

# Zero Samples Lost

RFID empowering Healthcare  
experts in clinical laboratories



In partnership with:



# Introduction

## What have we learned over the last few years?

Our healthcare systems are vulnerable and in many countries reeling from a legacy of underinvestment in personnel, facilities, and systems. We have learned how vital supply chains are to delivering the best quality healthcare. During the pandemic, the urgency to manufacture and distribute vaccines to billions of people, and protective equipment to millions of front-line healthcare workers, exposed the weak links in global supply chains.

We explore how proven technologies are enabling clinical laboratories, hospitals, and medicine suppliers to transform their sample and inventory management as well as quality control along with supply chain performance. Using digital identification and automating processes, leaders in the healthcare industry are directly improving patient care, reducing costs and the burden of administration and bureaucracy for healthcare staff.

What is RFID?

Radio Frequency IDentification (RFID) — is a technology used in digital identification solutions.

The small and often invisible RFID tag is already relied upon across the supply chain by multiple industries because it generates accurate data that unlocks insights and drives informed decision-making.

Retailers and brand owners including Walmart, Zara, Levi’s, major automotive brands, and parcel carriers apply RFID tags to create a digital identity and track products and assets across the entire value chain.

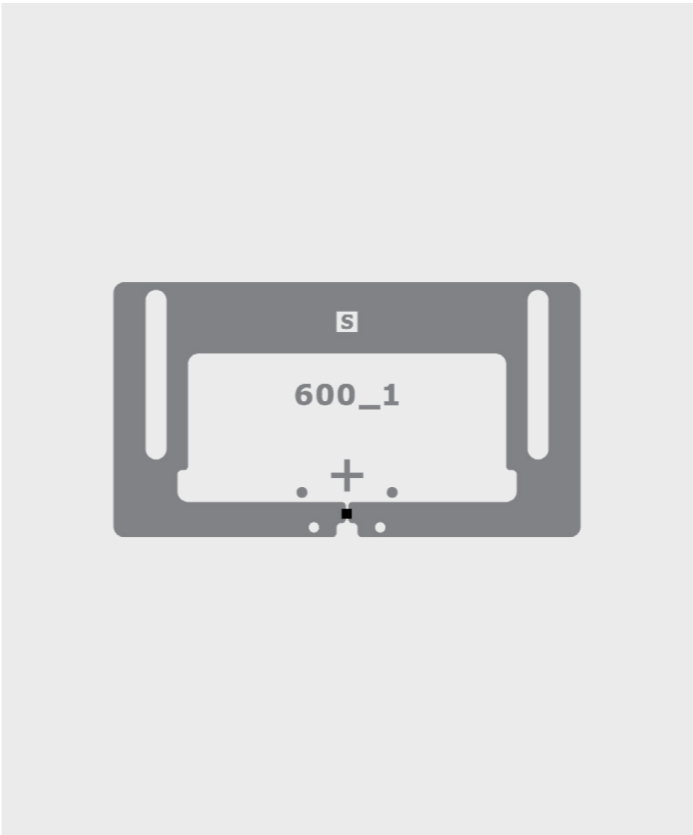
In the retail environment, RFID offers a hundred fold increase in item scanning speed compared to traditional barcodes.<sup>1</sup>

Radio Frequency IDentification is the wireless transfer of data to or from electronic tags that are attached to items.

Standard label:



RFID inlay:



RFID tag on product:

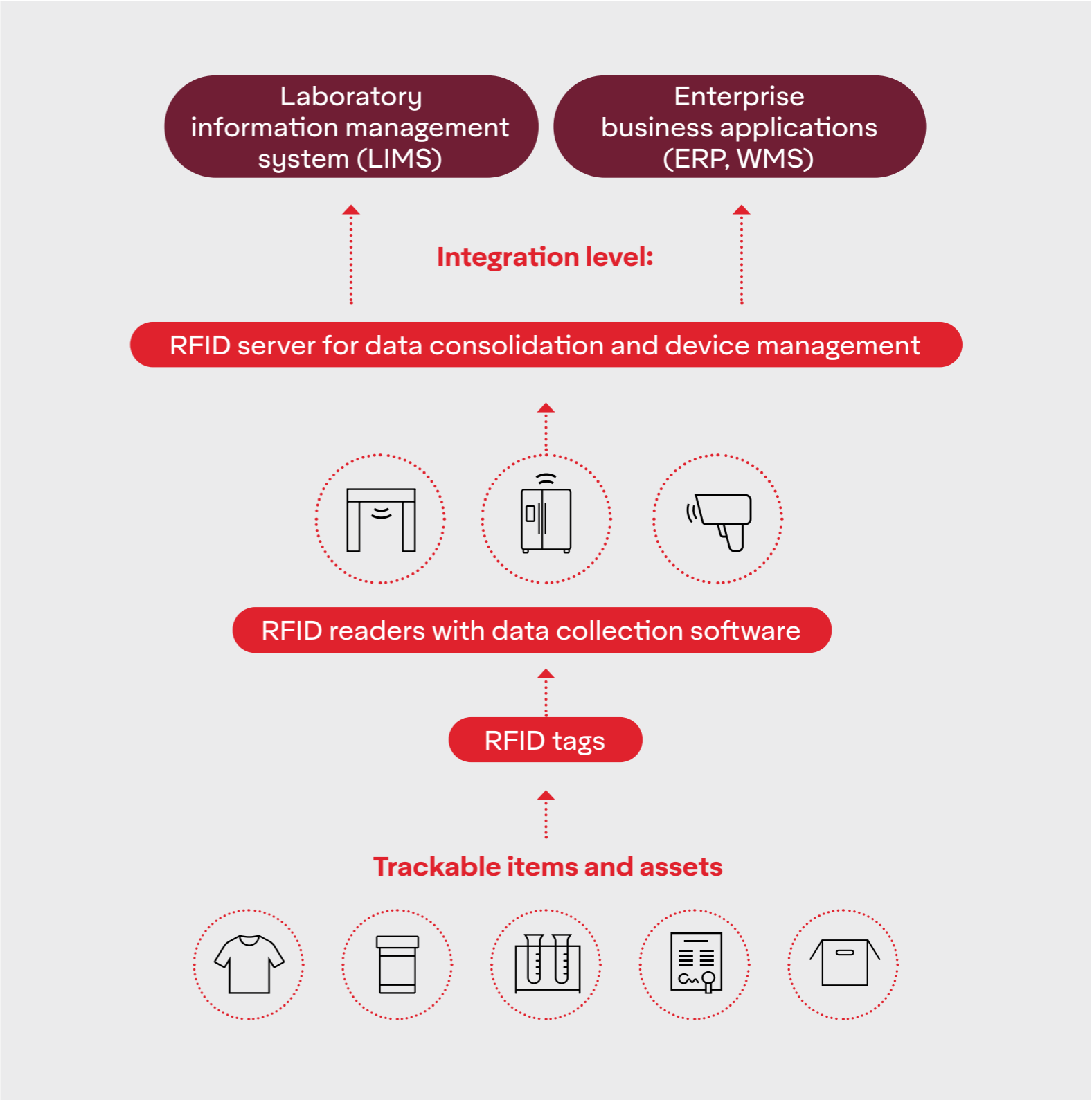


RFID systems

The primary components of RFID systems are the RFID tags and RFID readers with appropriate applications to energize the tags and collect the needed data.

Most solutions consolidate the collected data to a central database on a server or cloud, which also monitors system health.

Specialized RFID applications mediate between customer business applications such as LIMS (Laboratory Information Management System), ERP (Enterprise Resource Planning), Business Intelligence suites, and RFID equipment.



RFID systems

RFID has witnessed rapid adoption across multiple industries, from retail and logistics to healthcare and industrial manufacturing. The growth is forecasted to continue as users recognize the power of the technology in streamlining their supply chain and either reducing or re-allocating their labor force.

In healthcare, the use of digital identification labels is forecasted to grow at nearly 20% annually.<sup>2</sup>

US RFID in Healthcare Market<sup>2</sup>



# Digital identification technology

On average 8% of pharmaceutical stock either expires or is discarded annually, a global financial cost estimated at \$163 billion.<sup>3</sup>



## What is the true cost of lost inventory?

The reasons for this waste are often impossible to specify due to insufficient or missing data in the supply chain between producer and consumer. Creating a system that enables accurate, real-time data transfer from production, distribution centers, and healthcare facilities, to end consumers could eradicate wasted pharmaceuticals while enhancing sustainability and efficiency.

