INVENTORY CONTROL IN CLINICAL ENGINEERING

by

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ABSTRACT

The purpose of the Equipment Control Program in Biomedical Engineering is to optimize the safety, effectiveness, efficiency and economy of diagnostic, therapeutic and support equipment used for patient care.

In this study, the concept of the Inventory Control, a subprogram of the Equipment Control Program, is investigated. An Inventory Control method, to be applied to the Ministry of Health and Social Aid (S.S.Y.B) hospital, is determined.

Finally, this method has been applied to Sisli Etfal Hastahanesi, Istanbul.

Ö Z E T

Biyo-Medikal Cihaz Kontrol Programının amacı, insan sağlığıyla ilgili olarak kullanılan teşhis, tedavi ve yardımcı biyo-medikal cihazların kullanımının emniyetini, verimliliğini ve yeterliliğini optimize etmektir.

Bu çalışmada klinik mühendisliğinde Envanter Kontrol Kavramı, Biyo-Medikal Cihaz Kontrol Programının bir alt programı olarak incelenmiştir. Sağlık ve Sosyal Yardım Bakanlığı'nın bir hastahanesini örnek olarak uygulanmak amacıyla bir özgün Envanter Kontrol metodu belirlenmiştir.

Bu belirlenen metod İstanbul Şişli Etfal Hastahanesi'ne uygulanmıştır.

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1.1 Introduction

The Equipment Control Program permits the clinical engineer and the hospital to organize conceptual and managerial techniques for control of ever-increasing number of increasingly complex instruments which contributes to health care. The clinical engineer provides technical expertise to free nurses, physicians, technicians, administrators and other health personnel concern over such things as specifications and repair thus permitting them to concentrate on patient care. It allows centralization of hazard, quality and cost control functions and provides for regulatory compliance effort. Most of all, it provides a structure for assigning responsibility and authority to each department for appropriate elements of the hospital's efforts to manage the application of technology and it allows the recruitment of employees in this effort.

1.2 Overview

The Equipment Control Program provides a structure for the clinical utilization of equipment in the hospital, and directs the effort by entire institution to apply technical competence,

management techniques, and organizational skills to the control and application of technology. Many of today's advances in medical care are based upon technological successes as much as they are based upon advances in medical knowledge. However, medical personnel, though highly trained and experienced in their own fields, frequently have little technical knowledge. Therefore, they usually do not have the breadth of experience or education to appreciate all technical efforts required to assure the selection, acquisition, maintenance, and use of equipment in safe and effective manner. Nor do they appreciate its interaction with other hospital equipment more effective and more readily available for patient care.

Equipment used for patient care is increasing in both variety and complexity. The quantity and variety of new devices being sold to the health community over past ten years resembles the proliferation of pharmaceuticals in the preceeding decade.

A typical adult patient with a myocardial infarction is exposed on average of eighty different medical devices during three to four week of hospitalization. Behind the scenes, diagnostic and the clinical laboratory equipment used for this care may total an additional three hundred items. The typical pediatric tonsillectomy case is exposed to almost two hundred separate and distinct types of devices used for this care; the average adult undergoing gallbladder surgery may depend on over six hundred medical devices. Given the large number of devices which any single patient encounters during hospitalization, it should be noted that there is a high probability of contact with

defective equipment.

A disturbing portion of both traditionally accepted and new nondisposable electrical, electronic, mechanical, pneumatic and hybrid mechanical devices is demonstrably ineffective, of inferior quality, or dangerous. These devices frequently suffer from inadequate basic physiologic or clinical concepts, inappropriate design criteria, sloppy engineering and hasty development programs. They are too often manufactured with inadequate quality control. More than a few are advertised, marketed and distributed with an inappropriate sense of worth or balance; in some cases, outright misrepresentation is used in sales promotion.

Despite all of these problems, lack of effective control, inspection and maintenance of both equipment and related electrical distribution systems within the hospital, together with operator error, constitute the most frequent and significant causes of devices related injury and real or apparent failure of equipment to operate properly. The attendant penalties include patient discomfort, injury, and mortality, operator injury and death, and excessive cost to patients and health community.

The concept of an Equipment Control Program received major emphasis with the publication of a comprehensive plan in Health Devices (by Emergency Care Research Institute, 1971, given in Appendix A). Many of the programs in place today utilize elements of this effort.

There is a need for an overall institutional effort to manage equipment in the modern hospital facility. The hospital budget contains substantial funding for the acquisition of

instrumentation ranging from small, portable, electronic thermometer to massive, fixed radiological systems. The annual preventive maintenance and repair costs may average between five and fifteen percent of the equipment acquisition cost. With advancing technology, there is enormous pressure to purchase new devices in order to maintain a high level medical care. The very substantial hidden costs of managing and maintaining these instruments is often overlooked.

Technical support in the management of technology can minimize cost and help to allocate resources to real needs as evidenced by the description of the Equipment Acquisition Program.

The Equipment Acquisition Program describes a logical sequence of steps which can be taken to assure a successful Acquisition Program. Referring to the flowchart of Figure 1.1, the first three of these steps involve proper definition of medical requirement, assessment of environmental conditions, and a survey of commercially available equipment. This is the information gathering part of the process and assures that the medical needs are correctly translated into detailed , realistic and quantitative engineering requirements.

With this information in hand a decision can be made either to purchase the equipment "off-the-shelf" (i.e by specifying a vendor's catalog number) or to purchase via more detailed "specification-bid-contract" route. In the latter case the steps to be taken include generation of a system specification, solicitation of proposal evaluation, vendor selection, and

contractual acquisition of the system.

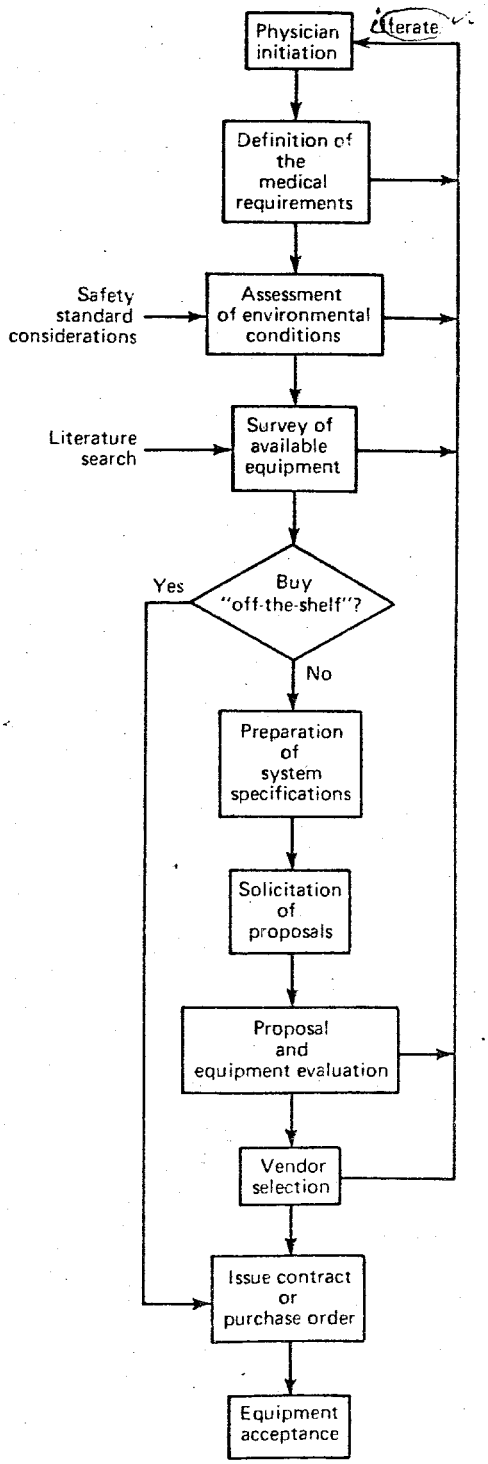


Figure 1.1 Equipment Acquisition Process

After a purchasing order or a contract has been issued, the procedures to be used for equipment acceptance must be prepared. Financial, quality and hazard control help assure that hospital is getting everything it pays for, and the patient is receiving the best possible care. Unfortunately, external recognition of the need for technical and managerial controls regarding equipment and facilities has led to the development of cumbersome and expensive regulations codes and standards.

Hospitals are clearly obligated to exert systematic and effective control over the selection, safety and performance of their diagnostic and therapeutic equipment. The fact that it may contract with an outside vendor for preventive or emergency maintenance in no way relieves the hospital of its legal and ethnical obligation to inspect incoming equipment and review through study of reports and spot checks by hospital staff or by an impartial outside consultant.

One example of a large academic hospital heart station illustrates the interrelationship between training and maintenance costs. Review of repair records of electrocardiographs demonstrated that the cost of outside vendor service was equal to the new replacement cost of all ten machines at nine-month intervals. A vicious cycle had been created. Machines broke down repeatedly. There was then an insufficient number available to meet hospital needs. The hospital's response to having too few working electrocardiographs available was simply to purchase new machines. This, in turn, escalated service costs.

The key was found by studying the performance of the ECG

technicians. Most were untrained. They abused the machines by pushing cards against walls and door frames. They purposely bend ECG styli and/or used excessive stylus heat when tracing becomes indistinct. Patient cables were dragged and run over by casters. Few of technicians understood the medical significance of getting good diagnostic recordings or its practical meaning to patients. The answer was to conduct a weekly training seminar to transmit both technical information and sense of motivation. Repair costs, of course, decreased drastically.

While training, periodic inspection and preventive maintenance will reduce many equipment related costs, no absolute reductions in costs for clinical equipment or its control and use can be expected due to escalating equipment costs and inflation. The best that can be achieved is to decrease the rate of acceleration of costs.

In addition to the economic issue, effective control of diagnostic and therapeutic equipment is subject to the codes and requirements of a number of organizations. These are minimal standards for safety, training, testing and maintenance related to clinical equipment in various areas. There are many other standards and codes (about fire protection , pollution, use of compressed gas etc.) which are both directly relevant and which have force of law.

The Equipment Control Program is helpful to the realization of an active safety program, training of staff in the safe use of equipment, formal scheduled maintenance and calibrations programs, technical assistance available to all employees, and substantional documentation. It is the cohesive framework, with

responsibilities delegated to each hospital department, with a central focus in clinical engineering, that helps promoting efficient management of complex, modern hospital.

1.3 Definition of the Equipment Control Program

The Equipment Control Program is a system employed by the hospital to insure efficient and effective procurement and utilization of medical devices and instrumentation. It is also a framework for defining the clinical engineer's roles, responsibilities and authority. Significant program components are:

- Policies
- Procedures
- Interdepartmental relationships
- Integration with other clinical engineering functions
- Communication

An Equipment Control Program, to be effective, must be consistent with overall mission and integrated within the organizational structure of the hospital. This program must be designed from the start for effective interaction with, and support of, other hospital departments; and closely integrated with all other clinical engineering responsibilities.

The Equipment Control Program, by virtue of its function as the framework for managing equipment, must incorporate a significant data base for managerial decisions and formulation of institutional policies and procedures. Figure 1.2 represents schematic representation of the components that must be

established in order to build a cohesive structure.

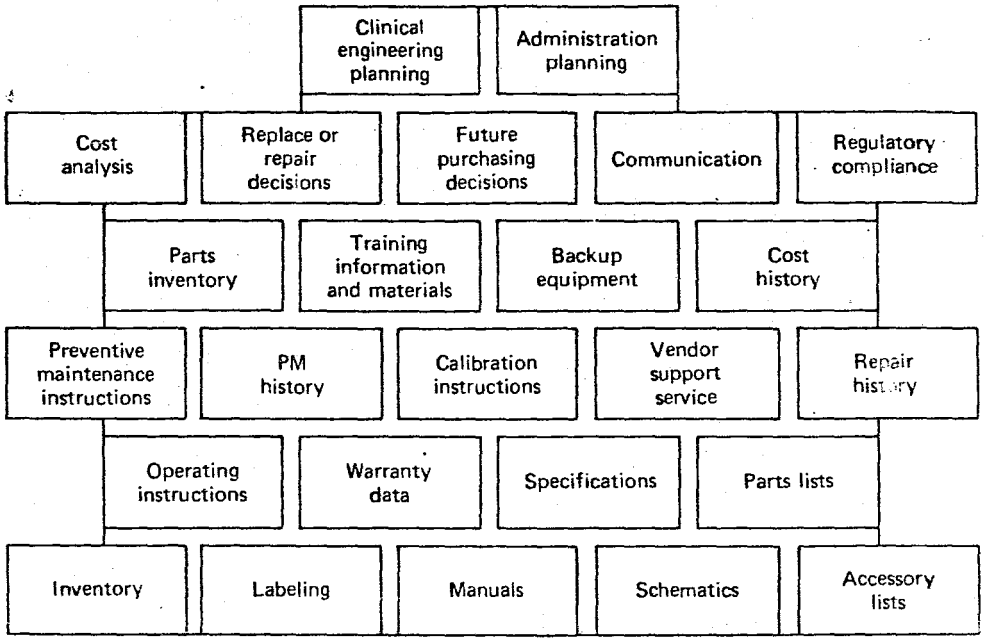


Figure 1.2 Elements of Equipment Control Program

A policy may be considered as a formal recognition of all institution-wide set of desired behavioral objectives. It allows to formalize the expectations of management in order to legally protect the institution and its employees; to provide the patient assurance of safety and quality of care; and to provide a framework for common communication and if necessary, disciplinary action. In a large organization, such as a hospital, the result is usually a series of policies and procedures that publicly identifies the important elements and organizational entities for bringing about expected performance.

The Equipment Control Program has two broad objectives:

i. Control of cost, quality and hazard

ii. Establishment of a focus for the management of technology in the hospital

The clinical engineer must be involved in each phase of the instrument's life, from acquisition to retirement, in order to reach these subjectives. Figure 1.3 shows that nearly every phase of equipment's lifetime of use in hospital will require some technical support and possible some documentation.

Each block of Figure 1.3 represents a function normally carried out by the clinical engineer. Appropriate engineering expertise can enhance the utility of a piece of equipment. Further, equipment exists virtually every department, is often shared by departments and is also often mobile. Therefore the clinical engineer must know how equipment functions, how and where it is used, and its typical modes of failure. This overall view is provided by the Equipment Control Program.

