

GAO

Report to the Chairman, Senate and House
Committees on Armed Services

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May 1992

MEDICAL ADR SYSTEMS

Composite Health Care System Is Not Ready To Be Deployed



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Information Management and
Technology Division

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May 20, 1992

The Honorable Sam Nunn
Chairman, Committee on Armed Services
United States Senate

The Honorable Les Aspin
Chairman, Committee on Armed Services
House of Representatives

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The Composite Health Care System (CHCS) is an automated medical information system being developed by the Department of Defense for use in 664 military medical facilities worldwide. The system is intended to improve the quality of care and operational efficiency of these facilities by integrating a wide array of data needed for managing and treating patients.

Defense is currently seeking approval to deploy CHCS from its Major Automated Information Systems Review Committee (MAISRC). If MAISRC approves CHCS for deployment, Defense will submit the results of the operational test and evaluation (OT&E) and a cost/benefit analysis, as required by law, to your committees before awarding the full-deployment contract. Defense plans to obtain a MAISRC decision in May 1992.

This report is intended to update you on Defense's progress in developing and testing CHCS. Our objectives were to (1) determine the status of critical system-development issues; (2) assess the OT&E process and results, to date; and (3) review the system's cost/benefit analysis. Details of our objectives, scope, and methodology are found in appendix I.

Results in Brief

CHCS is not ready to be deployed. Two critical system-development and operational issues remain unresolved—multiple patient records and archiving patient records. The test sites have identified a problem with multiple patient records which, until resolved, threatens patient safety since physicians could provide improper care on the basis of incomplete patient medical information. The test sites have also identified a problem caused, primarily, by the lack of capability to archive patient data. Specifically, most test sites have indicated that system performance suffers as a result of the volume of data the system must handle—an outgrowth of the lack of archiving capability. This performance problem is most often visible in the form of slow response times for clinical users. These two critical issues affect the current deployment decision. In addition, Defense has made limited progress on an efficient method of entering physicians'

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inpatient orders. The delay stems from the current design, which physicians find to be not user friendly and contrary to their usual work processes. This problem could have a significant impact on CHCS deployment.

Operational testing was supposed to provide Defense with sufficient data for making an informed decision on whether the system is ready to be deployed. However, test results are inconclusive because management limited the number of test sites included in OT&E, failed to conduct tests in realistic environments, and failed to execute parts of the test plan properly. Defense does not, therefore, have a basis for determining that CHCS is operationally effective and suitable for deployment.

The CHCS cost estimate—when applying standard Defense life-cycle cost directives—is more than \$400 million above the \$1.6-billion cap established by the Congress.¹ In addition, Defense has not validated a significant portion of the system's \$2.3 billion in benefits, and it acknowledges that important management changes will have to be made before Defense can realize them.



Background

The goal of CHCS is to improve the care of patients at Defense medical treatment facilities. The system is supposed to provide comprehensive, integrated data for patient management and treatment in a timely and easily accessible manner. Defense expects the degree of CHCS' data integration to be greater than currently available in civilian hospital information systems. Once fully deployed, CHCS would replace manual and outdated automated information systems now in use.

CHCS is intended to provide physicians with immediate access to all portions of a patient's medical record. The system would also integrate nine major hospital functions to improve patient care and operational efficiency. These nine functions include pharmacy, laboratory, radiology, nursing, patient-appointment scheduling, patient administration, inpatient clinical services, outpatient clinical services, and other ancillary services.

In March 1988 Defense awarded a contract to Science Applications International Corporation (SAIC) to develop, test, deploy, and support CHCS. Since that time, SAIC has developed and tested the system at a number of sites. However, because of software delays, the time needed to

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¹Unless otherwise indicated, all dollar amounts are in fiscal year 1986 constant dollars.

complete the required testing and evaluation has been extended a number of times. As a result, a decision on the deployment of CHCS has not yet been made.

Defense has obtained support from congressional conferees to take a two-phased approach to the deployment of CHCS. A decision on whether or not to deploy the first phase is expected in May 1992. This deployment is intended to include all CHCS functions listed above except nursing, inpatient clinical services (inpatient order entry), and parts of other ancillary services. Deployment of the second phase is scheduled for 1994 and is expected to include the remaining CHCS functions.