Furthermore, the personnel dealing with the errors often create “workarounds”, which result in more errors, creating a ripple effect in increased and often hidden costs. It is hard to quantify the true impact of avoidable waste in the supply chain on business drivers like sales, organizational efficiency, and sustainability. By implementing item-level digital identification, waste can be minimized through data-driven informed decision-making.<sup>4</sup>

**Studies in other industries have found that inventory management and product shipments reached 99.9% order accuracy when RFID was in use. In contrast, without RFID 69% of inbound orders contained errors.<sup>4</sup>**

## RFID vs Barcode



- No line of sight needed
- Readability of several meters
- One to many communication
- Extended amount of information unique per product



- Needs a line of sight
- Reads at close proximity
- Only one-to-one communication
- Delivers a limited amount of information

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## Benefits of RFID

- **Efficiency with reduced labor**
- **Speed and automation with no manual registrations**
- **Transparency with visibility on asset location**
- **Accuracy with fewer mistakes**

## Demonstrating the benefits of RFID for laboratories

In a laboratory context, the standard logistics process relies on labels with printed barcodes that are manually scanned. Every item needs to be verified with a close line-of-sight reading. In real-world situations, each handling brings the risk of read errors due to faulty scans, or handling accidents.

RFID simplifies scanning and provides numerous benefits. RFID tags do not need to be seen to be read like a standard barcode. An RFID reader automatically picks up all tags within the read zone and registers multiple tags in one scan.

These tags are digitally connected to internal systems and can be connected to partners' systems, which results in real-time accurate data on the status of every item. No manual data entry is needed. A laboratory process enabled with RFID saves time, reduces manual errors, and focuses staff productivity on core tasks.

# Clinical laboratories and RFID

**When using RFID for sample tracking, laboratories can ensure accurate temperatures and monitor the chain of custody.**



## Clinical laboratories and RFID

A former clinical laboratory CEO highlights the challenge, “Pre-examination processes are the leading source of laboratory errors due to their complexity. Any error in a clinical laboratory sample process can have severe consequences on patients’ treatment decisions and safety.

**“**  
**In clinical trials, there is no room for losing samples, either completely or by storing them in unfavorable conditions. Another sample could give flawed results, or especially in the case of biopsies, there might be no chance of getting another sample.<sup>5</sup>**

**”**

Shipping is the most vulnerable part of the process. It would be crucial to know exactly where the sample is, and it would be very beneficial to be able to make sure that the conditions in which the sample is kept are optimal. When connected to LIMS and other analytical tools, management can gain valuable insights into workflow bottlenecks, resource allocation, and process optimization.”

When using RFID for sample tracking, laboratories can ensure accurate temperatures and monitor the chain of custody. End-to-end sample workflow with RFID starts with tagging the specimen and assigning a physical location for it and ends with tracking the disposal of the sample. As a result, a transparent and traceable sample journey is guaranteed.

## Case study: Automating laboratory quality control with RFID

Any clinical laboratory striving to maintain stringent quality control must ensure an accurate and reliable test process. Our customer, an in-house clinical laboratory, automated their operations with the help of RFID to minimize manual errors. This enabled them to move their staff to more productive tasks.

The primary objectives of the RFID solution:

- Enhance sample traceability and chain of custody
- Minimize errors and reduce the risk of sample mix-ups and lost samples
- Improve regulatory compliance and accreditation
- Streamline quality control processes
- Increase operational efficiency and improve turnaround times

In the new system, every sample to be processed has an RFID tag attached, which gives it a unique digital identity. In the laboratory RFID gates and tabletop readers are installed at the key workflow checkpoints; sampling, storage, analysis, and disposal.

The readers register the unique identifier as samples pass through each stage. No manual scanning is required. At each stage, the product's status is updated in the LIMS, which receives the data from the RFID system. As a result, the laboratory has on-demand access to accurate sampling data.

## Results

By automating the capture of critical data, including item-level timestamps for every stage being recorded for monitoring and documentation, the quality control system has been made robust.

