Evaluating the Accuracy of Transcribed Clinical Data

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ABSTRACT

This study evaluated the accuracy of data transcribed into a computer-stored record from a handwritten listing of pediatric immunizations. The immunization records of 459 children seen in the UCLA Children's Health Center in March, 1993 were transcribed into a clinical computer system on an ongoing basis. Of these records, 27 (5.9%) were subsequently found to be inaccurate. Reasons for inaccuracy in the transcribed records included incomplete written records, incomplete transcription of written records, and unavailability of immunization records from multiple health-care providers. The utility of a computer-stored clinical record may be adversely affected by unavoidable inaccuracies in transcribed clinical data.

INTRODUCTION

Computer-stored medical records are often composed of clinical data transcribed either from voice dictation or from handwritten notes. Although transcription avoids the problems associated with requiring physicians to enter clinical data directly into a computer system, the cost and operational difficulty of transcribing clinical data into the computer system can be significant [1].

Part of this cost is related to the problem of entering clinical data into the computer system accurately and completely. Although a variety of methods have been proposed to minimize the work of data entry and to improve the accuracy and consistency of data as it is stored, there have been few analyses of the accuracy of computer-stored transcribed medical data.

This study examined the accuracy of pediatric immunization records transcribed from a handwritten immunization record in an outpatient chart and stored in a computer patient-tracking system. Differences between the computer-stored records and the commonly-accepted age-specific standards for childhood immunization were assumed to imply inaccuracies in the transcribed immunization data.

METHODS

Immunization records were recorded in a microcomputer-based patient-tracking system used in residents' continuity clinics and in full-time faculty clinics in the UCLA Children's Health Center. Immunization records were analyzed for all 844 children seen in March 1993 in the clinics during the study period. Of these records, only the 459 records pertaining to children between 0 and 12 months of age were analyzed.

Immunization records

The administration of immunizations was routinely documented in writing in the UCLA Medical Center chart. The written immunization record was updated contemporaneously by the nurse who actually administered each child's immunizations. In addition, physicians recorded immunizations as part of a structured "encounter form" that also included a medical problem list, current medications, reason for clinic encounter, and a brief description of the most recent previous clinic encounter (physician, clinic location, primary problem).

The handwritten records were transcribed daily by non-medical personnel from the structured immunization-history form into a computer-based patient-tracking system. Immunization data were transcribed at the same time as the other clinical data on each patient's encounter form.

The computer system in which immunization records were stored used a local-area network (IBM Token Ring) and a multi-user client-server

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architecture (OS/2 data servers and Microsoft Windows client workstations) [2].

Immunization records were entered into the computer system using a data-entry menu on which one or more data items may be checked off (see Figure 1).

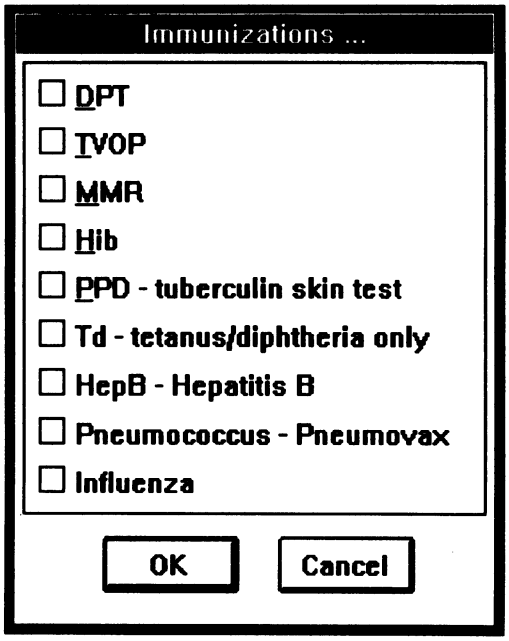

Figure 1. *The data-entry menu used to transcribe immunization data into the computer system.*

Data analysis

Database data were exported as dBase-compatible files; tabular analysis was performed using FoxPro™ and Microsoft Excel™. Potentially-inaccurate immunization records were identified by comparing the total number of recorded immunizations for each patient with established age-appropriate recommendations for routine childhood immunizations [3]. A rule-based expert system was used to cross-check these observations [4].

Each immunization record identified as being potentially inaccurate was compared to the written chart from which it was transcribed. Instances of inaccurate data were categorized as follows:

Transcription errors: inaccuracies stemming from incomplete or inaccurate transcription of data that appeared to be accurately written in the chart. Such errors included omission of data documented in the written immunization record but not in the computer system, and incorrect entry of documented immunizations into the system.

Incomplete data: inaccuracies related to incompletely-recorded data in the written chart. This category included immunization records for children who were underimmunized according to expert recommendations and who had no documentation of missed immunizations in the medical record.

Unavailable data: inaccuracies related to the unavailability of data in the written immunization record. For example, immunizations obtained from a non-UCLA health-care provider might be documented in a physician's note but not in the written immunization record.

RESULTS

In the sample of 459 computer-stored records of clinic visits by children ages 0-12 months, 27 (5.9%) of the computer-stored immunization records were identified as being potentially inaccurate. For 3 the 27 records, the handwritten charts were not available when the study was carried out. The remaining 24 computer-stored records were compared with the handwritten medical chart from which they were transcribed, and the differences between the written and computer-stored records were categorized.

