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The Need for a Thoughtful Deployment Strategy: Evaluating Clinicians' Perceptions of Critical Deployment Issues

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Abstract

This paper presents data collected from 899 clinicians across three Department of Veterans Affairs (VA) medical centers where existing terminal-based architecture was being replaced with client-server architecture. Surveys were conducted with physicians (n=184), nurses (n=355) and other clinicians (n=360) gathering user characteristics and their perceptions of five deployment issues (e.g. adequacy of technical and institutional support and perceptions of the soon-to-be-implemented clinical workstation). Mean scores for the five deployment issues for all clinicians indicates perceptions are somewhat neutral. However, when data is analyzed according to job classification, significant (p=0.05) differences in perceptions were noted among groups of clinicians (e.g., physicians and registered nurses). Results of analyzing data grouped by VA site (n=3) indicates significant (p=0.05) differences exist among sites in clinicians' perceptions of the deployment issues. A thoughtful deployment strategy including an in-depth assessment of clinician users by job classification and by location may produce important information, critical to the successful deployment of new technologies, in very large health management institutions.

Keywords

Evaluation Studies; Attitude to Computers; Planning Techniques; User Computer Interface; Medical Record Systems Computerized; Management Information Systems; Information Systems; Computing Systems

Introduction

There is a growing body of literature on how to successfully design clinical workstations [1,2], their effect on clinicians' planning, [3,4] and their cost-benefit to health care management [5,6]. However, even when the proposed clinical workstation seems flawless, implementing new workstations in dynamic, complex settings such as acute care hospitals and ambulatory care areas can be painful and impede the success of the system. For example, it is not uncommon for clinicians, particularly physicians, to resist change, a necessity when new clinical workstations are deployed [7]. This paper emphasizes the need for a thoughtful deployment strategy, which includes an evaluation of clinician users as well as a strong clinical workstation design.

The Department of Veterans Affairs (VA) Medical System has invested in client-server technology and is replacing dumb terminals with Pentium® personal computers (pcs) across all 162 VA medical centers. The new clinical workstation operates on an Microsoft® Windows NT 4.0 network supplying clinicians with Microsoft® Office products, access to decision support software on a CD jukebox and the Internet, and a new graphical user interface to VISTA, the VA patient medical record (formerly known as DHCP). The Information Management Departments (IMDs) are obligated to change current information infrastructures to support new requirements. These changes include: 1) new configurations to the existing network (e.g., updating wiring and installing new hubs), 2) moving and designing new workstation locations (e.g., changing desks and creating space for the new pcs and shared printers), 3) rethinking end-user support mechanisms (e.g., instituting a help-desk for Windows-based pc applications), and 4) enhancing the IMD staff (e.g., hiring persons with knowledge of Windows NT and client-server technology). The departure from the existing terminal-based architecture is accompanied by a host of other process and organizational improvements. For example, the Chief Information Office (CIO) has been actively reorganizing its management structure and workflow prior to initiating the clinical workstation pilots. In response to the wide array of clinical workstation technology, organization, and process change initiatives, the CIO has recognized that the impact of new functionality available after the installation of clinical workstations must be identified and assessed to optimize the effectiveness of the improved clinical information infrastructure. [8].

Purpose: Most IMDs do not have resources to perform large scale assessments of clinician users before deploying new technologies like the clinical workstations. The VA Puget Sound Health Care System, Health Services Research and Development Field Program, under an agreement with the Management Decision Research Center, Boston VAMC and the Chief Information Office was charged with the task of identifying critical success factors for deploying the clinical workstations. Multiple methods were used to collect the information. The clinician survey tool and quantitative data collected from more than 800 clinicians are presented.

Materials and Methods

Overview of the Methodology: The Cooperative Studies Group's data collection activities included surveying clinicians electronically, reviewing documents, conducting telephone and face-to-face interviews with IMD personnel, clinical coordinators, application specialists and administrators, and conducting work group meetings. Key contact personnel at each site included the Clinical Application Coordinators (CACs) and the Application Specialists for each service (hereafter referred to as ADPACs). Data collection activities at each site began in May 1996. Surveys of clinicians and key IMD personnel occurred in December 1996. At the time of the survey, clinicians should have been informed of the clinical workstation project and actively participating in training programs. The first work group meeting was held in April 1997. This discussion is limited to methods to conduct the clinician survey and analyze the quantitative data (36 questions). Chi-square analysis and other descriptive statistics were applied.