**By removing the need for manual sample manipulation, such as scanning and updating the LIMS, the new system saves up to 26.5 hours of work every week.<sup>6</sup>**

Furthermore, lost samples have been reduced to zero, removing the need for quality investigation. This positively impacts the bottom line and frees up laboratory staff to focus on value-added tasks.



Solutions for quality:  
Sample tracking process

Sampling

Physical sampling and assigning a tag ID to sample data.



Storage

Stationary verification of the sample collection in storage.



Analysis

Verifying the correct laboratory and the sample in the laboratory. Identifying the sample at the analysis station. Documented monitoring of the sampling process.



Disposal

Preventing the samples from returning to distribution. Documented disposal process.





## Application example: Ensuring chain of custody for laboratory samples

Laboratories striving to realize an end-to-end sample workflow must keep track of each sample's physical location and identity. Staff is required to log the entire process from specimen selection, collection, storage, and retrieval. Laboratories managed this process for a long time with the help of physical logbooks and handwritten labels on the samples. Today, many use LIMS, which still rely on a lot of manual inputs.

Using RFID for labeling of samples automates the sample tracking process. When a sample is sent by a vendor from a location, and received in a new location, RFID readers automatically register the new location, vendor, and timestamp the status.

Furthermore, should any sample need urgent processing, such information can be matched to the RFID tag, ensuring the system will prompt laboratory staff of priorities and help them locate the specimen easily. Finally, for temperature-sensitive samples e.g. requiring sub-zero conditions, the technology offers automatic tracking, promptly alerting on any temperature issues.

As RFID technology automates several process steps, the investment will pay off. Today highly qualified clinical laboratory staff need to dedicate 14% of their work time to manual data entry and administrative tasks, which can drop close to 1% of their time with the use of RFID technology.<sup>6</sup>

# Supporting the supply chain

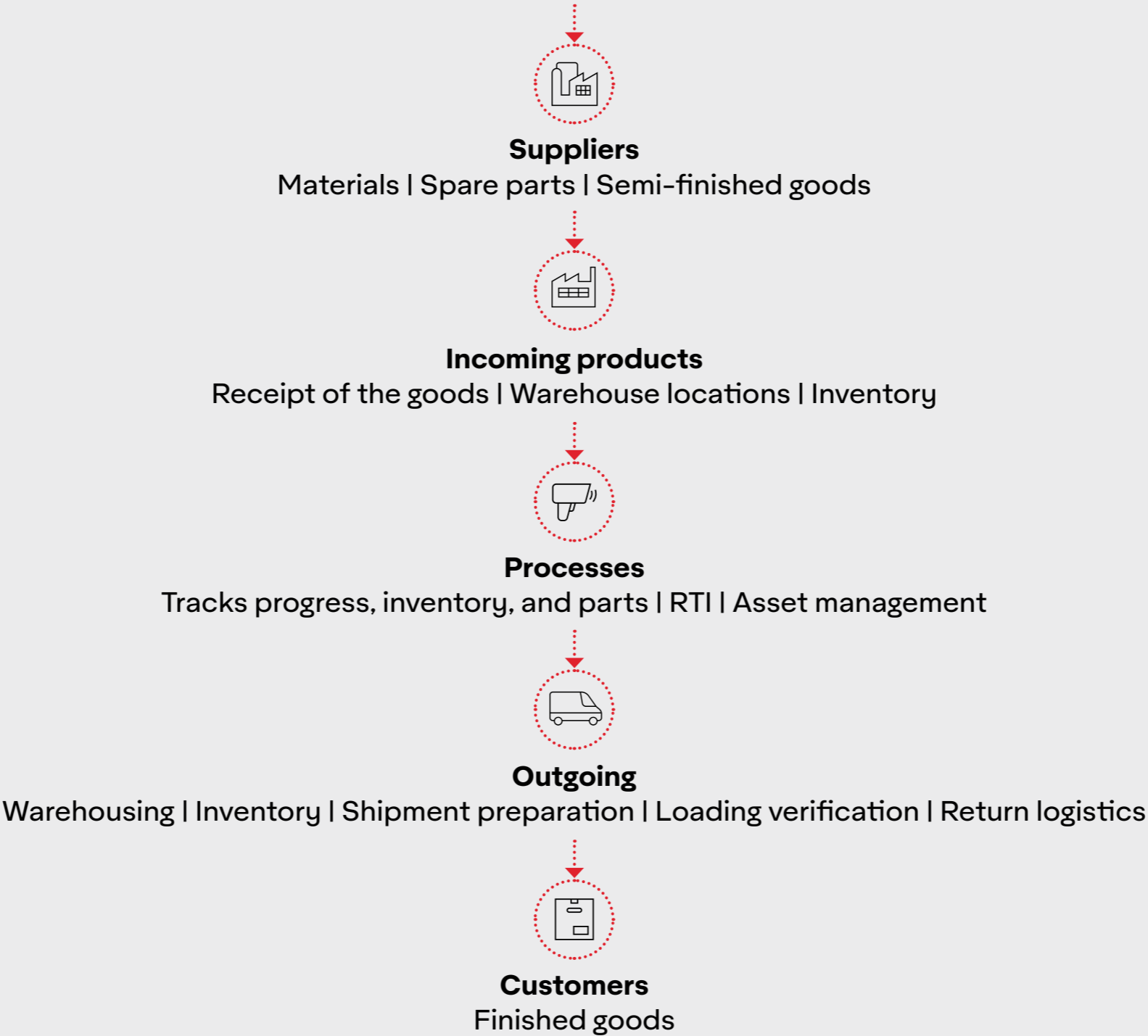
The importance of supply chains became apparent during the pandemic. The benefit of RFID in creating more reliable, efficient, and effective logistics across the entire supply chain is accurate data, both for real-time information and for insights to manage risk and optimize processes.