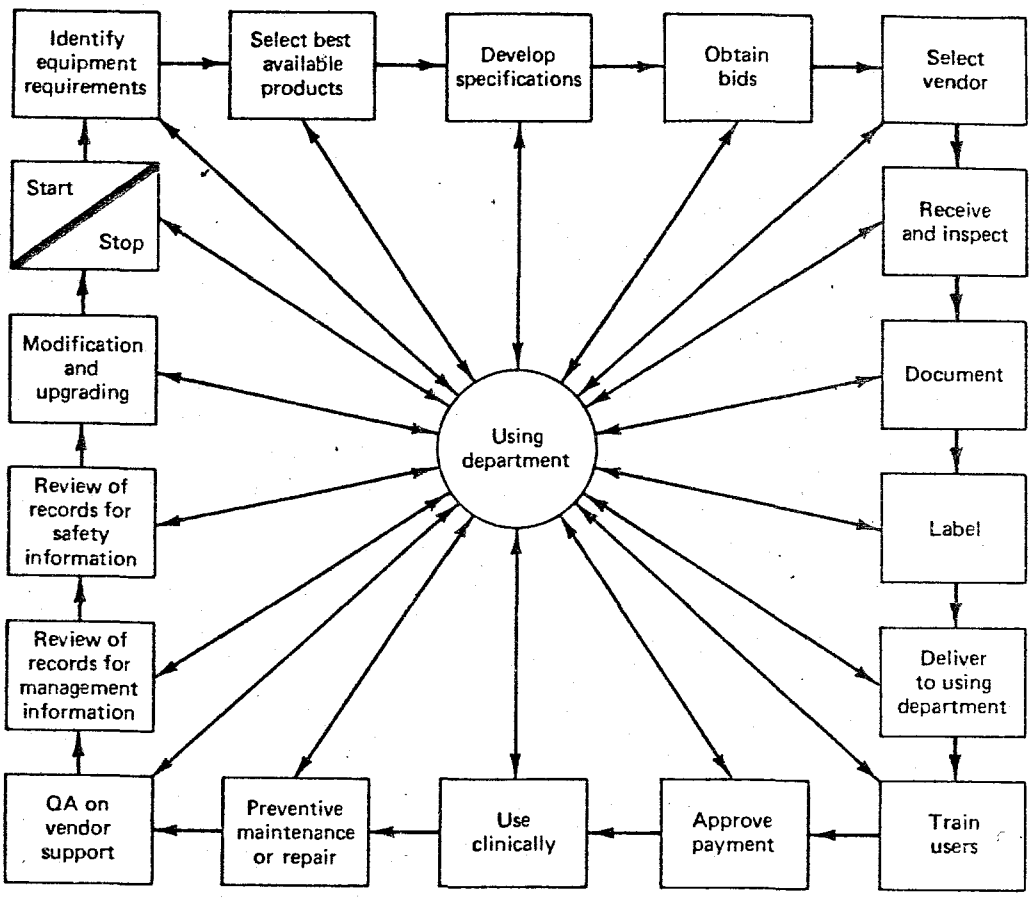


Figure 1.3 Equipment Lifetime of Use in Hospital

Defining the Equipment Control Program is a large undertaking which will require months. The program must provide a clear structure adaptable to a changing program. The Equipment Control Program, like technology it manages, is an evolutionary activity; if it changes slowly, it will be out of step with medical practice, while it changes too rapidly, the ensuing confusion will impede lasting relationships with other department.

The clinical engineer will often find that he fills a unique position within the hospital. This represents formidable problems regarding reallocation of responsibilities and other changes in hospital structure. The clinical engineer will find the hospital employees' dedication to the care of the patient and to the hospital most impressive. If the engineer develops and shares same dedication; he will become an accepted member of health-care team.

The ability to utilize the personnel, functions, and data relating to other clinical engineering responsibilities are fundamental to a successful Equipment Control Program.

Overall, the function of clinical engineering is to effectively apply technology to the solution of clinical problems. Since health-care delivery at clinical level involves a large and varied number of the sciences and the arts, clinical engineering is complex and interdisciplinary. Central concepts include organization, recognition of skills and limits and most important, team work. The clinical engineering program functions can be resumed as

i. Planning, development

ii. Adapting to technological change in patient care

iii. New facilities

iv. Renovation

v. Codes, laws and regulations

vi. Acquisition and application of technology

vii. Technological performance assurance

viii. Preventive maintenance and repair

For example, investigation of instrument-related "incident" will often require access to records of preventive maintenance and repair performed on a particular instrument, to the schematics and maintenance instructions provided by the manufacturer, to the user and his supervisor and possibly to the training programs conducted for the user. Decisions on procurement of additional instrumentation from a particular vendor will depend in part upon the maintenance frequency and the historical cost revealed in the equipment control file. The clinical engineer's ability to document his effort plays a role in accreditation and licensing of the hospital and in obtaining his budgetary requirements. Thus, the materials generated in one aspect of the clinical engineering program will be of great importance to other aspects of the program.

In achieving the objectives described above, the need for communication stands out. The engineer must gather information. He must then communicate his data and recommendations in clear and for right manner. There are number of communication channels available , although the importance of each varies from situation to situation. These include written memoranda and reports,

scheduled meetings with administrative personnel, committee meetings and frequent informal discussions with departments head, unit managers and special-care nursing staffs. For many people, on open office providing easy access to engineering support or frequent rounds of nursing units is a major part of the communi-cation process.

It may be useful to illustrate each of communication channels; written reports may be used to provide an outline of future plan for instrumenting a new clinical unit, informal discussions can give an opportunity to raise problem facing a department manager, and rounds present many opportunities for staff education. These channels of communication are the mechanisms for defining priorities, communicating results and obtaining resources with help of clinical departments and the administration.

The clinical engineer must develop the other communication paths. The first of these is a communication and data analysis system that provides report of work performed, recommendations, cost and quality control information, and in turn solicits the client's perception of quality and cost and his analysis of the program results. The Equipment Control Program includes:

i. Inventory Control

ii. Hazard Control

iii. Quality Assurance

iv. Cost Control

Inventory Control will be explained in detail, in the next section.

Hazard Control is one of the important part of the Equipment Control Program to fulfill the hospital's obligation to provide safe equipment for patient care. The Hazard Control begins with identifying the source of the equipment and continues with the participation in all significant aspects of equipment utilization. The steps which are involved in Hazard Control Program are:

i. Identification of sources of hazard information

ii. Identification of sources of acquired equipment

iii. Determination of hazard control policies

iv. Labeling of the equipment

v. Delivery of the equipment

vi. Application of written policies

vii. Reduction of hazards through training

viii. Realization of hazard investigations

Quality Assurance has the aim of the determination of any possible future hazard or misuse of the medical equipment. It begins with incoming inspection to the requirement of specifications, and to the Clinical Engineering requirements during acceptance tests. Incoming inspection is an appropriate stage to define the preventive maintenance routines and schedules. Quality Assurance includes quality assurance during procurement, quality assurance of maintenance service, quality assurance through other personnel (nurses, technicians, etc.)

Cost Control provides savings on the budget of the hospital in the purchase of instrumentation, in maintenance of equipment by training of personnel using the medical equipment, by replacement of old equipment with new ones, and by planning future development in concerning areas. Cost Control includes

i. Cost control in procurement

ii. Cost control in maintenance

iii. Cost control in administration

iv. Cost control through analysis

II. Inventory Control

2.1 Introduction

The Inventory Control is the necessary base for realization of the Equipment Control Program. Its importance and its relationship with other elements of the Equipment Control Program can be clearly seen in Figure 1.2. It represents the principal data base which allows to organize conceptual and managerial techniques for the control of medical instruments in a hospital. Adequate documentation is the keystone of the Equipment Control Program, and is absolutely essential in achieving efficiency and safety in the use of medical devices. It represents a relatively small part of total program costs.

2.2 Inventory Control Procedures

The Inventory Control can be analyzed in two categories:

i. Invertory Control for Existing equipment

ii. Inventory Control for New equipment

2.2.1. Existing Equipment

The first step in the effort to manage the variety and number of instruments utilized within the hospital is to identify

what they are, where they are located, and who is responsible for the ownership and use of each device. An orderly method for recording this and all other information related to each instrument must be established so that existing and future data can be retrieved, analyzed, and applied to future decisions and solutions of problems. In this purpose a special type of record form must be used.

a. What Is a Form

A form is nothing more than an objective having constant information printed on it and having spaces for the entry of variable information. It is generally printed on paper or some similar substance; it may be printed by any of many reproduction processes (it may be reproducible by itself).

b. Form Design Techniques

The fundamental purpose of forms design is to provide standardized media for the efficient processing of information. This includes the layout of the form and the specifications for its construction and manufacture.

The form designer's craft calls for a combination of practical and aesthetic qualities, plus an understanding of underlying system.Form should be so designed that it is for human users to do right thing, and should be easy to write, easy to read , easy to process and easy to dispose of.

To make the form easy to write ,sufficient space is needed for each entry. Entries should be in sequence of data being transcribed. Captions should readily indicate what is to be entered. As much information as possible should be pre-printed on

the form to reduce the time required to prepare it. All variables should be questioned to see if some of them are not really constants. Entries frequently but not always applicable should be pre-printed with a "ballot-box" preceeding them, thus making it necessary for user to make only a check mark or type an "X" rather than fill in the complete called for.The boxed design with with upper left caption for data entries, is usually an improvement over the caption followed by a dotted line,particularly if entries are made on a typewriter. This method conserves both space and user effort, it is also easier to read. When using boxed design, it is also simpler matter to line up many of boxes vertically so as to reduce the number of tab stops to set on typewriter.

Another way to make forms both easier to write and easier to read is to use variations in the weight of the columnar rules to set information apart. Use of hairlines for several breakdowns under one category column, then put a heavy or double rule before the next categorical grouping. The same technique can be used for horizontal ruling. All wording that is put on the form must be precise. Avoid abbreviations or incomplete phrasing that may be subject to misinterpretation.

Form titles must likewise be concise, yet indicative of the purpose of the form. Margins are important for both usage and appearance. Top and bottom margins are essential to good appearance as well as for facility in printing and use.

It is good advice to limit the size as possible. The size must be economical to print, stock, process and file. Anything larger results in higher costs , slower deliveries, more shelf

area, more costly handling and bulkier filing equipment. It is especially important to avoid odd sizes that are difficult or expensive for the printer to handle.

To layout the form with proper spacing, both vertical and horizontal, it is necessary to have a rough sketch or previous design of the form with all entries written in for guidance. After deciding on the best sequence for entry of the data, re-sketch the form roughly, then enter minimum width to each box and or column. Add these up, remembering the margins, and see if they come within allocated space. If additional space is available, increase the width of those boxes or columns that could use extra space,such as description, remarks and so on. If not enough space is available, check carefully to determine which areas can be reduced slightly without seriously affecting the usefulness of the form. Repeat this operation for each horizontal line, than make whatever adjustments are possible to line up the various boxes and columns vertically for the purpose of reducing the tab stops to minimum and improving the form's appearance.

By working out all these dimensions on the rough sketch, it will be possible to make up the final design with a minimum of time lost by trial and error. All printing should follow the conventional horizontal arrangement, because this is the way the form writer and form reader will look at it.

Last but not least, forms should be made attractive. One should not be satisfied with a purely functional design that is totally lacking in aesthetic qualities.

c. Inventory Control Form

In general, the inventory control record form for biomedical equipment must contain the following entries: description of the equipment, owner or department, normal location(s), control number, manufacturer, manufacturer address, manufacturer phone number, model number, serial number, acquisition number, warranty expiration date, requisition number, requisition date, vendor name, vendor address, vendor phone, purchase order number, purchase date, vendor order number, acquisition cost, incoming inspection (pass, date, inspector name), preventive maintenance (PM) and inspection responsibility, maintenance responsibility, inspection and preventive maintenance requirements (include frequency), applicable manuals schematics, etc. , and final disposition of equipment.

d. Forms used by Emergency Care Research Institute

The Equipment Control record, Form HD-101, Appendix A.The Control Number appears in the upper right as it does in all other forms containing this number. Similarly, the form number appears in the lower right of all forms. Space is provided for indicating the organization or department responsible for service, and for inspection and preventive maintenance requirements. The latter space can contain a reference to a separate document or procedures manual if the procedure is lenghty, or if there are many pieces of equipment requiring the same procedures.

The Equipment Service Request, Form HD-102, Appendix A. It is filled out by an individual (e.g. nurse or physician) responsible for reporting equipment failures or hazards. It may be half-size multi-part form, with one part sent via internal

mail to Equipment Control Officier or other individual responsible for providing service, and another part to be picked up with the instrument. One of these should be filed with Equipment Control Record. The hospital may wish to provide a third copy to be signed by the person taking the instrument for repair, which could serve as a receipt to be filed in the clinical unit.

The consecutive numbered Equipment Service Report, Form HD-103, Appendix A, is used both for preventive maintenance and repair work. It is designed to be used by an outside or regional cooperative equipment repair facility as well as by an in-house repair and maintenance department. The form serves a complete documentation of a service event.

The form shown in Appendix A can also illustrate the types of information and record-keeping procedure that may be employed in building the basic information required.

e. Tagging (Labeling)

The clinical engineer should add the control number and place a tag bearing this number on the equipment. Each discrete piece of medical equipment should be assigned a control number. This number, which will then serve as prime identifier of the device, is simpler than model and serial number, and facilitates documentation and filing.

The acquisition number, if any, is generally an institutional property control tag. The clinical engineer often adds a new control number instead of relying on the acquisition number. Reasons for this apparent duplication include differing criteria between equipment acquisition and control number assignement (acquisition numbers may be assigned only to

expensive items), modularity of the equipment (which may mean modules are moved, but the mainframe remains fixed), and the need for a consistent numbering system for both existing and new equipment. The acquisition number may help locate other information filed in purchasing or property control departments.

The Control Number is permanently affixed to each device by means of metal tag with solvent-activated adhesive. Consecutively pre-numbered tags are used. Other methods of marking can be employed for devices which are autoclaved, or those with dimensions, surfaces, or contours do not permit use of adhesive tags. Numbers can be punched or engraved into metal surfaces, or metal tags can be attached with rivets or screws. Care must be taken not to penetrate mechanisms or electrical insulation. In one hospital, a cast-cutter repeatedly triggered a ground fault alarm because a hole drilled through the case and the tag fastener caused a short circuit. Use of permanent hospital marking will, in addition to the other benefits of documentation, help reduce pilferage by permitting ready identification of hospital property.

Deciding what to tag will involve both consistency and common sense. The program presented here does not include house keeping, maintenance, or dietary equipment, although an individual hospital may choose to add these. The only items of furniture included are electric beds.In general, a modular system should have a separate control number assigned to each module, since it is possible to interchange modules from several systems.

A patient monitor, for example, would have a number for the

outside cabinet or mainframe, and a separate number for each plug-in module. Equipment carts and stands should be tagged separately if they readily separable from the associated equipment. Consumable or disposable should not be tagged.

Emergency Care Research Institute has developed and field tested a standard color-coded tagging system to meet the needs of an Equipment Control Program. It can be used as a fundamental part of any hospital program for equipment inventory control, inspection, maintenance, and documentation.Use of such a common system will facilitate inspection and maintenance procedures, training of personnel,and information exchange on performance, safety and deficiencies.

f. Obtaining and evaluation of the information

The clinical engineer should fill out Equipment Control form described for each piece of equipment that is located as apart of inventory. The basis of the documentation system is the Control Number, and the corresponding Equipment Control Record. During the initial inspection of the device he can obtain the manufacturer, model number, serial number, and the description of the equipment. He should carefully describe the equipment and recognize that there are many pieces of medical equipment that are uncommon. When he is unsure as to the function of a piece of equipment, he should ask someone (a nurse for example).

The clinical engineer can obtain for equipment the items such as the warranty expiration date, purchase order (PO) number, acquisition cost, owner, manufacturer's address, and equipment location. The acquisition cost may be important in depreciating the equipment, in third-party billing, or in decisions to repair,

modify, or buy new equipment.

It is useful to determine the acquisition cost and date for all equipment so that depreciation costs are known. The manufacturer's address is important in procuring manuals, schematics, and technical support. However, before obtaining these items from manufacturer, the clinical engineer should check with maintenance or plant engineering to see if they have appropriate manuals. If so, he can enter this information in the appropriate space on the form.

Perhaps the most time-consuming aspect of inventory about existing equipment is obtaining as complete list as possible. Locating and identifying the equipment as to manufacturer, model and responsible (owner) department is but part of this task.

