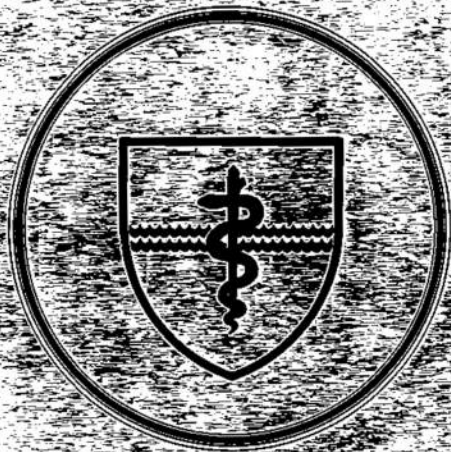# NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY

SUBMARINE BASE, GROTON, CONN.

REPORT NUMBER 1110

CPDX — A DECISION SUPPORT SYSTEM

FOR THE MANAGEMENT OF ACUTE CHEST PAIN

USER'S MANUAL

by

Karen FISHERKELLER, LCDR David SOUTHERLAND, MC, USNR, and George MOELLER
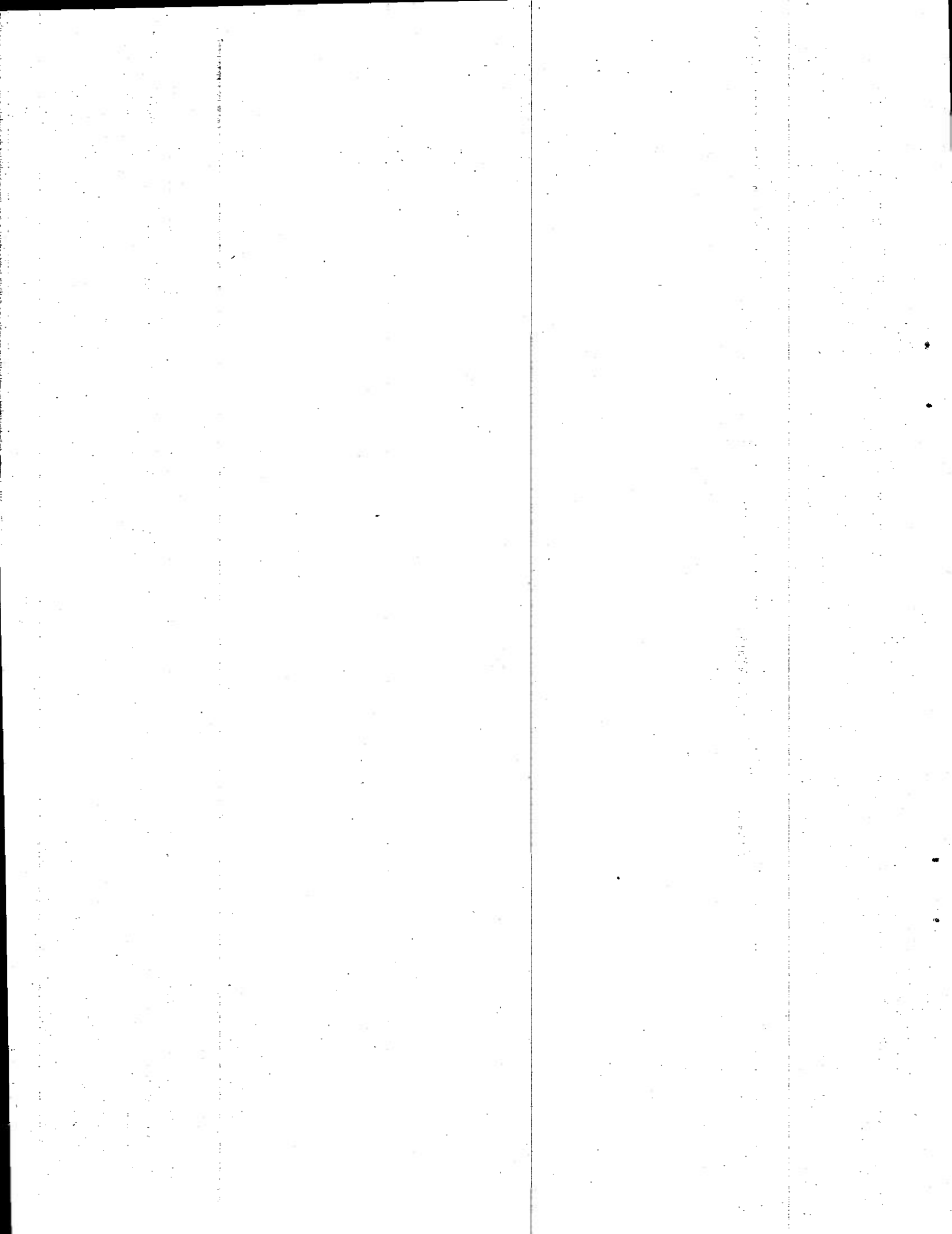
Released by:

C. A. HARVEY, CAPT, MC, USN
Commanding Officer
Naval Submarine Medical Research Laboratory
25 February 1988

CPDX -

A DECISION SUPPORT
SYSTEM FOR THE MANAGEMENT
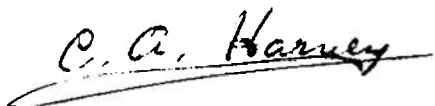## OF ACUTE CHEST PAIN

USER'S MANUAL

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George MOELLER

NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY

NSMRL REPORT NO. 1110

Approved and Released by

C. A. Harvey

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Summary Page

PROBLEM:

To provide a user's manual for the Acute Chest Pain Diagnostic Program (CPDX) for use by a corpsman unfamiliar with computers.

FINDINGS:

The manual contains introductory information, a description of equipment needed, an overview of the different parts of the system, a list of definitions, a list of the treatment protocols, and a sample data sheet.

APPLICATION:

This manual will be useful as a user manual, enabling a corpsman unfamiliar with computers to use the decision support program without the need form supplementary training.

ADMINISTRATIVE INFORMATION

Chest Pain User's Manual (ii)

Abstract

This user's manual is designed to accompany the CPDX system implemented on MS-DOS computers. The manual replaces the previous manual which was designed for use on the TEKTRONIX 4051. The manual contains introductory information, a description of equipment needed, an overview of the different parts of the system, a list of definitions, a list of the treatment protocols, and a sample datasheet.
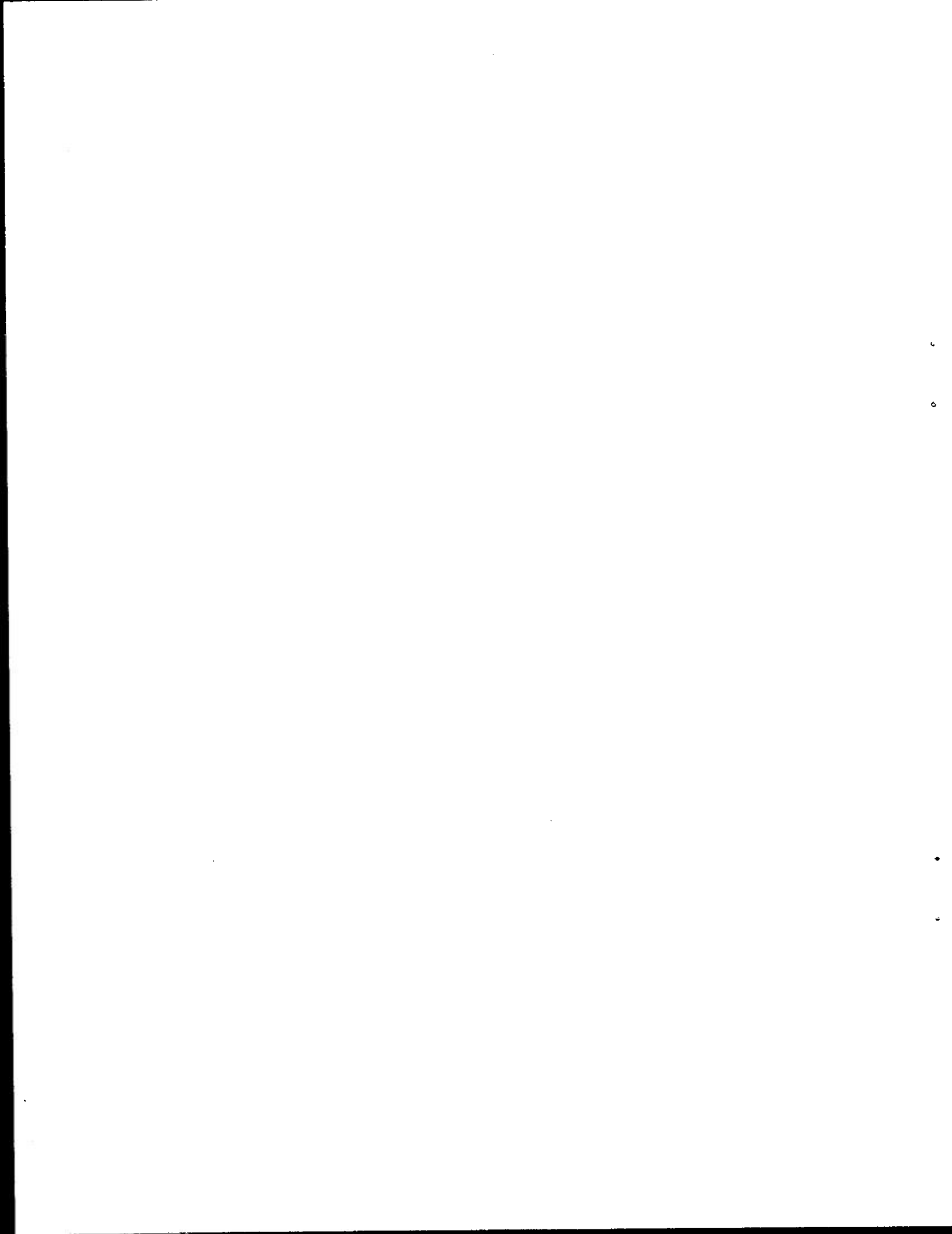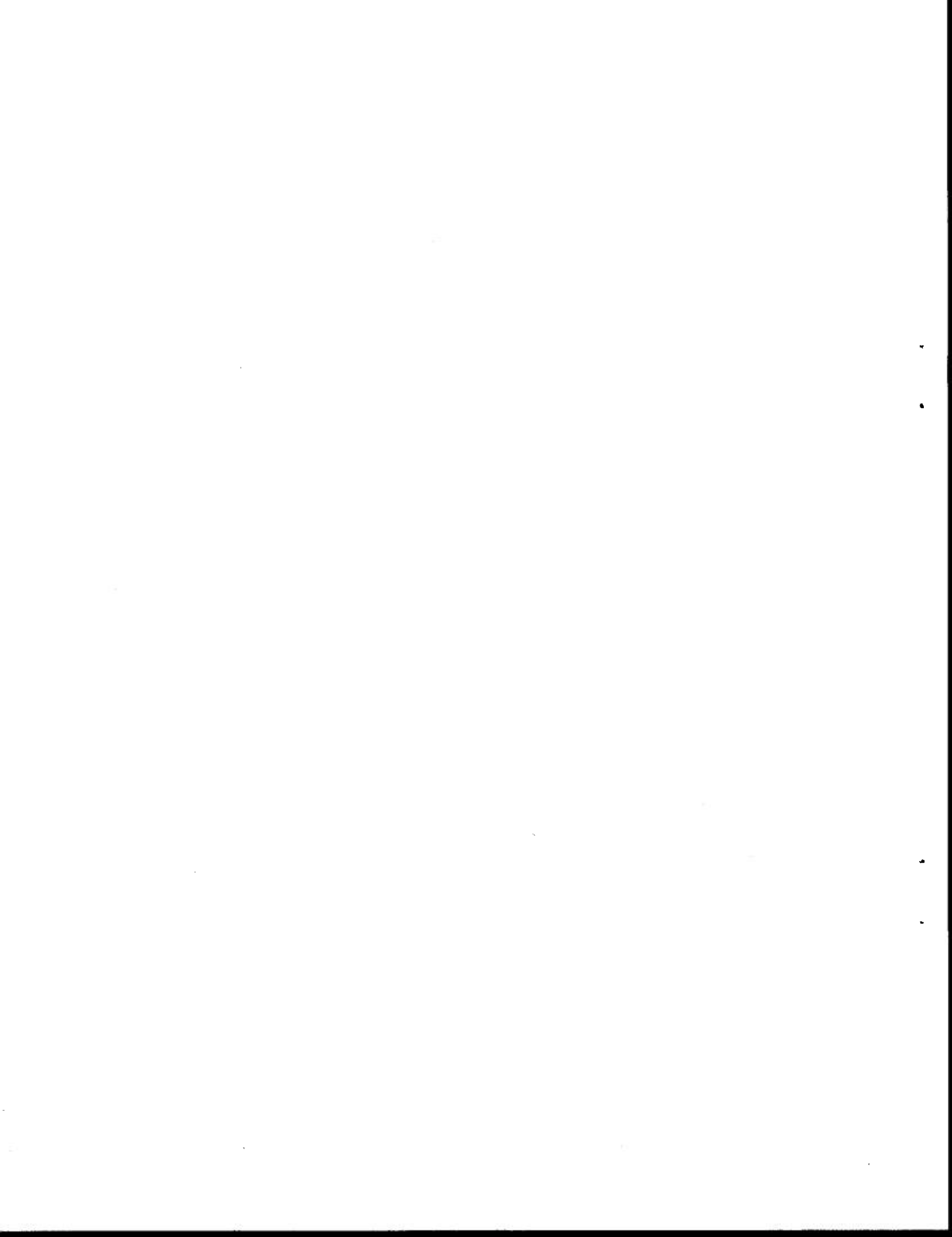
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1. INTRODUCTION

