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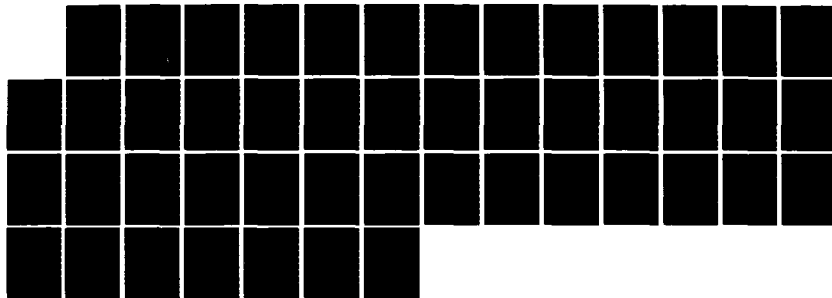
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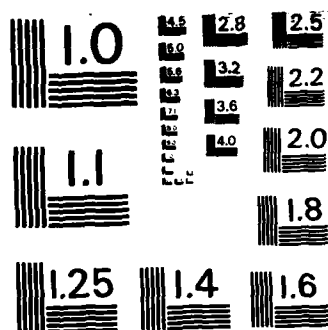
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EVALUATION OF
THE TRI-SERVICE LABORATORY SYSTEM

VOLUME III
WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL

ARTHUR D. LITTLE, INC.
Acorn Park
Cambridge, Massachusetts 02140
June 20, 1983

Final Report for Period 2/17/82-6/20/83

Prepared for

TRIMIS Program Office
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Results of the evaluation of the Tri-Service Laboratory (TRILAB) System at Wright Patterson Medical Center and Regional Hospital		

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I. INTRODUCTION

A. BACKGROUND

✓ The Tri-Service Medical Information System (TRIMIS) Program Office (TPO) has installed computerized clinical laboratory systems [Tri-Service Laboratory (TRILAB) systems] at Oakland Naval Regional Medical Center (Oakland NRMCC), Wright Patterson Medical Center and Regional Hospital (Wright Patterson), and Dwight D. Eisenhower Army Medical Center (Eisenhower). The costs and benefits of the system were evaluated at Oakland NRMCC. Evaluations at the other two sites were conducted on a smaller scale and consisted primarily of surveys of attitudes of the users of clinical laboratory services and of laboratory personnel. Information from evaluations at all three sites will be used in decision-making regarding the future use of automation in clinical laboratories in other medical treatment facilities.

This report, which is Volume III of a four-volume report, presents summary results of the baseline (Period X or pre-implementation survey) and detailed results of the post-implementation (Period Y) survey of attitudes of users and providers of clinical laboratory services at Wright Patterson Medical Center and Regional Hospital, and analyzes changes in staff perceptions of clinical laboratory services. The baseline surveys were administered in the winter of 1981. Implementation of the TRILAB system began in June 1982. The post-implementation surveys were carried out in the fall of 1982. The survey questionnaires addressed issues relating to clinical laboratory, laboratory efficiency, frequency of events occurring in the laboratory, expected turnaround times for different laboratory tests, and efficacy of information storage and retrieval. (Detailed baseline survey results are presented in Volume IV and Appendix C, Volume VI of the Baseline Evaluation Report.)⁽¹⁾

The remainder of this chapter discusses laboratory operations, and compares the TRILAB system with the Air Force Clinical Laboratory Automated System (AFCLAS) which it replaced. Chapter II presents the approach taken in the survey. Chapter III presents the results of the

surveys and Chapter IV the results of interviews that were conducted with providers and clinical laboratory personnel. Appendix C in Volume VI contains the post-implementation survey questionnaires, and the number of respondents to each question. Also included in the appendix are detailed results of the post-implementation survey.

B. THE SETTING

Wright Patterson Medical Center and Regional Hospital serves about 400,000 outpatient visits and 104,000 inpatient days (8,335 admissions) per year. The annual volume of laboratory tests performed was approximately 1,622,000 (CY 1982), equivalent to 4.8 million CAP units, including inpatient STAT and routine, outpatient STAT and routine, and emergency room STAT tests. The laboratory serves all wards and clinics at the hospital (in-house users), in addition to several outlying clinics and hospitals.

At the time of the post-implementation survey the laboratory had a staff of 42. The laboratory was organized into six sections: Automated Chemistry, Chemistry Processing, Hematology, Microbiology, STAT Laboratory and Urinalysis. This organization had not changed from the baseline period.

C. DESCRIPTION OF AFCLAS

Prior to implementation of the TRILAB system, the clinical laboratory at Wright Patterson had a Honeywell Air Force Clinical Laboratory Automated System (AFCLAS). Test results could be accessed by CRT terminal in the laboratory, and by teletypewriter terminals on a few (four or five) wards and clinics. The Hycel 17, a large-volume chemistry analyzer, was interfaced with AFCLAS, and other results were entered into the system via terminals. AFCLAS was capable of highlighting abnormal results and producing cumulative reports on patient tests; quality control and other laboratory management statistics were also retrievable. Figure 1 illustrates the flow of information in the baseline laboratory process.

In the baseline system, results were reported to providers in two ways:

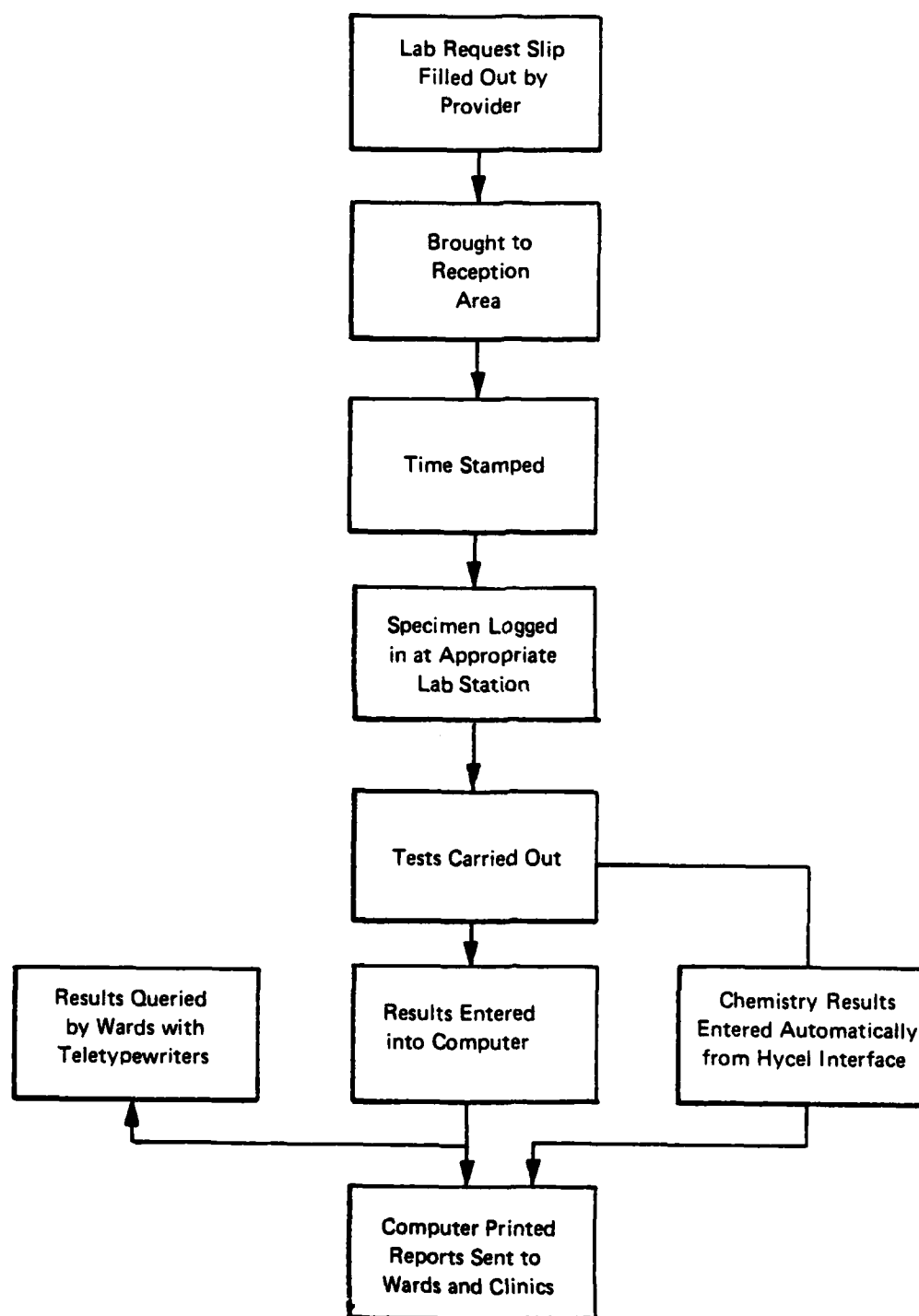


FIGURE 1 BASELINE WORK FLOW AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL CLINICAL LABORATORY (HONEYWELL AFCLAS SYSTEM)

1. Providers on those four or five wards and clinics with teletypewriter terminals could obtain results via interrogation;
2. Printed daily result reports were sent to each ward and clinic.