As the clinical engineer attempts to gather existing documentation on the instrument, he will find that much of this information does not exist. For example, some devices may have been the property of particular physicians rather than the hospital. It may no longer be possible to obtain documentation on older equipment. Another difficulty is determination of whether or not maintenance contracts exists, who provides the maintenance coverage, and at what cost. Some of this information may be readily available from the purchasing department and the financial officier.

Obtaining the information required on existing equipment is not only time-consuming but frustrating, because typical hospital usually has not centralized this information prior to the development of the clinical engineering program. Therefore the

engineer may have to deal with each department in obtaining the required information and will often find that data regarding current maintenance contracts, preventive maintenance, repairs, and calibration are scattered, if they exists at all. His ability to locate or obtain these data depends upon his communication on the importance of this information to each department as well as to the administration.

A central file of Equipment Control Records should be established. Records should be filled sequentially by Control Number. A cross-index, while not essential, is quite helpful for management information purposes. The cross-index should consists of one or more index card for each type of equipment. Each card should have, as a heading, the equipment type (e.g., Suction machines, tracheal) and followed by the Control Numbers of all such units owned by the hospital. Larger hospitals may wish to further subdivide this index by using one card for each manufacturer of a device, with Control Numbers grouped by type or model number. A master list of equipment types will facilitate filing and retrieval. This cross-index will permit the hospital to determinate, for example, how many tracheal suction machines it owns, to check the maintenance history of a particular model electrocardiograph, and to identify equipment whose Control Number tag has been removed or obliterated.

An initial inspection can supplement the data base obtaining during the inventory. High on priority list is a general safety inspection to identify malfunctioning, damaged, or worn instruments, or those which leakage current or other safety aspects need attention (Appendix C). Following this, the clinical

engineer can acquire or develop tests utilized for incoming inspection or preventive maintenance and apply these to obtain the base line data for future performance testing. He can compare these test results with the manufacturer's specifications and test criteria and set priorities for effort and corrective action. It is suggested that the criteria established for existing equipment be similar to those utilized in incoming inspection. This requires the clinical engineer, in collaboration with administration and the appropriate clinical departments, to evaluate the risks and costs of of corrective action when older equipment does not measure up to new standards.

2.2.2. New Equipment

The Equipment Acquisition Program contains much of the information required for the data base described in the previous section, is obtained as a portion of the purchase specification or internal purchasing procedures. Information regarding the manufacturer's support in the areas of warranties, guarantees, maintenance availability, and the preventive maintenance and repair requirements helps providing the basis for the preventive maintenance repairs, and consulting services offered by the clinical engineer. The information required for the equipment control form should then be available from the equipment acquisition process.

Once the clinical engineer has obtained a database on the existing equipment, he knows the hospital organization and personnel. He will find advantageous to initiate procedures for the purchase of new equipment.

2.3 Summary

The steps which are involved in Inventory Control Program can be summarized as

1- Identify the type and the number of instruments utilized in hospital

2- Locate them and identify the responsibles for ownership and the use of each device

3- Establish an orderly method for record keeping

4- Determine existing and future data to retrieve, to analyze, and to be applied to future decisions and solutions of problems

5- Determine form which will be used in equipment control record

6- Create a Equipment control number for each device

7- Collect the necessary data

8- Fill out the forms and label (tag) the equipment

9- Evaluate data obtained (listing, creation of files, cross-indexing etc.)

III. Application of Inventory Control Program to Sisli Etfal Hastahanesi

3.1 Introduction

The Biomedical Engineering Institute of Bogazici University has decided to apply an inventory control program to Sisli Etfal Hastahanesi, Istanbul of Ministry of Health and Social Aid (S.S.Y.B). The choice of this hospital for the inventory control program is due to its availability of various types of old and new equipment, its distance from the Institute. This application is a part of contract between Saglik ve Sosyal Yardim Bakanligi (Ministry of Health and Social Aid) and Biomedical Engineering Institute of Bogazici University.

3.2 Inventory Procedures

3.2.1 Stage I

The first stage of this application was the determination of Equipment Control Card (Inventory Card) form for the present and future inventory control program application of the Institute.

a. The Form of Equipment Control Card (Inventory Card)

The data related to each equipment necessary to retrieve, to

analyze and to be applied to future decisions and solutions of problems specified by Dr. N. Tanyolac

The inventory control card and tag are prepared according to his specification. It is a modification of Dr. N. Tanyolac's inventory control card prepared for Capa Hospital of Medical School of Istanbul University, in 1983. The items in the equipment control card (inventory card Appendix B) are:

Name, City, and District of the hospital
(Hastahanenin adi, ili ve ilcesi)
Inventory Number (Envanter No.)
Name of the instrument (Cihazin adi)
Owner or Department (Cihazin sahibi)
Normal Location(s) (Kullanidigi yerler)
Users' Name and Phone (Kullananlarin adi ve telefonu)
Equipment Control Number (BMAE No.)
Acquisition Number (Demirbas No.)
Acquisition Cost (Demirbas degeri)
Model Number and Type (Modeli ve tipi)
Serial Number (Seri No.)
Manufacturer's Name and Address (Imalatcisi ve adresi)
Vendor's Name, Address, and Phone
(Saticisi adresi ve telefonu)
Requisition Date (Siparis tarihi)
Acquisition Date (Teslim alinis tarihi)
Warranty Expiration Date (Garanti suresi)
Acceptance Date (Kati kabul tarihi)
Date Placed In Service (Ilk kullanis tarihi)
First User (Ilk kullanici)

Calibration Responsibility (Ayar sorumlusu)

Preventive Maintenance and Inspection Responsibility

(Koruyucu bakim ve muayene sorumlusu)

Alterations of the Equipment and Special Notes

(Degisikler ve ozel notlar)

Out Of Order, Duration (... den beri calismiyor)

In Repair, Date (... de tamir alindi)

Repair Impossibility (Tamiri imkansiz)

Out Of Date (Demode oldu)

Purchase State: New (Alindiginda yeniydi)

Purchase State: Used (Alindiginda kullanilmis idi)

Modified (Orijinalde degisiklik yapildi)

Paid by State (Parasini devlet odedi)

Paid by Special Funds (Doner Sermayeden alindi)

Donated by (... bagislandi)

Property of (... malidir)

The special entries which will be used during recording are

i. Inventory number (Envanter No.)

This number is associated to each device according to Medical Devices Products Listing (published by BMAE).

Example: 12-113 Incubators

ii. BMAE No.

This record number will be used in computer application of the Institute. Example: 34PD011235

The leftmost six digits specify the hospital. First two digits specify the city of the hospital, third and fourth digits specify the district code, and type of the hospital, respectively and

fifth and sixth digits specify the order number.

Example: 34 city code Istanbul

P district code Sisli

D type State Hospital

01 classification number

Seventh digit specify the person who has recorded the equipment, last three digits the record number of the equipment.

Example: 1 staff code

235 record number

b. Establishment of an orderly method for recording

The method consists of formation of a team (2-3 experts) from research assistants of the BMAE Institute, who will record all necessary data during inventory control program. Team should work in cooperation with Anditing Department (Ayniyat) where records on price and vendor are available. Assistance of the technical personnel and nurses who are in charge of the equipment, must be obtained.

3.2.2 Stage II

The director of the BME Institute arranged a meeting with the hospital director. After this meeting, date of the first visit to the hospital has been decided. The aims of this visit were to:

1. Obtain the permission and support of the Hospital Administration for the inventory control program.

2. Explain aims and procedure of the inventory control program to the Hospital Administration.

3. Co-operate with the Maintenance Department and Anditing

Department of the hospital to evaluate all existing records related to medical equipment.

4. Determine a person from hospital which will be responsible of the co-operation with institute personnel during the application of inventory control program.

5. Meet all department heads and clinical services chiefs and explain the aims and procedure of the program.

6. Provide to the Administration all necessary official documents (SSYB recommendation letter, Institute recommendation letter, and list of persons who will work in hospital during application of the program).

7. Obtain a plan and an organizational structure scheme of the hospital.

8. Obtain an idea about the amount of work involved.

9. Organize the communication between hospital and Institute to decide a schedule of visit to departments.

Success of the inventory program depends great deal on explanation the aim and contribution of the program to the chief of the hospital and department heads in the hospital. This will facilitate the communication and proper relation between the hospital staff and the Institute personnel.It is possible for the hospital staff to become personaly or perhaps emotionally concerned when the Institute team begins to implement the program.

Items such as acquisition number, acquisition cost, acquisition date, warranty expiration date, cost of the equipment can be obtained from auditing and purchasing department. Without

proper records of this department, it is difficult to make an adequate inventory for existing biomedical equipment.

The appointment of someone by the hospital administrator as "liaison" will facilitate all communication between hospital and the Institute (to schedule the inventory visit to departments, to confirm the visit etc.)

The plan and organizational chart of the hospital will be helpful for the assignement of department to each expert of the team and to locate departments and clinics.

3.2.3 Stage III

A copy of list of biomedical equipment in each department was given to the team by the Auditing Department (Ayniyat). Using the list of biomedical equipment and organization chart of the hospital, the departments were shared between experts of the team. During this partition, some specific properties of the hospital were considered such as appointment of a female expert to obstetrics department. A schedule of visit to departments was made in consultation with department heads. The hospital liaison wrote a letter to each department informing date of visit of the team and authorization given Institute personnel for inventory work. The travel to the hospital including transportation, lodging, expenses, and food has been arranged by the team leader. All team members have checked for the last time how to fill out inventory cards, how to communicate and to use the list of biomedical equipment of departments declared by the Auditing Department. A list of biomedical equipment of concerned department has been given to each specific person in the team.

The team members received necessary equipment for their work such as inventory cards, tags, mirrors, pens, and torches

3.2.4 Stage IV

Upon arrival to the hospital, the team leader called the hospital liaison to inform the presence of the team. Identification card for each person of the team was obtained. At the Auditing Department (Ayniyat), the list of biomedical equipment has been checked, and list of biomedical equipment that are taken away from service has been prepared by team leader. As organized before, all experts begun to make inventory in assigned departments. At the end of the day, for experts of the team who were unable to complete the inventory of their department, the next visit date to finish the job was set up with the department head concerned.

3.2.5 Stage V

When the inventory of biomedical equipment has been completed, all data obtained have been evaluated in the Institute, using computer. All data of the inventory cards was put into data file of the Institute computer for future control and use. The last form of the inventory has been typed by the Institute personnel. A report about inventory application has been prepared and submitted to the Director of the Institute. Two copies of inventory cards and summary reports presented with a letter of the Director of the BME Institute to the Chief of the hospital. The letter explains the use of the inventory report, and how to continue with the inventory for the coming year.

3.3 Structure of Sisli Etfal Hastahanesi

Sisli Etfal Hastahanesi is the second biggest ministry hospital of Istanbul. It is located in Sisli. It consists of three independent buildings, including a health college. Building A contains all pediatrics services (including premature). Building B contains 1st and 2st obstetrics services, gynecology department and a family planning department at the basement. The largest building is made of three blocks, and includes the following departments and services.

2nd Basement	General Surgery, Obstetrics, and other departments' Operating Rooms
	Emergency Rooms
1st Basement	Physical Therapy
	Biochemistry
	Clinical Laboratories
	Blood Bank
	Radiology
	Anesthesia
Ground	Polyclinics (including Ophtalmology, Internal Medicine, External Medicine, E.N.T, Urology clinics)

BLOCK A

1st Floor	Dermatology	
2nd Floor	Neurology	
3rd Floor	Internal Medicine	1st Service
4th Floor	Internal Medicine	2nd Service
5th Floor	Internal Medicine	3rd Service
6th floor	Internal Medicine	4th Service

BLOCK B

1st Floor	Intensive Care (Coronary Care, Reanimation)
2nd Floor	Orthopedics
3rd Floor	Urology
4th Floor	Ophtalmology
5th Floor	Ear, Nose and Throat

BLOCK C

1st Floor	Infection Diseases Child	
2nd Floor	Infection Diseases Adult	
3rd Floor	Neurosurgery	
4th Floor	General Surgery	2nd Service
5th Floor	General Surgery	3th Service
6th floor	General Surgery	1st Service

3.4 Evaluation of Inventory Data

The data obtained as a result of the application to Sisli Etfal Hastahanesi has been evaluated using the BME Institute computer; IBM Personal Computer XT. Several software programs are available for Equipment Control Program applications. Altman's Biomedical Equipment Database program was selected as a sample. It includes 14 different programs which were designed as an integrated set of application programs to provide most of features desired by a Biomedical or Clinical Engineering Department. The primary focus during development of the program was equipment management. The program offer inventory listings, histories, summaries and Preventive Maintenance scheduling and procedures.

The programs are all written in dBASE II. dBase was chosen for its popularity and ease for use. Also, the flexibility of dBASE offers the ability to change data bases and easily add custom reports. The programs included in this software can be seen in Appendix D.

A Basic program developed for use only in inventory control application for small hospitals. As it has been prepared for inventory control application of hospitals which have a biomedical equipment total in the range of hundred equipment, the access time is greater than desired. It can be used for hospitals with inventory less than hundred biomedical equipment. This Basic program can be seen in Appendix E.

To evaluate the data of the inventory of Sisli Etfal Hastahanesi LOTUS 123 software program has been used. It is a trade-

marks of Lotus Development Corporation for IBM Personal Computer. It represents a new generation of desk-top computer programs. It combines the largest and most advanced electronic worksheet yet developed with state-of-the-art graphics and a complete information management capacity. It allows all possibilities during the evaluation of data using worksheet, range, file, copy, move, data, and print commands facilities. All data obtained as result of the inventory control application have been put in data file as worksheet file using worksheet command facility of the LOTUS 123. Any desired data specification can be sorted according to Lotus sort command facilty. For any printout such as a report of biomedical equipment of any department, types of equipment etc. print command facility of the program has been utilized. Another advantage of the LOTUS 123 is its access time. The aim of the prepared basic program is to allow the user without the knowledge of English to use the program. All commands used in the basic program are written in Turkish. The program is self explanatory for use. The major disadvantages of the LOTUS 123 is that it requires knowledge of the commands, and all commands are written in English.

The LOTUS program involves the interchangebility of different programs and has the advantage of a pre-prepared software, namely 123, which is a spread-sheet database program. By the help of 123 one can divide the main data, written in ASCII format, to form a two dimensional matrice where the individual elements are called the cells. These cells are fully independent from each other and any kind of modifications upon one or some cells do not alter the data of the remainings. Therefore it is

possible to convey, alter, sort and save the data inside the cell or the group of cells. The efficiency of the program in accomplishing the above defined works, and the amount of data to be processed simultaneously is in the order of some megabytes resulted one to use this software. The menu relavant to the duties are so well designed and if someone who does not have any idea about the software can use this program with one exception , they should know English fair enough to understand a few command.

For the people who did not use this software before, can follow up the instructions below and can accomplish the tasks they want. The instruction sequence for the access and for the use of the program is as follows:

1. Use WORKSHEET command facility to create worksheet
2. Use worksheet COLUMN-WIDTH command to set the column-width to any desired length. Default value is nine columns.
3. There are three basic ways to make an entry into cell.
   a. Type it on the cell.
   b. Use COPY or MOVE commands to copy or to move existing entry into another cell in worksheet.
   c. Retrieve data from disk file
4. Use FILE SAVE command to save data put on worksheet.
5. Use FILE RETRIEVE command to bring data saved on worksheet.
6. Use PRINT command facility to obtain a printed copy (hardcopy) of worksheet data. An entire worksheet or one or more ranges can be printed. It is possible to print output directly to computer's printer and to store it in a print file for printing later or for

use with other programs.

