

Medicine traceability models and its drivers: some insights from USA, European Union, Turkey, Argentina and Brazil

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Abstract: - In this paper the existing medicine traceability models in 4 countries and European Union are analyzed. The objective is to verify similarities and differences among the models regarding important criteria such as implementation phases, goals, governance, technologies and information flow. The study employed a review of existing literature on the theme and interviews with experts. The findings show that there is not a consensus about the best medicine traceability model around the world: each regulation has its own peculiarities. The government's objectives - beside patient's safety - play an important role on traceability model requirements. The authors also verified that, in spite of the advances motivated by new laws, organizations still have a lot of work to use traceability as a tool of supply chain management .

Key-Words: - supply chain management, medicine traceability models, healthcare

1 Introduction

The new market environment has changed the way organizations compete [1]. Modern business management replaced the vision of autonomous entities to supply chains. The success of the network depends on companies' ability to integrate their business relationships [2].

Due to technological advances, traceability is increasingly seen as an important way to enhance collaboration within supply chains [3]. In addition, Track and Trace (T&T) systems provide more safety to consumers.

Within healthcare, these benefits are specially desired once it affects directly patients' life and enables the control of products' origin, an important issue especially considering current highly

globalized pharmaceutical market, as seen in Figure 1. The governments' tendency of establishing medicines traceability regulations supports this statement.

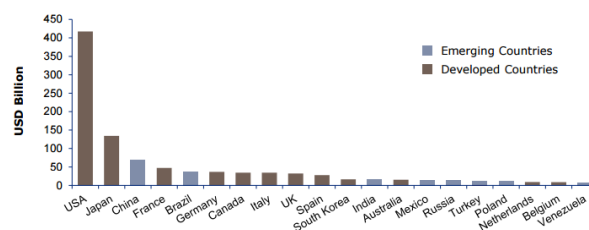


Figure 1. Top 20 Countries According to Pharmaceutical Sales in 2012 – adapted from [4]

With different models and applications, countries struggle to increase control over medicines and

reduce the entry of illegal products, among other benefits.

This article aims to present and discuss similarities and differences among medicine traceability models from USA, European Union, Turkey, Argentina, and Brazil concerning how they have been implemented, what are the main objectives, how does the information flow work, and what standards and overall processes have been defined. The collaboration within supply chain provided by traceability implementation was also investigated.

To perform the study, the authors analyzed articles, news and organizations/governments' reports concerning medicines traceability models and conducted non-structured interviews with professionals involved in implementation or post-implementation of these models.

The article is organized as follows. First, the literature in relation to traceability is reviewed. The second section encompasses a review of the five medicines traceability models studied. Afterwards, we present an analysis of similarities and differences among the medicines traceability systems and discuss them.

2 Theoretical background

This chapter aims to provide theoretical background regarding Supply Chain Management (SCM).

2.1 Supply Chain Management

Supply chain management (SCM), defined as the management of relationships across supply chain [1], has increased its importance since 1980, when organizations started to understand the benefits of collaborative networks [5].

The relationships managed encompass products/services and information, which flow through supply chain links.

SCM has the potential of providing competitive advantage to organizations [5]. For that, functional managers and departments have to be rewarded for behaviours that add value to the business [1] and are aligned to business strategy.

2.2 Supply chain management and strategy

Linking SCM with its strategy is an enormous source of competitive advantage and provides a necessary support for an organization to achieve its goals. Thus, strategy should define how SCM will be performed.

To achieve this goal, the cross-boundary nature of management supports the incorporation of supply chain objectives aligned to the strategic plan of the organization [5].

This nature is provided by strategic SCM processes, responsible for integrating the links [1]. The integration, which enables more collaborative supply chains, is at the heart of SCM and will be the key to its future success [6]. A study conducted by [7] with managers and senior executives, for example, raised the importance of bringing supply and demand sides to strategic organization's decisions.

However, integrating the supply chain is not an easy task and demands time and effort. One of the requirements for implementation is a boundary-spanning information system to provide relevant inter-organizational information and indicate supply chain opportunities [6].

In this context, traceability systems appear as an opportunity to value creation.

