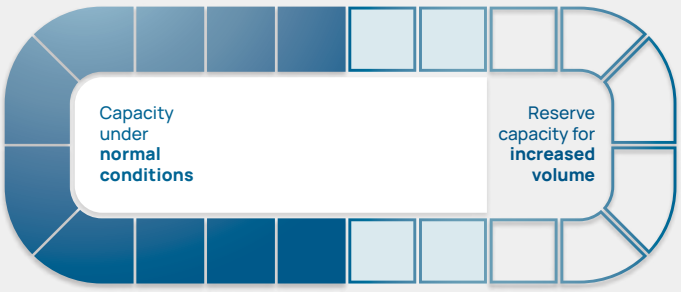
Automation for its own sake is never the goal. Our design process looks for the opportunities where automation will bring the greatest value. Velocity analysis consistently reveals a concentration pattern: approximately 5% of oral solid SKUs account for roughly 80% of oral solid dispensing volume. The result is a system that automates the right things and avoids over-investing in automation for mid- or low-velocity SKUs.

The 70–75% Capacity Principle

Equipment is sized to operate at 70% to 75% of rated capacity under normal conditions. This provides headroom for peak volume periods (seasonal surges, new therapeutic launches, etc.) without requiring additional capital expenditure, while also avoiding the opposite problem of underutilized capacity.

For organizations seeking more runway for rapid expansion, capacity is increased to a 50:50 ratio to accommodate projected growth and volume surge.

This principle is directly informed by dispensing velocity data. Capital expenditure aligns to current verified volume while the system architecture accommodates projected growth, so that adding capacity later is an incremental step, not a redesign.



Conveyance-First Infrastructure

Conveyance infrastructure, the paths along which medications, packaging, and materials move through the facility, is one of the most expensive elements to modify after a facility is operational. Retrofitting conveyance paths means disrupting a running production environment. Planning these paths during initial design preserves the flexibility to expand and reconfigure as the operation grows, at a fraction of the cost and disruption of addressing them after the fact.

The Partnership Model

Central fill automation is not a purchase. It is a long-term operational commitment, and the relationship between the automation partner and the health system needs to reflect that.

During the design phase, that relationship takes the form of a structured cadence of reviews, typically weekly, between the design team and the customer's project stakeholders. A steering committee structure pairs design team members with their customer-side counterparts across operations, engineering, information security, and implementation. This iterative approach ensures that design decisions are pressure-tested against operational reality at every stage, that emerging questions are surfaced and resolved early, and that the customer's team develops deep familiarity with the system architecture before implementation begins.

The partnership does not end at go-live. The engagement transitions into an ongoing optimization phase, with the possibility of a dedicated customer success engineer on site to streamline processes, adapt to changing needs, and support continuous improvement.

> "Iterative design ensures decisions are pressure-tested against operational reality."

Central fill operations face an environment where therapeutic categories and volume patterns shift rapidly. GLP-1 prescriptions have tripled since 2020, bringing significant volume at razor-thin margins, and that is only the most visible example. **A system designed with flexibility as a core principle, supported by a partner who understands the original design intent, is in the strongest position to adapt.**

Getting Started

Central fill automation is a defining investment. The methodology described in this paper exists because the decisions made during the design phase determine whether that investment compounds value or compounds cost. Every principle, from velocity-driven equipment allocation to conveyance-first infrastructure planning, is designed to ensure the system performs from day one and scales as the operation grows.

Organizations considering central fill automation can take concrete steps to prepare for a productive design engagement, even before a vendor conversation begins.

The intake checklist, dispensing velocity report, and facility drawings form the basis of every design engagement. Your first step is to map the data structure of your organization. Who owns the dispensing data? What formats can we export? Do we have dimensioned facility drawings (not floor sketches)?

Most importantly, identify the project stakeholders who will participate in the discovery and design process. This typically spans pharmacy operations, engineering, IT, and implementation. The internal steering committee is a linchpin group for a

successful deployment. The process pairs Capsa design team members with their customer-side peers. Knowing who those people are, and having their time committed, before the engagement begins removes one of the most common early delays.

Central fill design accounts for both current volume and projected growth. So, a clear set of growth assumptions is critical. Having a defensible view of where volume is headed, based on data rather than aspiration, enables more accurate capacity planning from the outset.

The design engagement itself begins with a discovery conversation to understand the operation's context, followed by a structured data collection phase, and then iterative design development. The goal is a system engineered for a specific operation, not a template and not a guess.

Capsa's central fill design team is ready to start that conversation. Whether you're early in your evaluation or ready to move forward, the first step is the same: a discovery conversation to understand your operation and identify the path forward.

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Ready to get started? Request a Consultation.

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