

The Complete Journey

In this day and age, most modes of transportation can send a constant mass of sensor data to central servers, with almost 50% of the world's population using a smartphone. So what is the biopharma R&D industry doing in terms of data capture within the clinical trial supply chain?

Andrea Zobel
at PAREXEL

Clinical trials are the most costly part of the pharmaceutical R&D sector, and are dependent on patients who are willing to participate. By streamlining study processes and developing a patient-centric approach, costs could be reduced, patient safety increased and data quality improved. The clinical trial supply chain contributes significantly to overall study expenses, but also bears great potential for optimisation by using the Internet of Things for data capture (1). To gain a better understanding of the supply chain, it is worth exploring the journey from the planning stage of clinical supplies to manufacturing, distribution and dispensing to patients.

Planning Supplies

Documentation is a key requirement in clinical trials. Although various data capture systems support the supply chain, these systems are not typically connected to each other, thus making manual processes and individual data entry necessary. Ultimately, all information for approval of a new pharmaceutical product is submitted electronically in one document. This creates an unusual situation, in which data are still recorded on paper documents but are also available online. Systems that capture and store these data include: software for demand planning; manufacturing systems; warehouse management systems; enterprise resource planning systems; clinical trial management systems (CTMS); and interactive response technologies (IRT, also known as interactive web response (IWR) or randomisation and trial supply management (RTSM)). These systems are normally used independently, and are only connected – if at all – when utilised within the same company.

A good example of this is the address of a clinical site pharmacy, which can often be found in the following locations: the CTMS, the warehouse management system of the central depot for the supplies, the carrier and IRT system. All of these systems receive the address via data upload – either from a list or by manual entry, both of which create the possibility of error.

Another apt example is the temperature history of an individual drug package. Data are available from the central monitoring systems of all storage locations of manufacturers and depots in the supply chain, from the temperature monitoring data of numerous shipments in the carrier systems, and in the temperature documentation during

storage at the clinical site. To collect and analyse these data for a potential excursion over the various steps is manual, time-consuming work.

Drug Manufacturing

The production of clinical supplies is supported at contract manufacturing organisations by their internal systems, such as the warehousing of materials, placebo manufacturing, filling, blinding and labelling/packaging runs. Blinded study materials need a careful tracking system that can eliminate or minimise the chance of a mix-up of materials. Often, labels barcoded for internal use are applied to guarantee the choice of the right material and for in-process controls. Since these barcodes are for internal purposes only, they are often removed before distribution, or remain on the package without further use when it moves to the next location. If these barcodes were originally designed with the required information to track the drug package throughout the entire clinical supply journey, supplies could be monitored from the first step of manufacturing, to the last step of final disposal or destruction.

Another technical solution at hand is sensors, which can be integrated into the drug's immediate container or into the outer packaging. This allows for the identification of the package and enables the collection of data regarding its condition. Some sensors are able to measure temperature, humidity, light, shock and pressure. This information can be used to track the condition of the drug package in the supply chain, as well as its consumption – for instance, the actual openings of the bottle/container (via light sensor), the opening of liquids and creams (via pressure sensor) or taking tablets out of a blister pack.

Such eMedication packages are already available, but they need to be integrated into the supply chain. Additionally, the adaptation of processes and data collection systems (to enable optimal utilisation) must also be developed and implemented before we can take full advantage of them.

Distribution and Dispensing

Along the clinical supply chain, supplies pass back and forth between various locations: from the manufacturer to the courier, from the courier to a central hub, back again to the

