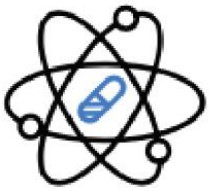


The Autonomous Pharmacy Metrics Catalog:

Version 1.0

February 2024

AUTONOMOUS PHARMACY ADVISORY BOARD

CATALOG OF AUTONOMOUS PHARMACY METRICS

February 2024

VERSION 1.0

CATALOG OVERVIEW

This is a catalog of automation-related metrics, each of which reflects the five levels of the Autonomous Pharmacy Framework[1]. For a specific automation capability of interest, each metric specifies a combination of qualitative and quantitative features and corresponding differences or thresholds, respectively. These metrics are intended to describe automation capabilities at individual facilities. However, facility scores for the metrics may be aggregated at the institutional or and enterprise levels.

The purpose of these autonomous pharmacy metrics is three-fold. First, they are intended to help health-systems measure automation capabilities at their facilities. Second, when combined, these metrics support a rough estimate of the degree to which a facility's medication process is automated. Third, these metrics make the ideas and concepts associated with the autonomous pharmacy vision more tangible.

Considering this metrics collection in more detail, each metric spans five levels from zero to minimal automation at Level 1 to the highest degree of automation and autonomy at Level 5. In addition, each metric is associated with one of more of the five major components of the Autonomous Pharmacy Framework:

- Enterprise Structure
- IT Infrastructure
- Automation
- Data Intelligence
- Human Activity

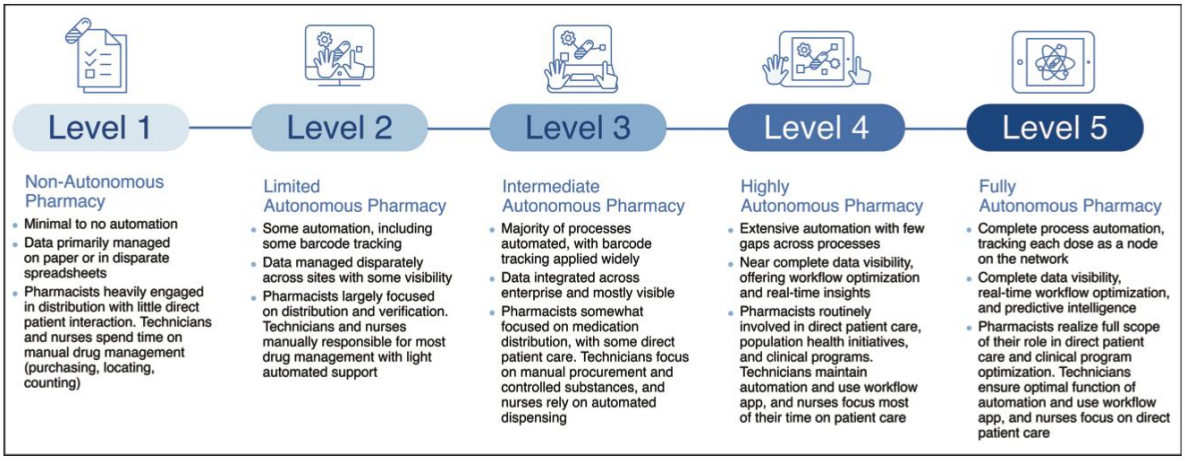
These metrics were developed over ____ years by Metrics Workstream members of the Autonomous Pharmacy Advisory Board. These members went about their work by … {Methods}

Finally, over the longer term, it is hoped this catalog of metrics will grow into a resource that comes to express the full breadth of the autonomous pharmacy vision and the technology-enabled transformation of the medication process involved in realizing it.

1. Flynn AJ, Fortier C, Maehlen H, Pierzinski V, Runnebaum R, Sullivan M, Wagner J, Stevenson JG. A strategic approach to improving pharmacy enterprise automation: Development and initial application of the Autonomous Pharmacy Framework. American Journal of Health-System Pharmacy. 2021 Apr 1;78(7):636-45.

HOW TO USE THE CATALOG

- Each metric is first described in a table and then portrayed in an info graphic.
    - First, use each metric's table to discover how the metric is defined and how to measure it.
    - Second, use each metric's info-graphic to quickly see how the metric unfolds over the five levels of the Autonomous Pharmacy Framework.