1.1 Historical Perspective

On board the submarine, the Independent Duty corpsman is responsible for the diagnosis and treatment of patients who present with serious illness during the patrol. In most cases, patients can be managed safely aboard the submarine. However, for some life-threatening illnesses it is the corpsman's responsibility to recommend evacuation of the patient to shore based facilities. The decision to evacuate is costly in terms of risk to the patient, the monetary expense of the evacuation, and possible compromise of the submarine's mission. The corpsman's decision is complicated by limited laboratory facilities and by mission constraints which often prevent communication with shore based facilities.

A computer based medical support system has been developed to assist the corpsman in the diagnosis, triage, and management of patients who present during the patrol. When completed, the system will consist of programs for acute abdominal pain, acute chest pain, dental complaints, psychiatric disorders, and trauma. Each program will provide the corpsman with diagnostic and treatment suggestions based on the signs and symptoms entered into the computer. The purpose of the system is to assist the corpsman in providing quality care aboard the submarine and to decrease the number of inappropriate medical evacuations.

The system was initially developed in the area of abdominal pain since it is the most frequently encountered presentation of serious illness. The program aids in the diagnosis of six causes of abdominal pain: appendicitis; renal colic; perforated duodenal ulcer; acute cholecystitis; small bowel obstruction; and non-specific abdominal pain. This program is currently undergoing sea trials to evaluate its effectiveness.

The second most frequent cause of serious illness aboard the submarine is chest pain. This decision support program provides diagnostic and treatment suggestions for 4 causes of acute chest pain. These are myocardial infarction, angina, chest infection and non-specific chest pain.

1.2 Purpose of the Manual

The purpose of this manual is to train the corpsman in the use of the computer based chest pain medical support program. Use of the chest pain program is predicated on training for duty as an independent corpsmen and mastery of the knowledge and skills required to take a history and conduct an examination for the indicants used by the program. The manual is written for the person with little or no prior experience with computers. After reading the manual, the user should be able to use the program without the need for supplementary training.

The manual is divided into four sections. Section 1 describes the history of the computer based decision support system. Section 2 lists the hardware and software needed to run the chest pain decision support program, the disk contents, and important keys. Section 3 discusses the four chest pain diseases diagnosed by the program, when to use the program, the chest pain data sheet and the definition of symptom categories. Section 4 describes actual use of the medical support program. This includes a detailed description of each module: the diagnostic module, the training module and the SF-600 generation module. In addition, there are four appendices. The four diagnostic categories are described in Appendix A; the definition of each symptom category is found in Appendix B; the treatment protocol for each disease is in Appendix C; and a full size reproduction of the chest pain data sheet is given in Appendix D. It is important to read through the entire manual and to be familiar with the use of the chest pain program before using it clincally.

