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RFID TECHNOLOGY IN MEDICATION-USE SYSTEMS:

CONSIDERATIONS AND RECOMMENDATIONS TO ADVANCE IMPLEMENTATION

IN THE REPORT

INTRODUCTION

Radio frequency identification (RFID) technology in medication-use systems and processes continue to evolve, yet adoption is not widespread. In contrast, there is broader use of this technology in non-healthcare settings and even in non-medication-related scenarios within healthcare, such as on equipment. This report builds on previous ASHP Foundation research results[1] to identify potential solutions to barriers and explore considerations for both current and future uses.

In this project, a strategic advisory group (SAG) of healthcare practitioners convened and utilized a combination of performance improvement (i.e., process mapping and failure mode and effects analysis)[2] and consensus development tools (i.e., online survey, discussion board, and live voting)[3] to create a set of prioritized recommendations to support and advance implementation of RFID technology in medication-use systems.

This report presents the results of a project, sponsored by Fresenius Kabi, and includes detailed methods to enable others to assess the barriers, opportunities, and recommendations to support the implementation of RFID in their practice setting.

ABOUT THE PROJECT

Participants and Methods

Twenty-five (25) participants engaged in the project, including eight members of the advisory committee, who led and participated in all aspects of the project. Participants included pharmacists in different roles (e.g., medication safety/quality improvement, operations, and informatics) and leadership positions in a range of practice settings (e.g., integrated delivery, children's hospitals, medical centers) with RFID technology experience. Two anesthesiologists and a pharmacy technician participated and provided unique perspectives throughout the project. Additional considerations for participant recruitment included experience with different RFID technology systems and other technologies (e.g., electronic health records [EHR], bar code medication administration [BCMA], and automated dispensing cabinets [ADC]), patients served (e.g., children and adults), and geographical distribution. The 25 participants are referred to as the strategic advisory group (SAG) throughout this report.

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FIGURE 1. STRATEGIC ADVISORY GROUP ENGAGEMENT

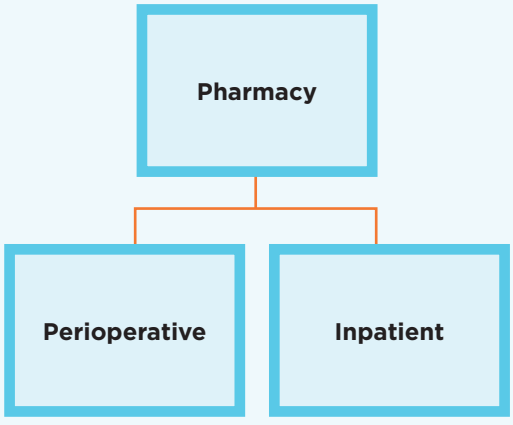
Convening	Meetings 1 & 2	Online Survey	Discussion Board	Meeting 3
Advisory Committee planning and SAG pre-work	Process mapping and analysis of failures, concerns, barriers, opportunities and potential solutions **Appendix B**	Assess the importance of recommendations **Appendix C**	Reflect on importance of survey results and expand process maps	Vote on priorities for recommendations **Appendix D**

The SAG engagement was a multipronged approach lasting approximately two months between April 27–June 22, 2023 (Figure 1). Additional details about steps in the SAG engagement with related results are highlighted in Appendices A–D.

Using a performance improvement framework, the SAG identified three processes, resources, and prompting questions to initiate SAG engagement. The SAG created and shared draft process maps and an engagement plan prior to the first SAG meeting (Figure 2). Participants used the drafts and resources to build out the process flowcharts for three current uses of RFID technology in medication-use systems. They completed an analysis of process variations across organizations and identified barriers, concerns, or areas of potential failure (Appendix B). From identified barriers and potential failures, members shared opportunities and possible solutions that resulted in 101 recommendations that were included in an online survey (Appendix C). SAG members responded to the survey using a 4-point scale to assess agreement on the importance of each recommendation to address identified barriers and advance RFID use.

The SAG reviewed the survey results for the 101 recommendations and merged similar or related items, resulting in a final set of 76 recommendations. SAG members also identified potential domain titles (e.g., workflow, engaging stakeholders), independently coded the recommendations to the domains, and reached a consensus on the final domains.

FIGURE 2. PROCESS MAPS



OVERVIEW OF RESULTS

The SAG identified dozens of barriers, concerns, and potential failures for each mapped process (Appendix B). Many barriers or potential failures affected more than one process. Commonly mentioned barriers across process maps included:

- Lack of medications tagged with RFID-embedded labels at the manufacturer level
- Lack of interoperability across technology vendors
- Time, space, and staffing resources needed to commit to RFID tagging, quarantining, activating, and deploying
- Lack of standardization of information within an RFID tag and in the placement of the tags

During the discussion of concerns and potential failures, the group also identified opportunities for implementing RFID. Many group members use RFID to manage drug shortages or recalled medications (see Workflow section). RFID offers the possibility of seamlessly capturing data in the electronic health record (EHR) at the unit-of-use level and providing accurate inventory and patient records. Controlled substance (CS) inventory management is an area where RFID could provide enhanced efficiency, visibility, and safety for patients and staff. Participants agreed that RFID technology has the potential to enhance the efficiency and safety of medication-use systems by addressing key areas included in this report.

This project aimed to generate an actionable set of recommendations that a group of users agreed were priorities to advance RFID that would address the identified concerns, barriers, and potential opportunities. The SAG voted on 38 of the 76 recommendations that all had 90% or greater participant agreement (i.e., agree plus strongly agree) as being important to enhance medication safety and efficiency of medication-use systems. SAG members voted during a meeting by selecting up to three top priorities per domain, depending upon the number of recommendations in each (Appendix D).

The next sections of the report delve into the domains, prioritized recommendations, and additional considerations for implementation and future uses of RFID technology. SAG members distilled the results and integrated their experience when writing this report.

DOMAINS

Policy, Regulations, and Standards

The SAG identified several concerns and potential opportunities for current and future use of RFID related to this area, including slow and/or inconsistent evolution of regulations, standardization at the tag level, role in tracking compared with BCMA, and possible use to comply with regulations.

Many governmental and non-governmental agencies and standards organizations factor into RFID systems within the medication-use process. Unfortunately, many regulations are behind the curve regarding newer technologies.

In 2004, the FDA acknowledged the potential use of developing technology, such as RFID, that could eventually be used instead of barcoding.[4] However, in a 2011 publication, the FDA stated that RFID cannot replace a linear barcode.[5] While much has been said about FDA regulations, Centers for Medicare & Medicaid Services (CMS), state boards of pharmacy, and accreditation organizations need to be brought into conversations about future uses of RFID in the medication-use process.

Standardization at the tag level is currently unresolved. GS1 with its Global Trade Item Number (GTIN) has been a leading organization in the standardization of barcodes in the retail industry. They have conducted many studies evaluating the Drug Supply Chain Security Act (DSCSA) readiness by collaborating with pharmaceutical wholesalers.[6,7,8] GS1 is also a driver towards RFID standards with their Electronic Product Code (EPC)-enabled RFID.[9] The UnitVisID Alliance (formerly known as DoseID) is also a catalyst behind RFID in the healthcare industry.[10,11] In addition, the International Organization for Standardization (ISO), which championed uniform dashboard symbols among all automotive manufacturers worldwide, together with the International Electrotechnical Commission (IEC) have a generic RFID symbol that the European Commission has promoted but is not currently used in the United States.[12,13]

FDA rule 21 CFR 201.25 made (linear) barcodes (that contain the National Drug Code or NDC) mandatory by mid-2006.[4,14] Despite ASHP's requests that manufacturers include the lot number and expiration date in the barcode, the FDA did not mandate it; instead, it only encouraged its inclusion.[4] The FDA has proposed changing the NDC format from a 10-digit number with varying field lengths to a 12-digit number with uniform field lengths[5,15,16] and revising the barcode label requirements to allow for liner or nonlinear barcodes. There are questions about how this 12-digit format will impact the GTIN.[16] Additionally, the timing of the NDC format change might disrupt RFID adoption/implementation within the pharmaceutical industry.

