ENHANCEMENT OF INFECTION DATA MANAGEMENT SYSTEM THROUGH COLOR GRAPHICS INTERFACE

Stephen A. Streed, M.S., Educational and Epidemiology Systems Coordinator; Steven P. Miller, Assistant Director of Patient Information Systems; James R. Wagner, Director of Information Systems; and Walter J. Hierholzer, Jr., M.D., Hospital Epidemiologist.

Program of Hospital Epidemiology and Information Systems Department
University of Iowa Hospitals and Clinics, Iowa City, Iowa 52242

Abstract

The University of Iowa Hospitals and Clinics developed and maintains an on-line Infection Data Management System within its IBM 370/3081-D dual processor environment. Tabular infection data obtained from a variety of reports produced by the system have historically been converted by manual means to graphic displays for teaching and demonstration purposes. Addition of the computerized graphics package allows interactive on-line color graphics review of complex data comparisons and has completely eliminated the need for manual production of graphics. In addition to an enhanced capability, a significant savings in time and money has been realized.

Introduction

A significant effort in infection control programs is devoted to orientation and in-service education offerings in which the major problem areas in institutional infection control are reviewed with the medical care worker. These presentations are most frequently representations of data on nosocomial infections generated from current or past experience in the institution. Tabular presentations of these data from multiple areas, sites, and infecting organisms become more complex than can be easily interpreted except by careful and detailed study, requiring time not easily committed by the already overbusy medical care worker.

A common solution to this complexity is the use of graphic presentations of these data. The Program of Epidemiology of the University of Iowa Hospitals and Clinics has routinely converted the hospital tabular nosocomial infection data reports to color graphics for presentation to clinical services, committees and nursing units. This paper describes the enhancement of the University of Iowa Hospital and Clinic Infection Data Management System with a commercially available graphics package to facilitate the preparation of graphics for these purposes.

Materials and Methods

The University of Iowa Hospitals and Clinics is a 1100 bed tertiary care teaching hospital that provides approximately 330,000 days of care to 40,000 patients admitted each year. There are 42 distinct acute-care inpatient nursing units under active nosocomial infection surveillance, with all nosocomial infection surveillance, consultation and teaching under the direction of the Program of Epidemiology. The Department of Information Systems is responsible for all phases of the development and operation of the Hospital Information System within its IBM 370/3081-D dual processor environment.

The development and routine use of the on-line Infection Data Management System, installed in May, 1980, has been described elsewhere. Infection control data are concurrently entered into the on-line system by trained surveillance technicians. At periodic intervals, the system produces over 20 routine batch reports, in tabular format, summarizing various facets of the cumulative data. Previously, the practice has been to convert portions of these tabular data into graphic displays for use in teaching or demonstration. These routine graphic displays have been produced manually by the technical staff of the program. For occasions requiring a more polished product, batch data have been submitted to an outside resource for artist or computer generated graphics material to provide a basis for slide and poster presentation. Augmentation of the Infection Data Management System to include on-line use of a classic report generator has also recently been described. This addition allows the infection control user to make ad hoc inquiries directly into the infection control data base. The tabular results of these inquiries are frequently converted into graphic displays to enhance the impact and clarity of the findings.

In the previous system, 90-100 graphs per month were created or updated as new data became available from the surveillance reports or from the ad hoc inquiries. The vast majority of these graphs were drawn by hand by the surveillance staff.

In a recent system upgrade, IBM's Graphical Data Display Manager (GDDM) and Presentation Graphics Feature (PGF) using the Interactive Chart Utility (ICU) have been added to the Time Sharing Option/Structured Programming Facility (TSO/SPF) extension developed for infection control with IBM's Dialogue Management Services (DMS) facility. A model 3279 IBM color graphics terminal and an IBM 3287 four-color dot matrix graphics printer were added to complete the configuration.

System Operation

While the extensive capabilities and details of GDDM/PGF system operation are described in detail elsewhere, several of its features...
are of special value to the infection control and user. This system allows the infection control user to create, maintain, update and view graphics displays on-line at the color terminal. Since all display parameters (chart type, heading text and position, data colors, color density and pattern, etc.) can be easily modified by the user, the impact of any format change may be immediately assessed, thereby assuring a final presentation of the data. Chart data and chart format specifications for each graph are stored as distinct entities under a single library name for that graph. Thus, either chart data or format specifications can easily be restored to an active working file. Updating of the chart data may be readily accomplished by restoring only the data portion of the library member. Preformatted data entry screens for each graph allows easy and relatively error-free entry of new data, e.g. successive surveillance months. These two features make it possible for surveillance technicians to key-in new data without otherwise disturbing the display or print parameters of the graph itself. GDDM automatically scales its graphics displays to the data, resulting in an optimal display of that data. Output print parameters (such as row and column size or number of copies desired) can easily be specified at the time the print request is submitted, thereby allowing the user to further tailor the graph to specific needs. The ability to produce multiple copies of graphs is especially helpful for presentations to meetings or at small group teaching sessions.