2.3 Traceability

Traceability has increased its relevancy by supporting collaboration among supply chain [3]. T&T systems provide several benefits, such as market advantages over competitors, reduction of recall costs, decrease of lawsuits, processes improvement [8] - enhancing consumers' security - and meet legal requirements.

To achieve them, organizations have different forms, technologies and goals of implementing traceability systems. Nevertheless, establishing systems that might be applied in different industries, sectors and countries is crucial in today's global market.

Once legislation normally does not specify technological requirements, organizations such as GS1 and Federal Agencies struggle to define minimum requirements and T&T standards, regardless of technology, for stakeholders interested in implementing traceability.

This interest is never more evident than for healthcare products [9]. Countries all over the world are establishing stricter laws for medicines and supply chains must adjust their processes in order to fulfill the requirements.

The next section presents some important models implemented or ongoing around the world.

3 Medicine traceability models

This section describes different medicine traceability models found around the world. The main characteristics regarding implementation phases, objectives, governance, processes and technologies are presented.

3.1 United States of America

On November 27, 2013, the Drug Supply Chain Security Act (DSCSA) was signed into law, a federal solution that replaced patchwork of state drug Pedigree and tracing laws in existence and established new requirements for product tracing, verification, notification, record keeping, and product identification.

DSCSA defined the implementation of an electronic interoperable system to identify and trace certain prescription medicines as they are distributed in the USA [10].

The main goals of the law are:

- consolidation of medicines supply chain regulation;
- standardisation of distributor licensure, creating uniformity across states and maintaining local authority;
- definition of processes to identify illegitimate medicines [11].

Therefore, in addition to the establishment of standards to be followed, the DSCSA system, when fully operational will facilitate the information exchange within the supply chain, which brings significant benefits to organizations, such as possibility of verification, down to the package level, of the legitimacy of the drug product identifier; enhance detection and notification of illegitimate products in the drug supply chain; and enable more efficient and effective drug products recalls [10].

For that, new requirements demand changes in all supply chain links - manufacturers, repackagers, wholesale distributors, dispensers, and third-parties logistics providers [12] - coordinated by Food and Drug Administration (FDA), which is legally responsible for developing standards, guidance documents and pilot programmes and conducting public meetings [10].

DSCSA requirements outline critical steps that must be path until the system's fully implementation by November 27, 2023 [13].

In summary, there are three major implementations phases. The first is the Lot-Level Management, when the transaction data started to be shared at the lot level of identification. Item-Level

Identification & Marking is the second phase, when packages of medicines must be serialized. Finally, the third phase is Item-Level Traceability, when the ownership of the product will be traceable back to who serialized it [14].

Generally, the DSCSA requires the transaction data to be passed/received for any transaction, which is defined as the transfer of product when a change of ownership occurs, except when it is explicitly exempted [14].

Transaction data encompasses the 3T's, transaction information (TI), history (TH) and statement (TS). TI includes information such as dosage, lot and National Drug Code, date of shipment and date of transaction. TH involves information for each prior transaction going back to who serialized it and TS is a statement that the entity transferred ownership in a transaction [15].

In the USA, T&T information flows forward, as shown in Figure 2.

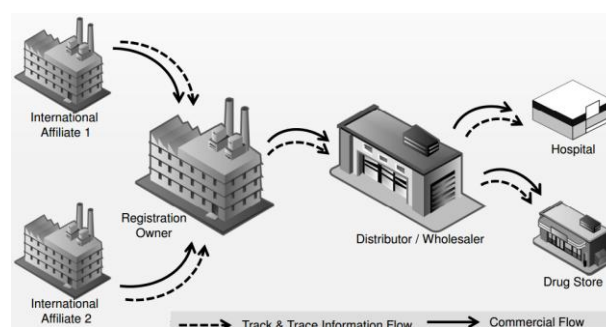


Figure 2. Commercial and T&T flows in the USA [16].

The information is transferred to the following buyer and the Database is decentralized. When asked by the government, the dispenser has to provide product tracing information. The information must be kept for six years following the transaction [16, 17].

3.2 Europe

Serialization of medicine products is not a new subject in Europe.

In February 2006 the European Federation of Pharmaceutical Industries and Associations (EFPIA) recommended the adoption of a 2 Dimensional Data Matrix to be introduced on all secondary packing of prescriptions products sold in Europe, suggesting the adoption of GS1 standard [18].

