Keeping a cool head over medicine storage

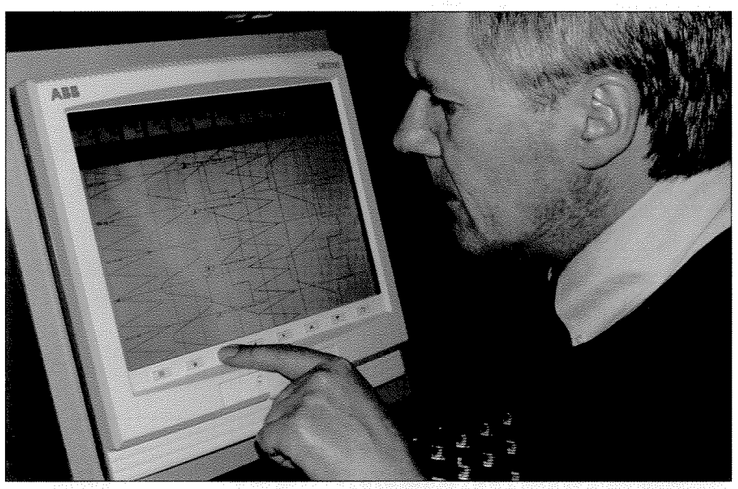
Many medicines can be destroyed by storage and transportation at the wrong temperature. Joe Fudge, service manager at ABB Measurement Products, examines how proper monitoring supports best practice.

Almost one third of "critical and major deficiencies" uncovered in the storage and transportation of medicines relate to the control and monitoring of temperature, according to the Medicines and Healthcare Products Regulatory Agency (MHRA). The Agency reported in 2009 that problems with temperature accounted for 30% of deficiencies, which is more than quality management failures (25%), documentation (24%), problems with premises or supply (8% each), and products (5%).

MHRA bases its guidance about storage and transportation on EU guidelines on Good Distribution Practice (GDP), which demand that distributors "ensure that storage conditions are observed at all times, including during transportation". This not only applies to medicines that need to be stored at low temperatures (cold chain products), but also to medicines that should be stored below 25°C or 30°C (temperate chain products). There is also a smaller, but growing, sub-set of products that need to be kept at sub-zero temperatures, and it is not only high temperatures that can present a problem, when products such as vaccines, insulin, biotechnology products, and blood products, can all be denatured by freezing.

Following dispatch from a manufacturing facility, the distribution chain for medicines can be complex, potentially involving several storage facilities, wholesalers, and modes of transport. Effective systems to measure and record the temperature at which products are held at every stage of their journey are therefore an important feature of systems designed to protect the quality of medicines ultimately administered to patients.

All distributors of medicinal products are required to record storage and transportation temperatures, as well as being licensed by the MHRA or its equivalent national regulatory body.



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Storage requirements

For instance, storage facilities looking to handle significant volumes of high-risk cold chain products need specialist refrigeration capable of holding contents reliably at between 2°C and 8°C throughout the storage volume. As a minimum in small fridges, temperature monitoring should be performed by electronic maximum/minimum thermometers accurate to ±0.5°C. Continuous, independent, recording with alarms is also advisable. Probes should be placed within the load (or within a suitable buffer) so that they record the temperature of the products, and not the air. Maximum and minimum temperatures should be logged daily.

Larger refrigerators and walk-in cold rooms used in high-volume operations should be fitted with an electronic temperature-recording device that measures load temperatures. The chart, printout, or direct reading, should be checked and recorded daily. Paper records do the basic job, but it may be worth considering electronic recorders, which offer several advantages.

For a start, videographic recorders can display multiple readings at a glance, making it much easier to keep track of installations that need to deploy a network of multiple temperature probes. The latest recorders also offer communications capabilities. For example, ABB units can be connected to wider control systems via Ethernet. This makes it easier to notify a central controller when a potential temperature problem triggers an alarm, or the system could be set up to send an SMS message to a responsible person so that remedial action can be taken right away. The third advantage is that electronic logging makes it easier to retrieve data days, weeks, or even months later, making batch traceability much easier if a problem comes to light later on.

