International Coalition of Medicines Regulatory Authorities (ICMRA)

RECOMMENDATIONS ON COMMON TECHNICAL DENOMINATORS FOR TRACK AND TRACE (T&T) SYSTEMS TO ALLOW FOR INTEROPERABILITY

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TABLE OF CONTENTS

List of acronyms used in the text

AIDC	Automatic Identification and Data Capture
CBV	Core Business Vocabulary
EMVO	European Medicines Verification Organisation
EPCIS	Electronic Product Code Information Services
EU	European Union
FHIR	Fast Healthcare Interoperability Resources
GDP	Good Distribution Practic
GTIN	Global Trade Item Number
ICMRA	International Coalition of Medicines Regulatory Authorities
ICCBBA	International Council for Communality in Blood Banking Authomation
IDMP	Identification of Medicinal Products
IEC	International Electronic Commission
ISBT	International Society for Blood Transfusion
ISO	International Organisation for Standirzation
MAH	Marketing Authorisation Holder
PhPID	PHarmaceutical Products IDentification
QR code	Quick Response code
RFID	Radio-Frequency IDentification
SMS	Substance Management Services
SRS	Substance Registry Services
T&T	Track and Trace
US	United States
VRS	Verification Route Service
WHO	World Health Organisation

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78
79
80

EXECUTIVE SUMMARY

The project built on the work previously published by ICMRA in 2017 and was carried out in parallel to the development of a T&T systems policy at WHO. This document provides technical recommendations which focus on interoperability rather than on single systems design and complements the WHO policy. ICMRA and WHO have worked in close cooperation in developing their respective documents, which include common parts (mapping of existing and planned T&T systems and glossary).

The 2017 ICMRA paper briefly analysed what the potential public health benefits of interoperability are. As common understanding of the benefits is key to promote global planning and implementation of interoperable systems, this document analyses further these potential benefits (section 4) and provides detailed use cases.

Technical features which would allow national/regional systems to be interoperable are provided in section 5, including identifiers of products, standards, data elements, data carriers, transitional and master data, traceability, information exchange. This section provides important recommendations e.g. on the use of Common Data Coding Standards and Common Data Carriers.

As regards coding standards, the 2017 paper stated that systems should be based on internationally agreed standards that allow for interoperability. This principle is strongly endorsed here, taking into consideration that different, sector-specific international standards are established such as GS1 standards, applicable inter alia to pharmaceuticals, and ISBT 128 standard from ICCBBA to identify medical products of human origin (including 180 blood, cell, 181 tissue, milk, and organ products).

Agreement of authorities on a single international standard (or one standard per defined sector) is a pre-requisite for transactional interoperability, e.g. in cases where data carriers shall be scannable in different system environments.

The 2017 paper also states that ‘data matrix barcode is one of the economical solutions in use in most of the current and planned T&T systems and appears to be the most cost-effective solution.’. This principle was endorsed and reinforced.

Section 6 builds on the recommendations in the previous sections and provides an example of a possible system architecture to illustrate how the principles and recommendations above can be

applied in practice. The system architecture described is an example and does not exclude other equally valid solutions.

An update of the mapping of existing and planned T&T systems worldwide published in 2017, developed jointly by ICMRA and WHO, is published as an annex, and a glossary, proposed by medicines regulators and private sector participants, should facilitate stakeholders' understanding of the challenges of T&T systems interoperability. The glossary has been to be understandable by experts, as well as other stakeholders, including regulators and personnel in the private sector with some technical knowledge.

1. SCOPE

For the purposes of this document T&T systems include:

- Full T&T systems (systems which allow full traceability of the product transactions and/or other supply chain events from beginning to end of its supply-chain, including the agents in the middle e.g. distributors)
- End-to-end systems (systems which allow verification of the product only at the beginning and at the end of its supply-chain) and
- Systems in-between (selected verification between the beginning and the end of its supply-chain, in addition to end-to-end).

These recommendations focus on T&T systems for finished medicinal products (drug products) for human use. Some of the recommendations however might be extended or adapted to other products (e.g. active substances, finished medicinal products for veterinary use, medical devices etc.).

In developing this document, it has been considered that:

- Several T&T systems are already in place or in the final stage of planning
- Most of the existing and planned T&T systems focus on medicines for human use
- Although theoretically T&T systems can be used for active substances, excipients, etc., most of the existing and planned T&T systems have been developed for or include finished products
- Interoperability among T&T systems is dependent on the establishment of a set of minimal common global technical features and standards.

2. BACKGROUND INFORMATION

The International Coalition of Medicines Regulatory Authority (ICMRA) is a global coalition of regulators who work together on matters of common interest or concern**(1)**.

Supply Chain Integrity has been identified as an ICMRA priority area, and the ICMRA work has focussed on alignment of existing and planned Track and Trace (T&T) systems for medicines, with a view to facilitating their interoperability as, to date, existing T&T systems for medicines have been designed with a national or regional focus only.

ICMRA published a paper on this subject in 2017**(2),** which built on previous work carried out by the World Health Organisation (WHO)**(3)**. This paper was developed by regulators from ICMRA participating authorities.

The 2017 document provided high-level recommendations on future interoperability of T&T systems, including some limited details on common technical features that T&T systems should present to enable interoperability.

After publication, it was agreed that more detailed technical recommendations were needed to make a real impact, and that complementary expertise from the private sector was necessary, in addition to that of regulators. A joint regulators/industry working group was formed, which has developed the present paper.

Regulators from ICMRA participating authorities could volunteer to be part of the group, while experts from the private sector were selected through a public call for expression of interest. Although the present document has been developed by the joint working group, final adoption is under ICMRA responsibility at plenary level (regulators only).

3. METHODOLOGICAL NOTES

Interoperability

Interoperability was defined in 2017 as: 'The ability of T&T systems to exchange information and make use of the information received from other systems.' This definition is still valid, and has been complemented in the present paper, by defining 'types of interoperability' applicable to different situations, as Information exchange and Transactional interoperability (see also glossary):

- *Information exchange* is the type of interoperability where information is exchanged between the interconnected systems without triggering a status change for a product, batch, and/or pack in the receiving system. Examples include the active notification of connected systems by the originating system about a quality defect (push principle) or the request from a system to be connected to another to retrieve the status of a pack e.g. 'commissioned', 'shipped', 'received', 'decommissioned' (pull principle). Information exchange is assumed to be the easiest to implement.
- *Transactional interoperability* means that a transaction in one system is extended to and/or shared automatically with another system. Transactional interoperability is more complex to achieve with the complexity depending on the functions that shall work across systems. For example, it would be less complex to implement a function that allows for a batch recall across systems compared to the interoperability of full T&T systems where product pack movements and related events are tracked across systems along their way through the supply chain.

It was considered that interoperability could be applied at different levels e.g.:

- A product (or a product class/category)
- A batch / a set of batches (of a product)
- A pack / a set of packs (of a product) that belong to a specific batch of that product
- A product component such as API's, other substances, packaging material, etc.

Aggregation

The concept of aggregation (see glossary) was introduced.

Standardized Information Included in the Carrier

The 2017 paper stated that: ‘Every pack of medicinal product on the market should carry some common standardised information, including: International Common Product Identifier, International Batch Number and expiry date.’

It was assumed that every pack of medicinal products would be identified with a product code, product license number, or similar product identifier according to applicable market requirements and carry a unique batch number. In combination, this would ensure the identification of each batch. Consequently, the group did not need to develop the concept of an ‘International Batch Number.

In the future however the concept of an International Common Product Identifier will have to be developed, as a common way to uniquely identify products which are the same but may differ in for example labelling/packaging for different jurisdictions.

4. BENEFITS ARISING FROM INTEROPERABILITY

T&T systems provide numerous Verification, Tracking and Alerting benefits. These include aspect such as real time notifications of falsified/unfit products, tracking product recalls, alerts to product quality issues and so on, as well as supply chain management aspects such as efficient commissioning/decommissioning of products, equivalency identification, information exchange about suppliers/products/facilities/etc..

Benefits Arising from Interoperability were defined in the 2017 paper as:

- Enhanced traceability: regulators knowing where the product has been before reaching their jurisdiction and/or from real time localization of products outside their jurisdiction
- Minimizing patients' exposure to risk associated with defective health products: upon receiving immediate notification of a product quality and safety issue, regulatory authorities taking fast actions in their jurisdiction and concerted risk mitigation actions with regard to this or similar product across all the markets where the product is distributed.

This definition was still considered valid, however defining these benefits more specifically and providing use cases was seen as a useful step forward to promote interoperability among decision-makers.

The use cases describe objectives that could be achieved by having interoperable T&T systems, in the format of user stories, which include: the type of user / party that could benefit, what is the desired benefit or goal and the reason why this is beneficial, together with alternatives that could achieve the same objective, although less efficiently.

Each use case is followed by an Interoperability Classification section, which refers to the categories outlined in section 3, and by implementation considerations, which details enablers and barriers. As some of the implementation considerations go beyond the specific use cases, general implementation considerations are presented in the first table below. Specific implementation considerations are then included in each use case.

The use cases presented aim at illustrating areas where interoperability of T&T systems for medicines is considered to bring benefits to public health. These areas include (the list is not exhaustive):

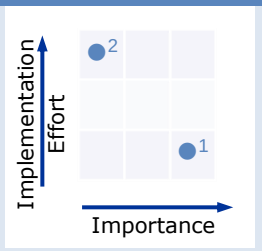
- Fight against falsified medicines
- Facilitate batch recalls
- Improve pharmacovigilance
- Reduce shortages of medicines.

The purpose of the use cases is to illustrate future opportunities and possibilities that would arise from interoperability of T&T systems, as well as constraints that need to be overcome. It does not imply their future implementation, which would be subject to the appropriate decision-making process and could vary among jurisdictions.

General Implementation Consideration	
Technical Enablers • Interconnected T&T system (currently not existing) • Use compatible open standards for the capture and exchange of traceability data (e.g. ISO/IEC 19987,19988 – EPCIS & CBV, IDMP PhPID)[1]	**Procedural Enablers** • Governance to define requirements and to control interoperability (currently there is some localized governance but not at a global level) • Agreed procedures to allow controlled access to data in non-local T&T databases (currently not existing)
Barriers • Technical barriers as establishing interconnected T&T systems globally is technically not easy and needs economical and human resources • Procedural barriers as establishing and operating harmonized processes across systems / jurisdictions and standardization of interfaces is difficult (e.g. it might entail creation/identification of an international body for this purpose) • Legal barriers related to access / share of some confidential information across databases operated / governed by regulators / other parties from different jurisdictions • Political barriers related to allowing regulators from other jurisdictions to access data in local databases	

[1] ISO/IEC 19988 defines the Core Business Vocabulary (CBV) to specify various vocabulary elements and their values for use in conjunction with the ISO/IEC 19987 on EPCIS standard, which defines mechanisms to exchange information both within and across organisations.

