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HEALTH SYSTEMS DIVISION NOTE

HSDN 77-3

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February 1975
(Updated February 1976
and March 1977)

Richard C. Brooks
Roberta G. Carlisle
Irving J. Casey
Paul W. Blackmon, Jr.

Approved by
Harry E. Emlet, Jr.
Vice President—Health Systems

Conducted for, and in cooperation with, the Directorate of Medical Plans and Resources, Office of the Surgeon General, Headquarters United States Air Force.

analytic services inc.

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I. INTRODUCTION

The purpose of this report is to present a plan for evaluating the impact of the Air Force Clinical Laboratory Automation System (AFCLAS) on the operation and management of the clinical laboratory and on users and beneficiaries of laboratory results outside the clinical laboratory. This plan is called an evaluation plan. The results of the evaluation are intended to aid those who must decide whether the AFCLAS system should be terminated, continued where already installed, or introduced at other Air Force medical centers. The results should also provide a basis for recommending changes that could enhance the operation of AFCLAS. The plan calls for evaluation of changes in the laboratory that result from the introduction of AFCLAS. Thus, two periods of data collection are planned: Period X, prior to installation of AFCLAS, and Period Y, after AFCLAS is operational. Minor modifications to the data collection procedures will have to be made before Period Y, based on the actual operation of AFCLAS.

AFCLAS is an automated data processing and management system that the Air Force is installing in the clinical laboratories at two test sites, both of which are Air Force hospitals:

- USAF Medical Center, Wright-Patterson AFB, Ohio
- Malcolm Grow USAF Medical Center at Andrews AFB, Washington, D.C.

The immediate goal of AFCLAS is to improve the operation and management of the clinical laboratory and thus ultimately to enhance the laboratory's contribution to quality patient care and to the patient's health status. It is anticipated that the following improvements will result from the introduction of AFCLAS:

- Shorter laboratory report turnaround time
- Increased laboratory staff productivity
- Improved accuracy, format, and content in reports of laboratory results
- Improved capability for evaluating laboratory performance
- Easier and more rapid access to laboratory records.

AFCLAS provides for accomplishing these objectives by:

- Maintaining for the individual patient internal data files that are rapidly accessible for data entry and retrieval
- Providing online monitoring of continuous flow laboratory instruments
- Automating clerical tasks such as preparation of worksheets and specimen collection lists
- Screening all test results and flagging those outside normal limits and those exceeding specified technical limits (e.g., incompatible with life)
- Providing daily reports and cumulative patient reports at regular intervals and current test result information on demand at I/O devices
- Automatically printing results for *stat* (emergency) orders as soon as they are entered and verified
- Providing quality control tools such as statistical analyses and monitoring of the results of tests on quality control specimens.

While AFCLAS will have little or no effect on the technical methods and procedures used by technicians in conducting the laboratory determinations, the improvements listed should contribute to improved quality of the analytical output. In

addition to providing better tools for quality assessment, AFCLAS should make more of the technician's time available for technical (as opposed to clerical) tasks. The reduction in clerical tasks should also make laboratory results less vulnerable to human error in computation, recording, and transcription because more time is available to conduct the tests and check results.

Another important objective of AFCLAS is that its operation and effects be acceptable to the persons upon whom they impinge. In the case of laboratory staff, acceptance is a prerequisite to any of the improvements listed. Outside the laboratory, personnel affected are physicians and staffs of outpatient clinics, nursing units, and the medical records department. In these areas, the impact of AFCLAS will be manifested through the laboratory reports. New laboratory report forms should change the time required for filing the reports in outpatient records and in inpatient charts. Most important, the accuracy, usability, and timeliness of reports sent to physicians should be affected. Patients will be affected through the service they receive from the laboratory. This includes waiting time, the attitudes of laboratory staff members, and availability of their laboratory results when needed by a physician.

The technical aspects of AFCLAS are defined in the RFP performance specifications and in the subsequent contract with Honeywell, Inc. These technical aspects of AFCLAS will have been evaluated prior to acceptance of the system by the Air Force. Therefore, it is assumed that when data are being collected under this plan following introduction of AFCLAS, AFCLAS will be operating in complete compliance with the RFP specifications and with the terms of the contract.

This evaluation plan provides for evaluating AFCLAS by: (1) investigating statistically some of the changes that are hypothesized effects of AFCLAS; (2) studying changes in personnel time required to perform functions that AFCLAS supports; (3) estimating dollar benefits and costs of introducing AFCLAS; and (4) surveying the acceptance of and satisfaction with AFCLAS by personnel inside and outside the laboratory and by patients. Effects of AFCLAS to be investigated in special detail include changes in completeness of the medical record, timeliness of laboratory reports, telephone calls to the laboratory, errors in arriving outpatient request slips, and service time at the reception desk.

The dollar benefits and costs analysis will estimate the net dollar cost of introducing AFCLAS, including costs associated with changes effected by AFCLAS inside and outside the laboratory and the cost of AFCLAS itself. Since not all of the changes anticipated can be quantified in dollars, a positive net cost, if found, must be considered as the price of benefits that are not quantified in dollars. The dollar benefits and costs analysis will be based on data collected at each test site before and after installation of AFCLAS.

The acceptance and satisfaction analysis will compare the prior receptiveness and actual response to AFCLAS of the laboratory staff, physicians, hospital support staff, and patients. The measures of acceptance and satisfaction will be scores derived from responses to questionnaires. Acceptance and satisfaction might be expected to affect such factors as personnel performance and personnel turnover. These factors in turn will affect dollar benefits and costs. Personnel performance will be reflected to a limited extent by the time to perform clerical tasks and tasks related to AFCLAS. However, no attempt will be made to measure the effect of AFCLAS

on turnover because the period planned for the evaluation is too short to permit significant changes to occur.

Evaluation of AFCLAS will require that data on laboratory operations be collected before and after AFCLAS is installed and in such a manner as to minimize interference with those and other facility operations. Therefore, wherever possible, data routinely generated will be used.

The evaluation plan is designed to reflect actual changes in the laboratory as accurately as possible subject to the limitations imposed by the situation in which the data must be collected. Some of the factors that could cause the data collected to give an inaccurate representation of the true laboratory situation are:

- Seasonal variation in number and distribution of laboratory requests
- Short-term variation in number and distribution of laboratory requests
- Effects of administrative operation and technical changes
- Effects of outside observers on laboratory and hospital operations
- Limited manpower available for data collection.

These problems were considered when designing the study and the evaluation plan attempts to minimize their effect through a careful study design and normalization of results for changes not introduced by AFCLAS.

Section II discusses the hypotheses to be investigated and Section III describes, in general terms, the data to be collected and several assumptions fundamental to the evaluation. An overview of the analysis is presented in Section IV.

Section V outlines an approach to estimating the effects of introducing AFCLAS in facilities other than the test sites. A brief summary of the main sections of the evaluation plan is given in Section VI. Appendix A contains the definitions of terms used in the plan. Appendix B is a data collection handbook describing the details of data collection. A discussion of the survey schedules (or questionnaires) and copies of the Period Y version of the questionnaires are contained in Appendix C. In December 1974 a pretest of the evaluation plan was conducted at an Air Force hospital similar in size and services to the two test sites. The procedures used for that pretest are described in a 12 December 1974 paper entitled Pretest for Evaluation Plan for the Air Force Clinical Laboratory Automation System (AFCLAS). This paper is included as Appendix D to this evaluation plan.

II. HYPOTHESES TO BE INVESTIGATED

Study of the objectives and operational specifications for AFCLAS, review of relevant literature, and observation of the manual information systems in the clinical laboratories at Malcolm Grow Medical Center and Wright-Patterson Medical Center led to identification of various planned and potential impacts of introducing AFCLAS in place of the existing information system. The anticipated importance of each impact, the possibility of measuring it, and the feasibility of collecting data to study the impact were considered. As a result, 58 hypotheses were defined for use in the evaluation. These hypotheses concern the effects of AFCLAS, including effects specifically planned in the Request for Proposals (RFP), on users inside and outside the laboratory and on patients. The term "hypotheses" used here does not imply that statistical hypothesis testing will be applied in each case. However, whenever appropriate, validity of the hypotheses will be tested using standard statistical techniques. The hypotheses are intended primarily to serve as a guide for data collection and analysis.

The data required to study the hypothesized effects will be explained in more detail in Section III and in Appendix B on data collection. Data are needed from each test site for two data collection periods (a total of four data collection efforts), one before AFCLAS is installed (Period X) and one after AFCLAS is in operation (Period Y). The two sets of data from each test site will be used to identify and quantify changes that occur between the two data collection periods. Generally, data to be collected must be identified, and all preparations for collection must be accomplished in advance of Period X. Data to be collected on new tasks generated by AFCLAS are an exception, since no data concerning them

will exist during Period X. These tasks can be identified and hypotheses concerning their effects can be incorporated in the evaluation plan after AFCLAS is installed but before Period Y begins. To preserve the objectivity and validity of the study, all hypotheses should be included in the analysis, and no new hypotheses should be added after the start of Period Y data collection.

The hypotheses to be investigated are:* † ‡

1. Time spent producing administrative reports will change, for an equal number and distribution of test requests.

2. The number of telephone inquiries to the laboratory central site (the reception desk or central computer site) will change, for an equal number and distribution of test requests and an equal number of telephone lines and personnel at the central site.

3. Time spent responding to telephone inquiries received by the laboratory central site will change, for an equal number and distribution of test requests and an equal number of telephone lines and personnel at the central site.

4. Time spent on the telephone for inquiries to the laboratory by personnel both inside and outside the

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* See Appendix A for definitions of terms.

† Accepting an hypothesis as stated above is equivalent to rejecting the null hypothesis if the hypothesis was worded in standard statistical terminology.

‡ There is a total of 57 hypotheses. The list contains 58 items because hypothesis #36 was dropped prior to the start of Period X data collection.

laboratory will change, for an equal number and distribution of test requests and an equal number of telephone lines and personnel at the central site.

5. The distribution by location and type of caller of telephone inquiries to the laboratory central site will change for an equal number and distribution of test requests and for an equal number of telephone lines and personnel at the central site.

6. Time required for filing laboratory clinical forms in laboratory files will change, for an equal number and distribution of test requests.

7. Time required to file laboratory reports in out-patient medical records will change, for an equal number and distribution of test requests.

8. Time required to file laboratory reports at the nursing stations will change, for an equal number and distribution of test requests.

9. Time required for preparing laboratory clinical forms will change, for an equal number and distribution of test requests.

10. Time spent compiling College of American Pathologists (CAP) standard workload figures will change, for an equal number and distribution of test requests.

11. Time required for labeling specimens will change, for an equal number and distribution of test requests.

12. Time required for preparing lists for specimen collection will change, for an equal number and distribution of test requests.

13. Time required for recording results of tests that will be online with AFCLAS will change, for an equal number and distribution of test requests.

14. Time required for recording results of tests that will be offline with AFCLAS will change, for an equal number and distribution of test requests.

15. Time required for entering laboratory requests by mark sense card will change, for an equal number and distribution of test requests.

16. Time required for keyboard entry of patient name and identification at the laboratory reception desk will change, for an equal number and distribution of test requests.

17. Time required for keyboard entry of patient name and identification in the registrar's office will change, for an equal number and distribution of test requests.

18. Time required for entering laboratory test results by mark sense card will change, for an equal number and distribution of test requests.

19. Time required for keyboard entry of free-text laboratory test results will change, for an equal number and distribution of test requests.

20. Time required for supervisor's review and certification of results and worksheets will change, for an equal number and distribution of test requests.

21. Time required for technician's review and certification of results and worksheets will change, for an equal number and distribution of test requests.

22. Time spent on statistical analysis for quality control will change, for an equal number and distribution of test requests.

23. The number of times statistical analyses of quality control sample results are performed will change, for an equal number and distribution of test requests.

24. The kinds of statistical analyses of quality control sample results will change, for an equal number and distribution of test requests.

25. The number and kinds of statistical analyses of patient results by population will change, for an equal number and distribution of test requests.

26. The time required for statistical analyses of patient results by population will change, for an equal number and distribution of test requests.

27. Time spent on calculations and/or conversions from raw to clinical values for test reports will change, for an equal number and distribution of test requests.

28. Time spent on operation of the computer by the laboratory staff will change.*

29. Kinds and numbers of laboratory clinical forms used will change, for an equal number and distribution of test requests.

30. Kinds and numbers of tests sent out to other laboratories for processing will change, for an equal number and distribution of test requests.

31. Kinds and numbers of tests sent to the laboratory being studied by other laboratories will change,

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* Time spent by laboratory personnel in computer operation does not include functions performed at remote terminals or input devices which are covered by other hypotheses; additional personnel added to the laboratory staff specifically to operate the AFCLAS system will be included as a cost of introducing AFCLAS.

for an equal number and distribution of test requests at the laboratories sending the test requests.

32. The number of *stat* requests will change, for an equal number and distribution of test requests.

33. Time that laboratory staff members work in addition to normal duty hours will change, for an equal number and distribution of test requests, and an equal number of laboratory staff.

34. Usability of laboratory reports to physicians will change.

35. Time to provide patient service at the laboratory reception desk will change, for an equal number and distribution of test requests.

36. (This hypothesis was dropped prior to Period X.)

37. Time the patient spends at the laboratory will change, for an equal number and distribution of test requests.

38. Patient satisfaction with the laboratory will change.

39. Physician acceptance of the laboratory will change.

40. Laboratory staff satisfaction will change.

41. Admissions and Dispositions Department staff acceptance of the laboratory will change.

42. Medical Records Department staff acceptance of the laboratory will change.

43. Registered nurses' acceptance of the laboratory will change.

44. The number of transcription errors will change, for an equal number and distribution of test requests.

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42. Medical Records Department staff acceptance of the laboratory will change.

43. Registered nurses' acceptance of the laboratory will change.

44. The number of transcription errors will change, for an equal number and distribution of test requests.

45. Completeness of the medical record will change.

46. Turnaround time will change, for an equal number and distribution of test requests.

47. Quality of patient care will change.

48. Numbers and kinds of reports produced will change.

49. Numbers and kinds of tests requested by physicians for outpatients will change, for an equal number of outpatient visits, for the same distribution of utilization by outpatient departments.

50. Numbers and kinds of tests requested by physicians for inpatients will change, for an equal number of total hospital inpatient days, for the same distribution of patients by inpatient category.

51. Time required to complete laboratory test request slips outside the laboratory will change, for an equal number and distribution of test requests.

52. The numbers of improperly completed outpatient test request slips arriving at the reception desk will change, for an equal number and distribution of test requests.

53. Time required by supervisors (laboratory officers) to respond to inquiries, complaints, errors detected before test results are reported, and errors in test results reported to physicians will change, for an equal number and distribution of test requests.

54. Time between distribution and filing of laboratory reports will change.

55. Time required for completing cumulative laboratory reports (equivalent to flow sheets of laboratory results) will change.

56. Time required to report *stat* results by telephone will change, for an equal number and distribution of test requests.

57. Time required for preparing a list for the laboratory of admissions, interward transfers, and discharges will change, for an equal number and distribution of test requests.

58. Time required for reviewing new AFCLAS-generated reports will change, for an equal number and distribution of test requests.

A number of potential effects of AFCLAS that have been identified are not included in the above hypotheses. Thus, they are not specifically addressed by the data collection and analyses. They are excluded for one or more of the following reasons:

- The estimated magnitude of the change was small.
- The change could not be defined precisely.
- The data collection would unduly disrupt laboratory or hospital operation.
- Data collection would be too expensive for the information gained.

The potential changes not specifically included are listed below:

1. The time laboratory personnel spend walking
2. Time spent by technicians to begin online data collection each morning and after each interruption of computer operation
3. The time lost with AFCLAS in correcting improperly completed mark-sense request forms and improperly marked test results and time lost in reentering the

corrected cards (If preliminary observation, after AFCLAS is installed but before Period Y, shows that this time is significant, the hypothesis can be added and listed.)

4. Time spent in maintaining backup system proficiency
5. A change in the laboratory staff's average skill level
6. A change in the number of tests that are repeated because of errors in the laboratory
7. A change in the number of physician requests for repeat tests
8. A change in accuracy of test performance (as contrasted with accuracy in transcription of results)
9. A decrease in the number of reports going to physicians with results that are inconsistent with patient life
10. Changes in time spent in quality control other than time spent on calculations
11. A change in the number of improperly completed inpatient request slips
12. A change in the number of physician walk-in inquiries to the laboratory
13. A change in the utility of administrative and quality control reports
14. A change in the number and kind of quality control reports
15. A change in the technician time involved in returning the laboratory to computer support when AFCLAS goes down (Actual time spent operating the AFCLAS computer is included in an hypothesis.)

III. DATA COLLECTION AND ASSUMPTIONS

This section describes in general terms the data collection effort required to implement the evaluation plan as well as several assumptions especially fundamental to the evaluation. The specific data to be collected, methods for estimating sample sizes, and methods for collecting the data are contained in Appendix B, Data Collection Handbook.

The evaluation plan requires that data be collected before AFCLAS is installed and again after it is fully operational to investigate the hypotheses listed in Section II. Ideally, Period Y, the data collection period after AFCLAS is implemented, should not begin until well after AFCLAS becomes operational and is functioning properly to support the laboratories (considering the risk of intervening factors*) because of slow user acceptance. This phenomenon of resistance to innovation or change, called *cultural lag*, is well documented in the sociological literature. This suggests that acceptance, satisfaction, and enthusiasm for AFCLAS would increase for at least several years after the system becomes operational. The Battelle study of the Technicon Medical Information System at El Camino Hospital in California found that physician acceptance of the system continued to increase for over 2 years after the system was operational. Assuming that AFCLAS becomes operational in 3 to 5 months after the end of Period X, then the data collection for Period Y might start 6 months after operation, which would be 1 calendar year following the beginning of Period X, in order to minimize seasonal variations. However, it has been decided by the Directorate of Medical Plans and Resources, Office of the Surgeon General, Headquarters United States Air Force, that Period Y will begin 3 months

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* See Appendix A.

after acceptance of AFCLAS. Three months is the minimum time acceptable to allow the laboratory to make the transition to smooth automated operation. The periods of data collection will be 4 weeks for most data items and several months for a few data items. The length of the actual data collection period is determined by the required sample size and physical limitations of sampling.

The time specified for Period X data collection should be selected after considering the following factors, which will influence data collection or analysis:

- Any changes in laboratory operations implemented before or during Period X in anticipation of AFCLAS will reduce the validity of the study.
- Efficiency of operation varies with workload (busy or slow month). During summer months, laboratory workload is traditionally low, and there are many military transfers.
- Short-term perturbations in laboratory operation (e.g., during flu season or over Christmas and New Year holidays) will influence the study.

The following list of general tasks for the data collectors provides an overview of the data collection effort:

- Gathering workload data routinely compiled by laboratory technicians
- Counting items in laboratory files, logs, etc.
- Performing time studies of laboratory tasks
- Observing laboratory activities during sampling periods
- Sampling records and reports
- Administering questionnaires

- Conducting interviews
- Gathering cost data from the finance department.

Generally, specification of the data items and the collection methods (see Appendix B) was guided by the hypotheses and the associated analyses. These are discussed in Sections II and IV, respectively. In addition, information is needed to assess the effects of intervening factors, and that information cannot be completely specified in advance. Some data items associated with the hypotheses will be useful in studying intervening factors, and the following items are included specifically for that purpose:

- The number of tests per day, by kind of test, received from any facilities other than outpatient clinics and dispensaries that routinely send laboratory specimens to the clinical laboratory for analysis in Periods X and Y.
- Significant changes in the laboratory equipment configuration (with the exception of AFCLAS hardware) from the beginning of Period X through the end of Period Y.
- Changes in administrative policy from the beginning of Period X through the end of Period Y, regardless of source, that affect kinds and volume of tests performed, information handling workload, utilization of expendables, or any other factors being assessed in the evaluation.

In response to a request for cooperation from the Office of the Surgeon General, the Directorate of Manpower and Organization, Deputy Chief of Staff Programs and Resources (AF/PRM) assigned members of the Management Engineering

Team (MET) to collect data for the evaluation of AFCLAS as described in Appendix B. The MET is a group of officers and noncommissioned officers (NCOs) trained in industrial engineering techniques. Their primary task is to support base level functional managers with studies of manpower related problems. They also participate in establishing and maintaining manning standards for diverse work centers and functions. The base level MET can also provide management consultant support to functional managers. In this capacity, they exercise a wide range of investigative and analytical techniques in addressing various management problems.

The data collection activities have been designed to interfere minimally with personnel at the medical facility. However, cooperation and some participation is needed in conjunction with the tasks of the MET data collectors. Appendix B contains lists of the data collection activities that require assistance from laboratory personnel and of those that require the assistance of other facility personnel. Assistance of laboratory personnel includes distributing forms to a sample of patients, completing a questionnaire, and providing daily workload records to the data collectors. Tasks for personnel outside the laboratory include completing questionnaires and providing certain workload information.

One task requested of laboratory officers should be mentioned separately. That task is to identify changes, occurring between Periods X and Y, that are not specifically associated with AFCLAS, and any other intervening factors that could potentially affect the results of the evaluation. This is particularly important since the data collection team will not be onsite during the interval between Periods X and Y.

The 58 hypotheses that served to guide the study, the methods of analyses, and the methods of data collection, all imply several assumptions. The most fundamental assumptions are as follows:

- Changes identified by the hypotheses are effects of implementing AFCLAS.
- The hypothesized changes account for the most significant changes due to AFCLAS.
- The case mix of inpatients seeking help remains constant.
- The proportion of each beneficiary class for both inpatients and outpatients remains constant.
- The values of several variables* that are affected by workload vary directly with the volume of tests requested.
- The "Hawthorne Effect"† operates during both Period X and Period Y, and the net impact of the Hawthorne Effect on differences between Period X and Period Y is zero.
- During Period Y, AFCLAS operates in compliance with the RFP specifications and terms of the contract.
- The unit times for the tasks time studied remain constant over small changes in workload.
- The unit times for the tasks time studied remain constant over small changes in staffing levels.

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* This assumption was made when adjusting the following variables for the change in workload between Period X and Period Y: number of old request slips, lines on worksheets, and inquiry phone calls.

† Working extra hard because of the feeling of participating in something new and special has come to be known as the 'Hawthorne Effect'" (Reference 1).

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(1) Edgar H. Schein. Organizational Psychology. 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970: 32.

IV. ANALYSIS

The previous sections and associated appendices list 58 changes as hypothesized effects of AFCLAS to be evaluated, and identify the data to be collected before and after the system is installed. This section describes the analyses of that data that will be performed in carrying out the evaluation. Three main kinds of analyses are planned:

- Statistical studies of selected hypothesized changes
- Calculation of a net cost of AFCLAS using system costs and the impacts that can be quantified in dollars
- Evaluation of survey questionnaire responses.

Separate statistical studies will be made of anticipated changes in:

- Percentage of laboratory reports filed in the outpatient medical record
- Percentage of laboratory reports filed in the inpatient medical record
- Percentage of outpatient request slips arriving at the reception desk with one or more serious errors
- Duration of inquiry phone calls
- Frequency of inquiry phone calls
- Patient time in clinical laboratory for specimen collection
- Patient service time at the reception desk

- Turnaround time for routine laboratory reports
- Turnaround time for *stat* laboratory reports.

All changes with which a dollar benefit or cost can be associated will be included in the analysis of dollar benefits and costs except those that require prohibitive data collection effort.

Responses to survey questionnaires will be used to study the acceptance of AFCLAS by the several categories of personnel affected by it, as well as to investigate their satisfaction with the system's performance. The responses will also provide information for evaluating possible effects on patient care and on the usefulness and timeliness of the laboratory reports that are provided.

Some effects of the system will not be evaluated in these studies. Some of them have been specifically excluded as explained in Section II. The proposed studies consider a wide range of expected impacts and should also reveal any significant ones overlooked.

The proposed analysis is described in the following subsections.

A. Accuracy and Completeness of Records, Requests, and Reports

1. Completeness of the Medical Record

A patient's medical record is not complete with respect to the laboratory work that has been done for him unless it contains a report of all tests completed for him. Medical record completeness is therefore defined for the evaluation as the percentage of completed laboratory reports that are filed in the medical record after a specified period of time. A possible benefit of AFCLAS will be to increase medical record completeness.

Inpatient and outpatient records will be studied separately. In each case, a sample of completed reports will be obtained from the laboratory for subsequent followup in a medical records search. For outpatients, the data will be tested for changes between Periods X and Y in: a) the percentage of laboratory reports found in the medical record 1 month after completion by the laboratory, and b) the time between completion of reports by the laboratory and their arrival in the Outpatient Medical Records Department. For inpatients, a test will be made for a change in the percentage of reports that are filed in inpatient records on the wards daily for 5 days after they are completed in the laboratory and for a change in the percentage that are filed in inpatient records after 1 month.

Since laboratory reports and laboratory records will be different before and after the automated system is introduced, comparable units will have to be carefully defined for sampling and analysis. As an illustration, with AFCLAS a single paper form may report results that would have been presented on three separate forms with the manual system.

2. Errors in Arriving Outpatient Requests

In order for laboratory reports to be distributed and filed, the laboratory request slip must contain information identifying the patient and the hospital area generating the test request. Inpatient identification information is highly reliable because a plastic or metal card is used with an addressograph printer. For this reason errors in arriving inpatient requests are not studied in detail. Outpatient identification information is not complete. Therefore, a statistical test for a change between Period X and Period Y will be conducted with respect to the number of errors in outpatient request slips at the time they arrive at the reception desk. For this study, such errors are defined as

missing or illegible patient name, missing, illegible or incomplete social security number, and illegible or missing clinic name.

3. Accuracy of Test Result Reporting

Improved accuracy of test result reporting is expected after AFCLAS is introduced because there will be less opportunity for errors in transcription of results and other test information. The number of errors avoided will be roughly estimated for a sample of laboratory sections or tests by considering the numbers of transcriptions required before and after AFCLAS is introduced and using standards for transcription error rates.

B. Timeliness of Laboratory Test Results

1. Laboratory Request Turnaround Time

An important objective of the laboratory is to provide results of laboratory tests to physicians as quickly as possible. Thus, a reduction in request turnaround time as a result of AFCLAS would be a positive contribution to the operation of the laboratory. Turnaround time begins when the request is received by the laboratory and ends when the report of results reaches the point to which laboratory personnel distribute it. (A precise definition is given in Appendix A.) Turnaround time will be investigated separately for *stat* and routine requests and by laboratory section as appropriate. Different turnaround times are characteristic of different sections due to the nature of the task performed. The data will be tested for a change between Periods X and Y in the turnaround time for these types of requests.

In addition, the physician questionnaire will provide information about the physicians' satisfaction with turnaround time during Periods X and Y and whether they perceive a change.

2. Telephone Inquiries

Another potential contribution of AFCLAS to timely availability of test results to physicians will be the increased accessibility of the information to laboratory personnel when answering telephone inquiries and accessibility of results in clinics and wards through remote terminals making such calls unnecessary. Thus, data on duration and frequency of such calls will be analyzed for a change between Periods X and Y.

3. *Stat* Requests

It is possible that the percentage of tests ordered *stat* will change after introduction of AFCLAS. In the event of a decrease, the laboratory will experience less disruption for this special handling. Part of the additional technician time required for tests ordered *stat* is considered in the analysis of dollar benefits and costs that are required to telephone results to nursing units or outpatient clinics—but this does not measure the total impact of a change in the proportion of *stat* requests so the percentage of tests ordered *stat* will be studied.

4. Remote Terminals

Timely availability of test results will be enhanced where remote terminals are provided. Through the use of remote terminals, physicians will be able to obtain laboratory results before they receive the laboratory report.

C. Dollar Benefits and Costs

The objective of the dollar benefits and costs analysis of AFCLAS is to estimate the net change in laboratory benefits and costs as a result of introducing AFCLAS; that is, to estimate the cost of the system and its operation decreased or increased by the cost changes associated with the impacts

studied. The change in benefits and costs to be derived is the difference between the net cost of operating the laboratory during Period Y with AFCLAS support and the hypothetical benefits and costs of handling the Period Y workload using the Period X (manual) methods. The cost of manual operation will be estimated using the workload observed during Period Y and the data on manual laboratory operations collected during Period X (e.g., what tasks are performed, and with what frequency in relation to test workload). If this net cost is negative (implying a dollar savings), the nondollar benefits of the system are "free." If the net cost is positive, it must then be weighed against the other benefits not quantified in dollars.

$$\begin{array}{c}\text{Net Change in} \\ \text{\$ Costs due} \\ \text{to AFCLAS}\end{array} = \begin{array}{c}\text{Direct \$ Cost} \\ \text{of AFCLAS}\end{array} + \begin{array}{c}\text{\$ Change in Other} \\ \text{Facility Costs}\end{array} . \quad \text{(i)}$$

In addition to the cost of the AFCLAS contract for provision of hardware, software, and maintenance, costs of the following items will be considered in calculating the direct dollar cost of AFCLAS:

- Site preparation
- Personnel (assigned exclusively to computer operation)
- Power costs (including power for air conditioning)
- Maintenance of AFCLAS-related facilities and equipment not included in the system contract.

The greatest change in facility costs will most likely be a reduction in the personnel time required to carry out the routine clerical tasks of operating the laboratory. The change in personnel cost of clerical tasks inside the clinical laboratory is designated ΔC_A. Other cost changes that will be included in the analysis are changes in the costs

associated with certain tasks performed outside the laboratory, designated ΔC_B, and changes in the cost of paper forms (including computer forms) designated ΔC_F.

Thus

$$\text{\$ Change in Other Facility Costs} = \Delta C_A + \Delta C_B + \Delta C_F \ .$$

The methodology is the same for calculating both the change in cost ΔC_A of personnel time inside the laboratory and the change in cost of personnel time outside the clinical laboratory ΔC_B. The methodology for calculating ΔC_A is to sum for all tasks that were time studied, the difference between the cost of performing the task in Period Y and the cost of performing the task in Period X. For any task, the difference can be positive or negative. A positive value represents an increase in cost, while a negative value represents a decrease in cost. The cost for a task can be zero in either or both Periods X and Y. The costs for each task are subdivided by personnel category. Mathematically, this addition of cost differences is expressed by equations (ii) and (iii).

1. Cost Changes for Tasks Inside the Laboratory

In this case, the cost change to be estimated (denoted by ΔC_A) is the cost of laboratory staff time saved or additional time required as a result of task changes after the introduction of AFCLAS. A "task change" for the laboratory staff may be a change in the number of times the task must be done or a change in the procedure for performing the task. The following tasks, for which changes were hypothesized, will be considered in estimating ΔC_A:

- Producing administrative reports
- Answering telephone inquiries
- Filing tasks within the laboratory

- Preparing laboratory clinical forms (including log books, worksheet, etc.)
- Labeling specimens
- Preparing specimen collection lists
- Recording and transcribing laboratory test results
- Entering test requests, patient information, and test results into the computer system
- Supervisors' and technicians' reviews and certification of results
- Performing statistical analysis for quality control
- Performing statistical analysis on patient results by population
- Calculations and/or conversions from raw to clinical values for test reports
- Operation of a computer by laboratory staff (does not include computer operation by personnel brought into the laboratory to perform this function)
- Responding to inquiries, complaints, and errors by laboratory supervisors
- Reporting results of *stat* tests by telephone
- Reviewing new AFCLAS-generated reports.