To reveal the full potential of RFID, the label needs to be applied at the source by the original supplier.

As the products are tracked throughout the entire journey to the end consumer, data instantly reveals problems, and over time it will improve informed decision-making.

This is the most effective system to ensure essential medicines and medical devices reach the people who need them when they need them, eliminating counterfeit products, and reducing waste.

End-to-end traceability protects from errors and counterfeit products



## Application example: Shipment verification of medical equipment

MedTech companies worldwide are under constant pressure to deliver high-quality products and services. They leverage cutting-edge technology for quality control and automation to ensure the absence of subpar products. However, the logistics and warehousing aspects often fall behind in terms of automation. Currently, their staff manually registers the picking, packing, and shipping of equipment, a time-consuming process that is prone to errors.

By implementing RFID technology within their delivery units, companies can significantly enhance shipping accuracy and ensure error-free deliveries. These delivery units can encompass a wide range of items, from large medical devices to boxes

filled with medical instruments or pallets containing multiple parcels. RFID equipment, including delivery stations, commissioning tables, and warehouse or distribution center gates, automatically cross-reference customer orders with delivery units and promptly flag any discrepancies.

This adoption of technology for shipment tracking not only improves accuracy but also leads to a remarkable 87% reduction in inward-outward shipment times, allowing staff to reallocate their time to more productive tasks.<sup>5</sup> Additionally, companies that embrace RFID for shipment verification experience a host of benefits, including a 99.9% delivery accuracy rate, a substantial decrease in customer claims, and significantly faster stock turnover.<sup>8</sup>



# Benefits of RFID in hospital environments

Hospitals typically lose up to 15% of their equipment and consumable assets every year. This translates into a cost per nurse of \$900, who are often tasked with finding missing medicines and equipment.<sup>2</sup>

## RFID used in healthcare facilities and laboratories ensures:

**01**

Inventory management of medical supplies

**02**

Asset tracking and inventory

**03**

Document tracking

**04**

Instruments tracking and cleansing process visibility

**05**

Textiles, beds, and other equipment usage visibility

**06**

Equipment in surgery rooms and ambulances accuracy

Hospitals are turning to RFID-based solutions to manage in-hospital logistics of patients, beds, and high-value equipment. However, the greatest opportunity for hospitals is automating inventory management for consumables, including medicines. In a typical hospital with hundreds of rooms that need to be stocked, and with a high turnover of patients, inventory management is a huge time drain on nursing staff.

In time-sensitive operating rooms, many hospitals improve safety and performance by using RFID technology to ensure fully stocked surgical trays. Saving time and reducing delays.