The volume of telephone calls to the laboratory for inquiry regarding test results or status was considered high, because most wards and clinics did not have terminals and, of those that did, many providers called the laboratory, rather than attempt to interrogate using the teletypewriter terminal.

D. DESCRIPTION OF TRILAB SYSTEM AT WRIGHT PATTERSON

The TRILAB system included a central processing unit, and peripheral printers and CRT terminals located in the departments, as summarized in Table 1. The system included a total of 25 terminals and 8 printers: 11 of the terminals were located in hospital patient care areas, and 1 printer and 3 terminals were located in outlying clinics.

With the TRILAB system, laboratory test requests were generated on wards and clinics by use of a single special precoded form, developed internally. Chemistry and Hematology test requests were centrally accessioned into the laboratory computer at the reception desk; Microbiology requests were accessioned at the section. The precoded form allowed the receptionist to review and accession the test request information efficiently into the computer. The computer automatically generated three labels for specimens. Specimens were then sent to the appropriate laboratory station according to the type of test requested. Figure 2 shows the work flow in the post-implementation period.

Tests were performed in the following order of priority: emergency room STAT, inpatient STAT, outpatient STAT, inpatient routine, and outpatient routine.

The Hycel was still the only laboratory instrument that had been interfaced with the computer. Other test results were entered manually through terminals. Results were verified by laboratory supervisors before release. As STAT test results were verified and made available, the terminal at the appropriate ward/clinic "beeped."

TABLE 1

SUMMARY OF TRILAB PERIPHERAL LOCATIONS
 WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL

	<u>Printers</u>	<u>CRTs</u>
<u>Medical Systems</u>	2	2
<u>Laboratory</u>		
Reception Desk	1	2
Automated Chemistry	0	1
Chemistry Processing	1	1
Hematology	1	1
Microbiology	1	2
STAT Laboratory	0	1
Urinalysis	1	1
<u>Outpatient Clinics</u>		
Family Practice, Surgery/Urology, ER, OB/GYN, Internal Medicine	0	5
<u>Inpatient Wards</u>		
Internal Medicine, North Medical Ward, North Medical/Surgical Ward, Intensive Care Ward, Pediatrics, Surgical, Psychiatry, OB/GYN, Orthopedics	0	6
<u>Outlying Clinics</u>		
Employee Health, Pediatric/Lab, OB/GYN, Occupational Health	<u>1</u>	<u>3</u>
	8	25

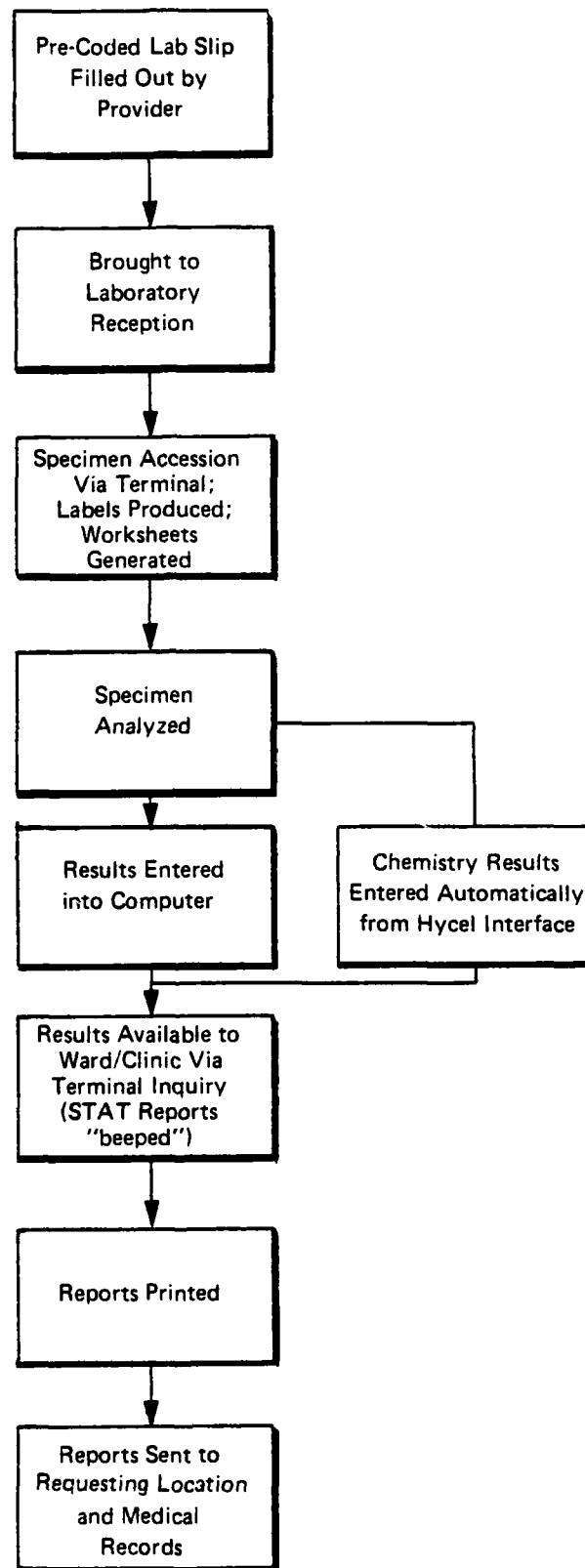


FIGURE 2 POST-IMPLEMENTATION WORK FLOW AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL CLINICAL LABORATORY (TRILAB SYSTEM)

Routine results were also available via inquiry. The major reports produced by the system were:

- A daily report by patient, summarizing the results of tests carried out during the previous 24 hours. These reports were printed at night and were available after midnight.
- An inpatient cumulative report, printed on discharge for inclusion in the patient chart. Interim printed cumulative reports were also available on request.

A description of management reports that the system also produced is available in Volume II.

E. DIFFERENCES IN WORK FLOW BETWEEN BASELINE AND POST-IMPLEMENTATION PERIODS

The major differences between the baseline (AFCLAS) and post-implementation (TRILAB) systems were as follows:

- Test Requests: In the post-implementation period tests were ordered by use of a single precoded form. In the baseline, tests were ordered on various forms.
- Test Results: The TRILAB system allowed for full inquiry capability through use of terminals on wards and clinics. For STAT results, the terminal of the appropriate location "beeped" as they became available, eliminating the need to call the laboratory; this capability (notification of STAT test availability) was not available with AFCLAS.
- Flexibility: Overall, TRILAB was considered a much more flexible system than the previous system. Information storage and retrieval was considered more efficient; in addition to having more terminals, results were more easily accessible to both laboratory staff and users via the CRTs than the teletypewriter terminals. In addition, computer program changes could be more easily made with TRILAB (via telephone input from the vendor to the site) than with the AFCLAS system.

- Management Reports: The quality control reports generated by TRILAB were more complete than those generated by the AFCLAS system. For example, the TRILAB system produced Levey-Jennings graphs, which were unavailable under AFCLAS.

To summarize, the basic work flows in the baseline (AFCLAS) and post-implementation (TRILAB) periods were similar. The major differences were in the results availability and inquiry capability of TRILAB compared with the AFCLAS system: the TRILAB system notified providers when STAT results were available; the CRTs were easier to use for inquiry by providers; and there were nine more terminals available in provider locations. In addition, the TRILAB system was more flexible and had improved reporting capabilities.

