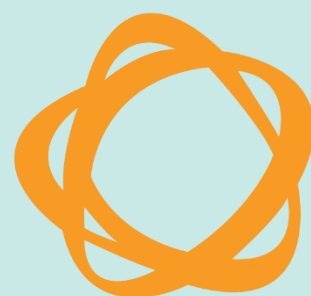


Achiever
medical



**ADDRESSING 5 COMMON SAMPLE
MANAGEMENT CHALLENGES FACED
BY LAB RESEARCHERS AND
TECHNICIANS**

About this white paper

This white paper draws on Interactive Software Limited's 20 years' experience of working closely with Biobanks, global pharma, and research, testing and academic laboratories to identify and provide solutions to sample, data and process management challenges faced by those working in the lab.

Similar challenges are faced by labs of all sizes. From small academic labs manually processing samples, through to large research institutes handling thousands of samples and working with multiple instruments. This guide delves into 5 common sample management challenges faced by lab researchers and technicians, to understand their cause and potential impact as well as offer practical advice and solutions.

Introduction

Life science labs are generating increasing volumes of data. Instruments and processes are becoming more sophisticated and complex. In addition, regulations are constantly evolving and tightening to ensure quality and safety.

Samples are at the heart of every lab. Behind each sample is a story and, importantly, a person. As such, samples are valuable, potentially leading to new drug discoveries, life-saving treatment for a patient or, in the case of the COVID-19 vaccines, helping to defeat a global pandemic.

Therefore, after health and safety and training considerations in labs, many of the other challenges faced by those working in such an environment concern sample management. Or rather a lack of sample management systems and consistent processes.

1. Challenges with handwritten labels

Handwritten labels are not just a challenge faced by small labs. Vials, boxes, and tubes with references hastily, and often illegibly, scribbled in pencil or black marker can be found in labs of all sizes. Sometimes this takes the form of labels, 'wonkily' stuck onto containers, other times someone has just written directly onto the container.

Some of the key issues with handwritten labels are:

- **Illegible handwriting**

Sometimes labels can be difficult to read. If you have combinations of letters and numbers you might not be able to tell the difference between the number 1, the letter I or L. As a minimum this makes it time-consuming to check and confirm the sample.

- **Faded writing**

Even if the label was beautifully written, sometimes age and tough storage conditions can cause the text on labels to fade. This makes it almost impossible to confirm you have the correct sample. It is also the same outcome if the label has fallen off.

- **Duplicate references**

If you are not using a system to manage or create reference numbers, then it is very easy for two completely different samples to end up with the same reference. If the samples are very different formats and types, then it may be obvious which sample is which. However, if the samples take the same format, it might be impossible to decipher which sample is which. In this case you may not be able to use either sample.

- **Inconsistent label formats**

Depending on who has created the label the format of the reference could vary, quite significantly. This could lead to confusion and incorrect identification of a sample.

All of these issues can lead to samples being incorrectly identified or sitting unused in storage. This not only takes up valuable storage capacity but also wastes valuable resources and budget.

Solution

One solution to handwriting labels is to use a barcode. This can be managed in two ways:

1. Obtain pre-barcoded containers like those offered by AltemisLab. These have a unique barcode on the bottom of the container that can be scanned using a hand-held or rack scanner. You can then assign the barcode to the sample record in your sample management system or spreadsheet.
2. Use software to generate unique barcode labels that can be printed onto temperature-resistant and freezer-proof labels of varying sizes. Some advanced laboratory information management systems (LIMS) automatically generate unique references for each sample and allow you to design label templates to create 1D and 2D barcodes.

Achiever Medical LIMS, for example, enables you to create barcodes using sample and/or donor data along with the unique sample reference and can include human readable text alongside the barcode. You can then scan the barcode in the software to locate the sample and return its details.