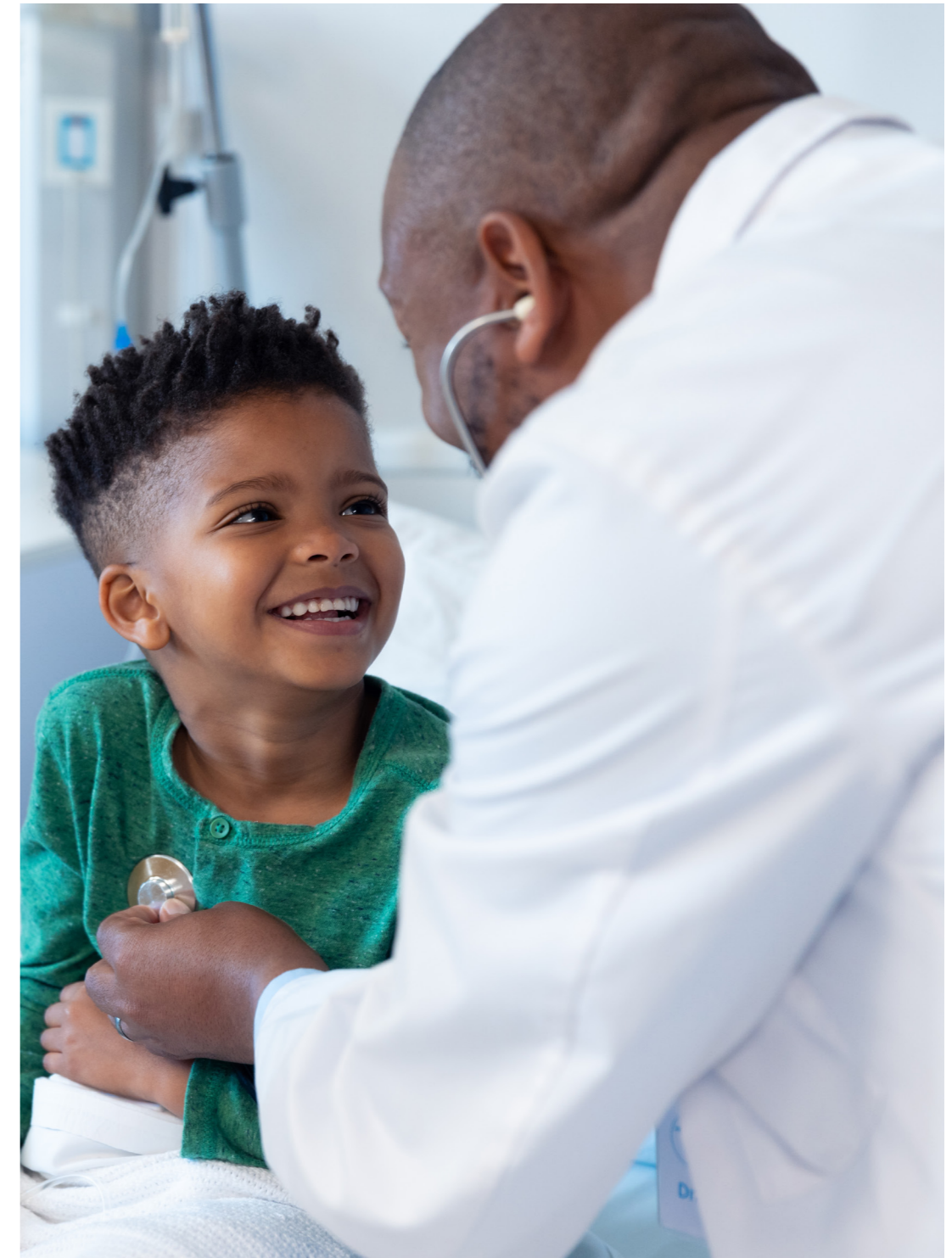
## Case study: New Children's Hospital – Finland

Finland's largest hospital is committed to providing the best treatment for children and their families. They aimed to create a positive environment where families could spend time as comfortably as possible. The hospital made it a priority to establish a patient process that was both efficient and seamless while also enabling swift and effortless communication among its staff within the facility. Technology played a pivotal and heavily relied-on role in realizing these goals.