The Congress capped CHCS life-cycle costs at \$1.6 billion. By the end of April 1992, Defense had obligated about \$515 million (actual dollars) for the development and deployment of the system.

Critical Development Issues Remain Unresolved

The first phase of CHCS, for which Defense wants to obtain approval to deploy this month, does not include two important capabilities: an effective method for identifying, eliminating, and preventing multiple patient records; and an effective method for archiving and retrieving patient records. The existence of multiple patient records is a threat to a patient's safety because it can result in a physician's providing treatment on the basis of incomplete patient medical information. The capability to archive and retrieve patient records is essential to efficient system operations.

The capability to enter physicians' inpatient orders in a streamlined manner is now scheduled to be included in the second phase of CHCS software, to be deployed in 1994. While Defense plans an initial system deployment without this capability, it remains critical to physician acceptance of CHCS and to the ability of the system to effectively and efficiently support the inpatient activities of clinicians. Defense, however, has had limited success in developing a solution to this problem.

Multiple Patient Records

A CHCS user sometimes fails—for a variety of reasons—to locate a record for a patient and, assuming the patient has no previous history at the facility, creates an additional record. This may occur because, in retrieving patient data, CHCS allows data searches by name. In such searches, name requests must be identical to the names on patients' existing records—including punctuation, spacing, special characters (i.e., hyphens), sponsor names, and abbreviations. If the searched names are not found,

then CHCS allows users to create new records. Multiple records were also created when data bases of earlier systems that contain multiple records were used during data conversions to establish new CHCS patient records.

Physicians who attempt to call up a patient's record may receive any one of the multiple records and base medical-care decisions on incomplete patient data. This situation occurs because multiple records are not automatically linked together by the system. Currently, the system does not automatically alert the physician that critical patient information may exist in one or more additional records for that patient. As a result, decisions on the patient's treatment could be made that may have serious health consequences. For example, a patient's allergic reaction to a particular drug may be in only one of the multiple records, but if the physician calls up another record when treating the patient, treatment could then be given without knowledge of this important information.

As of March 24, 1992, Defense estimated that the data bases at CHCS test sites contained from 2.1 to 5.5 percent multiple patient records. To illustrate the significance of this problem, Defense estimates that 4.3 percent—over 18,500—of the records at Tripler Army Medical Center in Honolulu, Hawaii, are multiples. Defense estimates one full-time person can oversee the actions required to merge five multiple records per day. At this rate—with existing technology—it would take until May 2003 to eliminate all multiple records at Tripler.

Defense has tried to reduce the magnitude of this problem by (1) restricting the number of personnel who are authorized to establish new records, and (2) purging multiple records from existing systems that will be used to establish future CHCS data bases. In addition, by September, the contractor plans to complete field testing of software that should identify and mark multiple records. However, until these management actions and software changes are fielded and tested, CHCS users will continue to create multiple patient records and, potentially, retrieve and work from incomplete patient records.

Archiving

Archiving is the ability to store patient data off-line and retrieve it as needed. Although essential to effective CHCS operation, archiving has yet to be operationally tested and evaluated. Defense has developed a potential archiving capability but has not completed field testing at the initial test site.

Defense has identified the absence of archiving as having a negative effect on system performance. System performance directly affects not only users' satisfaction, but also their ability to use other CHCS capabilities. In an April 1992 contractor progress report for CHCS, 8 of the 12 primary test sites listed system performance as one of the top-priority problems requiring resolution. Two sites—Walter Reed Army Medical Center in Washington, D.C., and the U.S. Air Force Medical Center at Keesler Air Force Base in Biloxi, Mississippi—had average response times that were 50 percent above acceptable performance levels.

Designing and implementing an effective CHCS archiving capability is complex. It is technically challenging, in part because CHCS software is highly integrated, relationships among patient data are complex, and a nontraditional file structure is used. The extraction of patient data from this file structure must be performed in a flawless manner to ensure that relationships between all segments of the active data base are preserved and that the archived data can be reassembled later, when needed for patient care or medical research. Before such a complex and important capability is fully deployed, it is essential that it be thoroughly tested in a representative set of hospital environments.