The DSCSA outlines steps to achieve interoperable, electronic tracing of certain prescription drugs as they are distributed in the United States to enhance the FDA's ability to protect consumers from exposure to drugs that may be counterfeit, stolen, contaminated, or otherwise harmful.[17] The DSCSA requires the standardized numerical identifier (NDC combined with a unique alphanumeric serial number), lot number, and product expiration date on the lowest saleable unit, with the current guidance recommending that this information be part of a 2-dimensional (2D) data matrix barcode.[4,5,14,20,21] Homogenous cases may use either a linear or 2D barcode. Unfortunately, at this time, DSCSA requirements only go as far as the lowest saleable unit, whereas the barcode rule goes down to the lowest unit-of-use. According to the FDA's website, GS1 has collaborated with pharmaceutical wholesalers on the readiness of the manufacturer DSCSA barcoding progress.[6]

PRIORITIZED RECOMMENDATIONS AND CONSIDERATIONS

Initiate discussions with federal agencies/regulators (e.g., FDA, CMS) regarding the future of RFID in the medication-use process.

- Pharmaceutical manufacturers and 503b outsourcing facilities may not see value in investing in implementing RFID technologies until mandated by a regulation from the FDA or other agencies/groups. However, they may reconsider if they stand to gain other collateral efficiencies, such as better inventory management throughout their supply chain.
- The FDA should look beyond currently available data carriers and adopt standards, allowing a linear, 2D barcode or RFID tag.[18, 19]

Assess the role of RFID in assisting organizations with becoming DSCSA-compliant.

- RFID's role in DSCSA requires guidance from the Secretary of Health and Human Services as currently only 2D and/or linear barcodes are acceptable.[20]
- The need for manufacturers to maintain compliance with linear barcode and DSCSA regulations has led to a proliferation of barcodes on pharmaceutical products.[21]

Work with State Boards and other regulators to optimize safe storage and minimize duplicative work.

- Regulations for controlled substance (CS) inventory management, including tagging and storage, are important considerations in RFID implementation.
- Issues include creating a secondary NDC number to scan in/out of an ADC, varying state regulations relating to purchasing trays/kits that include CS, and additional space required in the CS vault for tagged inventory and trays/kits.

Create a standardized icon across manufacturers and distributors that indicates that a medication is pre-tagged with RFID.

- Pharmaceutical manufacturers, wholesalers, and 503b outsourcing facilities should conform to using the symbol(s) ISO, IEC, and GS1 agree upon for RFID-enabled pharmaceuticals.

Workflow: People, Processes, and Technology

RFID systems in health systems are often siloed solutions managed by pharmacy, as was reflected in the 2022 ASHP Foundation report, *Advancing Medication Safety Through Technology Innovations: Focus on Radio Frequency identification Technology*,[1] in which 98% of survey respondents listed pharmacy as the key stakeholder for RFID systems at their site.[21] This report identified several key considerations when designing workflows for new implementations, expansions, and optimizations of current systems. While the pharmacy team may primarily drive these decisions, additional input from other stakeholders within the organization will likely positively impact the yield of RFID use.

One major consideration when looking to implement an RFID program that will impact all future workflows is the designated space to house inventory and equipment. Determining the appropriate scope of the organization's operation will allow space needs to be assessed accurately. How many trays/kits will be prepared by the pharmacy team? How often will these trays/kits be exchanged? How much inventory is required to act as an operational buffer? Is future expansion anticipated? Additionally, tagged items should be stored to segregate non-tagged and tagged inventory to prevent erroneous scans and the reading of tags not found in the specific kit/tray, also known as tag bleed over. This concept also applies to completed and incomplete kits/trays, as storage should be designed to minimize the risk of dispensing incomplete kits/trays.

Once the space to manage the RFID program has been designed, the next workflow decision is to determine which items should require RFID tags. When making this assessment, the expected utilization is essential to maintaining an appropriately sized inventory. If the anticipated utilization is high, consider purchasing pre-tagged items or using a third-party vendor to assist with tagging. Whether managed internally or externally, standardized expectations for tag placement are essential to ensure the product's vital information is visible. If the kits/trays require non-medication supplies such as syringes and needles, a decision must be made on whether those supplies will be tagged. If not, an alternate workflow is required to ensure that non-tagged inventory is appropriately replenished, along with the tagged inventory.

Currently, RFID-tagged medications received from the wholesaler into the hospital inventory management system and into RFID software requires medications to be electronically processed in both systems. There is no standard functionality for receiving electronically and manually in one step that will streamline receiving and cut down on multiple steps for pharmacy team members. Until that functionality is available and validated, there needs to be a clear training process for staff to understand how to receive RFID inventory electronically and manually in multiple systems to ensure all medications are accounted for and comply with DSCSA.

As outlined in the 2022 ASHP Foundation report, RFID is predominantly used in code trays, kits, and anesthesia trays and workflows should be designed around each use case. Oversight of the RFID use cases should be determined early on as there are various areas of change management, including determining who will have the ability to make adjustments in the system to add new formulary items/NDCs and adjusting templates, who is responsible for running and reviewing reports on system performance, who will triage issues as they come up, and how any changes to the system are communicated.

One of the benefits of investing in an RFID program is having the ability to easily track medications' expiration dates, as highlighted in

the 2022 ASHP Foundation report, where 72% of survey respondents reported a decrease in expired medications after implementation. Having a clear process to track and proactively replace soon-to-expire medications will help ensure all medications in the trays and kits and inventory in your RFID space are up to date when required. A clear understanding of tools available from the RFID vendor and used internally at your site to track kits/trays/carts, including real-time location services (RTLS) will be key to tracking medications that are beyond-use date (BUD) across the medication-use process.

With the accountability benefits of RFID workflow integration being well elucidated, there is potential value that could be gained by expanding the scope to include the distribution of patient-specific medications in health systems. Potential benefits include automated tracking of medications throughout the distribution process and greater accountability in dispensing high-priority and high-cost medications. Several factors, such as the usability of electronic health records (EHR) native medication tracking systems, the potential gaps that RFID can help meet, and recognition of the need to incorporate RFID into future healthcare facility builds to allow for moving the system out of the pharmacy and into patient care spaces will influence RFID adoption.

RFID-ENABLED DRUG SHORTAGES MANAGEMENT

Disruptions in the medication supply chain have the potential to impact areas where RFID is utilized and was raised repeatedly by the SAG. The increasing number of drug shortages will have an impact on RFID programs.[22] Several medications stocked in trays/kits, such as epinephrine and dextrose, have been impacted by ongoing shortages, creating a need for a clear strategy to ensure supply chain resilience.

- Establishing a comprehensive policy and process for handling RFID-tagged drugs that are now in shortage or recalled is essential and includes:
  - How teams will manage pre-tagged items to ensure it is well-known what is tagged and what the strategy is to address impacted supplies
  - Which staff have system privileges and provide appropriate training to update templates
  - The communication strategy to pharmacy staff, procurement, and end users
  - If the contents of kits and trays are part of a policy, how and where temporary changes will be reflected
  - How the organization ensures that any changes made are reversed once the shortage is resolved

Additional steps and considerations include:

- Pharmacy staff and end users need to actively engage in product substitution and alternate workflow discussions.
- Depending on the remaining inventory at the time of shortage/recall discovery, utilization mitigation or product substitutions may be leveraged to manage the event.
- Organizations should consider the impact of shortages on staffing costs when products are tagged from the manufacturer and if sourced alternatives are available.
- Appropriate training for all staff working with RFID (end users and the procurement team) should include:
  - Methods to identify pre-tagged medications
  - Circumstances to transition to manual tagging when a pre-tagged product is unavailable
  - To whom issues are reported
  - Procedures to update kit/tray templates and add new alternative NDCs to the system

Additional considerations and recommendations throughout this report are relevant and can be integrated into organizational strategies to manage RFID-enabled drug recalls and shortages.

PRIORITIZED RECOMMENDATIONS AND CONSIDERATIONS

Establish a quarantine process that delineates tagged vs. non-tagged items, non-checked tagged items vs. checked tagged items, and items that are tagged but not activated.