Sample: Four VA facilities were selected as pilot sites for the clinical workstations. These sites included two urban, academic medical centers (Site A and Site B), an integrated medical system comprised of four facilities (Site C) and a rural, psychiatric facility (Site D). Criteria for selecting these sites were the experience of IMDs, support from chief executives, and existing VISTA modules in use by clinicians. Clinicians asked to participate included physicians (house staff and residents), nurses (all levels) as well as other professionals using VISTA (e.g., social workers, physical therapists, pharmacists, technicians). One pilot site (Site D) was unable to participate. Some characteristics of the participating sites are presented in Table 1.

Data Collection Instrument: The clinician questionnaire was designed based on published literature, interviews with key clinicians, administrators and IMD personnel at each site, conversations with VA informatics evaluation specialists, and evaluators' knowledge of existing VA information systems. The evaluators identified many different kinds of deployment topics that could have been assessed but realized that busy clinicians were unlikely to complete lengthy questionnaires. Deployment topics were therefore organized into a conceptual model and prioritized. Six topics were selected: 1) clinicians' perceptions of characteristics of the current system, 2) adequacy of institutional and technical support, 3) impact of using clinical information systems, 4) usability of the current system, and 5) perceptions of the soon-to-be-implemented clinical workstation. The questionnaire was pilot tested at a fifth VA site, first on paper and then using the VA electronic survey generator, with ten clinician users. Based on the pilot test, the questionnaire was revised and assessed by two clinician users. The final version of the questionnaire consisted of 38 questions (36 closed-ended and 2 open-ended) covering the five topics and will be published on the VA CIO web site.

Data Collection Procedures: The questionnaire was uploaded into the VA survey generator. The VA survey generator is an M-based program supporting the distribution of questionnaires to VISTA users as part of their electronic mail within a VA facility or across VA facilities. Several procedures to distribute the survey for the clinical workstation were required: 1) obtaining permission from each local IMD to post the questionnaire in clinicians' electronic mail boxes, 2) creating electronic flags to notify clinicians about the questionnaire when opening their electronic mail, 3) accessing local IMD tools to monitor the progress of the survey, 4) accessing local IMD tools to collect and send data back to the evaluators, and 5) converting the M-Data to SPSS. Using the VA survey generator, the questionnaire was published to all VISTA users at three pilot sites. Each VISTA user was flagged notifying them of the survey. The flag requested that only self-defined clinicians respond. Electronic reminders were periodically sent to all VISTA users during the two-week period the survey was available for response. CACs and ADPACs encouraged clinicians to respond. Data was returned to evaluators where it was prepared for statistical analysis (e.g., removing responses from non-clinicians).

Analysis: Responses to 38 closed-ended questions were analyzed using SPSS (version 7.0, SPSS Inc). Seven point Likert scales were collapsed, where appropriate, into a three categories (1-3 = disagree, 4 = neutral, 5-7 = agree). Chi-square (χ^2) was used to assess the statistical significance of differences among groups. Differences are reported only for those items for which $p = 0.05$. Responses to the open-ended questions will be published in the future.

Results

Respondent Characteristics

There were 161 respondents from Site A, 242 from site B and 496 from Site C. Since an accurate count of the number of clinical users at each site could not be obtained, response rates cannot be calculated. .

Table 1 - Information System Characteristics 1 = disagree completely; 7 = agree completely

Item	Mean (median, mode)
Usually up and running	4.6 (5,6)
Reliable and bug-free	4.2 (5,5)
Computer often broken	3.1 (3,2)
Know options to alter	2.9 (2,1)
Too slow	4.3 (4,4)
Sufficient clinical input	3.9 (4,4)
More trouble than worth	2.6 (2,1)

Respondents were most likely to be between the ages of 40 and 49 (38%), to be female (60%), to rate their typing skill as moderate (60%) and to rate their skill using a mouse as good (43%). Physicians (n=184), registered nurses (n=203) and other nurses (n=152) comprised 60% of the respondents. Other respondents included mental health specialists (n=93), rehab specialists (n=43), technicians (n=104), other clinicians whose job titles could not be specified (n=67) and clinicians in the role of supervisor (n=53).