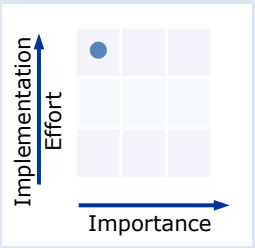
https://www.iso.org/standard/66797.html

Use Case 1: Accelerated Alerting Between Regulators About Falsified Medicines Incidents	
Use Case Description • As a patient, I don't want to get in contact with falsified products • As a regulator I want to take timely action and protect public health, including alert other regulators and the public and receive alerts from other regulators in the shortest time possible about falsified products that have penetrated the legal supply chain,	 Two scenarios apply: 1. Import without change of batch number and product code (e.g. under special import license for hospital trusts) 2. Import resulting in different batch number and product code
Benefits • Information regarding suspect falsified products which penetrated the legal supply chain could be shared among regulators in real time through the interconnected systems • It would be possible to start investigation, regulatory and risk management actions in a timely way with the further option of stopping in real time the dispensing of packs of the suspect falsified products which has entered the global legal supply chain e.g. in another jurisdiction • Timely information to the public and increased safety and vigilance	
Alternatives Exchange of information among regulators using existing channels (e.g. WHO Global Surveillance and Monitoring System, WHO Global Medical Product Alerts, National or Regional Networks or Rapid Alert System, normal emails/fax/phone calls).	

Interoperability Classification	
Type of Interoperability	• Information Exchange to alert regulators in connected countries • Transactional Interoperability to stop dispensing in multiple jurisdictions
Interoperability applied to	A batch / a set of batches (of a product) or a pack / a set of packs
Exchange of Expiry Date Information	Required as part of exchanged information in case falsification carries valid batch ID or an expiry date other than the expiry date of the original batch
Common Global Data Coding Standards and Common Data Carrier	Required to allow for identification of physical packs in jurisdiction other than the original country of destination in both scenarios #1 and #2

Implementation Considerations	
Technical Enablers • 'Alert Falsification Function' or equivalent in the interconnected systems	**Procedural Enablers** • Agreed procedure governing the use of the 'Alert Falsification Function' or equivalent
Barriers • There is no foolproof method to detect falsified products, but such measures can facilitate earlier detection and response to falsified products • Falsification of presentation of a product in one country usually does not allow to conclude that presentations in other countries are equally affected by the falsification	

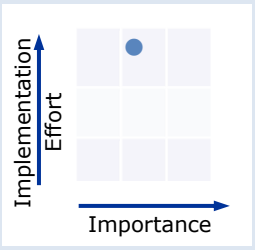
277
278

Use Case 2: Enhanced Traceability of Products in Case of a Falsified Product Detection	
Use Case Description • As a regulator, I want to have access to traceability information to support investigating falsification incidents • As a supplier, I want to know in the shortest time possible if a product I have in my possession is at risk to be falsified	
Benefits • It would be possible to determine where falsified products (e.g. packs of a falsified medicinal products) have penetrated the global legal supply chain and where they have been distributed globally)	
Alternatives Exchange of information among regulators and suppliers using existing channels (e.g. WHO Global Surveillance and Monitoring System, WHO Global Medical Product Alerts, National or Regional Networks or Rapid Alert System, normal emails/fax/phone calls).	

Interoperability Classification	
Type of Interoperability	Transactional interoperability to track products across multiple systems; information exchange to retrieve traceability information from multiple systems
Interoperability applied to	A pack / a set of packs
Exchange of Expiry Date Information	Not required but encouraged as it could help with investigation of falsification incidents
Common Global Data Coding Standards and Common Data Carrier	Required to allow for identification of physical packs across jurisdictions

Implementation Considerations	
Technical Enablers • Global unique product identifier (e.g. GTIN) • Global unique pack identifier i.e. unique product identifier + serial number • Interoperability where products are tracked & traced through multiple T&T systems (e.g. US pack can be tracked in EU system)	**Procedural Enablers** • Ensure implementation of full T&T systems across jurisdictions • Define and agree upon the data model, the interface, the SLA, the governance, etc. • Agreed procedures for exchange of information among regulators through T&T systems in case a falsified product is detected in the legal supply chain
Barriers • There is no foolproof method to detect falsified products, but such measures can facilitate earlier detection and response to falsified products • Scenario restricted to cases where falsified packs have penetrated T&T systems (have entered the legal supply-chain).	

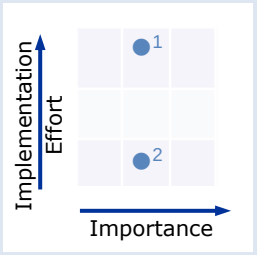
279
280

Use Case 3: Verify Product Outside Country of Destination	
Use Case Description • As a patient, I want to verify a product I purchase abroad e.g. it is not falsified • As a supplier, I want to verify a product I purchase abroad, so that I can reduce the risk e.g. of supplying a falsified product	
Benefits • Increased patient safety and vigilance	
Alternatives • Stand-alone (e.g. Brand owner) verification apps (these would be less effective than national/regional systems • Effective local regulation and enforcement against illegitimate imports and/or falsification; however, this is assumed to be very challenging in many markets	

Interoperability Classification	
Type of Interoperability	Transactional Interoperability to verify individual product packs across jurisdictions
Interoperability applied to	A pack / a set of packs
Exchange of Expiry Date Information	Not required but encouraged as it could help with investigation of falsification incidents
Common Global Data Coding Standards and Common Data Carrier	Required to allow for identification of physical packs across jurisdictions

Implementation Considerations	
Technical Enablers • Global unique product identifier (e.g. GTIN) • Global unique pack identifier i.e. unique product identifier + serial number • Standardized information included in the carrier (e.g. Product Identifier, Batch number, Expiry Date, Serial Number) • Cross-system authentication standards and capabilities (e.g. multi-market pack model in the EU, or VRS model in the US)	**Procedural Enablers** • Inter-system/legislation agreements on cross-use of systems and data
Barriers • There is no foolproof method to detect falsified products, but such measures can facilitate earlier detection and response to falsified/unfit products	

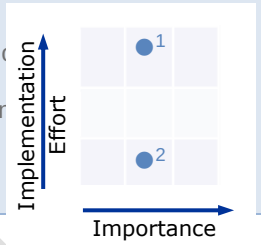
281

Use Case 4: Managing Batch Recalls	
Use Case Description • As a patient, I want the dispensing of a defective product be stopped in the shortest time possible • As a regulator, when a product is recalled (e.g. in case of a serious quality defect) or a safety issue), I want to execute the recall in the shortest time possible (ideally real time) • As a supplier, I want to know in the shortest time possible if a product I have in my possession has been recalled (either in the jurisdiction where I am located or in other jurisdictions).	 [1] Information about location of products in the supply chain is exchanged among jurisdictions [2] Information about batches recalled is exchanged among systems in real time
Benefits • Recalls could be managed through the T&T interconnected systems (e.g. information on defective batches could be exchanged among systems) in real time, with the further option of stopping dispensing in real time) • It would be possible to inform through the system supply chain actors which held packs of the batch(es) recalled e.g. in other jurisdictions.	
Alternatives Cooperation with the MAH, which is obliged to have a system in place to track its products distribution and between authorities through existing channels (e.g. Rapid Alert System, normal emails/fax/phone calls), this however takes time and resources to be achieved.	

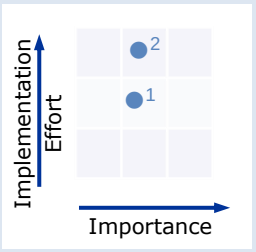
Interoperability Classification	
Type of Interoperability	• Information Exchange to inform users of connected systems about recall • Transactional Interoperability would allow batch recalls executed in one jurisdiction to automatically trigger a batch recall function in other jurisdictions; it would also allow continuous sharing of location information across jurisdictions • Visibility event data interoperability to locate products that have been recalled, and which may have been distributed.
Interoperability applied to	A batch / a set of batches (of a product).
Exchange of Expiry Date Information	Not required
Common Global Data Coding Standards and Common Data Carrier	Required to make practical real time identification of products and batches.

Implementation Considerations	
Technical Enablers • Global unique product identifier (e.g. GTIN) • Batch number that is unique for that product in different jurisdictions • Availability of a 'Dispense Pack' and 'Batch Recall' function across T&T systems	**Procedural Enablers** • Operation of a cross-systems 'Batch Recall' function for all connected jurisdictions, which could trigger a 'stop dispensing' function if allowed by procedures in place in the receiving jurisdiction. • Define and agree upon the data model, the interface, the SLA, the governance, etc.

Use Case 4: Managing Batch Recalls
Barriers Legal barriers as: • In case recall in one jurisdiction would trigger automatically a recall in another jurisdicti jurisdiction needs to allow for it, which currently is not the case • Confidentiality issues related to exchange of information in case information on location exchanged between systems.



283

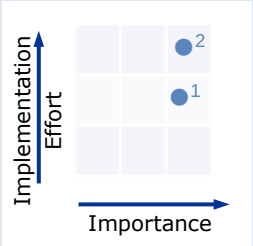
Use Case 5: Support Pharmacovigilance	
Use Case Description • As a patient, I want to avoid products for which a safety issue has been identified or is under investigation • As a regulator, I want to be alerted as soon as possible on pharmacovigilance issues; I also want to have access to traceability information to support pharmacovigilance and to improve the level of reporting of adverse events globally	 [1] Information exchange on products [2] Information exchange on products and substances
Benefits • It would be possible to exchange alerts among regulators through the interconnected systems in real time on a product, a group of products[2] (e.g. a group of products containing a substance of concern for which a pharmacovigilance issue has been identified) and, in case the interconnected systems were able to trace substances and other aspects, on the items of concern • Data on global distribution at patient level could be compared with reporting levels and help to inform the development of efficient pharmacovigilance systems	
Alternatives • Cooperate with the MAH who is obliged to have a system to track its products distribution, this however takes time and resources to be achieved • Cooperate with MAHs in order to access data on global distribution/sales of products	

Interoperability Classification	
Type of Interoperability	Information Exchange to share information among users of connected systems
Interoperability applied to	A product or a product class/category
Exchange of Expiry Date Information	Not required
Common Global Data Coding Standards and Common Data Carrier	Required to make practical real time identification of products

Implementation Considerations	
Technical Enablers • Global unique identifiers for products (e.g. GTIN) and/or substances and other aspects (e.g. linkages among individual GTIN numbers) in case the interconnected T&T systems are able to exchange information on substances, etc. (in addition to products)	**Procedural Enablers** • Agreed procedures use interconnected T&T systems in the management of pharmacovigilance cases

284
285

[2] Most of the existing and planned T&T systems currently have been developed for or include finished (drug) products, T&T systems however could be used for traceability of other aspects such as active substances, excipients, manufacturers etc.

