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This was a study to determine if the training being provided on the William Beaumont Army Medical Center Hospital Information system meets the needs of system users. The study used a survey instrument developed by Dr. James Bailey, Director of Industrial Engineering, Arizona State University, to evaluate user satisfaction with the William Beaumont Army Medical Center (WBAMC) Hospital Information System (HIS). HIS users were identified by three groups; physicians, nurses and others. The responses were evaluated using an algorithm developed by Dr. Bailey and a multivariate analysis performed with the personal computer version of Statistical Package for Social Sciences (SPSS/PC+). In general the user groups were satisfied with the HIS and its associated training programs. However, the physicians expressed dissatisfaction with not being able to retrieve laboratory results and radiology reports from the HIS.

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A Study to Determine

If The Training Being Provided On The William Beaumont Army Medical Center Hospital Information System Meets The Needs Of System Users

A Graduate Research Project

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Administration

by

Captain Grover C. Peters III

July 15, 1988

ACKNOWLEDGEMENTS

My sincere appreciation is given to all the people who assisted me in the completion of this project. First, to Dr. James Bailey, Director of Industrial Engineering, Arizona State University, for graciously granting permission to use a survey instrument he developed in another study. His kind support and willingness to answer questions made this study significantly easier than it otherwise would have been. Next I would like to thank Mrs. Sharon Ferris who dedicated numerous hours to typing and editing during the preparation of the graduate research project proposal. An eternal debt of gratitude is owed to Dr. Bill Lucker who provided invaluable assistance in completing the statistical computations using a microcomputer based statistical package. This alone saved many hours while at the same time educating me on the advantages of using a microcomputer for statistical analysis. Dr. Lucker's continued guidance throughout the study helped keep it moving in a forward direction. A very special thank you is extended to Colonel Johnny Conner, my preceptor and Chief of Staff, William Beaumont Army Medical Center. Colonel Conner granted me the time and autonomy essential to the successful completion of this study. His concern for academic excellence and commitment to the goals of the U.S. Army-Baylor program contributed to my receiving an outstanding education throughout the residency year. Finally, my most sincere appreciation is extended to my wife. This study would have been far more difficult to complete without her support and patience.

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CHAPTER ONE

Grover C. Peters III

CDR Lambert, LTC Lankford, Dr Funsten

Graduate Research Project

July 15, 1988

INTRODUCTION

William Beaumont Army Medical Center is a 600-bed hospital located in El Paso, Texas. The facility is an acute care and teaching hospital serving a population of approximately 90,000 (Schodt 39).

In 1980, Congress mandated that the three military services (Air Force, Army, and Navy) procure and install "turnkey[1]" computer Hospital Information Systems (HIS)[2] at three service hospitals to evaluate the ability of commercial systems to meet military requirements (Schodt 39).

The system installed at William Beaumont Army Medical Center is the Medical Information System (MIS) from Technicon Data Systems, Inc, since renamed TDS Health Systems Corporation.

The Hospital Information System (HIS) at William Beaumont Army Medical Center (WBAMC) is an automated system designed to improve the efficiency of admitting and tracking the treatment of inpatients. The basic objective of the system is to enhance patient care by maintaining medical records electronically and by improving interdepartmental communications and operations (Schodt 39). Physicians, nurses and ancillary personnel are groups of

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[1] See Appendix A for Definitions.

[2] Refer to Appendix E for a detailed description of the HIS.

professionals who must be able to interact with the HIS terminals and other peripherals. Since there are no other Hospital Information Systems within United States Army medical facilities, these people report for duty at WBAMC with little or no experience involving Hospital Information Systems. Before these new people can start working at WBAMC, they must receive training on how to access and use the HIS. The Information Management Division (IMD) at WBAMC is responsible for developing and conducting user-oriented training programs so newly assigned employees will be able to use the HIS in the delivery of patient care or in support of the delivery of patient care.

A Computer Information Center (CIC) has been established to provide training which is mostly self-paced. Approximately four hours are considered to be the minimum adequate time spent working through the hierarchy of pathways that a person will be using. A pathway[3] is the opening screen a user signs onto and all subsequent screens the user progresses through to either input or retrieve data. There are 28 possible pathways in the HIS (Appendix F).

Although the CIC staff encourages training in multiple pathways, most individuals limit themselves to the single pathway established for their specific category of HIS user. This can cause problems in the operational areas. The author observed a new medical resident attempting to input an order and experiencing some difficulty. The medical resident turned to a

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[3] Refer to Appendix A

nurse to ask for help, but to no avail. The nurse was unable to answer the physician's question because nurses receive limited training on physician pathways.

The typical new resident will spend one day in the training database, practicing the input of admission diagnoses, ordering pathology and radiology procedures, and ordering nursing care. New nurses typically spend a little longer time during the initial training, partially because they will spend more time recording histories, observations, and reading physician's orders via the HIS. There are separate pathways for nearly every group of HIS users; and while they have the opportunity to learn something about the pathways of others, that is relatively rare. Thus, the appointment clerk, the appointment supervisor, the ward clerk, the pharmacy tech, the pharmacist, the Patient Administration clerk, and the Patient Administration supervisor all have very different views as to what the HIS is, what it does to and for patient care and administration, and how efficiently and effectively the system works.

Conditions Which Prompted The Study

The CIC has responsibility beyond training people on the HIS. Other responsibilities include assisting personnel in the use of over 250 microcomputers throughout the facility, conducting training on application software, trouble shooting user complaints, installation of hardware, and software maintenance.

The staff of the CIC consists of approximately five people. Therefore, there has been little time for anyone to assess the validity of the training being provided. The Chief of Information Management Division (IMD) and the Chief of the Hospital Information System have both expressed an interest in having their training programs evaluated to determine if the training programs are meeting the needs of the HIS users.

In April of 1987, representatives from TDS conducted a system-wide applications audit. The objective of the audit was to conduct a review of the Management Information System (MIS) installation with emphasis on:

-Assessment of users' attitudes regarding the use of MIS in their department.

-Evaluation of MIS support staff organization, technical knowledge, and effectiveness in responding to user problems and change requests.

-Evaluation of hospital personnel's understanding of current MIS capabilities.

-Recommendations for enhancing system use (Mota 3).

The audit consisted of meetings with department representatives from 13 areas of the hospital. During the applications audit, several issues relative to user training were discovered. The physicians were concerned the Training Department does not have the expertise nor medical training necessary to revise the physicians' User Training Guide (Mota 6). The physicians also felt that physician training was inadequate (Mota 6).

A conclusion drawn by the TDS representatives was, "The staff is eager and has a positive attitude toward the system; however, it is evident that additional training is required to increase the technical proficiency of the 'newer' analysts" (Mota 7).

The TDS representatives provided the following recommendations. "William Beaumont should consider TDS courses in MIS System Fundamentals (#200) and MIS Duty Officer (#345) for the HIS staff" (Mota 7). An important note is that, initially, all training was conducted by TDS personnel on-site but, eventually, William Beaumont personnel decided they could conduct the training with their own personnel. There is the potential for the TDS findings to be biased since they lost a significant amount of contract dollars when they discontinued providing all William Beaumont HIS training. A second recommendation was:

> After the training courses have been completed, if feasible, the training should be supplemented with TDS consulting support in Laboratory, Nursing, Registration Control System (RCS)[4] and Patient Billing and Accounts Receivable (PBAR)[5] to enhance familiarity with current system capabilities and options. (Mota 7)

The TDS applications audit and its associated findings support the author's assertion that there are enough problems in the user training area to warrant a study into the appropriateness of the training programs. Most importantly, the author intends

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[4] Refer to Appendix E.

[5] Refer to Appendix E.

to determine if the training program meets the needs of HIS users. A properly trained user should be prepared to use all the HIS capabilities appropriate to the users' specific pathways.

As an example of users not being properly trained, physicians are entering laboratory orders before being fully trained on the HIS (Mota 10). The result of this is that 'stat' and routine orders for the same patient are frequently collected separately (Mota 10).

Problem Statement

To determine if the training being provided on William Beaumont Army Medical Center's Hospital Information System meets the needs of the HIS users.

Objectives

The objectives of this study were to:

1. Review current literature concerning Hospital Information Systems.
2. Assess the design of the current HIS training programs for all users through interviews with Computer Information Center personnel and documentation analysis.
3. Determine if HIS training programs meet user needs by surveying user groups with a questionnaire.
4. Develop recommendations to improve appropriateness of training

if existing training is found not to meet the HIS user's needs.

Criteria

1. Literature review will include system training information from major hardware and software suppliers; i.e., Technicon, IBM, Xerox and any available evaluation model.
2. Obtain HIS training objectives from WBAMC's Organization and Functions Manual.
3. Assess user satisfaction with the Hospital Information System and its associated training program using a survey instrument developed by Dr. James Bailey, Associate Professor of Industrial and Management Systems Engineering at Arizona State University.

Assumptions

1. The Hospital Information System will continue to be an integral part of the Medical Center.
2. HIS training for William Beaumont Army Medical Center personnel will continue as long as the HIS exists.
3. If a HIS user is satisfied with the HIS systems and the associated training programs, then the HIS is meeting the needs of the user.
4. HIS users know what their individual needs are.

Limitations

1. Survey participants will be limited to William Beaumont Army Medical Center personnel who are active HIS users.
2. The results of the study will not be immediately transferable to any other facility due to the nonexistence of Hospital Information Systems within Department of Defense.

Research Methodology

Objective one was to review current literature concerning Hospital Information Systems. A survey instrument, acceptable to this study, was found in the literature review. The survey was developed, tested and implemented by Dr. James Bailey. The survey instrument was developed in cooperation with the Hospital Management Systems Society of The American Hospital Association and funded by the Department of Health and Human Services. Dr. Bailey is an Associate Professor with the Industrial Engineering Department at Arizona State University. Dr. Bailey granted written approval to use his survey instrument for the purpose of this study (Appendix C). His instrument is being used to evaluate computer user satisfaction with information systems in Veterans Administration hospitals.

The survey instrument used for this study was developed by interviewing 53 users regarding their experience with computers. The interviews led to 1082 references about situations with

computers which were either satisfying or frustrating (Bailey 195). The 1082 references were consolidated into 41 characteristics which fall into five categories (Bailey 195). "Statistical tests have concluded that the chance of a characteristic, which is important to someone's attitude, not being on the list is less than one percent with an alpha of .01" (Bailey 195).

The survey used for this study was tested for internal validity[6], external validity[7] and reliability[8] by Dr. Bailey and his staff (Bailey 196). A reliability analysis was conducted for each characteristic and the average reliability was .89 (Bailey 196).

The existing training program at WBAMC was assessed using Dr. James Bailey's survey instrument with modifications for WBAMC. Where Dr. Bailey's instrument used the term "computer system" it was changed to read "Hospital Information System". Demographic questions were added in order to be able to better stratify the responses.