LIST OF METRICS

Metric Characteristics	
Metric	**Automated Dispensing Cabinet Medication Overrides**
Relevant Definition(s)	*Medication Override*: Process of bypassing the pharmacist's review of a medication order to obtain a medication from an Automated Dispensing Cabinet (ADC) when assessment of the patient indicates that a delay in therapy would harm the patient[1] *Medication Override without Order*: Removal of medication without an order[1]
Industry Consensus	There is no consensus for a standardized override rate that every organization should target, although some organizations have certain override rates or exceptions for specific operational areas which are considered tolerable or expected.
Research	Many studies and case reports have been published, primary themes include override list maintenance and override safety.
Metric Impact	Overrides represent the active decision by health care workers to circumvent the safeguards built into the medication use process. The ability to measure overrides and discern the appropriateness of individual overrides will provide health system leaders the ability to improve care delivery and reduce the risk of medication errors.
Current State Issues	• Anesthesia workflows and the medication use process in current state in the OR • EHR barriers, hospitals without Epic have difficulties operationalizing the use of profiled cabinets • Lack of appropriate order sets lead to staff accessing medications that should have been in a specific order set • Perception/culture with time associated with medication verification TAT and dispensing TAT (ex: Eds) • Increase in the inappropriate/reliance on the use of override functionality when it may not be clinically appropriate • Differences in pharmacy distribution models and staff availability 24/7 leads to potential increases in overrides
Measurement/Data Sources	
Measurement	Medication Overrides / Total Dispenses (synonyms for Dispenses include: Issues) Medication Overrides = { } Total Dispenses = { } Drill down into: Specific units – OB, ICU, recovery room etc., Medication, Users
Measurement Frequency	Monthly – may require exclusion of specific areas where overrides are designed to occur, e.g., non-profile ADCs
Data Sources	ADC System: (to gather medication override data from the ADCs) EHR System: (to know if there is an order placed or not; maybe eMAR data)
Data Accessibility	• Relatively easy to access, in current state, users need to manipulate to clean the data and create the override rate • Some organizations receive monthly data from their EHR vendor
Framework Alignment	
Metric Research Needs	None

Components, Features, and Capabilities	• EHR capabilities – ability to integrate with profiled cabinets
	• EHR capabilities – ability to report on overrides
	• Override list existence
	• Regular review and maintenance of the list
	• Separated by areas, Separated by user groups
	• ADC reporting
	  ○ Easy to manipulate to identify, Benchmarking
	  ○ No need for the end user to manipulate to evaluate data
	• Presence of AI verification/auto verification lists
	• Decision matrix/automated intelligence w/ integration in EHR

Metric: Overrides

Level 1

Non-Autonomous Pharmacy

- Lack of interoperability between EHR and ADCs leads to all cabinets on override/non-profiled
- Lack of profiled cabinets prohibits the ability to implement an override list

Level 2

Limited Autonomous Pharmacy

- EHR interoperability allows for the use of profiled cabinets, however there is no override list in place so any medication can be overridden
- Override data is reviewed in a reactionary manner to medication errors

Level 3

Intermediate Autonomous Pharmacy

- Override list in place with routine review and restrictions to user groups
- Routine review of overrides data is performed, however manual manipulation of reports is required to assess accurate override performance

Level 4

Highly Autonomous Pharmacy

- > 90% of overrides are appropriate per hospital policy
- Automated reporting eliminates the need to manually manipulate
- Appropriate hospital-specific filters are applied to view accurate representation of override performance

Level 5

Fully Autonomous Pharmacy

- 100% of overrides are appropriate per hospital policy
- AI/ML decrease medication verification turnaround times and # of orders requiring pharmacist review
- Automated checks ensure 100% compliance within ADCs

Outcomes

0

- ✓ Medication Errors
- ✓ Medication Waste
- ✓ Human Touches Pre-administration To Patient

100%

- ✓ Data Visibility
- ✓ Time Spent on Clinical Activity
- ✓ Regulatory Compliance

Metric Characteristics	
Metric	**Automated Dispensing Cabinet Stockouts**
Relevant Definitions	Measured in varying frequencies, a ADC stockout occurs when the quantity inside an individual medication pocket inside an ADC goes to 0. A stockout rate is the number of stocked out pockets over the total number of pockets in an institution within a given timeframe.
Industry Consensus	No current industry standard for stockout count or stockout rate. Achieving Level 5 of the Autonomous Pharmacy framework for this metric would reduce ADC stockouts to zero.
Research	TO BE ADDED
Metric Impact	Medication stockouts at ADCs impact pharmacy operations, nursing operations, and patient safety. If the stocked out medication is a critical need, then the pharmacy supplying this medication must interrupt current operations in order to supply a medication to the patient which should have already been easily accessible by ADC users. The ability to not only have real-time visibility into the inventory of a specific medication at a specific cabinet, but to also predict when a medication may stockout and then prevent all stockouts is the ideal state at Level 5. Decreasing the stockout rate translates to improved operational efficiency and decreased likelihood in delay of care due to a missing medication. Aligning this metric in the framework can help organizations identify how their individual stockout performance can be improved to ultimately impact their operations and patient care.
Current State Issues	In current state, management of stockouts is performed by homegrown optimization algorithms that rely on historical trends to make optimizations to par levels of various medications. This work is very time consuming and often requires the review of a pharmacist to ensure clinical needs of the area are met by these optimizations. Additionally, changes in patient populations may not be adequately supported by the optimizations and could lead to stockouts. Operations in current state often must stop production of cart fills in order to address the stockout/clinical need of a missing medication. ADC inventories become inaccurate due to pharmacy personnel misloads, lost opportunities to fix inventories, and ADC users taking more medication than recorded by ADC transactions. Stockout reporting in current state usually comes in the form of stockout report that identifies pockets with stockouts, along with the currently assigned par level. Utilization of this report is limited to operational staff responsible for addressing stockouts on a daily basis. If a pharmacy leader would like to identify trends or visualize the data, additional data manipulation must be completed. This involves the removal of “false positives”, or stockouts that are not truly stockouts and are either intended or irrelevant to the stockout rate calculation.
Measurement/Data Sources	
Measurement	Count - # of stockouts at a given point in time/over a specific time Rate - # of pockets with stockouts/total number of pockets over a specific time
Measurement Frequency	Count – daily for operational use Rate – weekly, monthly, quarterly, etc. (ideally users toggle between different frequencies depending on context)
Data Sources	ADC System
Data Accessibility	Count – daily report is easy to access for most pharmacies that have this capability Rate – requires additional manipulation and filtering
Framework Alignment	
Metric Research Needs	No additional research needs for framework alignment, future benchmarking capabilities may enable the Metrics Workstream to identify specific stockout rates to levels 1-4
Components, Features, and Capabilities	Potentially useful additional capabilities: • ADC optimization predictive algorithms • Enhanced stockout reporting Stockout management workflows could be improved and potentially automated to a greater degree.

