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Bar-coding in the Morgue: Raising the bar for accountability and efficiency

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ABSTRACT

To reduce errors and improve efficiency, health care systems have implemented linear bar-codes in various settings. At our institution, we introduced a bar-code body identification system in the morgue to link demographic data from hospital medical records to our SQL - based mortality and autopsy data file. Using conditional formatting, an algorithm was developed for scanning bar codes placed on the decedent's body, body bag, and mortality service work sheet. The medical record number entered by scanning the bar-code is used as a primary key to avoid duplication of a death entry into the database. The employee number and a time-stamp are entered into the database for personnel accountability. The impact on the mortality service was analyzed using two brief surveys respectively conducted nine and twenty two months after implementation. All users appreciated the system's ability to alert them to potential errors or identification mismatch in advance, and reduce the chance of data entry errors or misidentification. Operational for over 2 years, this system has had a positive impact on our pathology practice by averting cases of potential misidentification, and is a cost-effective and efficient mechanism for organizing data and minimizing errors on the mortality service.

Keywords: Bar code, mortality services, autopsy, error reduction, misidentification

Introduction

Maintenance of an accurate and complete mortality and autopsy database is paramount for health care quality assurance, epidemiologic studies, and continuous quality improvement. Incidents of misidentification of deceased bodies usually lead to extreme emotional distress among next of kin and may instigate punitive litigation. In order to reduce errors and improve efficiency, health care providers have employed linear bar codes in various settings including patient identification, organization of medical records, pharmacy allocation, and for the tracking of laboratory samples. In 1999, the Joint Commission on Accreditation of Healthcare Organizations suggested the use of "unique" identification bands for patients receiving blood transfusions.[1] The Food and Drug Administration, in March 2004, issued guidelines for the placement of bar codes on the labels of various drugs and biological products used in health care.[2]

Bar code technology is now extensively used to track clinical laboratory specimens and blood products, and is rapidly gaining acceptance in the tracking of surgical pathology and cytology specimens and microscopic slides. However, there is little information on the application of bar-code identification systems on mortality/autopsy services. The purposes of this study are: 1) To introduce a bar-code body identification system which links demographic data from the database of hospital patient records to our SQL- based mortality and autopsy database; and 2) To demonstrate the advantages of such integration in reducing data entry errors and in improving the efficiency and accountability of mortality service personnel.

Material and Methods



Figure 1. Mortality service employee scanning ID badge.

In December, 2005, we implemented a bar-code scanning process and a web site for body identification and for linking demographic data from the hospital's electronic medical records to the mortality service database. Prior to this implementation, mortality personnel manually entered the decedents demographic data into the mortality database. On average, the mortality service at our hospital handles 600 bodies per year, and performs approximately 100 autopsies annually.

Using conditional formatting, an algorithm was developed for scanning bar-codes placed on the deceased body, body bag, and mortality service work sheet. A wireless bar-code scanner (manufactured by Intermec Technologies Corporation [Model # Scan Plus 1802 Vista]) is used to scan the decedent's bar-codes followed by scanning of the identification badge of the mortality service attendant (Figure 1). As a quality assurance measure, the medical record number entered by scanning the bar-code is used as a primary key to avoid duplication of a death entry into the database. The mortality service employee's identification number and a time stamp are also entered into the database for accountability. The use of linked demographic information serves to place a check on any potential errors occurring during manual filling of data. The new data base was transferred to a Structured Query Language secure server.

A new work flow process was simultaneously developed to integrate with the application of the bar-code identification system (Figs. 2, 3). To evaluate the impact and acceptance of this bar-code

system on the mortality service, two brief surveys of the mortality service personnel were conducted. The surveys queried each responder about his or her experience as a user of this new bar-code scanning system after nine and twenty two months of implementation. Since implementation, the mortality data base entry errors and misidentification are tracked monthly as a departmental quality parameter.