2. GETTING STARTED

2.1 Equipment Needed

To use the Chest Pain Medical Support Program as supplied you must have an IBM PC or IBM PC-compatible computer with the following characteristics:

2.1.1 The Computer

The computer should be one sold as being "IBM-compatible", and the operating system must be MS-DOS version 2.0 or higher, or a comparable version of PC-DOS.

The Chest Pain Medical Support Program will not run on the Zenith-100 series microcomputers (Z-100 and Z-120) unless a special circuit board has been installed. Note that while the Z-100 series will not run the program, the Z-100 PC series computers will. As a general guide, Zenith computers with movable or detachable keyboards are IBM compatible, while those which have the keyboard built in are not IBM compatible, unless they have been modified by the addition of an adaptor circuit board. The easiest method of ascertaining IBM compatibility is to ask someone who uses the computer.

2.1.2 Graphics Capability

To run the program, the computer must have a color graphics adapter (CGA) or equivalent. (Note. Most enhanced graphics adapter (EGA) boards have a CGA mode.) A color monitor is not necessary, since color graphics can be displayed on a monochrome monitor by using shades of gray. Graphics capability is a standard feature on most IBM compatible computers.

2.1.3 Memory Requirements

No tests have been undertaken to determine the smallest memory needed to run the program. Most IBM compatible microcomputers now come with at least 512 kilobytes of random access memory (RAM). This is more than enough memory for using the program.

2.1.4 The Printer

The use of a printer is optional. Cases can be entered and stored without it. However, a printer is useful for making hard (printed) copies of written information displayed.

The program will work with both parallel and serial interfaced printers. The printer output is initially directed through the parallel port. If you have a serial printer, you will need to use the MS-DOS command, MODE, to redirect the output through the serial port.

You can obtain hard copies of the information displayed on the computer screen by pressing the SHIFT key and the PRTSC key at the same time. However, you must load the GRAPHICS.COM program which came with the MS-DOS operating system disks before running the program, or "garbage" may be printed. The MODE and GRAPHICS.COM program will be found on the MS-DOS system disk and it must be in the default drive or found in a directory or subdirectory referenced by the PATH command. Consult the MS-DOS user's manual or a local expert for more information on the PATH and MODE commands, the printing of graphics screens, and the GRAPHICS.COM program. Be sure you obtain the correct cable to connect the printer to the computer.

2.2 Disk Contents

The corpsman will be supplied with at least one copy of the chest pain medical support program. This disk contains the diagnostic module, a training module and a module to create patient narratives in the format of the SF-600.

2.3 Disk Backup

A backup is a separately stored copy of all of the files (programs and data) on a disk.

2.3.1 Why Make Backups

Backups ensure that your programs and data are always available to you. If a disk surface is damaged, the information on the damaged portion of the disk may be lost. This damage can occur as a result of poor disk quality, disk age, heavy use, electrical "glitches" in the power supply, or other events that subject a disk to strong physical or electromagnetic forces. Eventually you WILL lose a program or a data file in this manner. You may also lose data or programs through operator error. This should not happen if you always follow the procedures exactly as described in this manual. Proper backups maintain a current copy of the programs and data so that if a program or data is lost, you can quickly have the program running again.

2.3.2 When to Make Backups

When you first get the program disk you should immediately make three copies of the disk before you ever use it. Place your original disk in a safe place. Always use one of your copies as your working disk. You should make frequent backups of the working disk. Remember that while the original disk contains all of the

programs, it has NONE of the patient cases stored on it. There is no set time interval for making backups of the working disk. As a rule of thumb, make a backup of the disk often enough so that if the working disk is damaged, you can re-enter the lost cases in a timely manner. The number of backups that should be made will depend on how valuable your data and time are. Generally, two backups in addition to the working disk are adequate. This gives you a total of four disks: the original disk containing the programs but no patient data, and three backup disks, one of these being a working disk and the other two being backups of the current working disk, or the most recently 'retired' working disk.

If you find that either the working disk or one of the backup disks is damaged, then you should first remove the disk in question and insert an expendable disk which contains no valuable material. Using that disk, test the computer by listing the disk directory and by copying unimportant programs from the disk to the computer and back. Do this to ensure that the computer or disk drive are not damaging the disks. If the computer or disk drive is at fault, do not use the computer until it is repaired. If the computer and disk drive show no faults, then remove the expendable disk and copy one of the program backup disks to a new disk. Do not use the damaged disk – DISCARD IT. It has proved unreliable and there is a chance that it could fail again.

