Overcoming the limitations of barcode technology

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The introduction of armband barcode scanning capabilities to point-of-care glucose testing devices has been shown to greatly reduce patient identification errors. Barcodes may be scanned to identify operators, patient identification and reagents. Barcode scanning, however, does not eliminate all errors, and in some cases can be the source of significant error.

In this article, we will concentrate on errors that occur due to the limitations of barcoding, and how proper planning and training can limit those errors.

Basic recommendations to aid in successful barcoding solutions are printing the armband barcode in Code 128, incorporate a unique identifier in the armband, limit access to armband labels, keep barcode quality high, properly train anyone responsible for armband construction and train operators on the limitation of the device used as well as common errors when manually entering data. Through the use of barcode scanning and interfacing, manual entry may become a thing of the past.

Hopefully, industry can meet the challenge to improve current barcode systems, or develop new solutions such as radiofrequency identification (RFID). Until current barcode technology is improved, careful planning and training are essential in limiting the errors commonly seen with barcodes.

Introduction

The introduction of armband barcode scanning capabilities to point-of-care glucose testing devices has been shown to greatly reduce patient identification errors [1]. Barcodes may be scanned to identify operators, patient identification and reagents.

Barcode scanning, however, does not eliminate all errors, and in some cases can be the source of significant error. In this article, we will concentrate on errors that occur due to the limitations of barcoding, and how proper planning and training can limit those errors.

Basic recommendations to aid in success

Print patient identification barcode in Code 128

Lengthy patient identification numbers printed in the most commonly used barcode symbology, Code 39, when used for armbands, tend to curve around the patient's arm, making them difficult to scan.

Incorporate a unique identifier into the patient armband barcode label

At our facility we decided to place a "P" prior to the account number. Operators of our point-of-care glucose devices are required to scan the patient armband to enter the identity of the patient.

The presence of the "P" identifier in the armband barcode aids in evaluating operator compliance. Since the operator can enter the "P" manually, a better solution is a device that records whether the entry is manually entered or scanned.

If this is not an option, an identifier that cannot be manually entered should be selected. The most common selection is punctuation. This choice needs to be made carefully, since some punctuation may interfere with the database or interface.

The unique identifier used in the armband should be standardized for all vendor applications using armbands. When implementing a second application to make use of barcoded armband to document lab specimen collection, the Laboratory Information System (LIS) vendor installing the system indicated that the unique identifier would need to be changed to two alpha characters.

Since this would involve an interface script change with the glucose meter vendor, the LIS vendor agreed to adjust their system to use the "P". Interface providers must be prepared to handle the "unique" identifier when comparing the ID to the Admission Transfer and Discharge (ADT) record and when sending the record to the LIS.

Limit access to the armband labels containing the unique identifier

If barcode labels containing the unique armband label barcode are readily available, operators may be tempted to use them inappropriately. One of our intensive care nurses decided to apply one of the labels to the foot of the patient's bed to make it easier to scan.

The only problem was that the label placed on the foot of the bed was from a different patient.

While the treatment the nurse gave to the patient was not affected, there was a potential for the other patient to have inappropriate treatment since the values were entered into the electronic record.

Operators must be trained to realize that scanning a label not on the patient armband is an unsafe practice, since the normal tendency is to not compare this entry to the armband before the test is performed.

Keep barcode quality extremely high

Place the armband label in an armband with a protective pouch. Ensure that the print quality of the printer and the labels used to construct the armband are perfect. If labels are kept in a patient chart or folder they are subjected to wear and become worn, which may present problems.

This also applies to blood gas systems utilizing specimen labels. Our benchtop blood gas analyzers make use of specimen identification accession numbers (which are barcoded) for identification.

One of our point-of-care devices makes use of a specimen identification label in which the account number is barcoded in Code 39. These labels may be very prone to quality issues due to wear and initial print quality.

Train everyone that comes in contact with the barcode label what the limitations are

Admitting personnel and anyone else that may construct and put an armband on a patient must understand that the label with the unique identifier must be used, perfect in quality, and be printed from the correct account.

I should include that the armband must be applied to the correct patient. Training of the personnel involved with "*labeling*" the patient must make them aware that failing to do this correctly and according to procedure may result in grievous harm to the patient.

This may involve a number of types of clinical staff. At our facility, staff that may have an effect on the accuracy and quality of the barcoded patient ID includes admitting staff, nurses and technicians.

Train everyone using the device on its limitations

Operators generally assume that if they make a manual entry, it will be correct. Our experience is that with manual entry at least a 9.4 % error rate may be expected. We have had a difficult time convincing operators that they must check their manual entries.

It is even more difficult to convince operators that if they scan an entry, it can be invalid. If it is physically possible to scan a reagent, such as a test strip, barcode in as the patient ID, the operator must be made aware. My experience is that the operator expects the device to detect most, if not all, errors.