Metric: Stockouts

Level 1

Non-Autonomous Pharmacy

- Stockouts are only realized in a reactionary manner through internal messaging
- No stockout reporting available
- No ADC optimization is performed

Level 2

Limited Autonomous Pharmacy

- Stockout reporting available but minimally used
- Stockouts are managed at the next scheduled stocking
- ADC optimization is minimal, reactive, and is done manually

Level 3

Intermediate Autonomous Pharmacy

- Stockout reporting evaluated proactively, par levels adjusted if trends are manually identified
- Process in place for managing stockouts in real-time
- ADC optimization is extensive, proactive, and done manually

Level 4

Highly Autonomous Pharmacy

- Near 0% stockout rate, occasional patient fluctuations lead to some stockouts
- Proactive monitoring of stockouts in place via dashboards, similar sites are benchmarked
- ADC optimization is extensive, proactive, and utilizes homegrown formulas that encompass dispensing trends and patient data

Level 5

Fully Autonomous Pharmacy

- 0% stockout rate
- Predictive algorithms are employed to proactively compare patient clinical needs to local ADC and prevent stockouts in real-time

Outcomes

0

- ✓ Medication Errors
- ✓ Medication Waste
- ✓ Human Touches Pre-administration To Patient

100%

- ✓ Data Visibility
- ✓ Time Spent on Clinical Activity
- ✓ Regulatory Compliance

Performance Elements: Safety, Financials, Efficiency, Compliance, People

Metric Characteristics	
Metric	**IV Metric: Percent IV Workflow Management System (%IV WMS) Preparations**
Definition	The overall percentage (%) of all batch and patient-specific intravenous drug products prepared inside health systems using an IV preparation workflow management system (WMS). A WMS for IV drug product production may include bar code scanning, imaging, and/or gravimetric technology and may be integrated with EHRs and other systems. Such systems may exhibit different degrees of IV preparation process automation ranging from cameras in the IV preparation area to robots capable of producing IV drug products with little human intervention.
Industry consensus	No current industry standard for % of intravenous drug products prepared inside health systems using an IV preparation workflow management system.
Research	A significant published body of knowledge exists about intravenous compounding robots and IV workflow management systems. However, measurement studies about the %IV WMS metric are not evident.
Metric Impact	Because of the potential for error and consequent harm reduction and also for a high degree of automation, including robots, to come from doing IV drug product preparation using WMS, this metric is a dual gauge of quality and reduced human manual labor. A related metric is the number of near misses (mistakes caught and remedied in process) during IV drug product preparation.
Current State Issues	• WMS from various vendors support different levels of automation up to end-to-end robotic IV preparation • The cost of WMS, including IV compounding robots, can be a barrier to deploying and using WMS • By themselves, WMS cannot generate this metric because it is a measure of what is and is not produced inside health systems using WMS • WMS offer different capabilities for bar code scanning, photographing drug products and gravimetries, making it unclear which capabilities are involved in the %IV WMS metric
Measurement/Data Sources	
Measurement	For any given period of time, %IV WMS is measured as a fraction where the numerator is the number or count of all IV drug products prepared in a health system pharmacy using WMS technology and the denominator is the corresponding number or count of all IV drug products prepared in the same health system pharmacy by any means. This same measurement can be computed at the level of multiple health system pharmacies or whole institutions.
Measurement Frequency	Common frequencies of measurement could be daily, weekly, monthly, quarterly, or annually
Data Sources	• EHR for all drug products produced to fulfill medication orders in a given period of time at a given location • WMS for all drug products produced using WMS in a given period of time at a given location
Data Accessibility	Data accessibility is good but depends on combining data from EHRs and WMS
Framework Alignment	
Metric Research Needs	Measurement studies are needed to demonstrate the reliability of this metric under differing conditions, e.g., using different combinations of EHRs and WMS, and using more highly manual versus more highly automated robotic WMS.
Components, Features, and Capabilities	At health systems that use more than one WMS, e.g., camera and bar code scanning WMS inside IV preparation areas in conjunction with robot WMS, being able to report %IV WMS with manual effort and %IV WMS with robotic preparation is of interest. Gravimetric technology is of interest for using density to confirm the accuracy of additives added and base solutions used in IV drug product preparation. Inside health systems, technology like high performance liquid chromatography (HPLC) or something similar such as color spot tests may advance to the degree that they can be incorporated into IV drug product preparation workflows to confirm the chemical signatures of drug product ingredients and their concentrations in clear aqueous solutions.