For hospital managers, RFID is being used to give instant visibility to locate medical equipment throughout the nearly 50,000m<sup>2</sup> floorspace of the hospital. Over 100 fixed RFID read points are installed inside the new hospital, sending the last known location of the assets to the server, where the location of the tags can be viewed either from a report or a map of the floor plan.

**Real-time location allows operations to become more efficient and there is little time wasted on seeking the necessary equipment.**

With little change to the usual daily processes, the staff now uses their time more effectively, which in return provides the young patients and their families a more relaxed overall experience.

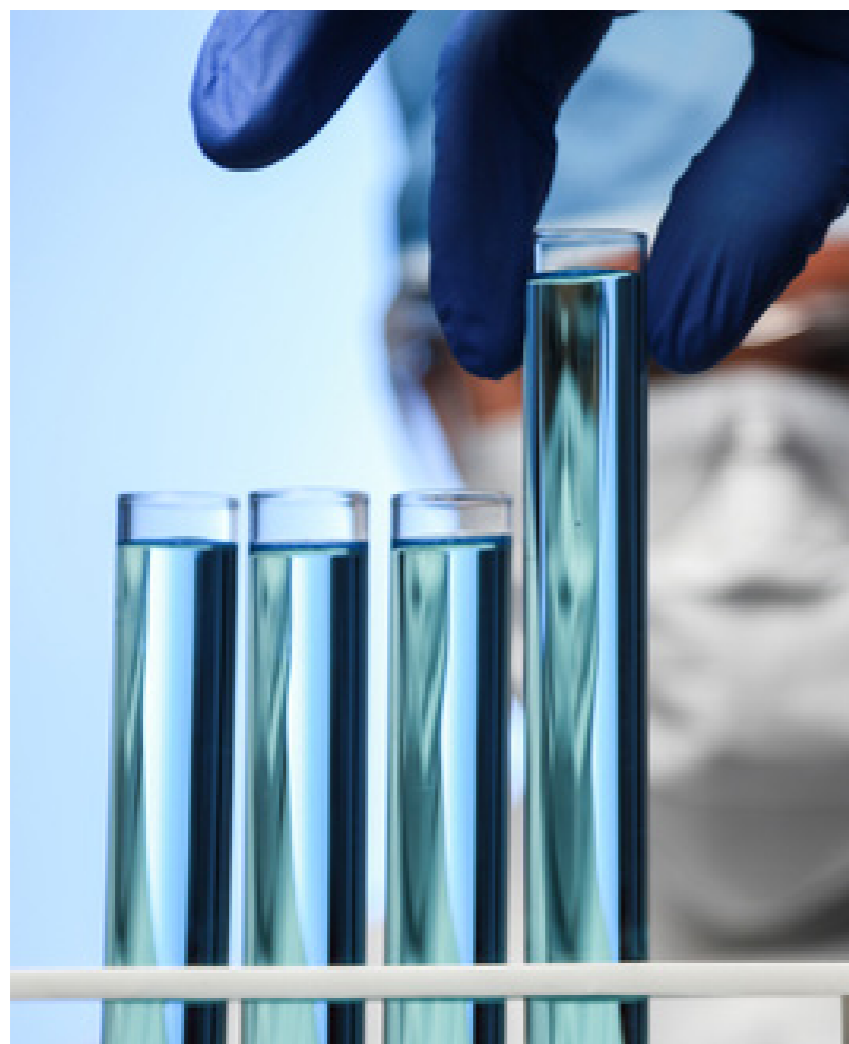


# Futureproof your systems

We started by asking what we have learned in recent years in the healthcare industry. In short, we have experienced that to deliver the quality and service we would all want to receive, it is imperative to reconsider the support and tools provided to highly qualified healthcare staff.

## Futureproof your systems

For hospitals and their partners, including laboratories and suppliers of medicines and equipment, working with digital identification technologies creates a flywheel of improvements.



### 01

**Inventory Management:** real-time tracking of medical supplies, ensuring that hospitals and labs always have essential items on hand.

### 02

**Efficiency in Laboratories:** Diagnostic labs can use RFID to track processes, reduce errors, and automatically update Laboratory Information Management Systems.