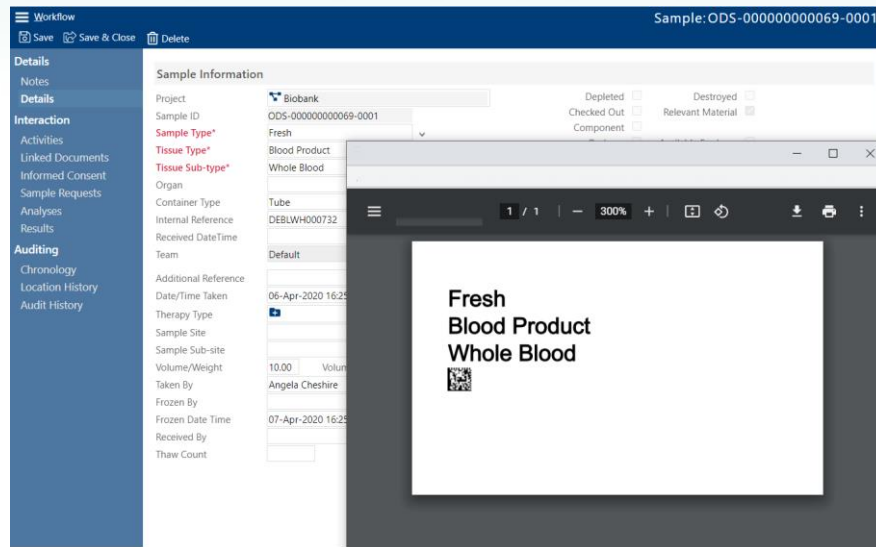


Figure 1: Example Sample Barcode Label Generation from LIMS

2. Finding samples is time-consuming

Your work depends on the quality of the samples you are using. Being able to source targeted, viable samples is essential to the success of your work. When using spreadsheets, legacy, or paper-based systems for sample management, finding the samples you need can be like finding a needle in haystack.

One reason for this is inconsistency when entering information. Although it is very quick and easy to add data into a spreadsheet there are very few, if any, rules to make sure everyone is entering information in the same format and using the same terminology. For example, when it comes to recording blood samples do you categorise them as blood, blood product, plasma, or serum? Then there are typos and spelling mistakes.

As a result, you are no longer just looking for the word blood in your spreadsheet, you are looking for it in all its possible guises including *blad*, *Plasma*, *Serum*, *Whole Blood*, *Blood*, and so on. This can take time and effort – which can be doubled, tripled, or increased more if you are searching across multiple spreadsheets.

It might be easier to ask someone. You might get lucky straightaway and find the person who knows where to look. However, you have still disturbed them and now instead of working on what they need to work on they are helping you – and you are not doing what you need to be doing either.



Even if you do find the samples you are looking for there is no audit trail in a spreadsheet, which makes it difficult to know if you are looking at the most up-to-date information. Also, there may be important data that is missing or incomplete which requires another email or phone call.

Solution

In order to make it easier for you to search and locate samples, you need a standardised, consistent way of capturing data. You could use a database to capture information consistently and in a formatted way. Alternatively, pre-built sample management software and LIMS have the relevant forms and tools to capture data including making sure all mandatory information is recorded.

Many LIMS and sample management systems provide lab users with a series of options to choose from when entering information which can be configured to suit your own terminology. This ensures everyone is entering data using the same classifications. In addition, any numbers and dates entered are automatically formatted within pre-defined parameters.

A LIMS also provides a full audit trail to show when records were created and updated.

These same rules apply when entering data manually or when importing multiple records.

Finally, a LIMS provides tools for searching records. Achiever Medical LIMS, for example, enables you to save regularly used searches as well as locate records where data is missing or samples expiring in the next 30 days for quality assurance purposes.

The screenshot displays the 'Work with Samples' interface in the Achiever Medical LIMS. At the top, there's a navigation bar with icons for Quick Links, Inventory Management, Project Management, Contact Management, and Dashboards. Below this, a search filter section allows users to refine results based on criteria like 'Sample.Reference', 'Sample.Depleted?', 'Sample.Consent Opt Outs', and 'Sample.Checked Out?'. The main area features a table of sample records. The table columns are Sample ID, Sample Internal Reference, Sample Type, Tissue Type, Organ, Gender, and Project Title. A dropdown menu is currently open over the 'Tissue Type' column, showing options such as 'FFPE', 'Fixed', 'Fluid', and 'Fresh'. The table lists several samples, mostly of type 'Frozen' and 'Fresh', with various internal references and project titles.