IV Metric: Percent IV Workflow Management System (%IV WMS) Preparations

Level 1

Non-Autonomous Pharmacy

- Manual IV preparation processes
- 0% IV products prepared through IV WMS
- Lack of transparency to measure near misses

Level 2

Limited Autonomous Pharmacy

- ≥ 50% IV products prepared with barcode scanning and camera technology with priority to prepare high-risk products per hospital policy
- < 50% manual IV preparation processes
- Access to near misses through software and data are analyzed

Level 3

Intermediate Autonomous Pharmacy

- ≥ 75% IV products prepared with barcode scanning/camera/gravimetrics or IV robotics with priority to prepare high-risk products per hospital policy
- < 25% manual IV preparation processes
- Access to near misses through software and data are analyzed

Level 4

Highly Autonomous Pharmacy

- ≥ 75% eligible IV products prepared with IV robotics
- < 25% IV products prepared with barcode scanning/camera/ gravimetrics technology with priority to prepare high-risk products per hospital policy
- 0% manual IV preparation processes
- Access to near misses through software and data are analyzed

Level 5

Fully Autonomous Pharmacy

- 100% eligible IV products prepared with IV robotics
- Measure IV robotics error rate

Outcomes

0

- ✓ Medication Errors
- ✓ Medication Waste
- ✓ Human Touches Pre-administration To Patient

100%

- ✓ Data Visibility
- ✓ Time Spent on Clinical Activity
- ✓ Regulatory Compliance

Performance Elements: Safety, Financials, Efficiency, Compliance, People

Metric Characteristics	
Metric	**IV Metric: Timeliness of Dispensation by Priority Type**
Definition	The duration of time, stratified by Priority Type for "STAT", "NOW", and "ROUTINE" orders, from when a medication order for an intravenous (IV) drug product is placed inside a health system to when the first IV drug product required to fulfill the first administration of the ordered medication to a patient becomes available to the administerer. This metric is sometimes called the IV drug product turn-around-time (TAT) from the moment a new order for a medication in the form of an IV drug product is placed to the time the first IV drug product dose associated with the order is available to the person who will administer it.
Industry consensus	None.
Research	TO BE ADDED
Metric Impact	In certain disease states and cases including suspected sepsis, spinal cord injury, stroke, and others, the quality of care is associated with timely administration of IV drug products. For this reason, being able to measure timeliness of dispensation (i.e., drug product availability to the person who will administer it) is a general measure of health system pharmacy service quality and a vital measure when IV drug products are needed urgently and so ordered with a "STAT" or "NOW" priority.
Current State Issues	This metric depends not only on IV drug product preparation time inside the walls of health system pharmacy but also on delivery time to persons who will administer drug products to patients. As a result, this metric encompasses the travel time required for IV drug products to travel from pharmacies to sites of administration. The travel time from sites of IV drug product preparation to sites of IV drug product administration embedded in this metric varies considerably within health systems, as does the mode of IV drug product travel (e.g., tube system, robot delivery, manual delivery).. For this reason, it is expected that intra-site variability in this metric will be an issue due to varying distances between preparation and administration locations and also due to varying delivery modes.
Measurement/Data Sources	
Measurement	When determining the TAT duration, the initial start time is measured automatically by a timestamp in EHR associated with order placement. The end time when an IV drug product suitable for administration as a first dose reaches the administerer is not associated with a reliable and consistent workflow step in any electronic system that could record IV drug product receipt by the administerer. The end time can be determined when an IV drug product is retrieved by the administerer from an automated dispensing cabinet (ADC) or it may be inferred from time of administration logged in the electronic Medication Administration Record (eMAR) component of the EHR.
Measurement Frequency	This measure can be taken for all medication orders for IV drug products.
Data Sources	EHR and ADC systems
Data Accessibility	Moderate. Having to infer the time of drug product receipt by the administerer from eMAR documentation of administration is not optimal.
Framework Alignment	
Metric Research Needs	Measurement studies are needed to determine the reliability and validity of measurement methods for this metric.
Components, Features, and Capabilities	Useful capabilities would be to link IV drug product indication with medication order Priority Type ("STAT", "NOW", or "ROUTINE") to determine the degree to which quality of care depending on rapid medication administration is being upheld.

IV Metric: Timeliness of Dispensation by Priority Type

Level 1

Non-Autonomous Pharmacy

- No EHR support for delivery frequency
- No IV automation, robotics, or interfaces
- No P&P in place
- No dedicated system or staff for medication delivery/preparation
- No TAT monitoring or oversight

Level 2

Limited Autonomous Pharmacy

- Manual notification of frequency within the EHR
- Minimal IV automation in place, no IV robotics or EHR integration
- P&P for routine TAT expectations defined
- USP 797/ 800 requirements
- Dedicated staff for STAT/NOW deliveries with dispense preparation
- Manual TAT metric reporting with ≤25% compliance to P&P

Level 3

Intermediate Autonomous Pharmacy

- Frequency designation on label
- IV automation, including robotics, in place with no EHR integration
- P&P for routine and STAT/NOW TAT expectations defined
- Dispense tracking capabilities end at time of dispense
- Eligible STAT doses dispensed via PTS
- Manual routine/STAT TAT metric reporting with ≤50% compliance to P&P

Level 4

Highly Autonomous Pharmacy

- Designated work queues for order frequency
- IV robotics with EHR integration with manual dose initiation
- P&P for routine and STAT/NOW TAT expectations defined
- Dispense tracking through entire delivery with manual scanning
- All STAT/NOW doses dispensed via delivery robotics
- Automated evaluation of routine/STAT TAT metrics with ≤75% compliance to P&P