7. Use DATA command facility to search for a particular record, to sort alphabetically, and to locate all records that satisfy certain criteria.

3.5 Difficulties Encountered During Application

There are certain difficulties encountered in carrying out an inventory control program. Mainly problems arise from incomplete and wrong records kept by the Auditing Department (Ayniyat), carrying out inventory while the hospital is in operation and the borrowing of medical equipment between different departments of the hospital.

The incomplete records kept by the Auditing Department (Ayniyat) hold the person carrying the inventory research from obtaining all the necessary information, like acquisition cost or acquisition date of a certain biomedical equipment, which should have been filled out at the time of the purchase and can not be acquired after years have passed. Wrong records are still more troublesome than incomplete ones. Apart from the mistakes of the "slip of pen" type, case have been seen where the data available on the biomedical equipment or in its manual has been interpreted incorrectly, because of the lack of knowledge of the personnel who formerly did the record keeping. The address of the manufacturing company can be mistaken for the model, the serial number and specifications of the equipment can be confused; there was even a case where the word "Achtung" was written down as the name of the biomedical device. Also, it was seen that certain

acquisition number (demirbas numarasi) were issued to two different devices, this resulting in for example a refrigerator being recorded as an aspirator.

The nurses who are unwilling to let strangers into their "territory" also create problems for the inventory personnel. Nurses are very sensitive about other people touching their precious equipment and sometimes it takes quite a while to persuade them to give permission to touch the equipment. Also, generally they are not willing to take the responsibility and want to wait till the Department Head comes.

Sometimes it is difficult to locate certain device because of the inter-departmental borrowing within the hospital. Usually no record is kept of the borrowing and it is possible that nobody can tell exactly where the device is. Also some devices can not be located because they are in service in the hospital or in the manufacturing company or with the representative.

Other problems that frequently arise can be listed as follows: Sometimes the device that is to be recorded is operating or even connected to the patient. When this happens it is difficult to put down data from the card and to tag. Devices which are paid for by physicians themselves can cause confusion. Also, because of the ignorance of the hospital personnel, two individual devices can be considered as one device and recorded as such.

Infection control is an important aspect that needs to be emphasized in inventory control programs. In Sisli Etfal Hastahanesi we wore the same clothes and used the same paper, pen, folders and so on going from Child Infection to Obstetrics, or from Futernal Diseases to Intensive Care. This can be very dan-

gerous and cause infection hazards. The Inventory Control personnel should wear gowns and use different paper and carriers, taking care not to have articles made of plastics. Putting emphasis on cleanliness is important for eliminating infection hazards in the hospital and for the welfare of the inventory personnel.

3.6 General Inventory Procedure

STAGE I

1. In the beginning, the director of the Institute should arrange a meeting with the hospital director, and the first visit to the hospital is performed by a person from the Institute, and the team leader.

The purpose of this trip

- Explaining the program to the hospital director
- Obtaining permission to obtain inventory program
- Ask the director to notify the Auditing Department (Ayniyat) to have

a. The most recent inventory lists of the departments,

b. The organizational chart of the hospital, prepared. And if possible to be sent to the Institute

- The director should appoint someone on the hospital, for the Institute representatives to contact.

2. A copy of the letter from the Ministry of Health should be given to the hospital liaison.

3. The initial team from the Institute and the liaison should tour the hospital. The aim of this tour;

- To meet the department heads and explain the goals of the program

- To obtain an idea about the amount of the work involved

- To tell them that they are going to call them to schedule the inventory visit to their department.

STAGE II.

4. After meeting the department heads, the Institute representatives will obtain a copy of the lists of the biomedical equipment at each department as declared by the Auditing Department (Ayniyat). The organizational chart of the departments should be obtained.

5. The hospital liaison should prepare a letter authorizing the team to make the inventory and send it to the team leader.

6. Teams will then be organized, (who, alternative days)

7. At least three days before the first alternative date, call the hospital liaison. Tell him the suggested dates and ask him for the best alternative for the hospital. Tell him you will call him in three days to confirm the date of the first visit.

8. Write letters to department heads. ("A standard letter form will be prepared", and will include (call us or write us))

9. Arrange for travel to the hospital

- Transportation, lodging, food, expenses

10. Tags, mirrors, pens, inventory forms, torches etc.

11. Two days before the departure, call the liaison to confirm the visit

STAGE III.

12. Upon the arrival to the hospital

- Let liaison know your presence

- Obtain some kind of identification: a tag, a uniform

- Go to the Auditing Department (Ayniyat) to check the list and the list of the equipment that are taken away from the service.

- Dispatch the teams to the departments as organized before.

13. If unable to complete the inventory, set up the next visit to finish the job.

14. When the inventory is complete, two copies will be sent to the chief of the hospital with a letter from the Director of the BME Institute with an explanation of what to do with them and how to continue with inventory for the coming year.

The General Inventory Procedure prepared by the Biomedical Engineering Institute for hospital, out of Istanbul city can be seen in Appendix F.

APPENDIX A

(Equipment Control Program Published by ECRI)

Equipment Control Program Protocol

TEXT

1. PURPOSE

The purpose of the Equipment Control Program is to optimize the safety, effectiveness, efficiency, and economy of diagnostic, therapeutic, and supporting equipment used for patient care.

2. PRINCIPLES

There are five primary principles which must be met by the Equipment Control Program. These are accountability, versatility, responsiveness, competency, and adaptability.

2.1 Accountability

Lines of communication and responsibilities for tasks must be clearly defined in writing. Tasks must be both performed and documented. Failure to document procedures and actions, no matter how competently they may be exercised, interrupts the chain of accountability. Inadequate documentation fails to meet a growing number of legal and quasi-legal requirements, and makes the system dependent on a few vulnerable individuals.

2.2 Versatility

The Equipment Control Program, to be effective, must encompass a broad variety of technical tasks. Some may be performed by hospital personnel and others by outside organizations, depending on the size, staffing and sophistication of the institution.

2.3 Responsiveness

The Equipment Control Program must be responsive to patient needs, user requirements, and a growing body of standards, guidelines, criteria for performance, and best current practice. By providing reliable objective information, it will control selection and purchasing decisions, but not delay acquisition. It must carry out inspections routinely and on-call service rapidly. It must provide training and technical guidance to upgrade the skills of equipment users.

2.4 Competency

The Equipment Control Program must maintain both technical competence and an awareness of its own limitations. It must monitor and control the quality of services provided by outside vendors, and must undergo frequent self-evaluation. It must adhere to relevant legal requirements and the standards of practice accepted by the health community.

2.5 Adaptability

The program must be adaptable. It must include the mechanism for rapid and frequent change to meet the demands of a rapidly developing technology.

3. GOALS AND GENERAL RESPONSIBILITIES

A practical hospital program to assure adequate safety and performance of patient-related equipment must include the following elements:

3.1 Careful and detailed pre-purchase evaluation and selection of clinical equip-

COMMENTS

It is important to realize that equipment control is an interdepartmental activity which affects many individuals and departments. In so doing, the Equipment Control Committee and Equipment Control Officer must sometimes hold some of the decision-making power formerly reserved for others. General staff acceptance of the overall broad plan is essential to minimize conflict. The hospital should modify this *pro-forma* example of an Equipment Control Program to meet its own special local conditions. There should be open discussions and formal agreement to the final draft of the program plan by all clinical department heads, the medical staff, nursing, maintenance, purchasing, plant engineering, biophysics, bioengineering, and others. The program should also be understood by any major outside equipment repair vendors under contract to the hospital.

ment to assure that optimum safety, performance and cost-benefit attributes control the choice of equipment from many vendor offerings.

3.2 Incoming inspection of safety and performance characteristics of all patient-related equipment prior to release to the clinical department and user. This applies equally to purchased, leased, loaned, consigned, or privately owned equipment.

3.3 Periodic inspection, inventory control, preventive maintenance, calibration and safety certification of equipment and supporting utility systems.

3.4 Effective and responsive on-call equipment maintenance.

3.5 Supervision and quality control of instrument repair services provided by outside vendors.

3.6 Training of all appropriate categories of personnel in the safe and effective application of instrumentation to patients.

3.7 Assistance to house, attending and nursing staff in the application of instrumentation to patients.

3.8 Effective communication and feedback between clinicians, purchasing personnel, biomedical engineers or technicians, hospital administration, and vendor.

ORGANIZATION AND SPECIFIC RESPONSIBILITIES

4.1 Equipment Control Committee

4.1.1 Purpose

The Equipment Control Committee has responsibility for overseeing and guiding the hospital and Equipment Control Officer and thus bears collective responsibility for the safety, effectiveness and efficiency of patient-related diagnostic, therapeutic and supporting equipment and of related utility systems.

4.1.2 Composition

The Equipment Control Committee shall have permanent representation from the hospital administration, clinical departments and units, and supporting departments such as purchasing, nursing service, plant engineering and bioengineering.

4.1.3 Responsibilities

The Equipment Control Committee is charged with responsibility for:

4.1.3.1 Reviewing program plans, coordinating resources and efforts, overseeing program operations, developing recommendations, and facilitating program implementation

4.1.3.2 Establishing equipment purchasing priorities and adjudicating disputes in cooperation with clinical, service and purchasing departments and the hospital administration

4.2 Equipment Control Officer

The Equipment Control Officer is the key individual in this program. He shall report periodically to the Equipment Control Committee and to the hospital administration. He is directly responsible for the Equipment Control Program and its inspections, periodic maintenance, repairs, training, and documentation system.

It shall be the responsibility of the Equipment Control Officer to implement the Equipment Control Program by the following means:

4.2.1 Establishing and maintaining the documentation system.

4.2.2 Participating in pre-purchase evaluation of clinical equipment and screening all proposed equipment purchases.

4.2.3 Controlling, coordinating, and implementing initial or incoming inspection and tagging of clinical equipment.

In smaller hospitals, the Equipment Control Committee may consist of a single individual from any of these departments. This individual may also serve as the Equipment Control Officer.

Some individuals or organizations have recommended that hospitals set up electrical safety, biomedical engineering, environmental safety or other types of committees. While the name itself is not very important, we feel that it should imply a broad range of activity related to equipment and the hospital environment rather than merely electrical safety. The issues of safety, performance and efficiency, and purchasing priorities are inextricably interwoven and require continuous coordination. If these responsibilities are not assigned to a single small group and coordinated by a single Equipment Control Officer, the inevitable result will be fragmentation of tasks and responsibilities with leadership and jurisdictional disputes and waste of valuable staff time.

The role of the Equipment Control Committee and/or Equipment Control Officer is to *coordinate* and *oversee* all activities. They may delegate any or all of their detailed functions to various individuals, departments or vendors. They may, depending on the size of the organization or type of hospital, have direct control of their own technical personnel.

4.2.4 Controlling, coordinating, and implementing routine periodic inspection of equipment and electrical receptacles.

4.2.5 Controlling, coordinating, and implementing preventive maintenance, calibration, and on-call service of clinical equipment.

4.2.6 Coordinating and implementing training of technical personnel in inspection and preventive maintenance, and of clinical personnel in operation of clinical equipment.

4.2.7 Coordinating accident and incident reporting to define causes and take corrective action.

Depending upon the size of the hospital, performance of some of these tasks may be delegated to others in-house, or to outside contract maintenance organizations, regional or cooperative service facilities, or manufacturers' service representatives. Some equipment may be returned to manufacturers for service or periodic inspection.

4.2.8 Reviewing and analyzing all reports submitted by individuals or departments for compliance with local, state, and national codes and requirements, and rendering to the Equipment Control Committee and/or hospital administration an opinion on the status of the program and its compliance with the requirements of the Joint Commission on Accreditation of Hospitals.

4.2.9 Reviewing equipment hazard reports and providing hazard warnings to clinical department and unit directors. The hospital's equipment control file shall be reviewed periodically for hazardous equipment reported in HEALTH DEVICES and other publications, and appropriate warnings issued to clinical personnel and/or corrective action taken.

4.2.10 Providing periodic inspection, preventive maintenance, and calibration reports to the clinical directors of the special care unit, operating suite, emergency care facility, cardiac catheterization laboratory, heart station, and pulmonary function laboratory if these functions are not exercised on a departmental or unit level.

4.2.11 Providing quarterly reports to the Equipment Control Committee and/or hospital administration. These shall include general activity and progress reports, and summaries of program costs.

Typical reports are shown on pages 85 and 86.

4.2.12 Preparing program budgets for submission to the Equipment Control Committee.

4.2.13 Maintaining appropriate and current references, standards and specifications, and other documents available in support of the program.

See page 84 for a list of suggested reference documents.

4.3 Departmental Responsibilities

4.3.1 Purchasing Department

It shall be the responsibility of the Purchasing Department to:

4.3.1.1 Compare equipment purchase requests not previously screened by the Equipment Control Officer against:

a) Ratings of equipment published in HEALTH DEVICES

b) Lists of hazardous or unacceptable equipment published in HEALTH DEVICES and other publications

4.3.1.2 Call discrepancies between equipment purchase requests and the items in 4.3.1.1 to the attention of the Equipment Control Officer and/or the individual who initiated the purchase requisition and request that the initiator reconsider or justify his purchase request.

4.3.1.3 Submit the issue to the Equipment Control Officer for review in the event of disagreement between the requesting individual and the Purchasing Department. Disagreements which remain unresolved shall be referred to the Equipment Control Committee.

The mechanism for rapid resolution of such conflicts must be provided.

4.3.1.4. Stamp or label all purchase orders for clinical equipment with the following statement: "This equipment must pass inspection for safety, performance, and compliance with manufacturer's specifications prior to acceptance for clinical use. It must be provided with a minimum of two complete user manuals which include instructions for use, warnings of

potential hazards, parts lists, schematics, and service and maintenance requirements, where applicable. The warranty period shall begin on the date that incoming inspection is passed. Payment to vendors will not be authorized until these conditions are fulfilled."

4.3.1.5 Withhold payment to the vendor until advised by the Equipment Control Officer that the conditions set forth in section 4.3.1.4 have been met.

4.3.1.6. Call to the attention of the Equipment Control Officer any issues or problems related to equipment vendors such as tardy delivery or insistence on payment prior to fulfilling appropriate conditions.

4.3.1.7 Maintain liaison with the Receiving Department and provide it with copies of purchase orders dealing with clinical equipment so that the Receiving Department may notify the Equipment Control Officer that the equipment has arrived.

4.3.1.8 Provide to the Equipment Control Officer a periodic summary of funds expended and committed for clinical equipment and related non-consumable parts and accessories.

4.3.2 Receiving Department

It shall be the responsibility of the Receiving Department to notify the Equipment Control Officer and the initiator of the purchase order that equipment and/or accessories have arrived. Even if equipment is not scheduled to be put into immediate use, incoming inspection should be performed as soon as possible. Not only is this a courtesy to the manufacturer, but it will disclose hidden shipping damage during the period when common carriers will honor claims.

4.3.3 Clinical Personnel

It shall be the responsibility of all clinical departments, clinical units and clinical personnel (physicians, nurses, technicians and administrative personnel) to:

4.3.3.1 Evaluate and select for purchase or lease only that clinical equipment which is safe, efficacious and cost-effective and to bring to bear on this task the information available in relevant general and specialty journals, scientific meetings, current standards of good practice and HEALTH DEVICES. Demonstrations and evaluations are to be coordinated with the Equipment Control Officer.