- Start with a designated RFID area with a clear process map to help ensure only items that have been activated and checked are utilized.
- Develop a defined workflow for the RFID space that incorporates visual indicators, including signs and designated quarantine spaces for each stage in the process. Consider creating blocks of time for different steps in the process to occur. For example, solely focusing on receiving for the first part of the shift, followed by inventory tagging and then moving to kit/tray replenishment.

Implement tracking of BUDs from the initial activation of RFID tags to the unit-of-use level.

- Consider how to manage nuanced situations for BUD tracking. For example, items such as rocuronium have a manufacturer's expiration date when refrigerated. However, they are assigned a room-temperature BUD when moved to a room-temperature storage in a kit or tray. When it is returned to pharmacy, the manufacturer's expiration date should not be used, but rather the updated room temperature BUD in the RFID system, which is only visible if placed back in the reader and scanned.

Outline processes for receiving inventory manually and electronically.

- As the use of RFID expands, how can it be incorporated into the tracking and receiving of medications at a site? Can manufacturers providing medications with RFID tags partner with medication wholesalers to incorporate data from each system to communicate efficiently, allowing ordering and purchasing to occur in one system?
- The increasing availability of medications equipped with RFID technology raises the question of whether it can capture the information embedded in the RFID system as they traverse the health system. Advanced RFID readers need to be developed and deployed in designated areas such as receiving rooms, RFID spaces, and medication rooms.
- Use RFID to track and notify staff of patient-specific medications throughout the hospital and at discharge.
- As organizations look to expand the use of RFID, they can consider how or if RFID information can be integrated into the EHR, making location information available for all applicable parties.
- Consider placing readers in key locations to automatically capture RFID information and configure the system with flexibility that allows designated medications to utilize RFID but others to continue using regular tracking and distribution configuration.

Stakeholder Engagement

The successful integration of RFID technology heavily depends on the active involvement of various stakeholders. Feedback from the SAG participants reflects that the use of RFID technology offers significant benefits to the end user and requires an important commitment to stakeholder engagement. These partners are generally internal and external members of the multidisciplinary team that will play a vital role in mapping out the use of RFID to ensure optimal outcomes and safety benefits for the patients receiving care within the organization.

Generally, pharmacists, pharmacy technicians, information technology (IT) and informatics specialists, and medical providers are stakeholders in implementing and advancing RFID. The 2022 ASHP Foundation report also identified these professionals as critical team members. Additional internal stakeholders include senior finance leaders, pharmacy administrators, and leaders on the provider side. External partners include RFID-focused companies with medication-related products, pharmaceutical manufacturers, federal and state-level regulatory and compliance agencies, EHR software developers, and other pharmacy automation vendors that support medication distribution for RFID-tagged items. The most substantial benefit of involving stakeholders early on is to ensure everyone's goals are met, thus gaining their buy-in. If the technology is integrated into routine operations seamlessly, there is a much higher chance of successful outcomes and reduced barriers to integration.

Policies and procedures must be co-created and compiled at the stakeholder level to enforce work standards. Stakeholder engagement encompasses a detailed analysis of all process-related outcomes and regulatory considerations to minimize patient care disruptions and support the needs of each group. Many SAG recommendations discussed routine connections with partners at all stages of use, comprehensive training programs for all staff, published security and privacy policies for protected health information, and ongoing input for process improvement initiatives and reflections.[23,24] It was also noted that early and frequent communication to all parties involved around tailored workflows for the pharmacy department, especially for pharmacists and technicians, is important. Effective training and support are essential to establishing a solid foundation for using RFID. Ongoing education for end users and sharing metrics associated with RFID deployment can play a key role in supporting the technology and operations. This helps mitigate resistance to change and overcome the fear of dealing with something new and unfamiliar in the workplace. The resulting opportunities and considerations related to this theme are outlined below. Pharmacy leaders continue to play a crucial role in integrating all stakeholders and supporting partnerships that will grow the adoption of the technology and create new future use cases.

PRIORITIZED RECOMMENDATIONS AND CONSIDERATIONS

Advocate for the standardization of RFID tags used in the medication distribution process so they can be read across any vendor's scanning technology.

- Collaborate to draft national guidelines on product development and usage specifications in the healthcare space.
- Integrate tag use with all pharmaceutical manufacturers, wholesalers, and 503B vendors.
- Emphasize the importance of standardized tag reading across all RFID vendors for increased adoption rates.

Package and purchase medication doses in units of use that are pre-tagged.

- This will require close collaboration with pharmaceutical manufacturers, wholesalers, and 503B vendors to offer pre-tagged medications.
- Manual tagging must be minimized by health systems experiencing pharmacy workforce shortages.
- As discussed in the Policy section, standards and regulations are evolving but aren't cohesive and consistent. Ideally, tag use is integrated with all pharmaceutical manufacturers, wholesalers, and 503B vendors, with the ability to read tags across the vendors and medication-use system technologies.

Develop an RFID-specific start-up guide for organizations that includes training checklists, safety audits, and environmental checklists for frontline staff across disciplines, inclusive of both centralized and decentralized operations.

- Create standard work guidance for implementation steps and staff training.
- Review the 20 elements of performance outlined in The Joint Commission on Medication Management Standards, which provide guidelines for secure medication storage, and see how RFID can impact compliance and patient safety.
- Customize organization-specific workflows tailored to present needs.
- Department heads engaging with multidisciplinary stakeholders and hospital leaders should consider the time commitments and subsequent resources needed to implement and maintain new technology and systems.

Work with vendors and partners to optimize the interoperability of multiple systems (e.g., EHRs, BCMA, ADCs)[25]

- Professional organizations such as the American Society of Health-System Pharmacists (ASHP), the International Organization for Standardization (ISO), and GS1 need to actively advocate for policies that optimize system interoperability, which is vital to efficient and safe patient care.
- Support technology interfacing across systems through collaboration, standards, and protocols
- Draft industry standards supporting the DSCSA.
- Test technology solutions throughout the medication supply and distribution channels
- Maximize RFID adoption throughout the organization's medication-use system to reduce the risk of communication errors and support innovation.

Work with vendors to design ways for RFID to capture administration and billing in the EHR seamlessly.[26]

- Ensure systems function at their optimal capacity, which enables staff to focus on patient care and spend less time on inventory management.
- Consider opportunities to work with vendors to test their solutions and systems.
- Collaborate to create proof of concept designs with consignment inventory management, emergency department patient tracking, and EHR patient data tracking.
- Support regulatory compliance goals with track-and-trace technology per DSCSA regulations.

Analytics and Outcomes

Outcomes and analytics must be at the forefront of driving business and process decisions. Developing an analytics strategy is essential to include when evaluating and implementing RFID. Health systems may not fully utilize data to optimize patient-care outcomes, which is true for all technologies that influence the medication-use system, including RFID.[27] Hence, a proactive approach is needed for an organization to benefit from optimizing specific workflows. The system needs to provide access to actionable reports, and staff accountability is needed for reviewing and acting on the report's findings. While less than half of the 2022 ASHP Foundation report survey respondents indicated that they were utilizing analytics, those that did reported a benefit to frequent metrics evaluation.[21] The most common uses included tray and kit utilization metrics, which drove optimization, tracking location of inventory for drug shortages management, and tracking labor utilization. Additionally, patient safety impacts were reported, including reduced restocking and expired medication errors within anesthesia workstations by using appropriately deployed RFID technology.[28]

Today, most pharmacy operations utilizing RFID technology do so through out-of-box solutions and standard reports.[21] The templated reports can be helpful for general needs. Still, evolving patient care needs and creative application of this technology will require easily customized reporting.[29] The SAG participants struggled with optimizing workflows and inventory levels and found this was often an experiment through trial and error. RFID technology is straightforward in design, but workflow is critical in choosing medications for implementation and designing appropriate processes. Using performance improvement tools, as incorporated into this project, provides essential information on existing workflows. To optimize processes and get the most from the technology, a team member needs to interpret the data regularly to act on the information, such as adjusting inventory levels and investigating safety events. While SAG participants agreed on the utility of templated reports, a standardized quality assurance report or a way to assess quality is lacking—as are recommendations within the workflow and responsibility of who reviews and signs off on reports once generated.