F. DIFFERENCES IN TRILAB SYSTEMS AT WRIGHT PATTERSON AND OAKLAND

NRMC

The TRILAB system at Wright Patterson is similar to the system at Oakland described in Volume II of this report. The following are differences between the two systems:

- At Oakland, test requests were generated by use of more than one form, and tests were as yet not centrally accessioned at the time of the post-implementation study.
- Cumulative reports were not routinely produced at Wright Patterson except on discharge (but were printed on request, in the Medical Systems office), considerably reducing the volume of paper generated.
- At Wright Patterson, the telephone number of outpatients was included on reports, thereby facilitating follow-up contact with patients.
- The system at Wright Patterson could store 150 days of on-line test results at the time of the post-implementation survey; at Oakland, only 30 days could be stored.
- At Oakland, the Coulter S+ instrument was interfaced to the computer system; at Wright Patterson, Coulter results were entered manually due to sequencing problems with the Coulter instrument.

II. APPROACH

A. SURVEY DESIGN

The baseline and post-implementation questionnaires were developed based on knowledge of the TRILAB capabilities, information gained during visits to the sites, and input from the TRIMIS Laboratory Project Manager and TRIMIS staff. The survey focused on important areas of laboratory services and those most likely to be affected by TRILAB. The questions related to:

- efficiency of laboratory operations;
- information storage and retrieval capabilities;
- functional aspects of test request/report forms;
- accuracy of laboratory results.

Respondents were asked their level of satisfaction with current performance of laboratory services. They were also asked to rate the importance of improvements in each area. Since TRILAB was expected to have an impact on availability of test results, users (physicians) were also asked to specify the service response times (turnaround time from request to receipt of laboratory results) they considered acceptable for different types of tests. Clinical laboratory personnel at Wright Patterson were queried concerning their attitudes regarding some aspects of the baseline computer system, so that the AFCLAS and TRILAB systems could be compared. All respondents were also provided with an opportunity to give free-form comments regarding any aspect of laboratory services.

The post-implementation questionnaires differed only slightly from the baseline questionnaires. They included additional questions regarding the perceived impacts of the TRILAB system. Copies of the post-implementation survey instruments and summary results are provided in Appendix C of Volume VI of this report.

B. QUESTIONNAIRE ADMINISTRATION

a. Baseline

Distribution and collection of completed questionnaires was the responsibility of the site in both surveys. In the fall of 1981, baseline questionnaires were randomly distributed to users (physicians, physicians' assistants, nurses and nurse practitioners, corpsmen, etc.), laboratory personnel, and patients. A total of 46 user questionnaires completed by physicians was available for analysis. The respondents included 22 "light" users of laboratory services (0-10 tests/day), 20 moderate users (10-20 tests/day) and 4 "heavy" users (21 or more tests/day). The sample included physicians from the following departments: 10 from Internal Medicine; 8 from Gastroenterology; 5 from Pediatrics; 3 each from Orthopedics, Psychiatry, and Surgery; 2 each from Neonatology, Cardiology, Aerospace Medicine, and Ophthalmology; and 1 each from Family Practice, Primary Care, Ear, Nose and Throat, Emergency Room, Urology, and Dermatology.

A total of 26 completed questionnaires from clinical laboratory personnel was available for analysis. The respondents consisted of 1 administrator, 3 laboratory officers, 20 laboratory technicians, and 2 receptionists/clerks.

b. Post-Implementation

In the post-implementation period survey (November 1982) questionnaires were distributed in the same manner to users, laboratory personnel, and patients. Responses available for analysis included the following: 32 physicians [14 "light" users (0-10 tests/day); 11 "moderate" users (11-20 tests/day); and 6 "heavy" users (21 or more tests/day)]. The sample included physicians from the following departments: 7 from Internal Medicine; 4 each from Pediatrics and Surgery; 2 each from Mental Health and OB-GYN; and 1 each from Medical Oncology, Psychiatry, Urology and Ear, Nose and Throat. Six were unspecified. Questionnaires were also obtained from 31 nurses and physicians' assistants, and 15 administrative personnel.

A total of 12 responses were received from the clinical laboratory personnel; 8 were laboratory technicians, 3 laboratory officers, and 1 was unspecified.

Additionally, questionnaires were received from 35 outpatients.

C. QUESTIONNAIRE ANALYSIS

Questionnaire results were keypunched and analyzed by use of a computer. Total responses to each question are presented on the questionnaires in Appendix C in Volume VI of this report and of the baseline report. For the portion of the questionnaire involving satisfaction and importance ratings or frequency of events relating to results availability, responses were weighted, summed and a weighted mean response computed. The following weighting scheme was used:

<u>Weight</u>	<u>Satisfaction</u>	<u>Importance</u>	<u>Frequency</u>
5	Very Satisfied	Very Important	Often
4	Somewhat Satisfied	Somewhat Important	Occasionally
3	Undecided	Undecided	Undecided
2	Somewhat Dissatisfied	Somewhat Unimportant	Rarely
1	Not at All Satisfied	Not at All Important	Never

III. RESULTS

A. USER ATTITUDES

1. Test Report Form

a. Baseline

Physicians in the baseline period indicated that the single most important aspect of the test report form was the completeness of information provided (weighted mean response of 4.8). Slightly less important was the conciseness of the report form (weighted mean of 4.5).

On average, users appear to be at least somewhat satisfied with all aspects of the forms in use during the baseline study. As noted in Table 2, they generally expressed some satisfaction with information completeness of the report form (weighted mean of 4.2). The levels of satisfaction with report conciseness and clarity were slightly lower (weighted mean response of 3.7 and 3.9). Users were less satisfied with the indication of normal/abnormal values (3.6).

b. Post-Implementation

As shown in Table 2, physicians, nurses, and administrators were, for the most part, satisfied with the test report form during the post-implementation study. User respondents were most satisfied with the clarity of the printout and the identification of abnormal values (weighted means of 4.7, or "very satisfied"). These and other responses regarding laboratory report forms are shown in Table 2.

c. Baseline and Post-Implementation Comparison

As can be seen from Table 2, physicians who responded to the post-implementation survey felt more positively about the test report form used with TRILAB than with that used with AFCLAS; all aspects measured showed greater satisfaction. The most marked improvement was in the indication of abnormal values, which had a weighted mean of 3.6 in the baseline and 4.7 in the post-implementation periods. The clarity and conciseness of information on the report form also showed increases in satisfaction, of 0.8 and 0.6 in average scale ratings.

TABLE 2

BASELINE AND POST-IMPLEMENTATION SATISFACTION LEVELS OF USERS OF CLINICAL LABORATORY SERVICES
REGARDING ATTRIBUTES OF THE TEST REPORT FORM AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL^a

Aspect	Satisfaction With Attribute (Weighted Mean) ^b				
	Baseline Physicians	Post-Implementation Physicians	Baseline Post-Implementation Change Physicians	Post-Implementation Nurses/PA	Post-Implementation Users/Adm All Users
<u>Test Request Form</u>					
Completeness of Information Provided by Report Form	4.2	4.5	+0.3	4.6	4.5
Conciseness of Information Provided by Report Form	3.7	4.3	+0.6	4.6	4.4
Clarity of Information on Report Form	3.9	4.7	+0.8	4.8	4.7
Indication of Normal/Abnormal Values on Report	3.6	4.7	+1.1	4.7	4.6

^a Baseline, 44 respondents; Post-implementation, 76 Respondents: 30 physicians, 31 nurse/p.a., 12 administrators, 3 others.

^b Weighted mean response was obtained by assigning values of 1 through 5 to the categories very satisfied, somewhat satisfied, undecided, somewhat unsatisfied, and very unsatisfied, and dividing the sum by the number of responses.

3. Clinical Laboratory Performance

a. Baseline

When asked to rate the importance of performance aspects of the current laboratory services in the baseline survey, physicians were virtually unanimous in considering the accuracy of results as "very important."

In the baseline survey, attitudes regarding satisfaction with accuracy of test results were fairly evenly divided, as reflected in the weighted mean of 3.0. Overall, users appeared to be slightly dissatisfied with service response time for ER and inpatient STAT, and inpatient routine results (weighted means of 2.8, 2.7, and 2.8, respectively) and undecided (weighted mean of 3.2) about response times for outpatient tests. In each case, however, 15 or more of the 44 respondents indicated that they were "somewhat" or "very satisfied." As shown in Table 3, overall users appeared to be "somewhat satisfied" with the performance of the clinical laboratory.