While some departmental autonomy is desirable and should be preserved, it is important that equipment demonstrations be arranged through, or coordinated with, the Equipment Control Officer. Failure to do so will result in consigned or loaned equipment being used on patients prior to any form of safety inspection. In addition, demonstrations and evaluations are a natural educational process for the clinical staff and the Equipment Control Officer. Participation of the Equipment Control Officer in the pre-purchase selection process will bring his technical guidance to bear at an early stage, before opinions have begun to crystallize and harden. It will also minimize future differences of opinion as to appropriate models or vendors, since the Equipment Control Officer ultimately must screen the purchase orders.

4.3.3.2 Report to the Equipment Control Officer all clinical equipment which lacks a Control Number or a currently dated green Type A or yellow Type B inspection tag.

4.3.3.3 Avoid and prohibit the use of any clinical equipment which lacks a currently dated inspection tag or which demonstrates a potential hazard (e.g., loose wires, frayed line cord, etc.).

4.3.3.4 Report formally all clinical equipment failures, hazards and potential hazards, and operating problems in writing through the use of Form No. HD-102 (Request for Service), as well as verbally if there is immediate assistance required. Defective equipment should have a "Do Not Use" tag affixed.

4.3.3.5 Recognize personal limitations in using clinical equipment and seek appropriate training and/or assistance from a competent source.

4.3.3.6 Facilitate equipment-related accident control and investigation by taking the following action immediately after every significant incident:

a) Undertake emergency measures to minimize and care for injury, discomfort and threat to life (e.g., thermal burns, electric shock, contusions, lacerations or fractures, cardiac arrhythmias, interruption of normal respiration or loss of consciousness) in patients or personnel.

b) Undertake appropriate action to minimize damage to equipment.

c) Notify the attending physician who has legal responsibility for the patient.

d) Notify the Equipment Control Officer or his designate.

e) Impound all equipment attached to or contiguous to the injured party in the same room or area. Do not disconnect or change the relative physical positions of equipment or connecting cables except as absolutely necessary to avoid further injury or damage.

f) Complete Form No. HD-102 (Request for Service) and Form No. XXX (Nursing Incident Report), and submit copies to the Equipment Control Officer as well as to the Nursing Department.

4.3.4 Directors of Clinical Departments and Units

It shall be the responsibility of all clinical department and unit directors to:

4.3.4.1 Implement methods and procedures to ensure that departmental and unit personnel comply with section 4.3.3, Responsibilities of Clinical Personnel.

4.3.4.2 Coordinate training of departmental or unit personnel in equipment operation, safety, hazard recognition and prevention, and problem reporting.

4.3.4.3 Comply with relevant inspection, calibration, preventive maintenance, training, service, safety, operation and documentation procedures required by local, state, federal and other appropriate authorities for specialized equipment (e.g. radiology, nuclear medicine).

4.3.4.4 Receive and review periodic records of inspection, preventive maintenance, calibration and repairs of clinical equipment, and inspection of the local electrical distribution system, and coordinate corrections as necessary.

4.3.4.5 Transmit copies of all reports to the Equipment Control Committee in compliance with section 4.3.4.3 if periodic equipment control activities delineated in section 4.3.4.3 are performed by personnel responsible to the clinical department or unit director.

4.3.4.6 Transmit to the Equipment Control Officer the results of communications or other dealings with vendors of equipment or service.

5. DOCUMENTATION PROCEDURES

5.1 Equipment Control Files

The hospital shall maintain equipment control files with the following elements:

5.1.1 Equipment Control Record

5.1.1.1 An Equipment Control Record shall be created for each unit of equipment. This record is numerically matched to the permanent Control Number tag of each individual equipment unit and placed sequentially in the central equipment control file.

5.1.1.2 All basic data required on the form shall be inserted at the time of initial inspection. Each periodic inspection, preventive maintenance, on-call service and other procedure shall be recorded. When the equipment is retired, the final disposition (e.g., trade-in, scrapping, etc.) shall be recorded on the form and the form, together with accompanying documents, placed in the Inactive file.

5.1.2 Inspection, Preventive Maintenance and Service Reports

The initial inspection form and all subsequent inspection, preventive maintenance and service report forms and records shall be filed with the Equipment Control Record.

The Equipment Control Record, together with its numerically matched Control Number tag which should be permanently affixed to the equipment, represents the primary document in a hospital's Equipment Control Program. ECRI has developed and field tested an Equipment Control Record form. Subscribers may reproduce it freely without further permission.

All Equipment Control Records and related documents should be kept in central files. It has been our experience that despite its relative inconvenience compared to a decentralized file system where each department or clinical unit is responsible for its own files, a

5.1.3 Vendor Documents

One copy of the user manual and schematics shall be filed separately by manufacturer and model number. One copy shall be forwarded with the equipment to the user department. Guarantee, warranty, and registration cards shall be completed and appropriate parts filed with the Control Record or returned to the vendor.

central system offers many advantages. These range from better file security to superior technical consistency. A dual system invariably causes both files and sets of documents to be incomplete. Use of a central file system demands, however, that a well-defined equipment control and reporting procedure be used.

.2 Tagging System

5.2.1 Equipment Control Number

All equipment, if found acceptable, should be permanently tagged with a control number following initial inspection.

The presence of a control number shall, by definition, indicate the following:

5.2.1.1 The equipment has passed initial or incoming inspection for safety and performance and conforms to manufacturer's specifications.

If Control Number tags are affixed with rivets or screws, special care shall be taken to avoid drill or fastener damage to the equipment.

5.2.1.2 A numerically matched Equipment Control Record has been generated and placed in the central instrument control file.

5.2.1.3 One copy of the user manual and engineering data is in the central file.

5.2.1.4 Approval for payment of the vendor invoice may be released by the owner department and/or hospital administration.

5.2.1.5 The equipment will automatically be inspected for safety and performance at appropriate intervals.

5.2.2 Ground Warning Tag

If electrical leakage in any ungrounded mode of test or operation exceeds 10 microamperes, the equipment should be conspicuously tagged with a warning placard. This placard shall state: "Danger, safe operation requires that this device be grounded prior to and during use."

See page 90.

5.2.3 Type A Clinical Equipment

All clinical equipment, whether or not electrically energized, which meets all general safety and performance standards as well as specific standards for use on electrically susceptible patients (i.e., those patients with exteriorized electrically conductive pathways directly to the heart) shall be termed Type A Clinical Equipment. The electrical leakage current limits for Type A line-powered devices are 10 microamperes between any patient electrode and ground (or any other patient electrode), and 50 microamperes between the chassis and ground. The higher limit for leakage to the chassis applies because patient contact with the chassis is not deliberate. However, Type A Clinical Equipment on which the leakage current to the chassis is above 10 microamperes should have ground warning tags affixed (see 5.2.2). These limits shall apply in all possible wiring and grounding configurations, and all operating modes. Type A Clinical Equipment shall have a green Type A tag indicating date of inspection, next inspection due date, and inspector affixed following initial and periodic inspections.

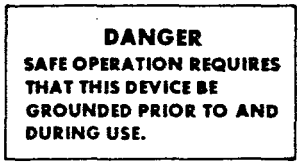
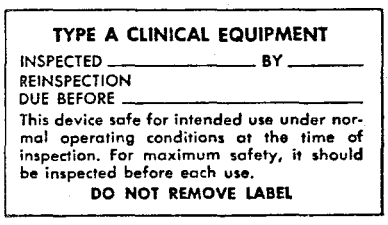
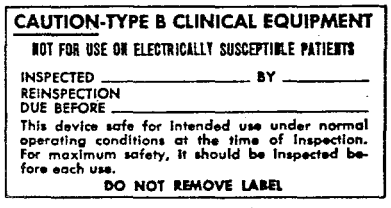
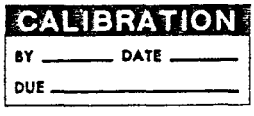
Equipment which is not energized electrically, and which meets all appropriate safety and performance standards is considered Type A Equipment.

5.2.4 Type B Clinical Equipment

All line-powered clinical equipment in which the electrical leakage current exceeds the limits stated in section 5.2.3, but is less than 500 microamperes in all modes of wiring, grounding, or operation, and which meets other applicable safety and performance standards shall be designated Type B Clinical Equipment. It may not be used on electrically susceptible patients unless grounding is confirmed at the time of use, and the leakage current when grounded does not exceed 10 microamperes. A yellow Type B tag, indicating the date of inspection, next inspection due date, and inspector shall be affixed to such equipment following initial and periodic inspections.

As the Equipment Control Program is being established, devices which exceed the leakage current limits stated here may be given a yellow Type B tag if definite steps are taken to reduce the leakage current, provide other safeguards, or retire the device.

TAGGING SYSTEM

LABEL	STOCK NO.	COLOR	MATERIAL	SIZE	BOND
	HCL-6 (Note 1)	Black and silver	Aluminum	7/16" x 1½"	Permanent, solvent-activated adhesive
	HCL-5 (Note 2)	Black legend on red	Aluminum	1" x 2"	Permanent, solvent-activated adhesive
	HCL-2	Black legend on green	Vinyl cloth	1½" x 3"	Removable, pressure-sensitive adhesive
	HCL-1	Black legend on yellow	Vinyl cloth	1½" x 3"	Removable, pressure-sensitive adhesive
	HCL-4	Green legend on white	Vinyl cloth	5/8" x 1½"	Removable, pressure-sensitive adhesive
	HCL-3	Black legend on red	Vinyl cloth	4½" x 2¼" (Note 3)	Removable. Attach by pressure-sensitive adhesive, or leave label on dispenser card (with hole) and attach with string tie.

NOTES: 1. These tags should be ordered with the desired sequential numbering.
2. This tag was formerly numbered HCL-3 (see HEALTH DEVICES, Vol. 1, page 32).
3. This label is sized to fit over defective electrical receptacles as well as on equipment.

EQUIPMENT CONTROL RECORD

ITEM			CONTROL NUMBER
MANUFACTURER		MODEL	
SERIAL NUMBER	ACQUISITION COST	DATE PLACED IN SERVICE	WARRANTY EXPIRES
VENDOR			PURCHASE ORDER NO.
OWNER OR DEPARTMENT	SERVICED BY		
NORMAL LOCATION(S)			
INSPECTION AND PREVENTIVE MAINTENANCE REQUIREMENTS (INCLUDE FREQUENCY)			
FINAL DISPOSITION OF EQUIPMENT			DATE

INSPECTION AND MAINTENANCE SUMMARY

DATES			TIME OUT OF SERVICE	WORK PERFORMED	PARTS & LABOR COST	
REPORTED	PICKED UP	RETURNED				

CHECK HERE IF CONTINUED ON REVERSE SIDE ____

Health Devices Evaluation Service
Form HD-101-771

THE EMERGENCY CARE RESEARCH INSTITUTE
913 WALNUT STREET/PHILADELPHIA, PA. 19107

DATES			TIME OUT OF SERVICE	WORK PERFORMED	PARTS & LABOR COST	
REPORTED	PICKED UP	RETURNED				

The remainder of this side of the Equipment Control Record is ruled as indicated here. See camera-ready copy inserted.

Enter number of main cabinet or module.

CONTROL NUMBER

EQUIPMENT SERVICE REQUEST

FROM		DATE	TIME
DEPARTMENT		LOCATION	
PERSON MAKING REQUEST	TELEPHONE EXT.	VERBAL REQUEST PLACED ☐ YES ☐ NO	
ITEM			

PROBLEM (Brief statement of malfunction or failure, other devices involved, conditions and time of occurrence, whether constant or intermittent fault, if human error was contributory, etc.)

The length of this portion of the form may be varied to suit hospital requirements. We suggest an overall length of 7 inches for this form.

Health Devices Evaluation Service
Form HD-102-771

EQUIPMENT SERVICE REPORT

NO.

THE EMERGENCY CARE RESEARCH INSTITUTE
913 WALNUT STREET/PHILADELPHIA, PA. 19107

CONTROL NUMBER

CHARGE TO	DESCRIPTION OF INSTRUMENT	
	MANUFACTURER	
	MODEL	SERIAL NO.
PROBLEM	LOCATION	
	USER & PHONE NO	
	DATE PICKED UP	REPAIR AUTHORIZATION
	ACCOUNT NO.	PURCHASE ORDER NO.

WORK PERFORMED:

QUAN.	STOCK NO.	PARTS DESCRIPTION	UNIT PRICE		COST	
			$		$	

LABOR COST:	HOURS @ $	= $	TOTAL PARTS	$	
TRAVEL TIME:	HOURS @ $	= $	TRANSPORTATION MILES @ ¢	$	
REPAIRED BY	APPROVED BY	TOTAL $	LABOR AND TRAVEL COST	$	
				$	
RECEIVED BY USER Signature		DATE RETURNED	TOTAL	$	

Health Devices Evaluation Service
Form HD-103-771

971

APPENDIX B

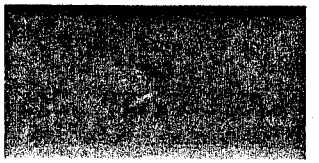
Inventory Card and Control Tag

(Biomedical Engineering Institute-Boğaziçi Üniversitesi)

BIOMEDIKAL CIHAZLARI ENVANTER KARTI

İSTANBUL .....İLİ ŞİŞLİ .....İLÇESİ

.....ETFAL.....HASTANESİ



ENVANTER NO	CİHAZIN ADI	CİHAZIN SAHİBİ	KULLANILDIĞI YER	KULLANANLARIN ADI ve TELEFONU
12-113 BMAE_NO 34PD011001	KUVÖZ BEBEK	PREMATJRE	PREMATURE	Ahmet Üstün 115

DEMİRBAS NO	DEMİRBAS DEĞERİ	MODELİ ve TİPİ	SERİ NO	SİPARIS TARİHİ	12.1960
16385-90	27.000.TL.	2M - 1300	1593 - A	TESLİM ALINIŞ TARİHİ	02.1961
İMALATCISI ve ADRESİ		SATICISI ADRESİ ve TELEFONU		GARANTİ SÜRESİ	2 YIL
DRAGER WERKE WEST GERMANY		Bilge Ticaret İSTANBUL		KATİ KABUL TARİHİ	02.1961
				İLK KULLANIS TARİHİ	02.1961
				İLK KULLANAN	Ali Karaoğlan
BAKIM KİTABININ YERİ ve ADEDİ		KULLANMA REHBERİ YERİ ve ADEDİ		AYAR SORUMLUSU	Mustafa Uçar
PREMATURE 1 Adet		PREMATURE 1 Adet		BAKIM SORUMLUSU	Mustafa Uçar

DEĞİŞİKLİKLER ve ÖZEL NOTLAR

...1 Yıldan DEN BERİ ÇALIŞMIYOR ..... DE TAMIRE ALINDI TAMIRI İMKANSIZ

ALINDIĞINDA YENİYDİ X KULLANILMIŞ İDİ ORJİNALDE DEĞİŞİKLİKLER YAPILDI DEMODE OLDU

PARASINI DEVLET ÖDEDİ X DÖNER SERMAYEDEN ALINDI .....BAĞIŞLANDI ..... MALIDIR.