Seven characteristics of the current information system were assessed by the respondents and are presented in Table 1. Additionally, respondents (n=849) assessed the frequency of unmet information needs associated with using the current system (1=very frequently; 5=never) resulting in a mean score of 3.1 (median=3, mode=3)

Respondents' assessment of the adequacy of institutional support and technical support and the impact of using clinical information systems are presented in Table 2.

Support for and Effects of Information System 1 = disagree completely; 7 = agree completely

Item	Mean (median, mode)
Can get support needed	4.3 (5,5)
Enough staff to support	4.1 (4,5)
Med center admin support	4.4 (5,6)
Service chief support	5.0 (5,6)
Able to get time to train	3.5 (4,1)
Faster clin doc using IS	4.0 (4,1)
All info in one place	4.4 (5,5)
Can get info abt pt groups	4.0 (4,4)

Respondents' assessment of the usability of the current IS are provided in Table 3 and their perceptions of the soon-to-be implemented clinical workstation in Table 4.

Table 2 - Usability 1 = disagree completely; 7 = agree completely

Item	Mean (median, mode)
Correspond to work struct	4.1 (4,4)
Normal work sequence	4.2 (4,4)
Enough info when error	3.7 (4,4)
Easy to find information	4.2 (4,5)
Multiple tasks not allowed	5.2 (6,7)
Reports useful	4.7 (5,6)
Too different from other IS	3.7 (4,4)
Mean score all items	4.3 ($\sigma = 0.9$)

Differences by Job Classification

Physicians were more likely to be male, older (34% over 50) and to report their mouse use skills as good; they were only slightly over represented among poor typists (22% of physicians vs. 18% overall). Physicians were more likely to *agree* that they had unmet IS needs. Physicians were more likely to *disagree* that the computer was often broken, that it was faster to do clinical documentation using the IS, that the IS allowed them to do work in a normal sequence, that the IS provided

Table 3 - Perceptions of the Soon-to-be-Implemented Clinical Workstation (CWS) 1 = disagree completely; 7 = agree completely

Item	Mean (median, mode)
Well aware of	3.5 (3,1)
Looking forward to	5.1 (6,7)
Will improve quality	4.9 (5,7)
Will improve efficiency	4.9 (5,6)
Will make care easier	5.6 (5,4)
Will make care more enjoyable	4.4 (4,4)

enough information when they make an error, that it was easy to find information, that the IS allowed multiple tasks, that it was easy to get information on patient groups, that there had been sufficient clinical input into IS development, that CWS would improve the efficiency of care, and that CWS would make care easier.

Nurses (RNs) were more likely to be female. They were more likely to *agree* that the computer was often broken and that they had unmet IS needs. They were more likely to *disagree* that they could get access to a computer when needed, that it was faster to do clinical documentation using the IS, that there had been sufficient clinical input into IS development, and that CWS would make care easier.

Other nurses were more likely to be female and to report their typing and mouse use skills as poor. They were more likely to *agree* that the computer was often broken, that it is faster to do clinical documentation using the IS, that the IS provides enough information when they make an error, that it is easy to find information, and that there has been sufficient clinical input into IS development. They were more likely to *disagree* that the computer was usually up and running, that they can get access to a computer when needed, that they have unmet IS needs, that they were well aware of CWS, that they were looking forward to CWS, and that CWS would make care easier.

Other clinicians were more likely to *agree* that they were well aware of CWS, that they were looking forward to the CWS, and that CWS would make care easier.

Supervisors were less likely to report their typing skills as average (higher percentages of both good and poor typists than overall). They were more likely to *agree* that they were well aware of CWS, that they were looking forward to CWS, that CWS would improve the quality and efficiency of care, and that CWS would make care easier. They were more likely to *disagree* that the computer was usually up and running, that it was easy to find information, and that the IS allowed multiple tasks.