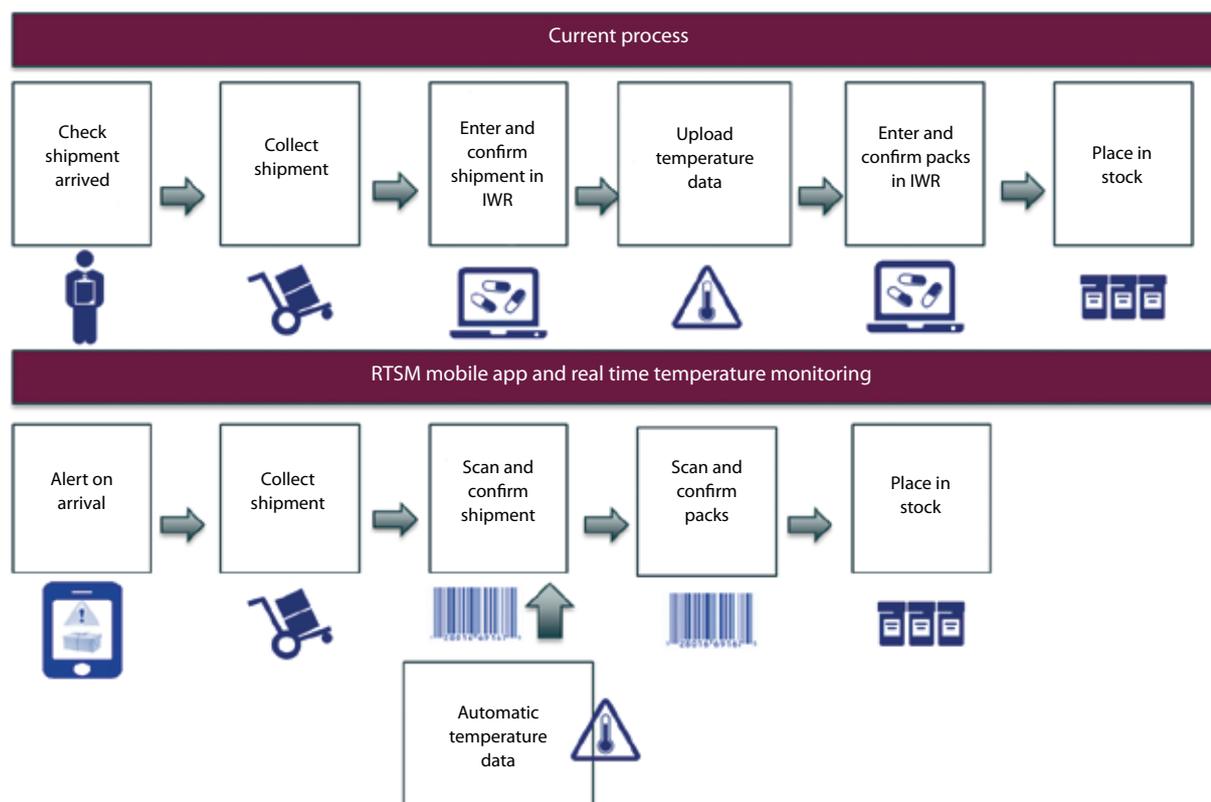


Figure 1: Arrival at site without and with active tracking and mobile RTSM app

courier, and – dependent on the final destination – passing through one or more local depots, until they finally reach the clinical site. In addition to the physical movement of the package, each one also passes through the systems of each step in the supply chain, and creates a dataset along the way. These data include temperature information from the central monitoring system of each warehouse and temperature logging during shipment, time data about the length of stay and location data, plus any other events. All of these data are collected individually and stored in various systems.

When the drug arrives at a site, it leaves the supply chain and enters into the clinical trial environment, with additional systems and processes required according to Good Clinical Practice. Site staff must use many different systems before the drug can be dispensed to patients. At this point, a large amount of the documentation still resides on paper, such as inventory reports, drug accountability and temperature logs on-site.

Site staff occasionally must return a form to the depot that sent the drugs, confirm the shipment in the IRT system, complete and file a paper form of arrival for the investigator site and, finally, file and download the temperature data from a logger. Using a system to track and analyse all supply chain data in the background, as well as to scan the medication using a mobile app, would reduce the work to confirm arrival in the IRT system.

An individual identifier on each package – such as a barcode or sensor – and data collection at a central system is possible with current available technologies. Instead of gathering data from each step in the clinical supply chain and putting them together manually, the data would be stored in one location and made accessible for further analysis or documentation.

At the clinical site, a drug package identifier can be used to track medication at three different stages with a mobile app connected to the IRT system: on arrival, during dispensing and later for reconciliation and drug accountability.

Patient Compliance

Subjects in trials leave clinical sites with a collection of various materials, including their treatment plan and description, study information, paper-based or electronic diaries, medical devices and further equipment if needed for treatment and/or collection of data. In some research settings, this amount of material is overwhelming for patients. Often, home deliveries are executed to enable them to participate in the trial.

In some studies, it is a challenge to decide the amount and type of lab samples the patients should collect. To address this, technologies used for tracking during the supply chain can also be used for at-home tracking to simplify clinical trial participation for a subject. Data regarding drug consumption can be gathered and automatically sent by eMedication



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packages. This medication can ‘speak’ directly to the patient through several methods – such as a patient engagement app (reading the identifier on the label), sending reminders or playing videos to demonstrate the administration method (2). Patient engagement apps and wearables can provide additional information, and medical devices can send their data to a central database (3). These technologies could positively affect patient compliance, the quality of adherence data and help the patient follow study procedures correctly.

The Clinical Supply Chain Future

All of the technologies described above will soon be available to improve the clinical trial experience for patients, with the potential to significantly impact enrolment, engagement and retention, and reduce the costs for the clinical supply chain and for processes at the site (4). Tracking techniques directly related to IRT systems will collect all of the supply chain data throughout the journey of a study drug package – from the manufacturer to the patient, to final disposal.

Clinical supply technologies must be closely linked to the devices that will be accessible to trial participants. Patient engagement apps, packages with readable identifiers, wearables and medical devices will provide them with a more convenient environment, and can also enhance data quality. The adoption of all of these technologies has the potential to offer researchers a complete picture of the drug development journey – from manufacturing to patient – with appropriate oversight and support.

References

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About the author



Andrea Zobel is Senior Director of Product Management, Clinical Trial Supplies and Logistics at PAREXEL. She has recently taken on the responsibility for the definition and implementation of new products and services in these departments. With a diploma in Biochemistry from the Freie Universität Berlin, Germany, and a PhD from the Max Planck Institute for Molecular Genetics, Germany, her scientific career includes 12 years of research in gene technology, pharmacology and preclinical development.

Email: andrea.zobel@parexel.com