The cost change to be estimated is ΔC_A, the dollar cost of the difference between the laboratory staff time required to do the tasks considered during Period Y (with AFCLAS) and the time that would have been required for these tasks manually (without AFCLAS). The cost for a task can be zero in either or both Periods X and Y. The manual time requirements are to be estimated by adjusting Period X time requirements to the Period Y workload. ΔC_A is the sum of the changes observed for the individual tasks.

$$\Delta C_A = \sum_{i=i}^{n} \Delta C_{A_i} \qquad \text{(ii)}$$

where

n = the number of tasks included

ΔC_{A_i} = the dollar cost change in manpower for task i, as a result of having AFCLAS during Period Y.

$$\Delta C_{A_i} = \sum_{j=1}^{k} \left(p_{ij}^{(2)} \; y_i^{(2)} \; h_i^{(2)} - p_{ij}^{(1)} \; y_i^{(1)} \; h_i^{(1)} \right) c_j \qquad \text{(iii)}$$

$$i=1, 2, \ldots, n$$

where

k = number of laboratory personnel categories (laboratory technician, laboratory officer, etc.)

c_j = cost per hour of personnel category j in Period Y

$y_i^{(t)}$ = number of units of task i that would be associated with the Period Y workload for the manual system (t = 1) and with AFCLAS (t = 2)

$p_{ij}^{(t)}$ = fraction of the total time required for task i that is routinely contributed by personnel in category j with the manual system (during Period X) (t = 1) and after introduction of AFCLAS (during Period Y) (t = 2). $\sum_{j=1}^{k} p_{ij}^{(t)} = 1$.

$h_i^{(t)}$ = number of hours required to do one unit of task i with the manual system (t = 1) and with AFCLAS (t = 2).

If there is no difference between the number of task i units with the manual system and with AFCLAS, then $y_i^{(1)} = y_i^{(2)}$. Similarly, if the time required per unit of task i is the same with the manual system and with AFCLAS, then $h_i^{(1)} = h_i^{(2)}$. Values of the variables $y_i^{(1)}$, $y_i^{(2)}$, $p_{ij}^{(1)}$, $p_{ij}^{(2)}$, $h_i^{(1)}$, and $h_i^{(2)}$ will be derived from data collected in the laboratory before and after the introduction of AFCLAS.

ΔC_A should be adjusted to account for computer downtime. Assuming that the manual system is used during computer downtime, one method for adjusting the value for ΔC_A would be to

reduce the absolute value of each sum and in the expressions for ΔC_{A_i} by the actual percentage of downtime. This adjusted value is only an approximation because it underestimates the cost for downtime in the prime shift by ignoring the technician time involved in returning the laboratory to computer support and overestimates the cost for downtime in off hours when the laboratory is running with a minimum number of technicians.

The value, ΔC_A, as it has been described, is based on a comparison of laboratory operations during two periods of data collection. The effects of intervening factors such as equipment changes (other than AFCLAS), seasonal variation in the laboratory workload, the rate of change of the laboratory workload, and the rate of change in costs will be considered to generalize and project the results.

2. Cost Changes for Tasks Outside the Laboratory

The cost changes for tasks outside the laboratory will be estimated in the same manner as for those inside the laboratory. The tasks that will be considered are:

- Placing telephone inquiries
- Filing laboratory reports in outpatient medical records and at nursing stations
- Preparing test request slips outside the laboratory
- Preparing cumulative laboratory reports
- Keyboard entry of patient information in the registrar's office
- Creating for laboratory use, a list of admissions and interward transfers.

Equation (iii) will be used to calculate:

ΔC_B = the cost change in laboratory-external manpower dollars of having AFCLAS during Period Y.

3. Change in the Cost of Laboratory Paper Forms

Some change in the cost of the paper forms used for laboratory operations may result from the introduction of AFCLAS. This is because the three-part carbon request slips will be replaced by single-copy mark-sense cards and because many laboratory worksheets and log books will be eliminated. The value of such a cost reduction to the laboratory is:

ΔC_F = the change in paper forms cost of having AFCLAS during Period Y (including computer forms).

ΔC_F is the difference between the estimated cost of using the paper forms associated with the manual system (those in use during Period X) during Period Y, and the actual cost of paper forms used with AFCLAS during Period Y.

4. Dollar Impact of Reports Provided by AFCLAS

AFCLAS will automatically generate some of the reports currently produced by manual methods. In addition, AFCLAS will generate new reports or provide additional information on old ones. The benefit expressed as cost of personnel time of replacing manually generated reports by computer generated reports is included in the calculation of cost changes for tasks inside the laboratory. The value of reports not available prior to the introduction of AFCLAS is difficult to assess. One way to attach a dollar value to reports generated by AFCLAS that were not available under the manual system is to assign them a value equal to the cost of producing them manually. Such a method is not consistent with the guidelines for this analysis. While it is reasonable to conclude that the reports have some dollar value to the laboratory, the cost of producing them manually does not adequately represent that value. The implied dollar benefit of such a report probably

lies somewhere between zero and the cost of producing it manually. It is a function of how frequently the report is used and by whom, as well as of its utility to the users. An estimate of the dollar benefit would be the amount the laboratory would be willing to spend to have the report without AFCLAS. However, no attempt is planned in this evaluation to obtain these hypothetical amounts. It is even more difficult to assess the value of information added to reports that existed previously. The usefulness to physicians of new reports or additional information on old reports will be studied qualitatively by means of the physician schedule. In addition, reports produced with the manual system and those produced by AFCLAS will be listed for comparison.

D. Acceptance and Satisfaction

Improved satisfaction with the clinical laboratory by persons affected is a potential benefit of AFCLAS. This includes physicians, registered nurses, the laboratory staff, patients, Outpatient Medical Records staff, and Admissions and Dispositions Department staff. In addition, the perception of AFCLAS by these people will be a determinant in realizing other aspects of the system's value. Personnel both inside and outside the laboratory will have to accept new and changed procedures. New report forms must be acceptable to physicians as well as to laboratory staff. Satisfaction by physicians may change their test requesting patterns in both the number and kinds of procedures requested.

Scores on survey questionnaires administered both before (during Period X) and after (during Period Y) AFCLAS is introduced or information gained during interviews will be used as the measure of acceptance and satisfaction in the evaluation. The following groups of people will be surveyed:

- Physicians
- Registered nurses
- Staff of the laboratory departments
- Patients
- Staff of the Outpatient Medical Records department
- Staff of the Admissions and Dispositions department.

The same method will be used for scoring both the physicians' and registered nurses' questionnaires. A method has been chosen that weights each question differently, since the pretest showed that the respondents attached a wide range of importance to the questions. A standard score is computed for each question by calculating the standard deviation of each response from an assumed normal distribution. The laboratory staff questionnaire is made up of two parts. The first part is a conventional job satisfaction questionnaire and will be scored using a Likert scale. The second questionnaire is designed solely to obtain data on the laboratory operation so it will not be scored. The responses will be tallied and summarized in a table. The laboratory patient questionnaire is designed to measure patients' perceptions of the organizational climate of the clinical laboratory and will be scored using a conventional Likert scale.

The survey questionnaires and further description of the analyses techniques are included in Appendix C.

E. Benefits to Patients

1. Quality of Patient Care

The laboratory exists to support patient care, but the impact of the laboratory on the patient is not direct since it occurs through its usefulness to physicians. Thus, the impact is not likely to be perceived by the patient. Therefore,

the physicians' questionnaire will measure a physician's perception of the impact of the laboratory on patient care.

2. Patients' Time to Obtain Laboratory Services

The time it takes for a patient to obtain laboratory service is the time between entering the laboratory with a request slip and leaving the laboratory after all necessary specimens have been collected. Data on the time patients spend in the laboratory will be tested statistically for a change between Period X and Period Y.

F. Demand for Laboratory Services

One possible effect of AFCLAS could be a change in the demand for laboratory services. This could occur in at least two ways. First, as previously mentioned, increased satisfaction of physicians with the services may cause them to alter their patterns of test requests. Second, increased patient satisfaction may lead to greater utilization of outpatient and inpatient services and, in turn, lead to increased demand for laboratory services.

Some indication of a change in physician utilization of the laboratory may be obtained from an examination of the ratios of outpatient laboratory requests to outpatient visits and inpatient laboratory requests to inpatient bed-days, assuming that case mix does not change and that the distribution of reasons for inpatient and outpatient utilization does not change significantly. These ratios will not be reviewed in this evaluation. Historically, the workload of clinical laboratories is rising for a constant patient workload. For example, when the physician has the option of ordering a panel, he often orders a panel rather than one or two tests. Preliminary analysis of historical data from one test site indicated an increasing workload per outpatient visit, but it was not possible to estimate accurately the

actual growth rate because of the wide fluctuation in the number of tests requested. Thus, it would not be possible to separate a change in demand for laboratory tests due to AFCLAS from a change due to natural fluctuations and an overall long-term increase in demand.

Change in patient use of outpatient and inpatient facilities because of AFCLAS will not be investigated because it would be difficult to collect valid data and because the expected impact of AFCLAS on patient demand is small.

G. Laboratory Productivity per Technician

One way that the changes in time required for laboratory tasks should eventually be reflected in laboratory operations is in a change in productivity per technician. Such a change will be determined primarily by the demand for laboratory tests and by administrative policies and decisions concerning manpower utilization. The effect of AFCLAS on the laboratory's manpower needs would probably not be indicated by a measure of the laboratory's productivity, since the period of the evaluation is too short. Hence, overall laboratory productivity will not be studied.

H. Analysis of Intervening Factors

Changes in the laboratory that are not related to the introduction of AFCLAS will probably occur in the interval between Periods X and Y. An important part of this study is to identify these intervening factors and to investigate their effects on the hypothesized changes. Data will be collected, and laboratory officers will be asked to help to identify intervening factors. In some cases, the impact of intervening factors on hypothesized changes may be directly measurable; in some, it may be possible to estimate the magnitude of impact; in others, it may only be possible to note that an external

change took place. The methods of analysis to study intervening factors will be dependent on the changes that are observed. Although it is impossible to eliminate the effects of intervening factors, careful study design has been used to minimize them wherever possible.

V. ESTIMATING THE EFFECTS OF INTRODUCING AFCLAS AT OTHER FACILITIES

One of the goals of the AFCLAS evaluation is to provide information for determining whether AFCLAS should be proliferated. All clinical laboratories using a manual information system must process the same basic information in about the same way (i.e., test requests come to the laboratory on request slips, intermediate and final answers are recorded on worksheets, and the answers are returned to the physician on the request slip). For this reason it is probable that if AFCLAS is introduced at laboratories of approximately the same size as the two test sites, many of the benefits will be approximately the same as the benefits realized at the two test sites. Such an extrapolation of benefits is less justifiable when estimating the expected benefits of introducing AFCLAS into laboratories significantly smaller or significantly larger than the two test sites. Some of the difficulties include:

- Laboratory operation is more likely to be different.
- The numbers and kinds of automated equipment are more likely to be different.
- The numbers and kinds of automated equipment that will be online with AFCLAS are more likely to be different.

One method for estimating the cost benefits of introducing AFCLAS into another Air Force clinical laboratory (call it Laboratory Z) is described below.

A large portion of the dollar benefits and costs of introducing AFCLAS is the result of changes inside the laboratory, such as:

- A reduction in the number of laboratory clinical forms that the technicians are required to complete (includes reduced transcription)

- A reduction in filing and handling of laboratory forms
- A reduction in the amount of time required to complete administrative reports.

With a detailed list of specifications for the AFCLAS system proposed for Laboratory Z and the results of the evaluation at the two test sites, the impact of AFCLAS in Laboratory Z can be estimated. A survey of the operation of Laboratory Z should be made to identify the following prospective effects of AFCLAS:

- All laboratory clinical forms that will be eliminated by AFCLAS
- The administrative reports that will be compiled by AFCLAS rather than by hand
- Tasks in which AFCLAS will reduce the filing and handling of laboratory forms.

Once these changes in the operation of Laboratory Z are identified, some data collection will be necessary to estimate their magnitude. These data will be similar to the data collected at each test site during Period X.

The object of data collection at Laboratory Z is to estimate the values ΔC_{A_i} used in the benefits and costs analysis. Accurate calculation of the ΔC_{A_i}'s would require data that can only be collected after implementation of AFCLAS. However, most of this data can be estimated from the data collected during Periods X and Y at the two test sites. The following examples are given for clarity.

- If AFCLAS will eliminate five different worksheets in the Chemistry Department of Laboratory Z, then the total number of worksheets that will be eliminated

per month can be calculated. Also, the average time to complete one worksheet can be computed using data collected during Period X. Since the task would be completely eliminated by AFCLAS, all necessary data are available for computing ΔC_{A_i} for the task of completing chemistry worksheets.

- The time required to retrieve information about test status for the physician when AFCLAS is implemented in Laboratory Z will not be known until the system is actually implemented. However, the method of retrieving test status using a CRT terminal will be the same for all AFCLAS systems. Therefore, the time to retrieve information about test status can be estimated as the average length of time to retrieve test status at the two test sites in Period Y.

The new tasks created by introducing AFCLAS into Laboratory Z will be essentially the same as those identified at the two test sites. The time involved in most of these new tasks is directly related to either the number of laboratory tests processed or to the number of patients having laboratory tests. Therefore, the increase in technician time spent performing new tasks after AFCLAS is installed can be roughly estimated from data collected at the test sites. When the dollar cost of introducing AFCLAS into Laboratory Z is known in addition to the previously described savings and costs, an estimated net cost of introducing AFCLAS can be calculated as described in Section IV-C.

If AFCLAS is accepted and satisfies staff members at both test sites, it is reasonable to assume acceptance and satisfaction at Laboratory Z. This should also be true of the other nondollar benefits. If the evaluation yields different results at the two test sites, then extrapolation to another clinical laboratory may be precluded.

Assuming that similar results are measured at the two test sites, as briefly outlined above, it should be possible to estimate the impact of introducing AFCLAS into other Air Force laboratories. At the present time, the scope of this evaluation does not include estimating the impact of introducing AFCLAS into any of the candidate Air Force laboratories; hence a detailed methodology has not been defined.

VI. SUMMARY

The results of the functional evaluation of AFCLAS are to be used in answering three questions:

1. What is the value of AFCLAS to the medical facility studied?
2. What would be the value of AFCLAS to other medical facilities?
3. What changes in AFCLAS could be made to enhance its value to the medical facility studied or to others?

The evaluation plan primarily addresses the first question by providing for calculation of the net dollar cost of AFCLAS as well as for investigation of nondollar benefits of the system. The plan thus recognizes that the total value of AFCLAS to the medical facility studied cannot be expressed in dollars.

The net dollar cost of AFCLAS is the difference between the cost of processing the workload of the clinical laboratory with AFCLAS and the cost of processing it with the previously used manual system. The net cost may be negative, indicating dollar savings after introduction of AFCLAS. The following changes are hypothesized and are considered along with the direct cost of AFCLAS in determining the net cost:*

- Changes in personnel time required (both inside and outside the laboratory) to process the laboratory's workload (this includes time to process paperwork);
- A change in the kinds and numbers of paper forms used.

*The direct dollar cost of AFCLAS includes items such as equipment cost, installation cost, maintenance cost, computer personnel salary cost, cost of electric power and cost of air conditioning.

The evaluation of nondollar benefits of AFCLAS includes surveys or interviews to study the reactions of persons affected by the system including physicians, patients, the laboratory staff, and staffs of nursing units, outpatient clinics, and the Medical Records Department. Also to be investigated is the hypothesized impact by AFCLAS on:

- The proportion of tests ordered *stat*
- The amount of time that the laboratory staff must work in addition to normal duty hours
- The completeness of the medical record
- Timeliness of laboratory results
- New reports and information that are available
- Patient care.

The plan was formulated to include as many of the potential effects of AFCLAS as possible without requiring a prohibitive amount of data collection. Data are required for analysis of hypothesized changes and effects, for assignment of dollar costs, and for investigation of factors other than AFCLAS that are affecting laboratory operations. These data include: numbers and distribution by kind of test request, time requirements of various tasks, numbers and cost of personnel by category, costs of AFCLAS, costs of paper forms, and information about equipment changes and changes in administrative policies.

The answers to the first question (What is the value of AFCLAS to the medical facility studied?) together with the data on current operations of other facilities to which introduction of AFCLAS is being considered, provide a basis for answering the second question. However, using the data to answer the second question is not planned as part of the evaluation.

It is expected that the data collected in answering the first question will also provide a basis for identifying certain changes in AFCLAS that might increase its value. However, much of the data needed for this purpose cannot be anticipated in advance of its installation. More specific evaluation for improvements must be planned when those improvements can be anticipated.

APPENDIX A

DEFINITIONS

1. Acceptance - level of system approval as measured by scores on an acceptability instrument.

2. Administrative reports - reports required by Headquarters USAF or subordinate commands.

3. Cumulative summaries or flow sheets - a summary of laboratory test results displayed so that it is easy to observe trends over time in the results of any specific laboratory test.

4. Direct dollar cost of AFCLAS - consists of operating costs and acquisition costs. The operating costs include rental of computer hardware and auxiliary equipment, maintenance of computer and auxiliary equipment, computer supplies, and electricity. The acquisition costs include facility modification, acquisition of permanent equipment, shipping, and installation of computer hardware.

5. Hypothesis - a tentative assumption about a potential impact of introducing AFCLAS. Use of the term hypothesis does not imply that statistical hypothesis testing will be applied in each case. However, where appropriate, validity of the hypothesis will be tested using standard statistical techniques. The hypotheses are intended primarily to serve as a guide for data collection and analysis.

6. Intervening factor - a change in operation or policy of either the laboratory or the hospital that occurs between the beginning of Period X and the end of Period Y, that was not associated with AFCLAS, and that could affect the data to be collected for evaluating AFCLAS.

7. Laboratory clinical forms - all forms (including logbooks) used in the laboratory for test requests, test processing, and test reporting; quality control forms and internal records of the number of tests performed.

8. Laboratory reports - all paper forms sent to physicians to report the results of clinical laboratory tests.

9. Laboratory request - a paper form or computer card sent to the clinical laboratory to request laboratory tests. In some cases a request may become a laboratory report when results are written on it.

10. Laboratory staff - all laboratory personnel excluding pathologists, laboratory officers, secretaries, and volunteers.

11. Quality of patient care - the degree to which health care provided by a health care system or a specified component of that system meets the standards or norms implicit in the system or explicitly established for it.

12. Job satisfaction - level of overall job contentment as measured by scores on a job satisfaction instrument.

13. Laboratory technicians - used herein to include both laboratory technologists and laboratory technicians.

14. Telephone inquiry - any telephone call to the clinical laboratory to obtain test status or test results.

15. Turnaround time - time from arrival of the request in the laboratory to time the report is ready for distribution. The specific definition of turnaround time varied slightly between Period X and Period Y and between a routine request and a *stat* request as follows:

    Routine request Period X - time of arrival of request is actual time of arrival for all requests that arrive between 0600 and 2000 hours. A constructive time of 0600 hours is assigned to routine requests that arrive between 2000 hours and 0600 hours. Completion time occurs when reports are brought to the front desk, stamped with the time, and placed in a box for later distribution.

    Routine request Period Y - time of arrival is actual time the test request card is read into the AFCLAS system in the reception area for all request cards that arrive between 0600 and 2000 hours. A constructive time of 0600 hours is assigned to routine requests that are read into the system between 2000 hours and 0600 hours. Completion time is the time daily cumulative summaries are printed.

    Stat request Period X - time of arrival of request is actual time of arrival for all *stat* requests. Completion time occurs when reports are brought to the front desk, stamped with the time, and placed in a box for later distribution. Note that the turnaround time defined herein is turnaround time for paperwork. In most cases the results of *stat* tests are telephoned to the physician prior to bringing the report to the front desk.

Stat request Period Y - time of arrival is actual time the test request card is read into the AFCLAS system in the reception area. Completion time occurs when reports are printed on the *stat* printer immediately following validation of the results. Note that the turn-around time defined herein is turnaround time for paperwork. In most cases the results of *stat* tests are telephoned to the physician prior to validation and printing.

16. Usability of laboratory reports - qualitative assessment by physicians of the convenience and practicability of reports.

APPENDIX B

DATA COLLECTION HANDBOOK

(Prepared Prior to Period X With Minor
Additions Prior to Period Y)

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NOTE ON APPENDIX B

This appendix discusses the special studies involved in the evaluation of AFCLAS and describes in detail the data to be collected as well as the methods of data collection. The data collection can be divided into the following categories:

- Measuring or estimating the time required to complete specific tasks (work measurement)
- Counting the number of times specified items or tasks are done
- Identifying the personnel involved in specified tasks by personnel category
- Obtaining information about laboratory operations
- Obtaining cost information
- Administering survey questionnaires.

The data items to be collected and the methodology for collecting them are presented in this appendix in the form in which they were provided to Management Engineering Team (MET) personnel as a data collection handbook.

Discussion of the questionnaires is deferred until Appendix C.

I. SUMMARY OF TIME STUDIES FOR EVALUATION OF AFCLAS

This section summarizes the time studies for the evaluation of AFCLAS, along with their associated time measurement, data collection item to be counted, and hypotheses (see Section II of the evaluation plan).

Task	Time Measurement	Items Counted	Associated Hypotheses
1. Tasks involved in preparation of administrative reports and College of American Pathologists (CAP) workload reports	Time per task accomplishment for each task	Number of times during Period X that each task is done	1, 10
2. Filing request slips in laboratory files	Time per request slip	Request slips	6
3. Filing test worksheets and workload log sheets in laboratory files by laboratory section and centrally	Time per page	Test worksheets and workload log sheets by laboratory section	6
4. Filing quality control reports/ statistical summaries in laboratory files	Time per report produced, by laboratory section	Number of times reports are produced by laboratory section	6
5. Other laboratory filing tasks	As appropriate	As appropriate	6
6. Removing outdated items from laboratory files for each kind of file	Time per task accomplishment by kind of file	Number of times outdated slips are removed from files, by kind of file	6
7. Filing laboratory results in outpatient medical records	Time per slip	Request slips for outpatients	7
8. Filing laboratory results in the medical records of inpatients (a) on wards (b) in medical record room	Time per slip (a) on wards (b) in medical record room	Request slips for inpatients and (a) percent filed on wards (b) percent filed in medical record room	8

Task	Time Measurement	Items Counted	Associated Hypotheses
9. Preparing and filing cumulative summaries or flow sheets of patient results	Time per patient	Percent inpatients for whom it is done	55
10. Filling out request slips at clinics and wards	Time per slip	Request slips	9, 51
11. Filling in laboratory request information on slips by laboratory personnel	Time per slip	Number of slips and percent filled in by laboratory personnel	9
12. Entering test results on slips	Time per test type (a) type (b) type (c) type (d)	Number tests by kind (a) kinds type(a) (b) kinds type(b) (c) kinds type(c) (d) kinds type(d)	9, 13, 14, 18, 19, 29
Period X: (a) printed automatically; (b) transcribed from worksheets or log books; (c) transcribed from instrument display; (d) transcribed from printout			
Period Y: (a) online; (b) manually entered into terminal from worksheets; (c) mark-sense worksheets; (d) mark-sense computer card			
13. Entering headings on test worksheets, workload log sheets, log book pages	Time per sheet or log book page	Test worksheets, workload log sheets, and log book pages	9, 29

Task	Time Measurement	Items Counted	Associated Hypotheses
14. Entering patient identification and tests requested on test worksheets, workload log sheets and in log books (except Chemistry worksheets at W-P)	Time per entry by type of sheet/log book	Test worksheet, workload, log sheet, and log book entries	9, 29
15. Entering results on test worksheets, workload log sheets, and log books, types (a), (b), (c), (d), in 12 above	Time per test types (a), (b), (c), (d), in 12 above	Worksheets, workload, log sheets and log books types (a), (b), (c), (d), in 12 above	9, 13, 14, 29
16. Labeling specimen tubes	Time per tube	Tubes labeled	11
17. Preparing "list" for routine specimen collection trips (sorting slips for technicians who collect the specimens)	Time per routine trip	Number of routine trips per day and number of technicians making trip	12
18. Supervisor's and technician's review and certification of results	Time per test, request slip, worksheet or other unit certified	Number tests, request slips, worksheets, or other units certified	20, 21
19. Performing statistical analysis of quality control sample results and recording results on report	Time per task accomplishment by laboratory section	Number of times statistics are calculated by each laboratory section and by each kind of report	22, 23, 24

Task	Time Measurement	Items Counted	Associated Hypotheses
20. Performing statistical analysis of patient results by population	Time per analysis	Number of analyses performed	25, 26
21. Performing test result calculations or conversions	Time per test by kind	Tests by kind for which calculations are done	27
22. Performing computer operation tasks (W-P)	Time per task accomplishment for each task	Number of times each task is done (per day, week, or month)	28
23. Calling a ward or clinic to report the results of a *stat* test (Consider calls originating in *stat* laboratory, hematology, and urinalysis.)	Time per telephone call	Number of telephone calls to report stat results	56
24. Supervisor's (laboratory officers) responding to inquiries, complaints, and errors	Time per supervisor	As appropriate	53
25. Processing inquiry phone calls to the laboratory	Time per telephone call	Number of inquiry calls to the laboratory	2, 3, 4
26. Retrieval of data to answer inquiries for call backs and completing the return calls	Time per telephone inquiry	Number of inquiries requiring a return call	3

Task	Time Measurement	Items Counted	Associated Hypotheses
27. Reviewing or processing new AFCLAS-generated reports	Time per report	Frequency of each report	58
28. Addition of Cytology to AFCLAS reporting system	Time per cytology report	Number of reports	11, 14
29. Preparing a list of admissions and interward transfers for laboratory use with AFCLAS	Time per transaction	Number of admissions, dispositions, and interward transfers	57

II. SPECIAL STUDIES IN THE EVALUATION OF AFCLAS

This section details the procedures to be used in data collection for a number of the special studies in the evaluation of AFCLAS.

A. Study of the Completeness of the Inpatient Medical Record and the Outpatient Medical Record (Period X).

This study is made by observing and sampling activities and records in a specified manner. The activities observed, the information extracted from records, and the procedures used are then documented.

Inpatient and outpatient reports will be treated separately following these general procedures. Each normal workday, starting on the first day of data collection and continuing for 16 days:

1. Xerox all the completed laboratory reports when they are ready for distribution. (A portable Xerox 3100 will be provided in the laboratory reception area.)

2. Separate the Xerox copies of the completed laboratory reports into the categories of (1) inpatient, (2) outpatient, (3) outpatient preoperative (preop), and (4) tests requested from remote facilities.

3. At the end of the day, number: (1) the Xerox copies of inpatient laboratory reports sequentially starting with number 1, (2) the Xerox copies of outpatient laboratory reports sequentially starting with number 1, and (3) the Xerox copies of the outpatient preop reports starting with number 1, (4) save the Xerox copies of reports for tests requested from remote facilities, but do not consider them further in the study of completeness of the medical record.

4. After the reports have been sequentially numbered, draw a random sample of 25 inpatient laboratory reports, 25 outpatient laboratory reports, and 10 outpatient preop laboratory reports. (The random sample of reports is drawn for 16 days, giving a total sample size of 400 inpatient reports, 400 outpatient reports and 160 outpatient preop reports.)

5. At the completion of the study, organize the Xerox copies of the laboratory reports as follows:

   - File the sample of 400 inpatient reports together.
   - File the sample of 400 outpatient reports together.
   - File the sample of 160 outpatient preop laboratory reports together.
   - File the copies of all other laboratory reports together by date Xeroxed.

Inpatient Medical Records

Each normal workday, starting on the first day of data collection and continuing for 16 days, do the following:

1. For each inpatient report in the daily random sample of 25, go to the ward where the inpatient is located, starting about 1900 hours. Look for the laboratory report in the following places:

   - Physician's in-basket waiting his signature (applicable to Wright-Patterson only)
   - The area where reports are placed until they are posted in the patient's medical record
   - Patient's medical record.

2. For each report found in step 1 above, note on the copy of the laboratory report:

   - Where the report was found
   - Date
   - Approximate time.

3. If a report was not found in step 1, note that fact.

4. The record of all laboratory reports not found in the medical record is to be saved. Look for each report again the evening of the next normal workday as described in step 1 above. Continue the search for a given report for 5 normal workdays (7 calendar days) or until it is located in the patient's medical record. If the report is not located in the patient's medical record in 5 normal workdays, discontinue search for the report, but retain the Xerox copy for the month-end check. (This study will be conducted only on the evenings of normal workdays. Weekends and Federal holidays will be ignored.)

5. If an inpatient is discharged before a laboratory report is located in his medical record, look for the report on the ward in the area where reports to be sent to Inpatient Medical Records are located. If the report is not found after a total of 5 normal workdays, discontinue search for the report. Retain the Xerox copy for the month-end check.

6. When an inpatient is transferred, look for his laboratory reports both on the patient's current ward and on his previous ward.

7. Repeat the above process in steps 1 through 6 for each of the 16 random samples of 25 reports drawn on the first 16 normal workdays of Period X.

Four weeks after the last day a sample was drawn, take the Xerox copy of all inpatient reports not found in the patient's medical record to Inpatient Medical Records or to the ward if the patient has not been discharged. Find all medical records in which the laboratory reports should be filed. Record the date and whether the laboratory report is in the patient's medical record or not in the record.

For all the laboratory reports not found in the medical record, determine if any of the patient identification information on the Xerox copy is missing, illegible, or incomplete. Document any missing, illegible, or incomplete information.

Outpatient Medical Records

Collect the random sample of 25 laboratory reports daily for 16 days (total of 400 reports). Four weeks after the last day a sample was drawn, search the appropriate outpatient's medical record for the laboratory reports and record the date and whether the laboratory report is in the patient's medical record or not in the record.

When looking for a specific laboratory report, look for the patient's medical record first in Outpatient Medical Records. If a patient's medical record is checked out, note where the record has been sent and also determine if the laboratory report is attached to the medical record signout sheet. If the laboratory report is attached to the signout sheet, record the date and note on the laboratory report that it was attached to the signout sheet. If the medical record is checked out and the laboratory report is not attached to

the signout sheet, trace the patient's medical record until it is found and record the date and whether the laboratory report is in the patient's medical record.

