Healthcare Distribution Alliance (HDA) Saleable Returns Pilots Report

The Healthcare Distribution Alliance (HDA) represents primary pharmaceutical distributors — the vital link between the nation's pharmaceutical manufacturers and more than 200,000 pharmacies, hospitals, long-term care facilities, clinics and others nationwide. Since 1876, HDA has helped members navigate regulations and innovations to get the right medicines to the right patients at the right time, safely and efficiently. The HDA Research Foundation, HDA's non-profit charitable foundation, serves the healthcare industry by providing research and education focused on priority healthcare supply chain issues. For more information, visit www.hda.org.

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EXECUTIVE SUMMARY

Beginning in 2019, the Drug Supply Chain Security Act (DSCSA) will significantly alter how wholesale distributors must process serialized saleable pharmaceutical returns from customers. Before it can resell a return, a wholesale distributor will have to verify that the identifier on the product corresponds to the standardized numerical identifier the manufacturer assigned and a manufacturer will have to respond within 24 hours to a verification request. According to an HDA member survey, saleable pharmaceutical returns comprise 2 to 3 percent of total sales annually — or nearly 59 million units. Given the volume of returns that wholesale distributors must process, HDA, working with Ernst & Young LLP (EY) and HDA's Traceability Pilots Work Group (Work Group) evaluated nine real-life scenarios or methods that could theoretically be employed to help meet the 2019 saleable returns requirements. Seven pharmaceutical manufacturers and six wholesale distributors from the Work Group participated in the pilots. The hope was that the results of the pilot study would allow stakeholders to reach consensus on which solution(s) would work best. The Work Group held seven workshops in which participants systematically assessed the impact of the scenarios upon manufacturers and wholesale distributors in terms of processes, cost, work, and technology. The objectives of the pilots were to:

- Provide data to the Food and Drug Administration (FDA) to illustrate the realities faced by manufacturers and wholesalers in processing and verifying saleable returns under the DSCSA.
- Demonstrate that manufacturers and wholesalers are taking the DSCSA requirements seriously, and are actively working to incorporate them into routine business processes.
- Illustrate to FDA and other members of the supply chain the relative practicality of possible methods for returns verification.
- Begin the process of building consensus on likely approaches that will work without adding significant burden to the supply chain.

The Work Group presented the results of its Pilot Study for Saleable Returns at HDA's Traceability Seminar in Washington, D.C. (held November 9-11, 2016), recommending two scenarios that it believes would help pharmaceutical manufacturers and wholesale distributors comply with the DSCSA requirements. The Work Group determined that these two scenarios were the most cost-effective and viable approaches to verifying saleable returns.

In the Work Group's first recommended option, a manufacturer sends to each individual wholesale distributor customer aggregated product identifier information for only the units of product that the manufacturer sold to that individual wholesale distributor; when the wholesale distributor processes a saleable return, the wholesale distributor references an internal database that it created from the information provided by the manufacturer to verify the product identifier information.

The second option the Work Group recommended employs a verification router service. In this scenario, each manufacturer stores all of its product identifier information in a local database, which is connected to a third-party routing service. Upon receiving a saleable return, the wholesale distributor captures the product data and sends the data to this third-party router service, which then routes the query to the appropriate manufacturer's database to verify the product's identifier.

HDA is forming a task force to develop technology requirements for the verification router service outlined in the second recommended scenario.

The Work Group recognizes there is no single method to comply with the 2019 requirements. Members of the supply chain should begin discussing the requirements internally and with external trading partners to determine what methods are most practical for compliance.

BACKGROUND

The Drug Supply Chain Security Act (DSCSA)

The Drug Supply Chain Security Act (DSCSA), enacted on November 27, 2013 in Title II of the Drug Quality and Security Act (DQSA), aims to help combat the threat of pharmaceutical diversion by enhancing the traceability of prescription pharmaceutical products in the U.S. The DSCSA amends the federal Food, Drug and Cosmetic Act (FDC Act) [1] to establish an interoperable electronic system for the identification and tracing of individual units of certain prescription drugs.

This legislation, which preempts state and local laws, mandates that all trading partners in the supply chain be authorized and hold appropriate licenses or registrations, details requirements for verification procedures and prescribes requirements for information necessary to identify and trace the distribution of prescription products down to the smallest unit intended for sale to a dispenser. That system is to be implemented in stages over the next seven years across the entire pharmaceutical supply chain. By November 27, 2023, each package of applicable prescription drug product must bear a product identifier,[2] which includes a unique serial number[3] that will link each saleable product unit to the selling and purchasing sources of the product in a secure, interoperable, electronic system [*See* § 582(g)(1)].

One important milestone in the progress towards the 2023 deadline and full product traceability begins on November 27, 2019. Starting on that date, each wholesale distributor is required to "verify" the product identifier on each unit (or sealed homogenous case) returned that the wholesale distributor seeks to resell.

Saleable returns requirements

Beginning on November 27, 2019, before it may resell a returned product, "the wholesale distributor ***shall verify*** the product identifier, including the [SNI] … for each sealed homogeneous case or on each package" [§ 582(c)(4)(D) (emphasis supplied)]. "Verification" or "verify" "means determining whether the product identifier affixed to, or imprinted upon on a package or homogeneous case corresponds to the [SNI] … assigned to the product by the manufacturer or the repackager…."[4] [§ 581(28)]. A

[1] Citations that follow to sections 581 and 582 refer to sections of the FDC Act as amended by the DSCSA and are codified at 21 U.S.C. § 360eee and §360eee-1, respectively.

[2] The product identifier requirement begins November 27, 2017, by which time manufacturers must affix or imprint a product identifier to each package and homogenous case intended to be introduced in a transaction into commerce [§ 582(b)(2)(A)]. Repackagers must affix product identifiers a year later, by November 27, 2018.

[3] The product identifier is a standardized graphic in human-readable form and on a machine-readable carrier that conforms to international standards and includes the product's unique standardized numerical identifier (SNI), lot number and expiration date [§ 581(14) (definition of product identifier); § 581(20) (definition of SNI)].

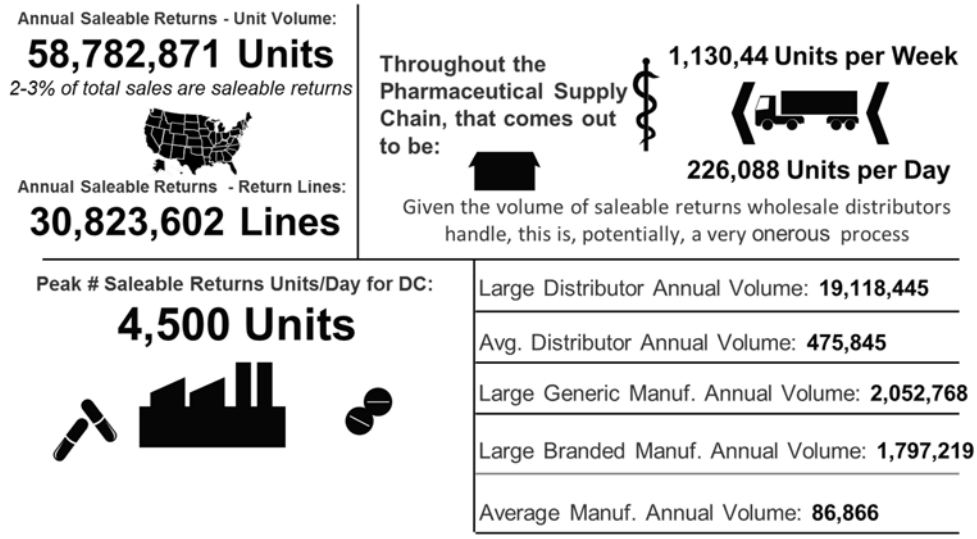
[4] Section 581(28) also permits verification of a product identifier by "lot number and expiration date." However, once all product is serialized, there would be no reason for trading partners to verify product by lot number and expiration

manufacturer who receives a verification request from a repackager, wholesale distributor, or dispenser must respond to that request within 24 hours (or such other time FDA establishes) [§ 582(b)(4)(C)]. A repackager also has 24 hours to respond [§ 582(e)(4)(C)].

The Challenge of Verifying Saleable Returns

According to the *HDA Factbook: The Facts, Figures and Trends in Healthcare (2016–2017)*, in 2015 nearly 94 percent of all U.S. pharmaceutical sales went to market through wholesale distributors. Each business day, national, regional and specialty wholesale distributors deliver more than 15 million prescription medicines and other healthcare products to pharmacies and other healthcare customers. And, according to data from the *HDA Factbook* and a 2015 survey HDA conducted, approximately 2 to 3 percent of the pharmaceuticals that wholesale distributors sell to their customers are returned, with approximately 94 percent of those returned units being deemed acceptable for resale.[5]

Wholesale distributors receive approximately 58.7 million units of saleable returns per year, amounting to about 226,000 units per day. Thus, wholesale distributors could be making more than 225,000 verification requests to manufacturers every day. Given this volume of saleable returns, the 2019 DSCSA verification requirement will significantly impact the U.S. pharmaceutical supply chain, and compliance will require process changes to verify saleable returns without adversely affecting supply chain efficiencies and the timely distribution of lifesaving drugs.



date when the product identifier (which includes the SNI, lot number, and expiration date (§ 581(14)) would be more accurate and efficient.

[5] Wholesale distributors' resale of intact, unused pharmaceuticals that they receive back from their dispenser customers is a longstanding, secure business practice that benefits patients and the supply chain by significantly reducing pharmaceutical waste and costs. The DSCSA specifically contemplates continuation of this practice and puts measures in place, including the verification requirement, to assure product integrity and continued supply chain security.