Use Case 6: Enhanced Traceability of Products in Case of Shortages	
Use Case Description • As a healthcare professional and/or patient, I want the treatment I need to be always available • As a regulator, when there is a shortage of a product in my jurisdiction, I want to know in the shortest time possible (ideally real time) if in other jurisdictions there is availability of the same or similar products	 [1] Identification of the same products in interconnected systems [2] identification of the same or similar (e.g. same active substance) products in interconnected systems
Benefits • Interconnected T&T systems could allow regulators to identify real time the availability of the same product or alternative products in other jurisdictions • Relevant regulators or Marketing Authorization Holders could be contacted immediately to resolve the supply problem, communication would be more efficient and more targeted if the system could give real time information on availability	
Alternatives • Build dedicated inventory reporting systems that are interconnected with each other • Cooperate with the MAHs or regulators in other jurisdictions in order to find out if/where there is availability of the same or alternative products in other jurisdictions	

Interoperability Classification	
Type of Interoperability	Information Exchange to share inventory information across jurisdictions
Interoperability applied to	A product or a product class/category
Exchange of Expiry Date Information	Not required
Common Global Data Coding Standards and Common Data Carrier	Not required since use case does not require identification of physical packs across jurisdictions

Implementation Considerations	
Technical Enablers • Global unique Identifier to identify same product in other jurisdictions in product master data • GTIN for exchange of information about existing products; agreed global standardized definitions (i.e. ISO IDMP standards), technical standards for data exchange (i.e. FHIR) and terminology e.g. Substance Management System (SMS, SRS) for identification of similar/alternative products	**Procedural Enablers** • Regulators to actively manage drug shortages through agreed procedures involving T&T systems
Barriers • Both MAHs and regulators in country B (where there is availability) would need to agree to mitigate shortage in country A (where there is a shortage) by moving product from B to A • Proper shortage management. needs to consider MAHs' sales and production forecasts to avoid supply chain disorder • Need for Implementation of full T&T systems in connected jurisdictions to locate available inventory in a country • Further technical difficulties if the systems need to be able to identify and exchange of information among similar/alternative products among different jurisdictions	

286

5. RECOMMENDATIONS ON COMMON TECHNICAL DENOMINATORS FOR T&T SYSTEMS INTEROPERABILITY

This section focuses on common denominators for interoperability scenarios across track and trace (T&T) systems, following the different phases of T&T systems implementation, and considering systems already implemented and systems under development around the world.

As the ICMRA remit is medicines for human use and considering that several T&T systems for medicines are already in place or in the final stage of planning and most of them have been developed for tracking finished (drug) products, this section focus on T&T systems for finished medicinal products (drug products) for human use. Some of the recommendations however might be extended or adapted to other products (e.g. active substances, finished medicinal products for veterinary use, medical devices etc.).

RECOMMENDATIONS

Production and distribution of medicines are globalized and rapid exchange of information among regulatory authorities is integral to the protection of the supply chain integrity and patient safety. So far, traceability systems have been designed and implemented with a local or regional focus, without consideration as to their interoperability with other systems at the global level.

It is important to note that the common denominators identified in these recommendations are a prerequisite for interoperability but are not enough on their own to guarantee full interoperability across traceability systems. For example, some of the current traceability systems could not be fully interoperable because the architecture model of each traceability system is different: e.g. Point of Dispense Verification system in the EU and full Track and Trace system in the U.S.A. However, there is room for 'lower' integration (see also section 6).

Note: "UtBene" is a fictitious pharmaceutical product, used through this document. The packs and barcodes used throughout this document are not intended to comply with any regulatory labelling or global data standards and are shown for illustration purposes only.

To ensure clear recommendations on how interoperability can be achieved are presented, this document follows the different aspects of how track and trace systems are usually implemented. In simplest terms it is broken down into (1) the process of identifying a pharmaceutical pack using a globally unique product code, (2) the capturing of that identifier from a data carrier and (3) the exchange of information each time the pack is moved and data is captured within the system.

The Recommendations are provided in grey boxes below and are NOT presented in order of preference or importance.

A. Product identification

In the context of this document, the product being tracked and traced is a pharmaceutical pack. This is usually defined as the unit of sale or use, i.e. the pack which is dispensed to the patient in its market destination(s). The regulatory requirements are generally that the unit of use packing must be identified using a unique number specific to that product. This allows everyone in the supply chain to be sure they are referring to the same product. This is to ensure that each product is identified with a different identification number, so products do not get mixed up in the supply chain and/or at point if dispense.

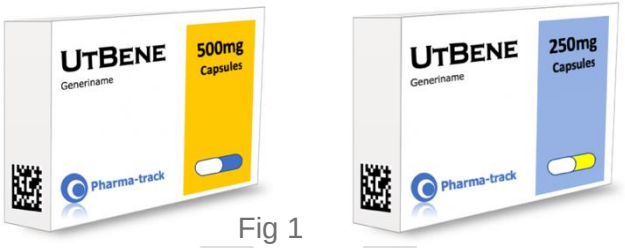


Fig 1

Figure 1 shows packs of two different pharmaceutical products, the first contains UtBene 500mg capsules and the second contains UtBene 250mg capsules. Each pack would be identified with a different product code to ensure the two products are distinguishable by product code.

Recommendation 1: Use numeric product identifiers: Product identification should ideally be based on numeric identifiers, instead of alphabetic ones. As countries use different alphabets the inclusion of letters within product identification can lead to interoperability issues between systems. This is illustrated below where the same word is shown is several different languages.

Product Продукт 产品 Ürün 製品 ഉൽപ്പന്നം

Recommendation 2: Enable the use of widely accepted international standards(4): It is essential that products can be uniquely identified on a global basis which is only possible if every country follows/aligns on the specifications defined by compatible international standards. A key to ensuring consistency and uniqueness, and thus interoperability, of the coding between T&T systems is the use of a single global data standard or "family" of standards. Although this document does not recommend a single data standard, it is acknowledged that at the time this document is written, GS1 standards are the most widely accepted and adopted international data standard for pharmaceuticals identification, coding and data exchange.

Product identification is not limited to product level only, there are more granular methods of identifying a product. Below is an illustration of packs belonging to the same product manufactured in two separate production batches. Every pack will have the same product code however the first five packs have a different batch number than the second five packs.

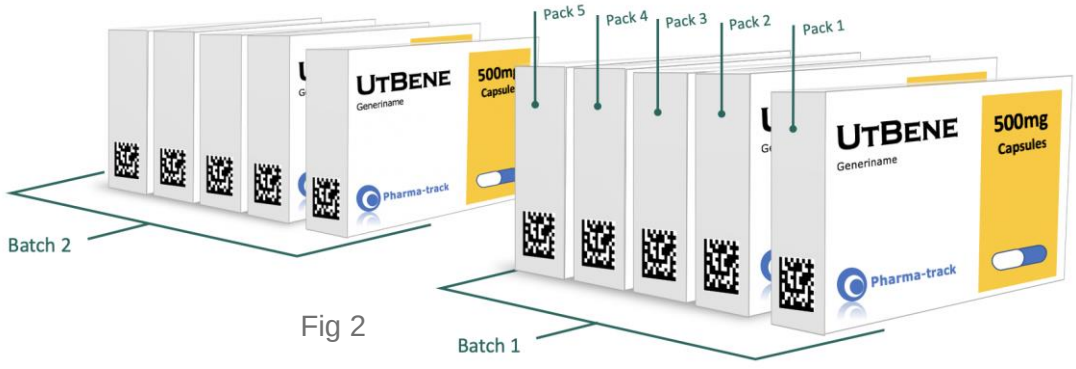


Fig 2

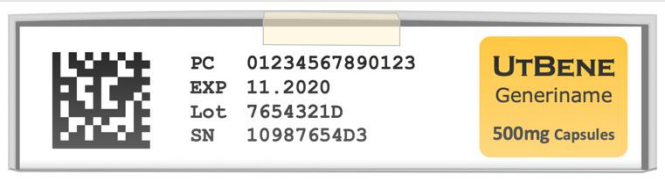
This extra level of identification and granularity enables not just the product to be tracked and traced but also to identify from which batch the specific pack comes from. This is especially important when it is necessary to capture the batch data within a business/regulatory process.

An additional level of granularity which can be added is the serialisation of each individual pack. This level of identification is more granular than based on batch numbers as the product code plus serial number identify uniquely and globally every single individual instance of every product. Serialisation of products allows for individual products to be tracked and traced through a supply chain, this in turn allows for the authenticity of an individual product to be checked as no two products will ever have the same identifying number. When a product is serialised, it is the combination of the product code and the serial number which ensures that the individual product is globally unique and can be unambiguously identified.

Usually when a pack is serialised the data carrier will then hold four pieces of information: product code, expiry date, batch/ lot number and serial number.

As for other system requirements addressed in this document, it is recognized that implementation of recommendation 3 for existing systems may take time. As an example, in China the data elements contain a drug identification code (corresponding to the product code) and a production identification code (corresponding to serial number, expiration date and batch number), in which the serial number is a compulsory requirement, while the expiration date and batch number are optional.

Recommendation 3: Use the four data elements: Align on the global framework of unique product identification of medicines which uses four data elements of coding, based on widely accepted global standards: a globally unique product code and a serial number which make the product identification globally unique, plus expiry date and batch/ lot number which are required in human-readable form and when encoded allow for the automation of business processes that require this information as input.



Within a supply chain, products are not shipped or stored as individual packs but instead they are often grouped into bundles, shipper cases and ultimately a pallet. After an individual serialised pack is placed into a bundle and then into a shipper case, it is not always possible to read the data carrier on the pack, which make it challenging to track and trace the pack through the supply chain since each supply chain actor would have to unpack pallets, shippers, and bundles to read the data carrier on each individual pack. Therefore, a process called “aggregation” is used**(5)**.

Aggregation is the creation of a hierarchical, parent-child relationship between a containing object (i.e., parent) and one or more objects (i.e., children) that are contained. Aggregation requires unique identification (i.e. serialisation) of both the parent (e.g. a bundle) and each child (e.g. the pack).