Sample ID	Sample Internal Reference	Sample Type	Tissue Type	Organ	Gender	Project Title
AML-000000000007-0005	DETTI000082	Frozen		Brain	Male	Biobank
AML-000000000007-0006	DETTI000083	Frozen		Brain	Male	Biobank
AML-000000000007-0007	DETTI000084	Frozen		Brain	Male	Biobank
AML-000000000007-0008	DETTI000085	Frozen		Brain	Male	Biobank
AML-000000000007-0009	DETTI000086	Frozen		Brain	Male	Biobank
AML-000000000007-0010	DETTI000087	Frozen		Brain	Male	Biobank
AML-000000000007-0011	DETTI000088	Frozen		Brain	Male	Biobank
AML-000000000008-0002	DETTI000108	Fresh	Tissue	Heart	Female	Biobank
AML-000000000008-0003	DETTI000109	Fresh	Tissue	Heart	Female	Biobank
AML-000000000008-0004	DETTI000110	Fresh	Tissue	Heart	Female	Biobank

Figure 2: Example Sample Search Screen from LIMS

3. Inefficient use of storage and uncertainty of what samples are in storage

Storing samples is expensive and for many, the main reason for collecting samples is to use them. Therefore, if you have unknown samples sitting unused in storage for many months, years or even decades these could not only be costing you, but you could also be missing out on valuable insight.

Using sample-centric spreadsheets for storage management is difficult and error prone. One common error is where users copy a cell instead of dragging it to increment place numbers. As a result, it looks like more than one sample is occupying the same storage slot. Many organisations use separate storage spreadsheets or hand drawn diagrams of freezers. Both of which become out of date very quickly.

Storage management is about more than seeing where an individual sample is stored. It also includes:

- managing different storage configurations and types
- auditing sample movement in/out of storage
- capacity planning to check remaining storage capacity for a freezer, lab, facility, or group
- being able to notify sample owners when a freezer fails and transfer all samples to a temporary location and automatically audit the move
- calculating and tracking freeze/thaw counts as samples are checked in/out
- confirming sample viability by checking they have been stored under the appropriate conditions
- checking efficient use and allocation of storage by seeing how many samples are in storage and how long they have been sitting in storage unused

You cannot capture this level of data in spreadsheets and hand drawn freezer diagrams.

Solution

There are purpose-built sample management software and LIMS systems that include storage management features, which, as a minimum, enable you to set up freezers and place samples into pre-defined slots. Some systems also provide a visual representation of the storage to show where your samples are currently placed – or empty slots where you can place samples.

Not all samples are stored in freezers and not all storage units have the same configuration. When considering software to manage your storage it is important to understand how flexible, and simple, the software is for you to set up and manage your different storage types and definitions.

Advanced LIMS, like Achiever Medical, also display, 'capacity remaining', against each storage location and item along with the ability to reserve slots. The LIMS provides features to track temperatures and alert a nominated individual or team in the case of any issues as well as offering workflow to transfer samples in the case of a freezer failure. In addition, the solution offers a library of dashboards to analyse capacity, sample time-spent in storage and sample movement within a single storage, lab, facility or globally.

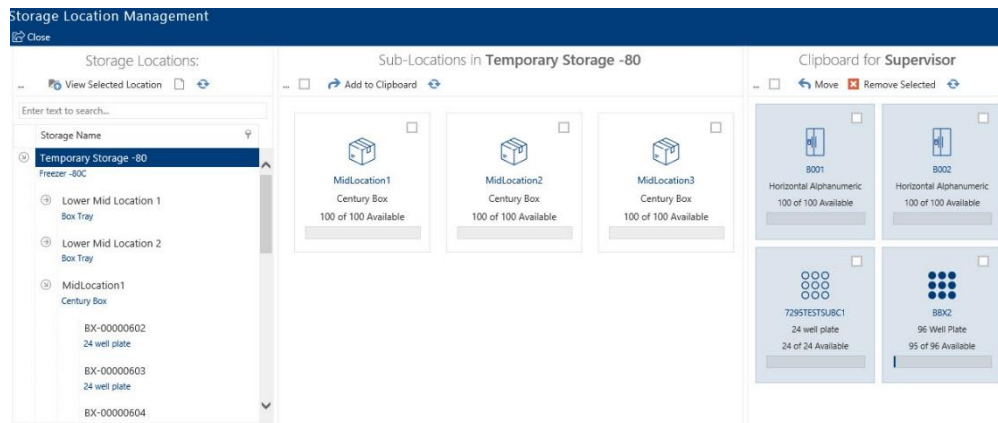


Figure 3: Example Storage Management in LIMS

4. Spending more time on admin than science

In a regulated environment where you are capturing valuable data resulting from research or testing, there is an expectation that you will be required to carry out some data entry and management. However, if you are entering data that is already stored somewhere else – essentially duplicating it – this not only wastes valuable resources but also leads to transcription errors. This data might originate from the initial registration of a donor and samples from a clinic nurse's paperwork, the output from an instrument or receipt of a sample from another team or lab.