APPENDIX C

SETTING PRIORITIES

for

Equipment Control Program

Establishing an Equipment Control Program is not a simple undertaking, and involves many tasks. The first of these is to organize an Equipment Control Committee and designate Equipment Control Officier, who will take the responsibility for the day-to day operation of the program. While this will take some time, a number of tasks should begin immediately, before all program detail are consolidated. Based on seventeen extensive technical and safety surveys undertaken by ECRI in hospitals ranging from 50 to 800 beds, the following immediate course of action and order of priorities are suggested

1. Inspect 220-volt wall receptacles, starting with special care areas, cardiac catheterization laboratories, special studies rooms, and operating suites, then proceeding to other diagnostic, therapeutic, and general patient areas. Improper wiring or grounding and excessive ground impedances should be corrected, and all two-blade receptacles and those which do not grip the plugs firmly should be replaced with highest quality of receptacles available.Due to the lack of uniform terminology among manufacturers, it is not sufficient to order "Specification Grade" recep-

tacles. Substitution of "equivalent" devices by electrical supply houses should not permitted. The difference in cost between the receptacles of higher qualities and inferior ones is less than the labor cost of their installation. Use of lower-cost receptacles is a false economy, since they will require replacement more often.

2. Ban the use of, and confiscate, all two-wire extension cords and "cheater" adapters. Make heavy-duty three-wire extension cords available where needed until additional receptacles can be installed.

3. Locate every piece of clinical equipment, attach a Control Number Tag to it, and create an Equipment Control Record. While doing this,inspect the line chord of all electrically operated equipment to determine that it has a three-prong plug, and that both cord and plug are in good condition. Verify continuity between the grounding pin on the plug and the chassis with an ohmmeter.

4. Inspect in detail all equipment represented by the newly created Equipment Control Records. Safety and performance characteristics should be measured on those devices, and leakage current and other safety indices measured on all other equipment. The following categories, while not exhaustive, indicate those devices which are more critical,or in which hazards are more likely. Devices are listed alphabetically within each categories.

Priority 1

Cryosurgical Units

Defibrillators (discontinue use of AC-output defibrillator)

Dialysis Machines

Dye Injectors

Electric Beds in special care areas

Electric Operating Tables

Electrocardiographs

Electrosurgical Machines

Examining Lights

External Pacemakers (discontinue use of line-powered pacemakers)

Heart-lung Bypass Machines

Incubators

Infant Warmers

Infusion Pumps

Mobile Imaging Intensifiers

Mobile X-ray Units

Monitors, bedside

Monitors, central

Physiologic Pressure Systems

Resuscitators

Suction Machines

Ultasonic Nebulizers

Priority 2

Diathermy Machines

Heading Pads

Hubbard Tanks and Whirlpool Baths

Hypothermia Machines

Radiologic Equipment (fixed)

Therapeutic Lamps

Priority 3

Clinical Laboratory Equipment

Electric Beds in general patient areas

Electric Examining Tables

Muscle Stimulators

APPENDIX D

Altman's Biomedical Equipment Database

The programs were designed as an integrated set of application programs to provide most of features desired by a Biomedical or Clinical Engineering Department. The primary focus during development was equipment management. The program offer inventory listings, histories, summaries and Preventive Maintenance scheduling and procedures.

The program are all written in dBASE II. dBase was chosen for its popularity and ease for use. Also, the flexibility of dBASE offers the ability to change data bases and easily add custom reports.

It includes 14 different programs which are

BIOMENU .CMD

The first program to run is always BIOMENU. It checks that the date is properly set, that all data files are available, initializes common memory variables, and finally, offers a choice of programs to run.

BIOADD.CMD

BIOADD.CMD adds or changes instruments in the master file, BIOSTR.DBF. The program may run either from the menu or as a

subroutine from BIOWO.CMD. The program adds or changes all BIOMSTR fields except total.

BIOCWO.CMD

The program BIOCWO.CMD changes work orders previously entered by BIOWO.CMD. It is a relatively complex program since it must be subtract totals from the equipment master file before adding new totals. The record must be searched by the data that were input even if they were wrong. The program will not update the BIOSUM.DBF summary database.

BIODISP.CMD

This program prints or displays a selected inventory. Unlike BIOSRCH.CMD, this program does not search history. Selection may be by manufacturer, model, description and/or cost center.

BIOLIST.CMD

BIOLIST.CMD lists the equipment inventory. The listings may be sorted by Identification number, manufacturer and model, description and cost center.

BIOPMI.CMD

The biomedical database enters PM Procedure check lists and prints them on work orders. Each procedure allows for up to 15 steps plus electrical safety. Six tests can be specified. Each test may include items such as Defibrillator output, ESU-readings, pressure, temperatures, etc. Allowable range are also provided. Six routine replacements parts may also be listed with each procedure along with part numbers, descriptions and costs. The procedures are stored in BIOPM.DBF and include the date last

changed. The date remains until the procedure is input or-updated. The printed procedure will show this date rather than print date.

The program, BIOPMI.CMD inputs or changes the procedure. BIOPMPRT.CMD will list the procedure and BIOPMIDX.CMD will print an index of all procedures.

BIOPMIDX.CMD

It provides two indexes of all PM procedures. The first will be sorted by procedure number. The second will be listed alphabetically by manufacturer and model.

BIOPMPRT.CMD

It lists a specified PM procedure for documentation purposes.

BIOPMSCD.CMD

It schedules PM procedures by selecting groups of instruments. The program will provide the ability to schedule based on manufacturer, model, description and department or any combination of the above. BIOPMSCD will search all matching instruments and present the opportunity to change PM scheduling, the PM number, Status, and the estimated hours for each device.

BIOSCHD.CMD

It prints PM procedures on work orders. It is possible to reformate the work orders to match individual needs. The program list manufacturer, model, serial number, description, PM procedure, tests, parts to be replaced and a brief summary listing the number of work orders, repair hours, parts cost, labor cost,

repair cost, cost ratio,and date last serviced.

BIOSID.CMD

This program lists all the work orders on a specific instrument. BIOSID.CMD will first find BIOMSTR record matching the ID number. After printing the complete record, the program then finds all work orders. These are then listed chronologically with totals at the bottom.

BIOSRCH.CMD

The search history program BIOSRCH.CMD selects custom history reports. The program allows searching by manufacturer, model, description and cost center. It is also possible to use multiple choices and abbreviated names. With this program, for example, data may be obtained for all Infusion Pumps.

BIOSUM.CMD

It provides department summaries that include totals by month for all departments that had service performed. Totals will also be shown for each technician completing work orders for the month. The program prompts for the month to report. It will then process any work order added since the last time the program was run. The processing sums the hours in the BIOSUMRY database for later printing. By saving BIOSUMRY totals, fewer records need to be read for each report.

BIOWO.CMD

The program enters work orders into the BIOHIST.DBF database. The program will give the option of changing the master record. If a change is requested, BIOADD.CMD is called as a subroutine. All

fields are presented for changing, including PM scheduling and status. If the ID Number is not on file (new instrument), the program will allow the option of adding the new instrument and then continue with inputting of the work order.

APPENDIX E

BASIC Program Developed for Inventory Control

```
10 REM **** ENVANTER ***
20 DIM U1$(100),U2$(100),U3$(100),U4$(100)
30 DIM U5$(100),U6$(100),U7$(100),U8$(100),U9$(100),U10$(100),U11$(100),U12$(100),U13$(100),U14$(100
),U15$(100),U16$(100),U17$(100),U18$(100),U19$(100)
39 REM DATE
40 CLS :LOCATE 4,39:FOR XX=1 TO 8 :PRINT CHR$(220); : NEXT XX
50 LOCATE 6,39: FOR XX=1 TO 8 : PRINT CHR$(223); : NEXT XX
60 LOCATE 5,33: PRINT "TARIH";
70 LOCATE 5,39:ML=8:GOSUB 2080 : DA$=IN$
79 REM OPTIONS
80 CLS
90 LOCATE 3,1: FOR XX=1 TO 80 : PRINT CHR$(177); : NEXT XX
100 GOSUB 2210 : GOSUB 2210
110 PRINT CHR$(177);"     ";:COLOR 0,7 : PRINT " 1     YENI KAYIT ";TAB(35); : COLOR 7,0 : PRINT TAB
(40); : COLOR 0,7 : PRINT " 2     DEGISTIRME ";TAB(75); : COLOR 7,0 : PRINT TAB(80);CHR$(177);
120 GOSUB 2210
130 PRINT CHR$(177);"     ";:COLOR 0,7 : PRINT " 3     INCELEME ";TAB(35); : COLOR 7,0 : PRINT TAB(4
0); : COLOR 0,7 : PRINT " 4     ENVANTER POSTASI ";TAB(75); : COLOR 7,0 : PRINT TAB(80);CHR$(177);
140 GOSUB 2210
150 PRINT CHR$(177);"     ";:COLOR 0,7 : PRINT " 5     ARAMA";TAB(35); : COLOR 7,0 : PRINT TAB(40);
: COLOR 0,7 : PRINT " 6     ENVANTER RAPOR ";TAB(75); : COLOR 7,0 : PRINT TAB(80);CHR$(177);
160 GOSUB 2210
170 PRINT CHR$(177);"     ";:COLOR 0,7 : PRINT " 7     DISKET OKUMA ";TAB(35); : COLOR 7,0 : PRINT T
AB(40); : COLOR 0,7 : PRINT " 8     DISKETE YAZMA ";TAB(75); : COLOR 7,0 : PRINT TAB(80);CHR$(177);
180 GOSUB 2210
190 PRINT CHR$(177);"     ";:COLOR 0,7 : PRINT " 9     BASIC'E DONME ";TAB(35); : COLOR 7,0 : PRINT
TAB(40); : COLOR 0,7 : PRINT" 10 ";TAB(75); : COLOR 7,0 : PRINT TAB(80);CHR$(177);
200 GOSUB 2210
210 GOSUB 2210
220 FOR XX=1 TO 80 : PRINT CHR$(177); : NEXT XX
229 REM CHOICE
230 PRINT : PRINT TAB(33);"BIRINI SECINIZ"
240 SEC$=INKEY$:IF SEC$="" OR (VAL(SEC$)<1 OR VAL(SEC$)>9) THEN 240
250 ON VAL(SEC$) GOTO 260,270,280,290,300,310,320,330,340,350
260 GOSUB 370 : GOTO 410
270 GOSUB 370 :GOSUB 1020:GOTO 80
280 GOSUB 370 :GOSUB 1020 : GOTO 80
290 GOSUB 370 : GOSUB 2560:GOTO 80
300 GOSUB 2220 : GOTO 80
310 GOSUB 2780:GOTO 80
320 GOSUB 1990:GOTO 80
330 GOSUB 1900 : GOTO 80
340 CLS :GOTO 360
350 GOTO 80
360 END
```

```
369 REM EQUIPMENT CONTROL NUMBER
370 LOCATE 22,1: PRINT "CIHAZIN KOD NOSU";
380 LOCATE 22,20: ML=3 : GOSUB 2080 : KN$=IN$
390 X=VAL(KN$)
400 RETURN
409 REM CREATE A NEW ENTRY
410 CLS
420 COLOR 0,7 : PRINT "  1 ENVANTER NO.";TAB(30) : COLOR 7,0 : PRINT : PRINT
430 COLOR 0,7 : PRINT "  2 CIHAZIN ADI";TAB(30) : COLOR 7,0 : PRINT : PRINT
440 COLOR 0,7 : PRINT "  3 CIHAZIN SAHIBI";TAB(30) : COLOR 7,0 : PRINT :PRINT
450 COLOR 0,7 : PRINT "  4 KULLANILDIGI YER";TAB(30) : COLOR 7,0 : PRINT :PRINT
460 COLOR 0,7 : PRINT "  5 BMAE NO.";TAB(30) : COLOR 7,0 :PRINT :PRINT
470 COLOR 0,7 : PRINT "  6 DEMIRBAS NO.";TAB(30) : COLOR 7,0 :PRINT :PRINT
480 COLOR 0,7 : PRINT "  7 DEMIRBAS DEGERI";TAB(30) : COLOR 7,0 :PRINT :PRINT
490 COLOR 0,7 : PRINT "  8 MODELI VE TIPI ";TAB(30) : COLOR 7,0 :PRINT :PRINT
500 COLOR 0,7 : PRINT "  9 SERI NUMARASI  ";TAB(30) : COLOR 7,0 :PRINT :PRINT
510 COLOR 0,7 : PRINT " 10 IMALATCISI VE ADRESI ";TAB(30) : COLOR 7,0 :PRINT :PRINT
520 LOCATE 1,32: ML=48 : GOSUB 2080 : U1$(X)=IN$
530 LOCATE 3,32: ML=48 : GOSUB 2080 : U2$(X)=IN$
540 LOCATE 5,32: ML=48 : GOSUB 2080 : U3$(X)=IN$
550 LOCATE 7,32: ML=48 : GOSUB 2080 : U4$(X)=IN$
560 LOCATE 9,32: ML=48 : GOSUB 2080 : U5$(X)=IN$
570 LOCATE 11,32: ML=48 : GOSUB 2080 : U6$(X)=IN$
580 LOCATE 13,32: ML=48 : GOSUB 2080 : U7$(X)=IN$
590 LOCATE 15,32: ML=48 : GOSUB 2080 : U8$(X)=IN$
600 LOCATE 17,32: ML=48 : GOSUB 2080 : U9$(X)=IN$
610 LOCATE 19,32: ML=48 : GOSUB 2080 : U10$(X)=IN$
620 LOCATE 21,30
630 PRINT "DEGISTIRMEK ISTIYORMUSUNUZ ?   (E/H)  "
640 LOCATE 21,70:ML=1: GOSUB 2080 : AN$=IN$
650 IF AN$<>"E" AND AN$<>"H" THEN 620
660 IF AN$="H" THEN 720
670 LOCATE 23,30
680 PRINT "DEGISTIRMEK ISTEDIGINIZ NO.YU YAZINIZ "
690 LOCATE 23,70:ML=2:GOSUB 2080:A$=IN$
700 IF VAL(A$)<1 OR VAL(A$)>10 THEN 690
710 ON VAL(A$) GOSUB  1520,1540,1560,1580,1600,1620,1640,1660,1680,1700:GOTO 620
720 CLS:PR=0
730 COLOR 0,7 :PRINT " 11 SATICISI VE ADRESI";TAB(30) : COLOR 7,0 :PRINT :PRINT
740 COLOR 0,7 : PRINT " 12 TESLIM ALINIS TARIHI";TAB(30) : COLOR 7,0 :PRINT :PRINT
750 COLOR 0,7 : PRINT " 13 GARANTI SURESI";TAB(30) : COLOR 7,0 :PRINT :PRINT
760 COLOR 0,7 : PRINT " 14 KATI KABUL TARIHI ";TAB(30) : COLOR 7,0 :PRINT  :PRINT
770 COLOR 0,7 : PRINT " 15 ILK KULLANIS TARIHI";TAB(30) : COLOR 7,0 :PRINT :PRINT
780 COLOR 0,7 : PRINT " 16 BAKIM KITABI YERI ADEDI";TAB(30) : COLOR 7,0 :PRINT :PRINT
790 COLOR 0,7 : PRINT " 17 KUL. REHBERI YERI ADEDI";TAB(30) : COLOR 7,0 :PRINT :PRINT
800 COLOR 0,7 : PRINT " 18 CIHAZIN DURUMU";TAB(30) : COLOR 7,0 :PRINT :PRINT
810 COLOR 0,7 : PRINT " 19 ODEME BICIMI";TAB(30) : COLOR 7,0 :PRINT :PRINT
820 LOCATE 1,32: ML=48 : GOSUB 2080 : U11$(X)=IN$
830 LOCATE 3,32: ML=48 : GOSUB 2080 : U12$(X)=IN$
840 LOCATE 5,32: ML=48 : GOSUB 2080 : U13$(X)=IN$
850 LOCATE 7,32: ML=48 : GOSUB 2080 : U14$(X)=IN$
860 LOCATE 9,32: ML=48 : GOSUB 2080 : U15$(X)=IN$
870 LOCATE 11,32: ML=48 : GOSUB 2080 : U16$(X)=IN$
880 LOCATE 13,32: ML=48 : GOSUB 2080 : U17$(X)=IN$
890 LOCATE 15,32: ML=48 : GOSUB 2080 : U18$(X)=IN$
900 LOCATE 17,32: ML=48 : GOSUB 2080 : U19$(X)=IN$
```