Deploying CHCS without assurances that the archiving solution can be effectively incorporated into the system could ultimately result in serious operational problems. Without archiving, system response time slows as the volume of data stored on-line reaches disk-capacity limits. Efforts to improve the response time can be time-consuming, disruptive, and eventually ineffective, as even more data are stored on disk. With no effective way to store patient data off-line, hardware costs will continue to increase as additional disk storage and related equipment (controllers and faster processors with more input/output channels) are added to handle increasing volumes of data.

Inpatient Order Entry

Inpatient order entry is the process through which physicians enter the orders for the treatment of hospitalized patients. As we reported in September 1991,² the existing inpatient order-entry capability was

²Medical ADP Systems (Changes in Composite Health Care System's Deployment Strategy Are Unwise (GAO/IMTEC-91-47, Sept. 30, 1991).

unacceptable to many physicians, primarily because of the length of time it takes physicians to enter both conditional and complex orders³ in contrast to the manual system. As a result of this resistance, Defense has decided to deploy CHCS without the inpatient order-entry capability, and to conduct more research toward development of an acceptable method for entering inpatient orders. Defense has performed an extensive analysis of the inpatient order-entry problem and has defined a set of potential solutions. A component of this set of solutions is commonly known as one-line-order-entry. This component will allow physicians to enter complex and conditional orders by typing a minimal amount of text.

The failure to develop a physicians' inpatient order-entry system will have significant cost and operational implications for CHCS. Until physicians enter their own orders, other hospital staff will be required to place these orders into the system for physicians. This requirement will not only add additional cost to the operation of CHCS, but will also make the system more error-prone because someone other than the physician will be entering orders.

Defense also faces a major unknown developmental risk in the designing and testing of the physicians' inpatient order-entry capability. The required characteristics of the physician interface for inpatient orders, combined with the system performance requirements and characteristics of the computer programming language used, substantially increase the difficulty and risk of this development initiative. It is still uncertain whether an effective and efficient inpatient capability can be designed.

While Defense is addressing the problems associated with the development of a physicians' inpatient order-entry system, the Congress directed that alternative solutions for inpatient order entry be evaluated. Consequently, in February 1992 Defense's CHCS contractor issued a request for proposals to solicit commercial order-entry-system solutions. Evaluation of these submissions is expected to be completed this month. Defense's CHCS schedule provides for the installation of an inpatient order-entry capability at test sites in 1994. However, Defense's ability to meet this schedule will, we believe, depend heavily on the quality of the responses to the request for proposals and the compatibility of the solution with the existing CHCS software.

³A conditional order is a procedure that is dependent upon the outcome of a prior procedure. For example, "Take vital signs - if temperature is greater than 100 degrees Fahrenheit, administer Tylenol." A complex order involves multiple procedures and possibly one or more conditions.

Test and Evaluation Planning and Implementation Inadequate

The primary purpose of the operational test and evaluation is to ensure that only operationally effective and suitable systems are delivered to the operating forces. OT&E is a field test—under operationally realistic conditions—to determine the effectiveness and suitability of weapons, equipment, or munitions. Testing should be accomplished in an environment as operationally realistic as possible. Defense's Test and Evaluation Master Plan for CHCS states that for test results to be valid, the test environment of the selected test sites should be representative of the environment in which deployment is intended.

OT&E was supposed to provide useful information for making an informed decision on whether CHCS was ready to be deployed. For the data to be useful, they must (1) come from test sites that are representative of the universe of Defense medical treatment facilities, and (2) include results from tests of all software installed and operational at the test sites. Inadequacies in OT&E planning and implementation, however, produced results that are inconclusive and not representative of the environment in which CHCS is to be deployed. Therefore, Defense does not have a basis, at this time, for concluding that CHCS is operationally effective and suitable for deployment.

Defense established five test categories—deployment, training, mobilization, technical, and functional—to determine the effectiveness and suitability of CHCS. Defense's Office of Health Systems Evaluation was responsible for managing the OT&E process. Defense contractors collected and summarized test data, and Defense appointed and trained an OT&E analysis team, made up of 15 members representing all three military departments, to review and evaluate the test data. An OT&E report was published in January 1992 identifying system strengths, weaknesses, and deployment risks in each of the five test categories.

The CHCS program manager received a copy of the OT&E report and is developing plans to address the system weaknesses identified. We also reviewed the OT&E plans, procedures, and results, and found additional testing inadequacies. Overall, OT&E inadequacies were primarily the result of (1) weaknesses in Defense's overall management of OT&E and (2) Defense's failure to conduct some tests in realistic operating environments.