Considerable attention was paid to the presentation of the material, and substantial resources were devoted to printing a high quality questionnaire. The Department of Clinical Investigations assists medical students in the preparation of high quality questionnaires as part of the intern and resident

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[6] Refer to Appendix A

[7] Refer to Appendix A

[8] Refer to Appendix A

programs. The Department was equally eager to make their Apple computer, laser printer, and desktop publishing software available to the Administrative Resident. A staff member from the Department of Clinical Investigations prepared the final master copy of the survey instrument. Assistance was requested from the staff member because of the person's expertise in using Pagemaker, the desktop publishing program. Once a master copy was obtained, the printing shop, in WBAMC, printed the copies needed for distribution to the study population.

Collection of Data

A questionnaire was found during the literature search which met the requirements of this study. Permission to use the questionnaire was obtained in writing from the author of the questionnaire (Appendix C). The questionnaire was presented to all active HIS users.

Recording of Data

1. All documents, journals, and books reviewed are referenced in the works cited section.
2. Responses to all completed surveys which were considered reliable were analyzed and incorporated into the study.

Evaluation of Data

1. An analysis of collected data will be included in the study.
2. Recommendations for correction of training program deficiencies,if any, will be developed.

Review of the Literature

Hospital Information System Description

Acquiring and using a Hospital Information System can save hospitals tremendous amounts of money. Technicon Data Systems (TDS) says it can prove savings and benefits from its HIS and has issued a public challenge to other vendors to do the same (Computers 4). The challenge, issued in response to comments made by a Datacare official in the March 24th issue of Computers and Health, said, "We at Technicon agree with Datacare's comment...that installing an unproven Patient Information System becomes a public works project for a hospital Data Processing Department" (Computers 4). TDS implies their system is proven by quoting four hospital users who attribute savings of millions of dollars to the Technicon system:

-Neilson S. Buchanan, CEO at El Camino Hospital, Mountain View, CA, says savings are about $20-$21 per patient day, or $2 million a year.

-At the Medical Center of Central Georgia, Macon, Ga., "extended cost benefit for a cumulative 7 years is over

$13 million," according to Larry Carter, Director of Management Engineering.

-Savings from "labor reductions, reduced overtime, forms savings, and eliminations of previous systems have totaled more than $4 million," says Don Blank, VP-Finance, Waukesha Memorial Hospital, Waukesha, Wis.

-FTEs "were reduced 27%" in admitting, "average patient time...was reduced by 39 minutes," and "staff turnover decreased from 59% to 1%, says Sandra Abney, Director of Admitting, Presbyterian Hospital, Albuquerque, N. M. (Computers 4)

According to the Chief of IMD, the TDS HIS has proven to be successful at William Beaumont Army Medical Center. In a military hospital, the savings realized is more in terms of time than in terms of money. Physicians no longer go to a patient's room only to find the patient was moved during the night. Physicians now receive an updated patient status report off of the HIS prior to beginning rounds which they use to verify a patient's location and status.

The Hospital Information System is a computer-based information system which makes it possible to transmit clinical data quickly and accurately from department to department throughout the Center. It replaces traditional paper-handling procedures and expedites the flow of information.

A pamphlet describing the New York University (NYU) Medical Center HIS says, "The HIS makes it possible to improve the quality

of patient care by providing accurate, legible, and timely information to the medical staff much faster than with manual processing procedures" (Hospital 4). With HIS, hospital personnel are able to enter and retrieve information from terminals using an electronic pen. The user selects desired choices from screens arranged in a logical series using the light pen. For example, the Administrative Officer of the Day (AOD) may be approached after hours by a visitor querying about the status of a patient. Using the terminal, the AOD enters an access code and quickly views a list of patients. The AOD uses the light pen to select the choices which will locate the specific patient by patient care unit. The attending physician's name is also available if requested.

Orders that impact more than one department have been integrated into the system, so they are automatically dispersed to each of the appropriate departments at the same time.

Security of patient information is maintained by issuing each user a unique alpha/numeric code. This code restricts the information within the system to specific individuals. Individuals can be restricted by pathways, read only privileges, or read and write privileges.

At NYU Medical Center:

> The HIS provides instant communication between the patient care units and the clinical support areas. It increases the amount of direct patient care time for physicians and nurses and provides concise, clear

records. (Hospital 4)

Department of Defense and Hospital Information Systems

In October 1984, a new charter was signed by the Deputy Secretary of Defense for the Office of the Assistant Secretary of Defense (Health Affairs) (OASD(HA)). This charter significantly broadened and strengthened the role of the Assistant Secretary of Defense (Health Affairs) (ASD(HA)), in managing and supervising the Military Healthcare System. (Defense a1) According to the Defense Medical Systems Support Center (DMSSC), prior to the new charter, the individual services had operated independently when it came to medical management information policy and information system control (Defense a1). "Automated systems were developed without inter-service coordination and without consideration of common data users" (Defense a1). The new charter granted to OASD(HA) resulted in the establishment of the Defense Medical Systems Support Center (DMSSC).

The DMSSC has an annual budget over $100 million and has an authorized strength of 110 positions (Defense a1). The Director of DMSSC reports directly to the ASD(HA). DMSSC is composed of four program offices. The offices include TRIMIS (Tri-Service Management Information Systems) and Hospital Systems; DEERS (Defense Eligibility Enrollment System) and Central Systems; Medical Readiness and Theater Systems, and Management Information Systems (Defense a1).

A formal objective of the Management Information Systems Office is to improve the performance and use of existing information systems (Defense a1).

"DMSSC is responsible for conducting health information planning, issuing information system policies and standards, and evaluating health information systems within the Department of Defense" (Defense a1). DMSSC also plays a key role in managing major acquisitions of Health Information Systems, such as the Composite Health Care System (CHCS).

The CHCS is an integrated automated system which will support many of the information requirements of both health care providers and health care administrators (Defense f-2).

> CHCS will provide the health care providers with patient care data through integration with the functional centers of Clinical Dietetics, Laboratory, Nursing, Patient Administration, Patient Appointment scheduling, Pharmacy, and Radiology. (Defense f-2) CHCS will assist the health care providers and administrators providing support to entry of orders and reporting of results, administration, quality assurance, managing resources and mobilization, and mass casualty operations. (Defense f-2) CHCS will provide interfaces to other TRIMIS and Department of Defense (DOD) initiatives which include Food Service, Medical Logistics, Defense Enrollment Eligibility Reporting System (DEERS), and Medical Expense and

> performance Reporting System (MEPRS). Source-specific administrative systems, tactical automation systems and National Disaster Medical System, and Veterans Administration Systems. (Defense f-2)

Obviously to ensure CHCS accomplishes what it is designed for users must be trained. Literally millions of dollars of hardware and software could be inefficiently used if user training is not properly designed, implemented and maintained. The assumption is that while training users of Health Information Systems may be a consideration in the acquisition and implementation phases, the responsibility for ongoing training and the type of ongoing training are often ignored during the planning phase.

> In 1979, the Major Automated Information Systems Review Council directed the Tri-Service Medical Information Systems (TRIMIS)[9] to follow a phased-approach in acquiring standardized Medical Information Systems. (Defense f-1)

Three commercial systems were purchased and installed in; a Navy hospital located in Jacksonville, Florida; an Air Force hospital located on Eglin Air Force Base, Florida; and in William Beaumont Army Medical Center, El Paso, Texas.

The Air Force and Navy systems never fully developed. As of the Fall of 1987 the Air Force and Navy were experiencing very

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[9] TRIMIS is a government agency subordinate to DMSSC, established to improve effectiveness and economy of the Military Health Care System by standardizing and centralizing automated medical information systems (Defense f-1).

limited use (Jackson). Compared to other DOD medical facilities, William Beaumont Army Medical Center has successfully established and maintained operation of the HIS. Major Jackson believes reasons for WBAMC's success includes receiving a superior system and excellent command support (Jackson).

William Beaumont Army Medical Center plans to continue operation of their existing HIS until such time as CHCS is fully functional and ready to be installed on-site. Therefore, providing user training is still a viable mission and will continue to be for a few years to come.

The Information Management Personnel are striving to improve the capabilities of the existing system within the limits of existing resources. As new capabilities come on-line, additional training will be needed for the users. Understanding user attitudes is an important element in developing any training program (Bailey 50).

According to the behavioral theory of organizations, ongoing operations in a hospital create a sense of expectation about computer services. The way in which each individual reacts to the system either reinforces or frustrates those expectations (Bailey 50).

Training Model

The training techniques used by NYU Medical Center vary somewhat from those used by WBAMC; so the question arises: Which method of training is best for a Hospital Information System?

Ann Stroh, HIS trainer, believes training at WBAMC should be modeled after NYU Medical Center's program because NYU trains nurses as one group and physicians as a separate group. Ancillary personnel are trained on their job site. Segregating trainees by occupational category allows the trainer to be more responsive to "what if" questions. WBAMC currently does not segregate trainees by category. (Stroh).

There are two categories of training referenced in various publications and journals. There is the training conducted prior to system implementation, and then there is training conducted for all new users throughout the life of the system.

Jeffrey S. Denaburg and Nancy Myers said,

> A hospital can take several steps to facilitate the change process. It is important to make the staff familiar with computers, in general, as well as with hospital systems. This process should start well before a computer is actually installed (73).

This comment supports the response obtained from Major B. J. Jackson when she was asked what she would have done differently during the design of the WBAMC HIS training program. She said she would have had more preliminary training on computer literacy (Jackson). She indicated the nurses were being exposed to hardware and software prior to them fully understanding the terms (Jackson). She further indicated it would have been extremely helpful if someone had provided a briefing on what automation was going to do for the hospital and nurses before they got into the

specific HIS training (Jackson).

Denaburg and Myers list four steps that should be a part of any project to acquire a Hospital Information System. These are:

- Heavy involvement of hospital staff in the system design and development.
- Familiarization of all staff with basic computer concepts and with the hospital's computer projects.
- A computer orientation seminar for all staff who will be using computers.
- A complete training program for each department. (73)

The second step listed, once again supports Major Jackson's comment about the need for computer literacy training in the early phases of system acquisition. The last step is the step which will be the focus of this paper.

CHAPTER TWO

DISCUSSION

Surveys were distributed to all active HIS users who were identified from a list of names provided by the Information Management Division. An announcement also was placed in the hospital's weekly bulletin asking all active HIS users to contact the author if they did not receive a copy of the survey within one week of the announcement.

Four hundred and sixteen surveys were distributed. Two hundred and fifty completed survey instruments (Appendix G) were returned. Forty nine surveys were deleted from the database due to incomplete responses. Consequently, 201 fully completed questionnaires were analyzed, representing 60 percent of the active HIS user population. Of the total 201 cases there were 50 doctors, 62 nurses, and 89 from the support staff.