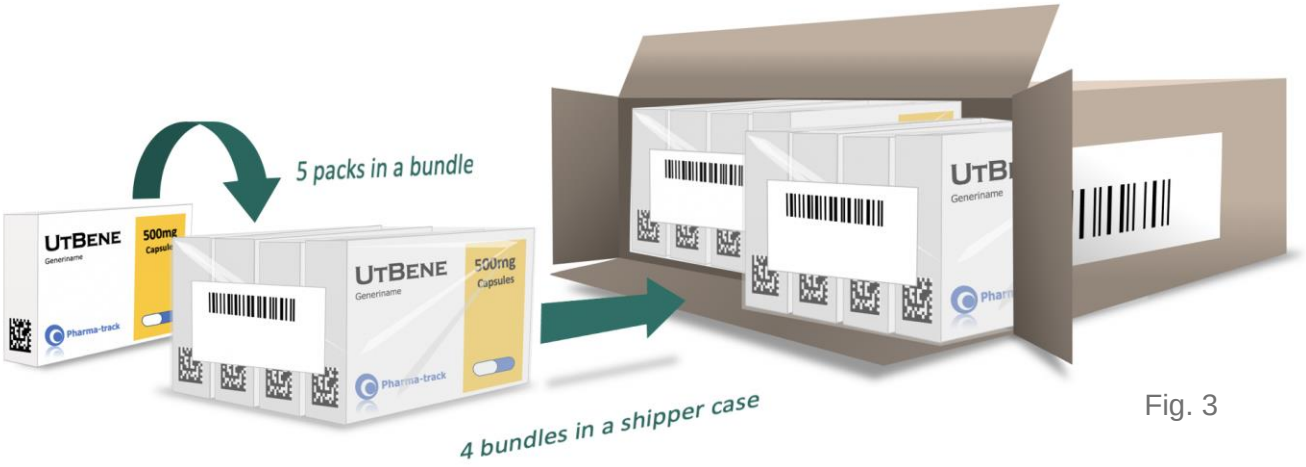


Fig. 3

In the example in figure 3 there are five packs in a bundle, by scanning each pack as it is placed into the bundle an association can be made between the five individual packs and the bundle. This aggregation is captured in an IT system so that when the bundle data carrier is scanned, the child can be looked up. A relationship can then be made between the four bundles in the shipper case and the shipper case itself in the same way. By working in this way, the relationships are built up so that a pallet data carrier can be scanned, and the shipper cases, bundles and individual packs inside can be looked up within the IT system. When a unit is moved or stored it can be scanned to capture the fact that all the units inside down to the pack level have also been moved or stored.

Recommendation 4: Provide clear requirements on packaging level identification: Provide clear guidance on identification and barcoding of the different packaging levels.
Aggregation should be allowed but not mandated. If aggregation is part of the specific country's traceability model, then details on how aggregation is structured, and the data model need to be clear, flexible and harmonised with other countries.
A suitable option for tracking of medicinal products is to trace data at secondary pack level but design a system that allows submission of aggregated data.

B. Data carriers, data fields and syntax

To allow the product to be identified in the supply chain it is necessary to mark or apply its identifiers on the physical pack, this is done using a "data carrier". There are many different types of data carriers, some of these are shown in figure 4, including the 2D/Matrix barcode (i.e. Data Matrix, QR code), RFID tag and 1D/Linear barcode.

Fig 4

2D / Matrix Barcodes

RFID Tag

1D / Linear Barcodes

Data carriers allow the identification information on the pack to be captured by a scanning device such as a barcode scanner or RFID reader. The automatic capture of the identification information prevents the need for the information to be gathered and input into a system manually, which is time consuming and error prone.

If different types of data carriers are used either on one level of the packaging hierarchy (e.g. items that depending on the product use different data carriers) or on the different levels of the packaging hierarchy (e.g. items using a different data carrier than shipper cases) then this can lead to scanning equipment in some instances not being able to scan the barcodes and potentially the IT systems not being able to process the data, especially where proprietary type data carriers are used.

Ultimately this prevents interoperability across track and trace systems.

Recommendation 5: Use ISO/IEC Data Matrix on secondary packaging(6): At this time ISO/IEC 16022 Data Matrix, an Internationally standardized two-dimensional (2D) barcode data carrier has been, and continues to be, the forward-looking data carrier of choice globally used in the implementation of Healthcare related traceability systems.
New Automatic Identification and Data Capture (AIDC) technologies continue to be developed and these developments should be monitored for applicability of use in globally implemented traceability systems. In order to ensure the stability, interoperability and global compatibility of traceability systems, there are several factors that must be carefully considered before adoption of a new AIDC technology:

- Is it globally standardised?
- Is it in the public domain i.e. non-proprietary?
- Has it been tested in real world use and at scale?
- Is it backward compatible with the AIDC technologies already in use?

Care and in-depth investigation must be taken when considering new AIDC technologies for use in place of or in addition to existing adopted solutions as, there is a high risk that introduction of new technologies will be more disruptive to healthcare traceability than beneficial.

Recommendation 6: The use of scratch-off mechanisms is not recommended: Scratch-off mechanisms add significant costs for manufacturers and do not significantly increase the overall security of the system.

Recommendation 7: Avoid mandating the use of RFID: Barcodes and RFID are different data carrier technologies and intermixing the use of barcodes with RFID will require two different types of data capture devices (i.e. a barcode scanner versus an RFID reader) at every point in the supply chain as well as the potential for different handling of the resultant device output. If the use of RFID is mandatory, it is important to keep the 2D/Matrix data carrier as a backup of the RFID and to interoperate with countries that do not mandate RFID.

Recommendation 8: Avoid mandating the use of 2D/Matrix bar code other than ISO/IEC Data Matrix on secondary packaging data carriers for product identification: Although 2D/Matrix data carriers other than ISO/IEC Data Matrix have been used on some pharmaceutical packaging, such as QR Code, their use has primarily been for purposes other than product identification, such as for access to product marketing information. Regulatory requirements for product identification and traceability have globally been focused on the use of Data Matrix as the single accepted data carrier, which can accomplish both the identification and marketing goals. Inclusion of alternate or additional data carriers on the same package or label is not recommended as it can introduce confusion, inefficiencies and errors.

Recommendation 9: Barcodes do not replace human readable information on the pack: barcodes shall only be used in addition to having the same information printed in human-readable format on the pack, next to the barcode or somewhere else on the pack.

To allow the data carrier to be read electronically and its contents properly processed, the data is encoded using a globally standardised syntax. This syntax is known by the scanning device which enables to read the data carrier and capture the data elements quickly and efficiently.

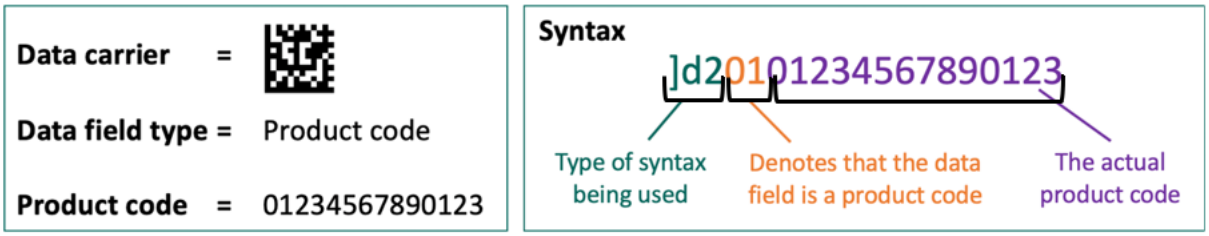


Fig 5

Recommendation 10: Use a globally standardised syntax: A globally standardised syntax issued by an approved standardisation body shall be used to ensure that scanning devices know how the data is encoded and are therefore able to read the data and interpret it.

As the name suggests, data carriers store data. On a pharmaceutical pack the data carrier will usually hold four data elements: the product code, serial number, batch number and expiry date (see Recommendation 3).

It is acknowledged that in some countries a national number, historically for reimbursement purposes, is given to a medicine and this is required on the pack and in the barcode (e.g. Italy, Spain, and Portugal). Where this is the case, interoperability will only be achieved if countries which do not require this 5th data element ignore it when processing the information. This is shown in the figure 6: Country A needs a national number and so captures, communicates and processes all five pieces of information whereas country B uses only four and therefore ignores the 5th data element in the barcode and the electronic message . National numbering systems become unnecessary when the four-element data set is used as described above. With this system, all other attributes (such as national number, price, etc) can in theory be derived by database lookup instead of printed on the pack.

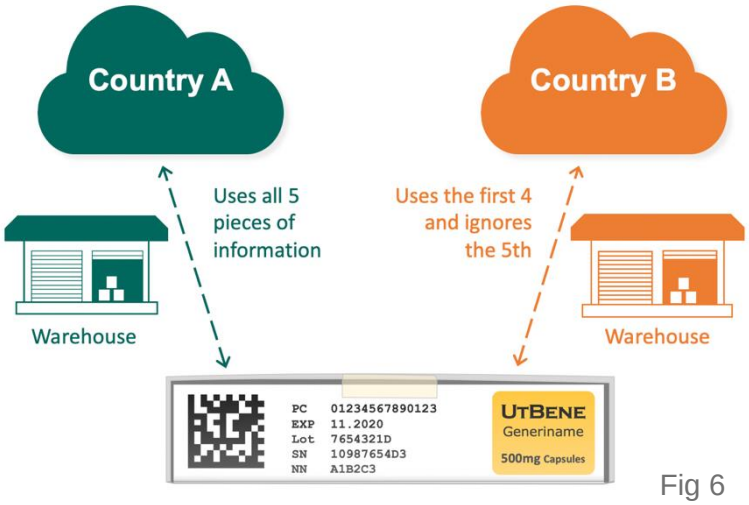


Fig 6

Recommendation 11: Avoid additional information in the barcode: In most instances any additional information can be stored as master data and looked up in IT systems using the product code as the primary key to access the information. This is how the product price is looked up in a supermarket when scanning a product at the cashier.

It is acceptable for different levels of packaging to use different data carriers (see Recommendation 6 on the avoidance of RFID) , this is because each data carrier has its own specific features, benefits and primary use cases, for example the Data Matrix barcode symbol can hold more information at a smaller size than a linear barcode even if it requires the use of a different type of scanner.

Note that there is no definition of tertiary package provided in global data standards, however the term most commonly refers to logistic units which are used to move and store products. Refer to local regulation and / or global data standard specification for more details.