Look for all laboratory reports not found in the patient's medical record or attached to the medical record signout sheet in the following places and make the appropriate notation when a laboratory report is located:

- Clinics that keep separate medical records for their patients (e.g., at Wright-Patterson the OB/GYN clinic maintains separate records for women having prenatal care).
- The area where Outpatient Medical Records stores nonfilable laboratory reports. For all nonfilable laboratory reports, determine why the report was nonfilable.
- Any other appropriate place the laboratory reports might be stored (e.g., physician's incoming and outgoing baskets).

For 10 normal workdays starting the first day of Period X, Xerox all laboratory reports arriving at Outpatient Medical Records. Record the date the report was Xeroxed. This is for determining the interval between the time outpatient reports are ready for distribution to the clinics and the time they arrive at Outpatient Medical Records.

Outpatient Preop Laboratory Reports (Inpatient Medical Records)

Outpatient preop laboratory reports (OPPOLRs) are considered separately as described below. An outpatient preop laboratory request is a request for laboratory work for an outpatient who will be admitted to the hospital, usually later the same day, for surgery the next day. These laboratory

reports receive special processing and become part of the patient's inpatient medical record. Completed OPPOLRs are usually sent to the Admissions and Dispositions (A&D) office in the afternoon. When the patient is admitted in the early evening, his laboratory reports should be in the A&D office. Hence, the OPPOLR becomes part of the patient's medical record at the time he is admitted.

Each normal workday starting on the first day of data collection and continuing for 16 days, do the following at the same time the reports for inpatients are processed:

1. Check the distribution point in the laboratory at about 1900 to determine if OPPOLRs were delivered in the afternoon. If reports were not delivered, note this on the random sample of 10 reports. Determine and document at the A&D office how many of the patients were admitted.

2. For each OPPOLR in the daily random sample of 10, go to the A&D office starting about 1900 hours. Determine the following:

   - Whether the OPPOLR is in the A&D office. Document whether the OPPOLR is found or not found.
   - Whether the patient has been admitted. If the patient has been admitted, document approximate time of admission and ward location.

3. For those patients who have been admitted and whose OPPOLRs were not in the A&D office, go to the appropriate ward and determine and document the following:

   - Whether the OPPOLR is posted to the patient's medical record.

- For patients whose OPPOLR is posted to the medical record, whether the OPPOLR was posted to the medical record when the patient arrived on the ward or whether ward personnel had to look for the OPPOLR.

4. Repeat the above process in steps 1 through 3 for each of the 16 random samples of 10 reports drawn on the first 16 normal workdays of Period X.

B. Study of Laboratory Request Turnaround Time Inside the Clinical Laboratory

Laboratory request turnaround time inside the laboratory will be investigated by studying the time between arrival of the specimen at the laboratory and the time the laboratory report is ready for distribution. This will be accomplished by stamping requests with time and date as they come into the laboratory and stamping reports with time and date when they are ready for distribution. The precise definitions for start and end of turnaround time will be different for each test site to conform with the procedures that exist at the site for time and date stamping of laboratory requests and reports. Also, there will be some variation between Period X and Period Y due to changes in certifying reports for distribution and availability of time data.

It will probably be necessary to determine turnaround time by laboratory section. A sufficient sample size will be available since a copy will be obtained for all laboratory requests and reports.

C. Study of Telephone Calls to the Clinical Laboratory

Data will be collected to study the frequency and duration of phone calls to the laboratory, and type of call (inquiry or non-inquiry). In addition, the frequency of other calls into

and out of the laboratory on the phone lines used by the receptionist will be monitored. Wright-Patterson has a decentralized system for responding to inquiries and Andrews has a centralized system. Therefore, the study of telephone calls will be tailored to each site.

Wright-Patterson

At Wright-Patterson the receptionist answers telephone calls coming into the laboratory on one of five lines. Requests for test results or test status are transferred to the laboratory section that performed the test. Each section maintains records of the tests it performed.

Laboratory reception area personnel will be asked to keep a record of all telephone calls received during the second and third week of Period X and Period Y. Telephone calls in each of the following categories are to be counted:

- Calls completed at the reception desk that are inquiries and those that are for other purposes.
- Inquiries and other calls transferred to each laboratory section or office area.

A form will be provided for this information.

MET personnel will collect additional data on telephone inquiries during eight randomly selected 15-minute observation periods per day. The information to be collected includes:

- Total duration of inquiry calls subdivided into receptionist time, time on hold, and time talking with technologist - This data will be collected by watching the light of each telephone line on the receptionist's telephone.
- Category and location of caller - This data will be collected by talking with reception area personnel.

- Disposition of calls subdivided into calls completed at reception area and those transferred
- Response calls - Inquiry calls transferred to laboratory sections will be followed up after the observation period to determine if the call was completed or whether a return call was made by the technologist. If a return call was made, an estimate will be made of the time to retrieve the requested information. Personnel in each laboratory section will be asked to record all response calls on a form provided by ANSER.
- An attempt will be made to observe the duration of calls made inside the laboratory to provide a check on estimated duration of response calls.

A small separate study will be conducted by MET personnel to determine the average duration of a telephone call for reporting *stat* results. Hematology, *Stat* Laboratory, and Urinalysis will be measured separately while all others will be grouped together. MET personnel will also conduct a work sampling study to determine the percentage of time telephone lines are busy.

Andrews

Since a central file of all laboratory test results is maintained in the reception area at Andrews, the receptionist answers most inquiry calls.

Laboratory reception area personnel will be asked to keep a record of all telephone calls received during the second and third week of Period X and Period Y. Telephone calls in each of the following categories are to be counted.

- Calls completed at the reception desk that are inquiries and those that are for other purposes.

- Inquiry and other calls transferred to each laboratory section or office area.

A form will be provided for this information.

MET personnel will collect additional data on telephone inquiries during four randomly selected 1/2-hour observation periods per day. The information to be collected includes:

- Total duration of inquiry calls completed at the reception desk
- Response calls by reception area personnel - The duration of all the response calls initiated by reception area personnel during the observation period will be measured, and an estimate will be made of the time to retrieve the requested information. An estimate will be made of the number and duration of response calls initiated in the laboratory sections.
- Category and location of caller - This data will be collected by talking with reception area personnel.
- Disposition of calls subdivided into calls completed at the reception area, calls requiring a return call, and calls transferred.

A small separate study will be conducted by MET personnel to determine the average duration of a telephone call for reporting *stat* results. Hematology, *Stat* Laboratory, and Urinalysis will be measured separately while all others will be grouped together. MET personnel will also conduct a work sampling study to determine the percentage of time telephone lines are busy.

D. Study of Errors in Arriving Outpatient Laboratory Request Slips

Laboratory request slips arriving at the reception desk are to be screened for the following errors:

- No patient name
- Illegible patient name
- No social security number
- Illegible social security number
- Incomplete social security number
- No clinic or ward name
- Illegible clinic or ward name
- No date
- Illegible date
- No patient telephone number
- Illegible telephone number
- No requesting physician
- Illegible requesting physician
- No rank or relation code
- Illegible rank or relation code
- Other.

For analysis and the determination of sample size a laboratory request slip is defined to be in error if one or more major errors exist (the first seven in the above list). A slip is defined to be correct if all requested information is on the slip and is legible or if it contains one or more minor errors (the last nine in the above list).

Two 1/2-hour observation periods per day will be selected randomly for the duration of Period X and Period Y. All outpatient laboratory request slips arriving at the reception desk during the observation period are to be screened for errors, using a data collection form provided by ANSER. Since the possibility exists that the errors on two or more request slips brought to the laboratory by one person at the same time may be correlated, the analysis will probably be on the basis of one request slip per patient. For this reason it will be necessary to record the patient's initials along with the errors on all request slips.

If feasible, it would be desirable to hand out the patient questionnaire at the same time laboratory request slips are being screened for errors. A sample size of 200 patient questionnaires will be required. One procedure for obtaining the necessary sample size would be to hand out five patient questionnaires during each 30-minute observation period, then collect all patient questionnaires at the end of the observation period. If less than five patients come in during an observation period, the questionnaires are to be handed out at the next observation period in addition to the five for that period.

E. Service Time at the Laboratory Reception Desk and Total Patient Time at the Clinical Laboratory

These two studies will be conducted simultaneously by observing the reception area during three randomly selected 1/2-hour observation periods per day for the duration of Period X and Period Y.

Service time at the laboratory reception desk for all patients arriving during the 1/2-hour observation periods is to be studied by collecting data on time of arrival, service at the reception desk, type of patient (outpatient or inpatient), and a note if the patient received instructions from the receptionist.

Total patient time at the clinical laboratory for all patients arriving during the 1/2-hour observation periods is to be studied by stamping a data collection form with time and date when the patient arrives at the laboratory, giving the form to the patient, collecting the form when the patient leaves the laboratory, and stamping the data collection form with time and date again as the patient leaves. MET personnel will be responsible for handing out the data collection form and insuring that the receptionist or other designated person collects the form.

III. DATA COLLECTION FOR EVALUATION OF AFCLAS

This section details the data that will be collected in the evaluation by general category of data.

A. Time Measurement and/or Estimation

This subsection specifies the data to be collected for determining time per unit that is spent in specified tasks. The data are to be collected by direct observation or by interviews.

1. Time per task accomplishment for each task involved in producing administrative reports and College of American Pathologists (CAP) workload reports

   Documentation—

   a. A list of all administrative reports, their frequency, purpose, and who requires them

   b. A list and description of all tasks involved in preparation of administrative and CAP reports, the frequency of the task, and copies of the forms used

   c. All time measurements obtained, a description of the measurement procedures used, and of any calculations done.

2. Time per request slip to file the laboratory copy of the slip in the laboratory files

   Documentation—

   a. A description of the filing task timed

   b. A copy of each kind of request slip

   c. All time measurements obtained, a description of the measurement procedures used, and of any calculations done.

3. Time per page to file test worksheets and workload log sheets by each laboratory section and centrally. (Separate determinations may be needed if procedures vary widely among locations.)

   Documentation—

   a. A description of the filing procedures timed, by laboratory section and centrally

   b. A list by laboratory section of all kinds of items filed and a copy of each

   c. All time measurements obtained, a description of the measurement procedures used, and of any calculations done.

4. Time per report produced to file quality control records and statistical summaries in the laboratory sections and centrally

   Documentation—

   a. A description of the filing procedures timed

   b. A list of the kinds of reports and/or summaries filed and a copy of each kind

   c. All time measurements obtained, descriptions of procedures used, and of any calculations done.

5. Time to perform other laboratory filing tasks, unit time and documentation as appropriate

6. Time per task accomplishment to remove outdated items from laboratory files for each kind of file (in preceding time measurement items 2, 3, 4, and 5) for which task is done

Documentation—

a. List of all kinds of files included in the preceding items 2, 3, 4, and 5 for which this task is done

b. Description of each procedure timed

c. All time measurements obtained, description of procedures used, and of any calculations done

7. Time per request slip to file laboratory results in outpatient medical records

Documentation—

a. Description of the filing procedure timed

b. All time measurements obtained, description of procedures used, and of any calculations done.

8. Time per request slip to file laboratory results in the medical records of inpatients on the wards and time per request slip to file laboratory results in the medical records of inpatients in the Medical Record Room

Documentation—

a. Description of the filing procedures timed

b. All time measurements obtained, description of procedures used, and of any calculations done.

9. Time per patient for preparation and filing in the patient's medical record of cumulative summaries or flow sheets of laboratory results

Documentation—

a. Description of the procedures timed

b. All time measurements obtained, description of the procedures used, and of any calculations done.

10. Time per request slip to fill out requests for laboratory tests at the clinics and wards

Documentation—

a. Description of the procedure timed

b. All time measurements obtained, description of procedures used, and of any calculations done.

11. Time per request slip spent by laboratory personnel in filling out or completing request information on laboratory slips

Documentation—

a. Description of procedure timed

b. All time measurements obtained, description of procedures used, and of any calculations done.

12. Time per test to enter test results on laboratory slips

For Period X:

- For test results printed automatically
- For test results transcribed from worksheets or log books
- For test results transcribed from an instrument display

- For test results transcribed from a machine printout.

For Period Y:

- Online
- Manually entered into terminal from worksheets
- Mark-sense worksheets
- Mark-sense computer card.

Documentation—

a. Description of the procedures timed (See Section B, number 7, and Section E, number 4 for list of tests.)

b. All time measurements obtained, description of procedures used, and description of any calculations done.

13. Time per page to enter headings on each kind of test worksheets, workload log sheets and log book pages (except those that are computer-generated pages, Wright-Patterson only)

Documentation—

a. Descriptions of procedures timed

b. List of all kinds of log books, test worksheets, workload log sheets, and a copy of each kind of page that headings are entered on

c. All time measurements obtained, description of procedures used, and of any calculations done.

14. Time per entry (line, patient) to record patient identification and test requests for each kind of test worksheet, workload log sheet, and log book (except those that are computer-generated, Wright-Patterson only).

Documentation—

a. Descriptions of the procedures timed

b. List of all kinds of test worksheets, workload log sheets and log books, and a copy of each kind of page that patient identification and requests are entered on

c. All time measurements obtained, description of procedures used, and of any calculations done.

15. Time per test to enter test results on test worksheets, workload log sheets, and log books

- For test results printed automatically
- For test results transcribed from other worksheets or log books
- For test results transcribed from an instrument display
- For test results transcribed from a machine printout.

Documentation—

a. Description of the procedures timed

b. List of all kinds of test worksheets, workload log sheets and log books, and a copy of each kind of page that test results are entered on

c. All time measurements obtained, description of procedures used, and of any calculations done.

16. Time per tube to label specimens

    Documentation—

    a. Description of the procedures timed

    b. All time measurements obtained, descriptions of procedures used, and of any calculations done.

17. Time per routine (scheduled) specimen collection trip to sort slips, prepare a list, or otherwise specify the patients to be visited by each technician

    Documentation—

    a. Description of the procedures timed

    b. All time measurements obtained, description of procedures used, and of any calculations done.

18. Time per test, request slip, worksheet, or other unit reviewed and/or certified for review and certification of test results by supervisors, and time per test, request slip, worksheet, or other unit reviewed and/or certified for review and certification of test results by technicians.

    Documentation—

    a. List of each kind of unit reviewed and/or certified by supervisors, each kind of unit reviewed and/or certified by technicians

    b. Description of the procedures timed

    c. All time measurements obtained, description of procedures used, and of any calculations done.

19. Time per analysis to perform statistical analyses of quality control sample results, or other calculations for quality control and to record them on a report

    Documentation—

    a. Description of procedures timed

    b. List of all kinds of quality control analyses performed and a copy of a report for each kind (See Section A, number 4, documentation item b.)

    c. All time measurements obtained, description of procedures used, and of any calculations done.

20. Time per analysis to perform statistical analyses of patient results by population

    Documentation—

    a. Description of procedures timed

    b. List of all kinds of analyses performed and a copy of a report of each kind

    c. All time measurements obtained, description of procedures used, and of any calculations done.

21. Time per test for test result calculations and/or conversions

    Documentation—

    a. Description of procedures timed

    b. List of all tests for which calculations and/or conversions are done and description of the calculation and/or conversion required

    c. All item measurements obtained, description of the procedures used, and of any calculations done.

22. Time per task accomplishment for computer operation tasks such as generating test worksheets with CREATE, a time-sharing, computer system used at Wright-Patterson

    Documentation—

    a. List of computer operation tasks

    b. Description of procedures timed

    c. All time measurements obtained, description of procedures used, and of any calculations done.

23. Time per telephone call to report *stat* results

    Documentation—

    a. Description of procedure timed

    b. All time measurements obtained, descriptions of procedures used, and of any calculations done.

24. Time per supervisor to respond to inquiries, complaints, and errors

    Documentation—

    a. Description of procedures timed

    b. All time measurements obtained, descriptions of procedures used, and of any calculations done.

25. Time per admission or interward transfer of admissions and interward transfers

    Documentation—

    a. Description of procedures timed

    b. All time measurements obtained, descriptions of procedures used, and of any calculations done.

26. Time per report to review or process new AFCLAS-generated reports

Documentation—

a. Description of procedures timed

b. All time measurements obtained, descriptions of procedures used, and of any calculations done.

B. Counting and/or Estimation

The measurements are made by counting or estimating the number of specified items and tasks done during Period X and Period Y; the numbers obtained and the procedures used are then documented.

1. The number of times during Period X and Period Y that each task involved in producing administrative reports and CAP workload reports is performed

Documentation—

a. See Section A, number 1, documentation items a and b.

b. All numbers obtained, description of procedures used, and of any calculations done.

2. The number of request slips received by the laboratory each day, by laboratory section and by inpatient and outpatient categories, further subdivided by *stat* and all others (count *stat* slips only in *Stat* Laboratory, Urinalysis, and Hematology.)

Documentation—

a. List of kinds of slips received by each laboratory section and a copy of each one

b. All daily slip counting forms and a description of the procedures used to obtain the numbers recorded.

3. The number of test worksheets, workload log sheets, and log book pages of each kind filled out each day by each laboratory section

   Documentation—

   a. List of each kind of test worksheet, workload log sheet, and log book used by each laboratory section and a copy of each kind of page (includes hand-prepared pages and a copy for each kind of use of a standard form)

   b. All daily forms for counting the pages and description of procedures used to obtain the numbers recorded.

4. The number of test worksheets, workload log sheets and log book entries per day by kind of sheet or log book

   Documentation—

   a. See Section B, number 3, documentation item a.

   b. All numbers obtained, a description of the procedures used, and of any calculations done.

5. The number of times during Period X and Period Y that each kind of statistical analysis for quality control is performed and that each kind of quality control report or statistical summary is produced by each laboratory section

   Documentation—

a. See Section A, number 4, documentation item b, and number 19, documentation item b.

b. All numbers obtained, description of procedures used, and description of any calculations done.

6. The number of times outdated items are removed from each kind of laboratory file (those for which the time to do this task is measured, Section A, number 6)

Documentation—

a. See Section A, number 6, documentation item a.

b. All numbers obtained, a description of the procedures used, and of any calculations done.

7. The number of tests done each day by kind of test, further subdivided into inpatient and outpatient for all tests and then by routine and *stat* for tests performed by the *Stat* Laboratory, Hematology and Urinalysis

Documentation—

a. List of all kinds of tests done by each laboratory section

b. All daily test counting forms and description of procedures used to obtain the numbers records.

8. The number of specimen tubes labeled per day

Documentation—

a. All numbers obtained, a description of the procedures used, and a description of any calculations done.

9. The number of routine specimen collection trips per day and the number of technicians involved in each

   Documentation—

   a. All numbers obtained, a description of the procedures used, and of any calculations done.

10. The number per day of each kind of item reviewed and certified by supervisors and by technicians (probably included in the preceding items of Section B)

    Documentation—

    a. See Section I, number 18, documentation item a.

    b. All numbers obtained, a description of procedures used, and a description of any calculations done.

11. The number of times during Period X and Period Y that statistical analysis of patient results by population are done

    Documentation—

    a. See Section I, number 20, documentation item b.

    b. All numbers obtained and a description of the procedures used.

12. The number of times per day each computer operation task is carried out (Wright-Patterson only)

    Documentation—

a. See Section I, number 22, documentation item a.

b. All numbers obtained and a description of the procedures used to obtain them.

13. The number of tests sent to other facilities for processing during Period X and Period Y by kind of test and the facility it is sent to

Documentation—

a. A list of all kinds of tests that are routinely sent to other facilities

b. A list of all facilities that the tests are sent to

c. All completed "tests sent out" counting forms and a description of the procedures used to obtain the information recorded.

14. The number of tests received from other facilities during Period X and Period Y by kind of test and sending facility

Documentation—

a. A list of all facilities that send in tests for processing

b. A list of all tests that the sending facilities routinely send

c. All completed "tests sent in" counting forms and a description of the procedures used to obtain the information recorded.

15. The daily inpatient census by ward

Documentation—

a. List of all wards and the type of patient on each (e.g., Orthopedic, Obstetrics)

b. All daily census data collected and a description of the procedures used to obtain it.

16. The number of outpatient visits per day by clinic

Documentation—

a. List of all clinics and type of clinic

b. All daily patient visit data collected and a description of the procedures used to obtain it.

17. The number of telephone calls per day to report *stat* results

Documentation—

a. List sections placing calls to report *stat* results

b. All numbers obtained and a description of the procedures used to obtain them.

18. For each new AFCLAS-generated report, the number of times per week the report is printed

Documentation—

a. List all reports and a copy of each kind of report

b. All numbers obtained and a description of the procedures used to obtain them.

C. Personnel

It is necessary to identify the personnel involved in each of the following tasks and to determine the fraction of the total time for the task that each contributes. Procedures and findings are documented for each.

1. Each task involved in preparation of administrative reports and CAP workload reports
2. Filing laboratory copy of request slips in laboratory files
3. Filing test worksheets and workload log sheets in laboratory files—in laboratory sections and centrally
4. Filing quality control reports and statistical summaries in laboratory central files and in laboratory section files
5. Removing outdated items from files for each kind of file in preceding items 2, 3, and 4
6. Filing laboratory results in Outpatient Medical Records
7. Filing laboratory results in medical records of inpatients
   - On wards
   - In the Inpatient Medical Records Room
8. Preparing cumulative summaries and flow sheets of patients' laboratory results
9. Filling out request slips
   - On wards
   - In clinics
   - In the laboratory

10. Entering laboratory test results on request slips for each laboratory section

11. Entering headings, patient identification requests, and results on each kind of test worksheet, workload log sheet, and log book

12. Labeling specimens (or specific tasks involved—writing name, batch labeling, etc.)

13. Preparing list or other identification of patients to be visited by each technician on specimen collection rounds

14. Supervisor's review/certification of results

15. Technician's review/certification of results

16. Statistical analysis of quality control results

17. Statistical analysis of patient results by population

18. Test result calculation and/or conversion by kind

19. Each computer operation task (Wright-Patterson only)

    Documentation—

    a. A list of name and classification of all laboratory personnel

    b. A description of the procedures used to obtain the information.

20. Calling a ward or clinic to report the results of a *stat* test

21. Supervisor (laboratory officer) responding to inquiries, complaints, and errors

22. Preparing a list of admissions and interward transfers for laboratory use

23. Reviewing or processing new AFCLAS-generated reports.

D. Information About Laboratory Operations

Specified information and documentation about laboratory operations must be obtained from the personnel involved.

1. Identify and list any records of laboratory results (other than request slips, test worksheets, workload log sheets, quality control reports and statistical summaries) that are filed in laboratory files.

2. Identify and list locations in the laboratory where telephone inquiries are routinely referred.

3. Obtain and estimate the percent of inpatient laboratory slips filed that are filed on the wards and the percent filed in the medical record room, and describe procedures used.

4. List all laboratory tests in the following way:

   - Tests for which results are printed on request slips automatically
   - Tests for which results are transcribed to slips from worksheets or log books
   - Tests for which results are transcribed to slips from an instrument display
   - Tests for which results are transcribed to slips from a machine printout.

5. List tests for which results are entered on test worksheets, workload log sheets, or log books in the following way:

   - Those printed automatically on the worksheet, workload sheet, or log book
   - Those transcribed from other worksheets, workload sheets, or log books

- Those transcribed from an instrument display
- Those transcribed from a machine printout

6. Identify and list any laboratory forms used in requesting tests, processing tests, reporting test results, and keeping quality control records that have not been included in the preceding lists.

7. Identify and list all automated laboratory equipment and the tests done by each. List those that will be online with AFCLAS and those that will be offline.

8. For each laboratory section list the kinds of quality control statistics that are calculated.

9. Identify and list all tests for which technicians do calculations and/or conversions and specify the calculation and/or conversion done.

10. Obtain estimates from laboratory supervisors of the time they spend in responding to inquiries, complaints, errors detected before results leave the laboratory, and errors in results reported to physicians. Describe the procedures used.

11. Obtain an estimate of the percent of laboratory request slips for which request information is filled in at the laboratory. Describe the procedures used.

12. Obtain an estimate of the percent of inpatients for whom cumulative summaries or flow sheets of laboratory results are prepared.

E. Cost Data

Cost information will be collected on the items listed below:

1. Identify total cost of AFCLAS computer system during Period Y. Include purchase price, monthly rental, and other operation and maintenance.

2. Identify average cost per person by personnel category for all laboratory personnel during Periods X and Y.

3. Identify total personnel costs for all laboratory personnel for Periods X and Y.

4. Identify cost per copy of laboratory clinical forms by kind of form used in Periods X and Y.

5. Identify cost of capital expenditures for the clinical laboratory from the first data collection period through the final data collection period.

6. Identify average cost per person by personnel category of personnel who file laboratory results in medical records in the Medical Records Department during Periods X and Y.

7. Identify average cost per person by personnel category of personnel who file laboratory results in medical records in nursing units during Periods X and Y.

F. Note on Sample Size for Observation and/or Sampling Studies

In order to conduct the Period X evaluation, an estimate of sample size is required for the following areas:

- Outpatient Medical Records (OMR)
- Inpatient Medical Records (IMR)
- Errors in arriving outpatient laboratory slips
- Duration of telephone calls
- Service time at the reception desk
- Total patient time at the laboratory.

In addition, we want to determine the effect of AFCLAS on laboratory slip turnaround time and on frequency of telephone calls. However, if all slips are Xeroxed during the 20-day evaluation period, we will have an ample number from which to draw a sample after Period X in order to assess turnaround time. Also, recording of all telephone calls by the receptionist for the second and third week of Period X should provide a sufficient number with which to analyze telephone call frequency.

There are three main factors influencing the sample size. The first of these is that we wish to test hypotheses on the effect of AFCLAS in each of the above areas, as opposed to merely making confidence interval statements about population parameters. A second and related consideration is that we are dealing with a two-sample problem, i.e., before and after AFCLAS, in contrast to hypotheses on parameters of a single population. Finally, we shall estimate the required sample sizes by specifying a probability distribution for each area.

1. Outpatient Medical Records (OMR)

This will be a study of (a) the percentage of laboratory slips not filed in the record after a month and (b) the time required for slips to reach OMR. If p_1 denotes the percentage of slips that can't be filed before AFCLAS and p_2 the percentage of slips that can't be filed after AFCLAS, then in (a) we wish to test the null hypothesis H_o: $p_1 = p_2$ against the alternate hypothesis H_A: $p_1 \neq p_2$. In any test of an hypothesis we must specify the probability α, the chance that we are willing to take that we have a nonrepresentative sample that causes us to reject H_o when in fact it is true. Clearly, we would like α to be low. We must also specify the probability β such that $1-\beta$, the chance that we are correctly rejecting H_o, is high. Finally, we must select the amount of

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EVALUATION PLAN FOR THE AIR FORCE CLINICAL LABORATORY AUTOMATIO--ETC(U)
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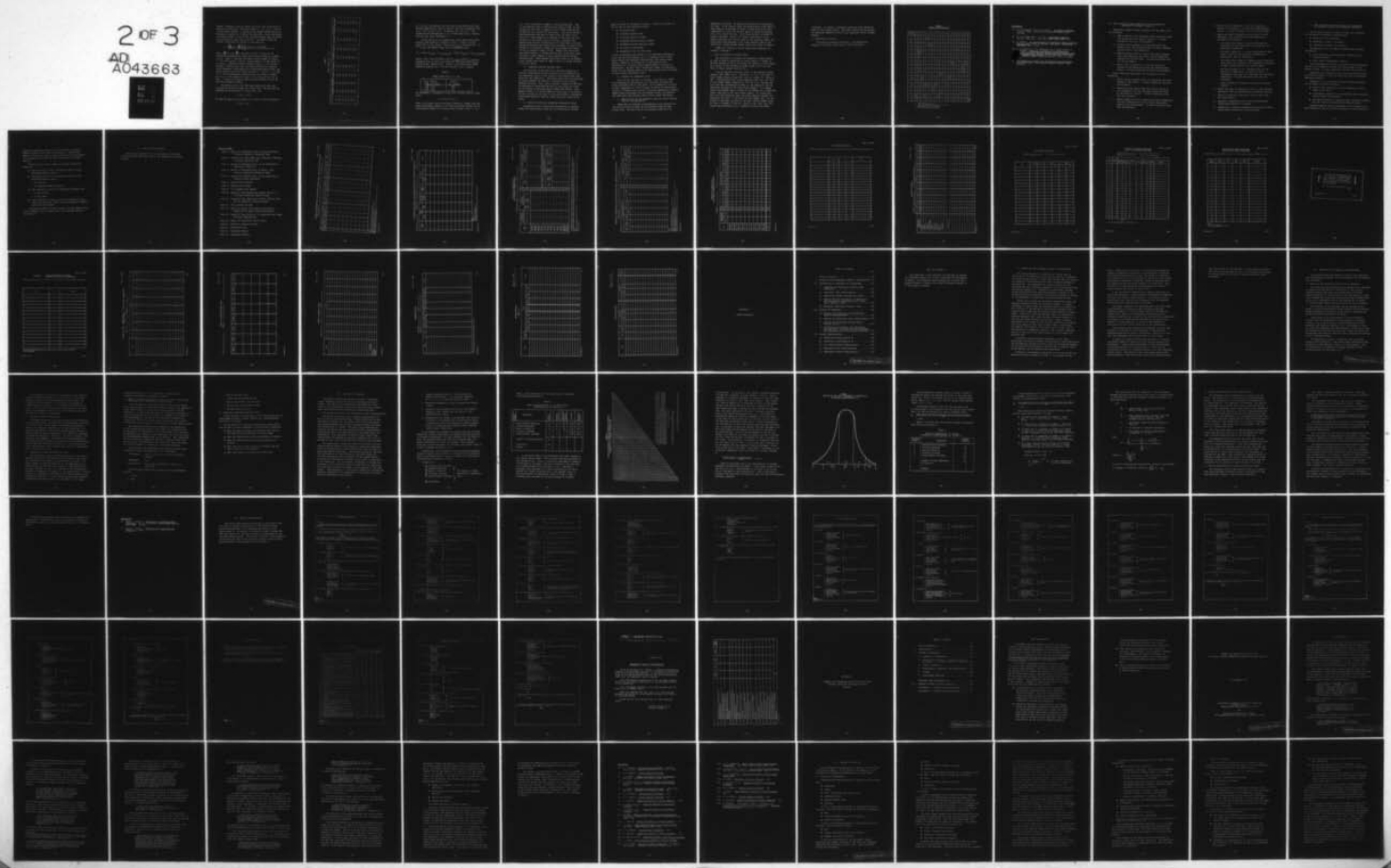

change δ between p_1 and p_2, which we would like to be able to detect by testing H_o. We shall regard $\delta = |p_1 - p_2| = .10$ as a significant change. We estimate our sample sizes similar to Reference 1 based on a binomial distribution, since the laboratory slips belong to one of two classes—either they are filed in the record or they are not filed. The sample sizes for Period X (and also for Period Y) are given by

$$N = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 \left[p_1(1-p_1) = p_2(1-p_2)\right]}{\delta^2}$$

where $Z_{\alpha/2}$ and Z_{β} are the $\alpha/2$ and β points of the cumulative standardized normal distribution function, respectively. Table 1 reflects the sample sizes needed to detect $\delta = .10$ for various α and $1-\beta$ values where p is the larger of p_1 and p_2. Previous studies indicate that $p_1 = .20$ may be a minimum. Sample sizes from the above formula were checked using Reference 2 and where minor differences were found, the larger sample sizes were used for Table 1. Using $\alpha = .10$ and $1-\beta = .90$ as reasonable probabilities, we project a sample size of N = 400 laboratory slips or 25 slips per day for 16 days. A means by which to select random samples of size 25 will be provided by ANSER.

