# Anomaly Detection in Clinical Laboratory

**Overview:**

Patient-based real-time quality control (PBRTQC) is essential for ensuring daily accuracy of laboratory tests, maintaining patient safety, and minimizing risks such as misdiagnosis or unnecessary sample reanalysis. This study investigates the application of machine learning, specifically Long Short-Term Memory (LSTM) networks, to improve PBRTQC.

**Problem:**

Traditional PBRTQC relies on statistical techniques like the Average of Normal (AON), which may struggle to capture complex patterns in laboratory data. Additionally, labelling anomalies in real-world scenarios is challenging, limiting the effectiveness of supervised approaches. The motivation is to explore whether machine learning can provide more robust anomaly detection in PBRTQC.

**Solution**:

* Adopted an **unsupervised learning approach** to detect anomalies in laboratory test data.
* Developed **LSTM** models, both with and without **Moving Average** **preprocessing**, for comparison.
* Used a **simple moving average** as a baseline model.
* Focused on **creatinine and sodium** analytes, training each independently.
* Simulated anomalies via **sudden shifts in analyte** **values** to provide controlled evaluation conditions.

**Outcome:**

* **LSTM with Moving Average preprocessing generally outperformed** other scenarios in detecting anomalies.
* Challenges were noted with small shifts (±5%), particularly for sodium.
* The study demonstrates the potential of machine learning to enhance PBRTQC, offering promising avenues for improved laboratory accuracy and patient care outcomes.

# Inventory Management with Excel VBA

**Overview:**

Developed a VBA-powered Excel database to efficiently manage and track stock for the company. The system monitors which specific items are sold to each customer, automates stock updates, and ensures accurate inventory records, improving both operational efficiency and data reliability.

**Problem:**

The company previously relied on a single, large CSV file to store all stock and product information. This led to significant issues including duplicate entries, difficulty tracking warranties without serial numbers, untraceable stock movements, and general inaccuracies in inventory data, which hampered decision-making and operational efficiency.

**Solution**:

* Developed VBA macros to automate stock updates, including conditional checks for stock addition and deduction when items are sold or purchased.
* Created a dedicated macro sheet to store product model information and maintain total stock per model.

**Outcome:**

* Enabled **100% accurate** stock tracking and stock information.
* **Improved efficiency in the tech support department** by allowing staff to identify the exact model and serial number purchased by each client.
* Automated low-stock highlight**, preventing over-purchasing.**