Results

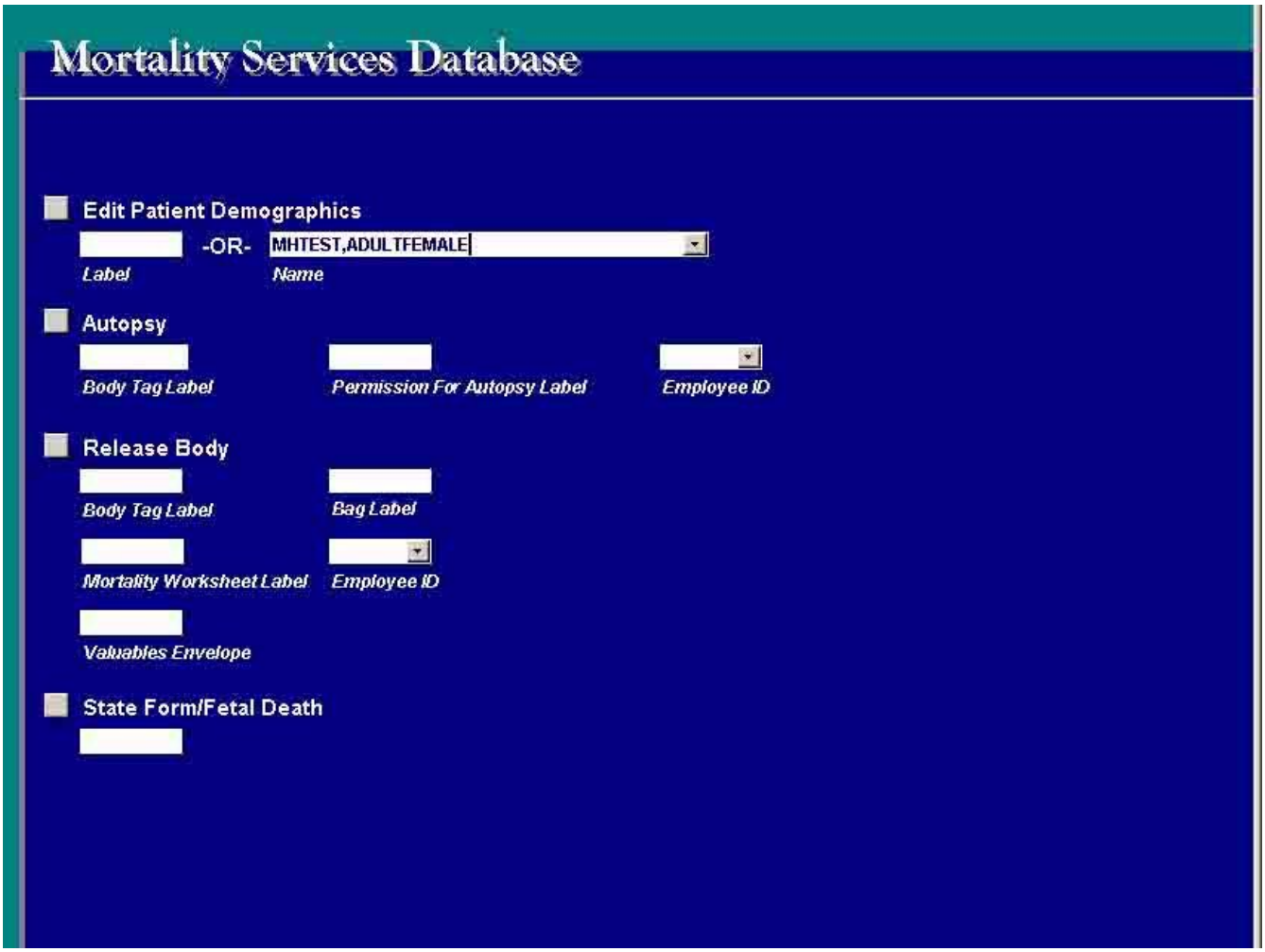

Figure 2. Mortality Data Base main screen showing four different accessioning options: Edit Patient Demographics, Autopsy Identification, Body release, and State Form/Fetal Death.