Likewise, you will experience similar challenges if you are using paper-based systems and processes where you do not have access to a system when carrying out your work and rely on taking notes as you go along. Sometime after the event you – or the unfortunate nominated person for that week - then type that data into spreadsheets or systems. This means that the system is always out of date. Also, notes can be lost, incomplete or illegible which can significantly impact the quality of the information being recorded.

When using spreadsheets, it is not always obvious when data is missing or something has been entered incorrectly as there are few, if any, rules, and no automated warnings. It can take weeks, or even, months to find and attempt to fix any data anomalies.

In addition, if you are working with collaborators in other labs or institutes tracking sample movement and ensuring the correct paperwork is in place, such as transfer agreements and consent, is time-consuming without the right systems in place to assist.

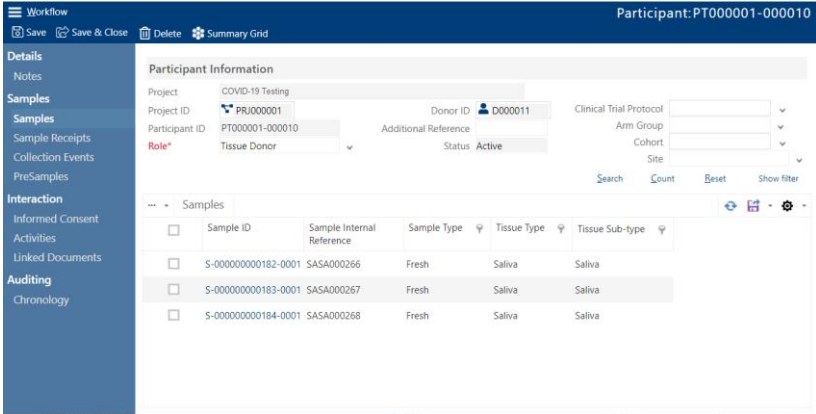
Solution

It may not be possible to remove all paperwork in the lab, but you can reduce it. A web-based, centralised software system that consolidates data across different labs and teams can help you achieve this. In addition, if the system can either import data from instruments or provide a view into other systems to give you access to data then this removes the need to re-key this information and eliminates errors caused by manual data entry.

LIMS are designed to help remove data silos while facilitating controlled access to data and workflows. Simple data forms and workflows enable data to be recorded digitally and, equally as important, consistently. Many LIMS also have an in-built audit trail. As a result, each sample record exists once in the central system with associated data, such as results and a chain of custody, linked. Similarly, you can also have a single donor record with all donated samples linked.

Advanced LIMS also provide data import and integration tools that enable authorised users to bring in or view data from other systems while enforcing data security, formatting, and quality rules.

Web-based LIMS, like Achiever Medical, can be accessed via a browser making it easily accessible so you can record the data at the time you carry out the work. This helps reduce the likelihood of transcription errors as well as ensuring you are working with up-to-date information. In-built workflows ensure critical information is recorded at the relevant step in the process while dashboards and automated alerts highlight any missing information. The LIMS can also help you to prepare your work, for example, pre-printing barcode labels for planned collections.



The screenshot displays the 'Participant Information' form in the Achiever Medical LIMS. The interface includes a sidebar with navigation options: Details, Notes, Samples, Sample Receipts, Collection Events, PreSamples, Interaction, Informed Consent, Activities, Linked Documents, Auditing, and Chronology. The main form area shows the following details:

- Project:** COVID-19 Testing
- Project ID:** PRJ000001
- Participant ID:** PT000001-000010
- Donor ID:** D0000011
- Additional Reference:**
- Clinical Trial Protocol:**
- Arm Group:**
- Cohort:**
- Site:**
- Role:** Tissue Donor
- Status:** Active

Below the participant information, there is a 'Samples' table listing linked samples:

Sample ID	Sample Internal Reference	Sample Type	Tissue Type	Tissue Sub-type
S-000000000182-0001	SASA000266	Fresh	Saliva	Saliva
S-000000000183-0001	SASA000267	Fresh	Saliva	Saliva
S-000000000184-0001	SASA000268	Fresh	Saliva	Saliva

Figure 4: Example Donor with Linked Samples in LIMS

5. Concerns about compliance

When working with human samples in the UK compliance with the Human Tissue Act (HTA) is a regulatory requirement. The consequences for non-compliance vary from minor recommendations to prison sentences for the most serious offences. Making sure you can legally and ethically use a human sample in line with the informed consent given by the donor or within study parameters is a mandatory requirement.