The survey results will be presented in four parts. First, the overall satisfaction of all HIS users will be discussed. Next, satisfaction scores for each system characteristic will be presented. Then the satisfaction scores of the three professional groups (doctors, nurses and support staff) will be reported. Finally, a brief summary of the demographic data in part II of the survey instrument will be discussed.

Overall HIS user satisfaction

User satisfaction is operationally defined as the respondents' answer to the following item[10]:

> Finally please score your overall sense of satisfaction with the Hospital Information System services you presently receive. Using the scale below put a check on the line to indicate your feelings of satisfaction with a ten (10) indicating extreme satisfaction and a negative ten (-10) indicating extreme dissatisfaction. Zero indicates neither satisfied nor dissatisfied.

For purposes of this study, user satisfaction is interpreted to mean the HIS and its associated training program is meeting the user needs. An assumption was made that HIS users know what their individual needs are.

The mean satisfaction score for all HIS users is 21.4. Using Table 1 for interpretation, the data reveal that the HIS users are slightly satisfied with the HIS. The score of 21.4 compares to the national standard of 33.2 and to a score of 18.2 found in Dr. Bailey's study (Bailey 199). Even though 201 completed survey instruments were received and evaluated not all of the 201 respondents answered the question on total satisfaction.

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[10] Refer to Appendix G for complete survey.

Table 1. Scoring table for satisfaction levels	
-100 to - 72	Extremely dissatisfied
- 72 to - 43	Quite dissatisfied
- 43 to - 14	Slightly dissatisfied
- 14 to + 14	Neither dissatisfied nor satisfied
+ 14 to + 43	Slightly satisfied
+ 43 to + 72	Quite satisfied
+ 72 to +100	Extremely satisfied

Source: Bailey, James. "Measuring and Managing Computer User Attitudes." A Report From The Healthcare Information and Management Systems Society. American Hospital Association 1986: 193-202.

System characteristics

To help understand components of overall HIS user satisfaction, 36 system characteristics of the HIS as identified by Bailey were also assessed (195). Each characteristic was measured using two pairs of adjectives and an importance scale. The bi-polar adjective pairs and the importance scale ranged one to seven (Bailey 196). The first adjective pair of any characteristic was scored with one representing the most negative response and seven representing the most positive response. On the second adjective pair the positive and negative ends of the response scale were reversed with seven representing the most negative response and one representing the most positive response. For the importance characteristic one represented unimportant and seven represented important.

"For any given characteristic a user's feelings were taken to be the average of their response to two adjective pairs multiplied by their response to the importance scale" (Bailey 196). The scaled responses were assigned values ranging from -3 to +3. The resulting score was then normalized to a value between - 100 and + 100. The algorithms are listed in Table 2.

Table 2. Algorithms for computing normalized values.

$$FS = \frac{(r1 - 4) + (4 - r2)}{2} \times I$$

$$I = (r3 \times .15) - .05$$

$$NV = (FS/3) \times 100$$

FS - Factor Score
I - Importance score
NV - Normalized Value
r1 - Response to Adjective 1.
r2 - Response to Adjective 2.
r3 - Response to Importance.

Source: Bailey, James. Telephone Interview. 6 Jul 88.

The overall means for each of the 36 system characteristics are presented in Table 3. Only the eight factors which received negative scores will be discussed. While the negative scores may seem to indicate users are dissatisfied in these areas, the reader should remember from Table 1 that a score of -14 to +14 means the respondent is neither dissatisfied or satisfied.

Table 3. Mean satisfaction scores for 36 HIS characteristics.

Factor	Mean	Std Dev	N	Bailey's Study	Nat.Std
1. EASE	11.70	47.74	171	17	57
2. DELIVER	13.91	45.68	157	8	35
3. COMPLET	26.97	43.66	158	25	47
4. FLEX	-10.01	53.41	162	-11	7
5. DEGTRAN	20.38	45.72	171	20	38
6. CHANGE	-22.82	45.96	146	-11	-4
7. ACCURAC	30.60	49.63	166	28	53
8. OUTPUT	19.63	55.62	162	38	40
9. JOB	21.00	57.76	171	38	39
10. INTERAC	-34.24	60.56	117	-10	2
11. DATA	-2.66	37.98	116	-3	17
12. ADMIN	3.66	49.21	129	-4	18
13. CONTROL	-5.68	42.59	135	11	14
14. STAFF	33.31	43.06	143	39	45
15. CAPABLE	9.77	51.59	161	-5	30
16. RESKILL	27.67	43.79	150	44	44
17. TESKILL	25.37	41.64	135	50	45
18. ATTITUD	35.00	51.48	148	58	46
19. SAVETM	26.07	56.81	173	34	43
20. RELVOUT	28.77	49.27	164	24	43
21. RELIOUT	16.66	48.81	161	4	17
22. NEED	41.84	47.35	170	35	60
24. HCKNOWL	8.30	46.09	130	18	26
25. GOAL	19.82	51.98	156	19	38
26. VOLUME	-10.10	50.95	159	7	25
27. ACCESS	31.64	57.09	176	54	36
28. INSTRUC	16.66	45.11	159	29	34
29. PROCEED	25.58	47.46	168	35	31
30. CURREN	33.09	46.53	160	19	49
31. VALUE	.21	44.82	138	22	47
32. CONFIDE	19.44	47.17	163	21	59
33. UNDERST	10.71	43.86	177	6	28
34. RERUN	-5.24	44.04	124	16	28
35. SECURE	-6.41	37.97	147	12	33
36. POWER	12.19	39.11	119	6	27

Source: (Bailey 201), WBAMC HIS user survey and SPSS/PC+.

The combined score of -10.01 for flexibility of the computer system seems to indicate the majority of the users are neither dissatisfied nor satisfied[11] with the ability of the Hospital

[11] Refer to Table 1.

Information System to change and adapt to fit new circumstances. This score is not much different than the score of -11 found in Dr. Bailey's study. Even though the national standard is scored as + 7 this still seems to indicate users of information systems would prefer information systems to be more adaptable to change and new circumstances. Two characteristics of the HIS may be reason for users to consider the system inflexible. First, the sequence and completeness of the orders is very inflexible by program design and second if an order is entered incorrectly the system requires the user to enter the data from the beginning rather than permitting correction of the erroneously entered portion (Copeland).

The score of -22.82 for the time and process for changes or new developments to the HIS indicates WBAMC HIS users are slightly dissatisfied with the time and process to accomplish change or incorporate a new development to the Hospital Information System. System Change Requests (SCRs) are submitted by WBAMC HIS users when a system change is desired. Any user may submit a SCR without processing it through their supervisor or anyone else in the chain of command. The SCRs which affect several departments are reviewed by the HIS configuration committee and subsequently prioritized. The hospital goal is to decide whether users SCRs is accepted within 24 to 48 hours of submission. If accepted the SCR is place in a queue with other SCRs. Requested changes must be implemented by a matrix analyst. There are only four matrix analysts available to input changes and one matrix analyst told the author it takes between 90 and 160 hours to complete the coding for a SCR. Writing

new screens and checking for proper system interface in the test hospital database is an extremely time intensive process.

The score for interaction of the HIS is -34.24 which indicates WBAMC HIS users are slightly dissatisfied with the ability of the Hospital Information System programs to link with other programs or computers. HIS users believe they should be able to use the terminals to access application programs other than the HIS. Users who access the system with a microcomputer and HIS interface card do have the capability to use their particular system to run other application programs but users with a terminal dedicated solely to the HIS do not have this capability. One of the major reasons users may be dissatisfied with the interfacing capability is because the HIS does not interface with the laboratory system. LTC Sam Magill reports this particular problem should be short lived since a laboratory information system (LIS) has been ordered and will interface with the HIS.

The total mean score of -2.66 for data processing policies seems to indicate the WBAMC HIS users are somewhat ambivalent about the data processing policies and priorities regarding allocation of computer resources to users. A negative score for this characteristic is surprising since everywhere one turns there is computer equipment whether it be part of the HIS or some other system. One possible explanation for this score is during the study there was a moratorium on purchasing microcomputer equipment due to fiscal constraints. Personnel who had to delay acquisition of desired hardware and software were not happy which could have

affected their response to this question. The WBAMC HIS users scored this characteristic very close to the score obtained in Dr. Bailey's study but below the national standard of 17.

As a group the HIS users are neither dissatisfied or satisfied with their power to control use (-5.68), maintenance and modifications of the Hospital Information System.

A common complaint heard throughout the medical center prior to the study the HIS produced too much documentation. The characteristic score for volume of output (-10.1) did not support the intensity of the complaints. One would have expected the users to be extremely dissatisfied with the volume of output however the respondents have indicated they are neither dissatisfied or satisfied.

The score of -5.24 for rerunning of incorrect output is quite appropriate since rerunning of incorrect output does not appear to be a problem. If incorrect output is identified the correct data is entered and a new printout requested. If the printer is the problem there are sufficient quantities of spare printers to be used for rapid replacement of defective printers.

The final characteristic from Table 3 is security of data with a score of - 6.41. Convincing users data stored in an electronic database can be kept secure has not been easy. The training department emphasizes many times during the formal training course the importance of protecting the user access code. Each user's access code serves as an electronic signature which identifies who is accessing the system and what they are looking at within the

system. Users are not granted access codes until they successfully complete the appropriate HIS training course. User access is limited to pathways appropriate to their area of work. For example, an admissions clerk does not have access to the inpatient treatment record. The lack of problems in this area seems to be supported by the users being neither dissatisfied or satisfied with this characteristic.

The analysis of all negative scores listed in Table 3 reveals users are only dissatisfied with two of the thirty six system characteristics, the time and process to accomplish change and the ability of the HIS to interact with other programs. Generally speaking, analysis of the thirty six characteristic scores supports the hospital personnel's satisfaction with the HIS.

Satisfaction of user groups

To determine whether there were differences in satisfaction levels among professional groups (i.e., doctors, nurses, and support staff), a one way analysis of variance[12] (ANOVA) of satisfaction by profession was completed and the results are listed in Table 4.

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[12] Refer to Appendix A for a definition of analysis of variance.

Table 4. One Way ANOVA of satisfaction by profession.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	49020.8918	24510.4459	9.0014	.0002
Within Groups	179	487407.6796	2722.9479		
Total	181	536428.5714			

Source: WBAMC HIS user survey and SPSS/PC+

The ANOVA revealed there were significant differences in satisfaction levels among professionals.

A Scheffé test[13] was completed using SPSS/PC+ to determine which pairs of means were significantly different at the .01 level. In looking at the means in Table 5 one can see there are large differences in the mean scores of doctors compared to nurses and in the mean scores of doctors when compared to the support staff. The results indicated the doctors are significantly less satisfied with the HIS systems than are nurses and support staff.

