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FUNCTIONAL CONCEPTS FOR A SHIPBOARD MEDICAL INFORMATION 1/1
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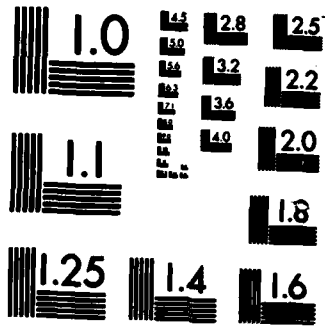
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FUNCTIONAL CONCEPTS FOR A SHIPBOARD MEDICAL INFORMATION SYSTEM

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SUMMARY

Shipboard medical departments are often distant from hospitals and must provide a broad spectrum of medical services, including routine sick call, acute trauma care, preventive and health maintenance programs, environmental surveillance, and medical and dental adjunctive services. Physicians and nurses generally are not available, and Independent Duty Corpsmen assume responsibility for primary health care.

DOD and OPNAV directives on occupational health and safety impact heavily on the Independent Duty Corpsman aboard ship; for example, OPNAVINST 5100.23B details a wide array of responsibilities pertaining to environmental and occupational health services and support documentation. Provisions have not been made for information management support to carry out these increased responsibilities. Also, the present requirements for administrative, supply and fiscal management, medical equipment readiness and maintenance, training, patient care, and medical record management represent an almost impossible burden under existing labor intensive manual methods. This primary deficiency in information processing capability renders comprehensive health maintenance and patient care objectives unattainable.

The design and development of an automated medical information system for fleet units will help promote the efficient management of personnel, medical and environmental data necessary to support acute and routine patient care, supply inventory/replenishment, administrative functions, occupational health and safety requirements, and epidemiologic analyses in operational environments.

INTRODUCTION

An essential contributing factor to the successful conduct of operations at sea is the medical readiness of crews manning ships and aircraft. Maintaining the health of these vital personnel resources is axiomatic if ships are to sustain maximum operational readiness. The shipboard environment is a unique habitat and contains work milieus which present a broad range of physical, chemical, and biological stressors to which personnel are continuously exposed. The mission of the Medical Command is to safeguard and promote the health of Navy and Marine Corps personnel and to provide early effective care to the sick, injured, and wounded.

BACKGROUND

The intensive and comprehensive occupational health programs required by DOD (1) and OPNAV (2-4) directives include workplace surveillance and personal medical monitoring components. Workplace surveillance includes those routine measures typically within ship's force capability (e.g. heat, noise, physical hazards, and limited chemical and biological measures). Evaluations beyond the ship's capability are functions of commands tasked with technical support responsibilities. Medical monitoring involves recording and evaluation of the health status of personnel as it relates to their job environment or occupational specialty. The comprehensive medical examination is the core of this monitoring and is designed to provide specific information for assessing hazards and commensurate levels of protection. Such information includes medical histories, physical examinations, clinical and laboratory tests, and occupational histories. The manpower and resources necessary to satisfy these needs, on a routine and continual basis, must be viewed in terms of how they impact on overall Medical Department functions that include routine and emergency medical care, administrative, supply, and fiscal management, medical equipment readiness, patient and record management, and training.

Current Data Handling Techniques

Current handling of medical records and associated information retrieval within fleet Medical Departments is manual and labor intensive. Sickbays performing routine medical care and specialized occupational health services rely on manual tickler files. These services are not based on accurate assessment of current exposures. Examination results are recorded only in the hard copy medical record. This makes results virtually irretrievable for other uses. All laboratory and other needed forms are produced and documented by hand.

To store, process and retrieve data and to monitor shipboard environments, the health of personnel who live and work in the environments, and contribute to the overall readiness of the ship's Medical Department requires automated data processing. The lack of an ADP capability is a deficiency that renders an effective and comprehensive medical surveillance program unachievable.

OBJECTIVES

Two areas where a comprehensive Shipboard Medical Information System will have greatest impact are occupational surveillance and Medical Department resource management. Specifically, acquisition of appropriate hardware and software to handle occupational health data will assist corpamen to: (a) conduct a comprehensive and reliable occupational and environmental sur-

veillance program, (b) provide continuous medical monitoring, (c) review information and data predictive of potential hazards, and (d) analyze health trends by specific exposure, environmental and demographic parameters.