The HDA Pilot Study

To better understand the operational impact of the 2019 verification requirements, and how the industry can best meet these requirements, HDA sponsored a pilot study. The following manufacturer and wholesale distributor members of HDA formed a Traceability Pilots Work Group (Work Group) to conduct the pilot study:

Manufacturers	Wholesale Distributors
Abbvie	AmerisourceBergen
Apotex	Cardinal Health
Astellas	H. D. Smith
Eisai	McKesson
Genentech	North Carolina Mutual Wholesale Drug
GlaxoSmithKline	R&S Pharmaceutical Wholesaler
Johnson & Johnson	Value Drug Company
Merck	
Novartis	
Otsuka	
Perrigo	
Pfizer	
Upsher-Smith	

Note: Not all companies listed participated in live pilot exercises.

The objectives of this pilot were to gain first-hand, real-world experience with the processes and technologies that would be required to effectively manage saleable returns from the dispenser to the wholesale distributor and conduct the required verification of product identifiers. The pilot study would identify, examine, evaluate, document and quantify the feasibility, efficiency and relative burdens and benefits of different methods for meeting the 2019 verification requirement.

The Work Group identified nine potential methods (or scenarios) for performing saleable returns verification (Fig. 1). Four scenarios, hypothesized to be the most feasible and efficient solutions, were executed as live pilots and involved significant coordination between trading partners. Two scenarios were executed as live desktop scenarios at a Work Group meeting on June 8–9, 2016. The remaining three scenarios were evaluated as white papers. The output of all pilots included a general evaluation of probable costs, effort, implementation considerations, and advantages and disadvantages from both manufacturer and wholesale distributor perspectives to allow for objective comparisons between and among scenarios.

The purpose of this report is to discuss the Work Group's findings regarding the advantages and disadvantages associated with each scenario for the benefit of the whole supply chain. Thus, the Work Group's findings take an industry-wide approach.

As will be discussed, certain verification methods that were piloted were shown to be more efficient than others. However, HDA and the Work Group collectively emphasize that no single verification method is being advocated as an industry-wide solution to

meet all verification needs. The advantages, disadvantages and relative costs of the different scenarios will not be the same for each business or for all of a businesses' products and transactions. It is likely that multiple verification processes will be utilized by trading partners to assure DSCSA compliance.

Assumptions in the HDA Pilot Study

In the conduct of the pilots, the Work Group participants had to agree upon numerous assumptions. These are addressed briefly below.

Only 2019 requirements are considered

All advantages, disadvantages and costs described for each scenario are associated with trading partner compliance with the DSCSA's 2019 verification requirements for saleable returns. The pilot and the Work Group's findings do not address advantages, disadvantages and costs associated with compliance with other DSCSA requirements, such as affixing product identifiers, assuring that trading partners are authorized, and the passing and maintenance of Transaction Information (TI) and Transaction Statements (TS).

Direct purchases

All scenarios tested assumed direct purchase transactions. That is, the manufacturer sells directly to the wholesale distributor who, in turn, sells directly to a dispensing customer who, in turn, returns the unit purchased to the selling wholesale distributor for credit. Because direct purchases and direct sales are assumed, it is also assumed that a wholesale distributor is able to accept the return from its customer for possible resale and that it can associate the product with the TI and TS for that product as required by the DSCSA. [*See* § 581(17) (definition of return); § 582(c)(1)(B)(i)(II) (associating return with TI and TS)].

Accomplishing "Verification"

The Work Group believes that, in the absence of other guidance to the contrary, the DSCSA may reasonably be interpreted as permitting a wholesale distributor to verify a return via any means so long as the definition of "verification" in § 581(28) is met; that is, the wholesale distributor is able to "determin[e] whether the product identifier affixed to, or imprinted upon on a package or homogeneous case corresponds to the [SNI] … assigned to the product by the manufacturer or the repackager…."

All of the scenarios assume that the particular method piloted allows for the wholesale distributor to make this determination by verifying a product identifier against a reliable source of the manufacturer's serialized data. All scenarios, therefore, are presumed to meet the DSCSA's definition of "verification" and meet the DSCSA requirements for 2019.

Other Important Observations from the Pilot

Scannable 2D bar codes, aggregation and inference

In order to maintain efficiencies and acceptable levels of through-put in the distribution chain, trusted supply chain partners may need to rely upon “aggregation” and “inference.” FDA may consider aggregation and inference in its guidance development, but has not defined or mandated the use of either to date.

Aggregation is commonly understood to be the collecting of units or parts into a mass or a whole. In the healthcare supply chain this term refers to the process of creating a data hierarchy whereby the product identifiers for individual product packages (unit level) are gathered and associated with the identifier for the larger shipping container (pallet, case, tote, etc.) for those products.

Inference in the healthcare supply chain refers to the ability of supply chain partners to apply business practices and efficiencies that exist today to DSCSA compliance and the task of recording serialized (uniquely identified) items in shipping and receiving processes. Inference applies in instances when a collection of units is moved through the supply chain in an outer container (*e.g.*, pallets, cases, totes, etc.), and less than 100 percent of data carriers in that collection are read by recipients.

In the pilots, the manufacturer participants all encoded their product identifiers in a 2-dimensional (2D), Data Matrix, scannable bar code. However, for wholesale distributors, this presents challenges because 2D Data Matrix bar codes use “line-of-sight” technology and a scanner cannot read multiple units or bar codes at one time to capture product information. Given the very high volume and pace of prescription drug distribution, scanning each individual product package that a wholesale distributor receives from a manufacturer is not practical or economically feasible. Wholesale distributors cannot maintain acceptable levels of security and rapid service to customers unless they are able to infer the contents of sealed cases upon receipt from manufacturers.

The scenario in which a manufacturer sends purchased unit product identifiers to respective wholesale distributors, creating an internal database against which verification requests were made, incorporated and tested aggregation and inference. The Work Group’s findings regarding aggregation and inference are included in its discussion and report of that scenario.

Interoperability and data standards

The Work Group believes that all scenarios tested would meet the DSCSA’s verification requirements for 2019. However, the Work Group also concluded that many of the scenarios tested ***would not*** satisfy the DSCSA’s requirements ***for 2023***. The DSCSA requires that, by November 27, 2023, all data between trading partners be exchanged in a secure, electronic, interoperable manner [§ 582(g)(1)]. As discussed in the reports, some of the methods piloted achieve verification, but do not involve the exchange of data between manufacturers and wholesale distributors in a secure, electronic manner.

One hurdle to electronic, interoperable verification systems is that the process requires transmission of the SNI to the verifying party or to a database that maintains the manufacturer's serialized identifiers. However, there is no data standard for the transmission of the SNI between trading partners. The Work Group believes that GS1's Electronic Product Code Information Services (EPCIS) may be an acceptable, and commonly used, data standard to support the verification process.

Concerns about unserialized products and serialized products without associated data

Manufacturers must serialize products by November 27, 2017 and repackagers by November 27, 2018; wholesale distributors must begin verifying saleable returns by November 27, 2019. However, a significant percentage of products have shelf-life/expiration dating extending well beyond two years. Also, manufacturers and repackagers are not required to provide wholesale distributors with the data associated with those product identifiers (as a part of TI) until 2023.

Because the DSCSA is implemented in these stages, for some period of years, product will be moving in the supply chain that is not serialized, or is serialized but is not accompanied by product identifier data when it is sold. These products will be moving forward in the supply chain to dispensers and be returned by dispensers to their wholesale distributors for many years. These implementation realities will complicate compliance with the verification requirement.

On a related note, FDA is required under the DSCSA to issue guidance regarding the "grandfathering" of products not bearing identifiers already in the supply chain at the time the requirements of § 582 go into effect [§ 582(a)(5)(A)]. For manufacturers and wholesale distributors, the phase-in period will present challenges. FDA's forthcoming grandfathering guidance will be critical to a smooth transition.

Outsourcing verification

Given the complexity of verification, the Work Group believes that some manufacturers and wholesale distributors may elect to outsource verification to third-parties. Trading partners considering this option will need to take into account the challenges of outsourcing, as well as its perceived benefits. Using third-parties for verification may be more efficient in certain respects, but may also add complexity, time and coordination effort, particularly to resolve exceptions.

Contract manufacturing

Pharmaceutical manufacturing is complex, with many application holders relying upon other entities, including contract manufacturing organizations (CMOs), labelers, packagers and repackagers, to produce their products. As with use of third-parties for verification, manufacturers using CMOs will need to closely coordinate with their CMOs in order to assure that bar codes are readable, that data transmitted by a CMO for verification purposes are being sent correctly, and that the CMO will be able to provide timely verification responses.

Scenario Reports

After conducting the live, desktop and white paper pilots, the Work Group authored reports on each of the pilot scenarios using the following criteria:

- Accuracy
- Compliance
- Cost
- Data access
- IT availability
- Risk/security
- Physical space considerations
- Solution complexity
- Scalability
- Speed/time

The scenario reports that follow (laid out in the chart below organized by type of pilot) present an overview of each scenario's advantages and disadvantages from manufacturer and wholesale distributor perspectives, cost considerations and an overall conclusion based on the views of the Work Group.

	Scenario Description
Live Pilots	Manufacturer sends purchased unit product identifiers to respective wholesale distributor, which creates an internal database against which verification requests will be made
	Central repository- each manufacturer sends all product identifier data to a central database which wholesale distributors access for verification
	Wholesale distributor scans product on outbound and creates internal database against which verification requests will be made
	Verification router service- distributor query is routed to appropriate manufacturer database
Desktop Pilots	Distributor accesses each manufacturers database through a portal
	Distributor manually confirms with manufacturers at time of return via phone or email
White Paper Pilots	Manufacturer sends to each direct purchase wholesale distributor the product identifiers for all units shipped within the U.S. to all direct purchase distributors
	Verification services- distributor builds point-to-point interfaces to each manufacturer's verification service, which automatically returns a verification response
	Distributor scans all purchased product identifiers on inbound receipt and creates internal database against which verification requests will be made

LIVE PILOTS

Manufacturer sends purchased unit product identifiers to respective wholesale distributor, which creates an internal database against which verification requests will be made

In this scenario, the manufacturer sends to each individual wholesale distributor aggregated product identifier information for only the products purchased by that wholesale distributor. The distributor then generates an internal database with the product identifiers. Upon receiving a saleable return, the wholesale distributor is able to reference the internal database to verify the product identifier information (SNI, lot number and expiration date).

