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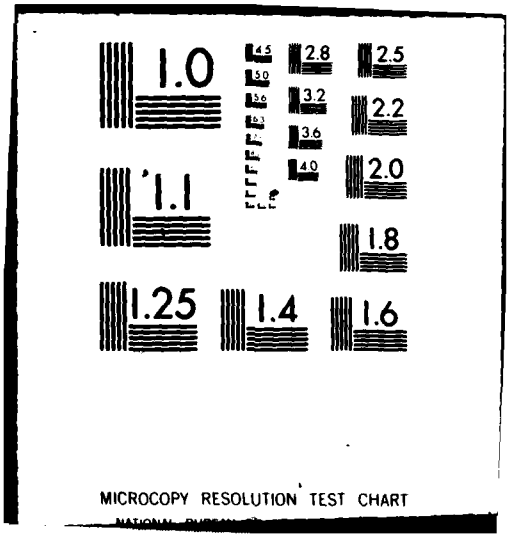
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LEVEL II

IMPLEMENTATION OF A PROTOTYPE REGISTRATION AND ADMINISTRATIVE SYSTEM FOR FIELD USE

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REPORT NO. 81-30

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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND

Implementation of a Prototype Registration and Administrative System for Field Use

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Report Number 81-30, supported by Naval Medical Research and Development Command, Bethesda, Maryland, Department of the Navy, under research Work Unit MF58.524.023-2022. The views presented in this paper are those of the authors. No endorsement by the Department of the Navy has been given nor should be inferred.

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Summary

A prototype medical monitoring system for collecting and storing dispensary data has been designed and is being developed as one component of an overall occupational health information system. In addition to being a component in the larger system, this medical monitoring system can operate as an independent medical surveillance system in U.S. Navy dispensaries. In this system, medical information is initially gathered on a patient encounter form designed to obtain all the data required in routine dispensary reports (e.g., Medical Services and Outpatient Morbidity Report and the Report of Occupational Health Services). The implementation of this system will be based on the Computer Stored Ambulatory Record System (COSTAR) developed at Massachusetts General Hospital. By augmenting COSTAR to accommodate the environmental surveillance requirements of occupational health, the physician will be informed of the patient's workplace exposures, and the tests and medical procedures appropriate for those exposures. Automation of these data will (a) facilitate the performance of routine functions, such as periodic physical examinations, (b) aid in the compilation of management reports and (c) provide a research capability through the compilation of information from multiple collection sites.

Before the medical record system being developed by the Naval Health Research Center (NHRC) to carry out registration and administrative functions can be adequately described, it is necessary to cover some of the background behind the system's development. First, one should be aware that this medical record system is being developed as a component of an overall occupational health information system. Following the enactment of the Occupational Safety and Health Act (Public Law 91-596) all employers, including the U.S. Navy, were required to provide safe and healthful working conditions for their employees. Responding to this directive, a program was initiated at NHRC to develop an occupational health information system that could fulfill the resultant recordkeeping requirements and perform other occupational health functions.

System Objectives and Design

Occupational Health

As Shindell and Goldberg (1) point out, the primary objective of an occupational health surveillance system is the identification of changes in health status that result from the type of work performed. To meet this goal they suggest that such a system requires that a base health status measure be made for each worker, that each worker's exposures be documented, and that analyses be conducted to assess health status changes that occur during an individual's employment. Therefore, it was concluded that the design and development of the proposed system should focus upon the medical certification process. Performance of this function requires that each person be identified, his exact work location be determined, the hazards in that area be surveyed, and that medical examinations corresponding to the employee's environmental exposures be conducted. Thus, information must be obtained from personnel files, dispensary encounters, and the industrial hygienists who survey the environment. Because the above information comes from such disparate sources, it has been concluded that a distributed data base configuration would be the best approach to take in developing the overall system. That is, separate subsystems would be used to capture and store the personnel, medical, and environmental data. When necessary these three files could be accessed to perform the medical certification function or any other process consistent with occupational health management.