The second part of the OMR study deals with the time required for slips to reach the record room. We postulate an exponential distribution for this time, i.e.,

$$f(x) = \theta e^{-\theta x}$$

so that the mean time required for a slip to reach records is

$$E(X) = 1/\theta.$$

TABLE 1

SAMPLE SIZES FOR $\delta = .10$

p	$\alpha = .01$			$\alpha = .05$			$\alpha = .10$		
	$1-\beta=.95$	$1-\beta=.90$	$1-\beta=.80$	$1-\beta=.95$	$1-\beta=.90$	$1-\beta=.80$	$1-\beta=.95$	$1-\beta=.90$	$1-\beta=.80$
.20	445	373	293	325	263	198	270	215	155
.25	561	470	369	410	331	249	341	271	196
.30	660	552	433	481	390	294	400	319	230
.35	740	619	486	540	440	330	449	357	258
.40	810	671	527	585	480	360	486	387	279
.45	850	708	556	618	500	380	513	409	295
.50	880	731	574	637	520	390	530	422	304

If $1/\theta_1$ and $1/\theta_2$ denote the true mean times before and after AFCLAS respectively, then we wish to test the hypothesis that $1/\theta_1 = 1/\theta_2$ or H_o: $\theta_2/\theta_1 = 1$ against H_A: $\theta_2/\theta_1 \neq 1$. The assumption of exponentiality is a traditional one in treating service time data (Reference 3).

Let $\bar{x}_1$ and $\bar{x}_2$ be the sample mean times before and after AFCLAS, each based on a sample of size N. Then it can be shown that $(\theta_1/\theta_2)\ \bar{x}_1/\bar{x}_2$ follows an $F_{2N,2N}$ distribution. If $\phi = \theta_1/\theta_2$, our sample sizes may be determined from

$$1-\beta = \text{Prob}\{F_{2N,2N} \leq \phi F_{\alpha/2,2N,2N}\} + \text{Prob}\{F_{2N,2N} > \phi F_{1-\alpha/2,2N,2N}\}$$

where α and β are as before, and $F_{\alpha/2,2N,2N}$ and $F_{1-\alpha/2,2N,2N}$ represent the $\alpha/2$ and $1-\alpha/2$ points of the cumulative $F_{2N,2N}$ distribution, respectively. Table 2 gives the sample sizes needed to achieve $1-\beta = .90$ for various α and ϕ values.

TABLE 2

SAMPLE SIZES FOR $1-\beta = .90$

α \ ϕ	95/100 (or 100/95)	90/100 (or 100/90)
.10	960	440
.05	1100	480

The parameter ϕ represents a true ratio of mean service times since

$$\phi = (1/\theta_2)/(1/\theta_1).$$

Thus, if we would like to be able to detect a change from 100 time-units before AFCLAS to 90 time-units after AFCLAS (or 90 units before AFCLAS to 100 units after AFCLAS) with $\alpha = .10$,

$1-\beta = .90$, we require a sample of 440 observations. Due to the relative ease of Xeroxing the slips at OMR, it was originally felt that a sample size of N=1000 would be desirable for this portion of the study. This would necessitate determining the age of these slips (in days) for a period of 1 week based on an average of 200 slips per day arriving at the record room for filing. However, the analysis may require stratification of the slips by clinic, thereby decreasing the sample size available for each clinic. Therefore, we estimate 2 weeks as the minimum time needed to give us adequate sample sizes. Sample sizes were also calculated based on a normal distribution of service times and using a small sample of data from the OMR at Wright-Patterson AFB. These sample sizes were found to be substantially higher than those of Table 2 due to a large variance in arrival times.

2. Inpatient Medical Records (IMR)

This portion of the study will also be treated as a binomial distribution since a search will be conducted for the laboratory slips in the record on the wards after they have left the laboratory. The slips could then be classified as having reached the record in the ward or not having reached the ward. Also, after a month, a search of IMR will be conducted to determine how many of the slips not found in the record on the wards have reached the record. Again based on Table 1, a single sample of 400 slips or 25 slips a day for 16 days can be used for the ward search, followed by a month-end search of IMR for those slips not found on the wards.

3. Errors in Arriving Outpatient Laboratory Slips

Once more we will require the observation of approximately 400 slips since a slip can be classified as either

being in error or not being in error. A slip is in error if one or more of the following exists:

- No patient name
- Illegible patient name
- No Social Security number
- Illegible Social Security number
- Incomplete Social Security number
- No clinic or ward name
- Illegible clinic or ward name.

A slip is defined to be correct if all required information is on the slip and legible, or if it contains one or more minor errors (all possible errors except the seven listed above). Based on an average of 16 arrivals per hour (Reference 4), we would require approximately 25 hours of observation. We feel that a sufficient number of laboratory slips will be checked based on an observation time of 20 hours or two 1/2-hour intervals a day.

4. Duration of Telephone Calls

This will be recorded in seconds. From Table 2, based on an exponential distribution, we must have at least 400 calls; we would like to have more. At an average of 10 calls an hour (Reference 4), this is about 40 hours of phone observation or 2 hours a day in eight 15-minute observation periods. Sample sizes calculated from an assumed normal distribution and using data from Keesler AFB are much higher estimates.

5. Service Time at the Reception Desk and Total Patient Time at the Laboratory

These may be conducted simultaneously since handing out the time in/time out cards to the patients requires very little time. Service time at the reception desk will be

measured in minutes. We assume an exponential distribution for both. If we require about 450 observations from Table 2, then based on an average of about 15 observations per hour (Reference 4), this will require about 30 hours of observation of 1.5 hours per day. This could be done in three 30-minute intervals. Again, the normal distribution using Keesler AFB data for service time at the reception desk, and using data from Reference 2 for total patient time at the laboratory, yields higher sample sizes than those in Table 2.

ANSER will provide a single observation schedule for numbers 3 through 5.

G. Note on Choosing a Random Sample

The following is a method for choosing a random sample of size 25 from a population of size n where n = number of Xeroxed laboratory slips from which the sample is to be drawn. As a result of the sequential number stamp, each slip will have a 3-digit number from 001 to n.

Pick an arbitrary starting point in the Chemical Rubber Company (CRC) Table XII.4 (Reference 5), e.g., the first 3-digit number group on page 480, line 10, column (7), which is 388. Continue down this column observing 568, 186, 363, etc. If the random number observed is from 001 to n, include the slip with the corresponding number in the sample of size 25; otherwise continue to the next random number. If a number (slip) has already been included in the sample and is observed again, continue to the next random number. To illustrate, the first slip selected under the above sampling scheme for a population of size n = 200 would be slip number 186. At the bottom of the page, proceed to the next 3-digit number group in line 1, columns (7) and (8), which is 791, 825, 792, etc. Follow this procedure until a sample of size 25 has been

collected. Of course, a different starting point should be used for each sample taken. The same process can be applied for selecting samples of size 10 by observing 2-digit random numbers.

H. Observation Schedule

This section consists of Table 3, the Observation Schedule for Period X and Period Y data collection.

TABLE 3
OBSERVATION SCHEDULE

Time \ Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0730	t_2	r		r	t_1 / t_2	t_1	r	r	r	t_2	e	t_1	t_2		t_2	e	r	t_2		
0800		r	e	t_2				t_1	t_2		t_2		t_2	r	t_2	t_1	t_2	t_1		e
0830	e		r		t_2	t_1 / t_2	t_1	t_2		e	r		e	t_2			e	r	t_1	
0900	t_2	t_1	t_2	t_1	r	r	t_2		t_1	e	r	r		t_1	t_1	t_2	r		r	r
0930	r	t_1 / t_2	e	r		r	e		r	t_2	r	r	e	t_1	r	r	t_1		t_2	
1000	r	t_2			e	t_2	e	e		r		r	t_2	e	t_1	t_1			t_1	t_2
1030	r	t_1		e				t_2	t_2	r	e		t_2	t_1		t_2			e	r
1100		e	r						e	t_1		e	t_2	t_1 / t_2	e	r	t_2	t_1	t_1 / t_2	e
1130	t_2	e			t_2		t_2	t_2	t_2		t_2			r	t_2	r		t_1 / t_2		t_1
1200	e	t_1	t_1	t_1	t_1	r		r	t_2		t_2	t_1		e		t_2	t_2	t_1 / t_2	r	
1230	t_1		r			t_1		e		t_1 / t_2	t_1	t_2	r	t_2				r	e	t_1
1300			t_1 / t_2			e	t_2	r			t_2	t_1	t_1 / t_2		t_2	t_1	t_2	e		r
1330	t_2	t_2	t_1		r	e	r	t_2		t_1	t_1	t_1		r	r		t_1		t_2	t_2
1400			t_2	t_1 / t_2	t_1 / t_2	t_2	t_1	t_1 / t_2	r			t_2	r			t_2		e		
1430		t_2	t_1	t_1	r		t_1 / t_2		e	r	t_1	t_2			r		r	r	r	t_2
1500		r	t_2	r			t_1		t_2	t_1 / t_2	t_1		t_2		e		t_1	t_1	t_1	t_1
1530	t_1 / t_2			t_1 / t_2	t_2	t_1			t_1 / t_2			e	r		t_2	t_1	t_1		t_2	
1600	t_2			e	e	t_2	r	t_1				t_2		t_2	t_1	e	e			t_1 / t_2

e = Observe number of lab slips in error
r = Observe service time at reception desk and hand out time-in/time-out cards
t_1 = Observe call durations during first 15-minute period
t_2 = Observe call durations during second 15-minute period

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(4) A. F. Dowling, R. S. Schlotman, R. F. King, and R. J. Jurkoshek. Analysis of Receptionist Function and Computer Operator Lab Test Result Inquiry Function Time Requirements Under AFCLAS, Wright-Patterson AFB, Ohio: USAF Medical Center, Wright-Patterson (AFLC), October, 1974.

(5) CRC Handbook of Tables for Probability and Statistics. Cleveland, Ohio: The Chemical Rubber Company, 1968: 479-483.

IV. DATA COLLECTION TASKS REQUIRING THE ASSISTANCE OF LABORATORY PERSONNEL (PERIOD X)

Laboratory reception area personnel will be asked to do the following:

1. Keep a record of all telephone calls received during the second and third week of Period X. (A data collection form will be provided.)
2. Collect from a sample of 450 patients the form handed out by MET personnel that is used to measure patient time in the laboratory.
3. Remind hospital staff to record the time of departure from laboratory and area to which laboratory reports will be delivered. (A data collection form will be provided.)
4. Record time of departure to deliver laboratory reports to the wards or clinics and general destination. (A data collection form will be provided.)

Other laboratory personnel will be asked to do the following:

1. Record return response calls for inquiries for test status or test result. (A data collection form will be provided.)
2. Record the time leaving and the time of return to the laboratory from all specimen collection trips to the wards or clinics. (A data collection form will be provided.)
3. Remind hospital staff to record the time of departure from the laboratory and area to which laboratory reports will be delivered. (A data collection form will be provided.)

4. Record time of departure to deliver laboratory reports to the wards or clinics and general destination. (A data collection form will be provided.)

5. Record workload information and provide it to MET personnel. The requested workload information includes the following:

   - The total daily number of tests performed for each kind of test subdivided into inpatient and outpatient categories
   - The daily number of *stat* tests performed for each kind of test for the sections of Hematology, Urinalysis, and *Stat* Laboratory
   - The total daily number of request slips by section subdivided into inpatient and outpatient categories. (A data collection form will be provided.)
   - The daily number of *stat* request slips for the sections of Hematology, Urinalysis, and *Stat* Laboratory subdivided into inpatient and outpatient categories. (A data collection form will be provided.)
   - Make available for Xeroxing historical workload reports.

6. Record the name of personnel on duty in the clinical laboratory each day subdivided by laboratory section.

7. Xerox all completed laboratory reports when ready for distribution.

8. Complete a laboratory staff survey questionnaire (takes approximately 15 minutes).

9. Cooperate in answering questions and providing information about procedures to MET personnel.

V. DATA COLLECTION TASKS REQUIRING THE ASSISTANCE OF PERSONNEL OUTSIDE THE LABORATORY (PERIOD X)

The following groups of people outside the laboratory will be asked to complete a questionnaire:

- Physicians (10-20 minutes)
- Registered nurses (10 minutes)
- Laboratory patients (10 minutes).

The Registrar will be asked to provide the following information:

- Daily admissions and discharges (Admissions and Discharge Report)
- Daily census (Commander's Report).

The Noncommissioned Officer in Charge of each outpatient clinic will be asked to provide the daily number of outpatient visits. (A data collection form will be provided.)

Personnel from outpatient clinics and inpatient nursing units will be asked to sign out when they pick up completed laboratory reports.

Personnel in the Outpatient Medical Records Department will be asked to do the following:

- Allow a data collector to Xerox laboratory reports ready to be filed
- Pull medical records to be screened by data collectors (approximately 500 records)
- Aid data collectors in tracking down laboratory reports not yet filed in the outpatient medical record.

Inpatient Medical Records personnel will be asked to provide information that will allow estimation of the fraction of

inpatient laboratory reports that are filed in inpatient medical records rather than on the wards. (They may be asked to count or to allow a data collector to count laboratory reports by the date the report was ready for distribution.)

Hospital staff will be asked to aid data collectors observing:

- Time required to file a laboratory report in the outpatient medical record
- Time required to file a laboratory report in the inpatient medical record
  - On the ward
  - In Inpatient Medical Records
- Time required to fill out a laboratory request slip
  - In the clinics
  - On the wards
- Time required to prepare and file a laboratory flow sheet (including the number and percentage of patients requiring flow sheets).

The Registrar/Hospital Administrator will be asked to provide information about changes that occur between Period X and Period Y.

VI. DATA COLLECTION FORMS

This part of Appendix B is a compilation of all data collection forms that were used in the evaluation of AFCLAS at MCWP.

List of Forms

Form 1: Record of Telephone Calls to Wright-Patterson Clinical Laboratory Reception Area

Form 2: Followup for Calls Made from Laboratory Sections at Wright-Patterson AFB

Form 3: Record of Telephone Calls (to be Completed by Laboratory Personnel)

Form 4: Record of Telephone Calls to Malcolm Grow Clinical Laboratory Reception Area

Form 5: Record of Telephone Calls (to be Completed by Reception Area Personnel)

Form 6: Daily Workload Record

Form 7: Request Slip Record

Form 8: *Stat* Request Slip Record

Form 9: Reception Area Observation Record (Errors in Arriving-Outpatient Request Slips)

Form 10: Reception Area Observation Record (Service Time at the Laboratory Reception Desk)

Form 11: Time In/Time Out Card

Form 12: Record of Return from Specimen Collection/ Departure for Result Slip Distribution

Form 13: Record of Tests Sent Out to (Received from) Other Clinical Laboratories

Form 14: Report of Outpatient Clinic Visits

Form 15: Report of Inpatient Census

Form 16: Turnaround Time

Form 17: Inpatient Reports

Form 18: Outpatient Reports

RECORD OF TELEPHONE CALLS TO WRIGHT-PATTERSON CLINICAL LABORATORY RECEPTION AREA

Observation Number _____ Date _____ Time: From _____ To _____ Prepared by _____

Call No.	Extension No. ___			Extension No. ___			Extension No. ___			Extension No. ___			Extension No. ___			Type of Call	Caller		Dispos.	Rec'd. By
	Recept.	Hold	Lab	Recept.	Hold	Lab	Recept.	Hold	Lab	Recept.	Hold	Lab	Recept.	Hold	Lab		Cat.	Loc.		

NOTES

Type of Call: Inquiry (I), Noninquiry (NI), Call originating in lab (O)
Category of Caller: MD, Nurse (N), Other hospital staff (HS), Patient (P), Other (O)
Location of Caller: Specific ward or clinic, outside (O)
Disposition: completed at reception area (C), receptionist will call back (CB), referred to lab section — (identify section)
Received By: Receptionist (R), Laboratory Technician (LT)

FOLLOWUP FOR CALLS MADE FROM LABORATORY SECTIONS AT WRIGHT-PATTERSON AFB

Date _____ Associated with Form 1 Observation Time: From _____ To _____ Prepared by _____

Response Call	Duration of Call		Estimated Time to Retrieve Information (minutes)	Category of Caller and Location	Person Called		Comments
	Measured	Lab Sec. Log			Location Called	Category	

NOTES

Response Call: Yes (Y), No (N)
Location Called: Name of ward or clinic
Category of Caller: Lab Officer (LO), Lab Section Supervisor (S), Lab Technician (LT)

RECORD OF TELEPHONE CALLS*
(To be completed by Laboratory Personnel)

Laboratory Section or Office _____ Date _____

Time of Call	Calls Received by Laboratory Personnel		Calls Placed by Laboratory Personnel		
	Inquiry	Other	Report Stat Result	Call in Resp. to Prev. Inq.	Other
0730-0830					
0830-0930					
0930-1030					
1030-1130					
1130-1230					
1230-1330					
1330-1430					
1430-1530					
1530-1630					
1630-1730					
Calls Outside Normal Duty Hours of 0730 to 1730					

Visits for Information on Test Status or Test Results		
Time of Visit	Categ. of Visit	Estimated Time to Retrieve Information (minutes)

Record of Inquiry Response Calls*					
Time of Call	Duration of Call (minutes)	Estimated Time to Retrieve Information (minutes)	Name of Person Placing Call	Person Called	
				Location Called	Category

*For all telephone calls placed by laboratory personnel in response to a previous inquiry, please complete the section entitled "Record of Inquiry Response Calls."
For all visits for information on test status or test results, please complete the section entitled "Visits for information on Test Status or Test Results."

NOTES

Inquiry Call: Any telephone request for test status or test results Location Called: Name of specific ward or clinic Category of Person Called: MD, Nurse (N), Other hospital staff (HS)

RECORD OF TELEPHONE CALLS TO MALCOLM GROW CLINICAL LABORATORY RECEPTION AREA

Observation Number _____ Date _____ Time: From _____ To _____ Prepared by _____

Calls Received at Reception Area							Response Calls from Lab Sections					
Call No.	Duration of Call	Type of Call	Caller		Disposition	Received By	Duration	Estimated Time to Retrieve Information	Caller		Person Called	
			Category	Location					Categ.	Locat.	Location Called	Category

NOTES

Type of Call: Inquiry (I), Noninquiry (NI)
Category of Caller: MD, Nurse (N), Other Hospital Staff (HS), Patient (P), Other (O)
Location of Caller: Specific ward or clinic or outside (O)
Disposition: Completed at reception area (C), Receptionist Call Back (CB), *Referred to Lab Section — (identify section)*
Received By: Receptionist (R), Laboratory Technician (LT)
Category of Caller for Response Call: Lab Officer (LO), Lab Section Supervisor (S), Lab Technician (LT)

ANSER (March 1975) FORM 4

RECORD OF TELEPHONE CALLS
(to be completed by Reception Area Personnel)

Prepared by _____ Date _____

Hour	Total Calls Received at Reception Area		Record of Calls Transferred																			
			Stat. Lab		Chem.		Central Proc.		Hem.		Coag.		Urin.		Micro.		Blood Bank		Histo.		Other	
	Inquiries	Other	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.	Inq.	Oth.
0730–0830																						
0830–0930																						
0930–1030																						
1030–1130																						
1130–1230																						
1230–1330																						
1330–1430																						
1430–1530																						
1530–1630																						
Totals																						

DAILY WORKLOAD RECORD

Lab Section _____ Date _____ Prepared by _____

	Routine		Stat		Total
	In	Out	In	Out	

Page ____ of ____ Pages

REQUEST SLIP RECORD

Prepared by _____ Date _____

Standard Slips by Laboratory Section	Date																					
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Stat Lab																						
Chemistry																						
Hematology																						
Special Hematology																						
Urinalysis																						
Microbiology																						
Parasitology																						
Serology																						
Histopathology																						
Other Slips (list)																						

ANSER (March 1975) FORM 7

STAT REQUEST SLIP RECORD

Prepared by _____ Date _____

Date	Hematology		Urinalysis		Stat Lab	
	In	Out	In	Out	In	Out

Page ____ of ____ Pages

RECEPTION AREA OBSERVATION RECORD
(Errors in Arriving Outpatient Request Slips)

Observation Number _____ Time: From _____ To _____

Date _____ Observer _____

Slips Observed	Patient's Initials	Errors								
		Patient's Name	SSAN	Clinic/ Ward	Telephone No.	Physician	Rank/ Relation	Date	Other	Comments
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										

NOTES

Identify Error: Missing (M), Illegible (IL), Incomplete (SSAN only) (IC)

Page____ of____ Pages

RECEPTION AREA OBSERVATION RECORD
(Service Time at the Laboratory Reception Desk)

Observation Number _____ Date _____ Time: From _____ To _____ Observer _____

Patients Observed	Time of Arrival	Service Time	Type of Patient	Instructions Given	Comments
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

NOTES

Type of Patient: In (I), Out (O)
Instructions Given by Receptionist: Yes (Y), No (N)

TIME IN

The time that patients spend in the clinical laboratory is being studied and your cooperation is needed. Please return this card to the receptionist or the person who gave it to you when you leave the laboratory.

TIME OUT

Are you here for a Glucose Test? ☐ Yes
☐ No

ANSER (March 1975)

FORM 11

RECORD OF: ☐ RETURN FROM SPECIMEN COLLECTION
☐ DEPARTURE FOR RESULT SLIP DISTRIBUTION

Location _____ Date _____ Certified by _____

Name	Time	Location*

*Specimen collection teams enter collection location; result distribution personnel enter destination of laboratory reports to be delivered.

Page____ of____ Pages

RECORD OF TESTS ☐ SENT OUT TO ☐ RECEIVED FROM } OTHER CLINICAL LABORATORIES

Date: From _____ To _____ Prepared by _____ Date _____

Test	Facility							

REPORT OF OUTPATIENT CLINIC VISITS

Clinic _____ Prepared by _____ Date _____

Week of	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

REPORT OF INPATIENT CENSUS

Prepared by _____ Date _____

Ward	Date								
Total Census									
Admissions									
Discharges									

TURNAROUND TIME*

Date of Sample_____ Prepared by _____

Sample Size _____ Date _____

Name	SSAN	Type of Patient	Type of Request Slip	Date/Time In	Date/Time to Dist. Pt.	Date Found at Record Location	Cannot Be Filed	Comments

*This form will only be used if laboratory reports cannot be Xeroxed.

Page ____ of ____ Pages
Prepared by _____

INPATIENT REPORTS

Ward _____

Name	Identification Number	Location							Comments
		Laboratory Out Box	Ward In Basket	Physicians Box	Patient Record	Patient Discharged	Report Signed	Flow Sheet	

ANSER (March 1976)

FORM 17

Page ____ of ____ Pages

Prepared by _____

OUTPATIENT REPORTS

Name	SSAN	Sample Number	Record Search				Record Search				Date Slip Found in Record
			Location	Date of Search	Record Found	Comments	Location	Date of Search	Record Found	Comments	

ANSER (March 1976)

FORM 18

APPENDIX C

SURVEY SCHEDULES

TABLE OF CONTENTS

NOTE ON APPENDIX C

The schedules in this appendix are designed to measure the attitudes toward the clinical laboratory and acceptance of AFCLAS. The schedules were designed not to prove some expected dramatic changes, but rather to measure change, if in fact there is change.

I. AFCLAS AND THE PERSONNEL SYSTEM OF THE HOSPITAL

The effectiveness of a technological change such as AFCLAS should be measured by more factors than its conformity to design specifications. AFCLAS will impinge upon the personnel system of the laboratory and other personnel systems of the hospital. Its acceptance by hospital personnel will determine how well technical capability will be converted into operational capability. Although the relationship between patient satisfaction and the effectiveness of AFCLAS is not as evident as the relationship of hospital personnel to AFCLAS, it is reasonable to assume that some relationship exists.

AFCLAS will impinge upon personnel subsystems within the hospital personnel system in different degrees. It seems reasonable to expect that the perceived impact of AFCLAS will be a function of the degree to which AFCLAS impinges upon a person's daily tasks and the perceived significance of these tasks. AFCLAS will have the greatest impact on laboratory personnel because their tasks are more directly related to it than are any other personnel categories. Other personnel subsystems in the hospital will be less affected since AFCLAS will have impact on only some of their tasks. Physicians, for example, will devote a very small part of their time to consideration of laboratory reports. The clinical laboratory report is only one of his many diagnostic tools—albeit an important one.

Studies of job satisfaction generally do not show a significant correlation between job satisfaction and productivity. Job satisfaction studies do show a positive correlation between job satisfaction and personnel retention and a negative correlation between job satisfaction and absenteeism.

AFCLAS is a man-machine system and it will not attain its expected technical capability unless it is accepted by the

users. Industrial sociologists and psychologists accept as axiomatic widespread resistance to technological innovation. The prejudice associated with this resistance to innovation is confirmed by the initial disruption caused by a new system. Acceptance by employees, therefore, cannot be expected until the system has been operating smoothly for some time. Thus, the Period Y schedules should be administered as late as possible after the system is operational.

A Job Satisfaction Schedule will measure acceptance by laboratory personnel. Other schedules will measure acceptance by physicians and registered nurses. In addition, patient satisfaction with the clinical laboratory will be measured before and after implementation of AFCLAS.

The terms "schedule" and "questionnaire" are often used interchangeably in studies of data collection methods. Schedule, however, is a more general term and includes all categories of data to be collected by the researcher by systematic observation. Schedules may range from the categories of behavior to be observed and recorded by the participant observer of group behavior to forced choice answers to questions on a form to be filled out by the respondents.

Questionnaires are standardized schedules in which each question is proposed to each respondent in the same way. Questionnaires may be used in interviews or may be in a form that the respondent may read and reply to in writing.

A scale is a method of measuring variables in a social environment based on response to more than one question by respondents. Scales may be developed in which the response to a given question is not significant in itself but is significant as part of a composite score; e.g., the Laboratory Patient Scale. The physician and nurse questionnaires are questionnaires in the instruction section and questionnaires

that form scales in the remainder. Each question provides data that is significant per se. Each question also is part of a scale that will provide a composite score for each respondent.

II. DESCRIPTION OF SCHEDULES AND INTERVIEWS

This section describes generally some of the techniques and considerations inherent in the development of the schedules and interviews.

A. Physician and Registered Nursing Staff Schedules

The physician and registered nurse schedules are designed to measure the perception of AFCLAS and of the clinical laboratory before and after the installation of AFCLAS. Rigorous measures of the validity of the instrument are impossible because the individuals administering the schedule have no source of information on the true perception of AFCLAS (if it were known there would be no need for the instrument).

The validity of an instrument may be defined as the extent to which differences in score reflect true differences between perceptions of AFCLAS or the clinical laboratories before and after installation of AFCLAS.

Since there is no known measure of true perception, validity must be determined by other measures. Prognostic validity (i.e., the accuracy of predictions based on the schedule) and construct validity (i.e., the degree to which an individual possesses some characteristic reflected in test performance and the scores on the test), which correlate with performance and behavior cannot be used to measure the validity of the instruments below.

The measure of validity of physician and registered nursing staff schedules is the self-evident relevance of the questions on the schedule to what is to be measured. This is referred to in literature on survey research as face validity—valid "on the face of it."

The question of validity of instruments is an unsolved problem in social research and a solution is not in sight. Although the social science researcher cannot ignore the problem, he can minimize it by avoiding the pitfalls of questionnaire construction. If the schedule he designs is valid, it will not be rejected for other reasons. In other words, the researcher should avoid all known practices that degrade the validity of schedules.

B. Laboratory Staff Questionnaire

Employee satisfaction has been studied by psychologists, social psychologists, sociologists, and management scientists for a long time. The variables identified are extensive. However, two general categories of variables—hygiene (i.e., the work environment) and motivation—are widely accepted. Within these two major categories, four classes of variables are generally accepted. These are: variety, autonomy, task identity, and feedback. Two additional variables—dealing with others and friendship opportunities—have sometimes been used in employee satisfaction research. In the laboratory staff questionnaire, each question was written to investigate one of the six variables.

C. Laboratory Patient Satisfaction Scale

The laboratory patient satisfaction scale is designed to measure the patient's perception of the clinical laboratory and is based on the theory of organizational climate. The basic concept is that the behavior of the membership of an organization reflects the work climate of the organization. The work climate, in turn, is perceived by the consumers on the basis of behavior of members of the organization. Finally, behavior of consumers is correlated with their perception of organization climate. In other words, employee and consumer satisfaction are correlated. For purposes of this study,

employee satisfaction is an independent variable, and consumer satisfaction a dependent variable.

D. Medical Records Department and Admissions and Dispositions Department Staff Interviews (Period Y Only)

Both the Medical Records Department staff and the Admissions and Dispositions Department staff are small, and members of these staffs appear to have little direct contact with the laboratory. A controlled nondirective interview is feasible to provide an estimate of the influence of AFCLAS on the staff of these departments. The use of the controlled nondirective interview at the initial installation sites also may provide insight that will be useful in evaluation of future installations.

The controlled nondirective interview is an adaptation of the technique developed by Carl Rogers for counseling and psychotherapy to interviewing. The interviewer sets the stage by describing the purpose of the interview, but from that point on the respondent communicates in his own way. The interviewer interjects neutral comments to keep the interview going and may bring the interviewee back on course by a directive remark but the interviewer is essentially respondent-centered.

The technique for interviewing the medical records staff might begin, after introductions, with a statement:

Interviewer - Part of your job is to file laboratory reports.

Respondent - Yes.

Interviewer- - You place the laboratory reports in the files?

The interviewer keeps the interview going by statements such as:

- I see.
- Hmm.

- How do you mean that?
- I don't quite understand that.
- Why do you think it is that way?
- Can you tell me more about that?
- Is there anything else?

E. Physician Interviews (Period Y Only)

During Period Y a random sample of 25 physicians will be interviewed to obtain further insight into the physicians' perceptions of AFCLAS.

The technique of controlled nondirective interviewing will be used to obtain responses to the following questions:

- What has been the impact of AFCLAS on your day-to-day practice in the delivery of health care?
- What has improved since the introduction of AFCLAS?
- What has deteriorated since the introduction of AFCLAS?
- What was your initial reaction to AFCLAS, and how has it evolved to the present?
- What improvements in AFCLAS would help you?