Of those users who described their use as heavy (21 or more tests/day) only one was "very satisfied" with the overall operations of the laboratory; the others were not very satisfied. For the most part these users were most dissatisfied with turnaround times for laboratory tests. Additionally, they were somewhat dissatisfied with their ability to get information such as laboratory results and summaries of patient data bases. Light and moderate users were consistently more satisfied than heavy users with these aspects of services. All heavy users emphasized the importance of laboratory functions to their work.

b. Post-Implementation

As can be seen from Table 3, generally users were slightly less than "somewhat satisfied" with most measures of performance of the clinical laboratory in the post-implementation period. They were, however, between "somewhat" and "very satisfied" with the accuracy of results that the laboratory produces (nurses 4.3; physicians 4.1; administrators 4.2). Heavy users among physicians were "very

TABLE 3

BASELINE AND POST-IMPLEMENTATION SATISFACTION LEVELS OF USERS OF CLINICAL LABORATORY SERVICES
REGARDING PERFORMANCE OF THE CLINICAL LABORATORY AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL^b

Aspect	Satisfaction With Service Aspect (Weighted Mean) ^b					
	Baseline		Post-Implementation		Post-Implementation	
	Physicians	Physicians	Physicians	Nurses/PA	Administration	All Users
Accuracy of Results	3.0	4.1	+1.1	4.3	4.2	4.2
Length of Time Between STAT ER Test and Results	2.8	3.4	+0.6	3.0	3.7	3.3
Length of Time Between Inpatient STAT and Results	2.7	3.2	+0.5	3.2	3.7	3.3
Length of Time Between Inpatient Routine and Results	2.8	3.7	+0.9	3.4	3.8	3.6
Length of Time Between Outpatient Routine and Results	3.2	3.8	+0.6	3.1	3.7	3.5
Ability of Laboratory to Handle Special Tests	2.7	3.3	+0.6	3.2	3.6	3.3

^a Baseline, 46 respondents; Post-implementation, 76 respondents: 30 physicians, 31 nurse/p.a., 12 administrators, 3 others.

^b Weighted mean response was obtained by assigning values of 1 through 5 to the categories very satisfied, somewhat satisfied, undecided, somewhat unsatisfied, and very unsatisfied, and dividing the sum by the number of response.

satisfied" with the accuracy of results (weighted mean 4.7); a slightly lower level of satisfaction was exhibited by light and moderate users (4.0). (Appendix C in Volume 6 presents weighted mean satisfaction levels for light, heavy, and moderate users.)

Satisfaction with turnaround times for laboratory results showed somewhat divided response, and tended to fall between the categories "somewhat satisfied" and "undecided." As can be seen from Table 3, all users were least satisfied with the laboratory's ability to turn around STAT laboratory requests for inpatient and emergency room patients (overall weighted means of 3.3 for both). Nurses expressed a weighted mean satisfaction of 3.0.

c. Baseline and Post-Implementation Comparisons

The survey results show that TRILAB has effected positive changes in physician attitudes towards laboratory services, as evidenced in Table 3. Satisfaction with all aspects of performance of laboratory services increased from the baseline to the post-implementation survey. Physician opinion in the baseline was largely divided, as indicated by weighted means of approximately 3.0. The post-implementation period survey results indicate that, for the most part, physicians were basically "satisfied" with laboratory services. The most marked change was in satisfaction with accuracy of laboratory results; respective weighted mean changes from the baseline to post-implementation were 3.0 to 4.1, or "undecided" to "somewhat satisfied." There was also a significant increase in satisfaction with routine results turnaround time, from 2.8 to 3.7.

3. Information Storage and Retrieval

a. Baseline

Baseline satisfaction of physicians with the ability to access laboratory results was 3.3, or between "undecided" and "somewhat satisfied." On average, physicians appeared to be slightly dissatisfied with the ease and timeliness of filing and the ability to obtain status reports on laboratory tests, and only slightly satisfied with three other aspects. The availability of cumulative laboratory

summaries on patients rated the highest overall satisfaction (weighted mean response of 3.7, indicating respondents were "somewhat satisfied"). Other levels of satisfaction with information storage and retrieval are presented in Table 4.

b. Post-Implementation

On average, users were "somewhat satisfied" with test result information storage and retrieval capabilities in the post-implementation period. As can be seen from Table 4, weighted mean responses fell between 3.3 and 4.4. All users were equally satisfied with TRILAB's ability to access test results (weighted mean of 4.4, or between "very satisfied" and "somewhat satisfied").

Of the user groups, nurses were least satisfied with TRILAB system ability to provide hard-copy results for STAT results (weighted mean response 2.8). The overall weighted mean for user satisfaction with this aspect of TRILAB information storage capabilities was 3.3, with 21 of the 77 respondents expressing some dissatisfaction.

As can be seen from Table 4, users were quite satisfied with the ability to search the patient data base, access laboratory results, and the timeliness of results filing. Weighted means of approximately 4.4 indicate that providers were between "very satisfied" and "somewhat satisfied."

c. Baseline and Post-Implementation Comparison

Physicians in the post-implementation period were more satisfied with information storage and retrieval capabilities than in the baseline. Overall physicians were "somewhat satisfied" with all aspects of information storage and retrieval. The most marked change in satisfaction appears to have been with the aspects of information storage and retrieval and the ability to access laboratory results, probably due to the greater flexibility and ease of data retrieval of TRILAB compared to the AFCLAS system. Both of these aspects showed an improved satisfaction with a difference of 1.0 and 1.1 (or from basically "undecided" to "somewhat satisfied"). Other changes in satisfaction from the baseline to post-implementation are shown in Table 4.

TABLE 4

BASELINE AND POST-IMPLEMENTATION ATTITUDES OF USERS OF CLINICAL LABORATORY SERVICES
REGARDING LABORATORY INFORMATION STORAGE AND RETRIEVAL CAPABILITIES AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL.^a

Aspect	Satisfaction With Information Capability (Weighted Mean) ^b				
	Physicians		Nurses/PA		All Users
	Baseline Physicians	Post- Implementation Physicians	Baseline Implementation Change Physicians	Post- Implementation Users/Adm	Post- Implementation All Users
Ability to access lab results	3.3	4.4	+1.1	4.4	4.4
Retrieval of previous lab data	3.3	4.3	+1.0	4.6	4.1
Ability to obtain cumulative lab summaries on patients	3.7	4.1	+0.3	4.2	4.2
Ease and timeliness of filing	2.8	3.9	+1.1	4.1	4.0
Ability to access paper copy for stat results	3.2	3.6	+0.4	2.8	3.3
Ability to search patient data base	2.8	3.7	+0.9	4.1	3.9

^a Baseline, 44 respondents, Post-implementation, 76 respondents: 30 physicians, 31 nurses/p.a., 12 administrators; 3 others.

^b A weighted mean was obtained by assigning the values 1 through 5 to the categories very satisfied, somewhat undecided, somewhat unsatisfied, and very unsatisfied, and dividing the sum by the number of responses.

4. Acceptable Turnaround Times for Clinical Laboratory Services

a. Baseline

The baseline distribution of responses regarding acceptable turnaround times (time from request to receipt of result) is shown in Figure 3. As can be seen, virtually no users considered a turnaround time in excess of 60 minutes to be acceptable for inpatient or emergency STAT tests. Most respondents considered a turnaround time of 24 hours or less acceptable for most routine tests, though 18 respondents considered times of 37-48 hours acceptable for routine tests for outpatients.

b. Post-Implementation

Figure 4 illustrates acceptable turnaround times for users in the post-implementation period. As in the baseline period, few users found STAT turnaround times greater than 60 minutes to be acceptable. Nurses, in particular, expected short turnaround times (30 minutes or less) for STAT tests. Most users felt turnaround time for routine tests of up to 24 hours was acceptable. Other measures of acceptable turnaround times are shown in Figure 4.

Mean acceptable turnaround times reported by physicians for laboratory tests in the post implementation were as follows:

Inpatient STAT:	44 minutes
Inpatient Routine:	13 hours
Emergency STAT:	32 minutes
Outpatient Routine:	26 hours

c. Baseline and Post-Implementation Comparison

User expectations for turnaround times for laboratory tests remained consistent. For example, in both periods few users found a STAT turnaround time of greater than 60 minutes acceptable. A comparison of Figures 3 and 4 shows very slight changes from the baseline to the post-implementation survey.