Prior to implementation of the system, each decedent‘s demographic data had been manually entered into a database. The level of error reduction following the implementation of bar codes could not be accurately quantified as error corrections were not tracked electronically prior to implementation of the system. However, the departmental quality manager noted marked subjective improvement in the reduction of data entry errors from approximately 33% (two years prior to implementation) to approximately less than 5% (two years post implementation).

During the initial implementation phase, we also encountered two cases with accession errors due to manual entries. These two situations would have been readily avoided with the use of proper bar-codes.

The initial survey results indicate that six of seven respondents preferred the new bar code scanning process over the old manual entry protocol. All respondents acknowledged an improvement in error reduction with the bar code scanning process at a level that was considered “exceptional” (2/7 respondents), greater than expected (4/7), or moderate (1/7). Accountability by mortality service personnel was recognized as improved by all respondents, who graded the system as “exceptional” (3/7respondents), greater than expected (3/7), or somewhat better (1/7). The results of the second survey indicated nearly identical results for the above 3 parameters - preference (5/6 respondents), error reduction (6/6), and improved accountability (6/6).

In the second survey respondents were also asked to evaluate work flow efficiency after bar-code scanner implementation. All responses indicated improved efficiency that was considered exceptional (2/6 respondents), greater than expected (3/6), or moderate (1/6). None of the respondents had experienced shut-downs of the system, failure of the scanning process, or data entry errors of the bar-code system during 22 months following implementation. Respondents also emphasized the reduction of typographical errors during data entry as demographic data were pulled from the hospital data base.

During the implementation and follow-up period, regular feedback to nursing personnel led to a standardization of decedent identification and bar-code placement. The level of correct identification and bar-code placement was 95% during the first three months of application and 99% after 22 months of use.