III. SCALING OF SCHEDULES

This section describes how the physician, registered nurse, laboratory staff, and patient schedules are being scaled. The section also summarizes the method for interpreting the interviews of physicians, Medical Records Department, and Admissions and Dispositions Department staff.

A. Scaling the Physician's and Registered Nurse's Questionnaires

The AFCLAS evaluation plan includes questionnaires for physicians and registered nurses. These questionnaires were developed to measure the attitudes of physicians and registered nurses toward the clinical laboratory before and after the installation of AFCLAS. The physician's questionnaire contains two parts, and the registered nurse's questionnaire contains one part; all three parts will be scored using the same method. The respondent is asked in each item of the questionnaire to express an opinion by checking one of five phrases or one of six quantities that relate to the statement.

The measurement of attitude change from before to after AFCLAS would be simple if the scores on individual questions could be aggregated and a mean obtained for the attitude of a population before and after. This cannot be done by treating each question as an equal measure of attitude toward the clinical laboratory, since a pretest of the questionnaires indicated the respondents attached a wide range of importance to the questions. It is necessary, therefore, to weight the responses to the questions (which has the effect of weighting the questions) in order to obtain a valid measure of attitude change. (See Reference 1.) The general method for scoring one question (repeated for all questions) is outlined as follows and then described in more detail:

1. Compute standard score for each response (a question has either 5 or 6 possible responses so i = 1, ..., 6) from the Period X data.

2. Determine frequency for each response from Period Y data.

3. Compute a mean standard score using the standard scores X_i from 1 above and the Period Y frequencies from 2 above.

4. Determine if the change in acceptance from Period X to Period Y is statistically significant by using a statistical test that compares the mean standard score in 3 with the mean standard score computed using Period X data only.

It is assumed for purposes of scaling that the attitude toward the clinical laboratory, as measured by each question, is normally distributed. For each question for the Period X data, the standard deviation from the estimated mean of a normal distribution is first calculated. Each standard deviation is then converted to a standard score with a mean of 50 and a standard deviation of 10.

Computation of the standard deviations and the standard scores for one of the questions in the physician's questionnaire is described below. Question number 23 of Physician's Questionnaire #2 reads as follows:

AFCLAS will:

- ☐ significantly decrease
- ☐ slightly decrease
- ☐ have no effect on
- ☐ slightly increase
- ☐ significantly increase

} the number of repeat requests for laboratory work.

- ☐ no opinion

Table 1 lists the data for the above question obtained from MCWP during Period X.

TABLE 1

DATA FOR QUESTION NO. 23 OF PHYSICIAN'S QUESTIONNAIRE #2 (PERIOD X)

Response Number	Responses	Number Checking	Percent Checking	Cumulative Percent Checking	σ-Values	Standard Scores
1.	significantly decrease	18	31	100	-1.14	38.6
2.	slightly decrease	29	50	69	0.16	51.6
3.	have no effect on	10	17	19	1.31	63.1
4.	slightly increase	1	2	2	2.44	74.4
5.	significantly increase	0	0	0	3.00	80.0
	Number of Valid Responses:	58				
	No Opinion:	28				
	Blanks:	3				

In the above table, the percentages have been rounded to the nearest whole number. The σ-values have been obtained in the following way: since no physicians responded to number 5, "significantly increase," the mean σ-distance, from the mean of a normal distribution, was set to 3.00. The mean σ-distance, from the mean of a normal distribution, of the 2-percent of a normal distribution at the extreme right of the distribution is obtained by going to Table 2, Mean σ-Distances from the Mean of Various Percents of a Normal

TABLE 2
MEAN σ-DISTANCES FROM THE MEAN OF VARIOUS PERCENTS OF A NORMAL DISTRIBUTION

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
1	270	218	196	181	170	160	151	144	137	131	125	120	115	110	106	102	97	94	90	86	82	79	76	72	69	66	63	60	57	54	51	48	45	43	40	37	35	32	29	27	24	21	19	16	14	11	09	06	04	01
2	244	207	189	175	165	156	148	141	134	128	122	118	112	108	104	99	95	92	88	84	81	77	74	71	67	64	61	58	55	52	50	47	44	41	39	36	33	31	28	25	23	20	18	15	13	10	08	05	03	
3	228	198	182	170	160	152	144	137	131	125	120	115	110	106	102	97	94	90	86	82	79	76	72	69	66	63	60	57	54	51	48	45	43	40	37	35	32	29	27	24	21	19	16	14	11	09	06	05		
4	216	191	177	165	156	148	141	134	128	123	118	113	108	104	100	96	92	88	84	81	77	74	71	67	64	61	58	55	52	50	47	44	41	39	36	33	31	28	25	23	20	18	15	13	10	08	05			
5	210	185	172	161	152	145	138	131	126	120	115	111	106	102	98	94	90	86	82	79	76	72	69	66	63	60	57	54	51	48	45	43	40	37	35	32	29	27	24	21	19	16	14	11	09	06				
6	199	179	167	157	149	141	135	129	123	118	113	108	104	100	96	92	88	84	81	77	74	71	68	64	61	58	55	53	50	47	44	41	39	36	33	31	28	25	23	20	18	15	13	10	08					
7	192	174	163	153	145	138	132	126	121	116	111	106	102	98	94	90	86	83	79	76	72	69	66	63	60	57	54	51	48	45	43	40	37	35	32	29	27	24	21	19	16	14	11	09						
8	186	170	159	150	142	135	128	124	118	113	109	104	100	96	92	88	84	81	77	74	71	68	64	61	58	55	52	50	47	44	41	39	36	33	31	28	25	23	20	18	15	13	10							
9	181	165	155	147	139	133	126	121	116	111	106	102	98	94	90	86	83	79	76	73	69	66	63	60	57	54	51	48	46	43	40	37	35	32	29	27	24	21	19	16	14	11								
10	176	161	151	143	136	130	124	119	114	109	104	100	96	92	88	85	81	78	74	71	68	65	62	59	56	53	50	47	44	41	39	36	33	31	28	25	23	20	18	15	13									
11	171	158	148	140	134	127	122	116	111	107	102	98	94	90	87	83	79	76	73	69	66	63	60	57	54	51	48	46	43	40	37	35	32	29	27	24	22	19	16	14										
12	167	154	145	138	131	125	119	114	109	105	100	96	92	89	85	81	78	74	71	68	65	62	59	56	53	50	47	44	41	39	36	33	31	28	25	23	20	18	15											
13	163	151	142	135	128	122	117	112	107	103	99	94	91	87	83	80	76	73	70	66	63	60	57	54	51	48	46	43	40	37	35	32	29	27	24	22	19	16												
14	159	147	139	132	126	120	115	110	105	101	97	93	89	85	81	78	75	71	68	65	62	59	56	53	50	47	44	42	39	36	33	31	28	25	23	20	18													
15	156	144	136	129	123	118	113	108	103	99	95	91	87	83	80	76	73	70	66	63	60	57	54	51	49	46	43	40	37	35	32	29	27	24	22	19														
16	152	141	134	127	121	116	111	106	101	97	93	89	85	82	78	75	71	68	65	62	59	56	53	50	47	44	42	39	36	33	31	28	26	23	20															
17	149	139	131	125	119	113	109	104	99	95	91	87	84	80	77	73	70	67	64	60	57	54	52	49	46	43	40	37	35	32	29	27	24	22																
18	146	136	129	122	117	111	106	102	98	93	89	86	82	78	75	72	68	65	62	59	56	53	50	47	44	42	39	36	33	31	28	26	23																	
19	143	133	126	120	114	109	105	100	96	92	88	84	80	77	73	70	67	64	61	58	55	52	49	46	43	40	38	35	32	30	27	24																	
20	140	131	124	118	112	107	103	98	94	90	86	82	79	75	72	69	65	62	59	56	53	50	47	45	42	39	36	34	31	28	26																		
21	137	128	121	116	110	105	101	96	92	88	84	81	77	74	70	67	64	60	58	55	52	49	46	43	40	38	35	32	30	27																			
22	135	126	119	113	108	103	99	95	90	87	83	79	76	72	69	66	62	59	56	53	50	48	45	42	39	36	34	31	28																				
23	132	124	117	111	106	101	97	92	89	85	81	78	74	71	67	64	61	58	55	52	49	46	43	41	38	35	32	30																					
24	130	121	115	109	104	100	95	91	87	83	80	76	73	69	66	63	60	57	54	51	48	45	42	39	36	34	31																					
25	127	119	113	107	102	98	93	89	85	82	78	74	71	68	64	61	58	55	52	49	46	43	41	38	35	32																					
26	125	117	111	105	101	96	92	88	84	80	76	73	70	66	63	60	57	54	51	48	45	42	39	37	34																					
27	123	115	109	104	99	94	90	86	82	78	75	71	68	65	62	58	55	52	49	46	44	41	38	35																					
28	120	113	107	102	97	92	88	84	80	77	73	70	67	63	60	57	54	51	48	45	42	39	37																					
29	118	111	105	100	95	91	87	83	79	75	72	68	65	62	59	56	53	50	47	44	41	38																					
30	116	109	103	98	93	89	85	81	77	74	70	67	64	60	57	54	51	48	45	42	40																					
31	114	107	101	96	92	87	83	79	76	72	69	65	62	59	56	53	50	47	44	41																					
32	112	105	99	94	90	86	82	78	74	71	67	64	61	58	54	51	48	46	43																					
33	110	103	98	93	88	84	80	76	73	69	66	63	59	56	53	50	47	44																					
34	108	101	96	91	86	82	79	75	71	68	64	61	58	55	52	49	46																					
35	106	99	94	89	85	81	77	73	70	66	63	60	56	53	50	47																						
36	104	97	92	88	83	80	75	72	68	65	61	58	55	52	49																							
37	102	96	91	86	82	78	74	70	67	63	60	57	54	51																								
38	100	94	89	84	80	76	72	69	65	62	59	55	52																									
39	98	92	87	83	79	75	71	67	64	61	57	54																										
40	97	91	86	81	77	73	69	66	62	59	56																											
41	95	89	84	80	75	72	68	64	61	58																												
42	93	87	82	78	74	70	66	63	60																													
43	91	85	81	76	72	69	65	62																														
44	90	84	79	75	71	67	64																															
45	88	82	78	73	69	66																																
46	86	81	76	72	68																																	
47	85	79	75	70																																		
48	83	78	73																																			
49	81	76																																				
50	80																																					

Average distance from the mean, in terms of σ, of each single percentage of a normal distribution (decimals omitted). Figures along the top of the table represent *percentages of area from either extreme*. Figures down the side of the table represent percentages measured from given points in the distribution.

Examples: The average distance from the mean of the highest 10% of a normally distributed group is 1.76σ (entry opposite 10 in first column). The average distance from the mean of the *next* 20% is $.86\sigma$ (entry opposite 20 in column headed 10). The average distance from the mean of the *next* 30% is

$$\frac{.26 \times .20 + (-.13 \times .10)}{.30}$$

or $.13\sigma$ (20% lie to the right of mean and 10% to left).

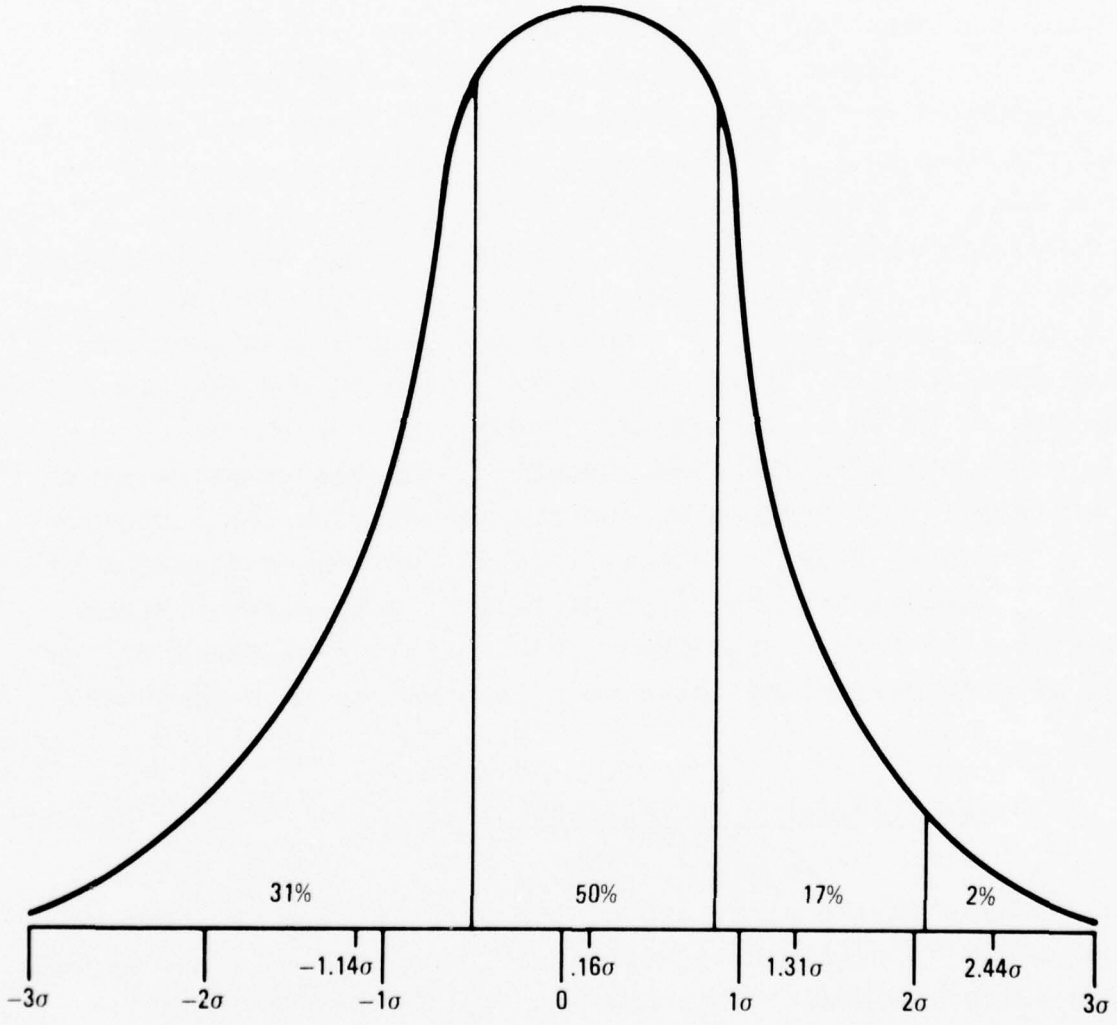
Source: Reproduced from Garrett, Ref. 2, by permission of the publisher.

Distribution. In the table, the average σ-distance from the the mean for 2 percent is 2.44 (column 0, row 2). Thus a response of "slightly increase" is given an σ-value of 2.44. Reference to Figure 1 will make this clearer. The σ-value for "have no effect on" is obtained by going to the column headed 2 and taking the entry at row 17, which is 1.31. This means that when 2 percent of the distribution has been used, the mean distance of the next 17 percent from the mean of the normal distribution is 1.31. The percent of respondents checking "slightly decrease" is on both sides of the mean of the distribution (31 percent to the right of the mean and 19 percent to the left). Since 19 percent of the distribution to the right of the mean has been accounted for, 31 percent of those who checked "slightly decrease" will be to the right and 19 percent to the left of the mean of the distribution. From the column headed 19 and the row marked 31 by Table 2, the mean σ-distance for the 31 percent is 0.41, which is the mean σ-distance for the 31 percent to the right. From column 31 (50 percent - 19 percent) and row 19, the entry 0.24 is taken. This is the mean σ-distance of the 19 percent for the response "slightly decrease," which lies to the left of the mean. The overall σ-distance of the 50 percent responding "have no effect on" is then computed as

$$\frac{(0.31)(0.41) - (0.19)(0.24)}{0.50} = 0.16.$$

Going to the other end of the distribution, 31 percent responded "significantly decrease." From column 0 and row 31, the entry is 1.14. (This becomes -1.14 since it is to the left of the mean of the distribution.) This is the mean σ-distance from the normal distribution mean for the "significantly decrease" response.

FIGURE 1
SCALING OF THE FIVE RESPONSES TO QUESTION 23,
PHYSICIAN'S QUESTIONNAIRE # 2



The corresponding standard score for each σ-value is obtained by moving the decimal one place to the right and adding 50. This is to convert from a [0, 1] normal distribution (mean = 0, σ = 1) to a [50, 10] normal distribution (mean = 50, σ = 10).

The average standard score for the population for question number 23 as computed from the Period X data should equal 50, and any deviation is due to roundoff error:

$$\bar{X}_x = \frac{(18)(38.6)+(29)(51.6)+(10)(63.1)+(1)(74.4)+(0)(80.0)}{58}$$

$$= 49.9.$$

Table 3 lists the data for question number 23 obtained from MCWP during Period Y.

TABLE 3

DATA FOR QUESTION NO. 23 OF THE
PHYSICIAN'S QUESTIONNAIRE #2 (PERIOD Y)

Response Number	Responses	Number Checking
1	significantly decrease	2
2	slightly decrease	16
3	have no effect on	37
4	slightly increase	26
5	significantly increase	21
	Number of Valid Responses:	102
	No Opinion:	9
	Blanks	1

A mean standard score for Period Y using the frequency of responses from Period Y and the standard scores from Period X is computed as follows:

$$\bar{X}_y = \frac{(2)(38.6)+(16)(51.6)+(37)(63.1)+(26)(74.4)+(21)(80.0)}{102}$$

$$= 67.2$$

When computing σ-values and standard scores, several special cases are handled as follows:

- If there are no responses to number 5, then set $\sigma = +3.00$, which implies a standard score of 80.
- If there are no responses to number 1, then set $\sigma = -3.00$, which implies a standard score of 20.
- If there are no responses to number 4 or number 5, then set $\sigma = +3.00$ for both responses, which implies a standard score of 80 for both responses.
- If there are no responses to number 1 or number 2, then set $\sigma = -3.00$ for both responses, which implies a standard score of 20 for both responses.
- If a zero response occurs between two non-zero responses, use the following formula to obtain the standard score for the zero-response item:

  standard score $= 10X_c + 50$

  where X_c is such that

  $$\int_{X_c}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-x^2/2}\, dx = \text{percent checking all previous responses.}$$

The statistical test to determine if the difference between the mean standard score from Period X is significantly different from the mean standard score from Period Y is described below.

Let

$\bar{X}_x$ = mean standard score computed using Period X data only,

$\bar{X}_y$ = mean standard score computed using the frequencies from Period Y and the standard scores from Period X,

f_i = the number answering each response in Period Y,

s = an estimate of standard deviation,

n = the number of possible responses to a question (n = 5 or 6).

Then

$$s^2 = \frac{\sum_{i=1}^{n} f_i X_i^2 - \left(\sum_{i=1}^{n} f_i X_i\right)^2 \Big/ \sum_{i=1}^{n} f_i}{\sum_{i=1}^{n} f_i - 1}.$$

Compute $t = \dfrac{\bar{X}_y - \bar{X}_x}{s \Big/ \sum_{i=1}^{n} f_i}$.

To test for statistical significance, compare t with tables of Student's t statistic using $t_{1-\frac{\alpha}{2}\left(\sum_{i=1}^{n} f_i - 1\right)}$.

B. Scaling the Laboratory Staff Questionnaire

The Laboratory Staff Questionnaire is made up of two parts. The first part is a conventional job satisfaction scale. The second part is a questionnaire designed solely to obtain data on: the laboratory environment; the individual respondent's activities that impinge upon the time he spends in the laboratory, e.g., time worked in the laboratory, overtime work in the laboratory, military duties outside the laboratory; the individual's qualitative evaluation of task frequencies in the laboratory, e.g., frequency with which he is rushed in performing tasks; and the individual's evaluation of the quality of the laboratory, e.g., quality of reports, quality control. The second part is not scaled. The first part is a Likert-type scale.

The Likert-type scale is an ordinal scale of attitudes toward some object or objects in the environment—in this case attitude toward the job or job satisfaction.

The Laboratory Staff scale for the first part of the Laboratory Staff Questionnaire is a typical Likert-type scale with five response categories. Since the statements all relate to a positive attitude toward the job, each item can be scored from 1 to 5 beginning with "strongly agree." Any other method of scoring that maintains the ordinality of response can be used. Each individual's composite score is obtained by adding his item scores. The second part of the Laboratory Staff Questionnaire will not be scaled, but the responses will be tallied to report the data collected.

C. Scaling the Laboratory Patient Satisfaction Scale

The Laboratory Patient Satisfaction Scale is a Likert-type scale designed to measure patient's perception of the organizational climate of the clinical laboratory.

The first 15 questions make up the scale. The last question divides the patients into two categories—inpatient and others.

The statements that make up the scale all indicate a positive perception of the laboratory climate. These responses may be scored from 1 to 5 beginning with "strongly agree." A composite score for individuals is obtained by adding the responses to each statement.

D. Interpreting Interviews With Physicians and the Staffs of the Medical Records Department and Admissions and Dispositions Department

The Medical Records Staff interviews and the Admissions and Dispositions Department Staff interviews are designed to obtain qualitative data on the influence of AFCLAS on the respective departments.

The interviews will be the controlled nondirective type. Although the number of respondents will be small, a large number of comments can be expected. The analysis of the data collected can be simplified by categorizing the comments.

The categories selected must be broad enough to include a large number of comments but not so broad as to include comments that are obviously dissimilar. The usual approach is to provide rather broad categories and break each category into subcategories. For example, responses to the medical records interview might be placed in such categories as filing and retrieval. Subcategories under filing might include: time, readability, quantity. Subcategories under retrieval might include: lost files, time to retrieve.

Comments by respondents will be placed in categories, and the number of comments in each category will be determined. This number then may be converted into a percent of respondents who made each category of response.

It should be emphasized that the results of analysis are descriptive. A descriptive study is an important source of hypothesis, which may be tested scientifically in a follow-on study.

REFERENCES

(1) Henry E. Garrett. Statistics in Psychology and Education. 6th ed. New York: David McKay Company, Inc., 1966: 323-327.

(2) Henry E. Garrett. Statistics in Psychology and Education: 68-69.

IV. SURVEY QUESTIONNAIRES

The survey questionnaires contained in this section are the Period Y version administered at USAF Medical Center Wright-Patterson AFB. The questionnaires which will be administered at the Malcolm Grow Medical Center, Andrews AFB, have the name of the hospital changed, but otherwise will be the same questionnaires. The Period X version of the questionnaires were the same as the enclosed questionnaires but with the appropriate verbs changed to future tense.

PHYSICIAN'S QUESTIONNAIRE #1

Instructions

1. Complete the first questionnaire based upon your knowledge and personal experience with the clinical laboratories at the Wright-Patterson Medical Center and other clinical laboratories (Air Force and non-Air Force).

2. Then complete the second attached questionnaire entitled "Physician's Questionnaire #2—AFCLAS."

3. Finally, insert the completed questionnaire into the accompanying envelope, seal the envelope, and print the following information on the front of the envelope:

Name
Department.

This information will be used only to ensure that responses from all physicians at Wright-Patterson Medical Center will be included in the study. The sealed envelope will be opened only by the research team of Analytic Services Inc. (ANSER), and the information you provide will be available only to the team.

1. Laboratory reports at this hospital are

- ☐ much more
- ☐ somewhat more
- ☐ about as
- ☐ somewhat less
- ☐ much less

legible than (as) clinical laboratory reports elsewhere.

2. At the Wright-Patterson Medical Center I have

- ☐ much more
- ☐ more
- ☐ about as much
- ☐ less
- ☐ much less

confidence in the clinical laboratory information I use with my patients than (as) I have had at other hospitals.

3. Overall, with respect to my experience with the clinical laboratory at the Wright-Patterson Medical Center, I am

- ☐ completely satisfied.
- ☐ well satisfied.
- ☐ reasonably satisfied.
- ☐ somewhat dissatisfied.
- ☐ completely dissatisfied.

4. At the Wright-Patterson Medical Center, the response time for routine laboratory results is

- ☐ much shorter than
- ☐ somewhat shorter than
- ☐ about as short as
- ☐ slightly longer than
- ☐ far longer than

I would expect at clinical laboratories generally.

5. I am

- ☐ completely confident
- ☐ very confident
- ☐ reasonably confident
- ☐ not very confident
- ☐ not at all confident

in the information I receive from the clinical laboratory at this hospital.

6. At the Wright-Patterson Medical Center, the response time for routine laboratory results is

- ☐ very short.
- ☐ short.
- ☐ moderate.
- ☐ long.
- ☐ very long.

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7. At this hospital, laboratory reports are lost

- ☐ much less often than
- ☐ less often than
- ☐ about as often as
- ☐ more often than
- ☐ much more often than

I would expect in this kind of hospital (Air Force and other).

8. At the Wright-Patterson Medical Center, filing of clinical laboratory reports in patients' charts is

- ☐ 100-percent complete.
- ☐ very complete.
- ☐ reasonably complete.
- ☐ somewhat incomplete.
- ☐ very incomplete.

9. At the Wright-Patterson Medical Center, it is necessary to repeat requests for laboratory work

- ☐ much less often than
- ☐ somewhat less often than
- ☐ about as often as
- ☐ somewhat more often than
- ☐ much more often than

I would expect for clinical laboratories of this kind (Air Force and other).

10. During the last week, I called the clinical laboratory

- ☐ none
- ☐ 1-5 times
- ☐ 6-10 times
- ☐ 11-15 times
- ☐ 16-20 times
- ☐ over 20 times

to inquire about test results.

11. During the last week,

- ☐ none
- ☐ 1-5
- ☐ 6-10
- ☐ 11-15
- ☐ 16-20
- ☐ over 20

of my clinical laboratory reports were lost.

12. During the last week, I visited the clinical laboratory to check on laboratory test status or test results on

- ☐ no
- ☐ 1-5
- ☐ 6-10
- ☐ 11-15
- ☐ 16-20
- ☐ over 20

occasions.

13. The number of errors in reports from the clinical laboratory at this hospital is

- ☐ much smaller than
- ☐ somewhat smaller than
- ☐ about the same as
- ☐ somewhat larger than
- ☐ much larger than

I would expect for clinical laboratories of this kind (Air Force and other).

14. Do you ever call the clinical laboratory to inquire about laboratory results?

- ☐ Yes
- ☐ No

If answer to question #14 is "No," go to question #18.

15. When calling the clinical laboratory at the Wright-Patterson Medical Center, I

- ☐ rarely
- ☐ occasionally
- ☐ about half the time
- ☐ very frequently
- ☐ almost every time

get a busy signal.

16. Once the telephone in the clinical laboratory is answered, there is

- ☐ a very short
- ☐ a short
- ☐ a moderate
- ☐ a long
- ☐ a very long

delay in obtaining information that I request.

17. Once the telephone in the clinical laboratory is answered, the delay in obtaining the information that I request is

- ☐ much shorter than
- ☐ shorter than
- ☐ about the same as
- ☐ longer than
- ☐ much longer than

I would expect for clinical laboratories of this kind (Air Force and other).

18. At the Wright-Patterson Medical Center, the response time for STAT results from the clinical laboratory is

- ☐ much shorter than
- ☐ somewhat shorter than
- ☐ about the same as
- ☐ slightly longer than
- ☐ far longer than

I would expect for clinical laboratories of this kind (Air Force and other).

19. Reports from the clinical laboratory at the Wright-Patterson Medical Center have

- ☐ much more
- ☐ somewhat more
- ☐ all of the
- ☐ somewhat less
- ☐ much less

clinical information than (that) I would expect in laboratory reports at this kind of hospital (Air Force and other).

20. The clinical laboratory at this hospital provides

- ☐ much more
- ☐ more
- ☐ all of the
- ☐ less
- ☐ much less

statistical information than (that) I require.

21. At the Wright-Patterson Medical Center, clinical laboratory reports are

- ☐ much more
- ☐ somewhat more
- ☐ about as
- ☐ somewhat less
- ☐ much less

readable than (as) reports from other clinical laboratories.

22. The clinical laboratory at the Wright-Patterson Medical Center makes a

- ☐ very large
- ☐ large
- ☐ moderate
- ☐ small
- ☐ very small

contribution to the quality of patient care.

23. Overall, I am

- ☐ much more
- ☐ more
- ☐ about as
- ☐ less
- ☐ much less

satisfied with the clinical laboratory at the Wright-Patterson Medical Center than (as) I have been with the clinical laboratory at other hospitals.

24. At the Wright-Patterson Medical Center, the reports from the clinical laboratory contain

- ☐ more than all of
- ☐ all of
- ☐ most, but not all, of
- ☐ somewhat less than all of
- ☐ much less than all of

the clinical information that I would like from the laboratory.

25. My relations with the clinical laboratory personnel at this hospital are

- ☐ completely satisfactory.
- ☐ very satisfactory.
- ☐ reasonably satisfactory.
- ☐ slightly unsatisfactory.
- ☐ completely unsatisfactory.

26. The clinical laboratory at this hospital provides

- ☐ much more
- ☐ somewhat more
- ☐ about as much
- ☐ somewhat less
- ☐ much less

} statistical information than (as) other clinical laboratories.

27. At this hospital, laboratory reports are lost

- ☐ rarely.
- ☐ occasionally.
- ☐ moderately often.
- ☐ often.
- ☐ very often.

28. At the Wright-Patterson Medical Center, it is necessary for me to repeat requests for laboratory work

- ☐ rarely.
- ☐ occasionally.
- ☐ moderately often.
- ☐ often.
- ☐ very often.

29. The accuracy of reports from the clinical laboratory at this hospital is

- ☐ very high.
- ☐ high.
- ☐ moderate.
- ☐ low.
- ☐ very low.

30. Laboratory reports at this hospital are

- ☐ completely legible.
- ☐ very legible.
- ☐ reasonably legible.
- ☐ slightly illegible.
- ☐ completely illegible.

31. At the Wright-Patterson Medical Center, the clinical laboratory contributes

- ☐ much more
- ☐ more
- ☐ about as much
- ☐ less
- ☐ much less

} to improved patient health than (as) clinical laboratories at similar hospitals.

32. The clinical laboratory at the Wright-Patterson Medical Center contributes

- ☐ much more
- ☐ more
- ☐ about as much
- ☐ less
- ☐ much less

} to the quality of patient care than (as) clinical laboratories at similar hospitals.

33. The accuracy of reports from the clinical laboratory at this hospital is

- ☐ much greater than
- ☐ somewhat greater than
- ☐ about the same as
- ☐ somewhat less than
- ☐ much less than

} I would expect for clinical laboratories of this kind (Air Force and other).

34. The clinical laboratory at this hospital provides reports that have

- ☐ virtually no errors.
- ☐ very few errors.
- ☐ a significant number of errors.
- ☐ many errors.
- ☐ very many errors.