Labs not bound by the HTA will as a minimum follow internally recognised Standard Operating Procedures (SOPs) and codes of conduct.

With legislation, processes and technology continuously changing it can be difficult to keep up.

Plus, it can be very time-consuming and distracting if you have to access information on your SOPs from multiple sources, including colleagues and managers as well as systems.

Solution

Perhaps the simplest solution is an easily accessible, preferably web-based, central document library outlining your current SOPs that sends notifications to all those impacted when any changes are made to the documents. This can ensure that everyone is at least aware.

With a LIMS you can go a step further by mapping processes as workflows in the software. These workflows guide you step-by-step through each process, prompting for data at the critical points, automatically auditing steps completed, auto filling repetitive data, and preventing actions if not approved or awaiting further information. As a result, you know you are working in line with SOPs.

In addition to offering this, Achiever Medical LIMS enables you to manage donor consent requirements, as well as providing workflows to ensure you are using samples in line with these settings. There are also workflows to manage the consent withdrawal process. Similarly, there are digital consent management systems available that can be linked to a LIMS.



Sample Information

Project: COVID19 Testing

Sample ID: S-00000000153-0001

Sample Type: Fresh

Tissue Type: Saliva

Tissue Sub-type: Saliva

Organ:

Container Type: Tube

Internal Reference: SASA000227

Received DateTime: 06-Apr-2021 11:00

Team:

Depleted: ☐ Destroyed: ☐

Checked Out: ☐ Relevant Material: ☐

Component: ☐

On Loan: ☐ Available For Loan: ☐

Consent Opt Outs: ☐ Consent Pending: ☐

Donor ID: 00000004

Participant ID: PT000001-000003

Donor Diseases:

Sample Disease:

Search Count Reset Show filter

Open	Consent Description	Status	Expiry Date	Consent Choice
No File Attached	Consent for specific research project only	Active	06-Apr-2022	Animal - Opt Out, Export - Opt Out, Genetics - Opt In

Figure 5: Example Sample Details with Digital Consent in LIMS

Improving sample management in the lab

Efficient sample management requires consistent processes and ways of working, as well as secure and effective data management. Too often sample management is entrusted to spreadsheets, legacy database, or paper-based systems. Although simple to use, these options are difficult to control with multiple copies and slightly customised versions appearing. Conversely, they can be time-consuming to search and find information with little or no auditing. In fact, these simple systems could be costing precious lab time.

Sample Management software or a LIMS could help you address the challenges around accurate sample identification and management. These systems can help you find the most appropriate samples to use and give you the information you need so you know you can legally and ethically use them. In addition, they can also help you make efficient use of your storage capacity.

When it comes to a LIMS there is no one size fits all. Each system offers a unique blend of features, workflows, technology, configuration, and deployment options. Finding the system that is right for you requires you to understand not only your main challenges but also your objectives and goals. Systems can be implemented in weeks, months or even years and you should not underestimate the changes that a new system will bring. You may even find once you have implemented a system that you spend more time entering data on sample registration. However, it will probably be information you were not able to record before giving you a greater depth of understanding of your samples – making them more valuable.

The adoption of a LIMS or sample management software in your lab can have a positive impact both in your lab and across your organisation delivering many benefits including:

- Saving time searching for samples
- Improving the efficiency of your storage (possibly even increase capacity by increasing sample usage)
- Reducing paperwork
- Eliminating data duplication
- Improving data quality leading to better utilisation of samples
- Improving collaboration within and outside your lab
- Reducing time preparing for an audit inspection
- Improving lab process consistency and quality
- Improving capacity planning

About Interactive Software Limited

For over 20 years Interactive Software Limited has been helping life science organisations implement successful software solutions that transform the way they work and deliver greater insight into their data. Achiever Medical Laboratory Information Management System (LIMS) is a modern, configurable web-based solution that centralises lab data and supports pre-clinical, clinical research, academic research and biorepository processes and compliance needs. Managing all sample life-cycle events, the LIMS gives complete traceability of all sample activities providing evidence for compliance and quality assurance.

Looking to solve your sample management challenges?

To discover more about how Achiever Medical LIMS helps address the challenges raised in this document and improve your sample management and lab processes contact our team:

E: enquiries@interactivesoftware.co.uk

T: +44 (0) 121 380 1010

Or visit www.interactivesoftware.co.uk to learn more.