Along with the ability to read tags across vendors, enforcing data standards and integrating with the EHR will drive more deployment of this technology in the coming years. In the future, it may be possible to query systems seamlessly in the event of medication errors. RFID systems are often disparate from the EHR and likely other inventory systems. Therefore, a strategy to curate this data with the EHR or to easily combine it with data from other inventory systems is critical—either by more technology vendors adopting RFID solutions or through more robust interfacing to the EHR and/or other systems. Active engagement with internal and external stakeholders is essential in advancing data analytics and reporting capabilities.

PRIORITIZED RECOMMENDATIONS AND CONSIDERATIONS

Conduct research on RFID in real-world environments to determine return on investment (ROI), including efficiency and safety.

- Organizations already implementing RFID in various settings are encouraged to collect, publish, and/or share ROI data when possible.
- Include metrics on shrinkage and/or waste in any ROI evaluations. Metrics like those used for ROI can also evaluate real-world time and motion within an organization. If real-world scenarios are unavailable, use simulated environments to illustrate patient safety benefits.

Work with the organization's informatics department to optimize existing reports that generate useful data for end users.

- Include optimization reports that help ensure periodic automatic replenishment (PAR) levels reconcile with utilization reports.

Share use cases, tracking opportunities, and safety implications of RFID across disciplines.

- Health systems and national associations are encouraged to share use cases.
- Technology vendors can assist by making stronger labor predictions associated with their solutions, providing actionable, out-of-box reports, and training at the facility and end-user level to optimize workflows.

Collect data to enable organizations to optimize RFID-enabled medication management, including details on specific medications, unit-of-use and PAR levels.

- Technology vendors or national associations can help organizations by providing recommendations on PAR levels and labor utilization (including tags placement) and informing pharmacies of available benefits and challenges of different configuration options.

CONCLUSION

Participants of this project see a future where technology-enabled medication-use systems allow the healthcare team to focus on patients and not on operations, materials, and medications with increased efficiency, visibility, safety, and quality. RFID technology, being able to communicate passively, and capture data through a networked system, offers an essential piece to this future.

Those interested in implementing or expanding RFID technology are encouraged to use this report and the 2022 report to engage their organizational stakeholders in assessing the processes and potential failures of existing and future technology. While there are barriers beyond an organization's control, such as some included in the Policy section, many concerns voiced by SAG members exist within workflows and can be addressed or accounted for. The SAG put forward a short list of recommendations they agreed were the highest priority to act on now. Those implementing should consider all the SAG recommendations in Appendix C and assess their importance in their organization.

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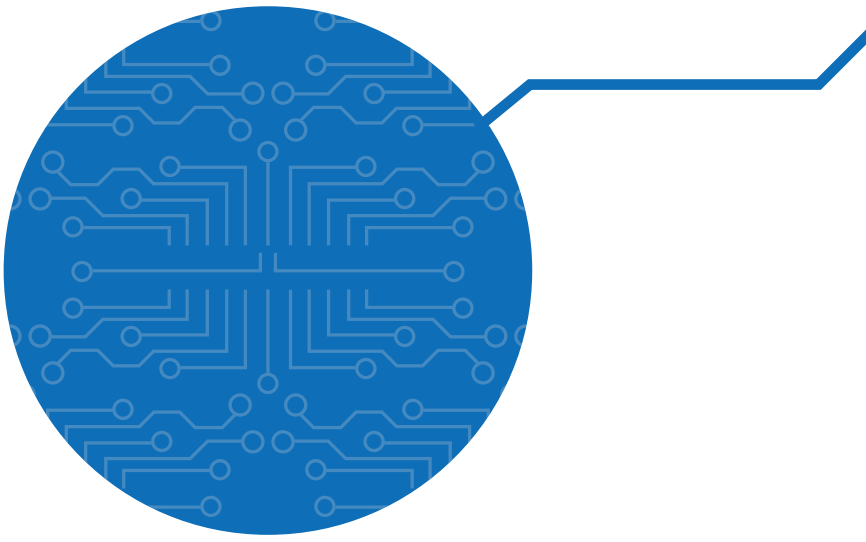
This ASHP Foundation report is a product of the Strategic Advisory Committee and could not have been created without the support and expertise of the staff at ASHP.



APPENDIX A. DETAILED METHODS

After initial outreach and confirmation of participation, the committee shared resources to prime strategic advisory group (SAG) work, including background readings, podcasts, and webinars. Additionally, committee members created and shared high-level process maps of three areas: pharmacy department, perioperative setting, and hospital unit/non-procedural setting. These areas were selected based on prior survey responders having implemented RFID within the pharmacy (76%) and in the operating room (49%), with fewer (14–36%) having implemented RFID in other care areas.

SAG ENGAGEMENT

Stage 1: Build out process maps, identify barriers/concerns/opportunities, and potential solutions

Meeting 1

Members received draft flowcharts and prompting questions prior to the meeting. They worked in small groups during the meeting, with facilitators asking members to share their responses to each prompting questions. Once member ideas were exhausted, facilitators moved on to the other questions.

- From your review of the process maps, what is missing or different at your organization?
- What issues or problems can and do occur in the process? Consider issues/concerns related to safety, quality of care, and efficiency.
- What are the challenges associated with the technologies you use for track-and-trace?
- What other factors influence the process (e.g., human resources, fed/state regulations, organization policies)?

Meeting 2

Members received the updated flowcharts that included identified concerns (Appendix B) and the below prompting questions. Members shared their ideas using a similar process to meeting one.

- From your review of the process maps, what concerns, problems, or potential failures are missing?
- What solutions would you propose to address the concerns included in the process maps that could positively impact the safety, efficiency, and quality of care?

Stage 2: Develop recommendations for identified concerns and potential solutions

SAG members created 101 recommendations related to the concerns and potential solutions. They were asked to complete an online survey through Qualtrics to assess their level of agreement with the recommendation's importance in advancing the implementation of RFID technology using a 4-point scale of strongly disagree, disagree, agree, and strongly agree. SAG members' survey results are included in Appendix C.

Survey results were shared with the SAG, and members were asked to reflect on the group and their individual responses during an online discussion board held June 8–12, 2023. SAG members facilitated the discussion using the following pre-set prompting threads:

- For each process flowchart, please review and add comments for additions or changes.

- How do your survey results of the priorities compare to others in the group? What do you think about the differences?
- What outcomes do or would you measure to evaluate for safety, efficiency, and quality of care related to RFID technology?
- What other factors influence the process, including the technology used (e.g., human resources, regulations, standards/policies, financial constraints/priorities)?
- If you use RFID in your code carts, how does that process differ from that outlined in the perioperative flowchart? (Note: this question was included as many SAG members commented that code carts are the most common use of RFID in their organization).

Discussion board responses were reviewed by SAG members with new or unique data included in the flowcharts, recommendations, and as examples in this final report.

Stage 3: Prioritize a set of recommendations thought most important to advance RFID technology in medication-use systems

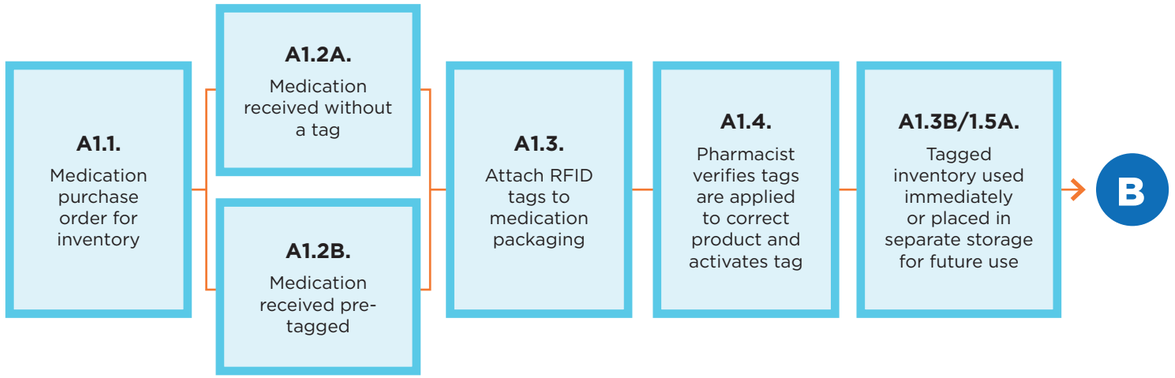
The recommendation review and refinement process used individual review, and all edits to the items were color-coded to enable tracking of the process. Results of the survey and refinement process were discussed in the report and noted in Appendix B. SAG members reached an agreement on the recommendations in the domains (Appendix D) to advance to the SAG for prioritizing.