Level 5

Fully Autonomous Pharmacy

- Full frequency designation based on order supported by EHR
- Direct robotic integration to EHR for all preparations
- Automated monitoring with automatic P&P updates for TAT expectations with 100% compliance
- Full RFID dispense preparation/tracking workflows
- All doses delivered via delivery robotics with intelligent delivery strategies
- Full visibility to status of order for all stakeholders

Outcomes

0

- ✓ Medication Errors
- ✓ Medication Waste
- ✓ Human Touches Pre-administration To Patient

100%

- ✓ Data Visibility
- ✓ Time Spent on Clinical Activity
- ✓ Regulatory Compliance

Performance Elements: Safety, Financials, Efficiency, Compliance, People

Metric Characteristics	
Metric	**IV Metric: Personnel Productivity**
Relevant Definition	IV Personnel Productivity: A multifaceted and composite metric that evaluates the IV drug product verification, compounding, dispensing, and administration processes to quantify workload safety and efficiency in a healthcare organization.
Industry consensus	There is no current industry consensus measuring IV personnel productivity that health organizations target. However, the American Society of Health System Pharmacy (ASHP) does strongly discourage pharmacy management from measuring basic IV compounding productivity solely from dispensing data. (1)
Research	Several case studies and reports have been published that evaluate user productivity and safety through reductions in human labor and IV waste, which also include comparisons between manual and automated IV workflow processes. (2,3)
Metric Impact	Personnel productivity serves as an important benchmarking metric that allows an organization to evaluate their IV workload efficiency to improve patient outcomes. Technician shortages, in addition to high variability in IV compounding processes, serve as catalysts for health system leaders to optimize their current IV workflow operations while maintaining their highest priority as patient safety. This metric extends to the patient bedside to include nursing processes around administration of compounded IV products.
Current State Issues	● IV verification, compounding, dispensing, and administering processes vary and can be unstandardized across hospitals and institutions ● Interoperability remains low across applications that support optimal measures associated with IV personnel productivity, example being connectivity between EHR, IV pumps, or Technology-assisted IV workflow systems(TAWS) ● Health system budgetary constraints reduce investments in technology required to streamline workflows ● Drug shortages currently require manual adjustments in IV workflow and require constant attention ● Technician shortages across all hospitals create high variability in staffing and technician training which can result in suboptimal compounding practices and introduce unsafe compounding workarounds
Measurement/Data Sources	
Measurement	This metric is measured through multimodal data available in IV workflow operations and can be divided into separate categories for an eventual composite personnel productivity metric score. Example metric calculations are as follows: ● Efficiency: (# of Compounds produced) / (specified period or per FTE) ● Safety: (# of safety events occurring) / # of compounds produced or period ● Waste: (# of re-dispenses)/(specified period or per FTE), (# of products expiring or requiring need for reverse distribution)/(specified period)
Measurement Frequency	Continuously measured personnel productivity metric(s) that can be reviewed daily, weekly, or quarterly
Data Sources	EHR, TAWS, Reverse distributor, Wholesaler, and 340B software
Data Accessibility	Current data accessibility will vary across institutions
Framework Alignment	
Metric Research Needs	Further research needed for framework alignment, future benchmarking capabilities may enable the Metrics Workstream to identify specific metrics required to monitor this composite metric score.
Components, Features, and Capabilities	Useful capabilities to achieve automated measurement of personnel productivity metric: ● Leverage reverse distributor data for waste reporting ● Integrations between IV pump data, EHR, TAWS, and purchasing data ● Advanced IV product tracking throughout the product lifecycle from supply receiving to administration
References	1. https://www.ashp.org/-/media/assets/policy-guidelines/docs/policy-positions/policy-positions-pharmacy-management.pdf 2. Meren ÜH, Waterson J. Evaluating An Automated Compounding Workflow Software for Safety and Efficiency: Implementation Study. *JMIR Hum Factors*. 2021;8(4):e29180. Published 2021 Nov 2. doi:10.2196/29180 3. Fan M, Yang D, Ng B, et al. Impact of technology-assisted versus manual sterile compounding on safety and efficiency in a Canadian community hospital. Am J Health Syst Pharm. 2022;79(19):1685-1696. doi:10.1093/ajhp/zxac167

IV Metric: Personnel Productivity

Level 1

Non-Autonomous Pharmacy

- No user/compounder productivity* reporting
- No data available to evaluate productivity to error ratio
- No oversight of waste data

Level 2

Limited Autonomous Pharmacy

- Manual user/compounder productivity* reporting
- Manual analysis of task productivity to error ratio
- Manual tracking of waste data

Level 3

Intermediate Autonomous Pharmacy

- Electronic user/compounder productivity* reporting
- Automated analysis of task productivity to error ratio
- Electronic waste tracking and manual ability to leverage data to minimize waste

Level 4

Highly Autonomous Pharmacy

- Electronic user/compounder productivity* actionable dashboard
- Automated analysis capable of adjusting personnel and automation based on task productivity to error ratio
- Electronic waste tracking tool that leverages multiple sources of data (e.g., IV data pump, reverse distributor) to minimize waste

Level 5

Fully Autonomous Pharmacy

- AI-generated user/compounder productivity* actionable dashboard with outcomes metrics
- Real-time AI analysis that adjusts personnel and automation based on task productivity to error ratio
- AI waste tracking tool that leverages multiple sources of data (e.g., IV data pump, reverse distributor, drug shortages) to mitigate waste