The advantage of the distributed configuration, then, is that the autonomy of the dispensary, the personnel department, and the industrial hygienists is maintained, insuring the privacy and security of their separate files. In addition, the separate subsystems can be designed to serve the needs of the individual users.

Medical Records

The medical record system being developed by NHRC is designed to gather and store information for the Navy's occupational health program and to perform administrative functions. To satisfy the occupational health requirements, a record of each individual working with hazardous materials or exposed to a hazardous substance must be maintained. Administrative needs further require a record of every dispensary visit. With complete sick call visit data it is possible to have the system generate the required Medical Services and Outpatient Morbidity Report (NAVMED 6300/1) used by Navy dispensaries to document on a monthly basis their patient load, adjunct services provided, individual clinic/service load, and types of illnesses and injuries treated. Additionally, it would be possible to generate all the medical information needed for the biannual completion of the Report of Occupational Health

Services (NAVMED 6260/1). To meet the requirements of the occupational health program as well as the dispensaries' administrative needs, the basic medical record system must capture data upon each dispensary visit. This procedure would enable the system to generate the required reports automatically. In addition, the information required for occupational health would exist as a subset of the entire data set.

Once these basic system requirements were laid out, the next step was to develop a patient encounter form. This form, shown in Figure 1, consists of a single page. On the initial portion of the encounter form the patient provides some demographic data, information that uniquely identifies him or her, and data that indicates where the individual works. The remaining portions of the form are completed by the health care provider (e.g., physician, nurse, or corpsman) and consist primarily of information needed to complete the Navy reports cited above.

In order to demonstrate the utility of this encounter form, a supply was given to a dispensary serving a Naval Air Rework Facility (NARF). After these forms were in use for one week the completed forms were coded for keypunching. The resulting cards were loaded onto a computer disk, then processed using software specially developed to generate the Morbidity Report and the Report of Occupational Health Services. It is important to realize that the above system is not what we plan to implement as the Navy medical recordkeeping system; in fact it is not even the prototype system. It is only a demonstration project that allowed dispensary personnel to see how reports could be generated from the proposed encounter form and to help NHRC personnel identify any problems with the form.

Once the forms were processed, some minor admustments were made. For example, additional categories were needed to discriminate flight physicals from other physicals and x-rays for tuberculosis from other x-rays. Dispensary personnel, however, found the encounter form very satisfactory and requested an additional supply so that data could be collected on an ongoing basis. It is interesting to note that the request for additional forms was not contingent upon a commitment to process the data with the computer. Rather, the content and organization of the patient encounter form facilitated manual derivation of the statistics required by the Navy reports.

System Development

Single Site

After the patient encounter form was developed, attention was focused on methods for capturing, storing, and processing the data. Clearly, automated procedures are required in order to have actual exposure data available during the periodic examination of individuals working in hazardous areas. Rather than attempting to develop such a system from "scratch," however, a review of existing systems was conducted to determine if a suitable system was available. Of the systems reviewed, only one--the Computerized Occupational Health/Environment Surveillance System developed by the Diamond Shamrock Corporation--integrated both the medical and environmental functions into a single system. However, the medical recordkeeping and report generation functions were considered to be too weak to meet the needs of a Navy dispensary. A system that did appear to have the required depth was the Computer Stored Ambulatory Record System (COSTAR) developed at Massachusetts General Hospital (2). COSTAR is a software package written in the MUMPS programming language which provides powerful capabilities designed specifically for medical records maintenance. COSTAR is designed as a modular system capable of carrying out a variety of functions including patient registration; appointment scheduling; entry,

PATIENT INFORMATION (TO BE FILLED IN BY PATIENT)

1. Today's Date ___ Month ___ Day ___ Year Time ___ (24 Hr Clock)
2. Name ___ Last ___ First ___
3. Social Security Number ___
4. ☐ Civilian ☐ Navy ☐ Marine ☐ Dependent ☐ Other (specify) ___