Manufacturer Perspective

Advantages:

- This scenario would reduce the need for manual communication between immediate trading partners since product identifier information is being communicated to the wholesale distributors, who can use the information to perform verification.
- There is no industry-wide, single point of failure as in other, centralized scenarios.

Disadvantages:

- Manufacturers would have to manage data transmission to trading partners.
- Aggregation needs to be implemented to associate product identifiers with specific customer shipments, both on packaging lines and in the distribution center.
    - Manufacturers who have decided not to aggregate until 2023 will not be able to utilize this solution, or will need to change their timing and scope of work for implementation of aggregation in advance of 2019.
- EPCIS solution must be implemented earlier than previously anticipated.
    - Significant improvement in data standards and communication are critical for this method to be successful.
    - All participants must align on adherence to public data exchange standards (EPCIS), including versions, required vs. optional data field population, etc.
        - Must configure system to allow for backwards EPCIS compatibility
- Manufacturers will not have provided product identifier information to non-direct purchasers. Without access to product identifier information, non-direct purchasers would not be able to verify their saleable returns. An additional solution may be required for non-direct purchasers to verify saleable returns.

Wholesale Distributor Perspective

Advantages:

- Since product identifier information is captured and stored internally by the wholesale distributor, the risk of external latency issues and dependence on external bodies (coordinating with manufacturers) for verification is eliminated.
- Reduces the need for ongoing manual communication. The data is readily available to expedite the verification process.
- No dependency on manufacturer look-up (GTIN cross-references); reduces complexity with co-marketed/co-licensed products.
- This scenario potentially provides a scalable solution to support DSCSA requirements in 2023, which will lead to additional learnings ahead of the required timeline.
- There is no industry-wide, single point of failure as in centralized scenarios.

Disadvantages:

- EPCIS solution must be implemented earlier than previously anticipated.
    - Significant improvement in data standards and communication are critical for this to be successful.
    - All participants must align on adherence to public data exchange standards (EPCIS) including versions, required vs. optional data field population, etc.
        - The system must be configured to allow for backwards EPCIS compatibility.
- Data storage requirement is significantly higher in this scenario versus alternatives like the central database or verification router service where data is stored by the manufacturers or a central database.
- Manufacturers will not have provided product identifier information to non-direct purchasers. Without access to product identifier information, non-direct purchasers would not be able to verify their saleable returns. An additional solution may be required for non-direct purchasers to verify saleable returns.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Aggregation (infrastructure, technology, process implementation, etc.) • Negative aggregation overall equipment effectiveness (OEE) impact of 10+ percent • Development and adoption of a new, custom transaction set to pass data • Installation of packaging and distribution equipment to support aggregation		• Establishment of accessible database of product identifiers for data transmission • Initial impact due to process changes • Configuring system to allow for backwards compatibility (EPCIS 1.0 vs. 1.1)

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Cost of data storage • Maintaining and updating point-to-point connections between each manufacturer and their wholesale distributors; cost is significant as compared to a scenario that employs a single, central repository or router to link databases • Impact to operational efficiency (4-5 percent loss) to support aggregation in packaging and distribution	• Ongoing, increasing cost of data storage for receiving product identifier information	• Increasing costs associated with third-party, pay-per-transactions. • If point-to-point connections are not owned by the direct trading partners and a Software as a Service (SaaS) is used, recurring costs of data transmission and usage fees may apply

Conclusion

In this pilot, manufacturers and wholesale distributors were able to successfully communicate data. However, significant improvement in adherence to data standards and communication are critical for this solution to be successful. Interoperability was the most significant hurdle in execution of this scenario. Keys to success include improvement as an industry in following common guidance, aligning between system versions, being consistent in definition of critical data fields, and employing universal/convertible data formats. As an example, when “optional” data fields from one version of EPCIS were fed into another version where the fields were “mandatory,” the system failed and data exchange was not possible. For this scenario, it is important for trading partners to adopt the same version of EPCIS to facilitate consistent data exchange.

Importantly, the data exchange in this scenario eliminates the risk associated with a single point of failure, since each manufacturer sends its data independently to its direct wholesale distributors. There is no dependency on GTIN cross-references.

This scenario is unique among the scenarios proposed for compliance with the 2019 saleable return verification requirement in that it is the only scenario that requires aggregation by manufacturers. The scenario requires that a manufacturer send the product identifiers for only the units the wholesale distributor purchased directly to each wholesale distributor. In the pilot, each manufacturer provided aggregated data for the units the wholesale distributor purchased and the wholesale distributor inferred the contents of sealed cases and pallets from those aggregated data in order to create an internal database against which it verified returned units. This solution will pose a challenge for manufacturers who are not prepared for the cost or effort to upgrade packaging lines and distribution centers to implement aggregation in advance of 2019. The Work Group further concluded that deferring aggregation could benefit some manufacturers and wholesale distributors by allowing them to defer implementing EPCIS and the associated IT investment and data storage. Additionally, this would allow manufacturers to defer investment in upgrading production or packaging lines to allow for aggregation. However, those who are able to adopt aggregation ahead of 2023 interoperability requirements may benefit from implementing the process early and capturing learnings.

Since this scenario only requires data transmission from the manufacturer to the direct purchase wholesale distributor, another solution will need to be used by non-direct purchase wholesale distributors for saleable returns verification.

Central repository- each manufacturer sends all product identifier data to a central database which wholesale distributors access for verification

In this scenario, each manufacturer sends product identifier information for all units shipped within the U.S. via real-time point-to-point connection to a centralized database, which is created and maintained by a third-party. Wholesale distributors will also have access and, upon receiving a return, the wholesale distributor must collect the product identifier information and verify against the centralized database. This collection and parsing of data can either be done automatically via scanners that are connected to the database, or via manual data entry of the product identifier. This scenario differs from other related scenarios in that wholesale distributors access each manufacturer's product identifiers that are stored in a single database and managed by a third-party, not the manufacturers.

Manufacturer Perspective

Advantages:

- Provides a single verification method for the industry (including non-direct purchasers) and is a potentially scalable solution for 2023 requirements.
- This scenario would reduce the need for manual communication between immediate trading partners since all product identifier information is being verified automatically.
- This solution is both automated and direct between wholesale distributors and manufacturers, and eliminates the need for complicated interfaces.
- Provides a solution if manufacturer doesn't have the internal infrastructure to support serialized data.
    - The manufacturer sends the data in a simplified format.
    - The manufacturer has the option to continuously parse the data to the central repository or upload in larger batches.

Disadvantages:

- There is a single point of failure in this scenario. If the database, or intermediary network, experiences a system-wide outage, all manufacturer data will become unavailable to wholesale distributors.
- Challenges may exist in determining the governance, ownership, funding and establishment of the centralized database.
- This model has been executed in a similar fashion in various countries (*e.g.*, China, Turkey), however, no such solution exists in the world today that can support the storage of the U.S. volume (approximately 25-30 billion records over a six-year period).
- A standard data format is required for all parties to accurately translate the data for verification purposes.

- A standard query interface and/or batch-type upload must be developed to transmit new/updated data to the database as it evolves.
- Changes in marketing authorizations (changes in product ownership between manufacturers), mergers and acquisitions (M&A) activity, product divestitures, co-marketed/co-licensed product, etc., would challenge historical product data coordination between the parties.
- Sharing and storing all product identifier information in a centralized database puts manufacturer data at risk for significant abuse within the supply chain, including the theft of batch yield information, sales information, GMP critical data, etc.

Wholesale Distributor Perspective

Advantages:

- Since the database contains all data stored in a single database, the response time is highly optimized.
- Like the manufacturers, wholesale distributors also would benefit from the reduced need for manual communication between immediate trading partners, since all product identifier information is being verified automatically.
- Full product data for all product distributed is not needed; rather, only verification data for queried product are exchanged, therefore, wholesale distributors have reduced storage requirements.
- Wholesale distributors will not have to maintain manufacturer lookups (GTIN cross-references), as this is a centralized solution and only one point-to-point connection is required per entity.
- This solution is viable for non-direct purchase wholesale distributors because the database, not the manufacturers, will have control over access and permissions.

Disadvantages:

- There is a single point of failure in this scenario. If the database, or intermediary network, experiences a system-wide outage, all manufacturer data will become unavailable to wholesale distributors.
- Challenges may exist in determining the governance, ownership, integration and management of a centralized database.
- Wholesale distributors require current and accurate data for verification. If a manufacturer does not upload its product identifier information to the centralized database in a timely manner, wholesale distributors will be unable to verify saleable returns and suffer negative impacts to their operations.
- Each wholesale distributor would have to establish and manage their respective secured connection to the centralized database.
    - As this is an external solution, latency risks to operation exist for wholesale distributors.

- Query interface and data format standards must be established and updated as the standards evolve.

Live Pilot IT Technical Execution

To build the testing environment, a centralized database was developed using open-source technologies, and was hosted on *Microsoft Azure,* a cloud-based service platform. Manufacturers supplied SNI data manually, by way of a QuickForm spreadsheet, which was imported into the database. These data were indexed and optimized for fast response times.

The database's Application Program Interface (API) endpoint was developed using an open-source framework called *Slim*, which was selected because of its simplicity and promotion of faster processing speeds. High processing speeds were further enabled by using Secure Sockets Layer (SSL) to establish a secure link between the database and each wholesale distributor.

According to the functional specifications as defined by all pilot participants, the wholesale distributors needed the ability to send *RESTful* (data exchange language) requests to the database's endpoint and parse the response, which used a *JSON* format, as it enabled faster processing speeds. This was demonstrated as response times were almost immediate and the database remained live, without any outages.