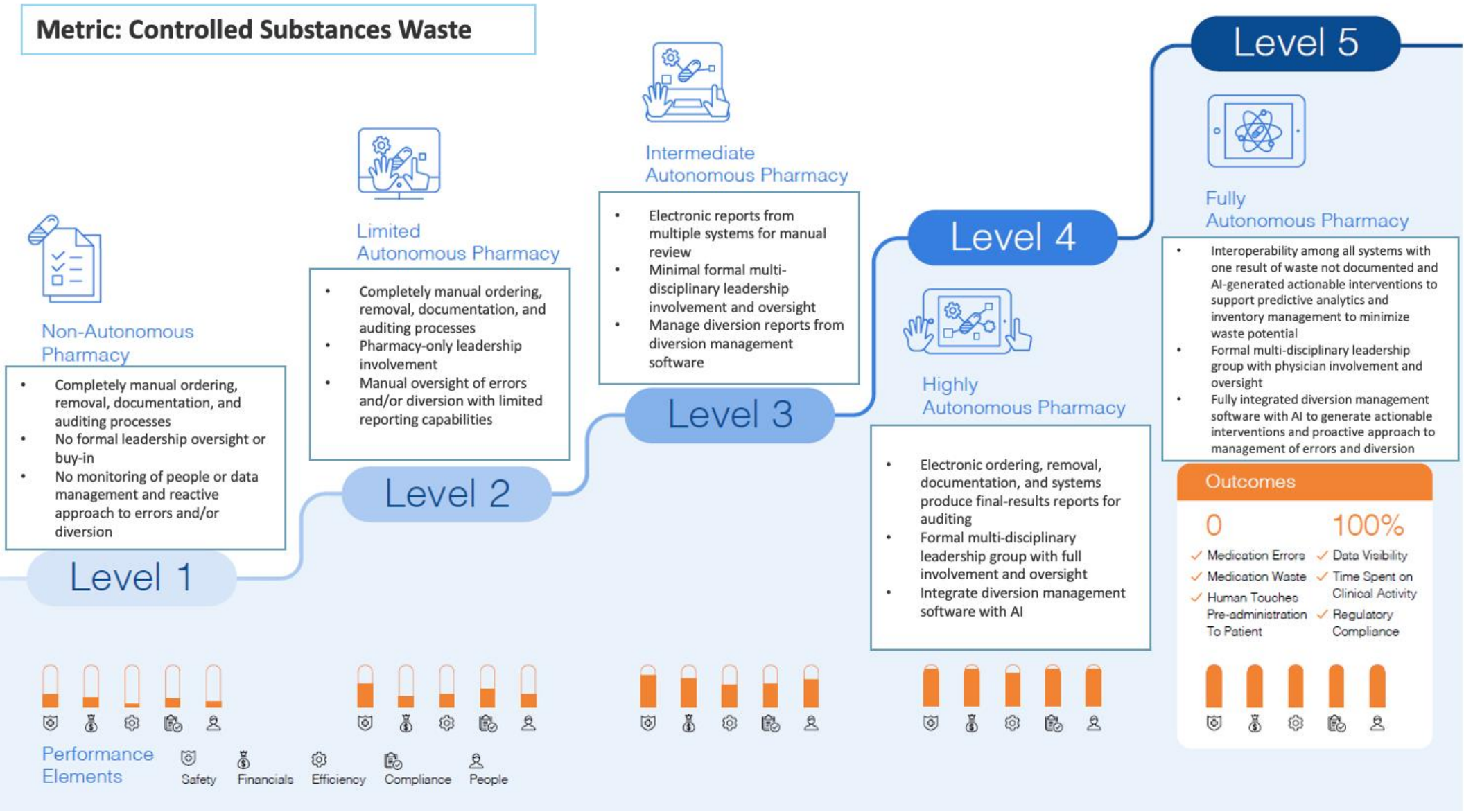
Outcomes

0	100%
✓ Medication Errors	✓ Data Visibility
✓ Medication Waste	✓ Time Spent on Clinical Activity
✓ Human Touches Pre-administration To Patient	✓ Regulatory Compliance