5. Frequency of Events Relating to the Availability of Test Results

a. Baseline

As shown in Table 5, the most frequent action required of a physician to access laboratory results in the baseline survey was telephone calls to the laboratory (a weighted mean response of 4.4,

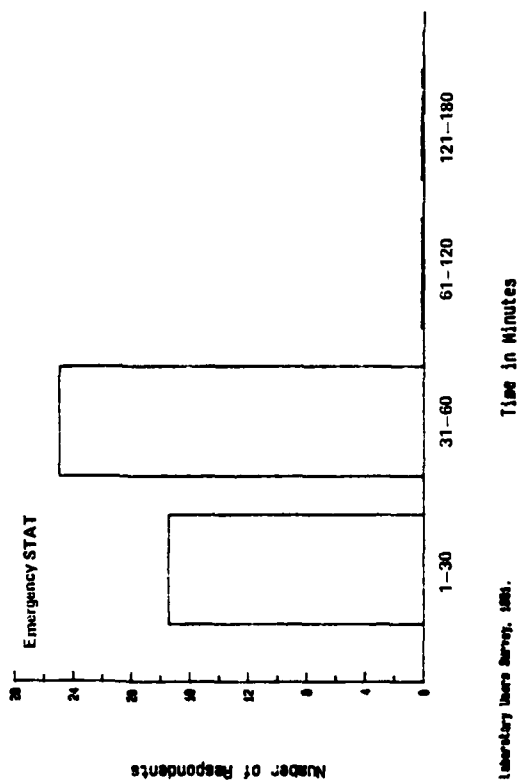
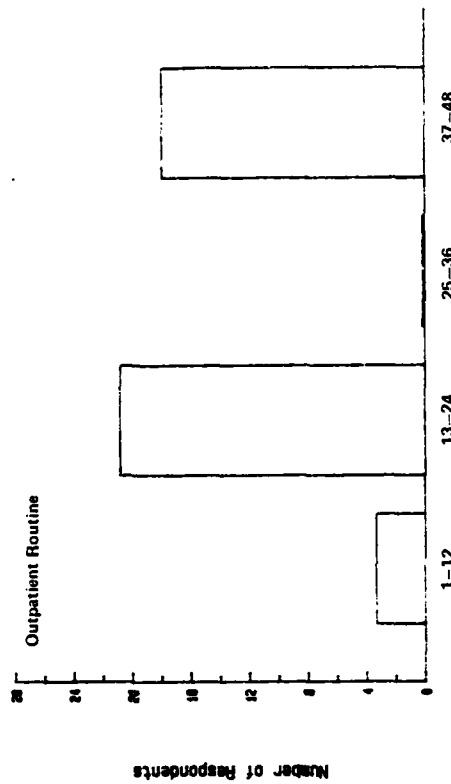
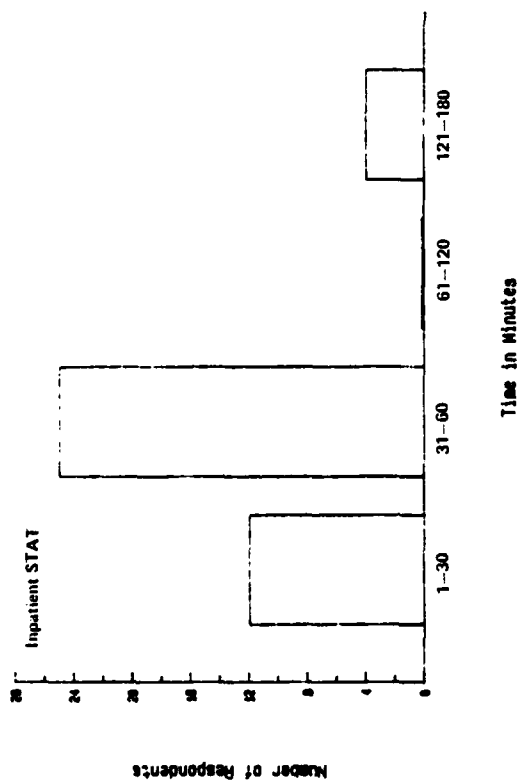
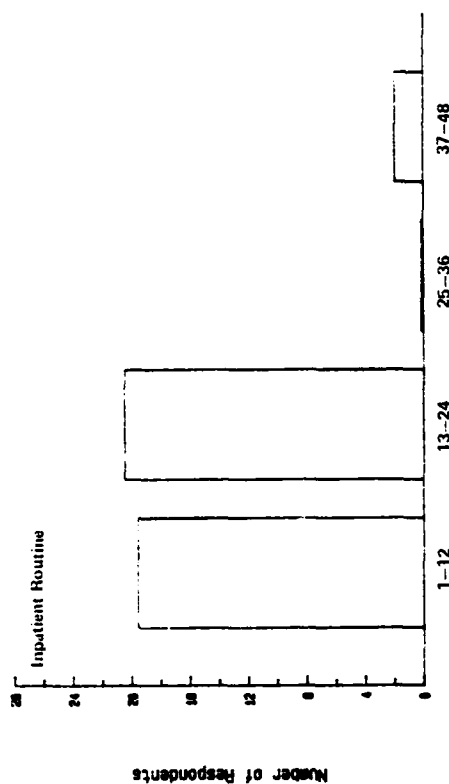


FIGURE 3 ACCEPTABLE TURNAROUND TIMES -- WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL
BASELINE CLINICAL LABORATORY USERS*

* Clinical Laboratory Users Survey, 1981.

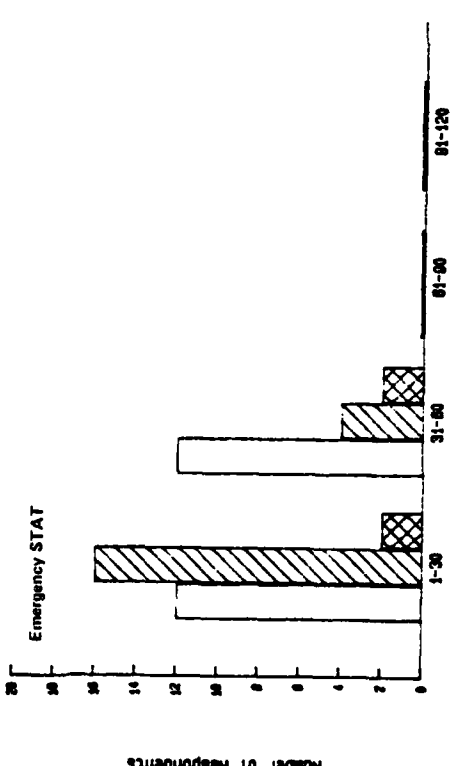
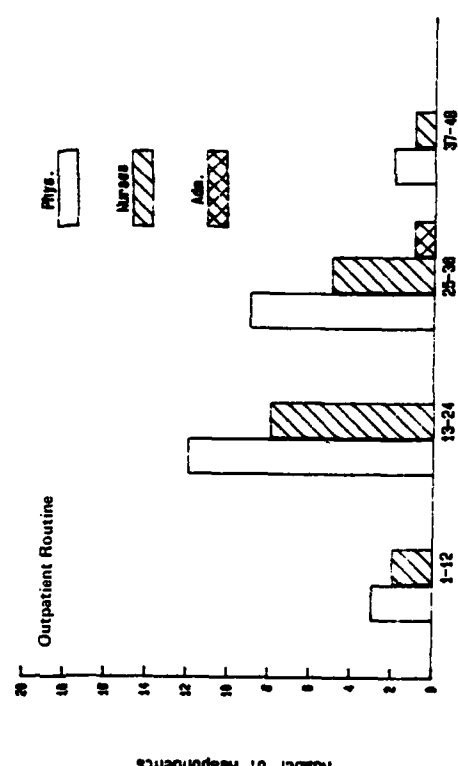
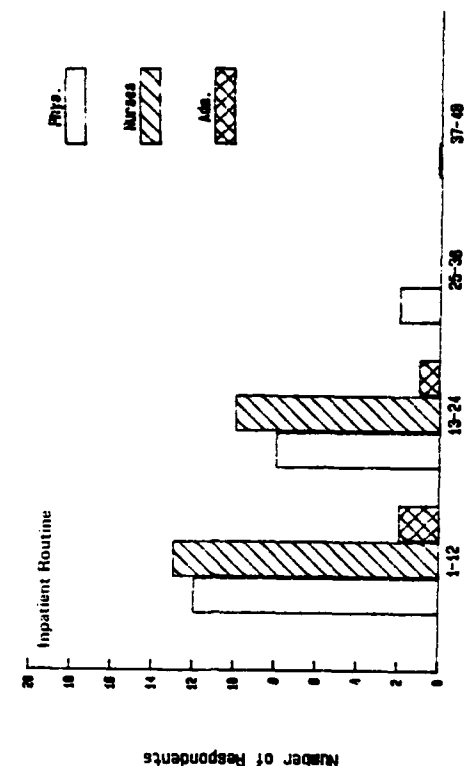