2.3.3 How to Make Backups

There are several ways to make backups. One method involves the Disk Operating System (DOS) command DISKCOPY which makes an exact duplicate of the desired disk including the blank space on the disk. Another method uses the COPY command.

Use the DISKCOPY command for copying from one floppy disk to another floppy disk. Use the COPY/V command to copy from the floppy disk to the hard drive (the computer's internal storage disk). DO NOT use the DISKCOPY command to copy from a floppy disk to the hard drive because you will copy the disk, but destroy all of the other information already stored on the hard drive. Consult your computer's user manual for detailed instruction on using the above commands.

2.4 Important Keys

To use the program effectively, you need to become familiar with several keys that are often used. The names of keys available for use are usually listed at the bottom of the display screen. The following is a short description of the use and possible locations for certain commonly used keys. If you cannot find the keys, consult your computer users manual for their location.

2.4.1 Question Mark Key

The question mark key, "?", is used to obtain help throughout the program. For example, pressing the question mark key while on one of the history or physical examination pages will give the definition for the sign or symptom highlighted by the cursor (highlighted bar). The question mark key, "?", is used to obtain help throughout the program.

2.4.2 Arrow Keys

The arrow keys are usually found on the numeric keypad at the right of the keyboard. To use these keys, you must first ensure that the numeric keypad lock key (NumLock) is set. The NumLock key toggles back and forth from using the keypad for the arrow and other special keys to using the keypad for entering numbers. Some computers do not have a numeric keypad. If this is the case, then consult your computer user's manual for information on the locations and labels of special keys.

2.4.3 Return/Enter Key

This is actually one key. On some computers it is labeled as "Return" and on others as "Enter". It is usually a large key just to the right of the conventional typewriter keyboard. This key is used to tell the computer that you are through typing and that the computer is to take the information just typed and use it in the program.

2.4.4 Tab Key

The Tab key is normally found in the same position as on a typewriter. The Tab key has a special function in the data entry section of the chest pain diagnostic program. When the key is pressed, the cursor will jump to the first item of the next question. If the cursor is on the last question of the display page, pressing the tab key will move the cursor to the first question on the page.

2.4.5 Ctrl-Break Key

Ctrl-Break is accomplished by simultaneously pressing the Ctrl key and the Break key. The Ctrl-Break key is used to abort the running program. This is an inelegant way of exiting the program. After pressing the Ctrl-Break key, you will be asked if you want to terminate a batch job. Reply by pressing the "N" key. The screen will be blanked and you will return to the MS-DOS prompt. The Ctrl-Break key should not be used routinely to exit the program.

2.4.6 Miscellaneous Keys

Several alphanumeric keys are also used as command keys. These are the letters "N", "P", and "X". These keys are used to move within a defined group of pages such as a treatment protocol.

The "P" key is used to take you to the previous page. If you are on the first page, you will be returned to the previous menu.

The "N" key is used to take you to the next page. If you are on the last page, you be returned to the previous menu.

The "X" key is used as an exit. It will return you to the previous menu.

2.5 Starting the Program

There are two methods of starting the program. You can run the program from a floppy disk or you can run the program from a hard drive.

2.5.1 Starting the Program from a Floppy Disk

If you are going to run the program from a floppy disk, first "boot" your computer in the usual manner using the computer's MS-DOS system disk. You may or may not have to enter the date and time depending on the way your system is configured. You should then have the MS-DOS prompt - usually the symbol "A>" followed by a blinking cursor. If you have only one external disk drive, you will have to remove the system disk (after booting) and insert the program disk. Then type "START". If you have two external disk drives, you can leave the system disk in drive A and place the Chest Pain Diagnostic Program disk in drive B. At the prompt, type "B:". Then type "START".

A floppy disk should never be inserted with force. If the disk can not be inserted easily, try a second time. If this fails, try using a backup disk.

2.5.2 Starting the Program from a Hard Drive

If you have a hard drive and room on the hard drive for all of the files on the program disk, you can create a subdirectory on the hard drive and then copy all of the files over to the subdirectory. If you are unsure of how to do this, get someone familiar with your machine to help you. After the files have been copied to the hard drive, you will no longer have to use the floppy disk to run the program. To run the program from the hard drive, first access the subdirectory where the program files are located and then type "START". If you are unclear about these directions, consult your computer user's manual or someone familiar with the machine for more information.