Weaknesses in Defense's management of OT&E were especially evident in instances in which the number of test sites and the extent of testing was so limited as to render the results unusable or of limited use. This occurred because Defense made changes in the number of representative test sites,

training procedures, and overall CHCS deployment strategy. For example, testing of the CHCS initial-training and deployment capabilities was conducted at only one site. Further diminishing the usefulness of the results was the fact that this site had activated only one of the nine CHCS functions—patient-appointment scheduling. Tests conducted under such limited conditions are not representative of the environment in which deployment is intended.

Defense also conducted tests in environments that were not operationally realistic. For example, when testing the system's technical capability, Defense ran security and performance tests on hospital systems with inactive system-security features. The test sites had deactivated system-security features to alleviate response-time problems. Additionally, the system-reliability computations did not include the component reliability for disk drives. Testing and analysis under such limited conditions renders test results inconclusive. Specifics on test inadequacies and the related background are included in appendix II.

While the OT&E test plan and its implementation were inadequate, the OT&E process did identify 17 fundamental CHCS management weaknesses, in the areas of security, training, deployment, capacity, and mobilization. For example, management failed to establish a structured security program to oversee and support site-level security management. As a result, little or no training was provided in automated-data-processing security, audit-trail functions were turned off or only partially employed, and contingency plans were often nonexistent or unrealistic. CHCS program management has prepared a list of actions it expects to take in dealing with these problems.

Life-Cycle Costs Exceed Congressional Ceiling, While Benefits Remain Largely Unsupported

A significant problem exists with respect to the costs and benefits of CHCS. CHCS life-cycle costs—when estimated under current Defense regulations and guidance—exceed the congressionally established \$1.6-billion ceiling by more than \$400 million. In addition, Defense has had a great deal of difficulty estimating and validating CHCS benefits. The most recent benefit estimate of \$2.3 billion is based on questionable data, and Defense acknowledges that many of the benefits cannot be realized until significant management changes are implemented.

Defense regulations require that prior to making a deployment decision, appropriate officials must (1) provide a life-cycle schedule with realistic cost and acceptable budget estimates, and (2) demonstrate that the system

is cost effective and affordable and remains the best alternative. The program cost estimate should include the cost of all resources associated with research and development, investment, and operations throughout the system's economic life. The benefit analysis should identify and quantify actual and anticipated benefits that reduce cost or enhance value when compared with the status quo.

Costs

Congress increased the CHCS cost ceiling from \$1.1 billion to \$1.6 billion in fiscal year 1991. The current CHCS program office cost estimate creates the illusion that total costs will remain within the ceiling established by the Congress. In reality, however, the total cost of CHCS, when estimated under current Defense guidance, will exceed the congressional ceiling by more than \$400 million. The CHCS program office cost estimate of \$1.538 billion does not follow Defense guidance, requires the elimination of the mid-life system upgrade that the program office used to justify the fiscal year 1991 cost-ceiling increase, and excludes all operation and support costs occurring beyond the fifth year after deployment to a site.

Guidance from the Assistant Secretary of Defense's Program Analysis and Evaluation Office states that Defense components should estimate system costs using a standard life cycle of 10 years and calls for a system upgrade 4 to 6 years after a system reaches initial operational capability. Using this guidance, CHCS costs would total over \$2 billion, or more than \$400 million over the congressional ceiling.

The CHCS program office, however, estimates CHCS life-cycle costs at \$1.538 billion. The CHCS program manager defends this estimate by characterizing CHCS as a "design-to-cost" system because of the congressional ceiling. This means that since the Congress has limited costs to \$1.6 billion, Defense is developing cost estimates that stay below this ceiling. This process has resulted in the (1) elimination of the mid-life system upgrade, and (2) institution of a 5-year, "rolling-window" concept.⁴ Under this concept, CHCS operation and support costs are included for only 5 years after deployment to a site, rather than the 10 years prescribed in Defense guidance.

