Current Technology for Temperature Monitoring

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Statement of the Problem

ISBER Best Practices specify monitoring and reporting of all fixed-temperature storage units in the laboratory. Additionally, the monitoring system should be an automated system that also creates logs, generates audit trails and generates alarms. A common approach has been a site-based system requiring the maintenance of a computer system that stores temperature data and generates alerts. Configuring and maintaining a computer and its related security systems (firewall and remote access token system) requires considerable time and IT expertise from biorepository personnel or the involvement of an external IT group.

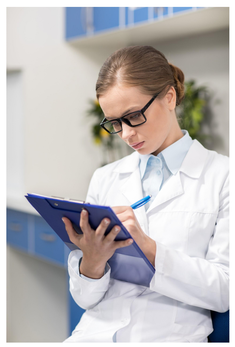
Background

Long-term storage of temperature-sensitive samples is an essential function of biorepositories. Tracking temperatures of Cold Storage Appliances (CSAs) is at least included as a best practice and is often a requirement based on the applicable regulatory requirements. Manually recording temperature information for CSAs is a standard practice for many labs. Scientists and technicians around the globe spend valuable time every day manually checking CSA thermometers and manually logging temperatures on paper.

Below are a few examples and respective capabilities of temperature monitoring technology currently used in laboratories.

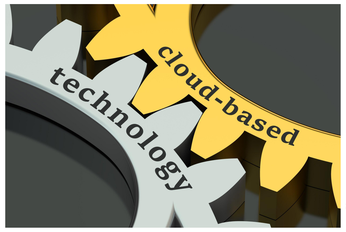
Type	Automated Monitoring	Produces Permanent Logs	Sends Alerts	Creates an Audit Trail	Automated Reporting
Writing Data in a Logbook	No	Yes	No	No	No
Chart Recorder	Yes	Yes	No	No	No
Data logger	Yes	No	No	No	No

Similarly, older temperature monitoring systems lack basic features and capabilities to satisfy the best practices recommendations and regulatory requirements of the modern biorepository. In addition, older monitoring systems are typically hardwired from the CSA to a building management system or connected to an onsite server. Installing utilities (e.g. phone lines or communications wires) can cause operational delays and can be expensive with installation costs depending on various factors including the age of the building, wall construction and the number of CSAs requiring monitoring.



Proposed Solutions

Automated temperature monitoring of CSAs with a wireless, cloud-based system has the advantages of avoiding the requirement and expense of running wires to an onsite server and is accessible 24/7 from any device with a browser and a network connection.
Below are important considerations when selecting a cloud-based, wireless temperature monitoring system:



Network security: IT departments are justifiably concerned with the network security. WiFi is notoriously prone to hacking and IT groups may require a dedicated Internet connection for a monitoring system at an additional cost for the lab. Alternatively, technology exists that eliminates the possibility of hacking the network or need for an additional network connection.

Alerts: Customizable alerts should be based on the extent and duration of the temperature excursion and need to go to the appropriate people. Cloud-based systems generally include more advanced features and have greater customizability for alert type, frequency and delivery method (e.g. text, phone call or email).

Comprehensive sensor availability: Biorepositories have specific needs for temperature monitoring ranging from room temperature (~20°C) to liquid nitrogen (-196°C). In addition, monitoring gases (e.g. CO_2/O_2) ensures a safe environment in areas susceptible to low oxygen conditions.

Automated reporting: The temperature recording feature should create a permanent record of the temperature data plus a log of the alerts with the respective person handing the alert and notes regarding the cause and resolution.

Advanced integrations: Laboratory Information Systems improve efficiency and accuracy in sample tracking and lab operations. A temperature monitoring system should include a comprehensive Application Programming Interface enabling seamless integration of environmental data with specific samples.

Conclusions

Onsite-based and some cloud-based automated temperature monitoring systems require the maintenance of a server and this requires considerable effort and IT expertise for laboratory personnel. Cloud-based systems typically eliminate the need to maintain an onsite server but involves additional challenges regarding network security. Selection of a secure and comprehensive environmental monitoring system enables continuous access to temperature data, optimized alert control and meaningful notifications thereby ensuring timely responses to temperature excursions.

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