During a final SAG meeting on June 22, 2023, members participated in voting on the priorities. Under each domain, and depending upon the number of items, members were asked to vote using Zoom polls for their top one or up to three recommendations that would support the implementation of RFID (Appendix D). Due to the relatively fewer number of recommendations in Workforce, Training and Tools, and Special Use-Cases, those with higher votes were incorporated into one of the other four domains in the report. Advisory committee members used the results from the vote and survey along with their expert knowledge in authoring the report.

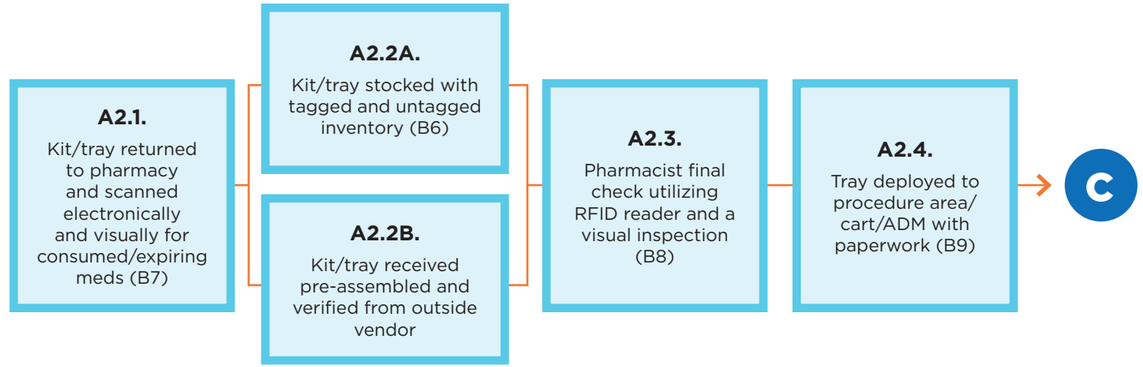
APPENDIX B. PROCESS FLOW CHARTS

A. IN THE PHARMACY

A1. Medication Management



A2. Kit/Tray Management



BARRIERS AND CONCERNS

A1.1.

- Contracting and formulary selection
- Price and availability of tagged vs. non-tagged medications
- Predicting medication use, PAR levels, and labor requirements
- Managing new formulary items and NDCs in the system
- Managing the kit/tray master template

A1.2A.

- Receiving location for non-tagged medication (warehouse vs. central location vs. satellites)
- Electronic vs. physical receiving for non-tagged medication
- RFID's role in track-and-trace systems
- Training staff on handling both tagged and non-tagged medications

A1.3A.

- Strategies for tagging non-medication supplies (e.g., needles and syringes)
- Establishing a quarantine process for items waiting to be tagged
- Staff training on these processes and procedures
- Selecting the tag size

A1.4A.

- State regulations regarding tag verification procedures (e.g., who can perform tag-checking duties)

BARRIERS AND CONCERNS

A2.1.

- Reports on PAR levels match the utilization reports
- Transporting kits/trays to pharmacy and processing upon arrival
- Managing and reporting recalled medications
- Locating kits/trays that need to be returned to the pharmacy
- Managing tag reader errors
- Tag reader interference

A2.2A.

- Establishing processes for replenishing untagged items such as supplies
- Managing beyond-use dates (BUD) for refrigerated items

A2.2B.

- State regulations and/or the hospital's standard operating procedures (SOPs) regarding stocking kits/ trays with tagged and untagged inventory

A2.3.

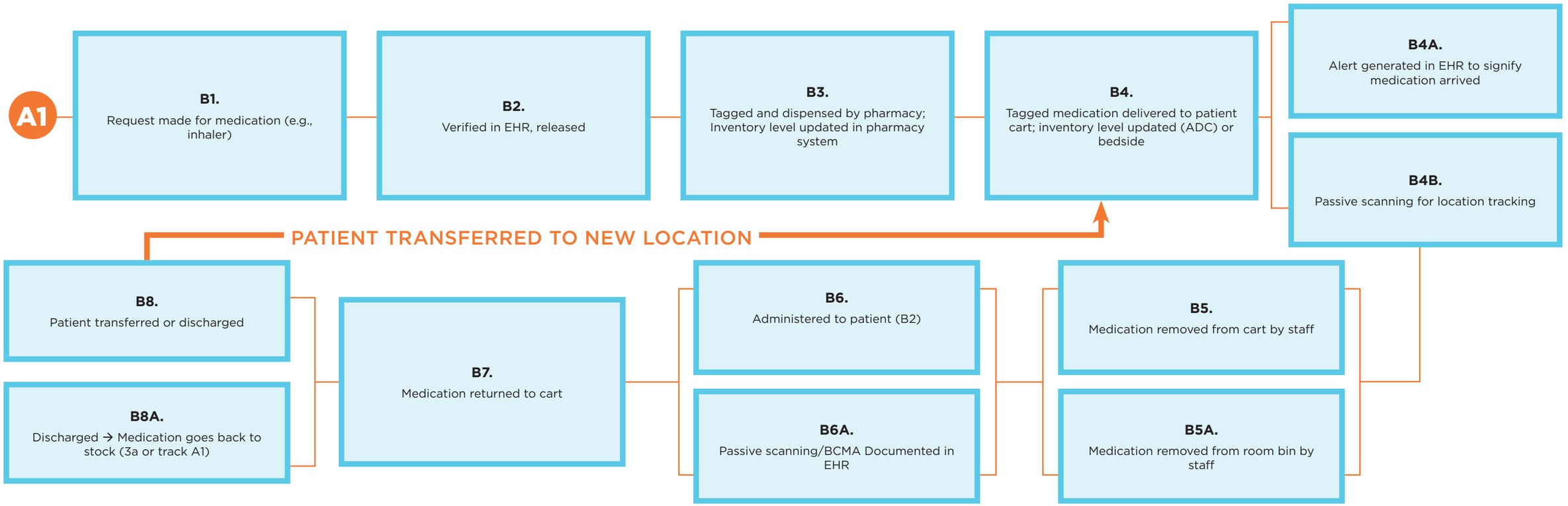
- Visual checks required, including for correct product in designated spots, used /opened products, and loose tags
- State regulations regarding which pharmacy staff can perform final check
- Determining how the kit will be verified in the RFID system

A2.4.

- Requirements for locking the final kit/tray
- Required paperwork
- Tracking the kit/tray's final location in real-time (RTLS)

RFID TECHNOLOGY IN MEDICATION-USE SYSTEMS

B. INPATIENT



BARRIERS AND CONCERNS

B1.

- Criteria for selecting medications/products for RFID tagging (e.g., high-cost, high-use)
- Non-standardized policy/process to tag patient-specific medications (e.g., inhalers)
- Workflow for patient home medications

B3.

- Tagging medication directly vs. tagging the box/overwrap/inhaler case
- Challenges of tracking a product vs. patient-specific medication

B4.

- Alerting the nursing staff when a medication arrives
- Tracking medications to a cart vs. to a patient-specific bin or room cabinet location

B5A.

- Tracking patient-administered medications

B6 OR B6A.

- Capturing documentation
- Requiring BCMA in addition to RFID tagging
- Potential diversion point

B7.

- Inventory levels not updated (ADC or bedside-specific)
- Placing a reusable dose back into stock
- Capturing and documenting waste
- Antenna issues (e.g., not broken during use)
- Ensuring waste occurred
- Potential diversion point

B8.