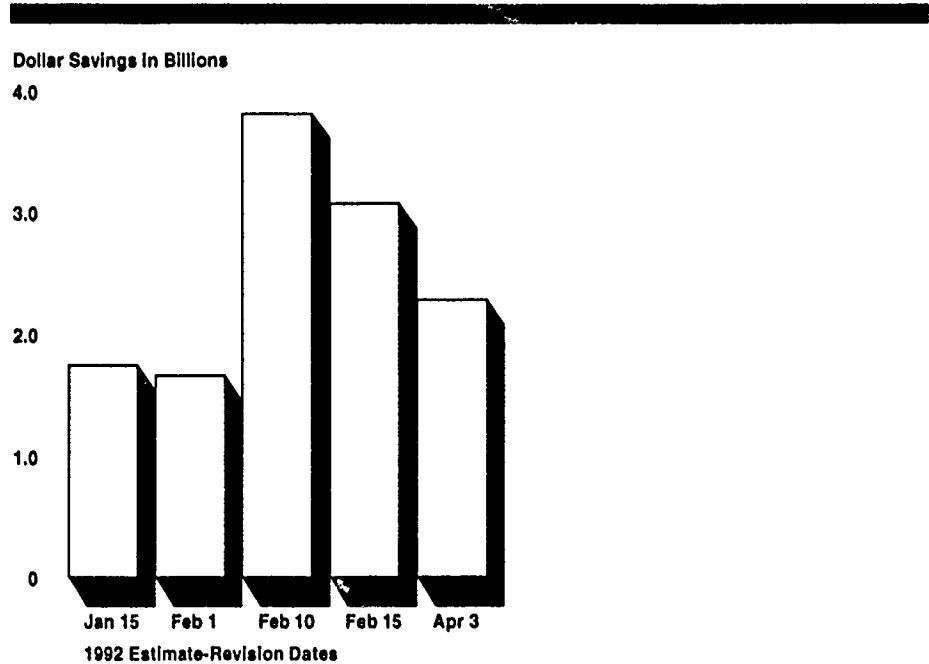
⁴Since CHCS cannot be deployed to all locations at once, the program office is using a rolling window of 5 years of cumulative costs from the date a site receives CHCS. All costs beyond the 5-year period are ignored.

While the CHCS program office continues to state that estimated system costs do not exceed the congressional limits, use of prescribed Defense guidance results in significant increases in estimated CHCS costs. In effect, the program office is establishing its own cost-estimating guidance in order to keep costs within the congressional ceiling.

Benefits

Wide variations continue to occur in both the amount and nature of estimated CHCS benefits. From January 15, 1992, to April 3, 1992, Defense conducted five benefit-estimate studies for the system. The estimated benefits have ranged from a high of \$3.8 billion to a low of \$1.7 billion. One specific benefit, time savings from electronic mail, accounted for \$1.8 billion in benefits in the February 10 estimate, but was less than one-half this amount in the latest, April 3, estimate. The following figure charts the five most recent benefit estimates.

Figure 1: CHCS Benefit Estimates



The most recent Defense estimate indicates that CHCS will generate about \$2.3 billion in life-cycle benefits. Defense expects that about two-thirds, or

\$1.6 billion, of these benefits will result from reduced Civilian Health and Medical Program of the Uniformed Services (CHAMPUS)⁵ costs. These CHAMPUS benefits, however, are not supportable. About \$832 million of them are expected to result from the use of electronic mail. Benefits in this category come from time saved by transmitting information, questions, and messages electronically. Defense expects that the time saved by physicians and nurses will result in their being able to treat more patients. Thus, CHAMPUS costs would be reduced because patients who now receive care from civilian medical facilities under CHAMPUS could, instead, be treated at a military medical facility. Defense, however, based these benefits on information provided during interviews with a select group of 78 physicians and nurses attending a CHCS users conference. CHCS officials agree that the sample used for this estimate is inadequate, and they are currently expanding this sample at several CHCS sites.

The majority of the remaining CHAMPUS benefits are based on improved records maintenance and closer scrutiny of the need for prescribed tests and procedures. These benefits were based on results from studies of other automated medical systems, some performed in the 1970s. Defense gathered data on records maintenance improvements during OT&E, but because some test sites already had some degree of automation and made management changes during testing, Defense was unable to validate for CHCS the benefits identified in the earlier studies. Similarly, cost reductions expected from closer scrutiny of tests and procedures are based on literature research rather than experience with CHCS.