VISIT TYPE (Check any that apply)

1. Injury
   A. New Case ☐ occupational or ☐ non-occupational
   B. Retreatment ☐ occupational or ☐ non-occupational
2. Illness or Medical Condition:
   A. New Case ☐ occupational or ☐ non-occupational
   B. Retreatment ☐ occupational or ☐ non-occupational
3. Pre-employment Physical ☐
4. Periodic Physical for Health Monitored Occupation ☐
5. Return from Sick Leave Evaluation ☐
6. Food Handler Evaluation ☐
7. Fitness for Duty Evaluation ☐
8. Disability Retirement Evaluation ☐
9. Flight Physical ☐
10. Other Comprehensive Physical ☐
11. Eye Examination
   A. Refraction NC ☐
   B. Refraction NSC ☐
   C. Spectacles Ordered:
      1. Single ☐
      2. Bifocal ☐
   D. Sight Screening Examination ☐
   E. Tonometry ☐
   F. Plano Spectacles Issued ☐
   G. Corrective Protective Spectacles Provided ☐
   H. Other (Slit Lamp, Field of Vision ☐
12. Other (specify) ☐

INJURIES, ILLNESSES, and SYMPTOMS

(Circle Code number for all conditions considered during each encounter)

1	Abdominal pain	27	Cholecystitis	53	Herpes simplex	79	Pharyngitis, strep.
2	Abrasion	28	Conjunctivitis	54	Herpes simp. type 2	80	P.I.D.
3	Abscess	29	Contusion	55	Herpes zoster	81	Pneumonia
4	Acne	30	Corneal abrasion	56	Hyperlipidemia	82	Prostatitis
5	Alcoholism	31	Cystitis	57	Hypertension	83	Puncture wound
6	Allergy	32	Cysts	58	Hyperthyroidism	84	Rash, non-specific
7	Amenorrhea	33	Depression	59	Hypothyroidism	85	Scabies
8	Anemia	34	Dermatitis	60	Hypoglycemia	86	Scoliosis
9	Angina pectoris	35	Diabetes mellitis	61	Impetigo	87	Serous Otitis
10	Animal bite	36	Diaper rash	62	Infectious mono.	88	Sinusitis
11	Anxiety	37	Diarrhea	63	Influenza	89	Sprain
12	Arthritis, osteo.	38	Eczema	64	Insect bite/sting	90	Strain
13	Arthritis, rheum.	39	Emphysema	65	Intestinal parasites	91	Syphilis
14	A.R.N.D.	40	Fatigue	66	Irrit. bowel syndrome	92	Tendonitis
15	Asthma	41	Fever (FUO)	67	Kidney disease	93	Tinea
16	Back pain	42	Fibrocystic br. dis.	68	Laceration	94	Tonsillitis
17	Breast nodules	43	Foreign body	69	Laryngitis	95	Tuberculosis
18	Bronchitis	44	Fracture	70	Menopausal syndrome	96	Urethritis
19	Burn	45	Gastritis	71	Menstrual disorder	97	U.R.I.
20	Bursitis	46	Gastroenteritis	72	Muscle spasm	98	U.T.I.
21	Cellulitis	47	Gonorrhea	73	Neuritis	99	Vaginitis
22	Carcinomas	48	Headache	74	Obesity	100	Vertigo
23	Cervicitis	49	Hearing loss	75	Otitis externa	101	Viral illness
24	Chest pain	50	Heart murmur	76	Otitis media	102	Vomiting
25	C.H.F.	51	Hemorrhoids	77	Pediculosis	103	Warts, venereal
26	Chicken pox	52	Hepatitis, inf. viral	78	Pharyngitis	104	Warts

--Use this space to enter any diagnoses not listed above--

ADJUNCT SERVICES PROVIDED

(Check all that apply)