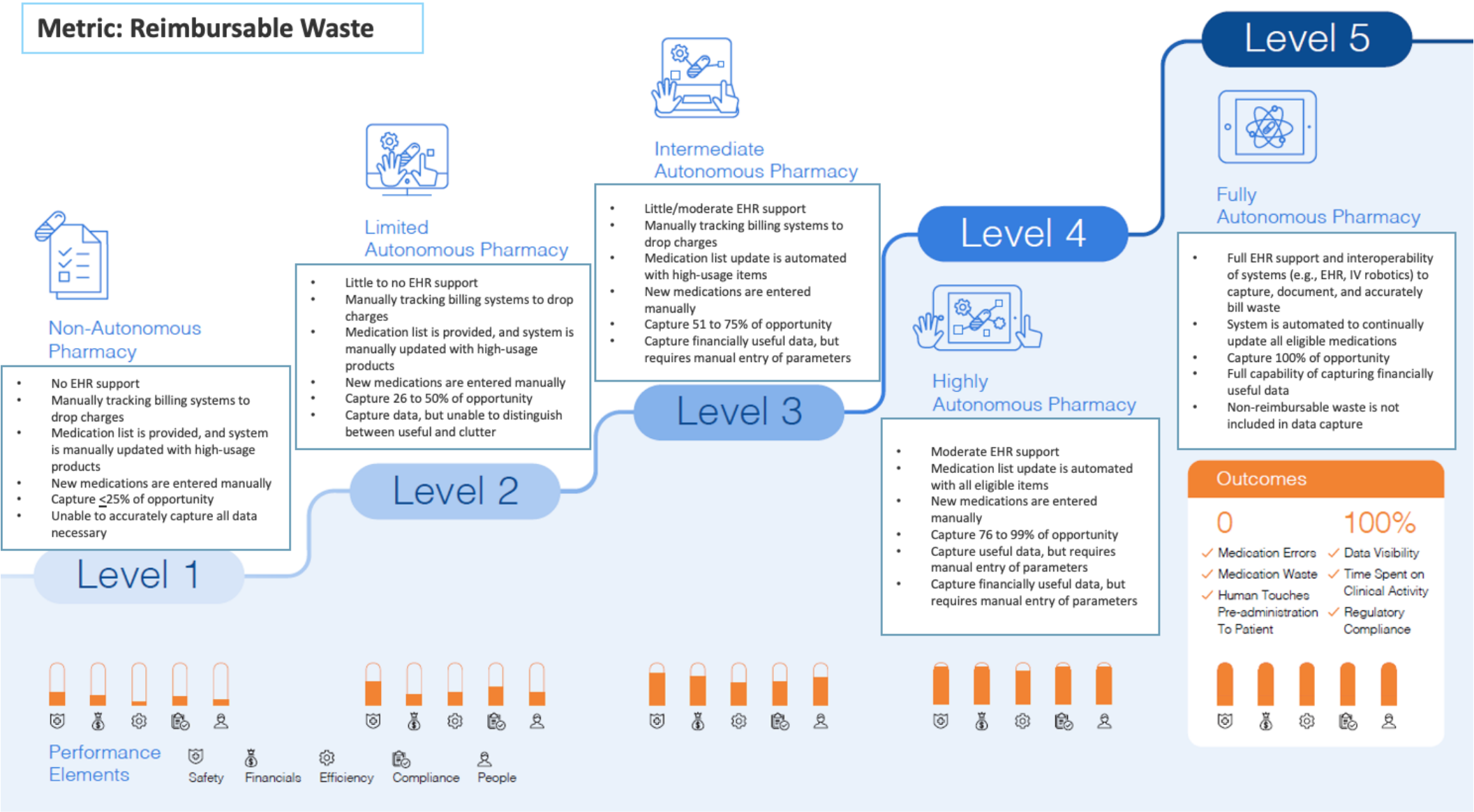
Performance Elements: Safety, Financials, Efficiency, Compliance, People

*Specific strategies for evaluating productivity are addressed in separate metrics (e.g. IV WMS, CS Waste)

Metric Characteristics	
Metric	**Controlled Substances Waste at the Point of Administration**
Relevant Definitions	For controlled substances, waste is any quantity of a drug product containing one or more controlled substances that, for whatever reasons, cannot and should not be administered to a patient but is leftover at the point of administration.
Industry Consensus	To counter controlled substance diversion, it is expected that all controlled substances will either be administered to patients or accounted for in documentation of controlled substance waste.
Research	TO BE ADDED
Metric Impact	Controlled substances waste and the accurate documentation of this waste impact pharmacy operations and inventory control and appropriate ordering, nursing operations, personnel and patient safety. The emphasis of this metric is on limiting or eliminating controlled substances diversion, supporting personnel with appropriate human resource measures to assist with mental health and drug addiction issues, and ensuring that patients always receive the intended therapies ordered for them.
Current State Issues	• Healthcare personnel must dispose of and document, manually and or in the EHR, item quantities of controlled substance waste in the presence of another person. This can ultimately impact productivity and can interrupt or distract from timely patient care processes. • The way controlled substances move from pharmacy to the point of administration is not currently instrumented for track and trace of controlled substances at every step along the way • Because controlled substances are often formulated in clear aqueous solutions, it is currently impossible to confirm the quantities of controlled substances in these solutions
Measurement/Data Sources	
Measurement	Controlled substance waste is measured using estimates given by the personnel who are documenting the waste in a waste documentation system. There are examples of information systems and technologies that can partially automate the measurement and confirmation of controlled substance wastage (e.g., PharmID, WasteWitness)
Measurement Frequency	Daily (ideally, discrepancies would generate real-time notifications to appropriate personnel)
Data Sources	Paper documentation, EHR-eMAR, Controlled Substance Manager
Data Accessibility	Varies
Framework Alignment	
Metric Research Needs	TO BE ADDED
Components, Features, and Capabilities	For administration by IV pumps where ongoing rates of administration apply, some real time process that feeds back patient-level usage either to slow down or speed up drug product production and dispensing against that patient's controlled substance orders is needed