FIGURE 4 ACCEPTABLE TURNAROUND TIMES - WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL
POST-IMPLEMENTATION CLINICAL LABORATORY USERS

TABLE 5

BASELINE AND POST-IMPLEMENTATION ATTITUDES OF USERS OF CLINICAL LABORATORY SERVICES
REGARDING THE FREQUENCY OF EVENTS RELATING TO AVAILABILITY OF LABORATORY RESULTS AT
WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL^a

Events	Frequency Rating (weighted mean) ^b					
	Baseline		Post-Implementation		Post-Implementation	
	Physicians		Physicians		Nurses/PA	
	Physicians	Physicians	Physicians	Physicians	Admin	All Users
Frequency of telephone calls to lab	4.4	3.1	-1.3	3.6	3.0	3.4
Unnecessary duplication of information	4.3	3.0	-1.3	2.6	2.4	2.8
Tests repeated due to lost results	4.0	3.4	-0.6	3.2	2.8	3.0
Tests repeated due to filing delay	3.6	3.0	-0.6	3.0	2.8	3.0
Tests repeated due to inaccurate results	3.0	3.0	0.0	3.7	2.5	3.1

^a Baseline, 44 respondents, Post-implementation, 76 respondents: 30 physicians, 31 nurses/p.a., 12 administrators, 3 others.

^b A weighted mean was obtained by assigning values of 1 through 5 through the categories "often", "occasionally", "undecided", "rarely", and "never", respectively, and dividing the result by the number of responses.

indicating telephone calling happened "fairly often"). Other events relating to obtaining laboratory test results were largely perceived as happening "occasionally."

b. Post-Implementation

As shown in Table 5, weighted mean physician responses concerning the frequency of certain events with TRILAB fell between 3.0 and 3.4, or between "occasionally" and "undecided." It appears that users overall felt the least frequently occurring event with TRILAB was unnecessary duplication of information (overall weighted mean 2.8). The frequency of telephone calls to the laboratory was the most frequently occurring event of all those presented on Table 5. Respondents felt that this occurred somewhere between "occasionally" and "undecided," or a weighted mean of 3.4.

c. Baseline and Post-Implementation Comparison

Table 5 compares attitudes of physicians surveyed in the baseline and post-implementation with regard to the frequency of problem events in getting laboratory test results (a negative shift in frequency indicates an event happens less commonly). As can be seen from the table, there appears to be significant decreases (of 1.3 in weighted response) in the frequency of telephone calls to the laboratory as a result of the installation of TRILAB and in unnecessary duplication of information. Decreases (of 0.6) were measured for tests repeated due to filing delays or to inaccurate results. All activities required to follow-up on laboratory test results were reported to occur less frequently with TRILAB.

6. TRILAB System Availability and Frequency of Events

The post-implementation survey included questions about the availability, accuracy and reliability of the TRILAB system. It appears from the survey that users overall were at least "somewhat satisfied" with these aspects.

Users were also asked how often they employed the inquiry capabilities of the TRILAB system to obtain test results. Users reported that most often they relied on TRILAB to obtain tests results from the previous day (weighted mean of 4.4, or between "often" and "occasionally"). Frequency of obtaining results of tests over one week ago was between "rare" and "occasionally."

In the post-implementation survey, 23 respondents who had worked at the facility before the installation of TRILAB were asked to rate the relative frequency of common laboratory events such as telephone calls to the laboratory, and tests repeated due to lost results, filing delays, or inaccurate results, since TRILAB. Most respondents felt that most common laboratory problems occurred less frequently with TRILAB than with the previous system. Physician responses fell between "undecided" and "less frequently" with regard to the relative frequency of delay in filing and necessity of tests being repeated due to lost results. As can be seen from the table, physicians, nurses, and administrators felt similarly about the relative frequency of events.

B. ATTITUDES OF CLINICAL LABORATORY PERSONNEL

This section summarizes the results of the baseline and post-implementation surveys of clinical laboratory personnel. As noted in Chapter II, only 12 responses were obtained in the post-implementation survey, so that differences in measured attitude scale ratings between baseline and post-implementation periods involve a degree of uncertainty and small differences should be interpreted with caution.

1. Efficiency of Laboratory Operations

a. Baseline

In order to ascertain which of the common daily laboratory activities were most important to the clinical laboratory personnel surveyed, they were asked to rate the importance of such events, and estimate time spent in activities such as acquiring test results, logging results, etc. The activity that personnel found most important was the time they spent between examination of specimen/culture and the time it took to complete the report of test results. The survey revealed a weighted mean importance level of 4.8, or a nearly unanimous response of "very important."

Second most important to clinical laboratory personnel in the category of laboratory time/efficiency was medical personnel familiarity with laboratory operations. The survey revealed a mean importance level of 4.6; over two-thirds of the respondents (16) felt that the user's familiarity with the laboratory was "very important".

Laboratory personnel in the baseline felt that the most important aspect of laboratory performance was the accuracy of the results that the laboratory produces. Personnel were unanimous in considering this "very important" (a weighted mean response of 5.0). The baseline survey showed that laboratory personnel considered quality control "very important" (weighted mean response 4.9), or nearly as important as the accuracy of results overall.

Satisfaction ratings in the baseline period varied from 3.2 to 4.0 for time spent on preparation of department logs, reporting on quality control information, training and identifying/indicating normal values (Table 6). A lower rating was given to medical staff familiarity with laboratory operations (2.3), indicating that laboratory staff were somewhat dissatisfied with this aspect of operations.

Overall laboratory performance received an average scale rating of 3.6.

Accuracy of results and quality control received ratings of 4.3, indicating that laboratory staff were basically satisfied with these aspects of laboratory operations.

b. Post-Implementation

In the post-implementation period, laboratorians appeared to have similar opinions as to their satisfaction with laboratory efficiency. This was evidenced by weighted mean responses between 2.8 and 4.0 (see Table 6). Satisfaction level with medical staff familiarity with laboratory operations was between "somewhat unsatisfied" and "undecided" (2.8 weighted mean), indicating that laboratory staff were still unsatisfied with this aspect of laboratory operations. Laboratory staff personnel were "somewhat satisfied" with time spent identifying abnormal values (weighted mean 4.0); this is the aspect of laboratory efficiency with which they were most satisfied.

Overall, laboratory performance received an average scale rating of 4.3, indicating basic satisfaction.

TABLE 6

BASELINE AND POST-IMPLEMENTATION ATTITUDES OF CLINICAL LABORATORY PERSONNEL
REGARDING TIME/EFFICIENCY AND RESULTS OF LABORATORY OPERATIONS AT
WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL.^a

	Satisfaction (weighted mean) ^b		
	Baseline Laboratory Personnel	Post Implementation Laboratory Personnel	Change
<u>Events</u>			
Time Spent Identifying/Indicating Abnormal Values	4.0	4.0	0.0
Adequacy of Personnel Training in Laboratory Duties	3.6	3.2	-0.4
Time Spent Logging/Reporting Quality Control Information	3.5	3.3	-0.2
Time Spent on Preparation of Departmental Log	3.2	3.1	-0.1
Medical Staff Familiarity with Laboratory Operations	2.3	2.8	+0.5
<u>Overall Performance of Laboratory</u>	3.6	4.3	0.7
<u>Results</u>			
Accuracy of Results	4.3	3.9	-0.4
Quality Control of Laboratory Data	4.3	3.3	-1.0

^a Baseline, 26 respondents, Post-implementation, 12 respondents.

^b A weighted mean was obtained by assigning values of 1 through 5 "very satisfied", "somewhat satisfied", "undecided", "somewhat unsatisfied" and "not at all satisfied" and dividing the sum by the number of responses.