Table 5. Mean HIS satisfaction score by professional group.

Group	Count	Mean	Standard Deviation
Doctors	49	-3.8776	58.6947
Nurses	67	37.4627	46.1993
Support	66	23.9394	52.7951
Total	182	21.4286	54.4398

Source: WBAMC HIS user survey and SPSS/PC+.

[13] Refer to Appendix A.

Perception of system characteristics by professional groups

To help understand differences in satisfaction among doctors, nurses and support staff, a multivariate analysis of variance (MANOVA) was completed. The 36 system characteristics were grouped into five categories according to Bailey and are presented in Table 6 (195). Each combination of variables was compared across three groups; doctors, nurses and support staff. If a respondent failed to enter a score for a characteristic or marked the characteristic nonapplicable then SPSS/PC+ dropped that case from consideration for the selected category. While this procedure diminishes the sample size it does not compromise the author's conclusions.

Table 6. Thirty Six Characteristics Grouped by Issue

ORGANIZATION MANAGEMENT ISSUES
1. Data processing policies
2. Administration involvement
3. Goal congruence
4. Rerunning of incorrect output
5. Time and process for changes to system
6. Power of EDP within organization

HARDWARE/SOFTWARE SYSTEM ISSUES
1. Flexibility of the system
2. Interaction (interface) of the system
3. Capabilities of the system
4. Need for the system
5. Security of data
6. Documentation

APPLICATIONS OUTPUT ISSUES
1. Ease of use
2. Timeliness of report delivery
3. Completeness of output
4. Accuracy of output
5. Form of output
6. Relevancy of output
7. Reliability of output
8. Volume of output
9. Convenience of output
10. Procedure to enter input or get output
11. Currency of data
12. Value of output

USER COMMUNITY ISSUES
1. Your degree of training
2. Effects of the computer on your job
3. Your feelings of control over the computer
4. Your relationship with computer staff
5. Computer saves you time
6. Your confidence in the system
7. Your understanding of the system

EDP STAFF ISSUES
1. Interpersonal skills of EDP staff
2. Technical skills of EDP staff
3. Attitude of EDP staff
4. Business knowledge of EDP staff

Source: Bailey, James. "Measuring and Managing User's Attitudes." Healthcare Computing and Communications. 3.11 Nov 1986: 50-54.

SPSS/PC+ MANOVA produces four commonly used tests for evaluating multivairate differences; Pillai's Trace, Wilks'Lambda,

Hotelling's Trace, and Roy's Largest Root (Norusis B-126). Values from Pillai's Trace are reported in this study because the significance level based upon it is reasonably correct even when the assumptions are violated (Norusis B-126). The significance level was selected to be .01 so that there would be less of a chance of rejecting the null hypothesis that there was no difference between the means. Additionally, the author wanted to focus on characteristics which were found to be significantly different with a high degree of certainty that the difference was not attributed to a chance error.

Significant differences in means were detected for only two of the five groups of issues, organization management issues and user community issues. The means for organization management issues are listed in Table 7.

Table 7. Mean satisfaction scores for Organization Mgt Issues

1. DATA PROCESSING POLICIES: The policies and priorities regarding allocation of computer resources to users.

	Mean	Std. Dev.	N
Doctors	-24.508	38.092	22
Nurses	8.672	35.273	32
Support	6.146	30.101	24
For entire sample	-1.464	37.145	78

2. HOSPITAL ADMINISTRATION INVOLVEMENT: The interest and involvement toward the HIS shown by the administration.

	Mean	Std. Dev.	N
Doctors	-21.098	51.469	22
Nurses	12.396	49.729	32
Support	4.826	38.354	24
For entire sample	.620	48.532	78

3. GOAL CONGRUENCE: The extent to which the HIS objectives agree with your objectives.

	Mean	Std. Dev.	N
Doctors	-12.538	49.648	22
Nurses	29.974	52.539	32
Support	17.500	50.172	24
For entire sample	14.145	53.353	78

4. RERUNNING OF INCORRECT OUTPUT: The methods and policies regarding rerunning of output when problems occur.

	Mean	Std. Dev.	N
Doctors	-23.144	39.708	22
Nurses	8.516	52.014	32
Support	-7.014	35.713	24
For entire sample	-5.192	45.513	78

5. TIME AND PROCESS FOR CHANGES TO THE HIS: The time and process to accomplish change or incorporate a new development to the Hospital Information System.

	Mean	Std. Dev.	N
Doctors	-40.189	41.190	22
Nurses	-31.354	40.125	32
Support	-9.896	30.831	24
For entire sample	-27.244	39.288	78

6. POWER OF THE COMPUTER STAFF WITHIN THE HOSPITAL: The position and power of the computer department and personnel within your hospital.

	Mean	Std. Dev.	N
Doctors	2.386	19.884	22
Nurses	24.740	36.153	32
Support	-.243	47.574	24
For entire sample	10.748	38.066	78

Source: WBAMC HIS user survey and SPSS/PC+.

$F_{(12,142)} = 2.937$ and $p < .01$

The data in Table 7 indicates the doctors are less satisfied

with the the HIS than the other groups. However some characteristics indicate hospital personnel are unhappy with organization management issues. The doctors seem to be slightly dissatisfied with the data processing policies while the other groups display a more favorable attitude. Dr. Randy Copeland, HIS physician coordinator, reports one reason for this may be the administrative decision to make order entry mandatory on the HIS leaves a distaste in the mouths of the physicians. The doctors do not believe the allocation of computer resources has been fair to them as a group but they tend to forget doctors did not readily accept the HIS during implementation and therefore nurses were able to rapidly gain control of the system (Jackson 1987). Doctors appear to be slightly dissatisfied with the hospital administration's involvement with the HIS, and the time and process for changes. The greatest degree of dissatisfaction in the organization and management issues is the time and process for changes or new developments. The doctors seem to be saying they want to implement some changes to the HIS and are encountering some difficulty in doing so. This may account for their dissatisfaction with hospital administration involvement in that they may feel the administration could help expedite the change process. The total HIS users group indicated they are neither dissatisfied nor satisfied with the rerunning of incorrect output but a further review finds the doctors are slightly dissatisfied. Insufficient evidence exists in this study to attempt to explain why the doctors are less satisfied than the other groups with this particular

characteristic.

Table 8, user community issues, lists the other set of factors where significant differences in means were discovered.

Table 8. Mean satisfaction scores for User Community Issues.

1. YOUR DEGREE OF TRAINING: The quantity and quality of training you received on the HIS.

	Mean	Std. Dev.	N
Doctors	27.028	40.071	30
Nurses	7.681	55.157	46
Support	27.419	43.742	31
For entire sample	18.824	48.651	107

2. EFFECTS OF THE HIS ON YOUR JOB: The effects the HIS has on enhancing your job and performance.

	Mean	Std. Dev.	N
Doctors	-11.056	57.457	30
Nurses	38.279	52.463	46
Support	33.172	63.030	31
For entire sample	22.967	60.463	107

3. YOUR FEELING OF CONTROL OVER THE HIS: Your power to control use, maintenance and modifications of the HIS.

	Mean	Std. Dev.	N
Doctors	-24.583	45.215	30
Nurses	-6.431	36.093	46
Support	1.801	43.250	31
For entire sample	-9.136	41.803	107

4. YOUR RELATIONSHIP WITH THE COMPUTER STAFF: The interaction process between users and the computer department personnel.

	Mean	Std. Dev.	N
Doctors	30.111	38.668	30
Nurses	31.232	42.529	46
Support	22.097	37.993	31
For entire sample	28.271	40.017	107

Source: WBAMC HIS user survey and SPSS/PC+.
$F_{(14,198)} = 3.135$ and $p < .01$.

Table 8. Mean satisfaction scores (continued).

5. HIS SAVES YOU TIME: The extent to which use of the HIS saves you time.

	Mean	Std. Dev.	N
Doctors	-8.611	58.280	30
Nurses	49.656	52.989	46
Support	22.204	57.527	31
For entire sample	25.366	60.362	107

6. YOUR CONFIDENCE IN THE HIS: Your feelings of assurance and certainty about the HIS.

	Mean	Std. Dev.	N
Doctors	12.056	49.254	30
Nurses	22.717	50.205	46
Support	22.876	45.716	31
For entire sample	19.774	48.463	107

7. YOUR UNDERSTANDING OF THE HIS: Your knowledge of and understanding about the HIS.

	Mean	Std. Dev.	N
Doctors	15.472	43.794	30
Nurses	23.188	40.880	46
Support	11.290	41.385	31
For entire sample	17.578	41.778	107

Source: WBAMC HIS user survey and SPSS/PC+.
$F_{(14,198)} = 3.135$ and $p < .01$.

Doctors do not appear to believe the HIS enhances their job performance while the nurses and support staff believe the HIS does enhance their job performance. The doctors also do not believe the HIS saves them time while the nurses and support staff do believe the HIS saves them time in the performance of their duties. Nurses are able to interpret doctors' orders much faster since there are no legibility problems (Jackson). Pharmacy personnel do not have to spend time interpreting scripts written for inpatients because once again there is no legibility problem. A recent inspection by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) was completed and the physician on the team indicated that a primary benefit of the HIS was the elimination of legibility problems often associated with a doctor's handwriting. It was his opinion that improved legibility could only help reduce errors in interpretation and therefore improve the quality of patient care delivered (Ettman)[14]. Earlier in the study the hospital personnel were reported to be neither dissatisfied nor satisfied with their feeling of control over the HIS. Looking at the means in Table 8 reveals doctors are slightly dissatisfied with their control over the HIS. Looking at these results together with the doctors' dissatisfaction with the time it takes to accomplish change, doctors apparently would like more control than they presently have to effect change. The underlying implication seems to be the doctors are recognizing they cannot avoid using the HIS so they

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[14] Captain David Ettman is an attorney in the Center Judge Advocate's office who attended the JCAHO outbriefing.

would like to implement some changes to the existing system. Another implication may be the doctors do not believe the administration is doing all it can do to improve the HIS and therefore would like to gain the control they think will fix the areas with which they are not happy.

Part II of the survey instrument reveals 91.6 percent of the respondents have completed the formal HIS training program and only 19.3 percent feel they need additional training. The average time spent going through training is approximately eight hours and 74.3 percent of the respondents feel the amount of time available for training is adequate. Only 24.3 percent of the respondents indicated they wanted additional training beyond what they had already received.