Depending on the level of IT maturity of the participants, delays were observed when establishing the wholesale distributor client certificates, which are used by client systems to make authenticated requests to a remote server. While requests were still secure (over SSL), this was not a necessity for the pilot program. However, for optimum security in a scalable solution, each wholesale distributor will need to install a signed certificate.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Developing manufacturers' standard data format and query interface • Creating the infrastructure and processes to parse product identifiers to the centralized database	• Establishing new, real-time point-to-point connections, which are validated and secure; includes establishing point-to-point connections to the database • Developing wholesale distributors' query requests	• Design, build, test and go-live elements for the real-time point-to-point connections are required. • Implementation timelines are subject to variation, as they are dependent on the capability and

		experience of the trading partners.

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
		• Maintaining security certificates to establish two-factor connections with the database o Prior experience will result in differing degrees of difficulty for each trading partner. • Full production solution will need to manage all industry return data volume (~30 billion records) to satisfy DSCSA record retention requirements, and withstand multiple entities pinging the system simultaneously. • As the composition of the industry changes, new point-to-point connections would need to be established and updated to verify saleable returns.

Conclusion

During the execution of the live pilot, this scenario generated the fastest verification speeds of the external solutions and met the goal of sub-second verification. Combined with the automatic query of manufacturer product identifier information via secured point-to-point connections, manual processes were eliminated for both parties, contributing to the solution's attractiveness. There is also no dependency on GTIN cross-references.

While the data is not owned and maintained by the manufacturer and is subject to security and access risks, the automated access points downplay such concerns, as all parties must maintain security certificates for two-factor authentication.

Furthermore, in the world market today, a number of countries (*e.g.*, Turkey, China, etc.) have implemented centralized databases for their respective pharmaceutical industries, demonstrating the solution's viability. However, these countries have significantly lower data volume needs than the U.S. market. To be able to handle the volume required, the solution must have the capability to auto-scale to request loads, with fail-safes and redundancies in place to support such demands.

Despite the automation and security benefits of this concept, the centralized database poses many challenges, the largest being the ownership, governance, funding and establishment of the centralized database, which would have to be overcome in order to implement this scenario as an effective and sustainable industry-wide solution. In addition, the associated setup and maintenance costs are vast. Finally, this solution has a single point of failure which, in the event of a critical malfunction, would prohibit the upload and verification of product identifiers, jeopardizing efficient saleable returns processing. Missing the 24-hour deadline is important, of course, but if sub-second responses are not achieved, the viability of saleable returns processing may be jeopardized.

Wholesale distributor scans product on outbound and creates internal database against which verification requests will be made

In this scenario, the wholesale distributor scans the sealed homogeneous case or smallest saleable unit product identifier on outbound. When the product identifier is scanned, the product identifier information is stored in an internal database. As saleable products are returned, the wholesale distributor verifies the product identifier(s) against its internal database.

Manufacturer Perspective

Advantages:

- This scenario is less complex and less costly to manufacturers relative to the other verification scenarios, as the burden of scanning and archiving product information falls on the wholesale distributors.
- No immediate investment in serialized data exchange/aggregation is required
- No dependency on manufacturer look-up; reduces complexity with co-marketed/co-licensed products

Disadvantages:

- This is not a single solution because if sealed cases are scanned on outbound, but units within that case are returned, the wholesale distributor will not be able to verify those units. Additional communication with the manufacturer will be required to verify units unless the manufacturer provided aggregated product identifier data. Also, this may not be a single solution for non-direct purchase distributors due to information integrity risks.
    - The manufacturer will incur additional cost and effort associated with manual verification (email, phone, etc.).

Wholesale Distributor Perspective

Advantages:

- The wholesale distributor owns and controls product data for verification, eliminating the risk of technology failure and time spent communicating between trading partners and systems. This will reduce the time and effort spent coordinating with another business to verify product data since this process is performed internally by the wholesale distributor.
    - Since product identifier information is captured and stored internally by the wholesale distributor, there is no dependence on external bodies (i.e., coordinating with manufacturers) for verification of data.
- No dependency on manufacturer look-up (GTIN cross-references); reduces complexity with co-marketed/co-licensed products.

- No significant capital investment for software is required.
- This solution is potentially scalable to meet the 2023 requirements.

Disadvantages:

- Significant process changes and investment may be required to implement complete scanning on outbound. This will require additional hardware, automation, labor and time to process outbound shipments.
- This is not a single solution because if sealed cases are scanned on outbound and units within that case are returned, the wholesale distributor will not be able to verify those units (unless it received aggregated product identifier data from the manufacturer). Additional communication with the manufacturer will be required to verify units.
- The wholesale distributor assumes that there are no compromises to the integrity of the product identifier information upon receipt. Product identifier and information integrity risk is limited for direct purchase wholesale distributors, but increases with non-direct purchase distributors.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
	• Costs to establish connectivity infrastructure and automation upgrades • Process changes and associated documentation updates (SOPs)	

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
	• Increased cost of data storage as distributors capture full product identifier information • Significant increase in labor management costs associated with managing outbound scanning	

Conclusion

This scenario requires wholesale distributors to scan each smallest individual saleable unit or sealed homogeneous case to obtain the product identifier information. While

some wholesale distributors may scan product on outbound in part today, scanning every unit or case on outbound will require significant labor investment and automation upgrades.

This scenario is dependent on the functionality, speed, and connectivity of bar code scanners with data storage systems. There is no dependency on GTIN cross-references.

In the live pilots, there were issues found with the quality of the bar codes (glare, grading, etc.) and their content, which would pose a major risk for successful data capture and verification. In addition, outbound scanning will reduce the efficiency of outbound operations which may result in lower throughput in the distribution center.

Finally, if wholesale distributors receive returned units from a sealed case that was sold, they will have no record of the individual units in the internal database that they have compiled by scanning units/cases on outbound. Only the case would have been captured, and the wholesale distributors will have to use another means to verify the product identifier information.

Verification router service - distributor query is routed to appropriate manufacturer database

In this scenario, upon receiving a saleable return, the wholesale distributor captures the product identifier information and parses the data to a third-party routing service, which references the associated GTIN to automatically query the appropriate manufacturer's database and return a response in real-time. This collection and transmission of data can either be done automatically via scanners, which are connected to the verification router service, or performed via manual entry. While this scenario is similar to the scenario in which a wholesale distributor builds a point-to-point interface to a manufacturer database and to the scenario in which a wholesale distributor accesses the manufacturer's portal, in this scenario the wholesale distributor must build and maintain a single connection instead of connecting with each trading partner, and the wholesale distributor is not responsible for maintaining GTIN cross-references.

Manufacturer Perspective

Advantages:

- Each manufacturer stores its own data and manages access and permissions to the router, thereby reducing data security risks.
- Manufacturers are able to leverage existing technologies and do not have to replicate their respective databases, reducing the burden of upfront capital expenditures relative to other scenarios.
- Data is stored in one location instead of multiple, eliminating risks of data synchronization errors. Additionally, if any discrepancies are discovered by the manufacturer, revisions can easily be made to those product identifiers.

Disadvantages:

- Challenges may exist in determining the governance, ownership, funding, establishment and access of the router service.
- A standard query interface and a standard data format must be developed to respond to router verification requests. Both standards must be updated as they evolve.
- New, real-time, point-to-point connections would need to be established between manufacturer and router for verification, as opposed to the existing batch-type, delayed response EDI structure currently in place.
- A single point of failure exists for the router only. If the connection between the router and a manufacturer malfunctions, only that manufacturer's data will be inaccessible to the industry.
- Changes in marketing authorizations (changes in product ownership between manufacturers), M&A activity, product divestitures, co-marketed/co-licensed product, etc. would challenge historical product data coordination between the parties.

Wholesale Distributor Perspective

Advantages:

- Less system capital investment is needed relative to scenarios which require new data transmission technology to be built.
- Reduced need for manual communication between immediate trading partners, since all product identifier information is being verified automatically.
- Data is accessed for verification of returns in one location instead of multiple.
- Full product data for all product distributed is not needed; rather, only verification data for returned product is exchanged, reducing storage requirements for wholesale distributors.
- The router, not the wholesale distributor, would maintain the manufacturer GTIN cross-references.

Disadvantages:

- Challenges may exist in determining the governance, ownership, funding, establishment and access of the router service.
- There are multiple points of failure in this scenario. However, only one, the router, would result in an industry-wide outage. If the router experiences any system-wide outages, all manufacturer data will become unavailable to the entire industry, rendering verification impossible. This situation, however, has a reduced probability of occurring as compared to a manufacturer's connection failures due to the number of manufacturers in the industry. If a manufacturer experiences a system timeout or outage, wholesale distributors only will be unable to verify that specific manufacturer's product identifier information.
- Each wholesale distributor must establish and maintain its own request to the router's service with the associated security certificates.
- Changes in marketing authorizations (changes in product ownership between manufacturers), M&A activity, product divestitures, co-marketed/co-licensed product, etc. would challenge historical product data coordination between the parties.
- A standard query interface and a standard data format must be developed to respond to router verification requests. Both standards must be updated as the standard evolves.
- A risk of external latency exists as this scenario requires a response from a third-party organization.

Live Pilot IT Technical Execution

The router was developed using open-source technologies and was hosted on *Microsoft Azure*, a cloud-based service platform. Manufacturers provided URLs to their Application Program Interface (API) endpoints, which were indexed in the database and tied to their respective GTIN. This allowed the router to quickly identify and direct the verification query to the appropriate manufacturer database.

The router was developed using an open-source framework called *Slim*. As a requirement, wholesale distributors needed the ability to *RESTful* (data exchange language) requests to the router's endpoint and parse the response, which used a *JSON* format, as it enabled faster processing speeds.

Depending on the level of IT maturity of the participants, some delays were observed when establishing the wholesale distributor client certificates, which are used by client systems to make authenticated requests to a remote server. While requests were still secure (over SSL), this was not a necessity for the pilot program. However, for optimum security in a scalable solution, each wholesale distributor will need to install a signed certificate.