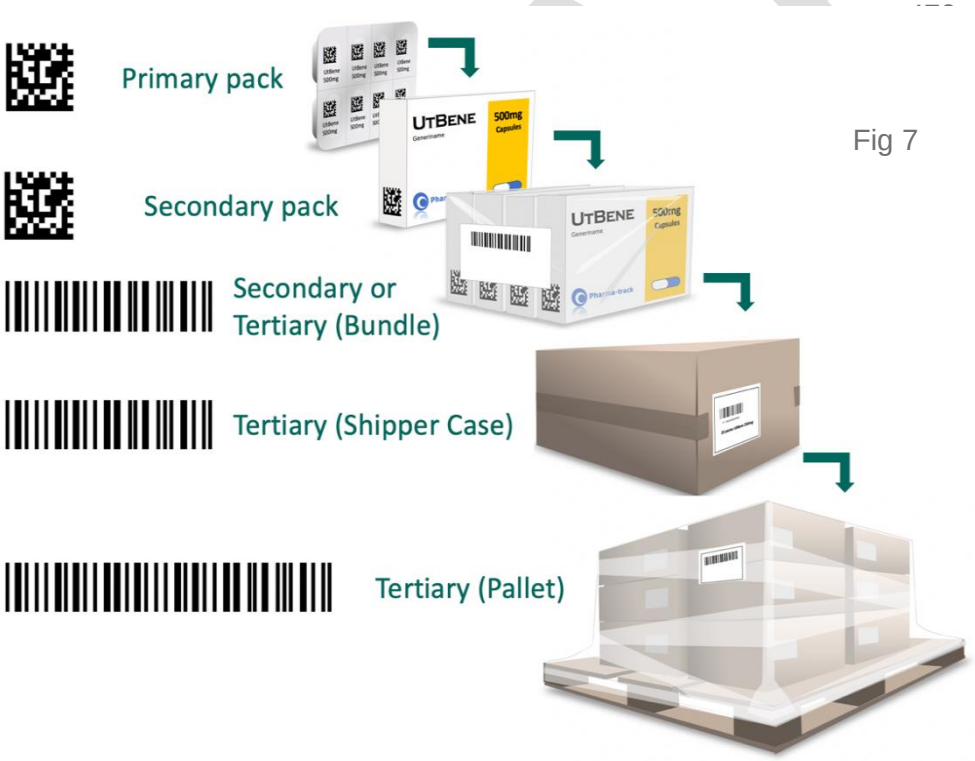


Fig 7

Recommendation 12: Use suitable barcodes for each packaging level and avoid multiple barcodes on the same pack: It is not necessary to use the same barcode type on all levels of packaging; however, the suitable barcode type should be used at each packaging level and this should then be used consistently across the globe to ensure interoperability.

Refer to widely accepted global data standards for additional information in the use of appropriate barcode symbols on packaging levels

Recommendation 13: Use only ONE barcode on a pack(7): Multiple barcodes on the same pack can cause confusion for users and could also increase patient safety concerns. For this reason, it is always best to only have ONE barcode on a pack.

C. Data exchange - product data, transactional data, and traceability data

For the purpose of this document, the focus is on data management. Data ownership and governance is not covered here.

In today's context of globalisation, medicines are very often imported or exported from one country to another. Even if the medicines and relevant packaging are duly identified and marked as per the requirements of the national T&T system of the exporting country and of the national T&T system of the importing country, the related traceability data must be reported and stored in the database of each country where the medicine will be marketed. Indeed, because the data exchange specifications of the national T&T systems are not interoperable, the national databases cannot be directly cross-referenced. Therefore, manufacturers and relevant supply chain stakeholders must implement one specific system for each country and must also develop and maintain more complex and costly data management processes and systems.

Below are recommendations focusing on the data model and data exchange elements needed to ensure the interoperability of T&T systems. Interoperability implies data exchange between T&T system across jurisdictions, as well as with other national / regional systems.

It may be necessary in the future to develop more detailed and specific guidance on global standards-based communications protocols within T&T systems.

5. CONSIDERATIONS ON POSSIBLE SYSTEM ARCHITECHTURES

This section focuses on the possible architecture for interoperable Track and Trace (T&T) systems. The possible architectures presented here take into account the systems that have been already implemented around the world**(8)** and are for illustrative purposed.

This section should be read in conjunction with the previous sections in this document.

DESIGN OPTIONS

Verification points

The number of possible data points in even a simplified supply chain, such as that shown in figure 9, is large. Collecting traceability data, especially at small unit level (e.g. packs) requires significant time and resources and generates costs.

When thinking about traceability systems for medicines, it is important to answer the hypothetical question: “who do we want to be able to verify the authenticity and origin of the medicine?” This could be the patient, or the last professional to handle the pack (usually a dispenser or pharmacist) or every stakeholder in the supply chain. Selecting these “Verification Point(s)” of the system then leads to various other decisions about how those checks should be conducted, as shown schematically in figure 8.

In order to make systems feasible and economically viable to operate, it may be necessary to prioritise a subset of data. Choosing the minimum useful architecture, and then building extra layers over time, is an option, in particular for those countries/regions which do not have a system in place yet. It also may allow a phased implementation approach, with learning along the way.

Figure 9 shows a model where traceability data are collected at each change of location and ownership. Green represents activities “upstream” of finished product (i.e. before most of the track and trace activities for medicines in systems currently implemented begin) and red represents downstream supply chain actions, after finished products are released to the market.

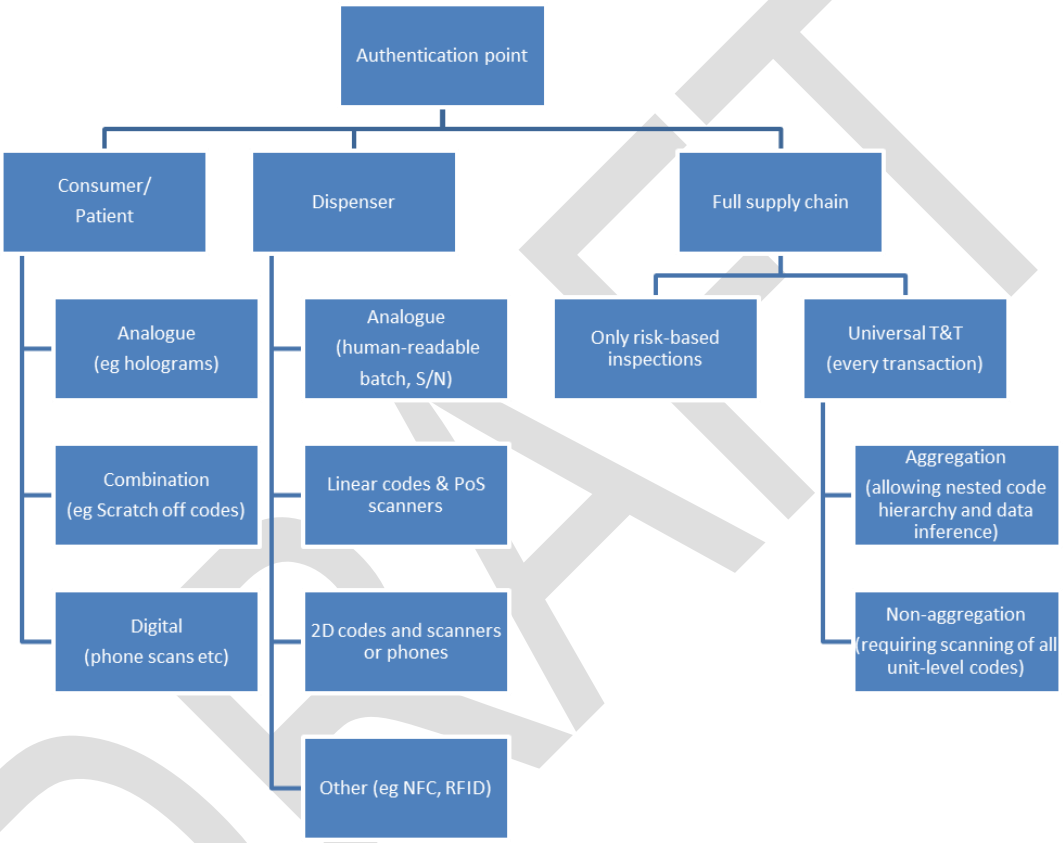


Figure 8: Decision Tree: In general, the traceability systems that are widely used today are designed to be operated by one or more elements of the supply chain, rather than by the patient. This is in keeping with the need of a quality-driven approach to the supply chain, as embodied in Good Distribution Practices (GDP) and other frameworks.

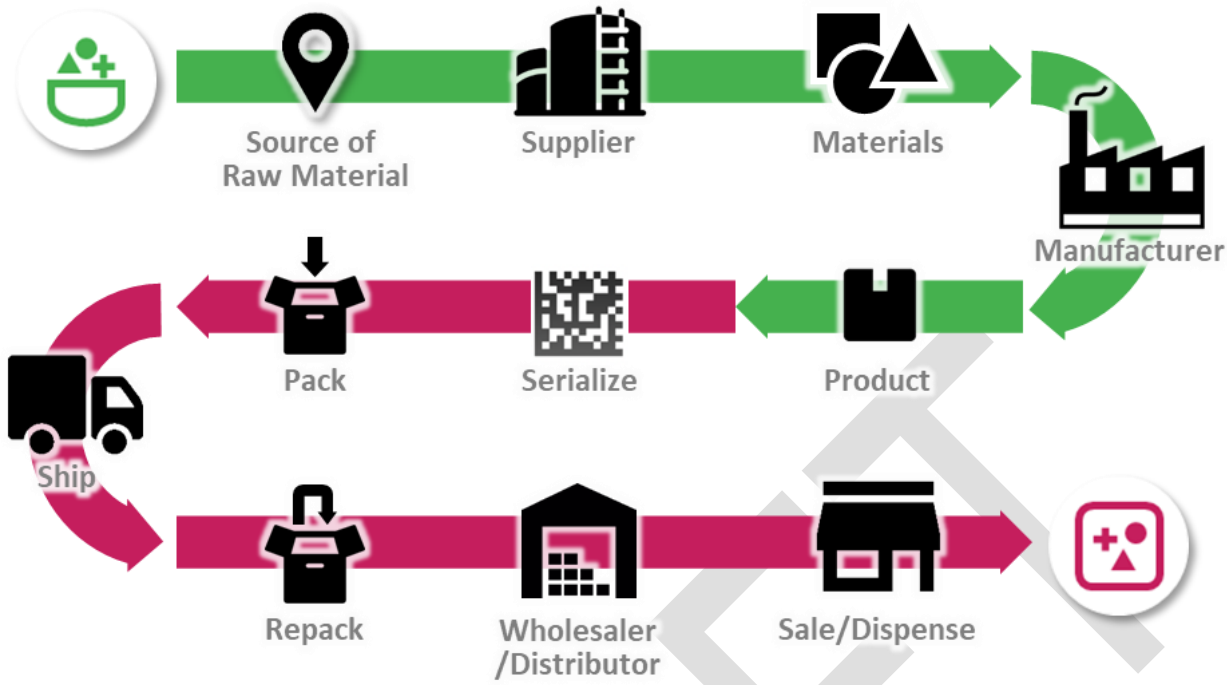


Figure 9: Typical supply chain for pharmaceutical product

A model like that (full track and trace system) is possible and allows for full traceability of products along the supply-chain, with clear advantages over simpler systems with a more limited scope. On the other hand, a model like that is complex and generates higher costs and need for resources.