1. Special (Number ___)
   A. Chest ☐
      1. TB ☐
      2. Other Chest ☐
   B. Other than Chest ☐
2. Pulmonary Function Test ☐
3. Neurological Examination ☐
4. Hematology Examination ☐
5. Urinalysis Examination ☐
6. Liver or kidney test ☐
7. Other Biological Monitoring (specify) ☐
8. Tuberculin Testing
   A. Read ☐
   B. Reactive ☐
   C. Convector ☐
   D. Nonreactive ☐
   E. Placed on INH ☐
   F. Reaction to INH ☐
9. Ear Protective Devices Issued ☐
10. Radiological Health Photodosimetry
    A. Medical & Dental X-ray Personnel ☐
    B. Industrial Radiographers ☐
    C. Other ☐
11. Radiological Health Monitoring
    A. Consultation ☐
    B. Radon Breath Sample ☐
    C. Body Count or Scan ☐
    D. Other ☐
12. Audiometric Test A. Initial ☐ B. Follow-up ☐
13. ECG ☐
14. Pharmacy Unit(s) (Number ___) ☐
    A. Specify medications prescribed
15. Immunization(s) (Number ___) ☐
    A. (Specify) ___

CAUSATIVE AGENTS FOR OCCUPATIONAL MEDICAL CONDITIONS

(Check if applicable.)

1. Exposure to Skin Irritant or Sensitizer
   A. Solvent ☐
   B. Petroleum Product ☐
   C. Epoxy or Organic ☐
   D. Acid or Alkali ☐
   E. Explosive or Pyrotechnic ☐
   F. Mechanical or Physical Agent ☐
   G. Other (specify) ☐
2. Physical Agents
   A. Ionizing Radiation ☐
   B. Nonionizing Radiation ☐
   C. Noise ☐
   D. Thermal Stress ☐
   E. Other (specify) ☐
3. Inhalation Hazard
   A. Organic Vapor ☐
   B. Gas ☐
   C. Fume or Mist ☐
   D. Dust ☐
   E. Oxygen Depletion ☐
   F. Other (specify) ☐
4. Other Occupational Illnesses
   A. Specify ___

INITIAL DISPOSITION

1. Duty ☐
2. Hospital ☐
3. Home ☐
4. Anticipated lose time ___ days.

FINAL DISPOSITION

1. Same job ☐
2. Change of Job ☐
3. Other (specify) ☐

PROVIDER'S COMMENTS

1. Diagnosis, treatment, etc. ___

Check if service is being provided by any of the following clinics

	Limited Services	Outpatient
1. Emergency Room	☐	☐
2. General Practice	☐	☐
3. Opthalmology	☐	☐
4. Physical Therapy	☐	☐
5. Psychiatry	☐	☐

1. Provider Signature: ___

Figure 1. Patient Encounter Form

storage, and display of medical data; automatic billing; management reporting; and a built-in maintenance function which allows the system to be tailored to the specific needs of each site (3). Depending upon the functions desired and unique site characteristics, between 1200 and 1700 program modules are generally required.

Considering the relative complexity of COSTAR as opposed to environmental surveillance systems such as those developed by the Michigan Division of Dow Chemical U.S.A. (4), Owens-Corning Fiberglass Corporation (5), and the Plastics Business Operations of the General Electric Company (6), it was concluded that the most effective strategy would be to use COSTAR as the primary implementation schema with modules for environmental surveillance to be developed as modifications to COSTAR. Clearly, when the COSTAR based system is fully operational, more functions will be performed than the generation of two administrative reports. It is expected that a detailed medical record will be compiled and stored for each person served by the dispensary. These records will be initiated through a pre-registration procedure for individuals identified through the personnel information as working in a hazardous area. For individuals not previously encountered, additional records will be created upon their first dispensary visit. Thereafter, a new encounter form will be issued to the patient upon each dispensary visit. If the visit was previously scheduled, a report can be generated from the medical history file to indicate pertinent facts about the patient's medical history. In addition, because this prototype medical record system will be functioning as a component of a prototype occupational health information system, this report will provide a list of the hazardous substances to which the patient has been exposed. During the examination, then, the physician will have a report on the patient's medical history and environmental exposures as well as the patient encounter form. After the examination the system will "wait" to record the results of any laboratory tests which are evaluated using a table of normal values. Finally, the results can be used to update the medical history file, to alert the patient to any physical problems, and to inform the command of any conditions that would preclude the person from performing his assigned tasks. A schematic diagram outlining the above procedures is shown in Figure 2.

