INTEGRATED BIOBANKING WORKFLOWS WORKING GROUP:
Workflow Case Studies and Lessons Learned Series

Workflow Case Study 3 – Primary tube barcode scanning failure on automated blood liquid handler

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Introduction

This case study is reviewing the difficulties with scanning primary blood tube barcodes in an automated liquid handling workflow. Scanning failures may occur due to issues with the equipment and/or consumables.

Problem

Issues with the equipment and/or consumables utilized may include:

- Labels not optimal for automated scanning
- Label printer unable to print 2D barcodes at high enough resolution
- Automated liquid handler script and associated scanning insufficient for (1) scanning 2D barcodes and reading the amount of information contained within the barcode on a tube which is turning around, and (2) scanning 2D barcodes on a cylindrical tube as opposed to a flatter surface
- Automated liquid handler workstation does not allow for manual scanning of barcodes due to the position of the tubes within the platform
- Positioning of barcoded labels on blood collection tubes varies which creates an issue during the automated scanning process as the tubes would then need to be turned and moved up and down in order to be scanned

In some of these cases, automated barcode scanning may be impossible altogether which then interrupts the automated liquid handling process; operator intervention would be needed.

Workflow Background

SOPs

- Use and Maintenance: Liquid Handler

Equipment

- 2D barcode scanner, manual
- Liquid handling workstation, automated (with Pick and Place arm and integrated barcode scanner)

Consumables

- Adhesive labels
- Blood collection tubes
- Sample storage tubes

Findings/Observations

The issues with the automated scanning failures may be time-consuming and may lead to increased workload as operator intervention would be required. Also, manual entry of the human-readable sample IDs may be required which would negate the benefits of an automated workflow. Furthermore, manual entry in itself may lead to quality issues with the data (e.g., data entered in varying formats, data entered incorrectly, etc.).

Solutions

- Change the liquid handling script so that the blood tube is presented to the operator and manual scanning becomes possible.
- Utilize less light-reflecting labels.
- Utilize a higher performance label printer.
- Utilize 1D instead of 2D barcodes on the primary blood tubes. However, note that the 1D barcodes are unable to contain the same amount of information as the 2D barcodes.
- Utilize rectangular instead of square 2D barcodes. The scanner settings may need to be changed in order for the rectangular barcodes to be recognized.
- The barcode content should be scanned and correspond to the sample ID so that manual entry is no longer necessary, thus creating a less error-prone process as a whole.

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Call for participation!

The Integrated Biobanking Workflows Working Group is recruiting members to develop more case studies based on this same template and where the objective is to uncover points in workflow integration which require improvement. Case studies may come from either automated or manual processes, from processes at any throughput level, and from a biorepository of any type and size.

If you are interested or have any questions, please email:

- Erik Steinfelder (Working Group Chair) at steinfelder@thermofisher.com and/or
- Conny Mathay (Working Group Member) at conny.mathay@ibbl.lu

Figure 1A

Figure 1B

Figure 1C

Figure 2A

Figure 2B

Figure 2C

Figure Legend

Figure 1A: The top label illustrates the size needed to effectively encode very simple information [for example, a sample ID (12345678)] in a 1D barcode. Encoding at a higher resolution requires a high performance barcode printer. 1D barcodes are very sensitive to scratches (see the bottom label). The size of the barcode grows proportionally with the amount of information to encode.

Figure 1B: This illustrates the issue caused by glossy labels. The ambient light or the laser beam from the barcode reader itself might interfere with the ability for the barcode to be read. As is illustrated by the 2D barcode on the bottom label, the combination of glossiness and light causes it to become completely unreadable.

Figure 1C: Here are two ways to encode the same information (in this instance, sample ID My_Sample). In the top label, the barcode is a square DataMatrix one; in the bottom, it is a rectangular one.

Figure 2A: 1D barcodes are completely insensitive to the tube's curvature; however, the amount of information which can be encoded within the barcode is limited.

Figure 2B: 2D barcodes become unreadable if the size is too big in comparison to the size of the tube. The effect becomes worse on tubes with a smaller diameter (illustrated by the tube on the right).

Figure 2C: Here are labels used in production at the Integrated BioBank of Luxembourg (IBBL). By using a rectangular DataMatrix, the curvature effect is minimized while maintaining the ability to encode more than 40 alphanumerical characters.