To measure the overall speed of the query, timestamps at each process checkpoint were recorded using an open-source HTTP client called *Guzzle*. Overall, this scenario met performance requirements. The router remained live, without any outages. As such, the slow/non-response times were solely based on the manufacturer's ability to respond to these requests in a timely manner. Another cause for slow/non-response times were attributed to data format mismatches between the wholesale distributor and manufacturer, which generated gateway timeouts and highlighted the critical nature of establishing data formatting standards.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Developing standard data format and query interface for router system	• Establishing new, real-time, end-to-end connections, which are validated and secure; includes establishing end-to-end connections to router • Developing wholesale distributors' query requests • Validating cross-referenced response data, with the router acting as the manufacturer's router	• Design, build, test and go-live elements for the real-time end-to-end connections are required, which may take several days to many weeks to be completed, and may vary depending on the capability and experience of the trading partners.

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Maintaining the GTIN cross-reference data in the event of M&A, product divestitures, and co-marketed/co-licensed products, etc.	• Maintaining security certificates to establish two-factor connections with the router	• Maintaining, securing and gaining permission to access validated, secure point-to-point connections • As the composition of the industry changes, new end-to-end connections would need to be established and updated to verify saleable returns.

Conclusion

As compared to the other external solution, some aspects of this scenario performed better and some performed worse. During the execution of the live pilot, observed verification speeds were slower than the scenario in which manufacturers send all data to central database, which the wholesale distributor accesses for verification, however, the performance was acceptable (sub-second verification times). This solution's performance was superior to the centralized database scenario in terms of data security and synchronization. As data never left the manufacturer's control and only one set of data existed, security and synchronization concerns were negligible.

While the performance of the router satisfied all requirements and minimized the associated risks, the main challenge regarding this solution is the ownership, governance, funding and establishment of the router. In addition, the associated setup and maintenance costs are vast. Finally, this solution has multiple points of failure, however, only one, the router, would result in an industry-wide outage. This event has a reduced probability of occurring as compared to other connection failures due to the number of entities in the industry. Despite these challenges, the Work Group believes this scenario remains the most feasible external solution due to its speed and security.

DESKTOP PILOTS

Distributor accesses each manufacturer's database through a portal

In this scenario, the manufacturer stores all product identifier information in an internal database and provides portal access information to a wholesale distributor. The wholesale distributor must build and maintain a list of portal addresses and sign-in information. To verify a saleable return, the wholesale distributor manually logs into a manufacturer's portal through a webpage and types in product identifier information for verification. While this scenario has many similarities to the scenarios in which verification takes place through point-to-point interfaces or through a router service, this scenario requires a manual query of a specific manufacturer's portal, rather than automatically routing the query to the appropriate manufacturer database based upon a scan of the product identifier affixed to the product. Note that under this scenario the manufacturer's portal would be designed independently by each manufacturer and the different portals may have a completely different look, interface and operation.

Manufacturer Perspective

Advantages:

- Each manufacturer stores its own data and manages access and permissions to its respective portal, which reduces data security risk.
- Less upfront capital investment is needed relative to other scenarios.
- Serialized data exchange is deferred.

Disadvantages:

- Risk of unauthorized user database breaches; increased complexity with potential system administration changes.
    - Vast time, effort, and coordination would be required to support system and documentation maintenance.
- Increased effort for continuous administration of portal login information for each wholesale distributor; there would need to be coordination with each wholesale distributor to identify staff that should have logins and those that no longer require them, or should not have them.
    - As the frequency of multiple users per direct trading partner increases, the risk of a breach exponentially increases.
    - This effort also entails scalability challenges.
- The appropriate portal for co-marketed and co-licensed product information may be challenging to find.

Wholesale Distributor Perspective

Advantages:

- Less system capital investment is needed relative to scenarios which require new data transmission technology to be built.
- Serialized data exchange is deferred.

Disadvantages:

- Increased human error (*e.g.*, keying in product identifier information incorrectly), which could result in null/negative verification response. Errors that result in an inability to verify the product would lead to time and resources spent utilizing an alternative verification method or conducting a suspect product investigation. Manual errors may include:
    - Searching for a product identifier in the incorrect manufacturer portal.
    - Incorrectly entering a product identifier in the correct portal.
    - Incorrectly entering portal address or login information.
- This scenario's verification process would take longer to complete than a fully automated solution due to network latency, portal latency and manual entry time.
- Technology infrastructure upgrades may be necessary.
- Inconsistent data formatting and manufacturers' different portal user interfaces would pose challenges to wholesale distributors.
- Scalability would be a challenge for this scenario, as the wholesale distributor would have to catalogue and maintain access information for each manufacturer's portals.
- Changes among manufacturers in ownership of product marketing authorizations (*e.g.*, M&A activity) would challenge historical product data coordination between parties.
- Requires a large effort to maintain login information for different manufacturers' portals.
    - Additional effort would be needed for co-marketed and co-licensed products to understand which portal to use for these specific products.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Portal creation • Coordination of portal addresses and access with wholesale distributors	• Technology infrastructure upgrades may be required, and the severity of these costs may differ across the industry	• Training material creation

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Portal and security maintenance o Management of user access changes for existing wholesale distributors and onboarding of new wholesale distributors	• Manual management of product identifier information, co-marketed/co-licensed products and cross-references • Manual login to each manufacturer's portal and the correct entry of product identifier information o Assuming two minutes to verify each product for 58.8 million annual saleable return units, 942 FTEs would likely be needed across the industry.	• Training of new hires • Additional time, effort and manual labor cost

Conclusion

The primary benefit of this scenario is increased data security relative to other scenarios where manufacturer information is transmitted externally. However, manual data entry and the increased risk of human error would have a significant impact on verification process efficiency. In addition, the continual maintenance of portal addresses, portal user access, and differing portal user interfaces poses significant process challenges when applied to the massive volume of industry-wide returns. Finally, changes in industry composition through M&A activities would prompt changes to the portal landscapes. Due to the volume of saleable returns, it is the opinion of the Work Group that this scenario is a not a viable solution for the verification of saleable returns, particularly given superior alternatives.

Distributor manually confirms with manufacturers at time of return via phone or email

In this scenario, the wholesale distributor manually verifies product identifier information with the Manufacturer by phone or email. This scenario uses existing technology — phone and email — and, as a result, has the fewest technological infrastructure barriers relative to all other scenarios.

Manufacturer Perspective

Advantages:

- Less complex additional technological infrastructure needed.

Disadvantages:

- Additional staff required to manually answer and manage verification inquiries within 24-hour window.
- Human error risk; manually exchanging information or entering data into a system could result in false negative verification responses.
- Risk of fraud, data theft and phishing attacks on phone and email systems.

Wholesale Distributor Perspective:

Advantages:

- Less complex additional technological infrastructure needed.

Disadvantages:

- Increased verification time requires product to be held in separate location before it could be reintroduced to the forward supply chain. This may result in:
    - Physical space constraints;
    - Inventory shortage;

    - Risk to product integrity (*e.g.*, cold chain); and,
    - Product destruction (if prompt verification response is not received).
- Additional staff required in returns to handle verification process.
- Risk of human error in manual management of product identifier information and cross-reference maintenance (*e.g.*, correct phone numbers and email addresses).
- Data security risk of phishing attacks on phone calls or email data. Manufacturers also may be hesitant to respond to non-immediate trading partners (*e.g.*, non-direct purchase wholesale distributors).

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
		• Infrastructure needs to support the creation of call center and hiring of call center representatives (*e.g.*, resource space, desks, phones, computers)

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
		• Salary and benefits for additional resources o If one unit takes five minutes to verify (*e.g.*, dialing manufacturer, routing to appropriate representative, dictating product information and verifying product information), the pilot participants estimate more than 4,700 FTEs would be needed across the U.S. pharmaceutical industry to manage this process.

Conclusion

The time and effort of this scenario make it a cumbersome and inefficient method for verification of saleable returns. If each unit takes approximately five minutes to verify for each party, the industry would need more than 4,700 additional FTEs to verify saleable returns annually, assuming a total industry saleable return volume of 58.8 million units.[6] This scenario takes the longest time for verification, thereby increasing the risk of being unable to verify saleable returns within in an efficient manner. The industry may choose to mitigate this risk by introducing additional inventory into the supply chain. Also, because the manufacturer must respond to a verification request within 24 hours, manufacturers would have to operate their verification call centers 24 hours a day, 7 days a week.

Given the amount of time and the number of resources required to verify each unit, it is the opinion of the Work Group that this scenario would likely only be a viable solution for manufacturers and wholesale distributors with low volumes (*e.g.*, orphan drugs).

[6] Data captured reviewed saleable returns processed by participating wholesale distributors, from November 2014 through October 2015.

WHITE PAPERS

Manufacturer sends to each direct purchase wholesale distributor the product identifiers for all units shipped within the U.S. to all direct purchase distributors

In this scenario, the manufacturer sends product identifier information for all units shipped within the U.S. to each of its direct purchase wholesale distributors. Each distributor uses these data to create an internal database of product identifiers. Upon receiving a saleable return, the distributor is able to reference its internal database to verify the product identifier information (SNI, lot and expiration date). Unlike the scenario in which the manufacturer sends only the product identifier information corresponding to the units purchased by the distributor, in this scenario, the manufacturer sends all of its product identifier information to each of its direct purchase wholesale distributors, regardless of which wholesale distributor purchased which individual units.

Manufacturer Perspective

Advantages:

- This scenario would reduce the need for manual communication between immediate trading partners since all product identifier information is being communicated to the wholesale distributors.
- This scenario does not require unique data sets to be transmitted to each wholesale distributor with only the product identifier information for the products that wholesale distributor purchased, so a single set of data could be sent to all wholesale distributors.

Disadvantages:

- Sharing all product identifier information could allow for significant abuse within the supply chain, including the theft of batch yield information, sales information, GMP critical data, etc.
- Sharing all product identifier information for all units could increase the risk of product identifiers being stolen or diverted, which could result in counterfeit product entering the supply chain with valid product identifiers.
- In addition to the increased security risks, data volume, costs and complexity, a new process will be required to determine the triggers for when to export product identifier information to the Distributors. This could create discrepancies in terms of data distribution cadence between manufacturers and wholesale distributors, potentially leading to a number of exceptions and variances throughout the process.