Examples of this kind of systems already in place include Russia and the USA. The key difference is that while in Russia there is a central repository to which all submissions and queries are sent, in the USA there is no central database, and each stakeholder must provide a way to allow its data to be queried.

At the other end of the complexity scale, there are simplified systems where data are only collected at key data points.

The system developed by the European Union is shown in figure 10. This system envisages mandatory serialisation (inclusion of the serial numbers unique for packs of medicinal products in the database) at manufacturers' level, and mandatory verification of such numbers during the dispensing process, by a health care professional (usually a pharmacist). Only partial or for-cause verification of the serial numbers is foreseen in between, during distribution (i.e. verification by distributors).

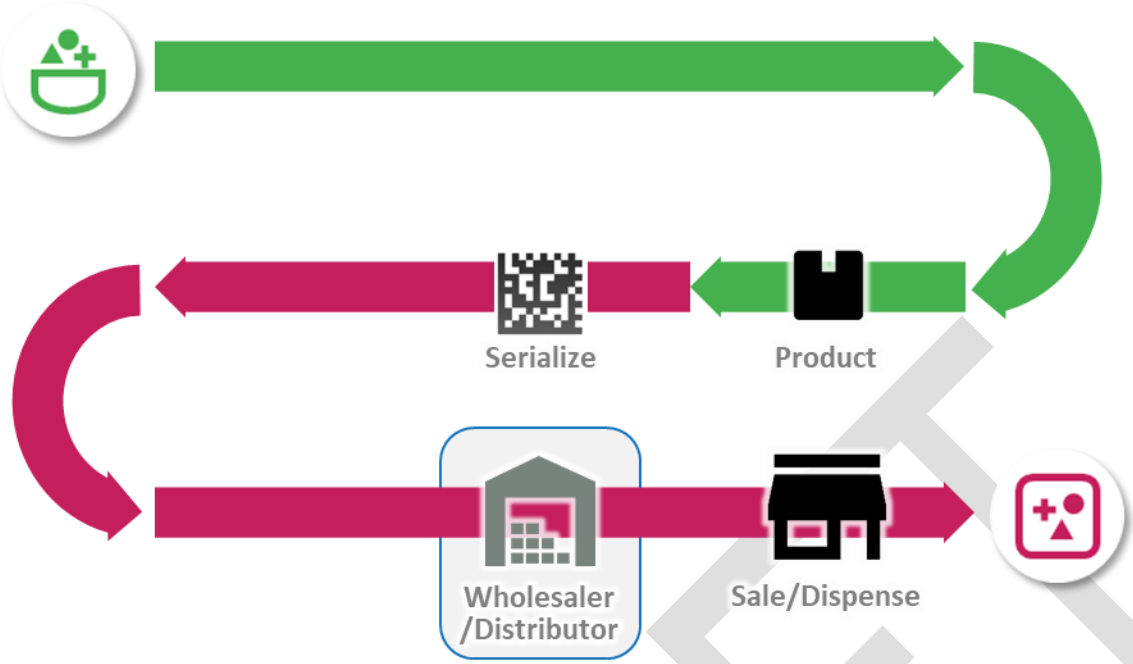


Figure 10: Simplified System

The main advantage of simplified systems is reduced costs and use of resources, in particular during distribution, at a price of a decreased traceability.

The simplified system in Figure 10 is a subset of the full T&T system in Figure 9. They are not mutually exclusive, and interconnection can be achieved among full T&T systems and simplified ones.

Centralised or Distributed Data

A central database or repository is generally the most efficient and simple way of allowing traceability data from multiple parties to be reported, stored and queried. It is perfectly possible however to design a system with distributed databases where each originator stores their own data.

If e.g. data associated with any pack of a medicinal product are to be accessed or queried by all the actors in the supply chain, the distributed databases option needs development of mechanisms for access to data and/or querying the databases, which can be rather complex.

The 3 main available types of architecture for collecting and reporting of data are briefly described below:

1. *Centralised:*

Centralised registration of entities and reporting of traceability data to a single (usually managed by a government agency) database or repository. This have been adopted, with different specificities, by most countries with traceability systems, including the EU, Russia and Brazil.

The two main variations are the “hub and spoke” architecture of the EU and the single central repository used elsewhere, as shown in figure 11 and 12.

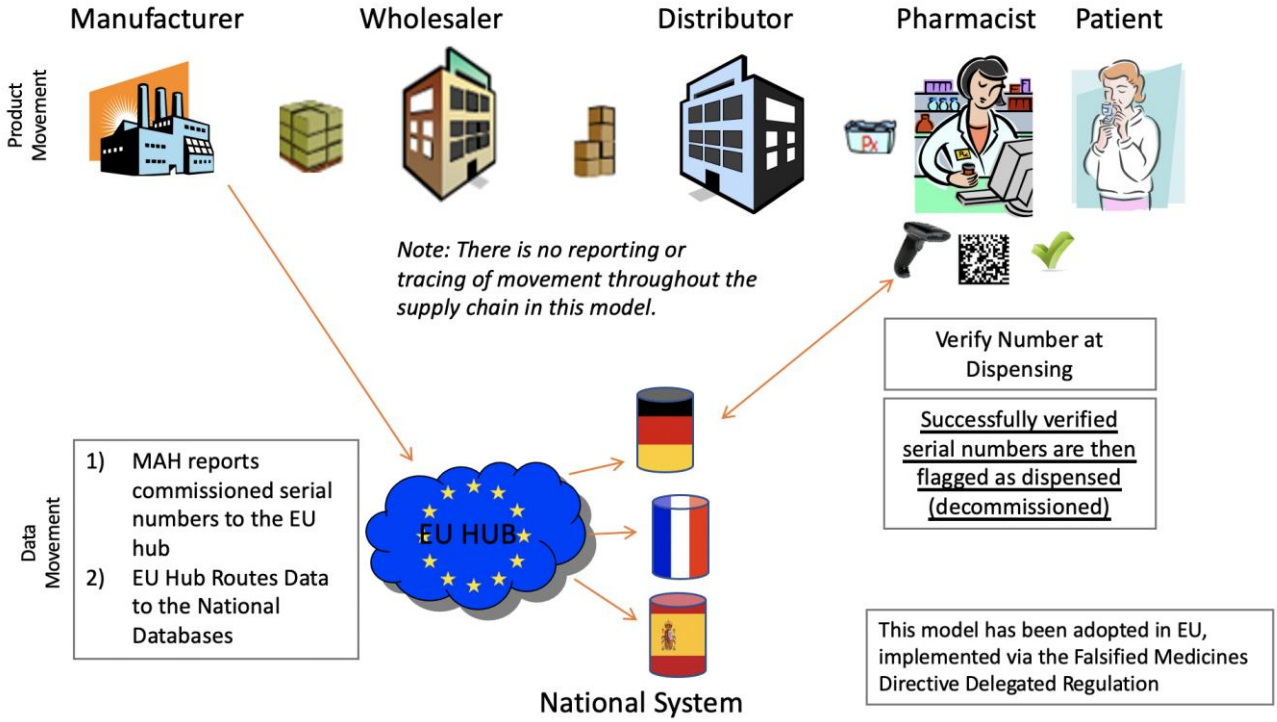


Figure 11: EU model, central hub, multiple national repositories (not full track and trace)

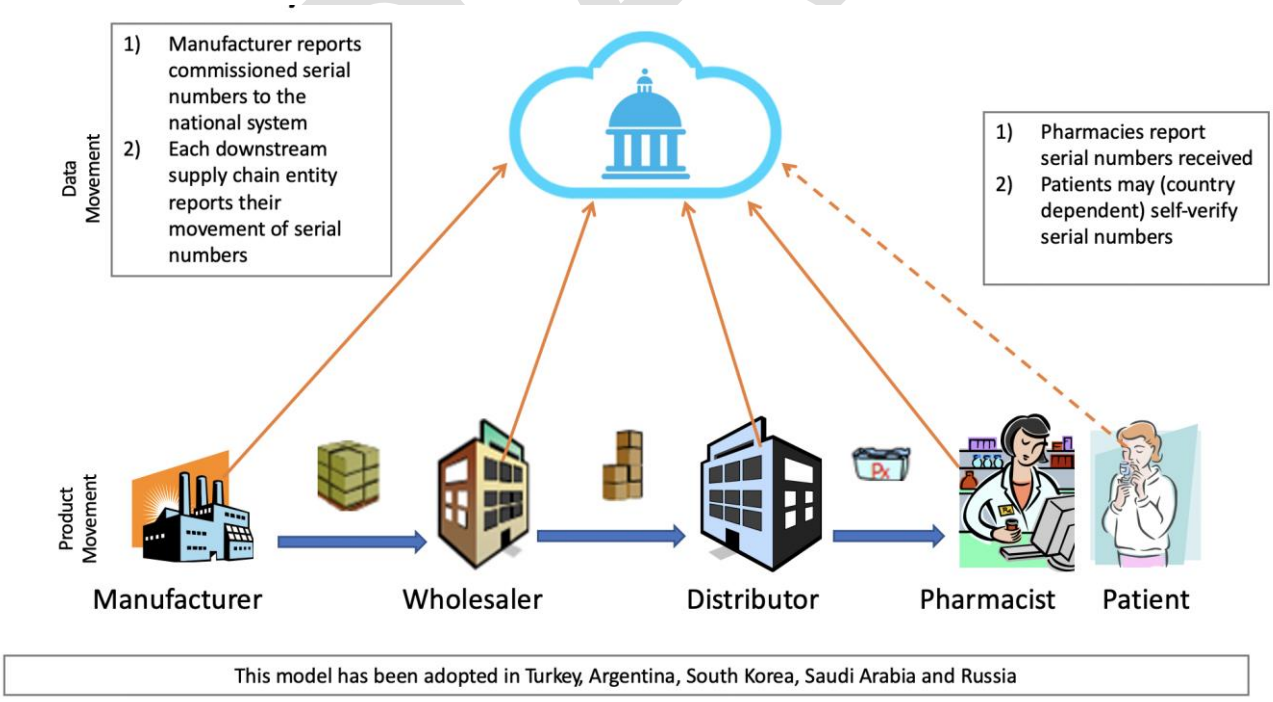


Figure 12: Track and trace model with a national repository

2. *Semi-Centralised (Cumulative):*

In this model, there is no central repository of data but rather a linear and cumulative flow of information. Each supply chain entity is legally responsible for confirming receipt of accurate data from its upstream business partner, adding its own data, and transmitting the full chain of custody data downstream to the next recipient. In this way, the downstream partners have visibility of previous history. This system is adopted by China and the USA.