This hardware and software will enhance shipboard Medical Department resource management by allowing: (a) efficient patient record management, (b) continuous monitoring of medical/dental supply and equipment inventories, usage rates, and quality control, (c) more prudent use of operating (OPTAR) funds, (d) the establishment of administrative data bases that will generate required reports, identify work patterns, and potential problem areas, and (e) interfacing with other shipboard data bases, such as the Shipboard Nontactical Automatic Data Process (SNAP), while maintaining appropriate security for medical information.

SHIPBOARD REQUIREMENTS

Preliminary Functional Concepts

The Shipboard Medical Information System would conceptually consist of four primary functional areas (5): (a) Clinical Support, (b) Workload/Morbidity Reporting, Evaluation, and Projection, (c) Medical Adjunctive Services, and (d) Preventive Medicine and Occupational Health, as shown in Figure 1. Although these functional areas are essentially independent, common among them is the medical record. Medical records are not standardized and do not always arrive aboard ship in a timely manner. Because they are frequently carried by transferring personnel, these records are not accorded appropriate security and are therefore susceptible to falsification.

Clinical Support

Clinical Support entails all health care programs and services provided directly to embarked personnel. As shown in Figure 2, a wide range of subordinate activities are incorporated into this functional area. In all of these activities there is a face-to-face encounter between an individual crew member and the Medical Department Representative (MDR). An encounter which may be abbreviated or long-term generally consists of a four-step process, beginning with the determination of health care requirements and ending with the actual performance/documentation of the service.

In determining clinical support requirements, the MDR incorporates information from a variety of sources. Among the primary sources are individual complaints and medical records. In addition, the MDR may use information gathered from personal observation, on surveys for example, and will consider previously scheduled health actions and pertinent health care directives.

The next step is the process of obtaining medical guidance and determining required resources. The MDR combines personal training, experience, and knowledge of health care requirements with information obtained from professional and technical references. If required information is not obtainable aboard ship, the MDR must contact shorebased facilities for support.

After obtaining appropriate guidance and determining what resources are required, it is necessary to determine resource availability and/or obtain those resources. When the resources are on board, this step can be quickly and easily accomplished. However, when resources are off the ship, the MDR is required to locate these resources, either through personal contacts or through the local chain-of-command.

Finally, clinical support must be provided and documented. If a treatment plan is required, the MDR will design and/or record it as appropriate. After performing medical actions, whether planned or unscheduled, reports and documentation completed and records updated. Current provisions for on-board clinical support are limited. In most instances, medical personnel have only the most essential medical facilities and diagnostic capabilities at their disposal. The limited diagnostic capability and lack of accurate information increases the likelihood that the MDR will be unable to accurately determine the severity or threat involved in a particular medical situation. These deficiencies can lead to unnecessary rerouting of the ship (and degrading of the mission) in apparent, but not real, medical emergencies. Computerized diagnostic aids would enable effective MDR patient management especially when sophisticated diagnostic services are not available.

Workload/Morbidity Reporting, Evaluation, and Projection

The second major functional area of a Shipboard Medical Information System is that of Workload/Morbidity Reporting, Evaluation, and Projection. The main subordinate activities within this functional area are shown in Figure 3. Several of these activities, including medical record census, binnacle and sick lists, Disease Alert Reports, and the Medical Services and Outpatient Morbidity Report, result directly from Clinical Support functions. The Medical Services and Outpatient Morbidity Report, for example, provides the Navy Medical Command with selected information on the health of U.S. Navy and Marine Corps personnel. These data are used to evaluate the effectiveness of Medical Department administration; as a data base for resource budgeting and management, i.e., determining the size of replacements or additions to existing facilities; and in evaluating selected morbidity levels.

Disease Alert Reports are particularly applicable for reporting outbreaks of infectious disease which may affect readiness, be spread through transfer of personnel and require diagnostic, epidemiological, and/or other, not readily available, medical assistance. The validity and usefulness of medical statistical data depends upon accuracy, completeness, and timeliness of source data. The application of automated processes would directly support these requirements. Other reporting requirements that the MDR may be required to submit, including those relating to accidents and injuries, would be supported by computer technology.

Automated methods could also be applied to the standardization of Medical-Dental Journals where a complete, concise and chronological record of events, of medical/legal importance or historical value, is required.

The MDR must continuously be aware of the status and maintenance requirements of Medical Department equipment. Currently, the semi-automated Current Ships Maintenance Project (CSMP) provides information on external work requests at the ship, department, division and work center level. An automated system incorporating these external requests with requests for medical equipment repair services and internal work requests would contribute to a viable maintenance and repair capability ensuring medical equipment readiness.

