

How Can the **Pharma Cold Chain** be Made More Sustainable?

The cold chain as a vital component of the modern pharmaceutical ecosystem has existed for many years, with its roots being able to be traced back to the early 20th century.

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It performs an essential function by ensuring the safe and efficient production, storage and shipping of key medicines and drugs which need to be kept at a very low temperature. These include some influenza and hepatitis vaccines, some speciality pharmaceuticals such as chemotherapy agents and ophthalmic solutions, and some hormone and enzyme replacement therapies.

Attention on the cold chain became heightened during the Covid pandemic, due to headline-grabbing vaccines needing temperatures as low as minus 80 degrees Celsius. Although this spotlight affirmed the cold chain's status as a lifesaver, it also resulted in increased attention becoming focused on its green credentials.

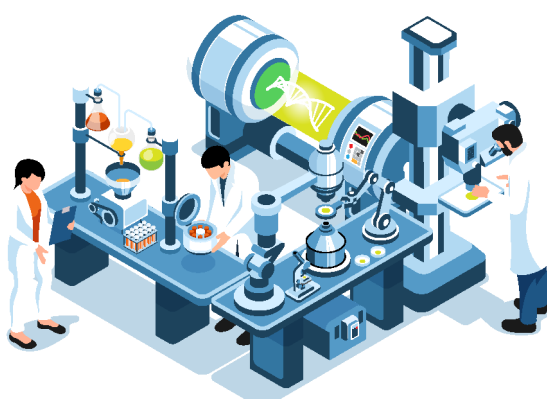
Indeed, many started to question just how sustainable the cold chain is, especially considering the significant energy and power needed to maintain such low temperatures.

Ensuring the pharmaceutical cold chain is sustainable involves various strategies, all of which need to work in unison to ensure its overall success. Let us examine some of these key approaches.

Energy Efficiency

Keeping a low temperature involves energy usage – this is a fact and there is no way around it. Therefore, it is key to use the energy needed as smartly as possible, and of course, rely on renewable energy sources.

Pharmaceutical manufacturers should be upgrading their equipment to ensure they are using the most energy-efficient refrigeration units and storage facilities. The modern equipment available today will usually have much better insulation and energy use metrics than that available even a few years ago. Therefore, a smart manufacturer will be regularly reviewing the options open to them to ensure they are working as smartly as possible.



Where possible, renewable energy should be used to provide the power that cold stores rely upon, with solar or wind power becoming increasingly popular. The latest energy management systems can harness this renewable energy and optimize its usage even further by reducing wastage. Such systems comprise sophisticated tools and technologies designed to monitor, control, and optimize the performance of energy within buildings or facilities. They play a critical role in improving energy efficiency, reducing costs, and minimizing environmental impact.

However, let us not lose sight that changes are taking place, meaning that energy usage is starting to diminish overall. For example, innovation is taking place meaning that some medicines, despite still needing to be kept very cold, do not require to be kept as cold as they once did.

This shift is largely influenced by the development of new formulations and improved cold chain management systems. Insulin provides a good example. Traditionally requiring strict cold storage, newer formulations of insulin can now withstand higher temperatures for limited periods, reducing dependency on constant refrigeration.

For example, some types of insulin can be kept at room temperature (up to 86°F) for up to 28 days once opened. This reduction in the thermostat temperature thus correlates, in many cases although potentially not all, with less energy being used to maintain the new, less cold, required temperature.

Sustainable Packaging

The usage of sustainable packaging goes a long way to reducing the harmful environmental impact of the pharma cold chain.

Sustainable packaging often involves using recyclable or biodegradable materials, which helps reduce the amount of waste generated. This is particularly important in the pharmaceutical industry, where packaging waste can be substantial. Eco-friendly packaging materials also typically require less energy to produce and recycle, reducing the overall carbon footprint, with lighter packaging going some way to reducing transportation emissions. Furthermore, cold chain monitoring systems often rely on software that seamlessly – on a non-intrusive basis – is interoperable with existing enterprise IT solutions. This means that the carbon footprint continues to be controlled, as no extra servers or hardware in many cases is needed. The correct packaging solutions will also enhance levels of product integrity.