3. GENERAL ASPECTS OF THE CHEST PAIN DECISION SUPPORT PROGRAM

3.1 Diagnostic Categories

The diagnostic program is not intended to specifically diagnose all causes of acute chest pain. Instead the program can aid the corpsman in reliably diagnosing four illnesses which represent the most common and most serious causes of chest pain. These are Myocardial Infarction (M.I.), Angina (ANGINA), Chest Infection (CHINF), and Non-specific Chest Pain (NONSCP). Chest infection includes not only illnesses such as bronchitis and pneumonia, but also pneumothorax. Originally, we intended to treat pneumothorax as a separate disease category, but its low incidence in the population necessitated including it with the Chest infection category. Non-specific chest pain includes those entities which are vague and general and amenable to symptomatic treatment. Together these categories encompass almost all of the causes of chest pain in the target population. The program does not address cardio-pulmonary problems characterized primarily by indicants other than chest pain. A discussion of each diagnostic category is presented in Appendix A.

3.2 When to Use the Chest Pain Diagnostic Program

The computer aids the corpsman by storing information on the presentation of hundreds of cases of chest pain, by rapidly sorting data, and by performing statistical analyses on the data. However, the computer lacks the ability to think. It is the responsibility of the corpsman to rely on his clinical judgment and expertise in deciding when to use the program, and in making the final diagnosis.

The Chest Pain Diagnostic Program is intended for use with males, between the ages of 17 and 79, who are experiencing chest discomfort of less than 7 days in duration. In making a decision to use this program, the corpsman must remember that not all patients with cardiac illness report pain in the chest. Some experience only referred pain to the jaw or teeth; others experience a sensation of tightness, and/or squeezing, heavy, pressing, crushing pain. You must also bear in mind that the program provides relative probabilities for only four disorders, M.I., ANGINA, CHINF, and NONSCP. Chest pain diseases other than these are not considered by the program. The corpsman must rely on his own expertise to decide when the program is appropriate to use.

The corpsman must rely on his clinical judgment and expertise both in deciding to use the program and in interpreting the results of the computer interaction.

3.3 Chest Pain Data Sheet

The chest pain data sheet provides the corpsman with a guide to use in performing the history and physical examination. It consists of 27 history categories and 20 physical exam categories. The history portion of the data sheet is shown in Figure 3-1. Findings on the history and physical exam categories are used by the computer program to arrive at a diagnosis. When a patient presents with chest pain, the corpsman should first conduct a history and physical exam and record his findings on the chest pain data sheet. Later, the corpsman enters the case into the computer, transfering the information recorded on the data sheet into the computer. A full size reproduction of the chest pain data sheet is provided in Appendix D for the corpsman's use.

Figure 3-1   History Portion of the Chest Pain Data Sheet

3.4 Symptom Category Definitions

The accuracy of the diagnostic program is dependent on the accuracy of the data collected by the corpsman. The corpsman must adhere to standardized definitions and methods of data collection in completing the chest pain data sheet. All indicants that can be assayed, given the patient's condition, must be evaluated as specified in Appendix B and entered into the program. Indicant definitions are presented in Appendix B for easy reference. They can also be accessed from within

the diagnostic program.

4. CHEST PAIN PROGRAM MODULES

The chest pain decision support program is divided into three primary modules: the main diagnostic program, the training program, and the SF-600 generation program. Each of these modules will be discussed in order.

4.1 Overview of the Main Diagnostic Module

This module contains the diagnostic program for evaluation of real and simulated cases. To load the chest pain diagnostic module follow the directions given in Section 2.5 - Starting the Program.

4.1.1 Customization Page

The first time you run the program, you will be asked to enter the name of your boat, the boat's hull number, your name, and your SSN. This page will be displayed only if the information has not been previously entered. To continue to the next display page, follow the directions at the bottom of the display screen and press any key. Throughout the program, directions can usually be found at the bottom of the screen.

4.1.2 The Title Page

Once the disk has been loaded and the "START" command given (see Section 2.5), the title page will appear on the CRT (see Figure 4-1).