Multiple Sites

The ease of record retrievability is a key feature of any automatic recordkeeping system. Automation ensures that individual medical records do not get lost and are available for reference during a patient visit. Moreover, the ability to retrieve selected data points from individual records and to rapidly accumulate information across all records greatly facilitates the compilation, standardization and accuracy of reports required from all Navy dispensaries. Therefore, once the medical information at the dispensary is automated, that information increases in value because it is readily retrievable.

Similarly, information increases in value if it can be combined with comparable data from other facilities. For this reason the capacity to combine data from various facilities is a planned feature of the proposed occupational health system. A schematic diagram for linking occupational health data from various sources is shown in Figure 3. In such a system, queries regarding the management of health care resources would be received at the system support management and service node, where it would be determined if the query came from an authorized source and, if so, who would supply relevant data. Next, the interface/relay node would access the required data from one or more separate data files and perform any data conversion or transformation necessary to make all the information compatible. Finally, the network control node would manage the transmission of the information, being responsible for the routing and for the security of the data as well as striving to make the information transmission as efficient as possible.

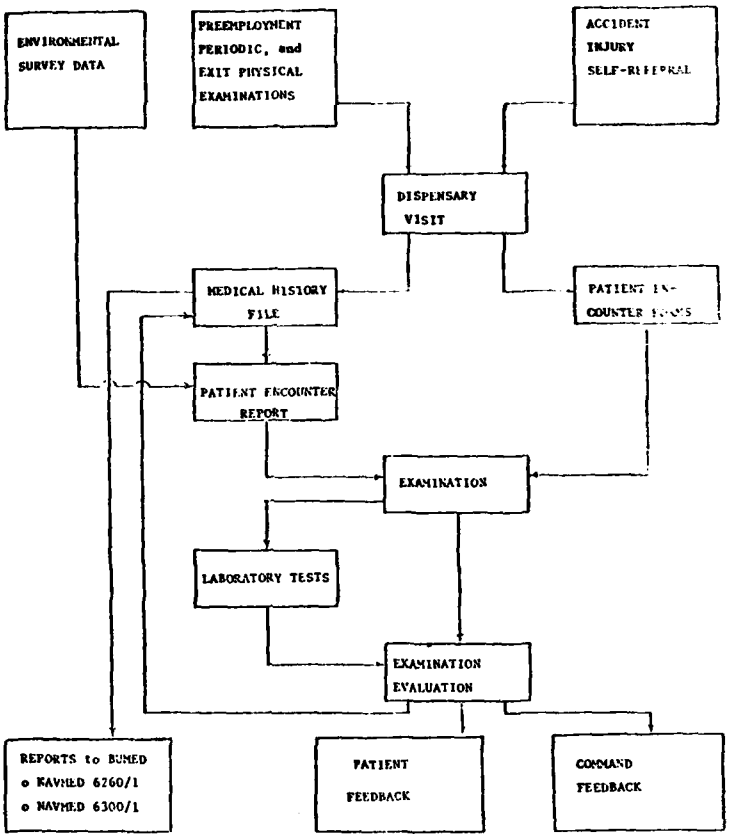

Figure 2. The operations of a Navy dispensary in an industrial setting.