Later, in 2011, the European Parliament and the Council of the European Union published the Falsified Medicines Directive, FMD (2011/62/EU). This directive had placed the European Commission under the obligation of detailing the new system

[19] and introduced obligatory safety features, which encompasses two elements placed on the packaging of a medicinal product:

- a unique identifier, a unique sequence carried by a two-dimensional barcode allowing the identification and authentication of the individual pack on which it is printed; and
- a device allowing the verification of whether the packaging of the medicinal product has been tampered with (anti-tampering device) [19].

The requirement represented an important step in better protecting patients from counterfeit medicines [20].

Towards this end, EFPIA, together with other European Groups, developed the European Stakeholder Model (ESM), a system designed to ensure patient safety and be cost-effective, pan-European and interoperable [20].

Many details were still unclear [21]. Therefore during approximately five years discussions and efforts were conducted to define the new medicine traceability system.

On February 9, 2016, the Delegated Acts on safety features (Regulation 2016/161) was published.

The main goals of Directive and Delegated Acts are to allow end-to-end verification of the authenticity of medicinal products subject to prescription and protect patients, and business alike from the risks of falsified medicines [19]. Also it established the scope of products applied to the rule and defined the specifications of the product unique identifier to be placed on the packaging encoded by a 2 Dimensional barcode, conforming to the International Organization for Standardisation/International Electrotechnical Commission standard ('ISO/IEC') 16022:2006 [22]. It shall be implemented until February 9, 2019.

Belgium, Greece and Italy may have an additional period of up to 6 years [23].

The verification of safety features and authenticity of the product shall be done by manufacturers, wholesale distributors and persons authorised or entitled to supply medicinal products to the public by checking:

- the authenticity of the unique identifier;
- the integrity of the anti-tampering device [22].

The manufacturer shall keep records of every operation performed for at least one year after the expiry date of the pack or five years after the pack has been released for sale or distribution, whichever is the longer period, and

shall provide those records to competent authorities on request [22].

In addition, to enable information-sharing, the repository systems will be composed of a central information and data router (European Hub) and national or supranational repositories (National System) [22]. The communication of two National Systems is made through the European Hub, in order to reduce connection possibilities. A model of the European system is presented in Figure 3.

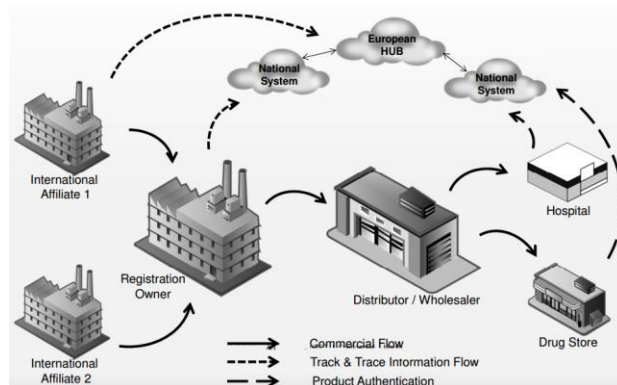


Figure 3. Commercial and T&T flows in the European Union [16].

The repository will be set up and managed by non-profit legal entities [22].

The German national system will be the first in European Union to contribute fully to the repository, through its securPharm system, a national scheme that has been piloted and benchmarked since 2013 [24].

3.3 Turkey

The Turkish T&T system applied to pharmaceutical industry is pioneer and one of the most famous around the world. Known as ITS, it defines the infrastructure to T&T all pharmaceutical products around the country [25].

The main goals are to ensure reliable supply of medicines to patients [27] - preventing illegal sales, enabling more efficient recalls and supporting rational medicines use – and also prevent double payment by reimbursement and tax frauds. The reimbursement amount in the Turkish Pharmaceutical Market was more than USD 7 billion in 2012 [4].

ITS have been fully implemented in 2013, 6 years after the project's kick-off [27]. From 2010, all license holders have to place a barcode on their products (project's phase 1) [4]. Nowadays, 7 billion of medicines are traced, whereas average number of medicines being tracked on a daily basis is 30 million [26].