Laboratorians were "somewhat satisfied" with accuracy of results they process in the laboratory (weighted mean 3.9). Laboratorians were less satisfied with the quality control of laboratory data; their opinion was basically divided between "somewhat satisfied" and "undecided" (weighted mean 3.3).

c. Baseline and Post-Implementation Comparison

Table 6 presents changes in laboratory personnel attitudes regarding the efficiency of laboratory operations and the results that the laboratory produces. As can be seen from the table, personnel felt there was little change in laboratory operations since the installation of TRILAB. The noticeable improvements in satisfaction since the installation was in medical staff familiarity with laboratory operations; however, overall response is still equivocal (weighted mean 2.8). Personnel were slightly less satisfied with the time they spend logging and reporting quality control information and in the training of laboratory personnel in the post-implementation than they were in the baseline period.

It appears that personnel were less satisfied with the quality control of laboratory data in the post-implementation period than they were in the baseline (respective weighted means 4.3 and 3.3); they also felt somewhat less satisfied with the accuracy of results that the laboratory produces. These results appear to be inconsistent with the interview results (Chapter IV), which indicate that staff are very pleased with the improved quality control reporting capabilities of the TRILAB system.

Overall satisfaction with laboratory performance, however, increased from 3.6 to 4.3 from the baseline to the post-implementation periods.

2. Information Storage and Retrieval

a. Baseline

Laboratory personnel were asked about their perceptions of the various aspects of information storage and retrieval. The mean level of satisfaction with results retrieval indicated that laboratory personnel in the baseline were basically satisfied with this function--3.7 being the mean satisfaction response (Table 7).

TABLE 7

BASELINE AND POST-IMPLEMENTATION ATTITUDES OF CLINICAL LABORATORY PERSONNEL REGARDING
INFORMATION STORAGE AND RETRIEVAL CAPABILITIES AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL.^a

<u>Aspect</u>	<u>Satisfaction (weighted mean)^b</u>		
	<u>Baseline</u>	<u>Post- Implementation</u>	<u>Change</u>
<u>Capability of Laboratory Information System</u>			
Speed/Ease with which results are retrieved	3.7	3.3	-0.4
Time Spent on Patient ID Verification	2.2	2.9	+0.7
<u>Attributes of Computer Hardware</u>			
Efficiency of Command Functions	3.9	3.8	-0.1
Legibility of CRT Screen	4.3	4.4	+0.1

^a Baseline, 26 respondents, Post-Implementation, 12 respondents.

^b A weighted mean was obtained by assigning values of 1 through 5 to the categories "very satisfied", "somewhat satisfied", and "not at all satisfied" and divided the sum by the number of responses.

Laboratory personnel indicated their greatest dissatisfaction with completeness of patient identification provided by forms, and the time spent tracking down this information when it is incomplete. The mean satisfaction response obtained was 2.2, or "unsatisfied," as shown in Table 7. Ten respondents indicated that they were "not at all satisfied;" in other words, they felt too much time was spent tracking down this information.

b. Post-Implementation

In the post-implementation period, laboratory personnel indicated some dissatisfaction with the time spent verifying patient information (weighted mean 2.9) and with the ease with which results were retrieved (3.3); see Table 7.

c. Baseline and Post-Implementation Comparison

Laboratory personnel were divided with regard to changes in satisfaction with information storage and retrieval capabilities. In the baseline, they were somewhat more satisfied with the speed/ease with which results could be retrieved, whereas in the post-implementation period they were significantly more satisfied with time spent verifying patient identification (baseline 2.2; post-implementation 2.9). Table 7 summarizes these findings.

3. Attributes of Computer Hardware

a. Baseline

The laboratory personnel at Wright Patterson who responded to the baseline survey felt that the most important aspect of the AFCLAS computer system was the efficiency of command levels. Twenty respondents (weighted mean of 4.7) felt command functions were "very important." Personnel appeared to be "somewhat satisfied" with this function--a weighted mean response of 3.9 was obtained (Table 7). They were also satisfied with legibility of the CRT screen (4.3).

b. Post-Implementation

As shown in Table 7, laboratorians appeared to be "somewhat satisfied" with the attributes of the TRILAB computer hardware and command functions. The weighted mean of 4.4 indicates that they were between "very satisfied" and "somewhat satisfied" with the legibility of the CRT screen.

c. Baseline and Post-Implementation Comparison

As can be seen from Table 7, attitudes regarding satisfaction with computer hardware remained basically the same from the baseline to the post-implementation period. Personnel were "somewhat satisfied" with the legibility of the CRT screen in both periods (weighted means of 4.3 and 4.4).

4. Frequency of Laboratory Problems

a. Baseline

In order to ascertain the perception of frequency of day-to-day occurrences that interrupt laboratory routine, respondents were asked to indicate the frequency with which these activities occur, from "never" to "often." Nearly all respondents in the baseline felt that most frequently occurring activity was telephone calling to the laboratory. A weighted mean response of 4.8 indicates that this happened "often," as shown in Table 8. Related to this was the time personnel spend telephoning STAT results to the ward, and nearly as many respondents felt that this, too, was a frequent occurrence. A mean response of 4.4 was obtained. Other perceptions of frequency of events relating to test results availability are noted in Table 8.

b. Post-Implementation

As can be seen from Table 8, respondents in the post-implementation period had divided opinions as to their perceptions of the frequency of laboratory events. It appeared, however, that the least frequently occurring event since TRILAB's installation had been the telephone calling of STAT results to units (weighted mean 2.4, or for the most part, "rarely." Weighted means indicated that laboratorians still spent time on manual record keeping (3.7, or "occasionally").

c. Baseline and Post-Implementation Comparison

Laboratory personnel were, overall, in agreement that frequency of common laboratory discrepancies decreased in the post-implementation period. In particular, there was a definite feeling that telephone calls to the laboratory had decreased significantly

TABLE 8

BASELINE AND POST-IMPLEMENTATION ATTITUDES OF CLINICAL LABORATORY PERSONNEL REGARDING
FREQUENCY OF EVENTS RELATING TO LABORATORY RESULTS AND RELATED ACTIVITIES AT
WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL^a

<u>Laboratory Activity</u>	<u>Frequency (weighted mean)^b</u>		
	<u>Baseline</u>	<u>Post-Implementation</u>	<u>Baseline Post-Implementation Change</u>
Telephone Calls to Laboratory	4.8	3.5	-1.3
Time Spent Telephoning STAT Results to Units	4.4	2.4	-2.0
Time Spent on Manual Record Keeping/Filing	4.3	3.7	-0.6
Duplication of Written Information	4.1	3.6	-0.5
Errors in Transcription, Calculation	4.3	3.3	-1.0
Tests Repeated Due to Lost Results	3.2	2.8	-0.4

^a 11 respondents.

^b A weighted mean was obtained by assigning values of 1 through 5 to the categories "often", "occasionally", "undecided", "rarely", and "never" and dividing the sum by the number of responses.

(baseline weighted mean 4.8, post-implementation 3.5). Time spent to telephone STAT results to units also was perceived to decrease substantially (from 4.4 to 2.4). Personnel also appeared to feel that there was a significant decrease in transcription and calculation errors (4.3 and 3.3, baseline and post-implementation, respectively), possibly because of improved highlighting of abnormal values. Table 8 presents other comparative values regarding frequency of laboratory events.

5. Expected and Realized Improvements

a. Baseline

When personnel were asked in the baseline survey what improvements in the new system would be most important to them, most indicated that improved accuracy of test results was their first priority, followed by improved efficiency, change in format of laboratory request/reports, and finally speed/ease of information retrieval. Laboratory staff were not asked to indicate the importance of these improvements on a weighted scale.

b. Post-Implementation

It appears that accuracy of results, the area clinical laboratory personnel felt was in greatest need of improvement, was, in fact, the area that improved the most (weighted mean 3.7). This result is inconsistent, however, with the results presented in Section C.1, which showed a small decrease in satisfaction with results accuracy. As mentioned above, the inconsistency may be due to the small number of responses received (12).

Other perceptions of improvements resulting from the installation of TRILAB are shown in Table 9, including improvements in ease of information storage and retrieval, number of telephone calls to the laboratory, and efficiency of laboratory operations.

6. Relative Frequency of Discrepancies with TRILAB

As can be seen from Table 9, it appears that personnel feel that common laboratory discrepancies happened with slightly less relative frequency than before TRILAB was installed. In particular, personnel felt that they "rarely" spent time calling results to units (weighted mean 2.1). Other results are presented in Table 9.