Sustainable packaging solutions are designed to provide effective thermal insulation, ensuring that temperature-sensitive pharmaceuticals remain within the required temperature range during transit. This is crucial for maintaining the efficacy and safety of the medications. Improved packaging designs can also offer better protection against physical damage and contamination, thereby reducing the risk of spoilage and wasting the products contained within it. Sustainable packaging also aligns with global sustainability goals, such as the United Nations Sustainable Development Goals (SDGs). This contributes to broader efforts to combat climate change and promote sustainable practices. Ensuring that packaging materials are sustainable supports the long-term viability of the pharmaceutical supply chain, making it more resilient and adaptable to future challenges.

Optimized Transport

A huge part of the pharma cold chain involves transportation. This could be anything from relatively localised transport from one town to another within the same country or sending a product halfway across the globe.

Ensuring a transport network is fully optimized involves several strategies which all need to work in perfect unison to ensure maximum levels of sustainability are being achieved.

One crucial component is route optimization. Advanced route planning, using sophisticated logistics software, will plan the most efficient routes, considering factors such as traffic, weather conditions, and delivery windows which will minimize travel time and fuel consumption. Furthermore, dynamic routing will allow the implementing of real-time route adjustments based on current traffic conditions and other unforeseen variables to avoid delays and ensure timely deliveries.

Once the routes have been sorted, the temperature control technology needs to be correct. Vehicles will need to be equipped with advanced refrigeration units that maintain precise temperature control throughout the journey. They will also need to be fitted with temperature-controlled containers that use battery-powered systems or passive containers with phase change materials (PCMs) or dry ice to maintain the required temperature range.

Compliance with regulatory standards is also essential. Ensuring that transport solutions comply with international standards such as Good Distribution Practice (GDP) and the World Health Organization (WHO) guidelines for the cold chain should be an integral part of all planning. Manufacturers should also look at their Standard Operating Procedures (SOPs), developing and adhering to these without fail for all aspects of cold chain transport, including loading and unloading procedures, handling protocols, and emergency response plans.

Technology-Powered Monitoring and Control Systems

The rise of modern systems has revolutionised the methods available for ensuring cold chain temperatures are kept at optimum levels. These systems leverage advanced technologies to provide real-time visibility, automated control, and proactive management, ultimately safeguarding product integrity and patient safety.

The use of Internet of Things (IoT) devices and sensors provide real-time monitoring of temperature conditions, ensuring that only the necessary cooling is applied. This is of course vital for conserving energy and ensuring that resources are not being used unnecessarily. Predictive analysis can furthermore anticipate and mitigate temperature excursions, reducing energy use by maintaining perfect conditions throughout the supply chain.

There are multiple benefits to be derived from systems such as this. They include improved product safety by ensuring that pharmaceuticals are stored and transported within the correct temperature range, and enhanced traceability by providing end-to-end visibility, reducing the risk of temperature excursions and ensuring accountability.

Operational efficiency is also maximised through streamlining supply chain operations through automation, real-time monitoring, and proactive management, and cost savings by reducing waste and spoilage of high-value products.

Further Sustainability Solutions in Brief

There are a host of other methods to ensure the cold chain benefits from higher sustainability levels.

These include much tighter coordination between the different suppliers and components of the supply chain, including suppliers, manufacturers, and distributors. This will help to ensure timings are tighter all round, minimizing the need for prolonged storage. It will also help to improve inventory management which will reduce overstocking and the associated energy costs for storage.

It is also worth emphasising that true end-to-end tracking, with just one point of contact, on a single item basis, enhances overall efficiency – saving time and energy - and a much lower overall total cost of ownership



More emphasis on training and awareness is also important. Educating employees on the importance of sustainability and training them on best practices for maintaining an efficient and eco-friendly cold chain will ensure the entire sector benefits from shared standards. Furthermore, engaging with stakeholders will ensure sustainability goals are aligned and supported across the supply chain.

Innovation and investment in research and development is also a factor. Research into new technologies that can improve the efficiency and sustainability of cold chain processes will ensure the future of the cold chain remains as sustainable as possible.

Conclusion

The pharma cold chain is key to ensuring that patients across the globe can rely on many types of medication being produced, stored and shipped to them in perfect conditions.

However, as with all aspects of the pharma sector, it cannot escape criticism from those who are concerned it needs to work harder to up its sustainability credentials. This criticism has increased since the eyes of the world were focused on it during the days of the Covid pandemic.

Let's not forget, the cold chain is essential. All parts of the pharma supply chain need to work together to ensure its sustainability credentials are as strong as its life-saving credentials.