CHAPTER THREE

CONCLUSIONS AND RECOMMENDATIONS

The first conclusion reached after reviewing the survey data is that the WBAMC HIS training program is meeting the needs of the users. No survey responses indicated dissatisfaction with the training program. In fact, the training program appears to one of the strengths of the HIS. Users agree that the amount of time made available for training is adequate and that the documentation made available meets their needs. Users prefer to acquire just enough knowledge to access the HIS via the formal training program and then enhance their knowledge with on-the-job experience. The dissatisfaction noted in the organization managment issues and user community issues can be considered practically negligible since the HIS is being used successfully by physicians to input orders and by nurses and support staff to support the physician's orders. Nevertheless improving the capabilities of the HIS continues to be a WBAMC goal.

Since the initiation of this study many improvements to the HIS have been undertaken which should help reduce the dissatisfaction noted for some of the system characteristics. The most significant improvement in the minds of the physicians is the acquisition of a Laboratory Information System (LIS) (Copeland). Until a LIS is acquired, the lab slips continue to be filled out by hand and the results from the lab often take a circuitous path prior to reaching the physician ordering the test (Copeland).

The LIS is being centrally procured through Walter Reed Army Medical

Center and will provide physicians with lab reports via the HIS. The next major improvement from a physician's perspective will be the availability of radiology reports through the HIS. The technical capability exists to provide the reports and steps are being taken to bring this capability on line as soon as possible (Magill). When TDS withdrew from the Composite Health Care System (CHCS) competition, some mainframe computer hardware became available from Charleston, South Carolina. The Information Management Division submitted a request to have the equipment turned over to WBAMC and was notified during the first week of July 1988 the equipment is being shipped (Magill). The new equipment will increase the speed of the HIS as well as expand the database capabilities (Magill). Each of these impending improvements should reduce dissatisfaction revealed in this study.

The staff of WBAMC are to be complimented for establishing and maintaining a successful Hospital Information System. Ms. Ann Stoh, HIS Training Coordinator, has done an excellent job in providing training needed to ensure that the HIS contributes to WBAMC's goal of providing quality patient care. The staff of the Computer Information Center (CIC) are a major contributor to the success of the HIS since they provide computer literacy training to potential HIS users.

There are only two recommendations. First, that the training program should retain its current format. Perhaps an addition to the effectiveness of the training program would be to assess an indivdual's computer literacy before asking them to complete the

HIS formal training program. Persons who do not meet a minimum level of computer literacy should be required to participate in computer literacy training before going on to the HIS formal training program. Defining computer literacy and a model for a computer literacy training program is a possible subject for another study.

Next, to ensure the HIS continues to function as intended and expands with increasing hospital needs, an independent audit by an objective agency or team other than the Information Management Division should be conducted once each year. The intent of the audit should be to ensure that the HIS is accomplishing the formal goals established for the system. Additionally, changes directed by the HIS configuration committee should be evaluated to determine whether the changes have the desired results. These regular reviews will provide the hospital management with the feedback necessary to determine whether information managment dollars are being spent in the most efficient manner.

Finally, the physicians' opinion of the HIS could be significantly improved by adding two features to the existing system, retrieval of lab results and retrieval of radiology reports. The physicians have indicated they would have a better opinion of the system if they could retrieve laboratory results from the system. Physicians have also indicated they would be much happier if they received radiology reports via the HIS. The technical capability exists to provide these reports and is being developed as this report is nearing completion.

APPENDIX A DEFINITIONS

ANALYSIS OF VARIANCE- a technique whereby the total variation present in a set of data is partitioned into several components. Associated with each of these components is a specific source of variation, so that in the analysis it is possible to ascertain the magnitude of the contributions of each of these sources to the total variation.

CENTRAL PROCESSING UNIT (CPU)- the main processor of information.

CLUSTER CONTROLLER- functions as a traffic controller for data traveling from a Video Matrix Terminal (VMT) or IBM Personal Computer (PC) to a Front End Processor (FEP). All VMTs and IBM PCs are connected to a cluster controller and all cluster controllers are connected to a Front End Processor. A maximum of 64 VMTs and/or IBM PCs can be connected to a single cluster controller.

CONSOLE- a device used to communicate with the system. It is connected directly to the CPU and normally consists of a monitor and a keyboard. It is used by the operator to monitor and control the computer.

DATABASE- a collection of tables and files retained on a disk pack. The Management Information System has the capability to operate 16 different data bases.

DISK DRIVES- a direct access method of storing and retrieving data. The direct access retrieval method allows the system to locate a record without taking the time to read other records.

DISK PACK- mounted stacks of rotating magnetic disks. Information can be retrieved from the disks quickly by means of an address code, without regard for the sequence in which the data was recorded on the disks.

DATA LINES- function as connectors to carry data between two points. Data lines can be telephone lines, coaxial cables, fibre optics or microwave/satellite signals.

EXTERNAL VALIDITY-an externally valid instrument is one which measure what it is supposed to measure.

FRONT END PROCESSOR- a computer dedicated entirely to handling data traveling from the main computer to a cluster controller. Each Front End Processor can handle up to eight cluster controllers.

HARDWARE- physical devices used by the Management Information System. Generally classified into input/output devices, communications equipment, and computer room equipment.
HIGH SPEED PRINTER- usually located in the computer room. It is used for long reports, operations reports, and data base personnel needs. Prints at approximately 20 pages per minute compared to 5 or 6 pages per minute for user input/output printers.

INTERNAL VALIDITY-an internally valid instrument is one which measures an adequate sample of the independent variables and measures them in a sound fashion.

MAGNETIC DISK- a flat, circular plate with a magnetic surface layer on which data is stored in tracks. Each track has a specific address.

MAGNETIC TAPE- a storage medium using sequential access. Data must be retrieved in the order in which it was entered. Magnetic tape is used mostly to backup disk files and for loading new software and data into the system.

MATRIX PACK- a disk pack used by the system to retain all displays (matrices) used by the system.

MODEM- stands for Modulator Demodulator. It is used to send data over telephone lines between two points.

OPERATING SYSTEM- a set of software programs dedicated to managing and controlling the operation of the resources of a computer. The computer cannot function without an operating system.

PRINTER- used to print reports, labels, orders, etc. Each nursing station and ancillary department should have at least one printer.

RELIABILITY-a reliable instrument is one which accounts for almost everything that effects the issue being measured and thus can repeatedly give the same results. Reliability of the instrument is given by:

$$R(i) = 1-[Ve(i)/Vs(i)]$$

where:
Ve(i) = Unexplained variance
Vs(i) = Estimated variance due to subjects

SCHEFFE TEST- a multiple comparison procedure for testing which pair of means is significantly different.

SOFTWARE- sets of instructions, called programs, that control the computer's operation.

VIDEO MATRIX TERMINAL (VMT)- may be used as an input or output device. When the user types data using the keyboard (e.g. a patient's personal information) or selects information from the different screens through the use of a lightpen (e.g. inputs a doctor's order), the VMT is used as an input device. The VMT is used as an output device when information is retrieved and displayed on the screen as a response to a request from the user.

Appendix B. LETTER APPROVING CHANGE IN PROBLEM STATEMENT

DEPARTMENT OF THE ARMY
ACADEMY OF HEALTH SCIENCES, UNITED STATES ARMY
FORT SAM HOUSTON, TEXAS 78234-6100

REPLY TO
ATTENTION OF

HSHA-IHC

25 April 1988

MEMORANDUM FOR: Chief of Staff, William Beaumont Army Medical Center, El Paso, Texas 79920-5001, ATTN: ~~COL Johnny L. Conner, MS~~ C SMazzB

SUBJECT: Modification of Problem Statement in Graduate Research Project Proposal (GRPP) in the case of Captain Grover C. Peters, MS, USA

1. Subject request indicated in your letter HSHM-MZC (640-b) dated 15 March 1988 is approved. The problem statement is modified to read as follows: "To determine if the training being provided on the Hospital Information System meets the needs of the users."

2. The GRPP and the Graduate Research Project (GRP) should be modified in the areas of objectives, assumptions, criteria, and others as appropriate to reflect this change.

MELVIN E. MODDERMAN
COL, MS
Program Director
U.S. Army-Baylor University Graduate
Program in Health Care Administration

Appendix C. LETTER AUTHORIZING USE OF SURVEY INSTRUMENT

Arizona State University

College of Engineering and Applied Sciences
Department of Industrial and Management Systems Engineering
Tempe, Arizona 85287-5906
602/965-3185
TLX 165878 COLL ENG TMPE

1/13/88

Capt. Grover Peters
1202 Country Club Road Apt. 51
Santa Teresa, NM 88008

Dear Capt. Peters:

I am sorry for the delay in getting these materials to you. I've changed jobs here at ASU and you got lost in the confusion. I've given you uncompiled BASIC versions of data collection of analysis programs so you can alter them. To start data collection now SATIS.BAS. To run analysis, run HOSP.BAS. HOSP,RPTS, SUBJS, COMTS, FILLD & GRAPH all have CHAIN statewide (eg CHAIN RPTS.EXE in HOSP). All of these need to be altered to CHAIN XXXX.BAS before they will run in a uncompiled mode.

You are granted permission to use these programs for research purposes only and not for managerial analysis. Best of luck in your efforts.

Sincerely,

James E. Bailey, PhD
(602)965-6874

JEB/bn

Appendix D. HOSPITALS WITH TDS HOSPITAL INFORMATION SYSTEMS

Technicon Hospital Information Systems are being used by the following hospitals:

1. Adventist Health System Porter Memorial Hospital Denver, Colorado
2. All Saints Episcopal Hospital Fort Worth, Texas
3. A. I. duPont Institute Wilmington, Delaware
4. Baptist Medical Center of Oklahoma, Inc. Oklahoma City, Oklahoma
5. Baylor University Medical Center Dallas, Texas
6. Bethesda Hospital, Inc. Cincinnati, Ohio
7. Cedars Medical Center Miami, Florida
8. City of Faith Tulsa, Oklahoma
9. Community Memorial Hospital Toms River, New Jersey
10. El Camino Hospital Mountain View, California
11. Elmhurst Memorial Hospital Elmhurst, Illinois
12. Forbes Health Systems Pittsburg, Pennsylvania
13. Frankford Hospital of Philadelphia Philadelphia, Pennsylvania
14. Hanemann Hospital and Medical Center Philadelphia, Pennsylvania
15. Halifax Hospital Medical Center Daytona Beach, Florida
16. Harper-Grace Hospitals Detroit, Michigan
17. Hospital Sisters Health System Springfield, Illinois
18. Huntsville Hospital Huntsville, Alabama
19. Ingalls Memorial Hospital Harvey, Illinois
20. Jewish Hospital of St. Louis St. Louis, Missouri
21. Kenosha Memorial Hospital Kenosha, Wisconsin
22. Leigh Memorial Hospital Norfolk, Virginia
23. Loyola Medical Center Maywood, Illinois
24. Maine Medical Center Portland, Maine
25. Medical Center Hospital Norfolk, Virginia
26. Medical Center of Central Georgia Macon, Georgia
27. Medical College of Virginia Richmond, Virginia
28. Medical Data Technology Roseland, New Jersey
29. Memorial Medical Center, Inc. Savannah, Georgia
30. Methodist Hospital of Indiana Indianapolis, Indiana
31. Michael Reese Hospital and Medical Center Chicago, Illinois
32. National Institute of Health Clinical Center Bethesda, Maryland
33. Nebraska Methodist Hospital Omaha, Nebraska
34. New York University Medical Center New York, New York
35. N. K. C., Inc. Louisville, Kentucky
36. Norfolk General Hospital Norfolk, Virginia
37. North Mississippi Medical Center Tupelo, Mississippi
38. Pascack Valley Hospital Westwood, New Jersey