Train everyone using the device on their own limitations

Prior to implementing barcoding into our point-of-care glucose program, we observed a patient identification error rate averaging 9.4 %. After achieving scanning rates of 99.4 % we have observed error rates with some operators, when they attempt manual entry, from 75 to 100 %.

Observations when procedures and processes outlined in basic recommendations are not followed

Patient's armband barcode will not scan or scans incorrectly

- Labels printed in Code 39 may be used for the armband, rather than the correct label in Code 128.
- Barcode labels printed on a standard printer soon become worn. The use of armbands with a protective pouch can reduce this problem, if the armband is constructed before any wear occurs. Laminated labels may also provide an alternate solution. If the person constructing the armband applies the label to the outside of the armband, the label will soon become too worn to work properly.
- Poor print quality can greatly reduce the ability of the scanner to read the barcode. Low toner levels and printer alignment problems are common.

Note: When scanning poor-quality labels, the scanner may misread the barcode. Most of the time, this only results in unidentifiable results. However, there can be punctuation entered into the patient identification field which may interfere with the data management system or interface.

In September 2004, we had 14 of 15,338 point-of-care glucose tests in which the barcode was interpreted. Two patient tests, had an apostrophe in the ID, causing the interface to stall. One occurrence on a Friday afternoon resulted in 1,900 patient results waiting to be transmitted by Monday morning.

Operator may scan the wrong barcode

- Operator scans a barcode on a reagent, such as glucose strip vial, or operator ID as the patient identification.
- Operator scans incorrect identification label. In some applications, the operator is expected to enter a specimen identification number, rather than the patient's account or medical record number. This is most commonly seen in our neonatal intensive care unit where blood gasses are performed. A LIS accession label is generated giving the operator a number to enter into the device. If the operator scans a patient chart label (account number barcode), the results will not cross the interface to the LIS. Rather than correcting the specimen identification on the analyzer and resending the results to the LIS, the operator may enter the blood gas results manually. Clerical errors, as we have seen before, are common during manual entry and may result in mistreatment of the patient.

Operator may manually enter invalid information

- Operator may have a choice of two or more identification numbers on the patient armband. The most common identification used is the patient's encounter or account number. Operator may inadvertently enter the patient's medical record number.
- Operator may inadvertently enter invalid reagent information. We commonly see operators enter the glucose strip lot number in the glucose meter as the control lot.
- Operator may enter the specimen identification number incorrectly. For blood gas testing in our lab, we scan the specimen accession number into the device. When operators enter the accession number manually, they may make a clerical error. When this occurs, test results will not be transferred to the LIS. Rather than correcting the specimen identification on the analyzer and resending the results to the LIS, operators may enter the blood gas results manually. Clerical errors are common during manual entry and may result in improper treatment of the patient.
- Operator may make clerical errors when entering the patient ID. This may result in a patient ID that is invalid and results that are unidentifiable. The ID entered may belong to another patient. When using account numbers as the ID, an invalid manual entry has a higher probability of belonging to another patient than using a unique identifier, such as the medical record number.

Operator scans a label that is not on the patient's armband

As discussed previously, operators are expected to enter the patient identification by scanning the patient's armband. Operators may be tempted to scan labels from a chart outside the patient room, or at a nursing station.

If the account number is not compared to the patient's armband when performing the test, the results may be posted to the wrong patient's electronic record.

Operator may scan an armband label which is not on the armband for point-of-care blood gasses

At one of our locations point-of-care blood gasses are performed on a device in which the patient's account number is entered. The tests are not performed at the bedside, so the patient armband should never be scanned. If the operator scans a patient-armband-only label, the device gives a patient ID length error.

Due to a software flaw, when the error is cleared, the armband identifier and the first nine digits of the patient account number are left in the device. The operator should correct the entry, but is able to proceed with the invalid patient ID. The results then fail to be entered by the data management system into the LIS.

Summary

Due to the limitations of currently available barcode printing and scanning devices, training becomes an essential component of implementing a successful barcoding system. Training must include anyone that might handle or use the barcode label. This should include admitting staff, Information Associates and device operators.

Operators generally expect the barcode system and devices to be perfect, so limitations should be stressed in training. While the frequency in which there is an entry of "*damaging*" punctuation into the data field is very small, the effect of even a single occurrence on the database may be of great significance.

There is clearly a need for manufacturers to develop smarter devices with systems designed to reject invalid entries. Even with its problems, the use of barcode scanning technology has greatly improved the quality and ease of information entry at our facility.

We have added barcode scanning capabilities to point-of-care and central-laboratory blood gas instruments due to the success seen in point-of-care glucose testing. Through the use of barcode scanning and interfacing, manual entry may become a thing of the past.

Hopefully, industry can meet the challenge to improve current barcode systems, or develop new solutions such as radiofrequency identification (RFID) [2]. Until current barcode technology is improved, careful planning and training are essential in limiting the errors commonly seen with barcodes.

References

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