Reason for inaccuracy	*Number of records*
Transcription error	13
Incomplete data	5
Unavailable data	6

Of the 24 records reviewed, 12 (50%) were inaccurate due to transcription errors, where the data recorded in the written chart were not copied accurately into the computer system. Another 5 (21%) of the inaccurate records were transcribed correctly, but were nevertheless inaccurate because immunization data were not recorded in the written chart. Six (25%) of the inaccurate records pertained to children who had received immunizations from non-UCLA health-care providers.

Ten of the 12 records that were transcribed incorrectly were inaccurate because they omitted one or more immunizations that were documented in the handwritten chart. The

remaining two inaccurate records contained incorrectly-entered immunization data (that is, the wrong immunization was documented in the computer system).

DISCUSSION

The results of this study challenge the tacit assumption that clinical data can be transcribed into a computer-stored medical record without compromising accuracy. The notion that electronically-stored records are inherently accurate — or at least, more accurate than a handwritten record — may apply to data gathered from electronic instrumentation, such as a physiologic monitor or a ventilator in an intensive-care unit. In the case of manually transcribed data, however, it is not possible to guarantee data accuracy to the same extent.

Inaccuracies in transcribed data

The data-error rates observed in this study are consistent with those noted in other computer-based immunization-tracking systems. For example, a recently-published retrospective review of 218 pediatric immunization records in a large health-maintenance organization revealed that 87.7% of immunizations were transcribed exactly as written; of the 12.3% of records that were transcribed inaccurately, 5.9% were dated incorrectly and 6.4% were written but not transcribed into the computer system [5].

Researchers and systems implementors have identified a number of potential sources of inaccuracy in data transcription, including typographical and spelling errors, inconsistency in terminology, and problems of handwriting legibility [6]. All these sources of inaccuracy can be addressed to some degree by technological approaches [7]. For example, typographical errors can be detected by validating numerical data with "reasonableness" criteria; the use of consistent terminology can be improved through reference lists or controlled vocabularies; and the problem of legibility can be avoided through the use of check-off lists and other structured print media [8,9].

In the present study, the computer-system user interface was designed to encourage data-entry consistency. For example, check-off menus such as the one illustrated above decrease the possibility of typographical errors [10]. The menu used for entry of immunization data is visually and functionally consistent with menus used in the same software for entry of other clinical data as well.

Some of the data-entry errors that were observed might have been prevented had the data been validated at the time it was entered (for example, by comparing the updated immunization history with expert recommendations, and alerting data-entry personnel to any inconsistencies). However, the value of such data validation would have been compromised by a high rate of "false alarms" generated for immunization records that were incomplete for reasons other than data-entry error.

Human factors

The repetitiveness of the task of transcription may lead to unavoidable errors. A straightforward computer-user interface may minimize the number of typographical errors introduced into the computer-stored record; only 2 of the 12 transcription errors described above could be attributed to incorrectly-entered data. The remaining transcription errors were related to the failure to transcribe immunization data recorded in the written chart. It is easy to imagine how these errors could have occurred through fatigue, boredom, or haste.

Again, technological solutions to this problem have been proposed and studied in controlled situations. For example, it is possible that the use of handwriting recognition or voice recognition for data input might have allowed transcribers to enter data more rapidly, although the accuracy of a handwriting- or voice-recognition system itself might also have affected the overall accuracy of the data [11,12].

Billing data as clinical data

An approach to enforcing completeness of transcribed data is to rely on clinical data entered for cost-accounting or billing purposes. In such a computer system, the financial incentive for storing complete and accurate billing data in the computer system presumably leads to more complete and accurate clinical data. In the case of discrete data such as immunization records, this approach might be workable. However, the danger in such an approach is that it might reinforce the transformation of the medical record into "an annotated bill prepared for third-party payers" [13]. Data recorded solely for billing purposes are not necessarily appropriate in format or content for clinical decision making.

Accumulating data from multiple sources
This study illustrates the problem of obtaining immunization data for patients who receive their health care from multiple providers. If there is no comprehensive mechanism for gathering data from multiple clinic sites, these patients' immunization records may be fragmented, incomplete, or nonexistent.

In the present study, incomplete and unavailable immunization data accounted for 46% (11/24) of inaccurate immunization histories. This observation is consistent with several British studies that document inaccuracies in computer-stored immunization records for children with multiple health-care providers [14,15,16]. Similar data for immunization-tracking systems in the United States have not been published, although experience with a centralized data-collection system in a health-maintenance organization suggests that a properly-designed data-collection system can decrease this kind of inaccuracy [5].

Consequences of inaccuracy
Inaccuracies in transcribed medical data compromise the utility of the computer-stored record. For example, part of the function of the computer system used in UCLA's Children's Health Center is to print a summary reminder of each child's current immunization status on an encounter form at the start of every clinic visit. However, this reminder is only as good as the data on which it is based. If the immunization data are incomplete or inaccurate, the reminder is also inaccurate.

It is also important to consider specific sources of inaccuracy in any analysis of aggregated immunization data. In particular, estimates of underimmunization rates in selected patient populations might be exaggerated by equating the absence of recorded immunization data with a failure to receive immunizations, particularly in mobile populations with multiple health-care providers [14].

CONCLUSION

The completeness and accuracy of data in a computer-stored medical-record system may be compromised by errors inherent in the process of transcribing clinical data. Some types of inaccuracy can be minimized or eliminated through appropriate system design. However, it is extremely difficult, if not impossible, to assure complete accuracy in an electronic medical record.

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