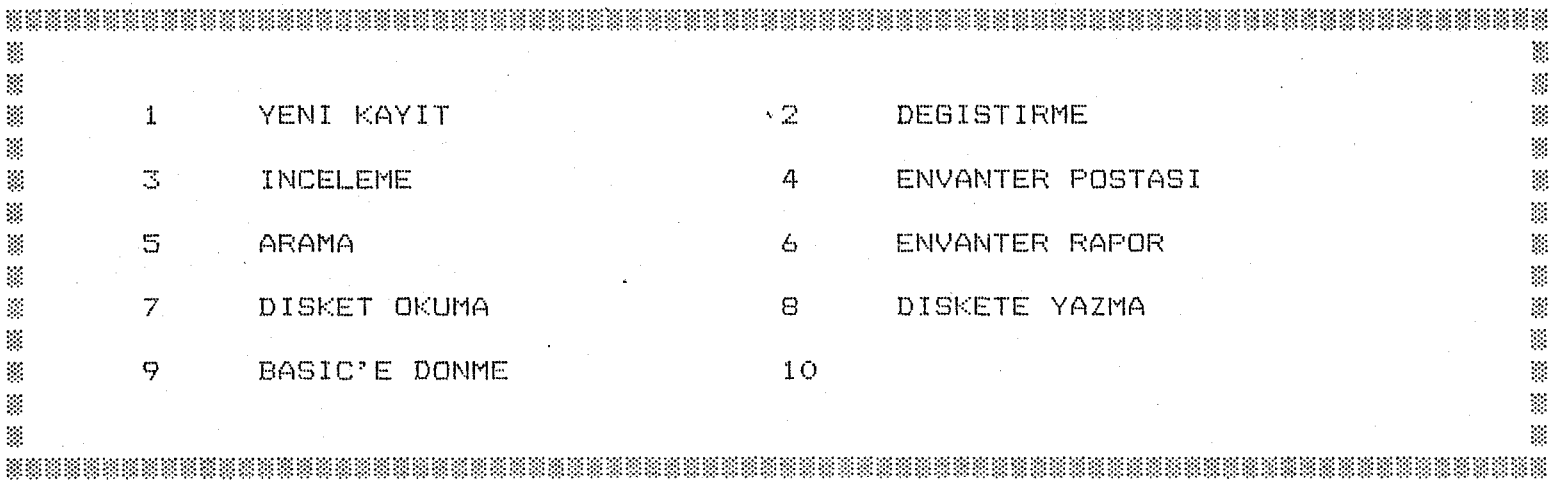
```
910 LOCATE 21,30
920 PRINT "DEGISTIRMEK ISTIYORMUSUNUZ ?   (E/H)  "
930 LOCATE 21,70:ML=1 :GOSUB 2080 : AN$=IN$
940 IF AN$<>"E" AND AN$<>"H" THEN 910
950 IF AN$="H" GOTO 1010
960 LOCATE 23,30
970 PRINT "DEGISTIRMEK ISTEDIGINIZ NO.YU YAZINIZ "
980 LOCATE 23,70:ML=2:GOSUB 2080:A$=IN$
990 IF VAL(A$)<11 OR VAL(A$)>19 THEN 980
1000 ON (VAL(A$)-10) GOSUB 1720,1740,1760,1780,1800,1820,1840,1860,1880:GOTO 910
1010 GOTO 80
1019 REM LIST and MODIFY ENTRIES
1020 CLS
1030 LOCATE 1,1:COLOR 0,7 : PRINT "  1 ENVANTER NO.";TAB(30) : COLOR 7,0 :PRINT TAB(32);U1$(X)
1040 LOCATE 3,1:COLOR 0,7 : PRINT "  2 CIHAZIN ADI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U2$(X)
1050 LOCATE 5,1:COLOR 0,7 : PRINT "  3 CIHAZIN SAHIBI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U3$(X)
1060 LOCATE 7,1:COLOR 0,7 : PRINT "  4 KULLANILDIGI YER";TAB(30) : COLOR 7,0 : PRINT TAB(32);U4$(X)
1070 LOCATE 9,1:COLOR 0,7 : PRINT "  5 BMAE NO.";TAB(30) : COLOR 7,0 :PRINT TAB(32);U5$(X)
1080 LOCATE 11,1:COLOR 0,7 : PRINT "  6 DEMIRBAS NO.";TAB(30) : COLOR 7,0 :PRINT TAB(32);U6$(X)
1090 LOCATE 13,1:COLOR 0,7 : PRINT "  7 DEMIRBAS DEGERI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U7$(X)
1100 LOCATE 15,1:COLOR 0,7 : PRINT "  8 MODELI VE TIPI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U8$(X)
1110 LOCATE 17,1:COLOR 0,7 : PRINT "  9 SERI NUMARASI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U9$(X)
1120 LOCATE 19,1:COLOR 0,7 : PRINT " 10 IMALATCI ADI VE ADRESI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U
10$(X)
1130 IF SEC$<>"2" THEN 1240
1140 LOCATE 21,1
1150 PRINT TAB(30);"DEGISTIRMEK ISTIYOR MUSUNUZ ? (E/H)";
1160 LOCATE 21,70:ML=1 : GOSUB 2080 : AN$=IN$
1170 IF AN$<>"E" AND AN$<>"H" THEN 1140
1180 IF AN$="H" THEN 1260
1190 LOCATE 23,30:PRINT "DEGISTIRMEK ISTEDIGINIZ NO.YU YAZINIZ ";
1200 LOCATE 23,70:ML=2 : GOSUB 2080 : A$=IN$
1210 IF VAL(A$)<1 OR VAL(A$)>10 THEN 1200
1220 ON VAL(A$) GOSUB 1520,1540,1560,1580,1600,1620,1640,1660,1680,1700
1230 GOTO 1140
1240 LOCATE 22,30:PRINT "DEVAM ICIN C TUSUNA BASINIZ"
1250 A$=INKEY$:IF A$="" OR A$<>"C" THEN 1250
1260 CLS:PR=0
1270 LOCATE 1,1:COLOR 0,7 : PRINT " 11 SATICISI VE ADRESI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U11$(X
)
1280 LOCATE 3,1:COLOR 0,7 : PRINT " 12 TESLIM ALINIS TARIHI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U12$
(X)
1290 LOCATE 5,1:COLOR 0,7 : PRINT " 13 GARANTI SURESI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U13$(X)
1300 LOCATE 7,1:COLOR 0,7 : PRINT " 14 KATI KABUL TARIHI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U14$(X)

1310 LOCATE 9,1:COLOR 0,7 : PRINT " 15 ILK KULLANIS TARIHI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U15$(
X)
1320 LOCATE 11,1:COLOR 0,7 : PRINT " 16 BAKIM KITABI YERI ADEDI";TAB(30) : COLOR 7,0 :PRINT TAB(32);
U16$(X)
1330 LOCATE 13,1:COLOR 0,7 : PRINT " 17 KUL. REHBERI YERI ADEDI";TAB(30) : COLOR 7,0 :PRINT TAB(32);
U17$(X)
1340 LOCATE 15,1:COLOR 0,7 : PRINT " 18 CIHAZIN DURUMU";TAB(30) : COLOR 7,0 :PRINT TAB(32);U18$(X)
1350 LOCATE 17,1:COLOR 0,7 : PRINT " 19 ODEME BICIMI";TAB(30) : COLOR 7,0 :PRINT TAB(32);U19$(X)
1360 IF SEC$<>"2" THEN 1480
1370 LOCATE 21,30
1380 PRINT "DEGISTIRMEK ISTIYOR MUSUNUZ ? (E/H)"
1390 LOCATE 21,70:ML=1 : GOSUB 2080 : AN$=IN$
1400 IF AN$<>"E" AND AN$<>"H" THEN 1370
```

```
1410 IF AN$="H" THEN 1510
1420 LOCATE 23,30
1430 PRINT "DEGISTIRMEK ISTEDIGINIZ NO.YU YAZINIZ "
1440 LOCATE 23,70:ML=2:GOSUB 2080:A$=IN$
1450 IF VAL(A$)<11 OR VAL(A$)>19 THEN 1440
1460 ON (VAL(A$)-10) GOSUB 1720,1740,1760,1780,1800,1820,1840,1860,1880
1470 GOTO 1370
1480 LOCATE 22,1:PRINT TAB(30);"DEVAM ICIN C TUSUNA BASINIZ"
1490 A$=INKEY$:IF A$="" THEN 1490
1500 IF A$<>"C" THEN 1490
1510 RETURN
1519 REM MODIFY ENTRIES
1520 LOCATE 1,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1530 LOCATE 1,32 : ML=48 : GOSUB 2080 : U1$(X)=IN$:RETURN
1540 LOCATE 3,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1550 LOCATE 3,32 : ML=48 : GOSUB 2080 : U2$(X)=IN$:RETURN
1560 LOCATE 5,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1570 LOCATE 5,32 : ML=48 : GOSUB 2080 : U3$(X)=IN$:RETURN
1580 LOCATE 7,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1590 LOCATE 7,32 : ML=48 : GOSUB 2080 : U4$(X)=IN$:RETURN
1600 LOCATE 9,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1610 LOCATE 9,32 : ML=48 : GOSUB 2080 : U5$(X)=IN$:RETURN
1620 LOCATE 11,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1630 LOCATE 11,32 :ML=48 : GOSUB 2080 : U6$(X)=IN$:RETURN
1640 LOCATE 13,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1650 LOCATE 13,32 : ML=48 : GOSUB 2080 : U7$(X)=IN$:RETURN
1660 LOCATE 15,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1670 LOCATE 15,32 : ML=48 : GOSUB 2080 : U8$(X)=IN$:RETURN
1680 LOCATE 17,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1690 LOCATE 17,32 : ML=48 : GOSUB 2080 : U9$(X)=IN$:RETURN
1700 LOCATE 19,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1710 LOCATE 19,32 : ML=48 : GOSUB 2080 : U10$(X)=IN$:RETURN
1720 LOCATE 1,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1730 LOCATE 1,32: ML=48 : GOSUB 2080 : U11$(X)=IN$:RETURN
1740 LOCATE 3,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1750 LOCATE 3,32: ML=48 : GOSUB 2080 : U12$(X)=IN$:RETURN
1760 LOCATE 5,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1770 LOCATE 5,32: ML=48 : GOSUB 2080 : U13$(X)=IN$:RETURN
1780 LOCATE 7,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1790 LOCATE 7,32: ML=48 : GOSUB 2080 : U14$(X)=IN$:RETURN
1800 LOCATE 9,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1810 LOCATE 9,32: ML=48 : GOSUB 2080 : U15$(X)=IN$:RETURN
1820 LOCATE 11,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1830 LOCATE 11,32: ML=48 : GOSUB 2080 : U16$(X)=IN$:RETURN
1840 LOCATE 13,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1850 LOCATE 13,32: ML=48 : GOSUB 2080 : U17$(X)=IN$:RETURN
1860 LOCATE 15,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1870 LOCATE 15,32: ML=48 : GOSUB 2080 : U18$(X)=IN$:RETURN
1880 LOCATE 17,32:FOR I=1 TO 48:PRINT CHR$(32);:NEXT I
1890 LOCATE 17,32: ML=48 : GOSUB 2080 : U19$(X)=IN$:RETURN
1899 REM PUT DATA
1900 CLS:LOCATE 15,4:FILES "A:":LOCATE 10,4:PRINT "YAZMAK ISTEDIGINIZ FILE ADI:"
1910 LOCATE 10,40:ML=8:GOSUB 2080
1920 F$="A:"+IN$+".DAT"
1930 OPEN F$ FOR OUTPUT AS #1
1940 FOR X=1 TO 100
```

```
1950 WRITE #1,U1$(X),U2$(X),U3$(X),U4$(X),U5$(X),U6$(X),U7$(X),U8$(X),U9$(X),U10$(X),U11$(X),U12$(X)
,U13$(X),U14$(X),U15$(X),U16$(X),U17$(X),U18$(X),U19$(X)
1960 NEXT X
1970 CLOSE #1
1980 RETURN
1989 REM RETRIEVE DATA
1990 CLS:LOCATE 15,4:FILES "A:":LOCATE 10,4:PRINT "OKUMAK ISTEDIGINIZ FILE ADI:"
2000 LOCATE 10,40:ML=8:GOSUB 2080
2010 F$="A:"+IN$+".DAT"
2020 OPEN F$ FOR INPUT AS #1
2030 FOR X=1  TO 100
2040 INPUT #1,U1$(X),U2$(X),U3$(X),U4$(X),U5$(X),U6$(X),U7$(X),U8$(X),U9$(X),U10$(X),U11$(X),U12$(X)
,U13$(X),U14$(X),U15$(X),U16$(X),U17$(X),U18$(X),U19$(X)
2050 NEXT X
2060 CLOSE #1
2070 RETURN
2079 REM READ CHARACTER FROM THE KEYBOARD
2080 IN$="":Z$="":ZL=0:FOR I=1 TO ML:PRINT CHR$(196);:NEXT:FOR I=1 TO ML:PRINT CHR$(29);:NEXT
2090 Z$=INKEY$ : IF Z$="" THEN 2090
2100 ZL=LEN(IN$)
2110 Z=ASC(Z$)
2120 IF Z=27 THEN 80
2130 IF (Z<32 OR Z>122) AND Z<>13 AND Z<>8 THEN 2090
2140 IF Z=13 THEN IN$=MID$(IN$,1,ZL) :FOR I=ZL TO ML:PRINT CHR$(32);:NEXT:RETURN
2150 IF Z=8 AND ZL>0 THEN IN$=LEFT$(IN$,ZL-1) :PRINT CHR$(29);CHR$(196);CHR$(29);: GOTO 2090
2160 IF Z=8 AND ZL=0 THEN 2090
2170 IF ZL>ML-1  THEN 2090
2180 IN$=IN$+Z$
2190 PRINT Z$;
2200 GOTO 2090
2210 PRINT CHR$(177);: PRINT TAB(80);CHR$(177);:RETURN
2219 REM SEARCH ENTRY
2220 CLS
2230 COLOR 0,7 : PRINT "  1 ENVANTER NUMARASI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2240 COLOR 0,7 : PRINT "  2 CIHAZIN ADI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2250 COLOR 0,7 : PRINT "  3 BMAE NUMARASI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2260 COLOR 0,7 : PRINT "  4 IMALATCISI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2270 LOCATE 10,30:PRINT "BILGI SATIR NO:"
2280 LOCATE 10,50:ML=1:GOSUB 2080:A$=IN$
2290 ON VAL(A$) GOTO 2300,2310,2320,2330
2300 LOCATE 1,32 : ML=48 : GOSUB 2080 : ARA$=IN$:GOTO 2340
2310 LOCATE 3,32:ML=48:GOSUB 2080:ARA$=IN$:GOTO 2340
2320 LOCATE 5,32:ML=48:GOSUB 2080:ARA$=IN$:GOTO 2340
2330 LOCATE 7,32:ML=48:GOSUB 2080:ARA$=IN$:GOTO 2340
2340 LOCATE 10,30:PRINT "DEGISTIRMEK ISTIYORMUSUNUZ ? (E/H)"
2350 LOCATE 10,70:ML=1:GOSUB 2080:AN$=IN$
2360 IF AN$<>"H" AND AN$<>"E" THEN 2340
2370 IF AN$="E" THEN 2290
2380 ON VAL(A$) GOTO 2390,2420,2450,2480
2390 FOR X=1 TO 100
2400 IF ARA$=U1$(X) THEN CNO=X:X=0:GOTO 2510
2410 NEXT X
2420 FOR X=1 TO 100
2430 IF LEFT$(ARA$,5)=LEFT$(U2$(X),3) THEN CNO=X:X=0:GOTO 2510
2440 NEXT X
2450 FOR X=1 TO 100
2460 IF ARA$=U5$(X) THEN CNO=X:X=0:GOTO 2510
2470 NEXT X
```

```
2480 FOR X=1 TO 100
2490 IF LEFT$(ARA$,3)=LEFT$(U10$(X),3) THEN CNO=X:X=0:GOTO 2510
2500 NEXT X
2510 LOCATE 16,1:PRINT "ARADIGINIZ CIHAZIN KOD NOSU:"
2520 LOCATE 16,30:IF CNO<>0 THEN PRINT CNO ELSE COLOR 0,7:PRINT "BULUNAMADI":COLOR 7,0
2530 LOCATE 22,30:PRINT "DEVAM ICIN C TUSUNA BASINIZ"
2540 A$=INKEY$:IF A$="" OR A$<>"C" THEN 2530
2550 RETURN
2559 REM PRINT OUT
2560 WIDTH "LPT1:",132:LPRINT CHR$(14),"STOK POSTASI "
2570 LPRINT"TARIH: ";DA$;CHR$(10)
2580 LPRINT"    ENVANTER NUMARASI      : ";U1$(X)
2590 LPRINT"    CIHAZIN ADI            : ";U2$(X)
2600 LPRINT"    CIHAZIN SAHIBI         : ";U3$(X)
2610 LPRINT"    KULLANILDIGI YER       : ";U4$(X)
2620 LPRINT"    BMAE NUMARASI          : ";U5$(X)
2630 LPRINT"    DEMIRBAS NUMARASI      : ";U6$(X)
2640 LPRINT"    DEMIRBAS DEGERI        : ";U7$(X)
2650 LPRINT"    MODELI VE TIPI         : ";U8$(X)
2660 LPRINT"    SERI NUMARASI          : ";U9$(X)
2670 LPRINT"    IMALATCISI VE ADRESI   : ";U10$(X)
2680 LPRINT"    SATICISI VE ADRESI     : ";U11$(X)
2690 LPRINT"    TESLIM ALINIS TARIHI   : ";U12$(X)
2700 LPRINT"    GARANTI SURESI         : ";U13$(X)
2710 LPRINT"    KATI KABUL TARIHI      : ";U14$(X)
2720 LPRINT"    ILK KULLANIS TARIHI    : ";U15$(X)
2730 LPRINT"    BAKIM KITABI YERI ADEDI: ";U16$(X)
2740 LPRINT"    KUL. REHBERI YERI ADEDI: ";U17$(X)
2750 LPRINT"    CIHAZIN DURUMU         : ";U18$(X)
2760 LPRINT"    ODEME BICIMI           : ";U19$(X)
2770 RETURN
2779 REM REPORT
2780 CLS:Q=0
2790 COLOR 0,7 : PRINT "  1 ENVANTER NUMARASI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2800 COLOR 0,7 : PRINT "  2 CIHAZIN ADI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2810 COLOR 0,7 : PRINT "  3 KULLANILDIGI YER";TAB(30) : COLOR 7,0 : PRINT : PRINT
2820 COLOR 0,7 : PRINT "  4 IMALATCISI";TAB(30) : COLOR 7,0 : PRINT : PRINT
2830 LOCATE 10,30:PRINT "BILGI SATIR NO:"
2840 LOCATE 10,50:ML=1:GOSUB 2080:A$=IN$
2850 ON VAL(A$) GOTO 2860,2870,2880,2890
2860 LOCATE 1,32 : ML=48 : GOSUB 2080 : ARA$=IN$:GOTO 2340
2870 LOCATE 3,32:ML=48:GOSUB 2080:ARA$=IN$:GOTO 2900
2880 LOCATE 5,32:ML=48:GOSUB 2080:ARA$=IN$:GOTO 2900
2890 LOCATE 7,32:ML=48:GOSUB 2080:ARA$=IN$:GOTO 2900
2900 LOCATE 10,30:PRINT "DEGISTIRMEK ISTIYORMUSUNUZ ? (E/H)"
2910 LOCATE 10,70:ML=1:GOSUB 2080:AN$=IN$
2920 IF AN$<>"H" AND AN$<>"E" THEN 2340
2930 IF AN$="E" THEN 2850
2940 ON VAL(A$) GOTO 2950,2980,3010,3040
2950 FOR X=1 TO 100
2960 IF ARA$=U1$(X) THEN RE(Q)=X:Q=Q+1
2970 NEXT X: GOTO 3070
2980 FOR X=1 TO 100
2990 IF LEFT$(ARA$,5)=LEFT$(U2$(X),3) THEN RE(Q)=X:Q=Q+1
3000 NEXT X: GOTO 3070
```

```
3010 FOR X=1 TO 100
3020 IF ARA$=U4$(X) THEN RE(Q)=X:Q=Q+1
3030 NEXT X: GOTO 3070
3040 FOR X=1 TO 100
3050 IF LEFT$(ARA$,3)=LEFT$(U10$(X),3) THEN RE(Q)=X:Q=Q+1
3060 NEXT X
3070 FOR L=0 TO Q-1:X=RE(Q):GOSUB 2560: NEXT
3080 GOTO 80
```