Adjunctive Medical Services

A third major functional area within the Shipboard Medical Information System is Adjunctive Medical Services. The main subordinate activities within this functional area are shown in Figure 4. These activities are fundamentally administrative in nature and relate directly to one of the areas where a comprehensive medical information system would have its greatest impact, i.e., Medical Department resource management.

Having authorized supplies and equipment onboard is of vital importance for fleet Medical Departments. The MDR must be cognizant of the amount of funds committed and the funds remaining available to support overall medical readiness. Similarly, the MDR must ensure that the quality and shelf-life of onboard supplies and emergency medical support equipment is acceptable, especially in relation to long-term and high tempo operations. Application of automated data processing support would help reduce the administrative workload for MDRs, and help promote an atmosphere conducive to direct medical and clinical support.

Preventive Medicine and Occupational Health

The final functional area of the Shipboard Medical Information System incorporates Preventive Medicine and Occupational Health activities. The provision of preventive medicine, including environmental and occupational health services, entails monitoring of all shipboard conditions and activities that may endanger the crew's health, correction of medical problems before/as they occur, and the incorporation of information from other functional areas to predict/prevent medical problems. The main subordinate activities within this functional area are shown in Figure 5.

The Navy Occupational Health Information Management System (NOHIMS)(6-10), developed for shorebased industrial activities, was designed to provide an information system that will coordinate the components of the Navy's occupational health program. NOHIMS, which could be equally adapted to the unique work settings encountered aboard ship, would form the central core of this functional area.

Several components of preventive medicine and occupational health that are common among operational units (and not currently incorporated into NOHIMS) would form the basis for a new Preventive Medicine subsystem in NOHIMS. The activities that would comprise this subsystem include (a) food service, (b) potable water, (c) vector and insect control, (d) waste water treatment and disposal (marine sanitation devices, Collection, Holding, and Transfer Systems, etc.), (e) reportable disease programs (TB, venereal disease, malaria), and (f) radiation safety.

This additional component operating in conjunction with the Environmental and Medical components of NOHIMS would help identify individuals exposed to work place hazards; schedule potentially exposed crewmembers for appropriate medical examinations; store and retrieve medical, environmental, and preventive medicine data; and, prepare required reports for use at the local and higher command levels.

In current shipboard preventive medicine programs there is no method for rapidly collecting and processing data to be used in predicting and correcting occupational and environmental problems. Similarly, no rapid method of compiling and reporting morbidity and mortality data or of comparing and analyzing shipboard environmental and occupational health data exist.

Ships to Which System is to be Applied

A prime consideration in system concept, software development, and hardware acquisition is the number and types of ships to which this system will be applied. Mission requirements and operating schedules, which may vary from ship to ship, will play a key role in designing a medical information system to provide the required flexibility and reliability in often adverse operating environments.

Table 1 presents a perspective of the U.S. Navy surface fleet (by class and general function) to which the Shipboard Medical Information System would be applied. These figures, which are useful for planning purposes, were obtained from Jane's Fighting Ships (11).

In order to assure a safe and healthful working environment on all vessels special consideration will have to be given to the design and development of the Shipboard Medical Information System for support ships and craft with average complements less than 100.

Examples of Potential System Support Modules

Several examples of Shipboard Medical Information System support modules that could be developed within the aforementioned functional areas are provided in the Appendix^a. For example, the Diagnostic Aid and Sick Call Log and Medical Treatment Record modules would fall within the Clinical Support area while, the Training Activity Planner and Supply/AMAL/OPTAR/3-M Manager modules would be in the Adjunctive Medical Services functional area. The Medical Report Generator module would cross functional areas--strong consideration should be given to providing a text editing capability in this module to encourage clear, concise written communication; especially in light of the wide range of letters, logs and correspondence that an MDR is required to write.

The above modules are examples of potential applications of automated data processing techniques in support of the Shipboard Medical Information System which provide a general scenario that could be applied across ship types.

^aThese modules are based, in part, on preliminary findings from an ongoing NHRC study, "Factors Affecting Performance and Effectiveness of Independent Duty Corpsmen" (Code 48-LT Tom Hilton).