- Manufacturers would have to manage data transmission to each trading partner.
- An alternate solution will be required for non-direct purchaser saleable return verification.

Wholesale Distributor Perspective

Advantages:

- Reduces the need for ongoing manual communication.
- Since product identifier information is captured and stored internally by the wholesale distributor, the risk of external latency issues and dependence on external bodies (coordinating with manufacturers) for verification of data is eliminated. This also allows for a reduction in the complexity of managing co-marketed and co-licensed products.

Disadvantages:

- Although receipt of product identifier information would reduce the need for manual communication and external latency, the increase in data volume (estimated to be at least 200 percent for major wholesale distributors and exponential for small wholesale distributors) would increase internal latency.
    - Each internal query would need to navigate through all data provided by all manufacturer trading partners, as opposed to only the product identifier information the wholesale distributor purchased.
    - There is no standardized data format for the product identifier information all manufacturers would provide. In the absence of a standard, wholesale distributors may have to reformat data received by manufacturers to facilitate their internal verification processes, thus further increasing processing times.
- Risk of data sharing and a security breach of a wholesale distributor's network could compromise both the wholesale distributor and manufacturer.
- Manufacturers may not be willing to share product identifier information with those wholesale distributors who are not direct trading partners. Without access to product identifier information, an indirect purchaser would not be able to verify their saleable returns. Indirect purchasers would have to use a different solution to verify saleable returns.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Developing a new, custom transaction set to provide data • Establishing point-to-point connections between each manufacturer and their wholesale distributors; cost is significant compared to a scenario that employs a single, central repository or router to link databases	• Creating a database to store product identifiers (if not built by third-party). • Establishing point-to-point connections between each manufacturer and their wholesale distributors; cost is significant compared to a scenario that employs a single, central repository or router to link databases	

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Maintaining and updating point-to-point connections between each manufacturer and its wholesale distributors; cost is significant as compared to a scenario that employs a single, central repository or router to link databases	• Increased cost of data storage for receiving full product identifier information from all manufacturers	• Increasing costs associated with pay-per-transactions with third- parties • If point-to-point connections are not owned by the direct trading partners and a Software as a Service (SaaS) is used, recurring costs of data transmission and usage fees may apply.

Conclusion

This scenario mitigates the need for manual communication, since data would be readily available to primary wholesale distributors. There is also no dependency on GTIN cross-references.

However, the wide availability of data poses a significant security risk — all manufacturer data (including product identifier information, batch yields and volume) would be vulnerable if any wholesale distributor's systems are breached. Additionally,

since the wholesale distributor now has to import, store and search all product identifier information, instead of only a subset of product identifier information for the products it purchased from the manufacturer as discussed in another scenario, the significant increase in data volume and complexity would create additional internal latency for the wholesale distributor. Furthermore, an alternate solution would be required for verifying returns to non-direct purchasers, since product identifier information is not passed to them from the manufacturers or direct purchase wholesale distributors.

Ultimately, this scenario creates significant data risks for manufacturers as well as volumes of data for the wholesale distributors. Therefore, it is the opinion of the Work Group participants that this scenario would not meet the needs of the industry for the verification of saleable returns, particularly given superior alternatives.

Verification services- distributor builds point-to-point interfaces to each manufacturer's verification service, which automatically returns a verification response

In this scenario, each manufacturer maintains product identifier information in an internal database. Each wholesale distributor builds and maintains a cross-reference to each manufacturer's verification service, which would automatically verify product identifier information (SNI, lot, and expiration date). This scenario has many similarities to the scenario in which a wholesale distributor query is routed to the appropriate manufacturer database through a verification discovery router service and the scenario in which manufacturers send all data to a central database which wholesale distributors access for verification. However, this scenario requires new, real-time, point-to-point connections between each set of trading partners.

Manufacturer Perspective

Advantages:

- Each manufacturer keeps its own data, which reduces data security and data synchronization risks.
- This scenario would reduce the need for manual communication between immediate trading partners since all product identifier information is being verified automatically.
- This system solution is both automated and direct between wholesale distributors and manufacturers.

Disadvantages:

- A standard query interface must be developed to respond to wholesale distributor verification requests. The standard query interface must be updated as the standard evolves.
- New, real-time, point-to-point connections with all wholesale distributors (with more than 100 wholesale distributors operating in the U.S. market[7]) would need to be established between trading partners for verification as opposed to the existing batch-type, delayed-response EDI structure currently in place.
- Manufacturers must build new contacts with non-direct purchase wholesale distributors to build point-to-point connections.
- Changes among manufacturers in ownership of product marketing authorizations would challenge historical product data coordination between the parties.

Wholesale Distributor Perspective

Advantages:

- Like manufacturers, wholesale distributors also would benefit from the reduced need for manual communication between immediate trading partners since all product identifier information is being verified automatically.
- Full product data for all product distributed is not needed; rather, only verification data for returned product is exchanged.
- There is no single point of failure in this scenario, so risk of technology failure is reduced.

Disadvantages:

- The wholesale distributor must establish and maintain validated, secure, point-to-point connections with all manufacturers whose products are sold by the wholesale distributor. More than 1,000 manufacturer connections per wholesale distributor are expected to be required. New, real-time connections would need to be established between trading partners for verification as opposed to the existing batch-type, delayed response EDI structure in place today.
    - Each wholesale distributor must establish and maintain its own cross-reference by GTIN to the manufacturers' databases with associated security to access the service.
    - M&A activity introduces substantial complexity to the maintenance of the point-to-point connections as all wholesale distributors must each make revisions to their respective systems' logic to indicate which manufacturer's database to ping based on the product identifier.
    - Changes among manufacturers in ownership of product marketing authorizations would challenge historical product data coordination between parties.

[7] 100 is an approximate number based on a HDA database list of members and wholesale distributors that are not members.

- A standard query interface must be established and updated as the standard evolves.
- Risk of external latency as this scenario requires a response from an external organization (the manufacturer or its delegated representative).

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Developing manufacturers' standard data format and query interface	• Establishing new, real-time point-to-point connections, which are validated and secure; includes establishing point-to-point connections with all manufacturers whose products are sold by the wholesale distributor, regardless of whether or not the wholesale distributor has a direct relationship with the manufacturer • Developing wholesale distributors' query requests • Developing wholesale distributors' cross-reference	• Design, build, test and go-live elements for the real-time point-to-point connections are required, which may take several days to many weeks to be completed, and may vary depending on the capability and experience of the trading partners.

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
• Maintaining the wholesale distributor cross-reference • M&A associated costs	• M&A associated costs	• Maintaining, securing and gaining permission to access validated, secure point-to-point connections • As composition of the industry changes, new point-to-point connections would need to be established and updated to verify saleable returns.

Conclusion

This scenario would mitigate the need for manual communication since point-to-point connections will allow the automatic query of manufacturer product identifier information and eliminate manual processes for both parties. Additionally, these automated access points limit data security concerns, as each manufacturer's data remains in its possession. It also provides an environment in which there is a single copy of product identifier information and removes the risk of data synchronization errors.

Despite the automation and security benefits of this scenario, the associated costs and maintenance efforts may hinder this solution's viability for trading partners. The cost and complexity of building and maintaining thousands of point-to-point connections is vast. These are new, real-time connections that would need to be validated and secured for use between each manufacturer and wholesale distributor. Changes in composition of the industry through mergers and acquisitions would require an update for each connection to ensure no verification interruptions. While the high costs and complexities associated with this scenario may be managed by some players in the U.S. pharmaceutical market, many others, particularly less technologically sophisticated or smaller organizations, may encounter adoption challenges if they do not have the IT or financial capabilities to adopt and sustain this solution.

Distributor scans all purchased product identifiers on inbound receipt and creates internal database against which verification requests will be made

In this scenario, the wholesale distributor scans every product identifier at the smallest saleable unit on inbound receipt. When the product identifier is scanned, the product identifier information is stored in an internal database. As saleable products are returned, the wholesale distributor verifies the product identifier(s) against its internal database.

Manufacturer Perspective

Advantages:

- This scenario is less complex and less costly to manufacturers relative to the other verification methods, as the burden of scanning and archiving product information falls on the wholesale distributors.
- No upfront capital investment for technology is required.
- This scenario is not dependent on any GTIN cross-reference, interfaces, etc. in consideration of changes associated with M&As.

Disadvantages:

- Increased handling of product could result in increased product packaging damage/degradation of bar code, and increased nonsaleable returns.
- Slower inventory turns due to additional time spent processing inbound product would lead to increased levels of expired product.
- Uncertainty as to whether this would be an adequate verification method for non-direct purchase wholesale distributors.

Wholesale Distributor Perspective

Advantages:

- Since product identifier information is captured and stored internally by the wholesale distributor, there is no dependence on external bodies (i.e., coordinating with manufacturers) for verification of data.
- The wholesale distributor owns and controls product data for verification, eliminating the risk of technology failure and time spent communicating between parties and systems. This would also reduce the time and effort spent coordinating with another business to verify product data since this process could be performed internally by the wholesale distributor.
- No upfront capital investment for technology is required.

Disadvantages:

- The wholesale distributor assumes that there are no compromises to the integrity of the product identifier upon receipt. Product identifier and information integrity risk is limited for direct purchase wholesale distributors, but increases with wholesale distributors who are not purchasing directly from manufacturers.
- One wholesale distributor estimated the volume of scans would increase about 2,000 percent (from 3.5M cases/month to 70M eaches/month) to capture product identifier information at the smallest individual saleable unit, which would severely decrease operational efficiency and require increasing physical processing space.
- Product processing would take longer due to the opening and scanning of cases and would necessitate more products being held in inventory to meet customer demand for shipments.
    - Requirement for wholesale distributors to increase inventory which reduces the level of funds available to invest elsewhere in the business.
    - Additional time to process receipts leads to physical constraints; temperature controlled environments, controlled substance space, and regular receiving may need to be expanded to accommodate additional inventory held in receiving.
    - Slower inventory turns due to additional time spent processing on inbound could lead to increased levels of expired product.
- Risk of counterfeit product being introduced into the supply chain due to tamper-evident primary packages having to be opened.
- Damage to labels due to additional handling of products on inbound scanning.
- Processing time is further increased when secondary packaging (*e.g.*, bundles) is received and requires unpacking.
- Physical space constraints for products (*e.g.*, cold chain, controlled substances, ambient storage) may exist and would require further capital expenditures.