As the system was designed to T&T all medicines on the market in all phases, it involves notifications to a central Database in transactions from production to consumption [25] and encompasses 40.000 stakeholders [27] from hospitals, health centers, family physician centers, pharmacies, pharmacy warehouses, manufacturers, importers and reimbursement institutions [4]. The central Database is centralized and controlled by Ministry of health (MoH DB). The commercial and T&T flows are detailed in Figure 4.

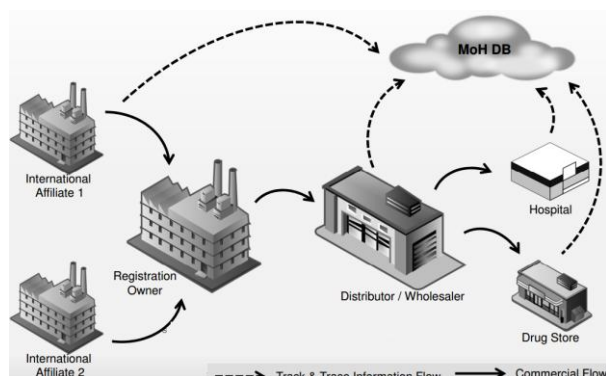


Figure 4. Commercial and T&T flows in Turkey [16].

The regulation requires a 2 Dimensional barcode to be placed on packages, which includes the serial number, expiration date and lot number [4].

The system has been designed according to the product transactions in real environments using linear processes. These transactions are transferred to MoH DB through notifications, such as manufacture, sale, purchase, consume and query sale notification [27].

Beyond ITS Turkey aims to implement PTS: a T&T communication system to connect supply chain links.

3.4 Argentina

In 1997, Argentina began the implementation of a surveillance model oriented exclusively to the detection and verification of illegitimate medicines in the supply chain. Afterwards, the government implemented the National Drug Traceability System (NDTS) at the end of 2011 [28].

The government intend to introduce gradually the legislation into the supply chain [2], aiming quick implementation. To do so, NDTS developed initially a catalogue of approximately 3.000 medicines which requires the placing on the secondary packing of a unique serial number and

tamper-evident feature [28] and the list's addition or reduction is being tested.

The regulation's scope encompasses the entire supply chain: importers or producers, wholesale distributors, health service establishments, doctors and patients [2].

Its main objectives were to reduce entry of illegal or stolen medicines in supply chain and mitigate risk of financial fraud [2].

The commercial and T&T flows follow the same path as presented in Figure 4 [16]. Logistic movements, such as product receiving, distribution, devolution and miscarriage have to be informed to a central Database controlled by ANMAT (National Administration of Drugs, Foods and Medical Devices) [2]. This communication can be performed internally or through third parties (software providers).

The data have to be in accordance to GS1 standards, but the code pattern was not established (e.g. 2 Dimensional or RFID) [2].

ANMAT inform the following buyer about the product information received, the buyer is responsible for checking the batch and informing that there are no discrepancies. The product's reimbursement just is paid by the government when it is a valid product, therefore organizations strengthened control over the traced medicines.

3.5 Brazil

In 2009, the Regulation no. 11.903/2009 created the National System of Medicine Control (SNCM), which involved the production, commercialization, dispensing and other predicted transactions for all medicines produced or commercialized in Brazil. Detailed by RDC no 54/2013, NSMC encompasses mechanisms and procedures to T&T medicines through technology for capturing, storing and transmitting electronic data among the supply chain.

The original law provides that all transactions have to be recorded and stored up to one year after expiry date. Every link has to record its own movements. In addition, the company that holds the product registration before ANVISA is responsible for keeping on time record of all transactions with their products within supply chain, as shown in Figure 5.

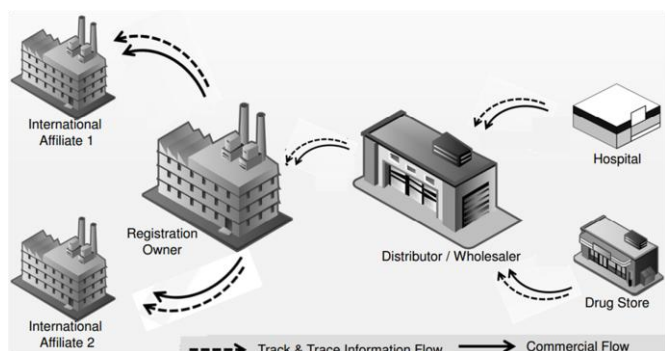


Figure 5. Original commercial and T&T flows in Brazil.