39. Penrose Hospital Colorado Springs, Colorado
40. Presbyterian Hospital Charlotte, North Carolina
41. Ralph K. Davis Medical Center San Francisco, California
42. Rehabilitation Institute of Chicago Chicago, Illinois
43. Riverside Community Hospital Riverside, California
44. Saint Anthony's Hospital Columbus, Ohio
45. Saint Barnabas Medical Center Livingston, New Jersey
46. Saint Francis Health System Pittsburg, Pennsylvania
47. Saint John Regional Hospital Saint John, New Brunswich Canada
48. Saint Joseph's Hospital Atlanta, Georgia
49. Saint Joseph's Hospital Parkersburg, West Virginia
50. Saint Luke's Hospital District San Francisco, California
51. Saint Luke's Regional Medical Center Sioux City, Iowa
52. Saint Mary Corwin Hospital Pueblo, Colorado
53. Saint Paul-Ramsey Medical Center St. Paul, Minnesota
54. Saint Vincent Health Center Erie, Pennsylvania
55. San Antonio Community Hospital Upland, California
56. Shadyside Hospital Pittsburg, Pennsylvania
57. Strong Memorial Hospital Rochester, New York
58. Temple University Hospital Philadelphia, Pennsylvania
59. Total Business Systems Presbyterian Hospital
60. University of California at Irvine Orange, California
61. University of Illinois Hospital Chicago, Illinois
62. University of Virginia Medical Center Charlottesville, Virginia
63. Washington Hospital Washington, Pennsylvania
64. Waukesha Memorial Hospital Waukesha, Wisconsin
65. Wesley Long Community Hospital Greensboro, North Carolina
66. West Jefferson General Hospital Marrero, Louisiana
67. William Beaumont Army Medical Center El Paso, Texas

Appendix E. DESCRIPTION OF HOSPITAL INFORMATION SYSTEM

Introduction

Manpower support of the Hospital Information System has been less than adequate. Initially Health Services Command authorized 8 positions however 7 months later 15 positions were withdrawn. WBAMC was forced to manipulate positions within the hospital to support the HIS.

Automation Personnel

HIS Branch Supervisor, (Data Base Administrator)	1
Data Base Administrator	1
Matrix Analyst/Coder	4
Trainer *	2
Rounds Technician *	3
Computer Operator **	9
Tape Librarian **	1

* Also used to support hundreds of microcomputer systems
** Supports 5 mainframe computer systems in addition to HIS

HIS Branch Supervisor

The HIS Branch Supervisor is responsible for managing the 10 employees that are dedicated to maintaining the automated portion of the HIS and also acts as the lead data base administrator. This individual controls the workload of HIS System Change Requests (SCRs), Incident Reports (IRs) and Engineering Change Proposals (ECPs). The individual responsibilities for data base administration are the same as the data base administrator mentioned below.

Data Base Administrator

It is the responsibility of the data base administrator to

keep the system up and running 23 hours a day, 7 days a week. The system is brought down each morning at 0130 hours until 0230 for performing backups and other maintenance work. A data base administrator is on call 24 hours a day (possesses a beeper during non-duty hours and weekends) to handle any problems that the computer operations branch personnel, or the HIS matrix analysts cannot resolve. The data base administrators must be extremely familiar with the hardware and executive and application software of the HIS. They must also be aware of all changes made to the system. Three data bases are maintained on the system: the live data base which contains the live patient data, the test and development data base which is utilized by the automation staff for development and testing of software changes and the training data base which is utilized by all users for learning the system. Identical application software to include 12,000 matrix screens is maintained for each data base. The data base administrator is responsible for the following tasks:

a. Monitor and maintain control of 3 data bases and 3 matrix packs.
   - Live data base, Hospital 1.
   - Test and development data base, Hospital F.
   - Training data base, Hospital 5.
   - MATRIX 1 pack, for live data base, Hospital 1.
   - MATRIX F pack, for test and development data base, Hospital F.
   - MATRIX 5 pack, for the training data base, Hospital 5

(1) MATRIX pack control and maintenance.

(a) Each MATRIX pack has over 12,000 screens that must be controlled and monitored.

(b) All MATRIX screen changes are made on a weekly basis, unless in an emergency situation.

(2) Data base management and control.

Each data base has over 30 tables and files that must be updated, managed and controlled, i.e., Bed Control File, Report Format Table, Process Extract Table, Hospital Parameter Files, etc.

b. Daily review of the Print log to uncover any system irregularities.

c. Provide technical assistance to four (4) matrix analyst/programmers.

d. Establish procedures for the Hospital Information Section and the Computer Operations Section to follow.

(1) For nightly backups of the data bases and MATRIX packs.

(2) For the weekly backups of VSAM files and disk packs.

(3) On line table updates.

(4) MATRIX move procedures.

e. Control and maintenance of the VSE/Interactive Computing and Control Facility (ICCF) Libraries, which include the following.

(1) Job Control Language which is used for the execution of all programs.

(2) All Report Format Tables (RFT) Source Code.

(3) All Program Extract Tables (PXT) Source Code.

(4) All Hospital Parameter Tables (HPT) Source Code.

(5) All Source Code and Preprocessor Decks used to create output for on-line table updates.

(6) ICCF performance standards.

(7) Establishing libraries for Matrix analyst/programmers to utilize.

f. Install and validate new system releases and application releases.

g. Install and validate all software patches.

h. Generate table updates as required.

i. Validate all updates to data bases for accuracy (that the update was done and that it ran to completion.)

j. Generate and control user sign-on codes for all HIS users.

k. Capacity monitoring.

(1) Monitor current performance statistics.

(2) Monitor multitasking performance.

(3) Review system I/O statistics.

l. File control.

(1) Review system messages.

(2) Monitor file utilization by direct analysis, data integrity and using system utilities.

m. Review, analyze and resolve all executive software and application program problems.

(1) Review all problems or incidents that Matrix analyst/programmers are unable to resolve and ascertain if they should be forwarded to the vendor for correction.

(2) Provide all the necessary documentation, such as SYSLIST, Printlog, etc, to facilitate the vendor in resolution of the problem.

n. Space management.

(1) Monitor IBM related files.

(2) Provide available DASD space for other functions.

(3) Monitor all data base files (30 files per data base).

(4) Reorganize files that are filling up, or expand files that cannot be reorganized to gain space.

o. Maintain and installs new system releases for:

(1) DOS/VSE

(2) Technicon System Releases

(3) Technicon Application Releases

Matrix Analyst/Programmer.

The duties of the matrix analyst/programmer include a wide range of activities from actual screen coding to researching tables and files in any one of the 3 different data bases for the purpose of functional enhancements to the system.

Changes and/or additions to the HIS are evaluated by analysts using knowledge gained from previous hospital employment and technical HIS training. It takes at least one year of

training on this system to become a qualified analyst/programmer.

Feasibility and scope of requested changes are decided by input from all HIS analysts and one of the data base administrators. Knowledge of the numerous tables and files that work through multi-integration within this system is an essential ingredient for feasibility determination.

Contact with users is a daily activity, thus good public relation skills are also essential to this position. Good communication among the analysts, data base administrators and the functional users are essential for accomplishing functional enhancements to the system.

The most invisible end products of the analysts's duties are the Cathode Ray Tube (CRT) displays and the printouts, obtained from different patient report forms. these are accomplished by detailed coding, i.e., matrix coding (for the CRT screens) and Report Format Tables (RFT) which produce the printed outputs. Less visible but perhaps more important, are the coding changes to the tables and files required for most enhancements and the knowledge as to which tables and files must be changed to accomplish a new function on the HIS. Even more invisible, but equally important, is a basic understanding of the control that the many programs within the HIS have several table and file functions. Because the programs are under proprietary protection as far as coding changes are concerned, it is necessary to understand how the programs exercise control over the tables and files when planning and executing changes to the system.

In retrospect it has become apparent that had the HIS analyst/programmers been involved in the original data collection, the volume of system change requests now being experienced at William Beaumont Army Medical Center would be much smaller.

The involvement of analyst/programmers from the beginning stages, pre-activation, is absolutely mandatory to the successful implementation and functioning of any HIS. This fact cannot be overemphasized.

One of the reasons that the HIS has been so successful at WBAMC, is that the system can be changed to the users' specifications. These changes are accomplished in-house with priority changes being worked on immediately.

HIS Trainer

The HIS trainer works in the Computer Information Center (CIC). The CIC is responsible for training all users on the HIS. They must be thoroughly familiar with all user pathways, i.e., physicians, nursing, radiology, etc., in order to properly instruct and assist users in working through their specific pathways. The 23 different specialty user training manuals are designed for self-paced study with the instructor acting as a resource person, available to answer questions and assist with problems.

The trainers coordinate training schedule dates directly with the nursing units, respective clinics or departments. It should be noted that not only do permanent employees receive the

training, but, also yearly reservists and college nursing students. Training of over 200 personnel i a month is not uncommon. As an incentive, each student receives a certificate of completion.

The two trainers are designated as assistant ADP security officers (ADPPSSOs) and are responsible for issuing access codes to user personnel. Students are required to successfully complete all exercises and self-tests in their manuals before being issued an access code. Each student brings to their first class session an access code request form signed by their supervisor. The training center is on the out-processing checklist for hospital personnel and is also responsible for deleting all access codes.

To ensure that manuals are kept current, proposed changes to pathways are staffed through the CIC before being loaded to the live hospital data base. The CIC personnel then make any necessary changes to the training documentation. All manuals are kept on microcomputer wordprocessing for easy updating.

The CIC personnel coordinate, provide or assist in giving demonstrations on the system's capabilities to new hospital personnel and distinguished visitors.

For instruction purposes the HIS contains a training data base. The trainers must create dummy patient records for student use. These patient records increase in size due to student input and must be purged weekly after the class has been completed.