The CHCS program manager characterized the current benefits study as an indication of potential benefits and stated that the purpose of OT&E does not include validation of benefits. Further, he agreed that significant management changes would be necessary before these projected benefits could be realized. The CHCS program manager is currently pursuing initiatives which, to be successful, will require high-level policy changes. For example: (1) hospital commanders could implement policies that would ensure that physicians would use the time saved from the implementation of CHCS to add CHAMPUS patients to their schedules, and (2) Defense could allocate CHAMPUS dollars directly to hospital commanders—providing them with the incentive to manage their resources more effectively and efficiently.

⁵CHAMPUS pays for health-care costs for families of uniformed services members who are unable to get care through a military hospital or clinic and receive medical services from private providers.

Conclusions

CHCS is intended to enhance Defense's ability to manage patient data and improve the quality of care. At present, however, the system cannot adequately accomplish this and therefore is not ready for deployment. Major deficiencies still exist in the system's capabilities. In addition, the scope and quality of system testing were inadequate, and test results are inconclusive. Until Defense corrects these deficiencies, operational problems will continue to occur and patient safety may be threatened.

Further, increased management commitment to making CHCS an integral part of medical-treatment-facility operations is necessary if needed improvements are to be realized. Many corrective actions and changes in policy are planned or have been proposed to improve CHCS management—particularly in the areas of patient safety, benefits realization, security, and training. Until these actions are taken and the outcome evaluated, the ability of CHCS to achieve its full potential is doubtful.

A significant financial investment is being made to develop a hospital information system with great potential benefits. Given its importance to the well being of service men and women, it is vital that the system meet established development requirements in order to help ensure that it is safe for use, likely to be deployed successfully, and the most reasonable alternative for providing needed medical support.

Recommendations

In order to help ensure the success of CHCS once deployed, we recommend that the Secretary of Defense direct the Assistant Secretary of Defense for Health Affairs to defer approval to deploy CHCS until:

- the ability to identify and remove multiple patient records has been incorporated into the software version of CHCS that Defense intends to deploy beyond the designated test sites,
- procedures have been established to prevent the creation of multiple patient records,
- the capability to archive and retrieve patient data has been successfully field tested,
- a sound testing methodology has been developed and carried out for those parts of the OT&E that were inadequate, and
- a complete and supportable cost/benefit analysis has been performed.

In addition, because an efficient method for entering physician inpatient orders is significant to the overall success of CHCS, we also recommend

that the Secretary of Defense direct the Assistant Secretary of Defense for Health Affairs to update the Senate and House Committees on Armed Services periodically on the progress being made on the development of a solution to the inpatient order-entry problem.

Agency Comments

Because we believe that it is important for MAISRC to have our official position regarding the deployment of CHCS, we requested oral comments on a draft of this report. We provided Defense with the draft report on May 6, 1992, and requested oral comments by May 13, 1992. On May 14, 1992, Defense indicated that although it intended to respond to the report, it could not provide a comprehensive response within the 7 days allotted. Further, Defense officials stated that they considered the issues too significant to address adequately within our prescribed time frame.

Although we did not obtain oral comments on our draft report, we discussed our findings and recommendations with the CHCS Program Manager. We also discussed our findings with the Defense officials who (1) were responsible for the oversight of all CHCS OT&E activities, (2) provided the independent reviews of cost and benefit data for the deployment decision, and (3) were responsible for software development. Defense officials generally acknowledged that problems exist and that these problems pose deployment risks. However, they do not consider them significant enough to delay a deployment decision. Although Defense is taking action to address the issues discussed in our report, we believe that until these issues are resolved, the risk of making a deployment decision at this time is too great.

We are sending copies of this report to the Chairmen of the House and Senate Committees on Appropriations; the Secretary of Defense; and the Director, Office of Management and Budget. Copies will also will be made available to other interested parties upon request.

We conducted our evaluation from July 1991 to May 1992, in accordance with generally accepted government auditing standards. This work was performed under the direction of Frank W. Reilly, Director, Human Resources Information Systems, who can be reached at (202) 512-6408. Other major contributors are listed in appendix III.