The original regulation also defined the implementation in three phases, finalizing in 2016.

Bearing in mind the difficulties faced by all supply chain links to adapt to the new law, changes are being discussed in Congress and Senate and ANVISA through PL4069/2015 and RDC no 54/2013, respectively.

In general, the main changes concern: (i) the creation of a centralized Database controlled by a Federal Agency (similarly to the flows shown in Figure 4); and (ii) postponement of deadlines and changes on schedule – is predicted up to one year to conduct a pilot, eight months to analysis and adjustments and then three years to full implementation.

Regardless the possible modifications, the law focus on changes of custody, including internal movements [16]. The main goals are to ensure patients safety and reduce the amount of illegal and counterfeit drugs, which may reach 19% in Brazil [29].

For that, it is required a 2 Dimensional Datamatrix barcode with a unique identifier to be placed on the secondary packaging. It contains information regarding registration number, serial number, expiry date and lot number.

4 Findings and discussion

Different countries have defined individual legislations in terms of technologies, processes, coverage, and governance.

These differences can be explained through the understanding of the main goals of medicines traceability implementation in each country.

Basically, they all aim to enhance patient safety. But by analyzing our data, we were able to unravel specific details of medicines legislations.

The top goals for traceability implementation identified are presented in Figure 6.

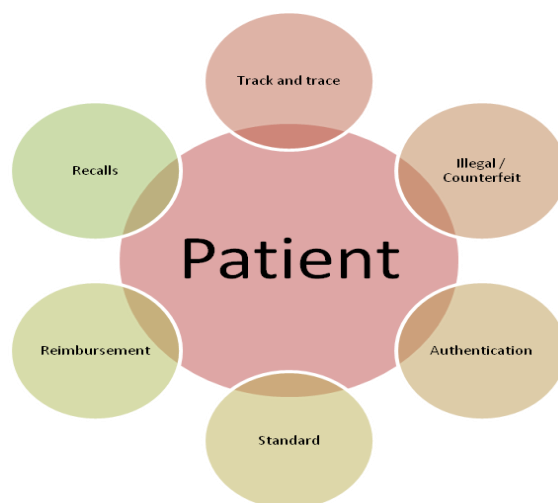


Figure 6. Main goals of medicine traceability – Adapted from [30].

In the USA, the definition of standards to consolidate regulations and uniform distributor licensure requirements and identification of illegal medicines, arise as important factors for traceability implementation. Therefore the main challenge was to develop a Federal law which encompassed all supply chain links and was feasible within deadlines.

In European Union, standard was also an issue, just like the number and accuracy of electronic transactions possibilities. To mitigate this problem, European Groups worked together to establish technology standards and create a centralized Database that exchanges information with National repositories. In addition, EU aims to ensure authentication of medicines. Thus, the most important transactions are the ones provided by the first and last supply chain links, when the medicine's authenticity is proved.

On the other hand, in Turkey reimbursement control addressed the system's implementation. To prevent double payment by reimbursement and tax frauds, a centralized Database controlled by the government and which encompasses all supply chain links was appropriate.

Also worried about financial fraud and aiming to enable a fast implementation, Argentina defined a centralized model, similar to the Turkish, controlled by ANMAT. The government defined crucial products that would have to be traced and is increasing the list over the course of time.

Finally, Brazilian model is still being defined. As the first law presented relevant issues such as the risks involving a decentralized Database, Anvisa, non-profit entities and organizations are struggling to define a model that achieves its main goals, of

ensuring patient safety and reducing the amount of illegal medicines within supply chain.

Therefore, the objectives' combination affects the requirements and definitions of each country and addresses the implementation.

By studying the existent models and their impact in supply chain, we also realized that SCM in much more complicated than exchanging data between links and the government. As stated by [6], coordination, compromise, and cooperation are really difficult to achieve within a supply chain. Whereas legislation encourages organizations to begin, they still have a long path to integrated medicines supply chain.

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