TABLE 9

POST-IMPLEMENTATION ATTITUDES OF CLINICAL LABORATORY PERSONNEL REGARDING RELATIVE FREQUENCY OF
LABORATORY EVENTS/ACTIVITIES WITH THE TRILAB SYSTEM AND RATINGS OF IMPROVEMENT WITH TRILAB^a
AT WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL

<u>Aspect</u>	<u>A. Improvement Rating (weighted mean)</u>
Accuracy of Results	3.7
Ease of Information storage and Retrieval	3.6
Number of Telephone Calls to Laboratory	3.6
Efficiency of Laboratory Operations	3.4
Format of Laboratory Request/Results	3.1
<u>Event</u>	<u>B. Relative Frequency (weighted Mean)</u>
Time Spent on Manual Record Keeping	3.6
Discrepancies in Transcription	3.1
Duplication of Information	3.1
Necessity of Repeating Tests Due to Inaccurate Results	2.6
Telephone Calling to Units	2.1

^a All respondents.

^b Weighted mean frequency and improvement were obtained by assigning values of 1 through 5 to the categories "often", through "never" and "very important" through "not at all important", respectively, and divided the sums by the number of responses.

C. PATIENTS

No patient data were available for analysis in the baseline period; therefore, only post-implementation data will be discussed here. In the post-implementation period, 35 outpatients responded to the survey. Table 10 presents patient responses to the post-implementation survey. It appears that these patients were on average "somewhat satisfied" with clinical laboratory services at Wright Patterson, including time waiting to be served in the laboratory. Delayed or repeated tests were considered to occur on average between "rarely" and "never."

TABLE 10

ATTITUDES OF OUT-PATIENTS REGARDING SATISFACTION WITH CLINICAL LABORATORY SERVICES AND
FREQUENCY OF EVENTS CONCERNING THE CLINICAL LABORATORY AT
WRIGHT PATTERSON MEDICAL CENTER AND REGIONAL HOSPITAL^a

	a) Satisfaction					Weighted Mean ^b
	Very Satisfied	Somewhat Satisfied	Undecided	Somewhat Unsatisfied	Not At All Satisfied	
Overall Satisfaction with Clinical Laboratory Services	21	7	3	-	3	4.4
Time Spent Waiting in Laboratory Reception	17	9	2	4	3	3.9
Time Waiting to be serviced by Laboratory Technician	18	8	1	5	3	3.9
b) Frequency						
	Often	Occasionally	Undecided	Rarely	Never	Weighted Mean ^b
Frequency Delayed Due to Incomplete Request Form	2	2	3	6	21	1.8
Frequency Tests Repeated Due to Lost Results	-	2	3	6	24	1.5

^a 35 patients, including 5 officers, 2 enlisted, 7 dependents, 10 retirees, 9 dependents of retirees.

^b A weighted mean was obtained by assigning values of 5 through 1 to the categories of "often", "occasionally", "undecided", "rarely", "never", and dividing this sum by the number of responses.

IV. INTERVIEW RESULTS

A. INTRODUCTION

In December of 1982, approximately 20 physicians, nurses, physicians' assistants, ward clerks and laboratory personnel were interviewed in order to gather additional information on post-implementation findings at Wright Patterson. The following discusses both the benefits and the problems of the TRILAB system as perceived by the providers and laboratorians interviewed.

B. USERS

1. Benefits

- Decrease in Telephone Calls to Laboratory: All personnel interviewed agreed that the amount of time they spent telephoning the laboratory to retrieve results had decreased substantially since the installation of TRILAB, particularly with regard to STAT results. Most personnel indicated that they rarely called the laboratory since the implementation of TRILAB.
- Visits to the Laboratory: Users interviewed reported that they rarely, if ever, had to visit the laboratory to retrieve results since the installation of TRILAB. Nurses and ward clerks were most concerned with this activity, as generally it had been their responsibility to retrieve results. With TRILAB, the only reason nurses/ward clerks visited the laboratory was to bring down STAT specimens.
- Filing of Results: Instead of having to sift through charts, users now relied on terminals to find patient laboratory data. Interviewees also indicated that the cumulative reports made available by TRILAB saved time in searching for retrospective data.

According to interviews in several wards and clinics, nursing staff estimated that an average of 3.5 hours per day at each nursing station with a terminal had been saved due to the above three effects, with the major savings coming from reduced telephone calls. This average took into account time spent on all three shifts.

- Errors and Duplications of Tests: The impact of TRILAB on errors involved in laboratory test procedures appeared not to have been as great as in other areas such as telephone call reductions and management reporting capabilities. Some users indicated that there was less duplication of tests, perhaps resulting from the fact that results appeared on the terminal as they became available, and there was less chance that they would be lost.
- Retrieval of Information: Users interviewed relied heavily on TRILAB's information storage and retrieval capabilities. All comments in this regard were highly positive. This capability was reported to provide a great deal of information to users.

2. Problems

Most users interviewed felt that there were no major problems with the TRILAB system. Comments included the lack of quickly available hard-copy STAT results, and the need for more terminals on wards/clinics.

C. CLINICAL LABORATORY PERSONNEL

1. Benefits

The following were perceived by clinical laboratory personnel to be benefits of the TRILAB system:

- Management Reporting: Laboratorians interviewed felt that TRILAB accomplished management reporting tasks more efficiently than in the baseline. They appeared to use the system effectively to generate workload statistics.
- Quality Control Reporting: Laboratorians interviewed felt that the quality control capabilities of TRILAB were excellent. One staff member in the Clinical Chemistry Department felt that TRILAB Levey-Jennings quality control charts were particularly helpful, and estimated they saved his section about one day of staff time per month.
- Volume of Telephone Calls to the Laboratory: Laboratorians in all sections indicated a very significant decrease in telephone calls to the laboratory.

- Errors and Duplication of Tests: It was felt by interviewees that duplication and errors in tests occurred "somewhat less" than in the baseline period.

2. Problems

Laboratorians articulated a few problems that they have had with TRILAB, the foremost of them being the response time of the system. Some personnel felt that terminal response time, particularly when inputting corrections, was long. Most laboratory personnel felt that there were minor issues related to the newness of the TRILAB system, and that these would be worked out in time.

D. CONCLUSIONS

Both the survey data and interviews suggest that the TRILAB system is perceived as a significant improvement over the previous AFCLAS system which it replaced. This improvement in perceived capabilities appears to be related not only to the fact that the system supports more terminals in patient locations, but also to the improved capability of the TRILAB system for results inquiry (including notification to provider locations of STAT result availability), improved management and quality control reporting, and greater flexibility in implementing program and report format changes.

Providers indicated significant improvement between the baseline and post-implementation periods with respect to the following:

- clarity of information on test report forms;
- indication of normal/abnormal values on the test reports;
- accuracy of results;
- length of time between result requests and results, particularly for inpatient routine tests;
- improved ability to access laboratory results and retrieve previous laboratory test data;
- improved ease and timeliness of filing results;
- significant reduction in frequency of telephone calls to the laboratory;
- reduction in unnecessary duplication of information.

Nursing staff estimated that the reduction in telephone calls to the laboratory, particularly with regard to STAT results, resulted in average savings of 3.5 hours per day at each station with a terminal. It was also felt that there were fewer visits to the laboratory to retrieve the results, a possible small reduction in number of test result transcription errors and duplication of tests, and a general improvement in the capability of retrieving results using the terminals, instead of attempting to find results in charts.

Laboratory staff reported that in general overall performance of the laboratory had increased somewhat between the baseline and post-implementation periods and felt that time spent on verification of the patient information had decreased, as well as indicating significant reductions in:

- telephone calls to the laboratory;
- time spent telephoning STAT results to units;
- transcription errors.

Although the survey results suggest that respondents were less satisfied with quality control aspects of TRILAB compared with the previous system, the interviews indicated that laboratory staff were very pleased with the improved management and quality control reporting capabilities of the TRILAB system, and specifically cited the improved quality control reporting capabilities of TRILAB.

To summarize, both providers and laboratory staff in general indicated the TRILAB system was an improvement over the AFCLAS system. The major perceived benefits appear to be associated with the improved flexibility and information retrieval capabilities of TRILAB, which has resulted in a significant reduction in telephone calls both to and from the laboratory, in providing users and laboratory staff improved information retrieval capabilities for test results, and in laboratory management reporting.

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