Temperature mapping

Temperature mapping should be undertaken annually to ensure that regular readings accurately reflect the true temperature profile in the cold space. Extra surveys may also be needed to check that everything is functioning well after alterations or maintenance work.

Three probes might be enough to build up an accurate picture of small fridges, while 18 or more might be needed to map walk-in facilities. Surveys should also be carried out for at least 24 hours, or however long it takes to give a fair reflection of the range of normal activities that take place within the facility, such as loading and unloading. It is also wise to allow extra time in addition for the temperature measurement equipment to stabilise. Anything unusual should be noted, such as loading with warm samples, for example, which can distort the results.

It is pretty common for temperature mapping to uncover particular regions of the cold store that are warmer than others. If the top shelf of a fridge is too warm, for instance, it must not be used until remedial action can be taken, and any high-risk products stored there will need to be quarantined.

Hitting the road

Transporting products between storage facilities can be thought of as an extension of storage activities. However, there are certain additional risks associated with being on the move. Anything from the time of year and the weather, to the length of time a vehicle may be stuck in a traffic jam, has the potential to impact on the effectiveness of temperature control measures during each journey. Every trip should therefore be treated as unique, rather than as a standard event that is assumed to be successful provided that certain standard procedures are followed.

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Cold chain products should be packed to ensure that the required temperatures are maintained throughout the journey. For example, insulated containers may be fine to protect small volumes of lower risk products with expected journey times of less than three hours. Gel or ice packs can be added for longer trips. However, larger volumes of higher-risk products will generally be shipped in refrigerated transport, especially if there is a chance that they could be held up. Whatever method of transport is used, it is important to show that the required temperatures can be maintained throughout the trip, so wholesalers should validate their temperature controls using temperature loggers.

The number of temperature monitors will depend on the size of the load, and they must be located to ensure that temperatures in all parts of the load remain acceptable, especially since the temperature gradient within a large load can vary significantly from the edge to the middle.

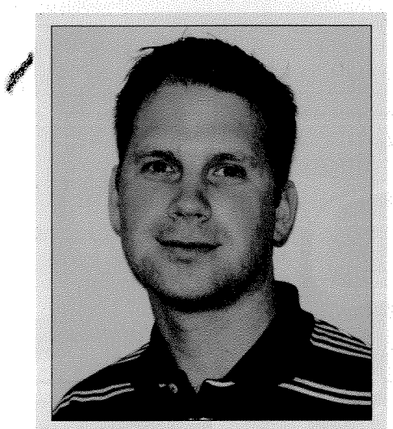
If temperature-stabilising materials are used they must be chosen carefully. For example, dry ice should not be used when shipping rubber-stoppered vials because the excessively low temperature can shrink the rubber.

Like static storage facilities, refrigerated vehicles handling high-risk products should be fitted with continuous recording devices, and transporters should provide a clear diary of each journey.

Connecting the links

Pick-ups and deliveries present a special risk throughout the supply chain. Suppliers should indicate clearly on the packaging both when any temperature-controlled products were removed from cold storage, and when they must be put back. At the other end, distributors should make recipients aware of any goods that require special storage conditions. The recipient should also check that the medicines have been properly protected during their journey, for instance by checking a recording device.

Of course, having a proper log of temperatures is only useful if distributors review them and have effective procedures in place to take corrective action if there is a problem. Good distribution practice (GDP) inspectors working for the MHRA have reported some appalling instances of bad practice, such as no temperature monitoring in some facilities, or alarms being ignored over the weekend as the temperature of a cold store continues to climb. The monitoring technology is there to support good practice, but success will ultimately depend on developing a culture of responsibility throughout the entire supply chain.



Joe Fudge

Based at ABB's Stonehouse site in Gloucestershire, Joe Fudge, service manager at ABB Measurement Products, is responsible for 20 service engineers, nine repair staff, and two office-based technical support staff. He oversees the service and repair of ABB Measurement Products' extensive range of flow meters, recording and control products, and analytical instruments.

Having started as an apprentice with ABB in 1992, he subsequently moved on to successive roles with ABB Measurement Products – including junior service engineer, service engineer, and senior service engineer. He was later appointed team leader of the repairs team at Stonehouse, with his success in this role culminating in him managing the teams across all three ABB repairs sites.