Techs were more likely to *disagree* that the IS allowed them to do work in a normal sequence, and that they were looking forward to CWS.

Differences by Site

Site A respondents were more likely to be over 59, to be physicians, other clinicians and psych, and to report their mouse use

skills as good. They were more likely to agree that the system was usually up and running, reliable and bug-free, that they could get access when needed, that the system was too slow, that they could get support when needed, that multiple tasks were not allowed, that reports were useful, and that they were looking forward to CWS. They were more likely to disagree that the computer was often broken, that it was faster to do clinical documentation using IS, and that they could get information about patient groups.

Site B respondents were more likely to be nurses, supervisors and technicians and to report their mouse use skills as good. They were more likely to agree that that the system was usually up and running, reliable and bug-free, that they could get support when needed, that they could get time for training, that multiple tasks are not allowed, that they have unmet needs, that they were aware of and looking forward to CWS, and that CWS would improve the quality and efficiency of care and make care easier and more enjoyable. They were more likely to disagree that the system was too slow, that it was faster to do clinical documentation using IS, that they could get information about patient groups, and that the current IS was more trouble than it's worth.

Site C respondents were more likely to be other nurses and rehab, and to report their mouse use skills as poor. They were more likely to agree that the computer was often broken, that it was faster to do clinical documentation using the IS, that they could get information about patient groups, that the IS allowed them to do work in a normal sequence, that they were aware of CWS, and that the current IS was more trouble than it's worth. They were more likely to disagree that the system was usually up and running, reliable and bug-free, that they could get access when needed, that they could get support when needed, that they could get time for training, that multiple tasks were not allowed, that they were looking forward to CWS, that CWS would improve the quality and efficiency of care and would make care easier and more enjoyable.

Other Findings

There was no association between typing skills and mouse skills (both self-reported). There was a strong association between poor typing skills and agreement with the statement that the current IS "is more trouble than it's worth" ($\chi^2 = 19.3$; $p = 0.001$).

Discussion

The response rate at each site varied significantly with an estimated overall response rate of approximately 10% or better (Site A being the lowest and Site C being the highest). It is difficult to say why one site had a better response rate than another. Reasonable conclusions might include a better familiarity with the survey generator or the novelty of performing an electronic survey. Future studies need to consider which type of clinician user is more likely to respond by electronic mail. In the VA system, electronic mail is an expected form of communication and is commonly used to inform clinicians of pertinent clinical events. Other health management systems may not be as 'electronic mail friendly'. Electronic surveys will need to be supplemented with other data collection methods if further analysis indicates that those who are highly motivated, using computers more frequently, were over-represented. Even so, this study provided important information to those developing the deployment strategy across the three VA sites. At the clinician level, typing skills may be a very strong indicator of how well new technologies such as the clinical workstation are accepted, especially when keyboard use is a major component.

Knowledge that clinicians' perceptions differ by job classification and by site is important. Different jobs require different interactions with workstations. The degree to which new clinical workstations are successfully implemented may depend on how clinicians performing specific jobs are oriented and trained. Multiple approaches to deploy the workstations may seem costly, but could contribute significantly to the long term success of the system.

What accounts for the differences in clinicians' perceptions between sites will require further analysis. Preliminary information from work group meetings suggest the level of understanding of business, data, technical and control architectures [9] was different at Site A, B and C. These differences may significantly influence clinicians' perceptions and ultimately their acceptance of new technologies.

Departing from terminal-based architecture impacts business, data and control architectures. If changes are occurring simultaneously with other architectures and these changes are not carefully coordinated, the organization may experience an interactive change resulting in negative perceptions towards the new technology. For example, if the business architecture and technical architecture both require additional resources from IMD, the interactive change experienced by clinicians may include an increase the number of broken computers and a reduction in the availability of support personnel.

In most managed care environments, these architectures have arisen in a rather random fashion, without much planning and analysis. As new technologies are introduced, organizations will need to develop thoughtful deployment strategies considering variations between clinicians according to their roles and responsibilities and variations between sites according to their level of understanding of business, data, technical and control architectures.

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