Discussion

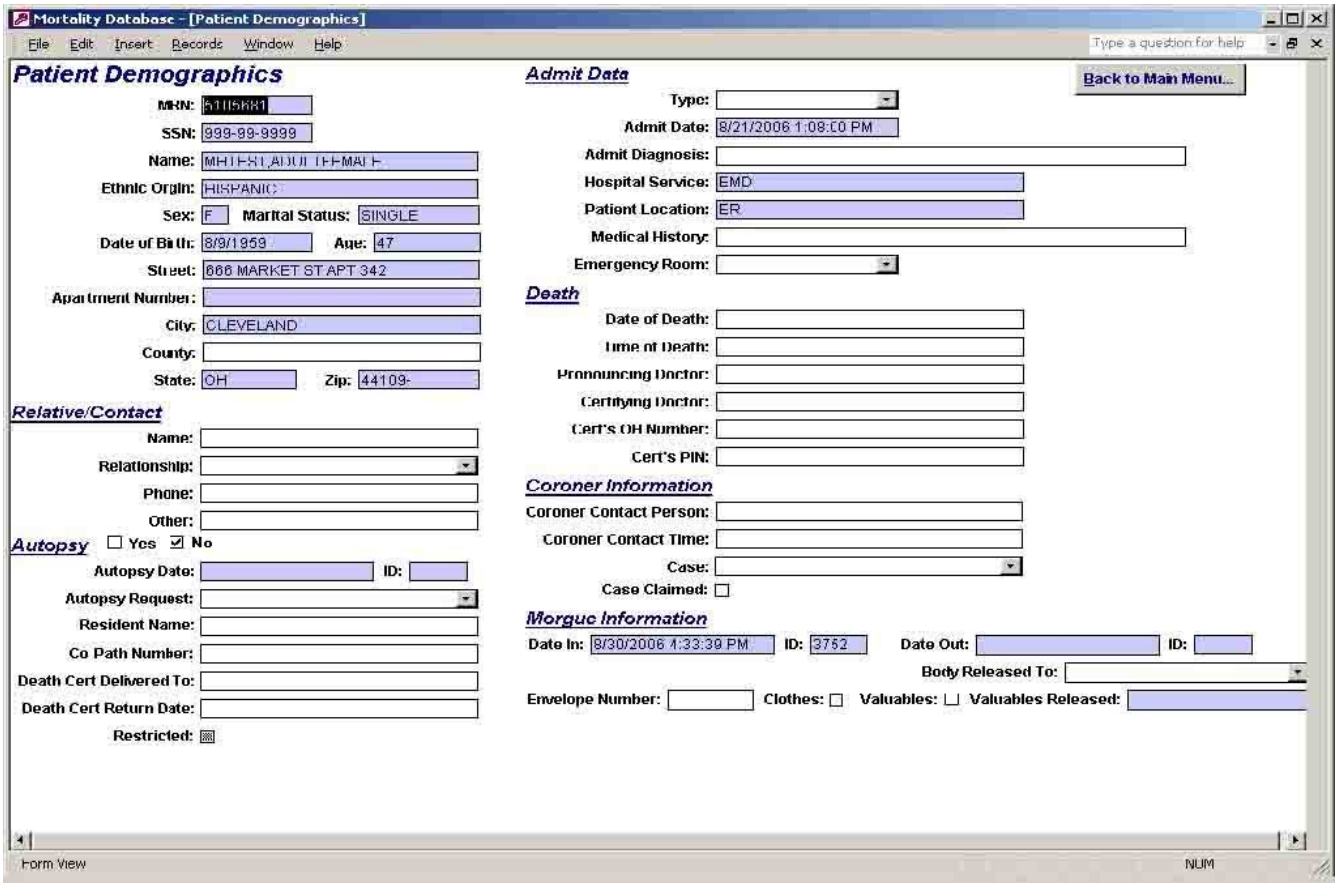

Figure 3. Mortality Data Base demographic sheet. Shaded areas are entered from bar-codes and are not modifiable.

The use of bar-codes as a positive form of patient identification was suggested by Longe in 1987.[3] This general idea was well supported by various articles featured in leading journals. In 2004, the FDA estimated that over the next 20 years more than 500,000 adverse events could be eliminated by implementation of bar code systems in dispensing of drugs.[2] Turner et al found that a bar-code patient identification system simplified and improved the clinical blood transfusion process.[4] Our user satisfaction surveys, conducted nine and twenty two months following implementation, showed the new bar-code body scanning process is preferred over the previous manual entry process. The perception of error reduction and increased accountability among users of the system were quite positive and encouraging. Since we did not have accurate data regarding entry errors prior to implementation of the system, the level of error reduction could not be precisely quantified. However, the departmental quality manager noted marked subjective improvement in the accuracy of data entry from approximately 33% (two years prior implementation) to approximately less than 5% (two years post implementation).

There is little information in the medical literature on the use of bar-code technology in the hospital mortality setting. University of Iowa Hospitals and Clinics interdisciplinary research team[5] implemented an online data-capture-response tool utilizing wireless mobile devices and bar code technology to track and improve the blood products administration process. Their preliminary results from pilot data indicate that the bar-code process captures data and minimizes errors better than the traditional manual process. Poon et al[6] found that bar-code technology significantly reduced the rate of target dispensing errors by 85%, from 0.37% to 0.06%. The rate of potential adverse drug events (ADEs) due to dispensing errors was also significantly reduced. In our general clinical laboratory experience, the use of standardized electronic order entry and bar-code labeling of laboratory specimens led to a dramatic 65 % decrease in specimen misidentifications within three months of implementation (unpublished data). During the initial implementation phase of bar coding deceased bodies, we encountered two cases with accession errors due to manual entries. These cases could have been averted with use of proper bar-codes. Subsequently, during a one year period we did not encounter any accession errors, further emphasizing the value of bar-codes.