### 03

**Asset Tracking:** Expensive medical equipment can be tracked to be readily available when needed, equally reducing theft or misplacement.

### 04

**Data and Insights:** Manual data entry is expensive and risks errors. With RFID data is captured automatically and accurately, ensuring that patient records, sample data, and inventory levels are always accurate and up-to-date.

### 05

**Patient Experiences and Safety:** In hospitals, RFID wristbands can monitor patients, ensuring they receive the correct medications and treatments, and enhancing patient safety and comfort.

### 06

**Supply Chain Transparency:** For medicine and equipment suppliers, RFID provides end-to-end visibility of products. This transparency ensures that products are stored and transported under appropriate conditions, maintaining their efficacy.

### 07

**Anti-counterfeiting:** RFID tags can authenticate products, ensuring that only genuine medicines reach patients.

### 08

**Regulatory Compliance:** With accurate tracking, healthcare providers can easily adhere to regulatory standards, ensuring that medicines and equipment are stored, used, and disposed of correctly.

Transformative approaches to healthcare processes start with a progressive leadership mindset. The early adopters of digital identification technologies in clinical laboratories and healthcare providers are experiencing a multitude of benefits beyond their initial goals. RFID will continue to enable best-in-class efficiency and service quality and provide leadership with the necessary insights for informed decision-making, keeping them ahead of the digital transformation curve.

## Appendix

<sup>1</sup> For more on RFID in retail: “CHIP Proof-of-Concept Whitepaper.” 2021, Auburn University RFID Lab

<sup>2</sup> Grand View Research. (n.d.). (rep.). RFID in Healthcare Market Size, Share & Trends Analysis Report by Product (Systems & Software, Tags), by Application (Blood Tracking, Patient Tracking, Pharmaceutical Tracking, Asset Tracking), by Region, and Segment Forecasts, 2023-2030. Retrieved from [www.grandviewresearch.com/industryanalysis/rfid-in-healthcare-market](http://www.grandviewresearch.com/industryanalysis/rfid-in-healthcare-market)

<sup>3</sup> “The Missing Billions: The real cost of supply chain waste.” 2022, Avery Dennison. The estimate is based on ‘inventory lost or wasted’ feedback from research respondents calculated against inventory carrying costs gleaned from balance sheets of Fortune 500 companies. This has then been extrapolated to the global market size of each sector estimated by Statista

<sup>4</sup> “EPC/RFID Data Exchange Study: Project Zipper Executive Summary.” 2018, Auburn University RFID Lab and GS1 US®

<sup>5</sup> Krohn et al: Laboratory Sample Tracking - Expert Interview. 2023 March 7-8

<sup>6</sup> Säilä et al: Turck Vilant Systems Customer Research 2023

<sup>7</sup> Unhelkar et al.: “Enhancing supply chain performance using RFID technology and decision support systems in the industry 4.0 – A systematic literature review”, International Journal of Information Management Data Insights 2 (2002)

## Avery Dennison

Avery Dennison Corporation is a global materials science and digital identification solutions company that provides branding and information labeling solutions, including pressure-sensitive materials, radio-frequency identification (RFID) inlays and tags, and a variety of converted products and solutions. The company designs and manufactures a wide range of labeling and functional materials that enhance branded packaging, carry or display information that connects the physical and the digital, and improve customers’ product performance. The company serves an array of industries worldwide, including home and personal care, apparel, e-commerce, logistics, food and grocery, pharmaceuticals and automotive.

[rfid.averydennison.com](http://rfid.averydennison.com)

## Turck Vilant Systems

Turck Vilant Systems delivers turnkey track & trace solutions for manufacturing, logistics and healthcare customers worldwide. Our in-house developed track & trace platform comprises an intelligent RFID system. In addition, it expands to utilize active tracking elements, such as BLE, GPS, or other IoT equipment when needed. Our platform includes RFID middleware for different read points and an RFID server on-premises or in the cloud for data mining, system maintenance and integration with enterprise IT systems such as ERP, LIMS and WMS. We equip hospital floors, stock rooms, dock doors, forklifts, mobile devices, and conveyor belts with RFID to track samples, documents, individual products, boxes, roller cages, or pallets.

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