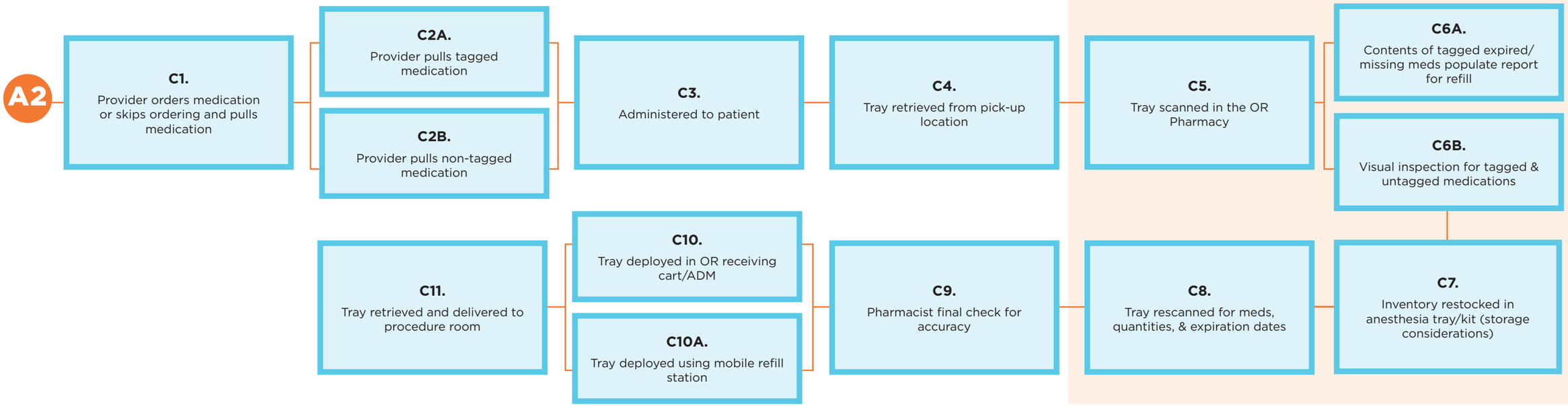
- New location not recognizing patient's medication
- Medication not following patient
- Potentially administering patient's medication to the new patient in the old location
- Medication taken out of circulation
- Alerting pharmacy when patient transfers or discharged

B8A.

- Labelling patient-specific medication
- Discarded outer box or wrapper with tag
- Decreased shelf life of unwrapped medication
- Tracking patient home use
- Drug waste if policies prohibit dispensing medication to home upon patient discharge
- Confirming that a medication was removed and returned to pharmacy upon discharge

RFID TECHNOLOGY IN MEDICATION-USE SYSTEMS

C. PERIOPERATIVE



BARRIERS AND CONCERNS

A2 PERIOPERATIVE-INTERFACE SPECIFIC

- High volume of untagged items that need to be tagged for use in the OR
- Human resources are needed to tag and/or manage inventory
- Customizable reports necessary to provide useful data

C2.

- Existing ADC not optimal for OR/RFID use
- Cart or cabinet location
- Controlled substances process/storage/diversion monitoring
- Tag issues
- Untagged items in tray
- Vial vs. pre-filled syringes

C3.

- Documenting and integrating information in the EHR/ MAR
- Charging for the medication when administered vs. when dispensed
- Not capturing the charge
- BCMA routinely not in use in OR, opportunity for RFID
- Tracking controlled substances, waste witness process, and diversion

C4.

- Timeliness of retrieval and turnaround time for a medication to be restocked

C5.

- Location of tray scanning units
- The tray reads the quantity of medications, not a specific medication

C6.

- Inaccurate counts with passive RFID reading due to cabinet door being left open
- Repeat visual inspections required
- Location for visual cues and/or scanning
- Using virtual checks and dashboards

C7.

- Matching inventory PAR levels of tagged items with utilization
- Designated storage of tagged/non-tagged/ decentralized storage
- Adequate training of technicians in decentralized locations
- Efficiency of turnaround for restocking trays

C8.

- Technician scans everything; paperwork optional

C9.

- State regulations and/or the hospital's standard operating procedures may authorize pharmacy technicians to conduct the final check
- Potential inconsistency in processes between centralized vs. remote procedural locations

APPENDIX C: RECOMMENDATION SURVEY RESULTS

RECOMMENDATION	Response (Count)					Agreement (%)	
	Strongly Disagree	Disagree	Agree	Strongly Agree	Total	Strongly Agree	Agree + Strongly Agree
1. Package or purchase doses in unit-of-use that are pre-tagged.	0	0	7	16	23	70%	100%
2. Standardize RFID tag placement directly to the final product (i.e., tag affixed directly to a vial vs. the outer box).	0	0	5	18	23	78%	100%
3. Create a national database of available pre-tagged items from manufacturers and distributors.	0	0	10	13	23	57%	100%
4. Develop master templates for kits, trays, ALS, etc.	0	6	14	3	23	13%	74%
5. Develop training materials for frontline staff across disciplines regarding RFID.	0	1	11	11	23	48%	96%
6. Advocate for tags to be sized in such a way as to not obstruct pertinent information (e.g., barcode, drug name/strength) on small unit-of-use products.	0	1	6	16	23	70%	96%
7. Develop process for handling non-medication supplies (e.g., needles/syringes), that may include bundling into a pre-prepared kit in the pharmacy to replace in trays/kits.	0	7	14	2	23	9%	70%
8. Standardize location of RFID tag placement on unit-of-use items to prevent obstruction of pertinent information (i.e., barcode, drug name, concentration).	0	0	6	17	23	74%	100%
9. Develop downtime procedures for RFID.	0	5	11	7	23	30%	78%
10. Develop process for real-time alert to designated personnel for managing system tag reader errors throughout the organization.	0	4	13	6	23	26%	83%
11. Develop standard templates to be used across vendors for trays/kits.	1	6	10	6	23	26%	70%
12. Design quality assurance check specific to paperwork/reports printing at certain steps within the process or at final step and how that sign-off occurs.	0	3	14	6	23	26%	87%
13. Work with vendors to develop reports that generate useful data for various end users.	1	0	8	14	23	61%	96%
14. Outline process for return of trays/kits to pharmacy.	0	8	9	6	23	26%	65%
15. Work with vendors to design ways for RFID or other technologies to seamlessly capture administration in the electronic health record.	0	1	8	14	23	61%	96%
16. Investigate impact of RFID on clinical decision support software when administration is passively captured.	1	3	14	5	23	22%	83%
17. Develop a way for tags to be inactivated once the product is opened, used, or broken.	0	5	4	14	23	61%	78%
18. Establish mechanism to utilize RFID to document waste.	1	3	13	6	23	26%	83%
19. Customize tray design to allow for placement of medications in such a way that multiple tags aren't scanned at once.	1	8	8	5	22	23%	59%
20. Work with vendors to optimize interoperability of multiple systems.	0	0	5	18	23	78%	100%