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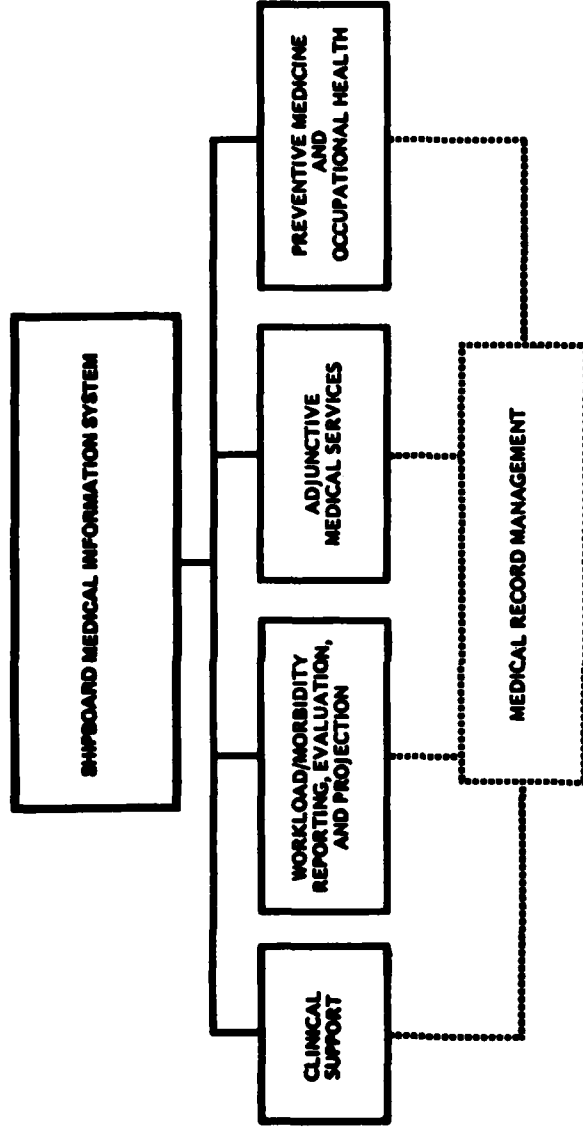


Figure 1. Functional Areas of the Shipboard Medical Information System

- Sick Call and Routine Care
 - o Sick call log
- Acute Care - Inpatient Care
 - o Inpatient admissions/disposition record
 - o Inpatient chart
 - o Inpatient data transmittal record
- Trauma Management and Triage
- Routine Physical Exams
- Specialty Physical Exams
- Routine and Specialized Laboratory Tests
- Pharmacy
 - o Prescription (DD Form 1289)
- Dental Exams
- Immunizations
- Eye tests
- Hearing Tests
 - o Reference audiogram
 - o Hearing conservation data
- Weight Control Program
- X-ray Procedures
- Health and Physical Readiness Program
- Diagnostic Aids

Figure 2 - Clinical Support Subordinate Activities

- Medical Record Census
- Binnacle and Sick Lists
- Disease Alert Reports
- Accident and Injury Recordkeeping and Reporting
 - o Personnel/injury/death/occupational illness report
 - o Material damage mishap report
 - o Motor vehicle mishap report
 - o Safetygram
- Medical Services and Outpatient Morbidity Report
- Medical Equipment Maintenance: PMS, POS
 - o Reporting and processing medical material complaints
 - o Report of assembly of a diagnostic x-ray system
 - o Medical casualty evacuation material excesses/deficiencies report
 - o Dental Information Retrieval System personnel onboard report
 - o Dental service report, equipment and facilities
- Medical-Dental Journals
- Other Reports
 - o Report of controlled medicinals inventory
 - o Issues of controlled drug substances from storage ships
 - o Report of excess personal property

Figure 3 - Workload/Morbidity Reporting, Evaluation, and Projections Subordinate Activities

Medical Fund Accounting
o OPTAR Fund

Authorized Medical/Dental Allowance Lists (AMAL/ADAL): requisition, inventory, quality control, survey
Record Retirement
Emergency Medical Support Equipment and Supplies: unit one, gunbags, first aid boxes, portable medical lockers, antidote locker, battle dressing stations, decontamination stations, oxygen, stretchers, biological and chemical warfare supplies
Casualty drills: man-overboard, nuclear weapons accident/incident, general quarters, fire, MEDEVAC, civilian evacuation
Training: quarterly and long range, first aid qualification, specialty training
Watch Quarter and Station Bill
Personnel Reliability Program (PRP) Screening

Figure 4 - Adjunctive Medical Services Subordinate Activities

Food Service
o Food service sanitation inspection

Other Sanitation/habitability Inspections: quarters, laundry, barber shop
Vector and Insect Control
o Deratization

CHT System
o Environmental pollution control report

Potable Water System
o Bacteriological water test
o Fluoridation program

Heat/humidity Surveys
o Report of heat/cold casualties

Hearing Conservation and Occupational Noise Control
o Report of audiometric equipment calibration