Ralph V. Carlone
Assistant Comptroller General

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Figure 1: CHCS Benefit Estimates

Abbreviations

CHAMPUS	Civilian Health and Medical Program of the Uniformed Services
CHCS	Composite Health Care System
GAO	General Accounting Office
IMTEC	Information Management and Technology Division
MAISRC	Major Automated Information Systems Review Committee
OT&E	operational test and evaluation
SAIC	Science Applications International Corporation

Objectives, Scope, and Methodology

The National Defense Authorization Act for Fiscal Year 1987, as amended, requires that GAO (1) monitor the OT&E phase and related CHCS acquisition activities, and (2) submit a report to the Senate and House Committees on Armed Services that evaluates OT&E results and Defense's contract award process for CHCS' full production and determines whether Defense conducted OT&E at a sufficient number of sites with sufficient software in operation to warrant a full-deployment decision. The act requires that our final report on OT&E for CHCS be issued 30 days after the Senate and House Committees on Armed Services receive Defense's report on the OT&E results.

Our objectives were to (1) determine the status of critical system-development issues; (2) assess the OT&E process and results to date; and (3) review the system's cost/benefit analysis. In conducting our review, we examined Defense's May 1991 Test Evaluation Master Plan and accompanying Detailed Test and Analysis Plan; reviewed the OT&E processes and procedures Defense and its contractors followed during testing and reporting; verified that Defense provided full disclosure of OT&E data to its OT&E Test Analysis Team, as well as to the surgeon general of each military department; reviewed the CHCS life-cycle cost analysis and supporting documentation; reviewed the CHCS benefits reports and supporting documentation; reviewed Defense's most current (May 1992) CHCS system decision paper and supporting documentation; evaluated the monthly progress reports provided to Defense by the CHCS contractor through April 1992; and tracked all delivery orders, including modifications, that Defense issued under the CHCS contract through April 10, 1992.

We viewed the operation of CHCS at 8 of the 14 operational test sites (12 primary test sites and 2 certification sites): Ireland Army Hospital, Fort Knox, Kentucky; Naval Hospital, Charleston, South Carolina; United States Air Force Hospital, Eglin Air Force Base, Florida; Naval Hospital, Jacksonville, Florida; 98th General Army Hospital, Nuernberg, Germany; United States Air Force Regional Hospital, Sheppard Air Force Base, Wichita Falls, Texas; Walter Reed Army Medical Center, Washington, D.C.; and Malcolm Grow Medical Center, Andrews Air Force Base, Maryland. Fort Knox serves as an alpha test site—a site where initial testing for new CHCS software is conducted. We also met with officials of SAIC (the prime contractor) in Falls Church, Virginia, and in La Jolla, California; officials of the four Defense OT&E subcontractors—Arthur D. Little, Inc., in Cambridge, Massachusetts; Vector Research, Inc., in Falls Church, Virginia; Naval Computer and Telecommunications Station in Pensacola,

**Appendix I
Objectives, Scope, and Methodology**

Florida; and MITRE Corporation in Falls Church, Virginia; officials of the CHCS Program Office in Falls Church, Virginia; and officials of Defense's Program Analysis and Evaluation Office.

We worked closely with senior program management officials, test officials, and OT&E contractor representatives to discuss our concerns as they arose, and confirm our understanding of potential problems and their implications for the achievement of test objectives.

We conducted our evaluation from July 1991 to May 1992, in accordance with generally accepted government auditing standards. We briefed senior program management officials during our review, and have incorporated their views where appropriate.

Operational Test and Evaluation

Our analysis of the OT&E results showed them to be inconclusive due to inadequacies in both the test plan and its implementation. To determine the effectiveness and suitability of CHCS, Defense established five test categories—deployment, training, mobilization, technical, and functional. Defense's Office of Health Systems Evaluation was responsible for managing the OT&E process. Defense contractors collected and summarized test data, and Defense appointed and trained an OT&E analysis team, made up of 15 members representing all three military departments, to review and evaluate the test data. The Office of Health Systems Evaluation issued an OT&E report in January 1992 identifying system strengths, weaknesses, and deployment risks in each of the five test categories.

The CHCS program manager received a copy of the OT&E report and is developing plans to address the system weaknesses identified. We also reviewed the OT&E plans, procedures, and results, and found additional testing inadequacies. Specifics on these inadequacies are discussed below.