RECOMMENDATION	Response (Count)					Agreement (%)	
	Strongly Disagree	Disagree	Agree	Strongly Agree	Total	Strongly Agree	Agree + Strongly Agree
21. Work with State Boards and other regulators to optimize safe storage and minimize duplicative work.	1	3	9	10	23	43%	83%
22. Integrate each step of RFID-tagged medication process (e.g., removal, administration, return) with the electronic health record.	0	1	9	13	23	57%	96%
23. Integrate with electronic health record to allow for automatic billing for what was used on a specific patient.	0	1	12	10	23	43%	96%
24. Work with vendors of cabinets/ADC to address sub-optimal RFID reading and tracking.	0	0	11	12	23	52%	100%
25. Develop policies, procedures, and training plans inclusive of centralized and decentralized operations specific to RFID processes.	0	0	14	9	23	39%	100%
26. Establish standard process for RFID checking that prevents interruptions mid-process.	0	2	13	8	23	35%	91%
27. Outline how remote verification of RFID tagging of products or trays may be allowed utilizing telehealth opportunities.	0	6	12	5	23	22%	74%
28. Implement passive boundaries from thresholds within the organization to alert when a medication leaves an area it wasn't ordered to be administered in (e.g., controlled substance ordered in OR moved to non-OR setting).	0	3	10	9	22	41%	86%
29. Establish process for handling pre-tagged drugs now on shortage or recalled.	0	1	9	13	23	57%	96%
30. Establish standard that RFID tag be specific to medication and vial size.	0	4	9	10	23	43%	83%
31. Adopt a different signal (i.e., visual or auditory) to alert at each step of the medication-use process when a high-alert medication (e.g., narcotic) is activated, removed, administered, or returned.	0	8	11	4	23	17%	65%
32. Create a standardized icon across manufacturers and distributors that indicates that a medication is pre-tagged with RFID.	0	2	9	12	23	52%	91%
33. Create systems that support local-level customization by user within software (i.e., new NDCs, kit templates, shortage management).	0	1	14	8	23	35%	96%
34. Advocate for standardization of RFID tags so they can be read across vendors (i.e., one vendor's tags can be read by another vendor's tag reader).	0	0	3	20	23	87%	100%
35. Explore tagging all inventory so that perpetual inventory can be tracked in all locations (e.g., carousels, automated dispensing cabinets).	1	5	7	10	23	43%	74%
36. Develop and deploy a robot to RFID tag inventory for your organization	0	6	13	4	23	17%	74%
37. Determine the healthcare savings related to RFID to the individual patient level.	0	3	11	9	23	39%	87%
38. Develop a P&T-type approval process that serves as an internal control process to evaluate technology such as RFID.	0	9	12	2	23	9%	61%
39. Develop an RFID FMEA template with question prompts that potential adopters can utilize to identify failure modes.	0	2	16	5	23	22%	91%
40. Develop a tool that calculates potential savings based on shrinkage or waste by having RFID tags on inventory.	0	4	9	10	23	43%	83%

RECOMMENDATION	Response (Count)					Agreement (%)	
	Strongly Disagree	Disagree	Agree	Strongly Agree	Total	Strongly Agree	Agree + Strongly Agree
41. Develop an RFID start-up guide for organizations that includes training checklists and environmental checklists.	0	1	9	13	23	57%	96%
42. Develop process to query RFID technology for medication errors or near misses occur.	0	3	13	7	23	30%	87%
43. Outline standard work for how a master template would be changed/ adapted in a timely manner in the event of a drug shortage.	0	2	14	7	23	30%	91%
44. Develop safety audit protocols for unsafe storage of products within the RFID process.	0	0	17	6	23	26%	100%
45. Identify failure modes and opportunities throughout your systems that RFID could be utilized as part of the solution.	0	1	12	10	23	43%	96%
46. Identify process for optimizing tech-check-tech opportunities in states that allow this practice.	0	1	11	11	23	48%	96%
47. Initiate discussions with federal agencies/regulators (e.g., FDA, CMS) regarding the future of RFID in the medication-use process.	0	1	9	13	23	57%	96%
48. Investigate error logs in existing track-and-trace systems (e.g., BCMA) to learn additional failure modes.	0	2	14	7	23	30%	91%
49. Provide use cases, tracking opportunities, and safety implications of RFID in a way that can be shared across disciplines.	0	0	15	8	23	35%	100%
50. Research pricing standards in regards to value across vendors for tags, tagging, etc.	0	3	11	9	23	39%	87%
51. Standardize RFID tagging decisions based on medication in an effort to allow organizations within regional area to share standard work for Ambulance/EMS boxes/kits.	0	2	16	5	23	22%	91%
52. Standardize what information is embedded in the RFID tag (e.g., drug name, NDC, concentration).	0	0	9	14	23	61%	100%
53. Trial RFID in a real-world environment to determine ROI, including efficiency and safety.	0	1	15	7	23	30%	96%
54. Utilize RFID with all medications to allow for ease of tracking of expiration dates.	0	8	4	11	23	48%	65%
55. Develop policies that include ethical implications of using RFID to track people, including personnel and patients.	1	4	12	6	23	26%	78%
56. Develop customizable templates to be used across vendors for trays/ kits.	0	5	13	5	23	22%	78%
57. Work with your informatics department to optimize existing reports that generate useful data for various end users.	0	3	12	8	23	35%	87%
58. Assess workforce roles, responsibilities, and skill needs related to adoption of new technologies	0	3	14	6	23	26%	87%
59. Identify adequate space for RFID-tagged inventory are stored, in central pharmacy or decentralized areas.	0	0	14	9	23	39%	100%
60. Establish clear quarantine process that clearly delineates non-checked tagged items from checked tagged items.	0	0	11	12	23	52%	100%
61. Establish process that clearly delineates activated tagged items from non-activated items.	0	0	12	11	23	48%	100%

RECOMMENDATION	Response (Count)					Agreement (%)	
	Strongly Disagree	Disagree	Agree	Strongly Agree	Total	Strongly Agree	Agree + Strongly Agree
62. Develop a process that utilizes RFID technology to reconcile medication purchase orders from the wholesaler to invoice to inventory receipt.	0	2	13	8	23	35%	91%
63. Develop best practices and procedures for designating RFID and non-RFID-tagged inventory.	0	1	11	11	23	48%	96%
64. Collect data to enable organizations to optimize RFID-enabled medication management, including details on specific medications, unit-of-use, and PAR levels.	0	1	11	11	23	48%	96%
65. Develop procedure for adding new formulary line items and/or NDC numbers into RFID process.	0	0	14	9	23	39%	100%
66. Request RFID status be added to hospital master formulary.	0	5	14	4	23	17%	78%
67. Develop guidance on how to affix RFID tags specific dosage forms.	0	1	9	13	23	57%	96%
68. Develop mechanism to efficiently program and deploy patient-specific active tags.	0	1	16	6	23	26%	96%
69. Design a real-world time and labor study of tagging and deployment of RFID.	0	2	10	11	23	48%	91%
70. Assess role of RFID in assisting organizations with becoming compliant with the Drug Supply Chain Security Act (DSCSA).	0	0	8	15	23	65%	100%
71. Establish points of entry location (e.g., door, box) that becomes a passive tag reader as RFID-tagged products enter the organization, logs them into inventory, and put into stock.	0	2	10	11	23	48%	91%
72. Outline processes for both physical/manual, and electronic receiving of inventory.	0	1	16	6	23	26%	96%
73. Standardize the terminology related to RFID: pre-tagged vs. encoded tags.	0	1	11	11	23	48%	96%
74. Plan for adequate space within controlled substance storage area to allow for separate RFID scanning equipment, workflow, and inventory to be kept within secure monitored area.	0	3	11	9	23	39%	87%
75. RFID management software to be customizable, including managing staff permissions.	1	1	8	13	23	57%	91%
76. Designate space within the pharmacy where only RFID tagging occurs.	0	4	11	8	23	35%	83%
77. Develop visual cues to be placed in quarantine areas for items waiting to be tagged.	0	2	15	6	23	26%	91%
78. Establish guidelines for storage of controlled substances with and without RFID tags within locked/monitored storage areas.	0	1	14	8	23	35%	96%
79. Develop standard work and procedures for RFID-tagged controlled substances that require a secondary NDC for scanning in/out of vault.	0	5	12	6	23	26%	78%
80. Develop procedures that account for activation of RFID tags on products, trays, kits.	0	1	17	5	23	22%	96%
81. Design standard optimization reports to ensure PAR levels reconcile with utilization.	0	2	14	7	23	30%	91%
82. Enable interoperability across technology vendors to connect RFID (e.g., EHR, BCMA, billing platforms) to impact efficiency and decrease errors.	0	0	4	19	23	83%	100%