NAVOSH Program
Quarantine Declaration

Asbestos Surveillance
o Medical surveillance questionnaire

Radiation Safety
o Personnel exposure to ionizing radiation
o Radiation incident report
o Ionizing radiation equipment survey
o Microwave over-exposure report
o Personnel exceeding radiation exposure limits
o Suspected laser over-exposure incident
o Relationship of radiation exposure to personnel injury/illness

TB Screening and Follow-up
o Report of TB contact investigation program

Sexually Transmitted Disease Control Program
o Venereal disease contact report

Report of Occupational Health Services

Figure 5 - Preventive Medicine and Occupational Health Subordinate Activities

Table 1

Type of Ship, Complement and Projected
Growth of U.S. Navy Surface Forces

<u>Type</u>	<u>1981^a</u>	<u>1987^b</u>	<u>Average Complement</u>
Aircraft Carriers	15	17	5200 ^c
Battleships	1	3	1600
Cruisers	31	52	525
Destroyers	93	94	335
Frigates	110	117	235
Amphibious	66	68	800 ^d
Auxilliary	93	98	825
Hospital	0	2	1000 ^e
<hr/>			
Total	409	451	
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^aActive, under construction, conversion

^bReagan Administration Planned 5-year Shipbuilding/conversion
Program (FY 82-86) (11)

^cIncludes Airwing

^dIncludes Troops

^eBed capacity

APPENDIX

Examples of Potential Shipboard Medical Information System Support Modules

SICK CALL LOG & MEDICAL TREATMENT RECORD

Upon entry of each patient's SSN into this subsystem, the computer would first warn you of any allergies or other medical condition, then prompt you for input regarding: (a) purpose of visit, (b) nature of complaint, (c) case disposition, (d) medication issued, and (e) clinical remarks. Two copies of each report would be typed out by a printer. A signed version would be entered into the health record, and the second copy would be entered into a binder to serve as sick-bay log. (In conjunction with other systems, this information could also be used to automatically generate morbidity summaries for MEDCOM.)

MEDICAL TICKLER & ACTIVITY PLANNER

Accessible by SSN or NAME, basic record data, similar to what is currently put into a tickler file, would be entered into this subsystem. Tied to a built-in calendar clock, the week's work would be outlined each Monday in a "Summary For Planning," which might include: (a) physicals due that month, (b) consults outstanding, treatment follow-ups, and health and sanitation inspections, (c) Rad Health requirements, (d) PRP requirements, (e) PMS, SMAPs, IWRs, and supply chits outstanding, and (f) reports outstanding. Progress could be updated daily or weekly, and would be reflected in the following week's "Summary For Planning."

SUPPLY/AMAL/OPTAR/3-M MANAGER

This subsystem would contain both the AMAL and Supplementary AMAL for the ship, as well as a dictionary of all medical department supplies by Navy and secondary stock numbers, along with cost, units of issue, and source codes. In addition, it could be programmed to: (a) generate supply request chits (by marking a part-name listed on the screen, and responding to prompts from the computer), and (b) provide feedback on OPTAR funds available & committed. (It could interface with the medical tickler subsystem for 3-M support.)

MEDICAL REPORT GENERATOR

This subsystem would display the requested form and prompt for entry information. Any out-of-range entries would produce an error signal. The completed report would be generated by the computer in required quantity. This system could be inter-faced with all other systems, automatically storing most required information entered during the daily routine (e.g., sick call

entries would be summarized for the MEDCOM morbidity summary). You would only have to provide minimal input to generate each report, thereby avoiding the requirement to tally data by hand.

TRAINING ACTIVITY PLANNER

This subsystem would provide summaries of all training planned each month, with dates, times, and places for each lecture. In addition, this subsystem would provide: (a) convenient storage of lecture outlines and tests, (b) updates and changes, (c) further expansion, and (d) explicit documentation of training accomplishments and course contents to show inspection teams, the planning board for training, etc.

DIAGNOSTIC AID

This subsystem would be programmed to assist you in arriving at diagnoses for problems irregularly encountered, such as chest pain, dermatological disease, tropical disease, psychiatric disorder, etc. The system would prompt you for input such as symptoms observed and reported, vital signs, and time since onset. It would formulate a preliminary diagnosis and ask for additional input in order to confirm or reject the diagnosis. Once confidence was high, a final diagnosis and treatment options would be generated, as well as additional references to consult in your medical library. A summary of your input and the program's recommendations could be generated for inclusion with the medical record as part of the case history, should MEDEVAC be required.

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