Using IoT to Trace Shipments

Healthcare · Medicine · Sensors · Supply Chain

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Who did it?

Controlant, a company providing real-time, digital supply chain tracking to the pharmaceutical industry.

What they did

Equipped shipments of COVID-19 vaccines with cellular-connected devices to provide real-time data about the shipment's temperature, location, humidity, and light exposure, to ensure the batches were safe and effective to use when they arrived.

When the COVID-19 vaccine became available, it was essential to get it to distribution centers across the world as quickly as possible to help avoid infections, save lives. The Pfizer vaccine, which Controlant tracked, needs to be kept between -25 and -15 degrees Celsius when shipped, and within -80 and -60 degrees Celsius when stored for use, to ensure the doses are still viable when they reach their destination.

Since the beginning of the pandemic, Controlant has deployed devices to track more than 6 billion COVID-19 vaccine doses as they traveled across the world, as of March 2024. It was an expansion of an earlier effort in Controlant's home country of Iceland, where the company helped monitor vaccine distribution during the significant spread of H1N1 in 2009.

As packages equipped with Controlant devices move, sensors send real-time data to a platform that provides information like the temperature of the contents and the package's location. Once a shipment is complete, Controlant can also reuse the devices, collecting them and recycling them back to new shipments that are leaving distribution centers.

How it helped

Packages containing pharmaceuticals are often tracked passively: a sensor travels with the package and records temperature during the shipping process, but that information is not available in real time and is not aggregated on an accessible platform. Instead, when that package arrives at its destination, the recipient must download data files from the sensor onto their computer or request that information from the sensor's owner to make sure the contents are still safe to use. That system had several issues, according to Controlant's co-founder and chief strategy officer Erlingur Brynjúlfsson. Suppliers couldn't act on temperature changes in real time, and it was also impossible to tell which parts of the supply chain caused the issues because sensors are usually not able to tie temperature changes to a location. In the traditional shipping scenario, a recipient may be able to tell that their package spoiled a week ago only after they receive it, but they aren't able to prevent spoilage before it occurs.

Temperature problems cost the healthcare industry roughly $35 billion USD each year. If temperatures start climbing inside an atmosphere-controlled package equipped with

a Controlant sensor, the company's data platform creates enough transparency for potential real-time changes in handling. "In our case, we would actually notify both our pharma partner and also the logistics service provider shipping the shipment, so we can actually intervene and save that container," Brynjúlfsson tells MIT Horizon. "We have the temperature, we know the condition, we know that there's an issue. And we also know which logistics provider actually has ownership, or the responsibility of delivering the box at that time."

Aggregating data on a platform accessible by multiple users also streamlines tracking when it's not possible to have client-to-originator contact. In the case of the COVID-19 vaccine, Pfizer was shipping billions of doses, which would have been difficult to track without a centralized system. In the first two years of the pandemic, Controlant delivered 99.99% of those packages with no issues, reducing waste and ensuring that more doses reached people during a time of great need. Today, Controlant is still tracking COVID vaccines as they travel, but its work tracking other types of medicines and vaccines is growing to encompass a larger share of its work.

Why IoT

Internet of things (IoT) technologies allow diffuse devices to be connected on the same platform, aggregating sensor data and reporting information to a centralized location. That "consistent flow of high-quality data" helps drive decision-making, Brynjúlfsson says.

In the future, Brynjúlfsson says pharmaceutical companies may increasingly ship treatments straight to patients, meaning even more complicated logistics, and even more need for tracking.

For more on how IoT devices sense their environment and share that data, see How IoT Works.