RECOMMENDATION	Response (Count)					Agreement (%)	
	Strongly Disagree	Disagree	Agree	Strongly Agree	Total	Strongly Agree	Agree + Strongly Agree
83. Collaborate with partners to standardize formulary and processes for RFID-tagged medications or trays/kits that are managed via central fill/shared distribution sites (e.g., deployment to a hospital/ASC and deployment within the final site).	0	0	16	7	23	30%	100%
84. Evaluate utility of RFID report opportunities for managing medication recalls.	0	1	11	11	23	48%	96%
85. Outline standard work for visual scanning of returned trays/kits for used products.	0	4	12	7	23	30%	83%
86. Develop master list of beyond-use dates for refrigerated items frequently incorporated in RFID processes.	0	6	8	9	23	39%	74%
87. Develop standard work for managing expiration dates in RFID-tagged inventory.	0	1	13	9	23	39%	96%
88. Implement tracking of BUDs from point of initial activation of RFID tags to the unit-of-use level.	0	1	16	6	23	26%	96%
89. Develop standard work process for activation of RFID tags on products, trays, kits.	0	0	14	9	23	39%	100%
90. Develop criteria for selection of products to be RFID-tagged (e.g., high-cost/patient-specific).	0	4	10	9	23	39%	83%
91. Develop a centralized database for beyond-use date or expiration dating standards for products when they are removed from their external package and tagged (i.e., removed from overwrap, box).	0	6	9	8	23	35%	74%
92. Establish a prompt within the technology that alerts nurse on their screen that a patient-specific medication has been delivered or a medication has been delivered to a patient-specific bin.	0	3	10	10	23	43%	87%
93. Utilize technology to ensure medication follows patient throughout the organization when a patient location changes.	0	0	14	9	23	39%	100%
94. Evaluate organizational policies on dispensing inpatient RFID-tagged patient-specific medications being dispensed upon discharge.	0	6	10	7	23	30%	74%
95. Explore RFID technology use in home/outpatient settings to document patient home-use/adherence.	0	5	13	5	23	22%	78%
96. Leverage RFID to alert staff when patient is discharged allowing for patient-specific medications to be returned to the pharmacy.	0	3	14	6	23	26%	87%
97. Create a visual alert when anesthesia providers remove a medication from the tray/kit for patient use.	0	5	15	3	23	13%	78%
98. Assess optimal cart, cabinet and scanning equipment locations that are RFID enabled.	0	1	12	10	23	43%	96%
99. Work with OR/procedure area team to identify formulary of non-pharmaceutical supplies found in trays to be tagged to allow for all items being RFID-tagged.	0	4	11	8	23	35%	83%
100. Investigate place for RFID in areas where BCMA is not currently optimized.	0	1	15	7	23	30%	96%
101. Implement OR restocking process that utilizes RFID scanning over visual scan.	0	1	11	11	23	48%	96%

APPENDIX D. PRIORITIZED RECOMMENDATIONS

POLICY, STANDARDS, AND REGULATIONS

Prompt: Select Your Top Priority	Tally
32. Create a standardized icon across manufacturers and distributors that indicates that a medication is pre-tagged with RFID.	6/23
47. Initiate discussions with federal agencies/regulators (e.g., FDA, CMS) regarding the future of RFID in the medication-use process.	7/23
70. Assess role of RFID in assisting organizations with becoming compliant with the Drug Supply Chain Security Act (DSCSA). *(Edited item, includes 62 and 13)*[1]	8/23
73. Standardize the terminology related to RFID: pre-tagged vs. encoded tags.	2/23

WORKFLOW

Prompt: Select Your Top 3 priorities	Tally
26. Establish standard process for RFID checking that prevents interruptions mid-process.	4/23
29. Establish process for handling pre-tagged drugs now on shortage or recalled.	6/23
43. Outline standard work for how a master template would be changed/adapted in a timely manner in the event of a drug shortage.	3/23
59. Identify adequate space for RFID-tagged inventory are stored, in central pharmacy or decentralized areas.	5/23
60. Establish clear quarantine process that clearly delineates non-checked tagged items from checked tagged items. *(edited, combined with 61, 64, and 77)*	17/23
65. Develop procedure for adding new formulary line items and/or NDC numbers into RFID process.	3/23
72. Outline processes for both physical/manual, and electronic receiving of inventory.	9/23
80. Develop procedures that account for activation of RFID tags on products, trays, kits. *(edited, combined 89)*	5/23
88. Implement tracking of BUDs from point of initial activation of RFID tags to the unit-of-use level.	16/23

1 Notes in parentheses by some items explain the edits to the original survey items included in Appendix C.

STAKEHOLDER ENGAGEMENT

Prompt: Select Your Top 3 Priorities	Tally
1. Package or purchase doses in unit-of-use that are pre-tagged.	8/23
3. Create a national database of available pre-tagged items from manufacturers and distributors. *(Similar to item 30)*	4/23
6. Advocate for tags to be sized in such a way as to not obstruct pertinent information (e.g., barcode, drug name/strength) on small unit-of-use products.	6/23
13. Work with vendors to develop reports that generate useful data for various end users. *(edited, combined 84)*	5/23
15. Work with vendors to design ways for RFID or other technologies to seamlessly capture administration in the electronic health record. *(edited, combined 23)*	8/23
20. Work with vendors to optimize interoperability of multiple systems. *(edited, combined 22, 24, and 82)*	17/23
33. Create systems that support local-level customization by user within software (i.e., new NDCs, kit templates, shortage management).	3/23
34. Advocate for standardization of RFID tags so they can be read across vendors (i.e., one vendor's tags can be read by another vendor's tag reader). *(edited, combined with 52)*	18/23
51. Standardize RFID tagging decisions based on medication in an effort to allow organizations within regional area to share standard work for Ambulance/EMS boxes/kits.	1/23
75. RFID management software to be customizable, including managing staff permissions.	2/23
83. Collaborate with partners to standardize formulary and processes for RFID-tagged medications or trays/kits that are managed via central fill/shared distribution sites (e.g., deployment to a hospital/ASC and deployment within the final site).	0/23

REPORTS, ANALYTICS AND OUTCOMES

Prompt: Select Your Top Priority	Tally
49. Provide use cases, tracking opportunities, and safety implications of RFID in a way that can be shared across disciplines.	8/23
53. Trial RFID in a real-world environment to determine ROI, including efficiency and safety.	7/23
64. Collect data to enable organizations to optimize RFID-enabled medication management, including details on specific medications, unit-of-use, and PAR levels.	3/23
69. Design a real-world time and labor study of tagging and deployment of RFID.	5/23
81. Design standard optimization reports to ensure PAR levels reconcile with utilization.	0/23

WORKFORCE, TRAINING AND TOOLS+

Prompt: Select Your Top Priority	Tally
2. Standardize RFID tag placement directly to the final product (i.e., tag affixed directly to a vial vs. the outer box). *(edited, combined 8 & 67)*	2/22
5. Develop training materials for frontline staff across disciplines regarding RFID. *(edited, combined with 25)*	16/22
39. Develop an RFID FMEA template with question prompts that potential adopters can utilize to identify failure modes. *(edited, combined with 44)*	1/22
41. Develop an RFID start-up guide for organizations that includes training checklists and environmental checklists.	2/22
45. Identify failure modes and opportunities throughout your systems that RFID could be utilized as part of the solution. *(edited, combined 48)*	0/22
46. Identify process for optimizing tech-check-tech opportunities in states that allow this practice.	1/22
+ Due to few overall recommendations in this domain, any with high votes were incorporated into a different section of the report	

SPECIAL USE CASES+

Prompt: Select Your Top Priority	Tally
68. Develop mechanism to efficiently program and deploy patient-specific active tags. *(edited, combined 93)*	6/23
71. Establish points of entry location (e.g., door, box) that becomes a passive tag reader as RFID-tagged products enter the organization, logs them into inventory, and put into stock. *(edited, combined with 61, 63)*	5/23
78. Establish guidelines for storage of controlled substances with and without RFID tags within locked/ monitored storage areas.	3/23
+ Due to few overall recommendations in this domain, any with high votes were incorporated into a different section of the report.	

ENDNOTES

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About the ASHP Foundation

The ASHP Foundation was established in 1968 by ASHP as a nonprofit, tax-exempt organization. As the philanthropic arm of ASHP, the Foundation shares ASHP's vision that medication use will be optimal, safe, and effective for all people all of the time. Our mission is to support ASHP by advancing the professional practice of pharmacists and the pharmacy workforce by funding research and education that improves health outcomes through optimal, safe, and effective medication use. To learn more about the Foundation's programs, visit **ashpfoundation.org**.

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