35. At the Wright-Patterson Medical Center, filing of clinical laboratory reports in patients' charts is

- ☐ much more
- ☐ somewhat more
- ☐ about as
- ☐ somewhat less
- ☐ much less

} complete than (as) I would expect at a similar hospital.

36. My relations with the personnel in the clinical laboratory at this hospital are

- ☐ much more
- ☐ more
- ☐ as
- ☐ less
- ☐ much less

} satisfactory than (as) I had expected.

37. At the Wright-Patterson Medical Center, the contribution of the clinical laboratory to improved patient health is

- ☐ very large.
- ☐ large.
- ☐ moderate.
- ☐ small.
- ☐ very small.

After completing this questionnaire, please complete the "Physician Questionnaire #2—AFCLAS," which follows.

PHYSICIAN'S QUESTIONNAIRE #2—AFCLAS

A Clinical Laboratory Automation System (AFCLAS) has been installed at the Wright-Patterson Medical Center. We would like to know your opinion—as a practicing physician—of the impact AFCLAS has had on your professional activities.

1. AFCLAS has

[] significantly increased
[] slightly increased
[] had no effect on
[] slightly decreased
[] significantly decreased

the quality of patient care.

[] No opinion

2. AFCLAS has

[] virtually eliminated
[] slightly reduced
[] had no effect on
[] slightly increased
[] significantly increased

errors in clinical laboratory reports.

[] No opinion

3. AFCLAS has provided

[] much more
[] slightly more
[] about the same amount of
[] slightly less
[] significantly less

statistical information.

[] No opinion

4. AFCLAS has

[] significantly increased
[] slightly increased
[] had no effect on
[] slightly decreased
[] significantly decreased

the amount of information available from clinical laboratory reports.

[] No opinion

5. AFCLAS is

[] far superior to
[] slightly superior to
[] about the same quality as
[] slightly inferior to
[] far inferior to

the previous system.

[] No opinion

6. AFCLAS is

[] far superior to
[] slightly superior to
[] about the same as
[] slightly inferior to
[] significantly inferior to

the previous system in providing accurate requests for laboratory tests.

[] No opinion

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7. AFCLAS has been

[] far more effective than
[] slightly more effective than
[] about as effective as
[] slightly less effective than
[] significantly less effective than

} the previous system in retrieving test information on patients.

[] No opinion

8. AFCLAS responds to STAT requests in a way that

[] significantly improves
[] slightly improves
[] does not differ from the previous system in providing
[] slightly impairs
[] significantly impairs

} patient care.

[] No opinion

9. AFCLAS has

[] significantly improved
[] slightly improved
[] had no effect on
[] slightly impaired
[] significantly impaired

} the ability of the physician to use clinical laboratory data.

[] No opinion

10. AFCLAS has

[] significantly improved
[] slightly improved
[] had no effect on
[] slightly impaired
[] significantly impaired

} the physician's ability to locate patient's clinical laboratory data in the laboratory report.

[] No opinion

11. AFCLAS has

[] significantly increased
[] slightly increased
[] had no effect on
[] slightly decreased
[] significantly decreased

} the accuracy of clinical laboratory reports.

[] No opinion

12. With AFCLAS, the clinical laboratory

[] functions much more smoothly.
[] functions slightly more smoothly.
[] functions about the same.
[] functions slightly less smoothly.
[] functions significantly less smoothly.

[] No opinion

13. With AFCLAS, I am

[] significantly more knowledgeable
[] slightly more knowledgeable
[] about as knowledgeable as in the past
[] slightly less knowledgeable
[] significantly less knowledgeable

} about my patients.

[] No opinion

14. With AFCLAS, I am

[] much more confident with
[] slightly more confident with
[] about as confident as I was in the past with } the clinical laboratory information
[] slightly less confident with } that I use with my patients.
[] significantly less confident with

[] No opinion

15. With AFCLAS, the format of information in lab reports is

[] significantly more
[] slightly more
[] no more } convenient to use than was the previous format.
[] slightly less
[] significantly less

[] No opinion

16. AFCLAS has

[] significantly decreased
[] slightly decreased
[] had no effect on } the time that I have to wait for routine laboratory
[] slightly increased } reports.
[] significantly increased

[] No opinion

17. AFCLAS provides statistical information that is

[] significantly more useful in
[] slightly more useful in
[] no more useful than in the past in } patient care.
[] slightly less useful in
[] significantly less useful in

[] No opinion

18. AFCLAS has made chart reading

[] significantly easier.
[] slightly easier.
[] about as easy as before AFCLAS.
[[slightly more difficult.
[] significantly more difficult.

[] No opinion

19. AFCLAS has

[] significantly improved
[] slightly improved
[] had no effect on } telephone retrieval of test information by calling the
[] slightly impaired } laboratory.
[] significantly impaired

[] No opinion

20. AFCLAS has

[] significantly increased
[] slightly increased
[] had no effect on } the speed in retrieving test information on patients.
[] slightly decreased
[] significantly decreased

[] No opinion

21. AFCLAS has

- [] significantly decreased
- [] slightly decreased
- [] had no effect on
- [] slightly increased
- [] significantly increased

the response time for STAT reports.

- [] No opinion

22. AFCLAS has

- [] significantly decreased
- [] slightly decreased
- [] had no effect on
- [] slightly increased
- [] significantly increased

the number of lost test reports.

- [] No opinion

23. AFCLAS has

- [] significantly decreased
- [] slightly decreased
- [] had no effect on
- [] slightly increased
- [] significantly increased

the number of repeat requests for laboratory work.

- [] No opinion

24. AFCLAS has

- [] significantly increased
- [] slightly increased
- [] had no effect on
- [] slightly decreased
- [] significantly decreased

the legibility of laboratory reports filed in the patient's medical record.

- [] No opinion

25. AFCLAS has

- [] significantly increased
- [] slightly increased
- [] had no effect on
- [] slightly decreased
- [] significantly decreased

the legibility of laboratory reports.

- [] No opinion

26. AFCLAS has

- [] significantly decreased
- [] slightly decreased
- [] had no effect on
- [] slightly increased
- [] significantly increased

the number of times that I call the laboratory to obtain test results.

- [] No opinion

27. AFCLAS has

- [] significantly decreased
- [] slightly decreased
- [] had no effect on
- [] slightly increased
- [] significantly increased

the total time that I spend obtaining and using laboratory reports.

- [] No opinion

28. AFCLAS has

- [] significantly improved
- [] slightly improved
- [] resulted in no change in
- [] slightly impaired
- [] significantly impaired

relations between physicians and laboratory personnel.

- [] No opinion

29. AFCLAS has

- [] significantly decreased
- [] slightly decreased
- [] had no effect on
- [] slightly increased
- [] significantly increased

the number of times that I visit the laboratory to obtain test results.

- [] No opinion

30. Cumulative laboratory reports provided by AFCLAS are

- [] much more useful than
- [] more useful than
- [] about as useful as
- [] less useful than
- [] much less useful than

the previous laboratory reports.

- [] No opinion

31. AFCLAS has

- [] significantly increased
- [] slightly increased
- [] had no effect on
- [] slightly decreased
- [] significantly decreased

the percentage of laboratory reports filed in the patient's medical record.

- [] No opinion

32. My primary responsibility is

- [] inpatient care.
- [] outpatient care.
- [] other. Please specify _____

33. Were you assigned to the Wright-Patterson Medical Center during March 1975?

- [] Yes
- [] No

Please place your completed questionnaires into the accompanying envelope, seal the envelope, and print the following information on the front of the envelope:

Name
Department.

REGISTERED NURSING STAFF QUESTIONNAIRE

Instructions

A Clinical Laboratory Automation System (AFCLAS) has been installed at Wright-Patterson Medical Center. We would like to have your opinion—as an R.N.—of the impact AFCLAS has had on your professional activities.

Please indicate your response to each question by placing a mark in the appropriate box.

When you have completed the questionnaire, insert it in the accompanying envelope, seal the envelope, and print the following information on the front of the envelope:

Name
Department or Ward.

This information will be used only to ensure that responses from all R.N.'s at Wright-Patterson Medical Center will be included in the study. The sealed envelope will be opened only by the research team of Analytic Services Inc. (ANSER), and the information you provide will be available only to the team.

1. There has been

[] a significantly smaller
[] a somewhat smaller
[] about the same
[] a somewhat greater
[] a significantly greater

number of telephone calls for STAT results with AFCLAS.

[] No opinion

2. With AFCLAS, the time that I spend on clerical work related to laboratory reports has been

[] significantly reduced.
[] slightly reduced.
[] about the same as before AFCLAS.
[] slightly increased.
[] significantly increased.

[] No opinion

3. AFCLAS has made it

[] much easier
[] somewhat easier
[] as easy as in the past
[] somewhat more difficult
[] much more difficult

to obtain information on status of laboratory tests being performed.

[] No opinion

4. AFCLAS has

[] significantly decreased
[] slightly decreased
[] had no effect on
[] slightly increased
[] significantly increased

the total time I spend processing test requests and laboratory reports.

[] No opinion

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5. STATS are being returned

- [] much faster
- [] somewhat faster
- [] about as fast as in the past — with AFCLAS.
- [] somewhat slower
- [] much slower
- [] No opinion

6. AFCLAS has permitted me to interact

- [] much more effectively
- [] slightly more effectively
- [] about as effectively as in the past — with clinical laboratory personnel.
- [] slightly less effectively
- [] much less effectively
- [] No opinion

7. AFCLAS is

- [] far superior to
- [] superior to
- [] about the same as — the previous system.
- [] inferior to
- [] far inferior to
- [] No opinion

8. The collection of specimens has been

- [] much better organized
- [] better organized
- [] about as well organized as in the past — with AFCLAS.
- [] less organized
- [] much less organized
- [] No opinion

9. With AFCLAS, it has been

- [] much easier
- [] easier
- [] about as easy as in the past — to tell what laboratory work is to be done on a given day.
- [] more difficult
- [] much more difficult
- [] No opinion

10. AFCLAS has made it

- [] much easier
- [] somewhat easier
- [] about as easy as in the past — to obtain information about patients' clinical laboratory results.
- [] somewhat more difficult
- [] much more difficult
- [] No opinion

11. AFCLAS had made the nurses' tasks in ordering laboratory tests

- [] much easier.
- [] somewhat easier.
- [] about as easy as in the past.
- [] somewhat more difficult.
- [] much more difficult.
- [] No opinion

12. Clinical laboratory reports provided by AFCLAS are

- [] much easier
- [] somewhat easier
- [] about as easy as in the past
- [] somewhat more difficult
- [] much more difficult

to read.

- [] No opinion

13. With AFCLAS, it is

- [] significantly easier
- [] slightly easier
- [] about as easy as in the past
- [] slightly more difficult
- [] significantly more difficult

to schedule patients for laboratory procedures.

- [] No opinion

14. AFCLAS has made posting of clinical laboratory reports in a patient's chart

- [] much easier.
- [] somewhat easier.
- [] about the same as before AFCLAS.
- [] somewhat more difficult.
- [] much more difficult.

- [] No opinion

15. AFCLAS has

- [] significantly increased
- [] slightly increased
- [] had no effect on
- [] slightly decreased
- [] significantly decreased

the quality of patient care.

- [] No opinion

16. With AFCLAS, the number of telephone calls that I make to the laboratory is

- [] much smaller.
- [] slightly smaller.
- [] about the same as before AFCLAS.
- [] slightly greater.
- [] much greater.

- [] No opinion

17. My primary responsibility is

- [] inpatient care.
- [] outpatient care.
- [] other. Please specify _____

18. Were you assigned to the Wright-Patterson Medical Center during March 1975?

- [] Yes
- [] No

Please place your completed questionnaire into the accompanying envelope, seal the envelope, and print the following information on the front of the envelope:

Name
Department or Ward.

LABORATORY STAFF QUESTIONNAIRES

Instructions

1. Complete the first attached questionnaire entitled "Laboratory Staff Questionnaire #1" before completing the second attached questionnaire entitled "Laboratory Staff Questionnaire #2."

2. Indicate your response to each question by placing a mark in the appropriate block.

3. Insert the completed questionnaires into the accompanying envelope, seal the envelope, and print the following information on the front of the envelope:

Name
Section.

This information will be used only to ensure that responses from all laboratory staff at Wright-Patterson Medical Center will be included in the study. The sealed envelope will be opened only by the research team of Analytic Services Inc. (ANSER), and the information you provide will be available only to the team.

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LABORATORY STAFF QUESTIONNAIRE #1

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. During my day in the laboratory, I do many different tasks.					
2. There is an opportunity in the laboratory for independent thought and action.					
3. In contrast with workers in industry, laboratory people know the final results of their work.					
4. Supervisors in the laboratory provide valid comments on my performance.					
5. The most important part of my job is helping other people.					
6. Laboratory people get together after work more frequently than do people in other parts of the hospital.					
7. My laboratory assignment permits me to do many different test procedures.					
8. My supervisor leaves me pretty much alone to perform my work in the laboratory.					
9. I know how well I am performing my job each day.					
10. Dealing with other people in the laboratory is an important part of my job.					
11. The laboratory is a great place to develop close friends.					
12. My laboratory assignment permits me to use many different kinds of equipment.					
13. Supervisors in the laboratory provide frequent comments on my performance.					
14. Dealing with people outside the laboratory is an important part of my job.					
15. I perform tasks in the laboratory that are important but outside of my technical specialty.					
16. During a day in the laboratory, I use many different pieces of equipment.					
17. I am responsible for doing complete test procedures in the laboratory.					
18. While on duty, there is almost always an opportunity to talk with laboratory people about nonlaboratory subjects.					
19. When I am on duty, the order in which I perform my tasks, except STATs, is left up to me.					
20. Automated equipment in the laboratory does not interfere with my decisions about the tasks I perform.					
21. When I complete a laboratory test procedure, I consider it a result of my own efforts.					
22. When I start a test procedure, I know that I will have the opportunity to see it through to the end and know the result.					
23. Supervisors often get together with laboratory people after duty hours.					

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LABORATORY STAFF QUESTIONNAIRE #2

1. The normal work week in this laboratory is

- ☐ less than 35 hours.
- ☐ 35-40 hours.
- ☐ 40-45 hours.
- ☐ 45-50 hours.
- ☐ over 50 hours.

2. During the past week, I worked in the laboratory

- ☐ less than 35 hours.
- ☐ 35-40 hours.
- ☐ 40-45 hours.
- ☐ 45-50 hours.
- ☐ over 50 hours.

3. During the past week, I spent

- ☐ 2 hours or less
- ☐ 2-5 hours
- ☐ 5-8 hours
- ☐ 8-11 hours
- ☐ over 12 hours

} on military duties outside the laboratory.

- ☐ I have no military duties outside the laboratory.

4. During the past week, I was on pass or leave

- ☐ no
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

} days.

5. During the past week, I worked

- ☐ less than 1
- ☐ 1-3
- ☐ 3-6
- ☐ 6-10
- ☐ over 10

} more hours than the normal work week in the laboratory.

6. In performing my tasks in the laboratory, I feel that I have

- ☐ much more than
- ☐ more than
- ☐ all of
- ☐ somewhat less than
- ☐ much less than

} the time that I need to accomplish my tasks.

7. In performing my tasks in the laboratory, I feel that I have

- ☐ much more
- ☐ more
- ☐ about the same amount of
- ☐ less
- ☐ much less

} time than (that) I would expect for a laboratory of this type.

8. When performing my tasks in the laboratory, I am rushed

- ☐ rarely.
- ☐ occasionally.
- ☐ moderately often.
- ☐ often.
- ☐ very often.

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April W-P 1976

9. When performing my tasks in the laboratory, I am rushed

- ☐ much less often than
- ☐ less often than
- ☐ about as often as
- ☐ more often than
- ☐ much more often than

I would expect in a clinical laboratory of this kind.

- ☐ No opinion

10. The quality of reports in this laboratory is

- ☐ far superior to
- ☐ slightly superior to
- ☐ about the same quality as
- ☐ slightly inferior to
- ☐ far inferior to

reports for similar laboratories.

- ☐ No opinion

11. The time available for quality control in this laboratory is

- ☐ more than is needed.
- ☐ all that is needed.
- ☐ almost all that is needed.
- ☐ slightly less than is needed.
- ☐ much less than is needed.
- ☐ Quality control is not part of my job.

12. In laboratories such as this, there is typically

- ☐ more than enough time
- ☐ all the time that is needed
- ☐ almost as much time as is needed
- ☐ less time than is needed
- ☐ much less time than is needed

for quality control.

- ☐ No opinion

13. Please give your rank _____

14. Please give AFSC number _____

15. Are you a student?

- ☐ Yes
- ☐ No

16. Were you assigned to the Department of Pathology at the Wright-Patterson Medical Center during March 1975?

- [] Yes
- [] No

Please place your completed questionnaires into the accompanying envelope, seal the envelope, and print the following information on the front of the envelope:

Name
Section.

analytic services inc.
5613 LEESBURG PIKE, FALLS CHURCH, VIRGINIA 22041 (703) 820-2830

3 March 1976

LABORATORY PATIENT QUESTIONNAIRE

Analytic Services Inc. (ANSER), a research organization located in Falls Church, Virginia, is conducting a scientific study of Air Force laboratories. An important part of the study is to find how people like you who use the laboratory feel about the laboratory and its people.

Your conscientious completion of the attached questionnaire will be a major contribution to the scientific study of the laboratory.

Your individual response to the questionnaire will be known only to ANSER's staff.

When you complete the form, seal it in the enclosed envelope and return it to the person who gave it to you or to the receptionist.

Thank you for your valuable help in this important study.

Richard Brooks, Ph.D.
Project Director

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1. High caliber people work in the clinical laboratory at the Wright-Patterson Medical Center.					
2. I never have to wait a long time in line at the clinical laboratory at the Wright-Patterson Medical Center.					
3. I would prefer to use the clinical laboratory at the Wright-Patterson Medical Center rather than any other clinical laboratory.					
4. The clinical laboratory people seem happy to work here.					
5. I can completely depend upon the clinical laboratory people each time I come here.					
6. The atmosphere of the clinical laboratory is warm and friendly.					
7. I like to see the same clinical laboratory people each time I come here.					
8. It seems that the clinical laboratory people help each other when the laboratory is busy.					
9. The clinical laboratory people do everything possible to provide the best possible service.					
10. I am never annoyed by the way I am treated by the clinical laboratory people at the Wright-Patterson Medical Center.					
11. The clinical laboratory people treat all who come to the laboratory as equals.					
12. The clinical laboratory people treat me as an individual, not just as another patient number.					
13. The doctor always gets my test results that are needed and gets them when they are needed.					
14. The people in the clinical laboratory always tell me what they are going to do before they do it.					
15. There is no better clinical laboratory than the clinical laboratory at the Wright-Patterson Medical Center.					
16. Are you currently an inpatient at the Wright-Patterson Medical Center?	☐ Yes ☐ No				

(March 1976)

APPENDIX D

PRETEST FOR EVALUATION PLAN FOR THE AIR FORCE CLINICAL LABORATORY AUTOMATION SYSTEM (AFCLAS)

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NOTE ON APPENDIX D

In December 1974 the AFCLAS Evaluation Plan was pretested at the USAF Medical Center, Keesler AFB, Mississippi. The rationale, general methodology, and detailed plan for pretesting the AFCLAS Evaluation Plan at the Medical Center, Keesler AFB, is contained in the document entitled Pretest For Evaluation Plan for the Air Force Clinical Laboratory Automation System reproduced in this appendix.

The pretest considered the entire process of data collection with considerable emphasis placed on pretesting the survey questionnaires. The Medical Center at Keesler was selected as the pretest site because it is similar to the two AFCLAS test sites. The ANSER study team and the four MET personnel who collected the data during Period X and Period Y spent 7 days conducting the pretest. As a result of the pretest, a number of changes were made in the evaluation plan and are summarized as follows:

- A questionnaire for hospital staff other than physicians, registered nurses, and laboratory staff was dropped. This was done because interviews with people taking this questionnaire showed that they did not have enough background information to answer the questions.
- Ambiguous questions in the physician, registered nurse, and laboratory questionnaires were dropped. Our interviews with physicians, nurses, and laboratory staff showed that several questions on each questionnaire were ambiguous, and since we did not have time to pretest revised questions, the only valid action was to drop the problem questions.

Dropping ambiguous questions did not seriously impact the evaluation because the original questionnaires contained overlapping questions.

- Some methods for collecting data inside the laboratory were revised. As an example, "Methods Time Measurement," an industrial engineering technique utilizing standard times, was dropped in favor of time studies preferred by the MET team.
- Data collection forms were revised. The revision of data collection forms was primarily in layout to improve usability.

PRETEST FOR EVALUATION PLAN FOR THE AIR FORCE CLINICAL LABORATORY AUTOMATION SYSTEM (AFCLAS)

12 December 1974

Directorate of Medical Plans and Resources
Surgeon General
Headquarters United States Air Force

and

Analytic Services Inc. (ANSER)
5613 Leesburg Pike, Falls Church, Virginia 22041

I. INTRODUCTION

It would be difficult to find a general work on research methods that did not warn the researcher of the hazards of collecting data from a study population without first pretesting the study design (Reference 1). The warning is clear in the literature, but a detailed description of pretest design and technique is not to be found. Writers on research methods who do go beyond the warning seldom devote more than a few pages to details (Reference 2, 3, 4). Although material on pretesting is not concentrated in a single place, basic concepts can be gleaned from literature on research methods.

The terms "pretest" and "pilot study" are often used interchangeably. John Mudge contends that, although the terms are synonymous, pretest is more widely used in the United States and pilot study more frequently in England (Reference 5). Babbie, however, makes a clear distinction:

> ...two types of testing: pretests and pilot studies. Pretests...refer to the testing of one or more aspects of study design: the questionnaire, the sample design, a computer program for analysis and so forth. Pilot studies...refer to miniaturized walkthroughs of the entire study design....(Reference 6)

Babbie further contends in his discussion of pretesting and pilot studies that:

> ...controlled sampling should be completely ignored at this point...the pretest phase of investigation...but... pilot studies are another matter.... (Reference 7)

The same point in respect to probability sampling in the pretest is made by Galtung, who states:

> ...it is unnecessary to have a statistically sophisticated sample...in pretest. (Reference 8)

The pretest design proposed below will be as complete as the pilot study proposed by Babbie but will not require a probabilistic sample.

Neither of the sites for pretest will be selected randomly, i.e., probabilistically. The samples will be accidental in one case and purposive in the other. The basis for pretesting at Malcolm Grow USAF Medical Center at Andrews AFB was an accidental sample; the basis for selection of testing at USAF Medical Center, Keesler AFB, is a purposive sample.*

> ...no reputable investigator will permit a questionnaire to go into the field without having "pretested" it on a range of individuals or individuals representing the principal social groups, and experimenting on word selection with them....(Reference 11)

Arnold Rose considered only the questionnaire in the above quotation. The pretest design described in this document goes beyond the questionnaire to the entire data collection and analysis process. The importance of extending a pretest beyond the questionnaire is suggested by Galtung:

> ...it should be noted that the pretest is never in any abstract sense only a test of the instrument, but a test of the entire process of data collection and even of the first steps in analysis.... (Reference 12)

The pretest plan proposed below conforms to Galtung's contention that the entire process of data collection should be pretested.

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*...In accidental samples, one simply reaches out and takes the cases that fall to hand....(Reference 9)

...The basic assumption behind purposive sampling is that with good judgment and appropriate strategy one can handpick the cases to be included in the sample and thus develop samples that are satisfactory in relation to one's needs....(Reference 10)

Pretesting is important, but it is not the only important step in an overall study. The first major step, study design, has been completed by ANSER. It conforms to Simon's admonition to researchers to:

> ...think at length, think in detail, think about everything before collecting data. This must begin to sound like a broken record but it is worth the repetition. Time and money spent collecting data before you have done all the thinking will be expensive in the short and long run. But of course the future cannot be seen perfectly....(Reference 13)

No scientist, no matter how much he thinks, can perfectly predict what will happen when the design is implemented in the field. The basic purpose of pretest is to provide a more valid prediction of what will happen when data are collected in the field and what will happen when data collected are analyzed. As Babbie points out,

> ...Inevitably the researcher fails to recognize in advance all the decisions he must make....(Reference 14)

The research staff and, if possible, the interviewers should participate in all phases of the pretest (Reference 15) The staff will obtain a feel for the data that can be obtained only by participation in the data collection process.

Much of the literature on pretesting is concerned with the purpose of pretesting questionnaire and interview schedules. Selltiz, et al., comment on the pretest of questionnaires:

> ...The pretest is a tryout of the questionnaire to see how it works and whether changes are necessary before the start of full scale study. The pretest provides for catching and solving unsolved problems in the administration of the questionnaire, such as phrasing and sequencing of questions or its length....(Reference 16)

They further point out that:

> ...questions that seem clear and straightforward to the research staff may, on a trial testing, prove difficult to comprehend, or ambiguous, or simply not productive of useful information....(Reference 17)

In a different context, though directly applicable to the pretest, S. L. Payne speaks of the critical issue in questionnaire design:

> ...to make sure the particular issue which the questioner has in mind is the particular issue on which the respondent gives an answer....(Reference 18)

In designing a study, the researcher usually has clearly in mind the information he wants to obtain, but when he develops the schedules they reflect his own perception of the meaning of words. Words mean one thing to the researcher and another to the respondent. Researchers are bound by their own experience. In studying a professional environment other than his own, the researcher tends to impute his meaning of words to the respondent. As Oppenheim states:

> ...Pilot work is needed to ensure that we use terms that are like those that the respondents use themselves and have roughly similar meaning to most of them—and to us....(Reference 19)

An important part of the pretest, thus, is to determine what words and terms mean to the population studied in the survey.

The interview questionnaire creates the same kinds of problems as the written questionnaire. It is possible in an interview to probe, of course, but there are still problems. Kahn and Cannell contend that:

> ...No matter how astute the interviewer has been in wording questions, in developing the proper sequence of questions and in the design of the questionnaire, he

> needs, wherever possible, to try it out before collecting the actual interview ....(Reference 20)

Oppenheim also writes of the significance of pretesting to identify ambiguities:

> Pilot work can be the greatest help in devising the actual wording of questions and it operates as a healthy check, since ambiguities may lurk in the most unexpected quarters....(Reference 21)

The emphasis on question wording is apparent in the above. Mudge goes beyond this to contend that a pilot study is primarily an exercise in answering questions for the researchers (Reference 22).

Most writers would agree with Selltiz et al. that the objective of pretesting is to test all of the data collection techniques to be used in the survey:

> ...Much difficulty can be avoided by carefully pretesting the techniques to be used, to ensure that they will collect the information needed....(Reference 23)

The sections of the pretest design that follow provide a detailed description of what is to be done in pretesting questionnaires and schedules.

Some general remarks on the method of pretesting are in order at this point. The two sites for the pretest are to be selected on the basis of 1) an accidental sample and 2) a purposive sample. Malcolm Grow Hospital was selected for pretest of activity charting and some other tasks, such as the identification of the reports generated in a clinical laboratory. It was chosen primarily for the convenience of the MET team stationed at Andrews AFB and the proximity of the base to others concerned with the study (an accidental sample). Since Malcolm Grow Hospital will be the site of

the second AFCLAS installation, it would be inappropriate to pretest some of the questionnaires and schedules at that base. The Medical Center, Keesler AFB, was selected as the pretest site on the basis of the similarity of the population of the pretest site to the population of the survey sites (Reference 24). The Medical Center, Keesler AFB, is similar to the Malcolm Grow Hospital and USAF Medical Center, Wright-Patterson AFB in:

- Number of procedures per year in the clinical laboratory
- Characteristics of the medical staff (teaching hospital)
- Size of the hospital
- Population served.

The sample was thus a purposive sample.

The data collection section in the pretest design relates data collection techniques to each hypothesis to be tested. In the pretest, each technique will be tested and evaluated. Section III, below, describes in detail the method for the pretest of data collection techniques to be used in the study. In addition to techniques, the forms used in data collection will be pretested and evaluated (Reference 25).

The study design requires samples of a population, e.g., physicians, nurses, patients; samples of objects, e.g., patient records, laboratory requests; and samples of activities, e.g., time to retrieve information, number of calls to the laboratory. The samples of populations will follow established methods and will not require pretesting. The sampling of patients' records will require pretesting to determine the sample size for the survey and to estimate the time required to collect data. The sample of activities does

not present any methodological problem, but it is difficult to anticipate the specific problems that might exist in recording data.

The pretest, as noted above, does not require a probabilistic sample (References 26,27). However, as a part of the pretest of schedules, physicians will be interviewed at the pretest site to obtain their observations on the schedules. In order to reduce the time required for interview, each physician will be asked to comment on four randomly selected questions from the schedule. Howard Schuman refers to this as the random probe technique (Reference 28). The random probe technique will be discussed in more detail in Section II below.

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II. PRETEST OF SCHEDULES

The rationale for pretesting of schedules was discussed in Section I, above. In this section the details of data collection for pretesting schedules will be described.

A. Selection of Respondents

Schedules have been developed for generating information from:

- Physicians
- Nurses
- Staff (outpatient and nursing unit)
- Laboratory staff
- Medical records staff
- Patients.

A list of physicians assigned to the hospital will be obtained. The list should include the following information:

- Name
- Primary assignment within the hospital
- Career or noncareer.

A list of all nurses assigned to the hospital will be obtained. The list should include:

- Name
- Primary assignment within the hospital
- Whether civilian or military.

A list will be obtained of all personnel, except physicians and nurses, assigned to the hospital outpatient department and inpatient nursing units. The list should include the following:

- Name
- Status (officer, airman, civilian)
- Specialty.

A list of all personnel assigned to the laboratory will be obtained. The list should include the following:

- Name
- Status (officer, airman, civilian)
- Specialty.

A list of names of all medical records personnel will be obtained.

Patient respondents will be identified by a sample of every nth (n to be determined) patient who enters the laboratory during selected hour(s) and day(s). The days and hours for sampling will be determined by stratifying the hours into before noon and after noon. If it is assumed that there are differences in population among the days of the week, the week should be stratified accordingly.

The study design assumes that use and perception of the laboratory by physicians vary with (and only with) primary assignment, specifically, inpatient and outpatient, and whether the physician is career or noncareer. The pretest physician population will be stratified into:

- Career, outpatient assignment
- Career, inpatient assignment
- Noncareer, outpatient assignment
- Noncareer, inpatient assignment.

A sample from each stratum will be selected for interview only if significant differences among strata are observed in the responses. The interview will be for purposes

of testing the validity of the questions on the schedule. It will be necessary, therefore, to identify the physician with the completed questionnaire. There is a risk that there will be bias because of identification. To avoid or reduce such bias, the following procedure will be followed. Each questionnaire will be numbered, but no other identification will be on the questionnaire. The respondent will place his completed questionnaire in an envelope and print his name on the outside. ANSER personnel will compile a list of questionnaire identification numbers and the associated name of the respondent. This list will be kept confidential, known only to the staff and not disclosed to others.