Metric: Controlled Substances Waste
Non-Autonomous Pharmacy
Completely manual ordering, removal, documentation, and auditing processes
No formal leadership oversight or buy-in
No monitoring of people or data management and reactive approach to errors and/or diversion
Level 1
Limited Autonomous Pharmacy
Completely manual ordering, removal, documentation, and auditing processes
Pharmacy-only leadership involvement
Manual oversight of errors and/or diversion with limited reporting capabilities
Level 2
Intermediate Autonomous Pharmacy
Electronic reports from multiple systems for manual review
Minimal formal multi-disciplinary leadership involvement and oversight
Manage diversion reports from diversion management software
Level 3
Highly Autonomous Pharmacy
Electronic ordering, removal, documentation, and systems produce final-results reports for auditing
Formal multi-disciplinary leadership group with full involvement and oversight
Integrate diversion management software with AI
Level 4
Fully Autonomous Pharmacy
Interoperability among all systems with one result of waste not documented and AI-generated actionable interventions to support predictive analytics and inventory management to minimize waste potential
Formal multi-disciplinary leadership group with physician involvement and oversight
Fully integrated diversion management software with AI to generate actionable interventions and proactive approach to management of errors and diversion
Level 5
Outcomes
0
Medication Errors
Medication Waste
Human Touches Pre-administration To Patient
100%
Data Visibility
Time Spent on Clinical Activity
Regulatory Compliance
Performance Elements
Safety
Financials
Efficiency
Compliance
People

Metric Characteristics	
Metric	**% of Reimbursable Waste Opportunity Captured**
Definition	*The percent of reimbursable waste opportunity captured r*efers to the fraction of available credited dollars arising from eligible unused medications that are not administered to patients and for which purchase costs may be reimbursed by sharing waste documentation with manufacturers or payers.
Industry consensus	There is no current standard for % of reimbursable waste opportunity captured.
Research	There are few to none relevant research articles evaluating reimbursable waste opportunity capture or waste capturing-related process improvements pertaining to health system pharmacy services.
Metric Impact	The importance of identifying, tracking, and managing reimbursable waste opportunity captured corresponds to an organization's ability to effectively manage and improve medication cost management.
Current State Issues	● The system for tracking reimbursable waste is marked by variability in practice and a lack of systematic collection and processing of eligible medication waste data ● Difficult to maintain up-to-date list of eligible reimbursable medications ● Current waste data can be reviewed utilizing reports from a reverse distributor service to manually determine opportunities for reducing the amount of expired or wasted drugs ● There is a manual review and tracking to ensure that all reimbursement credits are received by the pharmacy for eligible waste products ● Review tasks are time consuming, prone to human error, and retrospective ● There is minimal EHR support and lack of interoperability amongst automation devices (IV robotics) that result in difficulties in documenting waste data automatically
Measurement/Data Sources	
Measurement	A ratio of actual dollars returned to the health system as a result of documenting and communicating eligible reimbursable waste to manufacturers or payers divided by the number of potential dollars that the health system could have received if all eligible reimbursable waste was documented and communicated to manufacturers and providers.
Measurement Frequency	Frequency of eligible reimbursement waste medication data capture is continuous while it is expected that the percent of reimbursable waste opportunity captured could be reported on a monthly, quarterly, or annual basis depending transaction times with manufacturers and payers.
Data Sources	EHR, IV robotics, Reverse distributors, ADC, IV pumps
Data Accessibility	Varies between hospital systems and their respective current suite of healthcare technology (IV robotics, IV Workflow management systems, ADC, EHR, IV pump)
Framework Alignment	
Metric Research Needs	Measurement studies are needed to show the reliability and validity of using current data sources to estimate percent of reimbursable waste opportunity captured.
Components, Features, and Capabilities	In future health care settings, the following represent features and capabilities of importance when tracking and monitoring reimbursable waste: ● Higher interoperability of systems (eg, EHR, IV robotics) to capture, document, and accurately bill waste ● System is automated to continually update medication lists with eligible waste products ● System is capable of differentiating between non-reimbursable waste and reimbursable waste to reduce data clutter


Metric: Reimbursable Waste
Non-Autonomous Pharmacy
No EHR support
Manually tracking billing systems to drop charges
Medication list is provided, and system is manually updated with high-usage products
New medications are entered manually
Capture ≤25% of opportunity
Unable to accurately capture all data necessary
Level 1
Limited Autonomous Pharmacy
Little to no EHR support
Manually tracking billing systems to drop charges
Medication list is provided, and system is manually updated with high-usage products
New medications are entered manually
Capture 26 to 50% of opportunity
Capture data, but unable to distinguish between useful and clutter
Level 2
Intermediate Autonomous Pharmacy
Little/moderate EHR support
Manually tracking billing systems to drop charges
Medication list update is automated with high-usage items
New medications are entered manually
Capture 51 to 75% of opportunity
Capture financially useful data, but requires manual entry of parameters
Level 3
Highly Autonomous Pharmacy
Moderate EHR support
Medication list update is automated with all eligible items
New medications are entered manually
Capture 76 to 99% of opportunity
Capture useful data, but requires manual entry of parameters
Capture financially useful data, but requires manual entry of parameters
Level 4
Fully Autonomous Pharmacy
Full EHR support and interoperability of systems (e.g., EHR, IV robotics) to capture, document, and accurately bill waste
System is automated to continually update all eligible medications
Capture 100% of opportunity
Full capability of capturing financially useful data
Non-reimbursable waste is not included in data capture
Level 5
Outcomes
0
Medication Errors
Medication Waste
Human Touches Pre-administration To Patient
100%
Data Visibility
Time Spent on Clinical Activity
Regulatory Compliance
Performance Elements
Safety
Financials
Efficiency
Compliance
People