3. *Distributed:*

Copies of compliance data are shared with other supply chain partners on a request basis, to verify product, but are not stored in a central place. This mechanism is used for management of USA saleable returns, via a verification router service (VRS).

Charging model and user fee structure:

The shared infrastructure needed for traceability can be expensive. In the case of the EU, the costs were transferred to the commercial sector, by allowing an industry stakeholder consortium, the European Medicines Verification Organisation (EMVO) to fund, set up and run the system. In other countries, costs are recovered by volume-based usage fees or annual licenses levied on manufacturers. In either case, the commercial model needs to be considered before the system design is finalised, as it can be very contentious, as experience in regions of the world where a T&T system has been implemented has demonstrated.

Data access rights:

The data generated by traceability systems is a very a valuable resource. Mining this data can generate insights into safety issues, enhance pharmacovigilance, and help to equalise stock levels during shortages (see also section 4), among other societal benefits. It can also highlight commercial patterns which are of value to manufacturers and distributors.

Such data however are often considered commercially confidential, so it is necessary to define, establish and regulate who will have access to what data. This discussion should be started early in the design process, as it will impact other decisions to be taken on how the system will be designed and implemented.

Cyber-security:

As in many other areas, cyber-security is critical. If e.g. a database of authentic serial numbers in packs of medicinal products is hacked by criminals, those numbers could then be used to “authenticate” falsified products. Every effort must be made to ensure that technology systems are hardened against cyber-attacks, including regular penetration tests, that can be performed by an expert third party.

Build in-house or outsource to vendor or stakeholder consortium:

Some countries/regions may have the necessary resources and technical capacity to build their own systems. Taking all the above complexities into consideration however, outsourcing the management

of T&T system to a commercial partner is also an option. Competent vendors exist which may fulfil the necessary criteria.

FLEXIBILITY IN THE DATA FORMAT

Traceability systems do not exist in isolation. They will inevitably be grafted onto existing data flows within the infrastructure of each supply chain stakeholder. It is important to allow as much flexibility as possible for file formats, while standardising only where necessary.

Standard data structure (e.g. EPCIS) is more important than specific file formats, as many modern track and trace platforms can cope with multiple file formats. As shown below, it is also necessary to consider all systems which might report data, whether hosted on-premise on in the cloud.

Transformation (making sure that all data is harmonised into standard form for processing), and orchestration (making sure that data flows between systems easily) should be considered. Modern commercial traceability systems can perform these functions automatically.

Almost all potential use cases are already in use somewhere. The key benefit of using established successful system designs, rather than re-designing a specific national system, is the rapid deployment and cost saving that can be achieved.

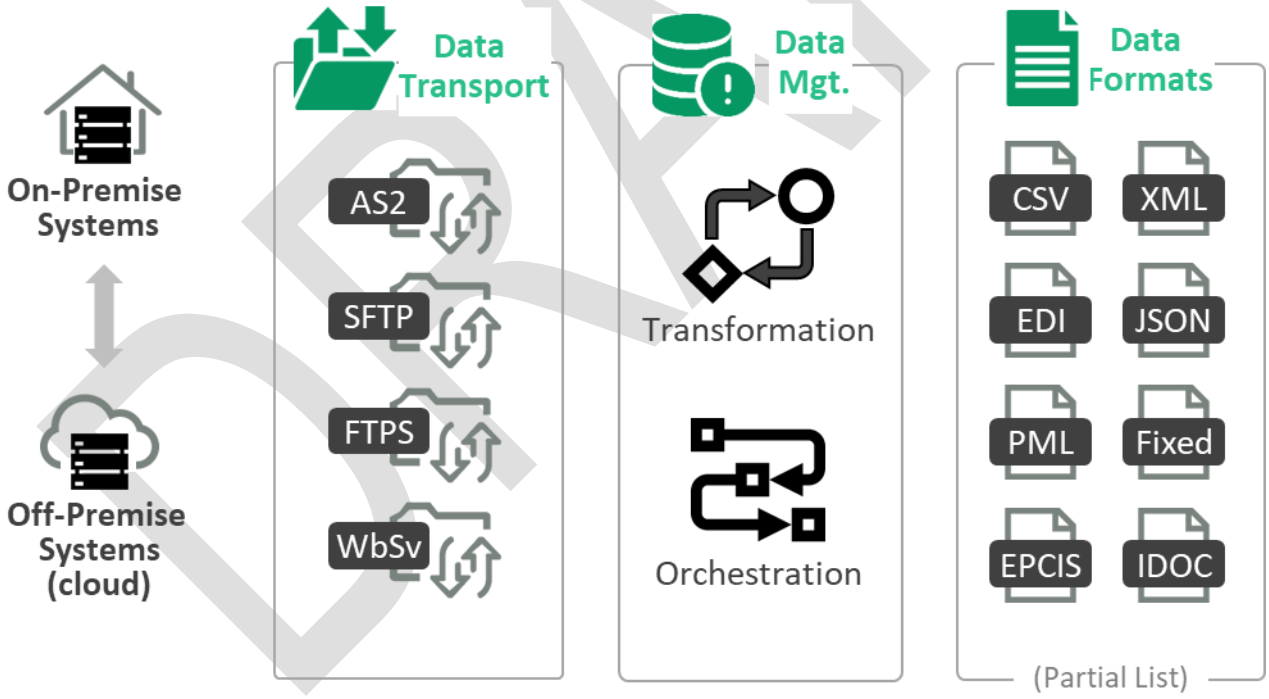


Figure 13. Complexity of data transfer between various systems needs flexible solutions

DATA AUTHENTICATION

The quality and security of a traceability system depends on reliable and robust processes, this include ensuring that only authorized users can upload data.

Various methods can be used to ensure this. In general, anything which creates dependencies on specific physical hardware (e.g. USB sticks) should be avoided, as they can be stolen or lost and are generally hard to update efficiently once issued.

Authentication methods also depend on how data are uploaded. Low volume users may prefer manual upload, but large organisations will generally prefer the greater efficiency of automated processes.

Options for authentication of data include:

- Manual Upload
  - Dongle based security
  - Physical Key
- Automated upload
  - Web Services
  - SSL certificates and Token (Refreshed regularly)
  - Digital Signatures based integration

DATA HIERARCHY(5)

In most cases currently, the traceable unit is the secondary pack or unit of sale/dispense of the medicinal products. Pharmaceutical items however are not shipped as individual units of sale, they are aggregated into higher levels of packaging for efficient distribution, as shown below. These cases and pallets will often have their own codes.

It is possible to associate all these nested code hierarchies in a database, a process known as aggregation, during manufacturing or shipping processes, so that the presence of a single pack in a pallet can be inferred by scanning the exterior pallet code and looking up in a database.

Aggregation generates costs and complexity and requires tight control of data to avoid errors, but on the other hand, it optimizes the logistics and traceability of shipments. The recommended option is to trace data at secondary pack level and design a system which allows submission of aggregation data hierarchies (see also section 5).

Figure 14: Packaging hierarchy, aggregation, and associated codes

MOBILE VERIFICATION

The widespread availability of mobile phones gives opportunities for code verification where scanners are not a feasible option. These might include small or remote pharmacies, or those in rural areas in developing countries. In these cases, medical professionals could be provided with a specific application for use in conjunction with their mobile phone. This would enable the identity of the verifier to be registered and checked. During the sale or dispense process, the person providing the medicine will act as a last link in the supply chain, performing a final check of the product identifier.

As well as the professional application above, it would also be possible to provide a consumer application for code verification. This would work in a similar manner, by allowing those receiving or purchasing medicines to check their codes. This should always be an adjunct, not a substitute for, the professional oversight described above.

This could also be used to provide patients with up-to-date information about the medicine and how to use it safely and to best effect. This may mean linking to a regulators' database or other source of medicines information which would be specific to the jurisdiction in which the patient was located. Such use of mobile apps however has never been put in practice so far, and its implementation would be subject to complex regulatory decisions.

One well-known drawback of consumer verification is that it can cause confusion which is then exploited by counterfeiters. For example, counterfeited drugs have been found in packaging which promotes fake websites for "authentication" of the medicine. This "parallel universe" problem, where the counterfeiters attempt to copy both the packaging and the verification mechanism, can give a false sense of security and make consumers vulnerable.

In general, the prevalence of camera phones makes it possible to scan permanent bar-codes (as recommended for traceability systems) in most countries, as opposed to scratch-off mechanisms. However, it may be necessary to allow for SMS-based methods in some countries where mobile internet or smartphone availability is low.

6. GLOSSARY

This glossary has been developed together by ICMRA and WHO. Common definitions have been established for terms used in the documents below:

- The ICMRA Recommendations on common technical denominators for Track and Trace (T&T) systems to allow for interoperability
- The WHO “Policy Brief on Traceability of Medical Products”

The definitions are intended to be as simple as possible to help better inform readers who are not experts in traceability systems. They are not intended to be exhaustive.

Aggregation

The documented parent/child relationships between uniquely identified items and the uniquely identified outer container they are contained within for the purposes of improving the efficiency of serialisation business processes involving data exchange and/or regulatory requirements.

Architectural Model

A description of how traceability data is structured, exchanged and stored amongst parties such as regulators and members of a supply chain to meet recognized goals, i.e., improving the security of a given supply chain.

Authentication

The act of determining the authenticity of a product or a system user.

Authenticity

The quality of a product and labelling, establishing that they are unquestionably genuine.

Automatic Identification and Data Capture (AIDC)

The processes used to automate the assignment, marking and capturing (reading) of product identification, through the use of carrier technologies such as barcodes and Radio Frequency Identification (RFID) tags.