Dinklage and et al[7] studied the effect of a bar-code system on personnel time requirements and data-entry accuracy in an existing automated controlled substances inventory system. They found a significant reduction of errors from 1.53 % to 0.79% after implementation of bar-codes, although mean data-entry time for keyboard and bar-code methods was not significantly different. In our study, the system attributes most helpful to users were auto-fill function, time saving, accuracy, ease of use, and efficiency of maintenance of morgue inventory.

The results of the College of American Pathology Q-Tracks inter-laboratory quality improvement program in 1999 and 2000 were quite promising.[8] A total of 217 institutions voluntarily participated in continuous monitoring of patient wristband errors. Wristbands were inspected by each institution’s phlebotomists for any error before performing phlebotomy. The errors were recorded and suggestions to reduce them were also recorded. The feedback resulted in a continuous improvement occurring in each quarter. The participants' mean wristband error rate for the first quarter in 1999 was 7.40%; by the eighth quarter, the mean wristband error rate had fallen to 3.05% ($P < .001$). Modifications in the design of bar-code and label placements have been advocated to further reduce errors.[9] We also noted an improvement in correct bar-code placement by nursing personnel which occurred during the first 22 months following implementation of the body bar-code system.

Hock and et al[10] prospectively audited the documentation relating to 7,761 bodies received in the mortuary of the Walsall Hospitals NHS Trust during 1996-2000. Any discrepancies between the wrist bands, labels, identification papers and registration details were audited; one or more discrepancy qualified as a failed case. The discrepancies were conveyed to the ward managers and funeral directors as a part of an internal quality assurance audit. Their failure rate for bodies fell from 10.2 %(1996-97) to 2.9 %(1999-2000) which was attributed to continuously alerting the staff of errors as part of the audit.

University of Texas Southwestern Medical Center autopsy service[11] under supervision of the office of the Dallas County Medical Examiner in 2003 made a successful attempt of transition from a Word-based system to a database system. The new database was linked to the hospital laboratory information system (LIS) and resulted in an autopsy database and reporting system that met the user's diverse interests. The new autopsy database and reporting tool were designed using Filemaker Pro 5.5 software (Filemaker Inc, Santa Clara, California). The generated database was stored on a central server and accessible to both PC and MAC platforms.

Nichols and et al[12] highlighted the inability to achieve a target of zero errors in spite of bar-code scanning of patient identification. Various factors like manual data entry due to unavailability of bar-codes, multiple bar code labels, and placements of expired bar-codes were implicated. They emphasized the importance of additional administration steps to ensure successful bar-code scanning by verifying the information contained on the wristband containing the bar-code. In our study, survey respondents pointed towards delay in printing labels, mislabeling, damaged or misplaced bar-codes and lack of training as potential failures within the scanning process. Similar suggestions of continuous feedback were made by survey respondents as a quality assurance evaluation of the system.

Our survey results pertaining to bar-code identification are encouraging as 85% (survey1) and 83% (survey 2) of users positively accepted the new bar code system. Same users also graded the degree of error reduction as exceptional (28% and 33% in each survey, respectively). In survey 2, all users emphasized the system's ability to alert them of potential errors or identification mismatch in advance, and 83% of respondents felt more comfortable and confident that the bar-code system reduces the possibility of data entry errors or misidentification. Users graded bar-coding as a superior method of increasing personnel accountability, and felt that bar-code scanning increased their efficiency. None of the respondents experienced shut downs, or failure to scan or data entry errors of the bar-code system during two years of implementation.

Conclusion

Utilizing commonly available bar-code scanners and a database management program, we have developed a complete, low cost, accurate, and efficient mortality and autopsy database. Operational for over 2 years, this system has been effective in our health care practice in minimizing data entry errors and avoiding potential misidentifications. The application of similar systems in tracking of mass casualties due to terrorist attacks and military operations is feasible and represents a potentially important extension of this technology.[13]

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