Examples of Infection Control System Graphics

The figures described below demonstrate some of the common chart types that are routinely produced by the system for use and distribution by the Program of Hospital Epidemiology. Figure 1 is an example of a clinical service graph that is sent to the chief of the service on a monthly basis, together with the tabular report of findings for the past month. Figure 2 represents a graph of the type that is posted on each of the nursing units under surveillance. This graph is produced in poster size, updated each month, and allows easy comparison of the unit's recent and past nosocomial infection experience. Figure 3 displays a series of two-week interval rates for a clinical department and may be produced in conjunction with a notification of potential epidemic report when the current infection rate for that department rises above its "epidemic threshold". Figure 4 represents an age group and sex distribution of nosocomial infections, the data for which was obtained through an ad hoc database inquiry using the on-line report generator.

Time Savings and Other System Advantages

The above described examples represent only a subset of the types and quantities of graphs produced by the Program of Hospital Epidemiology staff. Graphs similar to Figure 1 were previously produced by hand for each of the 42 hospital areas and 16 clinical departments or services on a monthly basis. Hand prepared graphs similar to Figure 2 were prepared and distributed monthly.
for each of the 42 hospital areas. Other graphs such as Figures 3 and 4 were produced by hand on an ad hoc basis when the need arose. In all, more than 100 graphs per month were routinely hand produced or updated. In addition, periodic composite graphics for major audiovisual presentations and clinical conferences were prepared by submitting data to the medical graphics section of the health center for slide or poster preparation.

Formal time evaluation by the technical staff of the program indicated that an average 66 hours per month were devoted to graphics preparation (Table 1).

### TABLE 1

<table>
<thead>
<tr>
<th>Time for hand production of graphics</th>
<th>66 hours per month</th>
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<tbody>
<tr>
<td>Time for computer graphics preparation Primary format preparation</td>
<td>2 hours per month</td>
</tr>
<tr>
<td>Monthly updates</td>
<td>4 hours per month</td>
</tr>
<tr>
<td>Difference = time savings</td>
<td>60 hours per month</td>
</tr>
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* One time programming amortized over the first year

Implementation of the present graphics package has allowed a documented time savings of approximately 60 hours previously devoted each month to hand preparation of graphics. This time represents the recovery of approximately one third of a full time position. Time recovered has been devoted to assistance in other Quality Assurance activities of the hospital.

In addition, the quality of the graphics produced has allowed substitution of in-program preparation most of the slides and posters previously purchased through external medical graphics units. This latter change has reduced the cost of color slide preparation from approximately $25.00 per slide to less than $2.00 per slide and the cost of posters from approximately $60.00 per poster plate to less than $5.00 per poster plate.

### Discussion

The addition of a color graphics package to the Infection Data Management System completes the final phases of the planned enhancement of this portion of the Hospital Infection System. The development of the system has progressed through close cooperation between the Information Systems professional staff and the Program of Epidemiology users. The system is in full daily use in support of patient care at the University of Iowa Hospitals and Clinics, providing infection control support services to all clinical units. Training in the use of the GDDM/PGF package by designated Epidemiology staff has proceeded smoothly largely as a result of the extensive online help screens included with the package. Monochromatic CRT's may be used for all GDDM/PGF functions, except for the "display" option. Thus, the less common color terminal need not be tied up for routine updating of existing charts where intermittent display is not critical to the chart's creation.

Application of software in preparation will allow routine production of the periodic batch data graphics without the current requirement for four hours monthly updating by technical personnel, allowing future incremental savings.

The use of a 35mm camera to photograph displays directly from the CRT is being explored. This will allow a greater color range to be used with higher display resolution when compared to printed graphs. Either color slides or prints may be produced using this technique.

In addition to its service function, the system provides educational and research support to the Program and to medical students, nursing students, preventive medicine students, house officers, faculty and staff who rotate through the Program. The system's operational components emphasize to these potential new users an example of some of the current capabilities in the application of computer methods to medical care.

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