Deployment

Initially, Defense planned to conduct OT&E of CHCS deployment at 13 sites, but due to the collection of unusable or incomplete test data, changes it made in its overall deployment strategy, and congressional concerns about deploying CHCS to additional test sites, it revised the test plan and in the end tested this capability at only one site. This site was using only one of the nine CHCS functions—patient-appointment scheduling. The results, therefore, are inconclusive because the test data were not representative of all CHCS functions or all sites to which deployment is intended. The Defense OT&E team, which evaluated the deployment capability, found the data insufficient for evaluating this test area and, as a consequence, gave it no final rating.

Training

The evaluation of the effectiveness and suitability of user training for CHCS required testing in three areas: initial training, familiarization training, and continuing training.¹ In 1989, when Defense began deploying CHCS to the original test sites, it also began collecting data for use in its OT&E of CHCS

¹Initial Training—The set of courses, prescribed and provided by the prime CHCS contractor, that accompanies initial installation of CHCS. It is designed to enable medical-treatment facility personnel to perform their assigned duties using the system. Familiarization Training—Additional training of a remedial or refresher nature—provided by government trainers to CHCS users following work center activation. Continuing Training—Training provided by government trainers to personnel newly assigned to a medical treatment facility.

training. Defense completed the OT&E of the continuing-training and familiarization-training areas at each of three representative test sites that were using most of CHCS' nine functions. However, the OT&E for the initial-training area proved to be inadequate. This was due primarily to the fact that Defense significantly changed its procedures for conducting initial CHCS training in 1991 and re-tests were infeasible since personnel who had received initial training were no longer assigned to the test sites. As a result, the initial-training OT&E data Defense had been gathering since 1989 became useless. Since none of the original CHCS test sites was suitable as an initial-training test site, Defense tested this capability at a single, newer test site, with only one CHCS function—patient-appointment scheduling. However, the test results from this site do not support an evaluation of the effectiveness and suitability of CHCS initial training because they are not representative of all CHCS functionality and sites to which deployment is intended.

Mobilization

The objective of testing in this area was to evaluate CHCS' effectiveness in supporting missions encompassing mass-casualty, contingency, and mobilization situations at medical treatment facilities. Testing in this area involved using CHCS during Operation Desert Storm. At that time, however, Defense had not integrated CHCS operations into its command mobilization and contingency plans. Mobilization testing was, therefore, inadequate because Defense did not test and evaluate CHCS as part of these plans, and Operation Desert Storm was completed with so few casualties that work loads did not increase sufficiently for sites to test CHCS performance under stress.

According to a Defense test official, although plans did not exist at the time of OT&E for using CHCS for mass-casualty, contingency, and mobilization situations, Defense has now prepared such plans. Defense does not, however, intend to test and evaluate these plans prior to its 1992 deployment decision.

Technical

Defense inadequately implemented OT&E plans for several technical areas because managers did not control test conditions. As a result, some tests were not conducted in a realistic operational environment. Defense did not

ensure that hospital test sites had activated certain system-security features.² We found that test sites had deactivated system-security features to alleviate response-time problems. In addition, the system-reliability computations did not include the component reliability for disk drives. As a consequence, system-hardware reliability test results are inconclusive. Because of these problems, the OT&E did not adequately evaluate CHCS system security and performance.

A test official stated that sites had not activated some security features because Defense had not issued guidance regarding the need to activate them for OT&E. According to this official, Defense is attempting to address this inadequacy before making a deployment decision by (1) requiring the CHCS program office to certify that the system will afford medical records the required confidential level of security, and (2) testing and evaluating CHCS' audit-trail security feature at the Charleston, South Carolina, test site.

Functional

Although Defense conducted its most complete testing in the functional test area, we found weaknesses in Defense's data collection methodology relating to one of the six critical operational issues in the functional area—quality of care. Seven of the 27 tests pertaining to this issue contained test-plan or test-execution weaknesses. These weaknesses included testing at a small number of nonrepresentative sites and very low response rates to some questions. A Defense official stated that these data weaknesses occurred because: (1) only a few test sites had the specific automated capabilities that were being measured during OT&E; (2) limitations were placed on the number of survey questions to minimize respondent burden and encourage more accurate responses; (3) test procedures did not ensure that respondents completed survey forms; and (4) data were not comparable because those questions asked after CHCS installation were different from those asked before CHCS installation. The above weaknesses impeded any meaningful analysis of the quality-of-care issue.

²Test sites turned off audit trails to preserve computer capacity and protect overall system responsiveness from further deterioration

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