The nurses will be stratified into inpatient and outpatient nurses. An approximately equal number will be selected from each stratum. The number selected from each stratum should be at least 50. The nurses to be interviewed will be selected in the same manner as physicians. As was noted in Section I, the sample need not be random.

The outpatient staff and inpatient nursing unit staff respondents should consist of the entire population if 50 or less or a sample of approximately 50 if the population is significantly greater than 50, i.e., 60 or more.

The clinical laboratory staff should be stratified into officer, airman, and civilian. Since the reliability and validity of the schedule administered to the clinical laboratory staff has been tested previously, only two or three respondents need be selected from each stratum.

The medical records staff population will not be administered by a schedule but will be interviewed. Since the number in this population is expected to be small, it is necessary only to identify elements in the population.

In summary, the following steps will be taken to select respondents:

- Obtain lists of the following:
  - Physicians, including: name, primary assignment in the hospital, whether career or noncareer
  - Nurses, including: name, assignment in hospital, and status (civilian or military)
  - Outpatient staff and inpatient nursing unit staff (excluding physicians, nurses), including name and status (civilian or military)
  - Laboratory staff, including: name, status (officer, airman, civilian), and specialty
  - Medical records staff, including name only
- Sample time periods for administering schedules to outpatients
- Stratify physicians by career, noncareer, outpatient, inpatient assignment
- Identify elements to be surveyed
- Identify elements to be interviewed.

B. Sampling of Questions or Schedule That Will Be Subject of Physician and Nurse Interview

The random-probe technique (Reference 1) will be used to identify the questions to be asked each physician and nurse element in the study. The use of the random-probe technique will reduce the time required to interview each element.

Each element in the sample will be interviewed for response to four, and only four, questions. The method for selecting the questions is described in the Technical Note appended to this section.

C. Types of Interview

Interviews will be conducted with a sample of each category of personnel (except the medical records personnel) to determine the validity of the questionnaires.

Each of these interviews will be composed of three basic types of interviews:

- Focused standardized open-ended
- Standardized open-ended
- Nondirective.

The focused interview was developed by Merton, Fiske, and Kendall (Reference 2). In a focused interview, the interviewer knows the experience of the respondent, and the interviewer focuses attention on the aspects of experience significant for goals of the project. In this study the interviewer will know in advance the response that the respondent has previously given to the questions that will be the subject of the interview.

Specifically, interviews with physicians and nurses will focus on the following subjects:

- The reason for response to a given question, e.g., the reason physician responded "no opinion" to question number 5
- How the respondent perceived the meaning of the question, e.g., when asked about the accuracy of laboratory reports, did the respondent answer in terms of technical accuracy of the laboratory or the accuracy of the report with respect to the respondent's related activity?
- Perception of terminology, e.g., was the terminology too technical, not technical enough, not professional terminology?

- Was the meaning of words precise or ambiguous to the respondent?
- Was the response subjective or objective, i.e., was response based on the feelings of the respondent or upon specific knowledge?
- The importance of the subject matter of the question to the respondent, e.g., did the respondents consider ease of calling the laboratory significant in their instrumental activity?

Standardized questions will be used in exploring each of these subjects. In a standardized interview the same questions are asked of all respondents. The wording and order in which the questions are asked are the same for all respondents. The response to the initial question in each case will be open-ended. The respondent replies exactly as he thinks.

The open-ended response will be followed by nondirective probing. Nondirective interviewing was developed from the work of Carl Rogers in client-centered counseling (Reference 3). In client-centered therapy, the client determines the subjects to be discussed. The therapist makes only neutral responses to the client's remarks, e.g., "Oh," "Uhm," "I see." The technique has been modified and adapted to the information gathering interview. Instead of the client (respondent) determining what will be discussed, the interviewer focuses on matters to be discussed. This is called controlled non-directive interviewing. The neutral role of the interviewer remains in controlled nondirective interviewing. The interviewer introduces the problem or question and then remains neutral until he has gathered the information desired on the problem or question, at which time he introduces another problem or question.

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A variation of controlled nondirective interviewing referred to in the literature as controlled nondirective probing will be used in interviewing nurses, physicians, laboratory personnel, and outpatient staff.

In interviewing the medical records staff, only controlled nondirective interviewing will be used. In interviewing patients, nondirective probing will be used.

Thus, the techniques to be used in interviewing each population are:

Population	Interview Technique
Physicians	Focused standardized open-ended; standardized open-ended; nondirective probing
Nurses	Focused standardized open-ended; standardized open-ended; nondirective probing
Outpatient staff	Focused standardized open-ended; standardized open-ended; nondirective probing
Laboratory staff	Focused standardized open-ended; standardized open-ended; nondirective probing
Medical records staff	Controlled nondirective
Patients	Nondirective probing

D. Categories of Questions and Questionnaires

There are many categories of questions and questionnaires identified in the literature. The categories described below are only those that apply to the AFCLAS study and pretest. Questions and questionnaires are categorized in the three ways that are applicable to this study: method of administration, content of questions, types of questionnaire.

The administration of questionnaires will take two forms: self-administered and group-administered.

Self-administered questionnaires typically are given to the respondent by someone not a part of the research team. The respondent completes the questionnaire and returns it to a designated person or place. In the present study, the patient questionnaire will be passed out to every nth (n to be determined) patient who enters the clinical laboratory during periods defined by the pretest staff. If there is an operations or reception desk in the laboratory, a person regularly assigned to that function will pass out the questionnaire. It will be collected before the patient leaves by another person assigned to the laboratory.

The technique that will be used in the pretest interviews of physicians, nurses, outpatient staff, and laboratory staff is a group-administered questionnaire. The questionnaires will be administered to each group of personnel in a general meeting.

The content categories of questions applicable to the pretest are:

- Facts - A question about a fact is directed to a person who should know the fact, e.g., a member of the laboratory staff might be asked how many hours overtime he worked last week.
- Belief about what the facts are - The respondent is asked questions not to find out objective data but what the respondent believes the facts are. Selltiz et al. state the typical example of this:

  > ...one does not measure the temperature of a room by asking the people in it how hot they believe it is. But if one is interested in the subjective experience of temperature under varying conditions, one may follow precisely this procedure of asking people how hot they believe the room is.... (Reference 4)

There are a number of factual questions included in the AFCLAS schedules that ask questions that are factual, but the interest is in perception of these facts, e.g., perception of accuracy of laboratory reports.

- Feelings - It is often important not only to know how a person perceives of facts, but also his feelings toward these facts. In the physicians' schedules there are questions that relate to how the physician feels about the clinical laboratory.
- Standards of action - These are "should" or "ought to" questions. The researcher is concerned with what the respondent thinks should or ought to be done about something. For example, one of the questions that has been proposed to ask physicians in the survey is, "What should be done to improve the clinical laboratory?"

The AFCLAS study will use a single type of questionnaire that will be of the standardized type and will provide the respondent with fixed alternatives.

E. Probing

No matter how much care and skill the researcher exerts in the development of a questionnaire, there is always a possibility that his questions will be misunderstood or misinterpreted by respondents in the field.

The purpose of pretest is to perfect the questions in the field for the survey to the extent possible. The probe is a technique by which prepared questions are supplemented during the interview process.

The probe can be in any form of interview or in combinations of forms. The probe in the pretest will be a combination of standardized, focused, and nondirective.

The interview for pretest of the questionnaires will focus on the six response variables listed in Section C, above, and the content categories listed in Section D, above. The interviewer will be provided with standardized open ended questions, which he will ask the respondent. When the respondent replies, the interviewer will use a controlled nondirective probing technique.

The interviewer will be provided with the questions he will discuss with the physician, the category of each question based on the intent of the question as designed, and the standardized question he will use to begin the probe of each variable.

The following is a brief illustration of the technique.

After introducing himself and setting the scene the interviewer continues —

I. (Interviewer)—Dr. Able, in response to question 5 you checked "No opinion." Would you tell me something about your reasons for this?*

R. (Respondent)—Oh, I don't know. I think it's hard to speak of accuracy in the laboratory.

I. —It's hard to speak of accuracy?

R. —Yes, it's hard when you can't be sure what standards there are. Are they my standards or laboratory standards?

I. —I see. Could you tell me more?

---

*The questions with the asterisk are standardized and will be provided to the interviewer. The interviewer dialogue other than the standardized question is nondirective.

R. —Well, I have my standards and the laboratory might have theirs.

I. —Um!

R. —I don't know which standards, so I checked no opinion.

I. —I see.

I. —How did you perceive the meaning of the question?*

Nondirective probing takes the form of neutral statements. The neutral statement may be a repetition of what the respondent said; e.g., in the above interview, R. says, "I think it's hard to speak of accuracy in the laboratory" and I. says, "It's hard to speak of accuracy?"

The neutral statement may be in the form:

—I see

—Oh

—Tell me more

—Uh huh

—Um.

F. Interviewer Selection

There are no definitive rules for the selection of interviewers. However, there are certain general principles that can be derived from the experience of survey researchers and from sociological theory. The principles relate to the dynamics of the interview.

---

*After this standardized question the interviewer would probe again until he was satisfied that he had an answer to the question. He would continue the interview in this way until the six response variables had been discussed with the respondent.

The interview is an encounter between two strangers who thus become a two-member (dyadic) group. The interaction in a group thus formed is somewhat different from groups formed for purposes other than interviewing, but there are characteristics common to all groups.

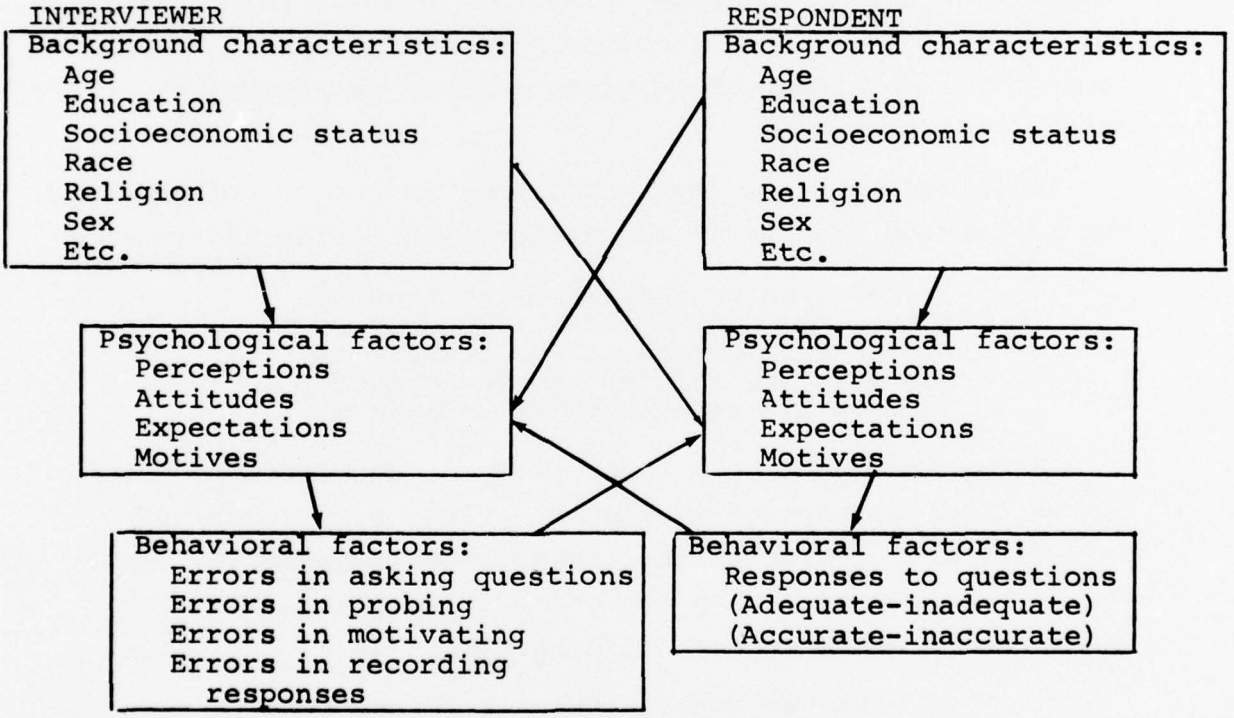
When two strangers meet, the decision to interact is based on their perception of each other. Initial influences are observable characteristics of each other, e.g., dress, grooming, language, sex, ethnicity. From variables such as these we may deduce other characteristics, such as social status and education. If interaction begins, each member of the group may estimate social variables from the interaction process. In the interview encounter these variables will influence not only whether a group will form, i.e., whether the respondent will agree to be interviewed, but also the validity and reliability of the information obtained from the interview.

As Sjoberg and Nett point out, the reliability and validity of data generated by interviews depends upon rapport, which is directly related to roles and statuses of the interviewer and the respondent:

> ...The interview, we must remember, involves a complex set of interactions between persons who occupy particular statuses in the social order. Consequently, the reliability and validity of the data obtained depend not merely upon the merits of the questionnaire but also upon the degree of rapport, or trust, that develops in the interaction situation. Thus if we are to understand the structured interview, we must analyze the status and roles of the principal parties concerned....(Reference 5)

Kahn and Cannell relate the status variables of interviewer and respondent to intervening psychological variables and, in turn, to behavior factors. The model they propose,

reprinted below, emphasizes the psychological nature of the interview. The interaction in the model is not explained by action but by psychological factors. (Note that the arrows do not connect interviewer and respondent.) A sociologist would present a quite similar model but omit the intervening variables. We would postulate their existence but would not analyze the psychological intervening variables.



Source: Reproduced from Kahn and Cannell (Reference 6)

The model appears to emphasize the possible errors made by the interviewer. The errors can be made by the respondent as well as the interviewer. As Sjoberg states:

> ...It is clear that the status of the investigator is a significant variable affecting the quality of data that a respondent will provide. More generally, we advance the proposition that the potential impact of the interviewer on the interviewee, judged by the reliability and validity of the data collected, is greater in highly stratified social systems than in the more loosely organized or relatively homogeneous ones....(Reference 7)

The study of the military hospital brings the researcher into two of the most highly stratified systems in our society—the hospital and the military service. If Sjoberg is right, more status problems can be expected than in surveys of a less stratified population.

Williams contends that difference in status perceived by the respondent results in the respondent biasing his response:

> ...The greater the disparities among status characteristics between interviewer and respondent the greater is the pressure felt by the respondent to bias his responses....(Reference 8)

Benny and Hughes, in their study of the influence of status upon interaction in the interview, were concerned primarily with a high status interviewer interviewing lower status respondents. They contend that such status differences can be minimized by training:

> ...Whatever actual inequalities of sex, status, intelligence, expertness or physique exist between the parties should be muted. Interviewer training consists very largely of making interviewers aware of the kinds of social inequalities with which respondents are likely to be concerned and of teaching them how to minimize them.... (Reference 9)

They appear to be less confident of the effect of training when a low status interviewer interviews a high status respondent. In fact, they suggest that the respondent will respond subjectively not to the interviewer but to someone else. They follow the statement quoted above with:

> ...But what happens when, as increasingly happens, a run of the mill, middle class interviewer encounters a member of some financial, intellectual or political elite? Our own impression is that such respondents contrive to reestablish equality in the interview by addressing themselves subjectively, not to the actual interviewer, but to the study director or even his sponsor.... (Reference 10)

Williams states categorically that:

> ...The greater the social distance between the interviewer and the respondent the greater the likelihood of bias, all else being equal. (Reference 11)

Dohrenwend and her associates conclude from a review of studies of the effect of status differences between interviewer and respondents:

> ...that lack of status homophyly between interviewer and respondent produces biased responses....(Reference 12)

The few quotations from the extensive literature concerning the influence of status differences on validity and reliability of interview generated data are significant. It appears that the best way to minimize bias is through selection of interviewers. Denzin observes that:

> ...A degree of muted equality permeates the interview...yet this sense of perfect equality seldom fits any interview. High status respondents may...talk past the interviewer....Thus if the fiction of equality is to be realized, a fit in background and status between interviewer and subject must be maximized....(Reference 13)

Kahn and Cannell make an even stronger statement:

> ...Such characteristics as age, sex, education, race, religion and socio-economic status can be influenced, for the most part, only by selection.... It is impossible to bring about changes in background characteristics by training or by practice....(Reference 14)

Background characteristics of respondents to be interviewed at the AFCLAS pretest site vary widely, but the respondents can be placed in categories relative to background characteristics.

In the social system of the military hospital the following status groupings can be identified:

- Physicians
- Nurses
- Other officers
- Airmen
- Civilians

The above categories are not in a hierarchical order, since high ranking nonmedical officers may have higher status than low ranking physician officers. It is unnecessary for purposes of the AFCLAS pretest to place status groupings in a hierarchical order. It is sufficient to recognize that if bias is to be avoided, selection or assignment of interviewers must be based upon some "fit" of interviewers and respondents.

Social status appears to be the most significant variable in interviewer selection. Education may be a variable, but it is probably correlated with social status. There is no reason to believe at this stage in the development of the pretest plan that other background variables such as age, sex, race, or religion will significantly affect the validity and reliability of interview generated data.

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TECHNICAL NOTE FOR SECTION II

ASSIGNMENT OF QUESTIONS TO INTERVIEWS FOR PRETEST OF SCHEDULES

Let n = number of questions on the schedule

p = number of questions to be tested in each interview

2 = number of interviews in which each question will be tested

Then

$$I = \text{number of interviews required} = \begin{cases} \frac{2n}{p} & \text{if } p \mid n^{*} \\ \left[\frac{2n}{p}\right]^{\dagger} + 1 & \text{if } p \nmid 2n \end{cases}$$

The number p of questions per interview should be chosen so that $p \mid 2n$ and preferably so that $p \mid n$. However, the primary consideration in selecting p is how well that number of questions asked each respondent will serve the purposes of the test.

Each of the I interviews will be randomly assigned p questions by the following procedure:

1. Generate 2 random permutations of the numbers 1 through n. Let these be $q_1, q_2, \ldots, q_n$ and $r_1, r_2, \ldots, r_n$.

2. Assign question $q_1, q_2, \ldots, q_p$ to the first interview, $q_{p+1}, q_{p+2}, \ldots, q_{2p}$ to the second interview and so on until n questions have been assigned.

3. Case 1. $p \mid n$.

Repeat 2. for the second permutation beginning with the assignment of questions $r_1, r_2, \ldots, r_p$ to interview number $\frac{n}{p} + 1$. When the process is completed there will be exactly

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* $x \mid y$ is read x divides y, i.e., there is an integer z such that $x \cdot z = y$. $x \nmid y$ is read x does not divide y.

† $[x]$ = the greatest integer $\leq x$.

p questions assigned to each of $I = \frac{2n}{p}$ interviews.

Case 2. $p \nmid n$.

When n questions have been assigned there will be $\left[\frac{n}{p}\right]$ interviews with p questions assigned and the $\left[\frac{n}{p}\right]$ + 1st interview will have been assigned the $n - p\left[\frac{n}{p}\right]$ questions $q_{p\left[\frac{n}{p}\right]+1}, q_{p\left[\frac{n}{p}\right]+2}, \ldots, q_n$. Complete the assignment of p questions to interview $\left[\frac{n}{p}\right]$ + 1 as follows: Assign the first $p - \left(n - p\left[\frac{n}{p}\right]\right)$ questions of the second permutation unless $q_i = r_j$ for some q and r in the assignment. If $q_i = r_j$ for some q and r assigned in this way, choose a random starting point in the second permutation and assign the next $p - \left(n - p\left[\frac{n}{p}\right]\right)$ questions to the $\left[\frac{n}{p}\right]$ + 1st interview unless $q_i = r_j$ for some q and r in the assignment. If there is some $q_i = r_j$ in the assignment, choose another random starting point in the second permutation. Repeat this process until an assignment is made with no $q_i = r_j$. Continue, assigning the next p questions in the permutation to the next interview and so on as in 2. following assignment of r_n with r_1 if r_1 was not the starting point, until all n questions have been assigned.

Subcase 2.1. $p \mid 2n$.

In this case the procedure described will result in p questions assigned to each of $I = \frac{2n}{p}$ interviews.

Subcase 2.2 $p \nmid 2n$.

In this case, the procedure described will result in $\left[\frac{2n}{p}\right]$ interviews with p questions assigned to them and one interview with $2n - p\left[\frac{2n}{p}\right] < p$ questions assigned

$\left(I = \left[\frac{2n}{p}\right] + 1 \right)$. Conduct this interview with only $2n - p\left[\frac{2n}{p}\right]$ questions or randomly select for the interview an additional $p - \left(2n - p\left[\frac{2}{n}\right]\right)$ questions, ignoring questions selected that are already included in the assignment.

Example: $n = 13$

$p = 3$

$3 \nmid 2.13$ so $I = \left[\frac{2.13}{p}\right] + 1 = \left[\frac{26}{3}\right] + 1 = 8 + 1 = 9.$

The two random permutations are:

A.	13	2	3	5	4	1	8	7	6	11	12	9	10
B.	13	10	1	8	9	7	11	12	6	5	3	2	4

↑ Start

Interview	Questions
1.	13, 2, 3
2.	5, 4, 1
3.	8, 7, 6
4.	11, 12, 9
5.	10, 5, 3
6.	2, ↑4, 13
7.	10, 1, 8
8.	9, 7, 11
9.	12, 6, [1]

(↑ indicates end of permutation A. $3 \nmid 13$ so this is Case 2. Continuing with first number of permutation B would give the assignment 10, 13, 10. A random starting point selected from a table is 10.)

(Last question assigned, number 1, was selected at random. An initial random selection of question 6 was ignored.)

III. PRETEST OF DATA COLLECTION METHODS

This plan specifies procedures for pretesting the methods of data collection to be used in Period X of the AFCLAS evaluation. Data collection methods and forms to be tested as well as the test procedures are given for each hypothesis except those for which survey schedule responses will provide the information. The pretest of survey schedules is treated separately in Section II of the pretest plan. Parts of the pretest of data collection method can, and in some cases should, take place before or after the planned pretest week at Keesler AFB.

Hypothesis 1: Time spent producing administrative reports will change, for an equal number and distribution of test requests.

The data collection concerning time spent preparing administrative reports is to consist of identifying the reports and all tasks involved in preparing them and then measuring or collecting data to estimate the time spent by each category of personnel for each task. Pretest data will be collected for two administrative reports:

- A report required by an authority external to the laboratory, such as the monthly workload report
- An internal management report, such as a quality control report.

Methods to be used in measuring the time spent on specific tasks associated with this hypothesis depend on the details of the tasks. These details will be determined before or during the pretest week. However, it is expected that most of these methods will be similar to those described herein for other hypotheses.

Procedure

1. MET—identify all tasks contributing to the report (Form 1, Attachment A)
2. ANSER—specify method of measuring or collecting data to estimate time spent by each personnel category for each task.*
3. MET—carry out data collection for at least one task for each method specified. Proposed methods include:
   - Charting and application of standard time units
   - Estimation by personnel involved of the time they spend (Form 2, Attachment A)
   - Recording by personnel involved of the time they spend (Form 2, Attachment A)
   - Work sampling observation.
4. ANSER/MET—review results, identify measurement problems, and revise methods.
5. Continue in 3, 4 loop until satisfactory measurement methods are established.
6. MET—obtain supervisor estimates of the fraction of total task time contributed by each personnel category for the tasks identified for which it is appropriate (Form 3, Attachment A)†

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* When the method is specified, other data collection and pretest tasks will be identified, e.g., developing charts, counting forms.

† This step is specified in the pretest procedures for numerous hypotheses. After it has been carried out successfully for several hypotheses, it need not be carried out for the remaining hypotheses.

Hypotheses 2, 3, 4, 5: Telephone Inquiries

2. The number of telephone inquiries to the laboratory central site (the reception desk or central computer site) will change, for an equal number and distribution of test requests and an equal number of telephone lines and personnel at the central site.

3. Time spent responding to telephone inquiries received by the laboratory central site will change, for an equal number and distribution of test requests and an equal number of telephone lines and personnel at the central site.

4. Time spent on the telephone for inquiries to the laboratory by personnel outside the laboratory will change, for an equal number and distribution of test requests and equal number of telephone lines and personnel at the central site.

5. The distribution by location and type of caller of telephone inquiries to the laboratory central site will change for an equal number and distribution of test requests, and an equal number of telephone lines and personnel at the central site.

Data for these hypotheses will be collected by observation during specified time intervals. The methods must be tested during the pretest week. (Additional trials at the test sites themselves prior to Period X are desirable and will probably be required. The two test sites are organized differently for answering the inquiries, centralized at one site, and decentralized at the other.)

Procedure

Case 1—for centralized system (Andrews) and entry point in decentralized system (Wright-Patterson):

1. ANSER—randomly select intervals for observation.

2. MET—observe area (reception desk or other area where inquiries are initially received) and record telephone inquiry data (Forms 4 and 5, Attachment A) during the selected intervals.*

The following information is to be recorded for incoming calls observed at the central area:

- The time that the call begins and the time that it ends or is referred
- Whether or not the call is an inquiry (An inquiry is any request for test results or information about test status.)
- For an inquiry, whether the caller is a physician, nurse, other member of the hospital staff, a patient (or relative of a patient), or other person
- For an inquiry, the caller's location: a specific ward or clinic, or "other"
- For an inquiry, the status when the call ends: complete, referred (and where referred), or laboratory will call back
- The personnel category of the person who receives the call.

The following information will be recorded for response calls (calls made from the central area back to the location initiating the inquiry) from the central area that are observed:

- The time that the call begins and the time that it ends

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* One question to be answered in the pretest is whether a single observer can record data for these hypotheses as well as for Hypothesis 35 during the same observation interval.

- Estimate by the person calling of the time that was spent retrieving the information requested
- The personnel category of the person responding
- The location called.

3. MET/ANSER—meet to review experience during observation, identify problems and revise forms and methods.

4. Repeat 2, 3 loop with discussion once daily or after observation periods as necessary/possible.

Case 2—for inquiries answered outside the central area in a decentralized system.

1. Assume all referred inquiries go to a laboratory department.

2. ANSER—randomly select intervals for observation, stratified by laboratory department.

3. MET—observe and record telephone inquiry data for specified department and time interval (Forms 4 and 5, Attachment A).

The information to be recorded for calls to and from the laboratory section is the same as that already specified for calls to and from the laboratory central area (see Case 1, step 2).

4. MET/ANSER—jointly review observation experience, identify problems, and revise forms and methods.

5. Repeat 3, 4 loop once daily or following observation periods as necessary or possible.

Hypothesis 6: Time required for filing records of laboratory results in laboratory files will change, for an equal number and distribution of test requests.

The method of measuring time spent in filing will be activity charting and application of time standards. The data collection includes identification of result records that are filed (slips, worksheets, etc.); activity charting and verification of associated times; and collecting the information required in using the charts to estimate time spent. Charting will not necessarily be done during the pretest week;* however, methods of counting items filed will be tested during the pretest week for each filing task identified.

Procedure

1. MET—chart request/result slip filing. If filing is decentralized, determine the number of different charts needed and prepare at least one. (If differences in the tasks introduce major differences in the charting, more than one chart should be prepared.) Include associated activity times and frequencies with charts, and indicate how they were derived.
2. ANSER/MET—review charts and associated times, and identify problems and needed revisions.
3. MET—revise charts and times.
4. Continue 2, 3 loop until charts and associated times are finalized.
5. MET—record number prepared daily of each of the following kinds of items filed:

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* The general chart development procedure outlined for Hypothesis 6 is to be used for all charts required. Charting done before or during the pretest week will test this procedure. Charting is included in the pretest procedures for numerous hypotheses. However, when charting for several hypotheses has been successfully accomplished, it need not be carried out in the pretest for the remaining hypotheses.

- Request slips by department (obtain from each department at the end of each day using Form 6, Attachment A)
- Others not yet identified (counting most of these items will be covered in procedures for other hypotheses).

6. MET/ANSER—review experience in obtaining information with the methods and forms indicated in 5, identify problems, and revise the methods and forms as required.
7. Continue 5, 6 loop until methods and forms are finalized.
8. MET—obtain supervisor estimates of fraction of task time contributed by each category of personnel involved (Form 3, Attachment A).

Hypothesis 7: Time required to file laboratory reports in outpatient medical records will change, for an equal number and distribution of test requests.

The comments and procedures for Hypothesis 6 apply except:

- Result slip filing is the only filing task.
- Items to be counted are result slips by day and by department for outpatients (Form 6, Attachment A).

Hypothesis 8: Time required to file laboratory reports at the nursing stations will change, for an equal number and distribution of test requests.

The comments and procedures for Hypothesis 6 apply with the following additional remarks:

- Filing will include all activities carried out in preparing slips to be entered in the patient's record.

- A separate chart may be needed for each nursing unit or a single chart may apply to two or more units—this is to be determined in the pretest.
- Items to be counted are result slips by day and by department for inpatients (Form 6, Attachment A).

Hypothesis 9: Time required for preparing laboratory clinical forms will change, for an equal number and distribution of test requests.

The method to be used in measuring the time spent in these tasks will be activity charting and application of time standards. Charting specified in the pretest procedure will not necessarily be done during the pretest week,* but methods for the counting or sampling that is required to apply the standards will be tested then. Data collection for this hypothesis includes identification of all laboratory clinical forms; activity charting and verifying time standards; and counting or measuring workload elements to which the standards apply. (This hypothesis applies only to activities inside the laboratory.)

Procedure

1. MET—prepare charts with associated times for preparation of the following laboratory clinical forms:
   - Request slips (Preparation includes verifying and completing request data and entering results.)
   - One kind of worksheet.
   - One log book.
2. MET—obtain copies of a sample of completed forms of each kind (to be used to establish the number of characters per unit) and other data in support of time standards (Form 7, Attachment A).

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* See note on page 224.

3. MET/ANSER—review charts and associated times, identify problems and needed revisions.

4. MET—revise charts and times.

5. Continue 2, 3, 4 loop until charts and times are finalized.

6. MET—count request slips by department by day (Form 6, Attachment A).

7. MET—count each kind of worksheet:

   - Count total number for 1 month in files if retained (Form 8, Attachment A).
   - Record number worksheets prepared by day, for each kind of worksheet (Forms 7, 9, Attachment A).

8. MET—measure log book entries (Measure will depend on time standards to be used). Measures to be tested include:

   - Measure inches of completed logs (time/inch standard applies).
   - Count log book entries—patients or quality control sample runs, etc. (time/entry standard applies).
   - Other kinds identified and suggested.

9. MET—count or measure other items (identified in the course of the pretest to which standards apply) (Form 8, Attachment A).*

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* Some initial work on charting at the test sites is needed to determine what methods must be tested for measuring items to which standards apply.

10. MET/ANSER—review experience in obtaining information with the methods and forms indicated in 6, 7, 8, and 9, identify problems, and revise the methods and forms as required.