BIRINI SECINIZ

CIHAZIN KOD NOSU ---

1	ENVANTER NO.	12-113
2	CIHAZIN ADI	KUVOZ BEBEK
3	CIHAZIN SAHIBI	PREMATURE
4	KULLANILDIGI YER	PREMATURE
5	BMAE NO.	34PD011001
6	DEMIRBAS NO.	16385-90
7	DEMIRBAS DEGERI	27.000 T.L.
8	MODELI VE TIPI	2M-1300
9	SERI NUMARASI	1593-A
10	IMALATCISI VE ADRESI	DRAGER WERKE- WEST GERMANY

DEGISTIRMEK ISTIYORMUSUNUZ ? (E/H) E

11	SATICISI VE ADRESI	BILGE TICARET-ISTANBUL
12	TESLIM ALINIS TARIHI	02.1961
13	GARANTI SURESI	2 YIL
14	KATI KABUL TARIHI	02.1961
15	ILK KULLANIS TARIHI	02.1961
16	BAKIM KITABI YERI ADEDI	PREMATURE -1 AD.
17	KUL. REHBERI YERI ADEDI	PREMATURE -1 AD.
18	CIHAZIN DURUMU	1 YILDAN BERI CALISMIYOR
19	ODEME BICIMI	PARASINI DEVLET ODEDI

DEGISTIRMEK ISTIYORMUSUNUZ ? (E/H) E

DEGISTIRMEK ISTEDIGINIZ NO.YU YAZINIZ 18

A1: '12-113 MENU

Worksheet Range Copy Move File Print Graph Data Quit

Global, Insert, Delete, Column-Width, Erase, Titles, Window, Status

	A	B	C
1	12-113	KUVOZ BEBEK	PREMATURE
2	12-113	KUVOZ BEBEK	PREMATURE
3	12-113	KUVOZ BEBEK	PREMATURE
4	12-113	KUVOZ BEBEK	PREMATURE
5	13-360	RESUSITATOR BEBEK	PREMATURE
6	12-114	KUVOZ BEBEK TASIMA	PREMATURE
7	13-739	ETUV KURU	2. COCUK
8	10-208	ASPIRATOR	3. COCUK
9	10-208	ASPIRATOR	3. COCUK
10	12-712	NEBULIZER	1. COCUK
11	10-208	ASPIRATOR	1. COCUK
12	10-778	SANTRIFUJ	1. COCUK
13	11-407	EKG	1. COCUK
14	10-208	ASPIRATOR CERRAHI	1. COCUK
15	-	INSUFLASYON CIHAZI	2. DOGUM
16	11-490	ELEKTROKOTER	2. DOGUM
17	15-657	TARAYICI DOPPLER	2. DOGUM
18	15-657	TARAYICI DOPPLER	2. DOGUM
19	10-208	ASPIRATOR	2. DOGUM
20	10-208	ASPIRATOR	2. DOGUM

APPENDIX F

(BME ENSTİTÜSÜ'NCE UYGULANAN)

BİYO-MEDİKAL CİHAZLARIN ENVANTERİ YÖNTEMİ

A. İstanbul İçindeki Hastahaneler İçin Yapılacak Olan İşler :

1. Enstitü Müdürü Hastahane Müdürü ile görüşerek ekip lideri ve yardımcılarıyla hastahaneye ziyarete gider.
2. Başhekime envanter nedenini ve metodunu açıklar. Envanterin başlama müsadesini talep eden ve çalışacakları bildiren mektubu Başhekime verir.
3. Başhekim envanterin sağlıklı yapılabilmesi için hastahane personelinin servis şeflerine ve Ayniyat Saymanlığına gerekli yazılı talimatı verir. Ayrıca ekibin muhatab olacağı bir yetkiliyi belirtir. (Danışman Koordinatör)
4. Ekip hastaheneyi koordinatörün nezaretinde ziyaret eder ve ilgililerle tanışır, kısmende Biyo-Medikal cihazlar hakkında ön bilgi elde etmiş olur.
5. Ekip lideri hastahanenin en son envanter kayıtlarının bir kopyasını Başhekim'den veya Ayniyat'tan temin eder.
6. Ayniyat'tan alınan envanter ertesi gün ekip tarafından incelenerek ekip için envanter çalışma programı hazırlanır. (Bu programı hazırlayabilmek için koordinatörden hastahane servislerinin çalışma zamanları ve saatlerin tespit edilerek, doktorların çalışmalarını aksatmayacak zamanlarda yapılması gerekir.
7. Bu programın ilgili servislere telefonla veya yerlerinde konuşarak mutabakatları alınır.
8. Programa göre formlar, etiketler, ayna, pens, fener v.s. malzeme Enstitü'de hazırlanarak tespit edilen gün ve saatte ekip elemanları hastahaneye gider.
9. Hastahaneye varıldığında koordinatöre gelindiği bildirilir, kimlik göstergesi elde edilir. (Ön yaka kartı, üniforma ...) Önceden kararlaştırılan şekilde elemanlar bölümlere dağılırlar.
10. Envanter bitirilmezse tamamlanabilmesi için gerekli sonraki ziyaret günü alternatifi ile tespit edilir.
11. Envanter bitirildiğinde, bütün ekip birlikte derledikleri envanter ile Ayniyat Saymanlığı'ndan aldıkları listeyi ve servisten çıkarılanların listesini kontrol ederler. Farkları ve nedenlerini tespit için Ayniyat Saymanlığı'na giderler. Gerekirse tekrar ilgili servis yetkilileriyle konuşarak envanter liste ve kartlarının o yıla ait son şeklini tespit ederler.
12. Ekip, enstitüye dönerek sonucu Biyo-Medikal Mühendisliği Enstitüsü müdürüne teslim eder. Enstitü müdürü durumu inceledikten sonra, değerlendirilmiş ve örneğine göre tasnif edilmiş 4 takım envanter dosyası ve 4 takım envanter kartı hazırlatır. Hazırlanan envanter dosyası ve envanter kartlarından 2 takımını enstitü müdürü yazı ile hastahane başhekimine ve bir takımınıda Sağlık ve Sosyal Yardım Bakanlığı'na yollar.

B. İstanbul Dışındaki Hastahaneler İçin Yapılacak Olan İşler

1. Hastahane Başhekimi'ne ekli örnek mektup Enstitü Müdürü tarafından gönderilerek envanter için gelinebilecek tarihler alternatifli olarak bildirilerek, mutabakat istenir. Aynı mektup Valiliğe ve İl Sağlık Müdürlüğü'ne gönderilir.
2. Yazıyla veya telefonla elde edilen mutabakat üzerine ekip liderinin başkanlığında o vilayete gidilir. (Mümkünse hastahanenin tahsis edeceği yerde kalınır ve çalışmaya orada başlanır).
3. Başhekim envanterin sağlıklı yapılabilmesi için hastahane personeline servis şeflerine ve Ayniyat Saymanlığı'na gerekli yazılı talimatı verir. Ayrıca ekibin muhatab olacağı bir yetkiliyi belirtir. (Danışman, koordinatör)
4. Ekip hastahaneye koordinatör nezaretinde ziyaret eder ve ilgililerle tanışır, kısmende Biyo-Medikal cihazlar hakkında ön bilgi elde etmiş olur.
5. Ekip lideri hastahanenin en son envanter kayıtlarının bir kopyasını Başhekim'den veya Ayniyat'tan temin eder.
6. Ayniyat'tan alınan envanter ertesi gün ekip tarafından incelenerek ekip için envanter çalışma programı hazırlanır. (Bu programın, koordinatörden hastahane servislerinin çalışma zamanları ve saatleri tespit edilerek, doktorların çalışmalarını aksatmayacak zamanlarda yapılması gerekir).
7. İlgili servislerle telefonla veya yerlerinde konuşarak, program için mutabakatları alınır.
8. Programa göre formlar, etiketler, ayna, pens, fener v.s. malzeme hazırlanır ve tespit edilen gün ve saatte ekip elemanları hastahaneye gider.
9. Hastahaneye varıldığında koordinatöre gelindiği bildirilir, kimlik göstergesi elde edilir. (ön yaka kartı, üniforma ...) Önceden kararlaştırılan şekilde elemanlar ellerinde liste ve boş envanter kartlarıyla bölümlere dağılırlar.
10. Envanter bitirilmezse, tamamlanabilmesi için gerekli sonraki ziyaret günü alternatifi ile tespit edilir.
11. Envanter bitirildiğinde, bütün ekip birlikte derledikleri envanter ile Ayniyat Saymanlığı'ndan aldıkları listeyi ve servisten çıkarılanların listesini kontrol ederler. Farkları ve nedenlerini tespit için Ayniyat Saymanlığı'na giderler. Gerekirse, tekrar ilgili servis yetkilileriyle konuşarak envanter liste ve kartlarının o yıla ait son şeklini tespit ederler.
12. Ekip, enstitüye dönerek sonucu Biyo-Medikal Mühendisliği Enstitüsü müdürüne teslim eder. Enstitü müdürü durumu inceledikten sonra, değerlendirilmiş ve örneğine göre tasnif edilmiş 4 takım envanter dosyası ve 4 takım envanter kartı hazırlatır. Hazırlanan envanter dosyası ve envanter kartlarından 2 takımını Enstitü müdürü yazı ile hastahane başhekimine ve bir takımını da Sağlık ve Sosyal Yardım Bakanlığı'na yollar.

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