Automated Patient Barcode Tracking and Sample Preparation Using the Gilson GX-281 Barcode Matching System

Application Note CL0413

Keywords

GX-281 Liquid Handler, sample tracking, barcode matching, Laboratory Information Management System (LIMS), laboratory informatics, sample preparation, automation, clinical laboratory, patient samples

Introduction

This work was performed by Norbert Wodke, Gilson, Inc.

Automated liquid handling is well established as a process by which efficiency, accuracy, and repeatability are vastly improved in the laboratory. Within the liquid handling framework, the ability to track and effectively manage samples is fundamental. Sample traceability is particularly important in clinical laboratories, where the misidentification of samples can have direct implications on patient safety. For instance, according to a 2006 report in which data from 120 institutions were extrapolated to all U.S.-based clinical laboratories, an average of 160,000 adverse patient events occur annually due to errors in sample identification and labeling.[1] Thus, patient samples and their derivatives (e.g., tissue cassettes and slides prepared from histological samples) – oftentimes processed in large numbers – must be positively tracked from accession through preparation, analysis, and final data reporting.

In most cases, clinical sample preparation and analysis involve steps that necessitate the frequent movement of samples, typically in the form of tube-to-tube transfers. Hence, the potential for patient sample misidentification to occur exists throughout the clinical laboratory process, especially when samples are processed manually. Tubes must be adequately labeled and a tracking system implemented to guarantee the unequivocal identification of samples throughout all preparatory and analytical steps. Accordingly, the field of laboratory informatics, which makes use of automation and other emerging technologies to facilitate the management of laboratory information, is gaining popularity in clinical facilities.[2]

Among the most common laboratory informatics tools is barcode tracking. In addition to being a reliable method for differentiating and identifying laboratory samples, barcoding is amenable to automation.[2] This application note discusses the GX-281 Barcode Scanning System, a barcode matching system designed for the Gilson GX-281 Liquid Handler that affords sample traceability through simultaneous tracking and liquid handling. Using the Gilson Barcode Matching System Software, the system removes manual sample preparation by automatically integrating the scanned barcode data from the scanner to correctly perform critical patient sample dilutions from the clinical laboratory for analysis. Shown in Figure 1, this system incorporates a barcode scanner and a tube gripper as third party devices on the GX-281 Dual Z-Arm.

Figure 1. Gilson GX-281 equipped with a barcode scanning system

Potential applications for this type of barcoding system are ubiquitous, particularly in clinical settings, as sample identification data from this software program can be easily imported into laboratory information management systems (LIMS). The combination of the Gilson Barcode Matching System Software with the GX-281 Barcode Scanning System presents a novel automated solution to the sample tracking process.

Materials & Methods

The barcode matching system was used to track patient samples during a dilution procedure on the GX-281:

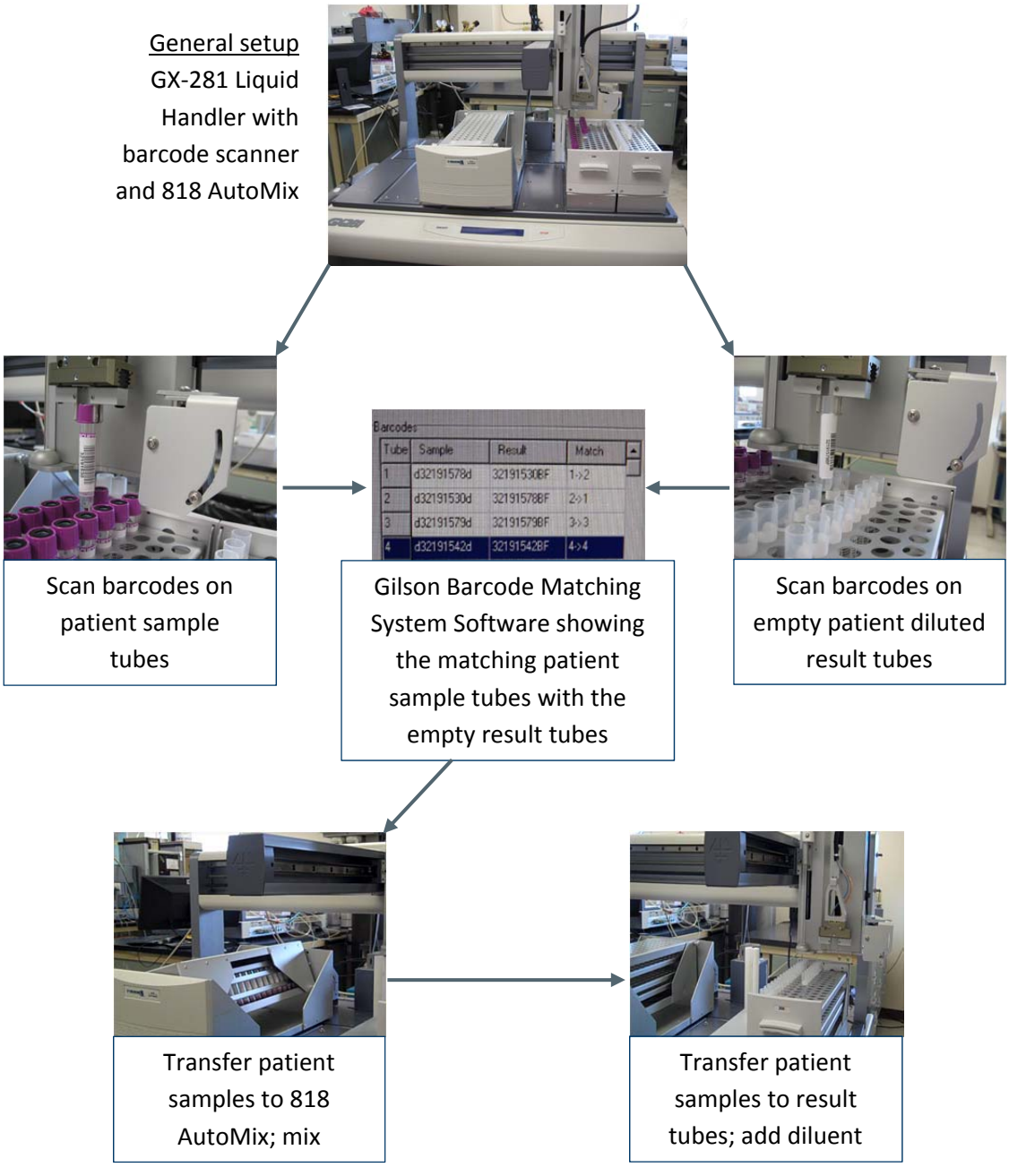

Figure 2. General dilution procedure with sample tracking.