11. Continue 6, 7, 8, 9, and 10 loop until methods and forms are finalized.

12. MET—obtain supervisor's estimates of fraction of total task time contributed by each category of personnel—for each kind of laboratory form and each laboratory section (Form 3, Attachment A).

Hypothesis 10: Time spent compiling College of American Pathologists (CAP) standard workload figures will change, for an equal number and distribution of test requests.

Pretest for Hypothesis 1 will serve as the pretest of this hypothesis.

Hypothesis 11: Time required for labeling specimens will change, for an equal number and distribution of test requests.

In investigating this hypothesis, it will be assumed that it is sufficient to consider only the time that is spent in recording the necessary information on the labels. The method to be used in measuring this time will be activity charting and application of time standards. The charting phase of this pretest procedure will not necessarily be done during the pretest week*, but methods of counting or estimating the number of labels prepared will be tested then.

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* See note on page 224.

Procedure

1. MET—prepare chart of specimen labeling and associated time spent with the information recording tasks.
2. MET—determine all information items recorded on a label and provide other data supporting the times specified.
3. MET/ANSER—review charts and times, identify problems and needed revisions.
4. MET—revise charts and times.
5. Continue loop until charts and times are finalized.
6. The number of labels prepared must be counted or estimated. Methods to be tried include:
   (a) Have the number of tubes per venipuncture recorded when the number of venipunctures is recorded. MET—collect number daily, or less often as appropriate (Forms 8 and 9, Attachment A).
   (b) ANSER—design a sampling scheme to estimate the number of tubes per request slip; MET—observe tubes per slip for specified sample of slips.
   (c) MET—obtain number of tubes and number of slips from each phlebotomist on return from collection rounds; have personnel in drawing room record number of tubes and slips; MET—collect record daily.
   (d) For specimens other than tubes of blood, MET—obtain labels per test, per request or other known relationship; provide information for selecting an alternative method if not feasible.

   MET/ANSER—select most feasible method and apply it.

7. MET/ANSER-review experience with forms and the methods of counting or estimating selected, identify problems and revise forms and method or select another method for trial.

8. Continue 6, 7 loop until forms and counting or estimating method are finalized.

9. MET-obtain supervisor estimates of fraction of total task time contributed by each category of personnel (Form 3, Attachment A).

Hypothesis 12: Time required for preparing lists for specimen collection will change, for an equal number and distribution of test requests.

The method of measuring the time spent in this task will be activity charting and application of time standards. As stated for previous hypotheses, the test of chart development may be independent of the pretest week.* However, methods of counting or measuring items to which standards apply will be tested in the pretest week.

Procedure

1. The procedure for chart development is the same as that described previously for other hypotheses.

2. Items to which the time standards will be applied are request slips for inpatient specimen collection rounds. Methods to be tested for counting or estimating the number of such slips include:

   - MET—count slips for inpatient specimen collection immediately before collection rounds (Forms 8, 9, Attachment A).

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* See note on page 224.

- Collection teams record number of slips for each regular collection trip. MET—obtain after each collection trip. If Hypothesis 11, Procedure 6(c) is selected for counting tubes labeled, this method will also be selected (Form 8, Attachment A).
- When inpatient slips are counted daily, allocate them by stamped time of arrival to the various collection trips. This implies the assumption that all inpatient specimens are obtained during collection rounds, and this is not the case. (Modify Form 6, Attachment A to include this information.)

MET/ANSER—select most feasible method and apply it.

3. MET/ANSER—review experience with forms and the method of counting or estimating the number of slips for inpatient specimen collection; identify problems and revise forms and method or select another method for trial.
4. Continue 2, 3 loop until forms and method of counting or estimating are finalized.
5. MET—obtain supervisor's estimates of the fraction of total task time contributed by each category of personnel (Form 3, Attachment A).

Hypotheses 13 and 14: Recording Results of Online and Offline tests

13. Time required for recording results of tests that will be online with AFCLAS will change, for an equal number and distribution of test requests.
14. Time required for recording results of tests that will be offline will change, for an equal number and distribution of test requests.

The time required for these tasks is included in the time to prepare laboratory clinical forms, which is measured for Hypothesis 9. The following pretest procedure pertains to additional information needed and will not be carried out during the pretest week.

Procedure

MET—identify equipment and associated tests that will be online and offline with AFCLAS. Also, determine what fraction of tests of a given kind will be online or offline.

Hypotheses 15 through 19: Computer Data Entry

15. Time required for entering laboratory requests by mark-sense card will change, for an equal number and distribution of test requests.

16. Time required for keyboard entry of patient name and identification at the reception desk will change, for an equal number and distribution of test requests.

17. Time required for keyboard entry of patient name and identification in the registrar's office will change, for an equal number and distribution of test requests.

18. Time required for entering laboratory test results by mark-sense card will change, for an equal number and distribution of test requests.

19. Time required for keyboard entry of free-text laboratory test results will change, for an equal number and distribution of test requests.

No data for these hypotheses will be collected in Period X. Pretest of data collection methods will be done prior to Period Y, but after Period X.

Hypotheses 20 and 21: Review and Certification of Results

20. Time required for supervisor's review and certification of results and worksheets will change, for an equal number and distribution of test requests.

21. Time required for technician's review and certification of results and worksheets will change, for an equal number and distribution of test requests.

The method of measuring review and certification time will be activity charting and application of time standards. Charting specified in the pretest procedure will not necessarily be done during the pretest week, but methods of counting or estimating the number of items certified will be tested then.*

Procedure

1. MET—chart the review and certification procedure for supervisors or technicians. The procedure for developing charts is the same as that described previously for other hypotheses. (Procedures for certification may differ in the various laboratory sections. Therefore, part of the task of charting will be determining whether the differences are great enough to require separate charts for each department or whether a single chart will suffice for several departments).
2. MET—identify all items that are certified by supervisors and those certified by technicians to which the time standards apply.
3. Procedures for testing methods of counting request/result slips, worksheets and log book entries have been specified for other hypotheses (See pretest procedures for Hypotheses 6, 7, 8, and 9; and Forms 6, 8, and 9, Attachment A).

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* See note on page 224.

4. ANSER—specify methods and forms for counting items certified that have not previously been considered.

5. MET—apply methods specified in 4.

6. MET/ANSER—review experience in using the methods and forms specified, identify problems, and revise the forms and methods.

7. Continue 5, 6 loop until methods and forms are finalized.

Hypotheses 22, 23, and 24: Quality Control

22. Time spent on mathematical analysis for quality control will change, for an equal number and distribution of test requests.

23. The number of times statistical analyses of quality control sample results are performed will change, for an equal number and distribution of test requests.

24. The kinds of statistical analyses of quality control sample results will change, for an equal number and distribution of test requests.

The method that will be used to measure time spent for calculations (Hypothesis 22) is activity charting and application of time standards. The frequency and kinds of analyses (Hypotheses 23 and 24) will be obtained as part of the charting procedure. Analyses of quality control sample results are tasks contributing to quality control reports that are included in Hypothesis 1. Charting specified in the pretest procedure will not necessarily be done during the pretest week.*

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* See note on page 224.

Procedure

1. MET—chart quality control analysis activity. The procedure for developing charts is the same one previously described.
2. MET—prepare a list of kinds of analyses performed.
3. MET—determine frequency of calculations. Methods to be tested include:
   - Obtain a schedule for the task from the laboratory supervisor if one exists; determine whether calculations are carried out each time they are scheduled.
   - Personnel involved record number of times each kind of calculation is performed (this may be done if few people are involved and calculation is infrequent) (Form 2, Attachment A). MET—observe to ensure that record is kept and collect weekly (Form 9, Attachment A).
4. MET/ANSER—select most feasible method and MET—apply it.
5. MET/ANSER—review experience in applying the method selected for determining calculation frequency; identify problems and revise method and forms used or select another method for trial.
6. Continue 4, 5 loop until method and forms are finalized.
7. MET—obtain supervisors' estimates of the fraction of task time contributed by each category of personnel (Form 3, Attachment A).

Hypotheses 25 and 26: Analysis of Patient Results by Population

25. The number and kinds of statistical analyses of patient results by population will change, for an equal number and distribution of test requests.

26. The time required for statistical analyses of patient results by population will change, for an equal number and distribution of test requests.

Since this task is performed infrequently, it may not be possible to collect hard data on it. Information provided by laboratory officers will have to be relied upon. Information will be obtained during the pretest week. Additional information from the test sites will be needed to make a decision about the treatment of the hypotheses in the evaluation.

Procedure

1. MET—obtain from test sites lists of analyses performed, their frequencies, and schedules if they exist.

2. MET—obtain a list of kinds of analyses performed at the pretest site and their frequency. Obtain a schedule if any. If analyses are scheduled during the pretest week, observe whether they are done.

3. MET—obtain from personnel involved an estimate of time spent for analyses carried out in the past, or a record of time actually spent during the pretest week (Form 2, Attachment A).

4. MET/ANSER—review information obtained and experience in obtaining it.

5. ANSER—use information from AFCLAS test sites and the pretest site to decide how the hypotheses will be treated in the evaluation.

Hypothesis 27: Time spent on calculations and/or conversions from raw to clinical values for test reports will change, for an equal number and distribution of test requests.

The method to be used in measuring time spent in doing calculations for test reports will be activity charting and application of time standards. Charting specified in the pretest procedure will not necessarily be done during the pretest week.*

Procedure

1. MET—prepare list of all calculations done by technicians for test reports.†
2. MET/ANSER—select one kind of calculation for charting. (If charting is to be done during the pretest week, verify that the calculation is done at the pretest site.)
3. The procedure for developing charts and standards is the same as described for previous hypotheses.
4. Items to be counted for applying the standard times are tests for which calculations are done. The method of counting tests has been specified for previously discussed hypotheses (see Hypotheses 6, 7, 8, 9, and Form 6, Attachment A).
5. MET—obtain supervisor estimates of the fraction of total time for each kind of calculation contributed by each personnel category (Form 3, Attachment A).

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* See note on page 224.

† To be done prior to the pretest week if possible.

Hypothesis 28: Time spent on operation of the computer by the laboratory staff will change.*

Data collection for this hypothesis will only be required at one of the two test sites, Wright-Patterson AFB, during Period X. The procedure for collecting this data cannot be tested during the pretest week.

Procedure

1. MET—identify computer operation tasks at the Wright-Patterson AFB clinical laboratory.
2. Possible methods for measuring the time spent include:
   - Determine number of full-time equivalent personnel assigned.
   - Use activity charting and application of time standards.
   - Have personnel involved record time spent (Form 2, Attachment A).

   MET/ANSER—select most feasible method and MET—carry out specified measurement at Wright-Patterson AFB.
3. MET/ANSER—review experiences in using the selected method; identify problems and revise method or select another method for trial.
4. Continue 2, 3 loop until a method of measurement is chosen.

Hypothesis 29: Kinds and numbers of laboratory clinical forms used will change, for an equal number and distribution of test requests.

Data collection for this hypothesis is included in that for Hypotheses 1 and 9.

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* Time spent by laboratory personnel in computer operation does not include functions performed at remote terminals or input devices.

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Hypothesis 30: Kinds and numbers of tests sent out to other laboratories will change, for an equal number and distribution of test requests, an equal mix of outside laboratories used, and an equal distribution of tests among them.

The data required for this hypothesis are routinely recorded in the laboratory and will be taken directly from the laboratory records. Procedures may be tested at the test sites rather than during the pretest week.

Procedure

1. For each test site, MET—compile a list of tests routinely sent out, the facilities to which tests are routinely sent, and the cost for each test.
2. MET—obtain from laboratory records the number of tests sent to each facility during the week immediately preceding collection of the data (7 days, not including the day of collection) (Form 10, Attachment A).
3. MET/ANSER—review experiences in obtaining the required information, identify problems, and revise methods and forms used.

Hypothesis 31: Kinds and numbers of tests sent to the laboratory being studied by other laboratories will change, for an equal number and distribution of test requests at the laboratories sending the test requests.

Comments, procedures, and forms are those identified for Hypothesis 30 changing "tests sent out" to "tests received."

Hypothesis 32: The number of *stat* requests will change, for an equal number and distribution of test requests.

The data collection for this hypothesis is counting *stat* requests. It will be done during the pretest week.

Procedure

MET—obtain number of *stat* requests per day by laboratory section by collecting it from each section at the end of each day (Form 6, Attachment A).

Hypothesis 33: Time that laboratory staff members work in addition to normal duty hours will change, for an equal number and distribution of test requests.

This hypothesis will be investigated by means of survey schedules (see Section II, this Appendix D).

Hypothesis 34: Usability of laboratory reports to physicians will change.

This hypothesis will be investigated by means of survey schedules (see Section II, this Appendix D).

Hypothesis 35: Time to provide patient service at the laboratory reception desk will change, for an equal number and distribution of test requests.

The method data collection for this hypothesis will be tested during the pretest week. Patient service times will be observed and recorded during specified time intervals.

Procedure

1. ANSER—randomly select intervals for observation.*
2. MET—observe patient reception area during specified intervals and record service times (Form 11, Attachment A).
3. MET/ANSER—review observation experience, identify problems, and revise procedures and forms.

Hypothesis 36: Deleted

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* One question to be answered in the pretest is whether a single observer can record data for this hypothesis as well as for Hypotheses 2, 3, 4, and 5 during the same observation interval.

Hypothesis 37: Time the patient spends at the laboratory will change, for an equal number and distribution of test requests.

Procedure

1. ANSER—specify the sample of patients (e.g., all patients who arrive during random time intervals).
2. MET—obtain arrival and departure time for the selected sample of patients (Form 12, Attachment A). A form will be time and date stamped and given to the patient when he arrives. It will be collected and stamped again as he departs.
3. MET/ANSER—review collection experience, identify problems, and revise procedures and forms.
4. Repeat 2, 3 loop once daily or after each observation as needed or possible.

Hypotheses 38, 39, 40, 41, 42, and 43: Acceptance and Satisfaction

38. Patient satisfaction with the laboratory will change, for an equal number and distribution of test requests.
39. Physician acceptance of the laboratory will change, for an equal number and distribution of test requests.
40. Laboratory staff satisfaction will change, for an equal number and distribution of test requests.
41. Outpatient clinic staff acceptance will change, for an equal number and distribution of test requests.
42. Medical records department staff acceptance will change, for an equal number and distribution of test requests.
43. Inpatient nursing unit staff acceptance will change, for an equal number and distribution of test requests.

These hypotheses concern the way various groups of persons who are affected by the laboratory perceive its operations. The hypotheses will be investigated by means of survey schedules (see Section II, this Appendix D).

Hypothesis 44: The number of transcription errors will change, for an equal number and distribution of test requests.

This hypothesis is to be investigated in part through survey schedules (see Section II, this Appendix D). In addition, application of standard error rates based on "opportunities for error" is being investigated. Actual data on error opportunities will be collected as part of the data specified for Hypothesis 9. Therefore, no pre-test data collection procedure is given for this hypothesis.

Hypothesis 45: Reliability of the medical record will change, for an equal number and distribution of test requests.

The data to be collected for this hypothesis are numbers of laboratory reports that have been filed in outpatient and inpatient medical records 3 days, 5 days, and 7 days after they are completed. These numbers are to be determined for samples of laboratory reports. Methods for collecting this data will be tested during the pretest week.

Procedure

1. ANSER—specify methodology for selecting random samples of completed result/request slips in the laboratory.
2. Laboratory personnel—stamp time and date on completed request/result slips when they are brought to the distribution point in the laboratory (e.g., the reception desk).

3. Outpatient Medical Records staff—stamp date on request/result slips when they are filed in the record.

4. MET—obtain the specified samples of completed reports. Make photocopies of the selected request/result slips and assign each slip a number (Form 7, Attachment A). (Testing this procedure is also included in the pretest procedure specified for Hypothesis 46.)

5. MET—hold the copied slips until at least 7 days after their completion date, then obtain the following information from the outpatient medical records of the patients whose slips are in the sample:

   (a) Is the record in the record room?

   (b) If yes to (a), is a copy of the slip filed in the record?

   (c) If yes to (b), how many days after completion by the laboratory was the slip filed? (Form 14, Attachment A).

6. MET/ANSER—review experiences in obtaining the required samples and in surveying the outpatient medical records; identify problems and revise the methods and forms used.

7. Continue 4, 5, 6 loop until methods and forms are finalized.

Hypothesis 46: Turnaround time will change, for an equal number and distribution of test requests.

For this hypothesis, data will be collected on the times of occurrence of four events in request turnaround. Two of

these are the times that laboratory teams return from inpatient specimen collection rounds and the times that result distribution personnel leave the laboratory to distribute completed request/result slips. The other two, for individual request/result slips, are time of arrival in the laboratory and the time the result slips are ready for distribution from the reception area or other distribution point. The procedures for collecting this data will be tested during the pretest week.

Procedure

1. MET—record daily the times that laboratory specimen collection teams return to the laboratory (excluding time of return for special *stat* collection trips). Have the teams sign in (Form 14 or 15, Attachment A).
2. MET—record times of departure of laboratory teams distributing results and of personnel from other parts of the hospital who are collecting result slips. Have personnel sign out (Form 14 or 15, Attachment A).
3. Laboratory personnel—time and date stamp request/result slips when they arrive in the laboratory and again when the completed slips are brought to the distribution point in the laboratory.
4. ANSER—specify methodology for selecting a random sample of completed, time and data stamped slips.
5. MET—obtain the specified sample of request/result slips. Make photocopies of the selected slips and assign each slip a number (Forms 7 and 16, Attachment A). (Testing this procedure is included in the pretest procedure specified for Hypothesis 45.)

6. MET/ANSER—review experiences in recording the times specified; identify problems and revise methods and forms used.

7. Continue 1, 2, 3, 4, 5, 6 loop until methods and forms are finalized.

Hypothesis 47: Quality of patient care will change, for an equal number and distribution of test requests.

Information concerning patient care will be obtained by means of survey schedules (see Section II, this Appendix D).

Hypothesis 48: Numbers and kinds of reports produced will change.

Most of the data needed for this hypothesis is included in the data to be collected for the preceding hypotheses. During the pretest week, any reports not covered in the preceding hypotheses will be identified.

1. MET—identify and determine frequency of any reports produced that are not included in the preceding hypotheses.

2. ANSER—specify methods for counting/sampling additional reports identified as appropriate.

3. MET—apply the counting/sampling methods specified in 2, if they have not been tested in the pretest procedures for preceding hypotheses.

4. MET/ANSER—review experiences in using the methods of counting/sampling, identify problems, and revise the methods as needed.

5. Continue 3, 4 loop until methods are finalized.

6. MET—compile a list of all reports and the number produced per day, week, month, etc.

Hypothesis 49: Numbers and kinds of physician requests for outpatient tests will change, for an equal number of outpatient visits, for the same distribution of utilization by outpatient departments.

The data required for investigating this hypothesis are laboratory workload for outpatients and workloads of the outpatient clinics. Methods of collecting these data will be tested during the pretest week.

Procedure

1. MET—record number of tests requested by day, department, and kind of test for outpatients (Form 6, Attachment A).
2. MET—record number of visits per day for each outpatient clinic. Obtain 2 or 3 times during the pretest week from clinics (Form 17, Attachment A).
3. MET/ANSER—review experiences in obtaining the required information, identify problems and revise the forms and methods.
4. Continue 1, 2, 3 loop until forms and methods are finalized.

Hypothesis 50: Numbers and kinds of physicians' requests for inpatient tests will change, for an equal number of total hospital inpatient days, for the same distribution of patients by inpatient category.

The data required for investigating this hypothesis are laboratory workload for inpatients and the hospital's inpatient workload. Methods of collecting these data will be tested during the pretest week.

Procedure

1. MET—record number of tests requested for inpatients by day, department, and kind of test (Form 6, Attachment A).

2. MET—record daily inpatient census by inpatient category,* and by ward, and the number of admissions and of discharges per day. Obtain 2 or 3 times during the pretest week from the registrar's office (Form 18, Attachment A).

3. MET/ANSER—review experiences in obtaining the required information, identify problems and revise the forms and methods.

4. Continue 1, 2, 3 loop until forms and methods are finalized.

Hypothesis 51: Time required to complete laboratory test request slips outside the laboratory will change, for an equal number and distribution of test requests.

The method to be used in measuring this time is activity charting and application of time standards. The charting specified in the pretest procedure will not necessarily be done during the pretest week.† Collection of data for applying the standards (number of request forms by inpatient or outpatient) will be tested during the pretest week.

Procedure

1. MET—chart the task of completing request forms. The procedure for chart development is as described for preceding hypotheses (see for example Hypothesis 6).

2. The method of recording the number of request slips by day for inpatients and outpatients has been specified for preceding hypotheses. (See procedure for Hypothesis 6, Form 6, Attachment A).

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* Same categories used by Air Force hospitals.

† See note on page 224.

3. MET—obtain supervisors' estimates of fraction of task time contributed by each category of personnel (Form 3, Attachment A).

Hypothesis 52: The numbers of improperly completed test request slips arriving at the reception desk will change for an equal number and distribution of test requests.

To investigate this hypothesis, a sample of size n (n to be determined) of arriving request slips will be checked for errors. This data collection will be tested during the pretest week.

Procedure

1. ANSER—specify a number of slips to be included in the sample and method of selecting the n slips for the sample (For example, all arriving slips until n are observed or all arriving slips until n/p are observed for p observation periods).

2. MET—record all errors for the n slips (Form 19, Attachment A).

Hypothesis 53: Time required by supervisors (laboratory officers) in responding to inquiries, complaints, errors detected before test results are reported, and errors in test results reported to physicians will change, for an equal number and distribution of test requests.

Time spent in these tasks will be estimated and/or recorded by the supervisors involved. This data collection will be tested during the pretest week.

Procedure

1. Supervisors record or estimate actual time spent by day in responding to inquiries, errors, and complaints (Form 2, Attachment A).

2. MET—obtain estimates/records from supervisors daily.

3. MET/ANSER—review experiences in obtaining the estimates/records, revise methods and forms used.

4. Continue 1, 2, 3 loop to finalize procedures and forms.

Hypotheses 54 through 59: These hypotheses were added to the study design after the pretest was completed. Hence, they were not pretested.

ATTACHMENT A

FORMS FOR DATA COLLECTION

List of Forms

Form 1: Administrative Report Summary

Form 2: Timesheet

Form 3: Task Time Distribution Form

Form 4: Record of Telephone Inquiries

Form 5: Record of Inquiry Response Calls

Form 6: Daily Workload Record

Form 7: Identification Slip (for samples of laboratory forms)

Form 8: Counting Form

Form 9: Counting Form

Form 10: Record of Tests Sent Out or Received

Form 11: Reception Area Observation: Patient Service Time

Form 12: Patient Time at the Laboratory

Form 13: Outpatient Medical Records Survey

Form 14: Record of Return from Specimen Collection Rounds or Departure for Result Slip Distribution

Form 15: Record of Return from Specimen Collection Rounds or Departure for Result Slip Distribution

Form 16: Turnaround Time

Form 17: Report of Outpatient Workload

Form 18: Report of Inpatient Workload

Form 19: Record of Errors in Arriving Lab Request Slips

The original 19 data collection forms used in the pretest are not enclosed because they are similar to the final forms reproduced in Appendix B, Section VI.

ATTACHMENT B

METHODS TIME MEASUREMENT (MTM)

Methods Time Measurement (MTM) is a system for estimating the time required to perform routine repetitive tasks by studying the motions of a person and then using standard data to estimate the time required for the operation. Master Clerical Data (MCD) as published by Serge Birn et al. (Reference 1) is a catalogue of standard elements used by clerical workers to perform office activities and the associated time to perform each element. The data provide standard values that are consistent and compatible with clerical activities.

The use of MCD is most easily understood by considering the following example.

Figure 1 is a simplified description of the clerical tasks involved in the collection, clinical analysis, and reporting of the results of a blood test. The time required for each clerical operation, taken from MCD, is given in Table 1. As computed in this simplified example using MCD, the total time in clerical activities per specimen tube processed that will be saved by introducing AFCLAS is 0.014 hour.

FIGURE 1
METHODS TIME MEASUREMENT (MTM)

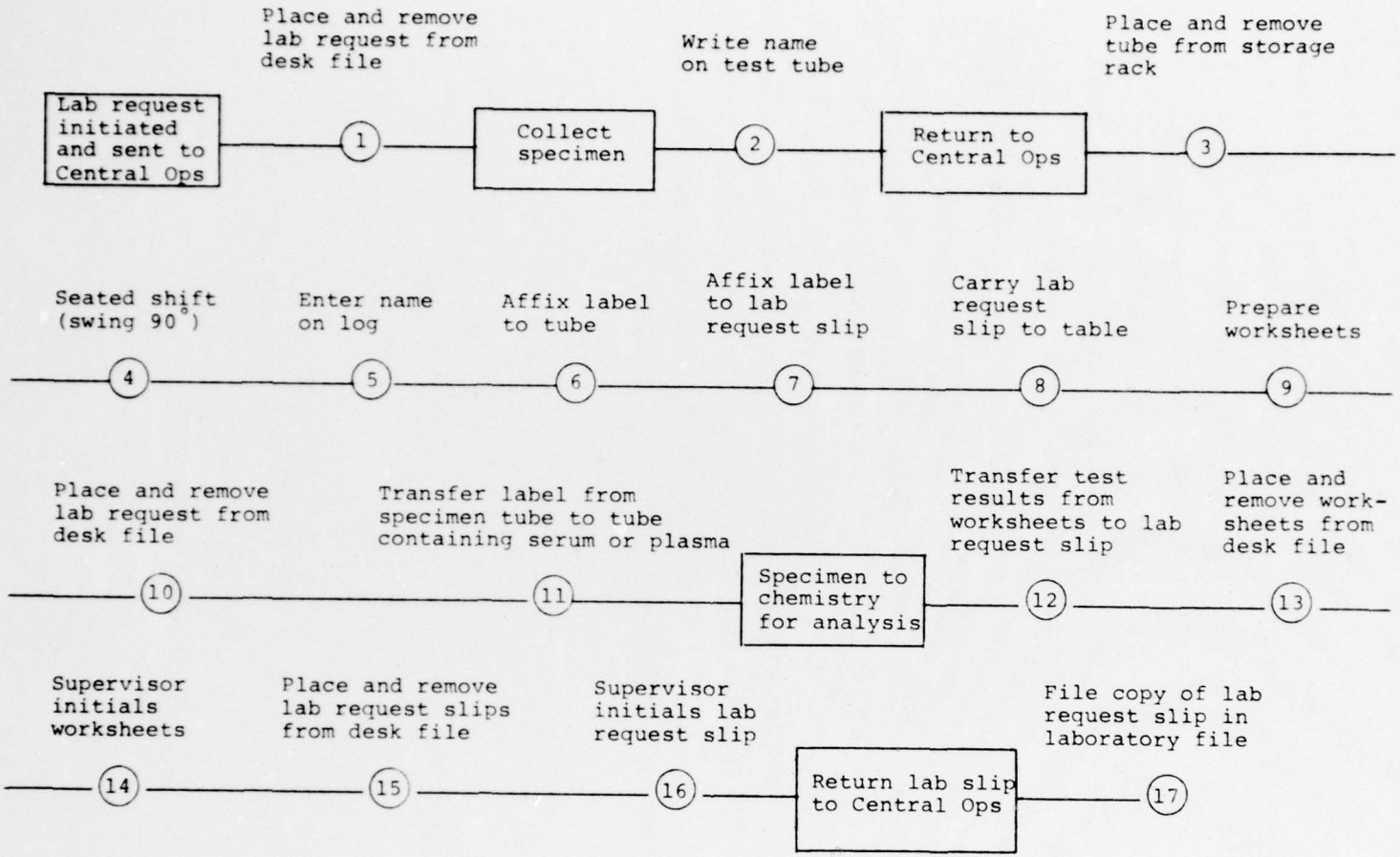

TABLE 1
METHODS TIME MEASUREMENT (MTM)

Flow Number From Figure 1	Description	Work Units	Frequency	Total Units* Per Action
1	Place and remove laboratory request from desk file	37	1	37
2	Write name on tube† (upper case letters)	24	2	48
2	Write name on tube† (lower case letters)	19	10	190
2	Write name on tube† (punctuation)	15	1	15
3	Place and remove tube from storage rack	87	1	87
4	Seated shift (swing 90° when removing and replacing tube in storage rack)	122	1	122
5	Write name in log† (upper case letters)	24	2	48
5	Write name in log† (lower case letters)	19	10	190
5	Write name in log† (punctuation)	15	1	15
6	Affix label to tube with 3-digit ID number	49	1	49
7	Affix label to request slip with 3-digit ID number	49	1	49
8	Carry laboratory request to table for completing work-sheets (assume a batch size of 10 requests)	30	1/10	3
9	Prepare worksheets	18	3	54
10	Place and remove laboratory request from desk file	37	1	37
11	Transfer label from specimen tube to tube containing serum or plasma	136	1	136

* One Unit = 0.00001 hour
= 0.0006 minute
= 0.036 second.

† Names are assumed to total 12 letters (last name, first name with comma between).

TABLE 1—Continued
METHODS TIME MEASUREMENT (MTM)

Flow Number From Figure 1	Description	Work Units	Frequency	Total Units* Per Action
12	Transfer test results from worksheet to laboratory request slip (read 3 digits and write 3 digits)	25	3	75
13	Place and remove worksheets from desk file (assume one worksheet for all tests is used for every 10 patients)	37	1/10	4
14	Supervisor initials (worksheets)	22	3 (1/10)	7
15	Place and remove laboratory request slips from desk file	37	1	37
16	Supervisor initials (laboratory request slip)	22	3	66
17	File copy of laboratory request slip in laboratory file	55	1	55
			Total Units:	1,324

* One Unit = 0.00001 hour
= 0.0006 minute
= 0.036 second.

REFERENCES

(1) S. A. Birn, R. M. Crossan, and R. W. Eastwood. Measurement and Control of Office Costs Master Clerical Data. New York: McGraw-Hill, 1961.

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This report presents a plan for evaluating the impacts of installing a medical information system, the Air Force Clinical Laboratory Automation System (AFCLAS), at the USAF Medical Center, Wright-Patterson AFB.

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The evaluation plan was developed by identifying 58 potential impacts of introducing AFCLAS in place of the existing manual information system. The plan provides for evaluating AFCLAS by (1) investigating statistically some of the changes that are hypothesized effects of AFCLAS; (2) studying changes in personnel time required to perform functions that AFCLAS supports; (3) estimating dollar benefits and costs of introducing AFCLAS; and (4) surveying the acceptance of and satisfaction with AFCLAS by personnel inside and outside the laboratory and by patients. Effects of AFCLAS to be investigated in special detail include changes in completeness of the medical record, timeliness of laboratory reports, telephone calls to the laboratory, errors in arriving outpatient request slips, and service time at the laboratory reception desk.

The plan provides for data collection at two different times—before and after the installation of AFCLAS.