Cost Considerations

One-time costs:

Manufacturers	Wholesale Distributors	Shared Costs
• As the receiving process becomes longer, lead time to process saleable returns would increase. Any increases to inventory would impact manufacturers from a production planning/scheduling	• Building infrastructure; costs to expand/build new receiving area and larger storage area to hold increased inventory • IT (WMS) investment to change receiving processing • Additional resource cost to open cases to	

and forecasting perspective. • New forecasting and planning associated with this lead time/inventory increase would be a one-time cost.	scan every smallest individual saleable unit product identifier.	

Recurring costs:

Manufacturers	Wholesale Distributors	Shared Costs
	• Since pallets and cases would need to be opened to scan every smallest individual saleable unit to scan the product identifier, there would be an additional resource cost to manage this work. • Increased cost of implementing additional security measures to monitor high-touch areas (more cameras on docks, receiving stations, focused cameras, etc.); scenario would require more coverage to ensure maintenance of product security and integrity • Increased cost of data storage as wholesale distributors capture full product identifier information	• Increased inventory costs across the industry would be necessary to combat the effects of longer lead times and increased damage and expiry risk.

Conclusion

With the wholesale distributor scanning all products on inbound, this scenario requires significant effort and investment for implementation by the wholesale distributors. This scenario does not require dependency on GTIN cross-references.

This scenario requires breaking down and scanning each smallest individual saleable unit and homogeneous case to obtain the product identifier information. One wholesale distributor estimated the volume of scans to increase about 2,000 percent to capture product identifiers at the smallest individual saleable unit, which would severely decrease operational efficiency and require an increase in physical processing space.

This extremely onerous process risks creating a significant backlog during the initial receiving process of all purchased product while placing physical constraints on warehousing facilities. Further, there is increased risk of both damaging pharmaceuticals during the opening of sealed containers to scan individual units and an elevated possibility of temperature excursions. To mitigate these negative effects, an increase in inventory throughout the pharmaceutical supply chain would be required. Since shipping and receiving cannot be performed simultaneously, this scenario also restricts the wholesale distributor's ability to use the available floor space for its standard operations, such as cross dock and pick, pack and ship processes.

The increase in lead time, physical constraints and the reduced ability to receive product efficiently would slow product movement for all parts of the pharmaceutical supply chain following the manufacturer's initial shipment. It is the opinion of the Work Group that this scenario is a not a viable solution for the verification of saleable returns, particularly given superior alternatives.

Summary of Costs for All Scenarios

Description	Illustrative One-Time Costs	Illustrative Recurring Costs
• Manufacturer sends purchased unit product identifiers to respective wholesale distributor	• Establishment of point-to-point connections • Operating technology to enable aggregation	• Labor, *e.g.* maintaining point-to-point connections
• Central database – manufacturers send all data to central database which the wholesale distributors accesses for verification	• Establishment of router • System interfaces and data exchanges • Data format standards	• Repository and security maintenance • Subscription fees
• Wholesale distributor scans product on outbound	• Potential capital need for infrastructure	• Additional labor costs (receiving and security)

	• Introduction of additional safety stock to cover increased processing times	• Increased inventory holding costs
• Verification router service – wholesale distributor query is routed to appropriate manufacturer database	• Establishment of central repository • System interfaces and data exchanges • Data format standards	• Router and security maintenance • Subscription fees • Manufacturer look-up maintenance
• Wholesale distributor accesses each manufacturer's database through portal	• Portal creation • Coordination of portal address and access with wholesale distributors	• Labor caused by the increase in processing time from manual processes
• Wholesale distributor manually confirms with manufacturers at time of return via phone or email	• Additional technological infrastructure for call center (desk, chairs, PCs, systems, etc.)	• Labor • Potential infrastructure upgrades
• Manufacturer sends product identifiers for all units shipped within the U.S. to all direct purchase wholesale distributors	• New, custom transaction set to provide data • Point-to-point connections with each trading partner	• Connection maintenance and security • Data storage costs
• Verification services – wholesale distributor builds point-to-point interfaces to each manufacturer's verification service, which automatically returns a verification response	• Point-to-point connections with each trading partner • Query requests and cross-references	• Connection and cross-reference maintenance and security
• Wholesale distributor scans all purchased product identifiers on inbound receipt	• Potential capital need for infrastructure • Introduction of additional safety stock to cover increased processing times	• Additional labor costs (receiving and security) • Increased inventory holding costs

OVERALL LESSONS LEARNED

In the process of conducting the pilots, participants learned lessons beyond the original intent of verifying saleable returns. The Work Group found these lessons to be significant in that they impacted not only their ability to complete the pilots, but also their operations as they proceed toward DSCSA milestones.

Overall these lessons fell into three broad categories: data and technology, interoperability, and pilot coordination. The most common issues encountered within these categories included bar code errors, manufacturer system outages, a serial number not present in database, “00” date field error, internal system issues, incomplete master data, and master data pointing to the wrong system. Additional details on each of these errors organized into the three broader categories follow.

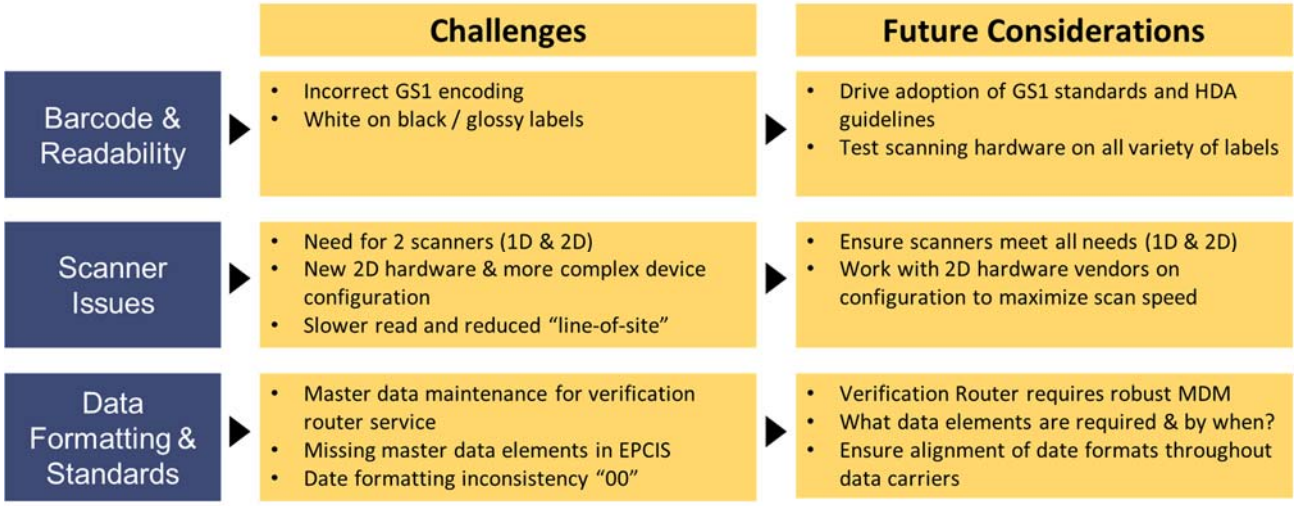
Data and Technology

Data formatting and standards challenges

A number of negative responses to verification requests were returned due to inconsistent data formatting and bar code read and format issues. Different versions of EPCIS require different data elements, so participants needed to align on which fields were mandatory. Additionally, certain fields differ based on various legislative requirements, so it is important to ensure the fields and formats are correct. Master data fields required for non-U.S. countries resulted in file send failures. Participants also experience middleware overwriting incorrect Global Location Numbers (GLNs). One of the more significant discoveries was the “00” expiration date field within the product bar code. Some manufacturers use “00” for the day, which typically means use the last day of the month as the expiry date. However, EPCIS does not allow for “00” in the date field. When verifying the product identifier and attempting to make a three-way match between the information encoded in the bar code, human readable printed on the bar code, and EPCIS data, false negatives were returned. As a result, guidelines have been updated to reflect the recommendation that bar codes contain a non-zero day and that EPCIS and bar code information, both encoded and human readable text, are consistent.

Bar code read and format issues

Systems experienced widespread issues due to the inability to read and decode bar codes, as well as a lack of alignment of physical bar code data and systemic data. Companies also experienced hardware issues, which may create processing efficiency challenges for trading partners who are immature in their bar code scanning and reading capabilities. For example, participants found that black on white bar codes were more easily readable than white on black. However, due to label longevity, some manufacturers have moved to white on black labels. It was determined that additional bar code scanner configuration and clarification is needed for white on black bar codes.



Interoperability

System interoperability

While carrying out the pilots, participants experienced several interoperability issues between and among systems operating different versions of data standards. For example, interoperability challenges appeared among participants using EPCIS version 1.0 versus version 1.1. There also were challenges associated with transfer of commissioning data and event time stamps. Middleware issues created challenges during messaging between systems. Certificate authority alignment is required for system interoperability and establishing necessary authorities can have longer than anticipated lead times. Voice picking technology also was unable to identify that a picking task was "serialized."

Connection issues

AS2 interoperability issues were experienced by multiple manufacturers and distributors participating in the scenario in which a manufacturer sends purchase unit product identifiers to respective wholesale distributors. AS2, however, provides traceability of data movement between trading partners that may not be present within other transmission methods like SFTP.