Rounds Technicians

The rounds technician also works in the Computer Information Center and is responsible for solving user hardware problems. If the problem is related to software, then it is resolved by the Matrix Programmer Analyst. User problems are called into the Problem Control Desk at the Computer Operations Section as they occur. The problem is logged into an automated incident reporting system and is responded to by the rounds techs as appropriate. The Incident Report is completed by the rounds techs or forwarded to appropriate individual for action. The rounds techs provide the hospital staff with assistance and service by performing minor technical adjustments, changing printer ribbons, replacing malfunctioning parts or exchanging defective equipment with floats. The hospital has six CRT and ten printer floats.

Rounds techs are assigned different areas of responsibility within the hospital to perform weekly preventive maintenance on the equipment (188 CRTs and 120 printers). EAch rounds tech has his/her own cart with tools, vacuum, ribbons and cleaning materials. Additionally, they train users to change printer paper and ribbons.

The rounds techs assist in setting up equipment for demonstrations on system capabilities, assuring that the equipment is functioning properly.

Configuration Management

Configuration management is the main tool which keeps the

automation staff and various HIS committee members out of trouble. We have a 100% audit trail of all problems and solutions. We have two automated data bases which control our Incident Reports (IRs) and System Change Requests (SCRs). Hard copy reports concerning all configuration actions have been retained since the system was installed. The following activities assist in the control of our problems and changes.

Configuration Management Committee

The Configuration Management Committee is a carry on of the INstallation Team minus the representatives from the Organization Effectiveness Office, Engineer Liaison Office, Comptroller, and Plans, Operations and Security. The committee is responsible for:

a. Reviewing and setting priorities on SCRs as necessary.
b. Coordinating the implementation of all major enhancements and changes.
c. Coordinating VIP briefs and tours.
d. Recommending policy changes for staffing by Project Director.
e. Reviewing and recommending courses of action for non-system related IRs (i.e., problems related to user procedures).

The committee meets once a week for approximately one hour. The Chairperson, Project Director, continually updates the Commander and executive staff on all pertinent actions concerning

the system.

System Change Requests (SCR)

A SCR is defined as a recommended change to the HIS system that can be made with the in-house staff. All SCRs are documented and submitted to the HIS branch. Once the SCR is logged into the SCR Status System by the Automation Management Branch, HIS section, it is presented at the weekly meeting of the Configuration Management Committee, if it is a major change to the system. The committee reviews the request and prioritizes it along with the others on the log. Once the SCR is completed the Data Base is updated, and the user is notified, usually through a message screen on the system and/or through the HIS-O-GRAM news letter. The use of an automated status log is a must due to the high volume of SCRs. The least number of SCRs awaiting action within the last 9 months has been 75. At that time, the General announced that the HIS was working well and that the physicians should be looking for innovative ways to use the system. Within three weeks our SCRs had climbed back to over 100. Even though our backlog increased, we were thoroughly convinced that the physicians were using the system.

Engineering Change Proposal (ECP)

An ECP is defined as a recommended change to the HIS which cannot be accomplished with in-house staff. If outside support is required, then an ECP is prepared and submitted through command channels to the TRIMIS Program Office. An ECP status report is prepared and distributed monthly to all appropriate staff members. When an ECP action has been completed it is dropped from the report.

Incident Reporting (IR)

An IR is a reported system problem (hardware or software), either identified by the user or the automation staff. All IRs are telephoned to the Computer Operations Section problem desk where they are immediately logged and acted upon. Hardware problems (terminals and printers) are resolved by the computer operators or rounds technicians on duty. Terminal and printer floats area available if one cannot be repaired. Our operations staff is also required to change all printer ribbons if asked by the user. The handling of printer paper is the responsibility of the user, to include picking it up at the Material Distribution Branch. Technicon is responsible for the maintenance of all mainframe and communication equipment in the computer Operations Section.

All software problems are referred to either a matrix analyst or a data base administrator. During non-duty hours one matrix analyst and one data base administrator is on call and

wears a beeper.

Each workday morning the Chief of the Computer Operations Section reviews the previous 24 hour IR report and all other unresolved problems with the Chief of the Automation Branch and the Chief of the HIS section. This review insures that proper action has been or is being taken on all problems. Once a problem has been solved, a written completion statement is returned to the Computer Operations Section and the problem is removed from the IR log. All closed out problems are archived for audit trail purposes.

HOSPITAL INFORMATION SYSTEM
SECTION STANDARD OPERATING PROCEDURES

PURPOSE. To define policy, responsibility, and procedures relative to the operation of the Hospital Information Systems Section.

FUNCTIONS

A. General

The HIS Section of the Automation Management Branch is responsible for the day to day operations of the on-line hospital information system (HIS). The Chief, HIS Section reports directly to the Chief, Automation Management Branch of the Information Mission Area.

B. Chief, Hospital Information System Section.

(1) Manages and establishes policy for the operation of the HIS branch.

(2) Provides advice and direction to the Data Base Administrators, and the computer programmer analysts.

(3) Responsible for writing performance appraisals for the data base administrators, computer programmer analysts.

(4) Responsible for keeping the HIS section SOP;s current.

(5) Responsible for writing training plans for the HIS Section personnel.

(6) Responsible for providing an up-dated status report to the Configuration committee each week with the System change Request's (SCR's) that are currently in process, and any priority SCR's received since the last meeting, also a report of all SCR's that have been completed since the last Configuration Committee meeting.

(7) Responsible for making certain that the HIs incident reports are completed in a timely manner, and if the Hospital analysts and/or Data Base Administrators can not resolve the problem, making certain that all necessary information is forwarded to TDS Product support properly labeled. Keeping track on all incidents that have been forwarded to TDS.

(8) When SCR are completed and ready to be loaded to the live data base forwards a copy of the SCR marked completed to all applicable persons, informing them that the request has been completed and the date the change will be effective. The SCR will be attached to an overprinted DF.

(9) Responsible for work assignments to the Data Base

Administrators and the Computer Programmer analysts.

(10) Functions as a data base administrator.

C. Data Base Administrators:

(1) Responsible for the management and control of at least 3 different data bases, (each data base has over 30 tables and files that must be updated, managed and controlled on a daily basis).

Appendix F. HOSPITAL INFORMATION SYSTEM PATHWAYS

1. Ward Clerk
2. Respiratory Therapy
3. Radiology
4. Physician
5. Nursing
6. Nursing Assistant
7. Appointment Clerk
8. Inpatient Admissions
9. Outpatient Administration
10. Chaplain
11. CMS
12. Material Distribution Supply
13. Nutrition Care
14. EKG
15. EEG
16. Laboratory
17. Nuclear Medicine
18. Radioisotope Lab
19. Occupational Therapy
20. Physical Exam
21. Pharmacy
22. Pulmonary Therapy
23. Speech Therapy
24. Social Work Service
25. Pharmacy Technician
26. Appointment Supervisor
27. Internal Medicine Clinic
28. Respiratory Therapy Technician

Appendix G. WBAMC HIS USER SURVEY

To Participants:

The purpose of this study is to measure how you feel about certain aspects of the Hospital Information System (HIS) at William Beaumont Army Medical Center (WBAMC). Quickly go through the questionnaire giving your own perception of the present situation.

Once you have completed the questionnaire you may place it in distribution and address it to Stop 1, Attn: Administrative Resident or call ext. 2401 to have it picked up. I sincerely appreciate your participation in this study.

NAME:

Which of the following features of the Hospital Information System do you use the most? Please check all that apply.

Physicians:

____Order Entry
____Department Order Sets
____Discharge Notes
____Capaability to Order Discharge Medications
____Occurrence Screening
____Order Entry on Pre-Admit Patients
____Drug Diet Interaction
____History and Physicals

Nurses:

____Nursing Care Plans
____Nursing Measures
____Act as Agent for Physician
____Charting
____Social Work Consults
____Diet Consults

Ancillary:

____Order Entry
____Appointment Scheduling

SATISFACTION WITH WBAMC's HOSPITAL INFORMATION SYSTEM

On the following pages you will find different factors each related to some aspect of support you receive from the Hospital Information System. Factor definitions are included in case the title is confusing to you. Please rate each factor on the descriptive scales that follow it, based on your present feelings about the factor.

A separate scale is provided for you to express how important or unimportant each factor is to you.

The scale positions are defined as follows.

A [1] [2] [3] [4] [5] [6] [7] B

(1) extremely A
(2) quite A
(3) slightly A
(4) neither A nor B. equally A and B
(5) slightly B
(6) quite B
(7) extremely B

INSTRUCTIONS

1. Check each scale in the position that describes your evaluation of the factor being judged.
2. Check every scale, do not omit any.
3. If you have no opinion or the factor is not applicable to you CHECK THE CIRCLE MARKED (NA). For example, (NA)
4. Check only one position for each scale.
5. Check in the space not on the lines
6. Work rapidly but consider each scale independently, especially the importance scale. It is possible that each scale will be marked differently.

Example factor:

SECURITY OF DATA: The safety of the data from illegal use, tampering, and loss.

(NA)	vulnerable	1	2	3	4	5	6	7	impregnable
	recoverable	1	2	3	4	5	6	7	irretrievable
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

1. EASE OF USE: How easy or frustrating the computer terminal is to use.

(NA)	unforgiving	1	2	3	4	5	6	7	user friendly
	easy to use	1	2	3	4	5	6	7	hard to use
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

2. TIMELINESS OF REPORT DELIVERY: The time the report or service is available relative to your need.

(NA)	tardy	1	2	3	4	5	6	7	punctual
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

3. COMPLETENESS OF OUTPUT: The degree of detail and the comprehensiveness of the output relative to your need.

(NA)	inadequate	1	2	3	4	5	6	7	adequate
	thorough coverage	1	2	3	4	5	6	7	incomplete coverage
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

4. FLEXIBILITY OF THE COMPUTER SYSTEM: The ability of the Hospital Information System to change and adapt to fit new circumstances.

(NA)	rigid	1	2	3	4	5	6	7	flexible
	versatile	1	2	3	4	5	6	7	limited
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

5. YOUR DEGREE OF TRAINING: The quantity and quality of training you received on the Hospital Information System.

(NA)	insufficient quantity	1	2	3	4	5	6	7	sufficient quantity
	superior quality	1	2	3	4	5	6	7	inferior quality
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

6. TIME AND PROCESS FOR CHANGES OR NEW DEVELOPMENTS TO THE HOSPITAL INFORMATION SYSTEM: The time and process to accomplish change or incorporate a new development to the Hospital Information System.

(NA)	unacceptably long	1	2	3	4	5	6	7	reasonably fast
	simple process	1	2	3	4	5	6	7	complex process
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

7. ACCURACY OF OUTPUT: Your confidence that output data are correct.

(NA)	inconsistent accuracy	1	2	3	4	5	6	7	consistent accuracy
	sufficient accuracy	1	2	3	4	5	6	7	insufficient accuracy
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

8. FORM OF OUTPUT: The design and appearance of the output.

(NA)	confusing layout	1	2	3	4	5	6	7	simple layout
	easy to read	1	2	3	4	5	6	7	hard to read
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

9. EFFECTS OF THE HOSPITAL INFORMATION SYSTEM ON YOUR JOB: The effects the Hospital Information System has on enhancing your job and your performance.