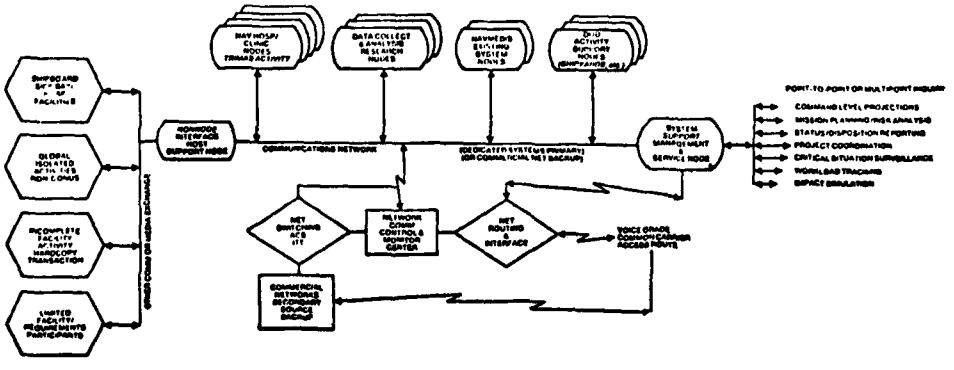

Figure 3. An occupational health information system for Navy industrial facilities.

The capabilities of this system must await the implementation of the prototype and the determination of the specifications. In the implementation of the prototype system, a PDP 11/23 will be used to capture the medical information. This machine will be placed at a dispensary serving a Naval industrial facility. For data entry and output there will be three CRT terminals and one printing terminal, which will be the console terminal. A second printing terminal will be connected to the PDP 11/23 to provide service to the industrial hygienists who supply the environmental data. Located at NHRC will be a PDP 11/24 that will perform the communications functions needed. The PDP 11/24 will have a CRT and a printing terminal and will emulate the systems support management operations and the interface support functions, as well as the network communications of the final occupational health information system. In the second phase of the prototype implementation, a second dispensary will be served. At that time the PDP 11/24 will be moved to the new facility and a larger machine will be used to perform the various communications functions at NHRC.

Conclusions

As noted above, the data set will gain in value when the contents can be readily retrieved, compared, and combined with other data. However, before data from different sources can be drawn together, it is necessary to promote user involvement so that complete and accurate information can be obtained. Typically in a system in which data is gathered, aggregated, and sent upward for the sole purpose of generating summary reports for higher levels of management, there is little motivation to supply accurate information because of the lack of feedback. But in a system that is composed of several subsystems which serve the separate parties supplying the data, the motivation is high to supply quality data because the contributors are also the consumers of the information. Once accurate data is obtained, the capacity to access many data files containing a wide variety of information, and to transmit the result to higher management levels, adds extra value to the local efforts. Therefore, it is believed that the proposed system for occupational health has the potential for meeting the requirements of the occupational health program and for obtaining the greatest return on the information available.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 81-30	2. GOVT ACCESSION NO. AD-A110 417	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Implementation of a Prototype Registration and Administrative System for Field Use		5. TYPE OF REPORT & PERIOD COVERED Interim 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William M. Pugh Donald D. Beck		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Health Research Center P.O. Box 85122 San Diego, CA 92138		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MF58.524.023-2022
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research & Development Command Bethesda, MD 20014		12. REPORT DATE 20 October 1981 13. NUMBER OF PAGES 8
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)* Bureau of Medicine & Surgery Department of the Navy Washington, DC 20372		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Presentation at the Fifteenth Annual Hawaii International Conference on System Sciences

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

medical records,
illness incidence
illness prevalence
illness episode

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A prototype medical monitoring system designed to collect and store dispensary data has been developed and is undergoing testing. Although this system is designed to function as one of several components of an overall occupational health information system, it can be used as an independent system for medical surveillance The patient encounter form developed for this program is designed to obtain the information necessary to complete routine reports required from dispensaries including the Medical Services and Outpatient Morbid-

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ity Report and the Report of Occupational Health Services. In addition, automation of medical data helps to insure the efficient performance of routine functions such as the scheduling of physical examinations. Finally, when combined with the other components of the occupational health monitoring system, the contaminants an individual is exposed to can be accessed and used to aid in diagnosis.