Timing of data transmission

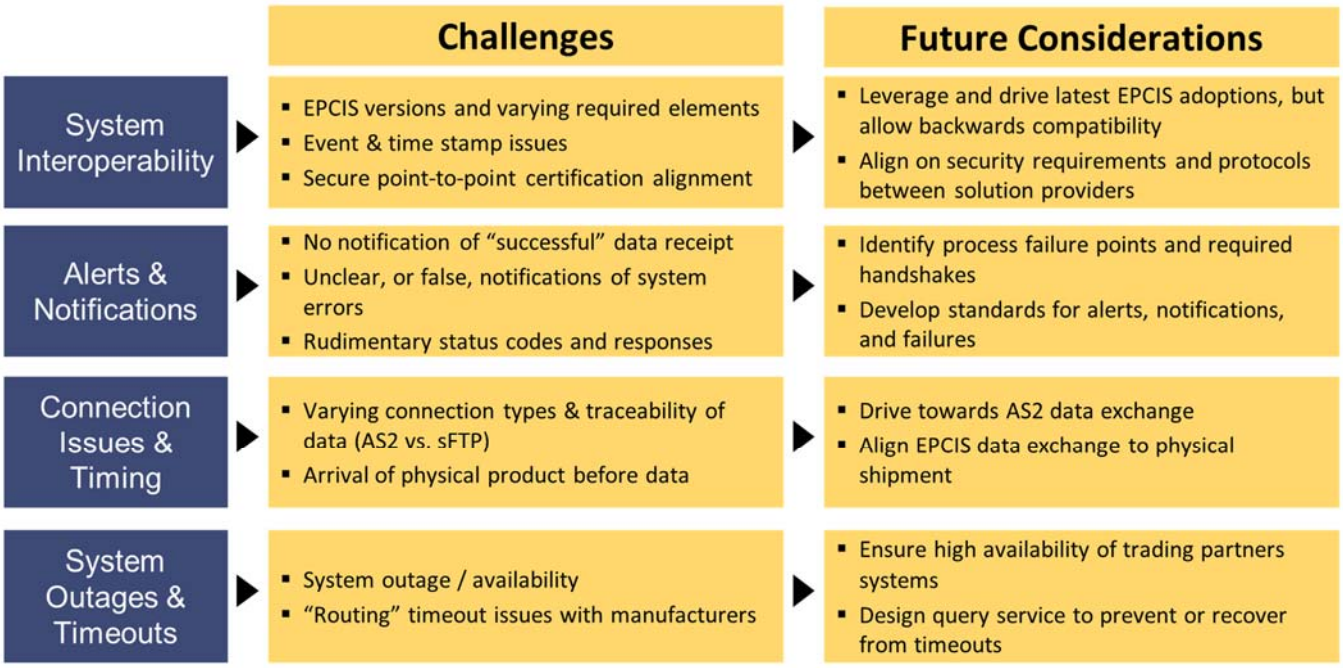
When systems were up and running, data transmission speed was not a concern and execution worked well. However, in instances where a system was not "up" or turned on, there were issues developing and generating data files for transmission.

System timeout issues

Multiple gateway timeout issues on the manufacturer side resulted in response failures and issues.

Alerts and notification

In many instances, false receipt notifications were received. Going forward, a robust alert and notification system will be needed to ensure messages are sent for request send, request receipt, response send, and response receipt and that a “handshake” occurs (the equivalent of a GS1 997 message could be adopted). Identification of where in the process the error occurred will be critical. A separate status code indicating “no redirect” in addition to a “true/false” response, would distinguish non-serialized product instead of returning a false negative. If only standard HTTP status codes are used and another code is received, this could cause potential issues.



Pilot Coordination

Pilot coordination was critical for execution. Key lessons learned fell into several categories, including: technology providers, system testing, and communication.

Technology providers

Many participants used external technology providers. Robust standards, testing, and the coordination of technical support with external technology providers are critical to pilot success. In some instances, technology providers reported data transmission success; however, the distributor never received the transmission file. In this small scale setting, the issue was resolved via email, but this is an item of concern for a real world operating environment. Multiple companies experienced AS2 issues with trading partners among multiple technology providers. Another technical challenge occurred when a technology provider was unable to send EPCIS and ASN messaging to two

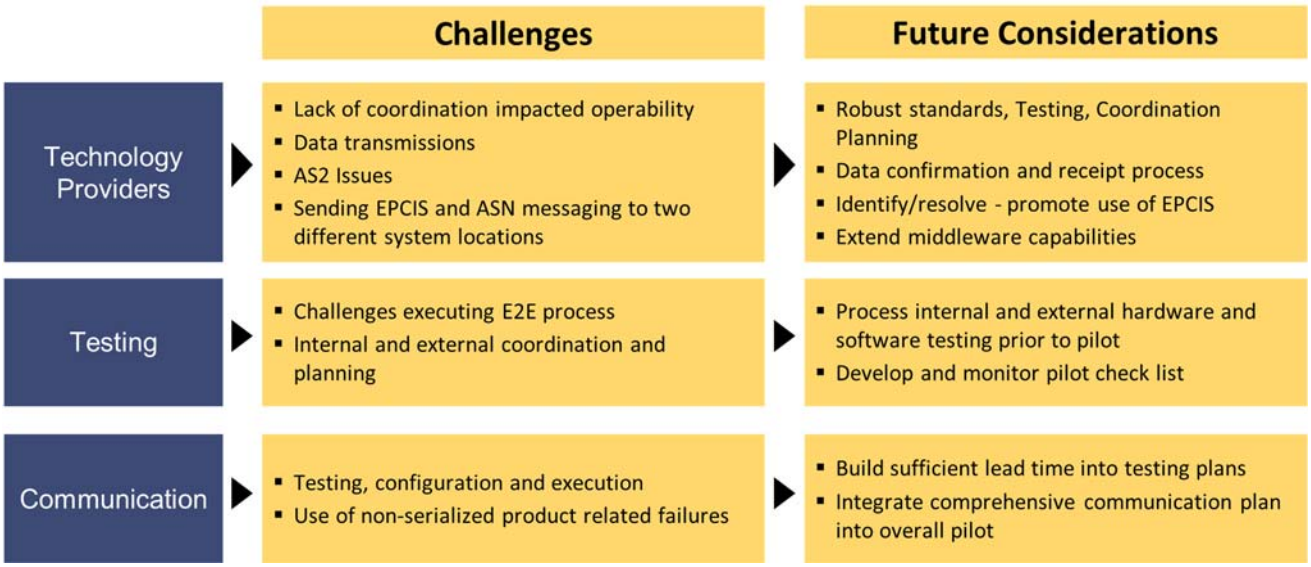
different system locations. Going forward, trading partners will need the capability to send files (including different file types) to multiple systemic locations.

Testing

End-to-end testing of systems and processes is essential. Performing data transmission, bar code scanner, and interoperability tests both internally and externally, in advance of pilot execution, is critical to pilot success. One tool used was a "checklist" provided to both technology providers and trading partners, prior to design and execution of the pilot. The setup and execution of tests took more time than originally expected. Encouraging all participants to participate in tests before execution will help avoid complications.

Communication

Communication around scanning only serialized product is critical. Inputting non-serialized product information during testing created issues during the pilot due to messaging failures between systems.



The Work Group captured additional items that companies may want to consider that were not tested in the pilots. These items include:

- Trading partners may need to employ multiple solutions for verification based on exception handling, business needs and current processes.
- Non-direct purchasers and trading partners may require a second layer solution if they do not have a direct relationship with the manufacturer (Scenarios 1 and 7).
- Returns processes may need to provide additional consideration for co-marketed/co-licensed product.
- Trading partners will need to be prepared for handling grandfathered products which have product identifiers that do not exist in the data repository.

- Data quality and data accuracy standards will need to be determined (including bar code grading).
- There could be additional data in the Data Matrix bar code in addition to the product identifier.

WORK GROUP RECOMMENDATIONS FOR INDUSTRY

The DSCSA requirement for wholesale distributors to verify saleable returns starting in 2019 poses a challenge for wholesale distributors and manufacturers. Through the process of evaluating nine scenarios, the Work Group captured key lessons learned, critical findings, relative costs and effort, performance and scalability metrics from some of the most prominent members of the pharmaceutical supply chain. While there is no single solution for the supply chain, the Work Group has put forward two preferred options, keeping in mind solution cost, implementation effort, process execution, exception handling, advantages and disadvantages, and sustainability implications from both the manufacturer and wholesale distributor perspective.

The two preferred options are (i) the scenario in which a manufacturer sends to each individual wholesale distributor aggregated product identifier information for only the products purchased by that wholesale distributor so that the wholesale distributor can verify a saleable return against its internal database of received product identifiers, and (ii) the scenario that uses a verification router service, in which a wholesale distributor query is routed to the appropriate manufacturer database for verification.

The first scenario requires aggregation and serialized data exchange using EPCIS; while some trading partners may be ready to implement this solution by 2019, the implementation of industry-wide aggregation and serialized data exchange between all trading partners by 2019 may not be feasible.

For the second scenario, the verification router service is not yet built. As an outcome of the pilots work, HDA will form a task force composed of manufacturers, distributors and service providers to develop the requirements for this system.

Depending on a company's role in the supply chain, the maturity of its operation, its strategy for compliance with DSCSA and other business considerations, one or multiple scenarios may be selected as the most practical for compliance. There is no single, industry-wide solution for compliance with the 2019 saleable returns requirements, and regardless of the option(s) a company chooses, manual processing will be required in some instances.

Through pilot execution, the Work Group determined that industry engagement and collaboration among trading partners is a critical element to meeting 2019 deadlines, ensuring patient access to needed medicines, and supply chain continuity. Establishing a company-specific serialization strategy and understanding company capabilities is essential to program success. Of course, each company should understand its role and

legal requirements under DSCSA and the impact of saleable returns volume on its business. Companies must establish a process to efficiently collect and manage master data required for the verification of saleable returns with their trading partners.

Importantly, companies should be prepared for program fatigue. Do not underestimate the time and effort required to execute pilots and prepare for DSCSA milestones. No one in the supply chain works in isolation. It is essential to understand trading partners' requirements and timeline pressures in preparation for 2019 DSCSA obligations.