(NA)	inhibiting	1	2	3	4	5	6	7	liberating
	improves productivity	1	2	3	4	5	6	7	reduces productivity
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

10. INTERACTION OF THE HOSPITAL INFORMATION SYSTEM: The ability of the Hospital Information System programs to link with other programs or computers.

(NA)	unsuccessful	1	2	3	4	5	6	7	successful
	sufficient	1	2	3	4	5	6	7	insufficient
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

11. DATA PROCESSING POLICIES: The policies and priorities regarding allocation of *computer resources to users.*

(NA)	vague policies	1	2	3	4	5	6	7	precise policies
	fair priorities	1	2	3	4	5	6	7	unfair priorities
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

12. HOSPITAL ADMINISTRATION INVOLVEMENT: The interest and involvement toward the Hospital Information System shown by the hospital administration.

(NA)	frustrating	1	2	3	4	5	6	7	helpful
	consistent involvement	1	2	3	4	5	6	7	iconsistent involvement
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

13. YOUR FEELING OF CONTROL OVER THE HOSPITAL INFORMATION SYSTEM: Your power to control use, maintenance and modifications of the Hospital Information System.

(NA)	ignored	1	2	3	4	5	6	7	dominant
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

14. YOUR RELATIONSHIP WITH COMPUTER DEPARTMENT STAFF: The interaction process between users and the computer department personnel.

(NA)	harmful	1	2	3	4	5	6	7	helpful
	user oriented	1	2	3	4	5	6	7	self-serving
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

15. CAPABILITIES OF THE HOSPITAL INFORMATION SYSTEM: The capabilities of the Hospital Information System relative to what you feel is reasonable.

(NA)	insufficient capabilities	1	2	3	4	5	6	7	sufficient capabilities
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

16. INTERPERSONAL SKILLS OF THE COMPUTER DEPARTMENT STAFF: The ability of computer department staff to understand and communicate with users.

(NA)	inferior skills	1	2	3	4	5	6	7	superior skills
	competent skills	1	2	3	4	5	6	7	incompetent skills
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

17. TECHNICAL SKILLS OF THE COMPUTER DEPARTMENT STAFF: computer and systems analysis skills exhibited by computer department staff.

(NA)	inferior skills	1	2	3	4	5	6	7	superior skills
	current understanding	1	2	3	4	5	6	7	obsolete understanding
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

18. ATTITUDE OF COMPUTER DEPARTMENT STAFF: The attitude and behavior of the computer department personnel toward users.

(NA)	impersonal	1	2	3	4	5	6	7	personable
	cooperative	1	2	3	4	5	6	7	unhelpful
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

19. HOSPITAL INFORMATION SYSTEM SAVES YOU TIME: The extent to which use of the Hospital Information System saves you time.

(NA)	time costly	1	2	3	4	5	6	7	time saving
	often	1	2	3	4	5	6	7	seldom
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

20. RELEVANCY OF OUTPUT: The compatibility of the output to your needs.

(NA)	useless information	1	2	3	4	5	6	7	useful information
	consistently useful	1	2	3	4	5	6	7	consistently useless
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

21. RELIABILITY OF OUTPUT: Your confidence that outputs will be available when needed.

(NA)	low confidence	1	2	3	4	5	6	7	high confidence
	consistent availability	1	2	3	4	5	6	7	inconsistent availability
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

22. NEED FOR THE HOSPITAL INFORMATION SYSTEM: The extent to which the Hospital Information System fulfills an important need.

(NA)	unnecessary	1	2	3	4	5	6	7	needed
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

23. TERMINALS RESPONSE TIME: The response time of your computer terminal.

(NA)	slow	1	2	3	4	5	6	7	fast
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

24. HEALTH CARE KNOWLEDGE OF COMPUTER DEPARTMENT STAFF: The computer department personnel's understanding of the hospital environment and special requirements.

(NA)	inadequate understanding	1	2	3	4	5	6	7	complete understanding
	correct	1	2	3	4	5	6	7	mistaken
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

25. GOAL CONGRUENCE: The extent to which the Hospital Information System objectives agree with your objectives (e.g. better patient care, cost containment, etc.).

(NA)	disagree	1	2	3	4	5	6	7	agree
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

26. VOLUME OF OUTPUT: The amount of information you get relative to your need.

(NA)	too much or too little information	1	2	3	4	5	6	7	appropriate information
	pointed	1	2	3	4	5	6	7	repetitive
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

27. CONVENIENCE OF ACCESS: The location and availability of the computer terminal is convenient

(NA)	hard to get at	1	2	3	4	5	6	7	easy to get to
	available	1	2	3	4	5	6	7	unavailable
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

28. WRITTEN INSTRUCTIONS FOR HOSPITAL INFORMATION SYSTEM USE: The formal description and documentation of the Hospital Information System and how to use it.

(NA)	useless	1	2	3	4	5	6	7	useful
	available	1	2	3	4	5	6	7	unavailable
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

29. PROCEDURE TO ENTER INPUT AND RECEIVE OUTPUT: The way you enter data (input) or acquire reports (output).

(NA)	inconvenient	1	2	3	4	5	6	7	convenient
	simple	1	2	3	4	5	6	7	complex
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

30. CURRENCY OF DATA: The age of the outputs information relative to your need for up-to-date facts.

(NA)	out-of-date	1	2	3	4	5	6	7	up-to-date
	adequate	1	2	3	4	5	6	7	inadequate
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

31. VALUE OF THE OUTPUT: Your feeling about the worth of Hospital Information System services relative to the expense of obtaining them.

(NA)	useless	1	2	3	4	5	6	7	beneficial
	inexpensive	1	2	3	4	5	6	7	expensive
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

32. YOUR CONFIDENCE IN THE HOSPITAL INFORMATION SYSTEM: Your feelings of assurance and certainty about the Hospital Information System.

(NA)	doubtful confidence	1	2	3	4	5	6	7	certain confidence
	consistent	1	2	3	4	5	6	7	inconsistent
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

33. YOUR UNDERSTANDING OF THE HOSPITAL INFORMATION SYSTEM: Your knowledge of and understanding about the Hospital Information System.

(NA)	limited knowledge	1	2	3	4	5	6	7	broad knowledge
	deep understanding	1	2	3	4	5	6	7	shallow understanding
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

34. RERUNNING OF INCORRECT OUTPUT: The methods and policies regarding rerunning of output when errors or problems occur.

(NA)	slow	1	2	3	4	5	6	7	fast
	simple procedure	1	2	3	4	5	6	7	complex procedure
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

35. SECURITY OF DATA: The safety of the data from illegal use, tampering, and loss.

(NA)	vulnerable	1	2	3	4	5	6	7	impregnable
	recoverable	1	2	3	4	5	6	7	irretrievable
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

36. POWER OF COMPUTER DEPARTMENT WITHIN THE HOSPITAL: The position and power of the computer department and personnel within your hospital.

(NA)	inappropriate power	1	2	3	4	5	6	7	*appropriate power*
	used well	1	2	3	4	5	6	7	misused
	To me, this factor is unimportant	1	2	3	4	5	6	7	important

Finally please score your overall sense of satisfaction with the Hospital Information System services you presently receive. Using the scale below put a check on the line to indicate your feelings of satisfaction with a ten (10) indicating extreme satisfaction and a negative ten (-10) indicating extreme dissatisfaction. Zero indicates neither satisfied nor dissatisfied.

Describe what you like most about the Hospital Information System.

_____

_____

_____

Describe what you like least about the Hospital Information System.

_____

_____

_____

PART II

This next section consists of questions specific to William Beaumont Army Medical Center (WBAMC), El Paso, Texas.

1. Have you ever used a HIS or MIS before using WBAMC's HIS?

   1 Yes
   2 No

2. Have you accessed the HIS in the preceding 6 months?

   1 Yes
   2 No

3. How many times each week do you access the HIS?

   1 1-5 times per week
   2 more than 5 times per week
   3 less than once each week
   4 not at all

4. Have you completed the formal HIS training program taught by the Computer Center Training personnel?

1 Yes
2 No

5. How many hours of training did you receive on the HIS system?

1 1-5 hours
2 5-9 hours
3 10-15 hours
4 More than 15 hours

6. The amount of time allotted for you to complete the HIS training course was

1 adequate
2 inadequate
3 excessive

7. Do you believe your training would have been more effective if it had been delivered at your job site?

1 Yes
2 No

8. Did your HIS training adequately prepare you to use the HIS in the performance of your hospital duties?

1 Yes
2 No

9. Do you need additional HIS training?

1 Yes
2 No

10. Do you want additional HIS training?

1 Yes
2 No

11. Do you believe the HIS enhances patient care?

1 Yes
2 No

12. Do you believe the HIS improves interdepartmental communications?

1 Yes
2 No

The following is the stated objective of the William Beaumont Army Medical Center Hospital Information System. The basic system objective of the WBAMC Hospital Information System is to enhance patient care by maintaining medical records electronically and by improving interdepartmental communications and operations.

13. Do you believe the HIS accomplishes the system objective as stated above?

    1 Yes
    2 No

14. Have you made any personal attempts to make suggestions for changes in the HIS by routine channels?

    1 Yes
    2 No

15. If you answered yes to the preceding question, did you get any response to your suggestion even if your idea was not accepted?

    1 Yes
    2 No

DEMOGRAPHIC INFORMATION

Please answer the following questions to assist in classifying survey results. Circle the number to the left of your selected response.

1. What is your educational level?

    1 less than 12 years
    2 High School Diploma or equivalent
    3 Some College
    4 Undergraduate Degree
    5 Graduate Degree
    6 Post Graduate Education

2. What is your age?_____

3. What is your race?

    1 Caucasian
    2 Black
    3 Asian
    4 Hispanic
    5 Other (please specify)_____

4. What is your sex?

1 Female
2 Male

5. What is your present job title?_____

6. Please circle the number next to the category which best describes you.

1 Intern
2 Resident Physician
3 Attending Physician
4 Staff Physician
5 Nurse
6 Enlisted Administration
7 Enlisted Clinical
8 Civilian Administration
9 Civilian Clinical

7. What is your rank/GS rating? _____

8. How long have you been on active duty?

1 0-3 years
2 4-6 years
3 6-10 years
4 more than 10 years
5 not applicable

9. How long have you been in your present job?

1 less than one year
2 1-3 years
3 4-6 years
4 more than 6 years
5 not applicable

10. How long have you been employed at WBAMC?

1 less than one year
2 1-3 years
3 3-5 years
4 more than 5 years
5 not applicable

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