Barcodes

A symbol that follows a data carrier standard that allows it to encode a finite amount of data, and which may be read repeatably and reliably to extract the data it contains. There are generally two types of barcodes used in commercial supply chains around the world: Linear and 2-dimensional.

Barcoding

The process of applying a barcode to a product package at any level.

Batch Number / Lot Number

An identifier assigned to a homogeneous quantity of a product that have identical manufacturing and packaging characteristics, including raw materials, manufacturing processes and timing. The batch or lot number associates an item with production information that the manufacturer considers relevant for traceability of the trade item. The data may refer to the trade item itself or to items contained in it.

Bundles

A homogeneous grouping of unit-level product packages—usually in sub-multiples of a full-case quantity—that are bound together during an intermediate step of the case-packing operation to ease the packaging process. Bundles may or may not be serialized but are generally not considered a "trade item" themselves.

Commissioning

1. The act of documenting the association of a new unique identifier with a specific instance of an object class, usually occurring at the moment the unique identifier is printed or affixed onto the object.
2. A type of "visibility event" defined in the GS1 EPCIS standard that documents the commissioning as defined in 1 above.

Data Capture

The process of collecting data about product instances. This includes data to be encoded into a data carrier to be affixed to an instance of a product package, as well as data read from existing data carriers on one or more product instances at any level of packaging.

Data Carrier

One of several technologies used to encode and present product identification data on a product package. There are many specific types of data carriers but those used in health product supply chains generally fall into these categories: Linear barcodes, 2-dimensional (2D) barcodes and Radio Frequency Identification (RFID) tags.

Data Exchange / Information Exchange

The sharing/movement of structured data from one party to one or more other parties. To be successful, all parties must agree in advance on the structure and the data transmission protocol. This is normally the subject of global standards.

Data Model

A description of how a specific set of data is organized, or structured, for a particular purpose.

Data Ownership

The recognition of the party that retains ownership rights to a given set of data.

Data Standard

A published standard that describes the characteristics of a set of data for a particular purpose.

Decommissioning

1. The act of documenting the disassociation of a unique identifier from a specific instance of an object class, typically when the object no longer exists or reaches the absolute end of its lifecycle (i.e., after destruction or consumption of a product).
2. A type of "visibility event" defined in the GS1 EPCIS standard that documents the decommissioning as defined in 1 above.

Expiry Date

The latest date the manufacturer of a product is confident a given instance of the product will meet the published/regulated application.

Falsified

Products that deliberately/fraudulently misrepresent their identity, composition or source.

Global Data Standards / "Family" of Standards

A set of standards specifically defined to work together coherently to facilitate a specific purpose, i.e., secure commerce within a supply chain.

Globally Standardised Syntax

Wording that uses a context of one or more global standards.

Globally Unique

Adjective describing something with the characteristic that it is unique throughout the world.

Global/Globally Unique Product identifier

A product code that cannot be assigned to more than one product throughout the world because it is defined with elements that are controlled by a global assignment agency and the manufacturer.

Governance

The process of developing and enforcing technical rules intended to enable secure product supply chains

Grandfathering exception

An exception to a traceability regulation granted explicitly by that regulation applies to products already in the supply chain on the day the new regulation goes into effect because they were packaged prior to that date and therefore cannot be expected to comply. These products are said to be "grandfathered".

Inference

The process of determining the unique identifiers on objects contained inside of outer containers like cases, totes and pallets, using aggregation data rather than opening the containers. The unique identifiers found are said to be "inferred" from the aggregation data because their accuracy depends on

the accuracy of the aggregation data and the integrity of the outer container since the actual objects and their identifiers are not visible.

Information exchange

The type of interoperability where information is exchanged between interconnected systems without triggering a status change for a product, batch, and/or pack in the receiving system.

Interoperability

The ability to exchange product traceability information accurately, efficiently, and consistently among trading partners in a supply chain and/or authorized regulators.

Legal supply chain

The supply chain paths and participants that are recognized and authorized by the government(s) of jurisdiction. Also sometimes referred to as the “legitimate supply chain”.

Logistic Unit

An item of any composition established for transport and/or storage that needs to be managed through the supply chain.

Marketing Authorization Holder

The legal entity that has been authorized to place specified medical products on a regulated market by the national regulatory authority.

National Number

A product code that is assigned by a national government to a given product for use within their national borders. National numbers have no expectation of global uniqueness.

National Numbering Systems

Product identification numbering systems that are defined by a single country or market for registration and use only within its boundaries.

Packaging Levels

The hierarchy of product packaging. Each level has a specific way for protecting and identifying the product during different types of handling. Recognized “levels” include “primary”, “secondary” and “tertiary”

Pack

The packaged product that moves through a supply chain and is sold/administered/dispensed to the end patient and that is typically the subject of serialisation requirements

Pallet

A wood or plastic structural foundation used for transporting a grouping of one or more shipper cases containing product

Point of Dispense (PoD) Verification

A recognized traceability architectural model that aims to limit the points in a supply chain where a drug must be verified to the point where it is dispensed or administered to a patient. Also referred to as a

"book-end approach" because it usually requires manufactures at one of the supply chain to apply a unique identifier to drug packages, and dispensers at the other end of the supply chain to perform the verification step. The Falsified Medicines Directive (FMD) in the European Union (EU) as defined by the Delegated Regulation (DR) is an example of a system that implements PoD Verification.

Primary Pack

The product packaging that touches the dose, i.e., a blister pack, a vial. If no secondary pack exists, then the primary pack is usually the lowest saleable pack.

Product

Usually a drug, biologic, vaccine or other health-related consumable that is regulated and moves through a supply chain from manufacturer to consumer.

Product Class

A well-defined description of a type of a product that would be registered, manufactured and sold in a supply chain.

Product Code

A numeric or alphanumeric sequence of characters that is registered as an identifier for a class of objects (e.g., a trade item)

Product Data

Data that describes the product class

Product Identifier

A numeric or alphanumeric sequence of characters that is registered as an identifier for a class of objects (e.g., a trade item) or an instance of an object (e.g., a logistic unit)

Product identifier Plus Serial Number

The combination of a product identifier and a serial number that uniquely identifies the type of packaged product (product class), and the single, specific instance of that packaged product.

Product Master Data

Data that describes various characteristics of a specific product to differentiate it from all others.

Real-time

A qualifier of an event or process that occurs so fast in response to a trigger that it appears to happen immediately or even simultaneously. "Near real-time" describes an event or process that occurs rapidly in response to a trigger, but not fast enough to be considered "real-time".

Secondary Pack

A package that contains one or more primary packages. A secondary pack in most, but not all, markets is the lowest saleable pack in the supply chain, when it exists. Sometimes referred to as "Finished Pack", "Finished Product" or "Sales Pack".

Serial Number

1. A unique numeric or alphanumeric code that, when associated with a product code, identifies a single instance of a product
2. Colloquial. A unique number that identifies a single instance of a product

Serialisation / Serialization

The processes and results of defining, assigning and affixing unique serial numbers to product packaging at any level.

Shipper Cases

A grouping for saleable packages in a shipping container, usually made of corrugated fiberboard (cardboard)

Stakeholder funding model

A method of funding the construction and management of the technology infrastructure necessary for a national traceability system that relies on the companies who are regulated (the "supply chain stakeholders") to pay for all or part of it.

Substandard:

Also called "out of specification", these are authorized products that fail to meet either their quality standards or specifications, or both.

Supply Chain

Two or more companies who buy and/or sell products, starting with the manufacturer and ending with the entity that supplies or administers the products to the end patient

Supply Chain Stakeholders

Companies, including non-governmental organizations (NGOs) and aid agencies, who participate in the supply chain of medical products, including, but not limited to, manufacturer, third-party logistics provider (3PL), importer, distributor, wholesale distributor, logistics company, pharmacy, hospital, clinic, etc.

System Architecture

See Architectural Model definition above (Architectural Model is used in the WHO policy document and System Architecture in the ICMRA document with the same meaning).

Tertiary Pack

A third level of packaging or higher, usually including logistic units like shippers, cases, totes and pallets

Trace

The ability to know where a product has been within a supply chain prior to its current location

Traceability

(ISO) The capability to trace something. In some cases, it is interpreted as the ability to verify the history, location, or application of an item by means of documented recorded identification.

Traceability Data / Traceability Information

Data that documents where a product, or products, has/have been within a supply chain

Traceability Model

A well-defined approach to capturing, sharing and storing traceability data

Traceability System

A systematic implementation of a traceability model

Track

The ability to know where a product is right now

Track and Trace

1. A type of traceability model that attempts to track and trace products through a supply chain
2. Colloquial. A term used to refer to any and all traceability models

Trade Item

A product or a homogeneous grouping of a product that is identified so that it may be treated as a "quantity one" unit for the purpose of registration, listing, marketing, sales, shipment, billing and other value chain and supply chain applications. Not all "homogeneous groupings" are trade items (see "bundle").

Trading Partner

Supply chain stakeholders who engage in the purchase, sale and donation of products between each other.

Transactional Data

Data that describes one or more transactions, whether financial, supply chain (product change of ownership) or both.

Transactional Interoperability

A transaction in one system is extended automatically to another system

Unique Identifier

A unique serial number in combination with a product code. A unique identifier identifies a single instance of a product.

Unique Number

A numeric or alphanumeric sequence of characters that identifies a single instance of a product such that no other instance has the same sequence associated with it.

Unit of Sale

Usually this is the trade item that is sold within a supply chain. The smallest unit of sale is usually the packaging level that is sold to the pharmacy, hospital or clinic and contains one or more "units of use"

Unit of Use

The item that is dispensed or administered to a patient by a healthcare professional

Unregistered/unlicensed

Medical products that have not undergone evaluation and/or approval by the National or Regional Regulatory Authority (NRRA) for the market in which they are marketed/distributed or used, subject to permitted conditions under national or regional regulation and legislation.

Verification

The process of determining that the unique identifier on a product is valid.

7. WEB REFERENCES

1) International Coalition of Medicines Regulatory Agencies (ICMRA) webpage
2) Recommendations on alignment of existing and planned Track and Trace (T&T) systems to allow for interoperability
3) Existing technologies and “track and trace|” models in use and to be developed by Member States

   Updated table: experiences in countries
4) Cooperating standards in healthcare
5) Discussion paper on aggregation in pharmaceutical supply chain
6) Use of GS1 2D Matrix Data Carriers in Healthcare
7) Discussion paper on multi-market packs for pharmaceutical products
8) Regulatory Roadmap: Traceability of Medicinal Products

ANNEX: MAPPING OF EXISTING AND PLANNED T&T SYSTEMS

Under development at WHO