Results

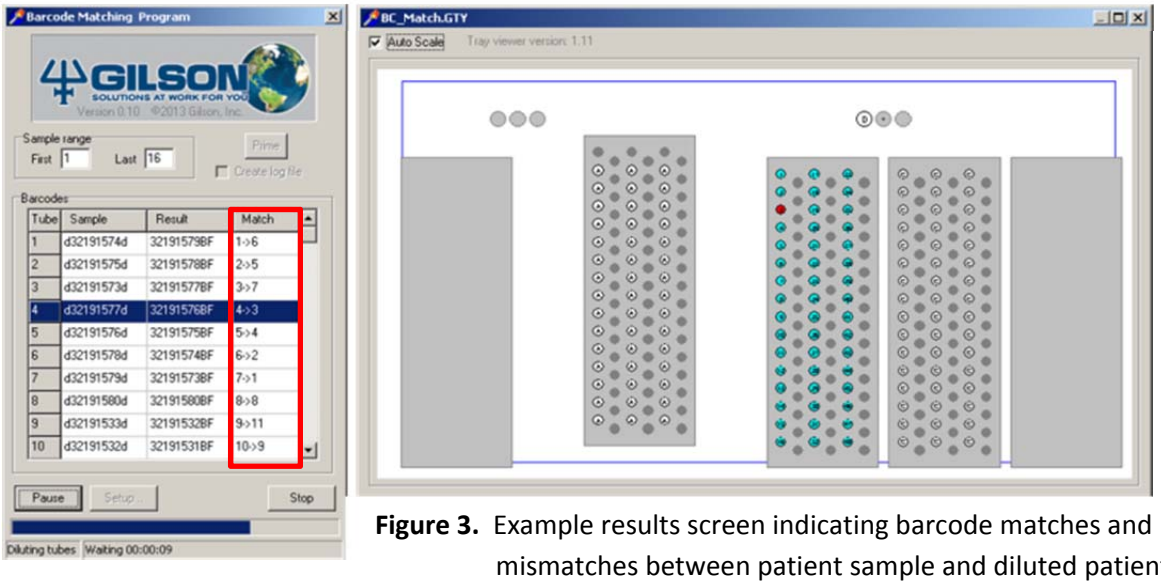

Figure 3. Example results screen indicating barcode matches and mismatches between patient sample and diluted patient result tube positions.

The GX-281 Barcode Scanning System using the Gilson Barcode Matching System Software successfully identified mismatches between sample and result tubes (Figure 3). The Gilson Barcode Matching System Software used this information to appropriately match patient sample tubes with the corresponding patient result tubes for the GX-281 Barcode Scanning System to correctly dilute the patient samples (Figure 4).

Mismatch identified

Mismatch incorporated into dilution procedure

```
************************************************
*                  Gilson, Inc.                *
*       Gilson Liquid Handler Log File         *
************************************************
Log file for Barcode_Match.EXE Version 1.07
Samples: 1 to 4
Run started: 13-07-11 09:17:38

Scan the Sample barcodes
09:17:48  Samples: 1 (d32191578d)
09:17:52  Samples: 2 (d32191530d)
09:17:57  Samples: 3 (d32191579d)
09:18:02  Samples: 4 (d32191542d)

Scan the Result barcodes
09:18:07  Results: 1 (32191530BF)
09:18:12  Results: 2 (32191578BF)
09:18:16  Results: 3 (32191579BF)
09:18:21  Results: 4 (32191542BF)

Match Report
1       1->2
2       2->1
3       3->3
4       4->4

Dilute Samples: 1(d32191578d)  into Results: 2(32191578BF)
09:19:56  Aspirate 50ul from Samples:1
09:20:10  Dispense 1000ul to Results:2

Dilute Samples: 2(d32191530d)  into Results: 1(32191530BF)
09:20:15  Aspirate 50ul from Samples:2
09:20:30  Dispense 1000ul to Results:1

Dilute Samples: 3(d32191579d)  into Results: 3(32191579BF)
09:20:35  Aspirate 50ul from Samples:3
09:20:50  Dispense 1000ul to Results:3

Dilute Samples: 4(d32191542d)  into Results: 4(32191542BF)
09:20:56  Aspirate 50ul from Samples:4
09:21:10  Dispense 1000ul to Results:4

09:21:14  Run finished
```

Figure 4.
Example log file of a dilution sample set performed using the Gilson Barcode Matching System Software.

Summary

A critical, yet simple dilution procedure was run on a GX-281 Barcode Scanning System. The Gilson Barcode Matching System Software rapidly identified matches and mismatches between the samples and the transfer tubes in corresponding positions on the GX-281 platform. Log files of the run delineate how the GX-281 utilized the barcode information to deliver aliquots of each patient sample to the appropriate patient result tubes.

An effective sample tracking method represents an intrinsic component of any LIMS, as the likelihood of clinical laboratory samples becoming misplaced increases with each manual step in the patient sample preparation and analysis workflow. Coupled with liquid handling on the GX-281, an automated barcode scanning system offers numerous benefits, including enhanced efficiency, positive patient sample identification, and electronic records reporting.

References

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2. Pantanowitz, L., Mackinnon, Jr., A.C., Sinard, J.H. Tracking in anatomic pathology. Arch. Pathol. Lab. Med. DOI: 10.5858/arpa.2013-0125-SA.