The Title Page contains the name of the diagnostic program and the address and phone number of the program developers. Please forward any problems or questions regarding the Chest Pain Diagnostic Program to the Naval Submarine Medical Research Laboratory, Box 900, Naval Submarine Base New London, Groton, CT. 06349-5900.

```
      SUBMARINE CORPSMAN
COMPUTER-ASSISTED DIAGNOSIS PROGRAM
              FOR
        ACUTE CHEST PAIN




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          └─────────────────┘

Developed by:
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              ▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀
              ▐To continue press any key▌
              ▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄▄
```

Figure 4-1 Title Page of the Chest Pain Diagnostic Program

Pressing any key, takes the user to the disclaimer page.

4.1.3 The Disclaimer Page

This page is displayed after the title page. The disclaimer page is a very brief summary of the program including a statement which once again emphasizes that the corpsman's judgment takes precedence over the computer's diagnosis when any doubt exists.

4.1.4 The Main Option Page

The Main Option Page provides the user with 8 program options (see Figure 4-2).

Chest Pain Diagnosis Program

Main Options

```
┌─────────────────────────┐
│ REAL CASE               │
│ SIMULATED CASE          │
│ TRAINING PROGRAM        │
│ LAST REAL CASE          │
│ LAST SIMULATED CASE     │
│ INSTRUCTIONS - HELP     │
│ GENERATE SF600          │
│ EXIT PROGRAM            │
└─────────────────────────┘
```

Use the arrow keys to move the cursor to the desired position. Push RETURN
to select the desired response or '?' for more information.

Figure 4-2 Main Option Page

4.1.4.1 Real Case

This option is selected when the user wants to enter the signs and symptoms and
obtain a computer-based diagnosis for an actual patient. Real cases are stored on the
disk in a way so that they can be printed in a narrative form on a SF-600.

4.1.4.2 Simulated Case

The simulated case option should only be used for training purposes. It allows
the user to 'make up' history and physical exam findings and to see how changes in
symptom entries affect the computer diagnosis. Both real and simulated cases
entered into the computer are stored on the disk, but only real cases are stored in a
way that allows SF-600 medical record entries to be printed.

4.1.4.3 Training Program

The training program presents patient narratives. Based on the narrative, the corpsman completes a datasheet, makes a diagnosis, and compares his diagnosis to the computer derived diagnosis.

4.1.4.4 Last Real Case

Selection of this option will result in the retrieval of the last real case entered by the corpsman into the computer. This option will allow you to review the signs and symptoms for the last case. Also, if you are performing serial exams, you can update a copy of the last exam instead of having to re-enter the entire case each time. Be sure to update the date and time when performing serial exams (see Section 4.1.5.4). Cases prior to the last real case cannot be retrieved.

4.1.4.5 Last Simulated Case

This option retrieves the last simulated case entered by the corpsman into the computer. As with real cases, simulated cases prior to the last simulated case cannot be retrieved.

4.1.4.6 Instructions - HELP

The instructions consist of three pages of general background information on computer-assisted diagnosis of chest pain.

4.1.4.7 Generate SF-600

Select this option to run the SF-600 generation program. This program creates patient medical narratives based on the signs and symptoms entered for real cases. It is discussed in detail in section 4.3 - Overview of the SF-600 Generation Module.

4.1.4.8 Exit Program

Select this option to end your interaction with the computer. Use of the program should always end with selection of either this option or the End Interaction option on the Diagnostic Summary Page. Ending your interacton with the program in any other way risks both the loss of case data and damage to, or loss of, the program.

4.1.5 Data Entry Options Page (Real Case Example)

Suppose you want to enter a real case. Using the arrow keys, move the cursor to the REAL CASE option and then push the RETURN/ENTER key. Once this option is selected the computer requests the patient's social security number, age, and confirmation of the date and time of the exam. If the corpsman enters an age which is outside the limits of the program (less than 17 or greater than 79), the program warns the corpsman and asks him to re-enter the patient's age. If either the date or time is in error, the corpsman should make appropriate corrections.

Next, the corpsman proceeds to the Data Entry Options Page (see Figure 4-3). The options are: GO TO HISTORY PAGES, GO TO PHYSICAL EXAM PAGES, MAKE DIAGNOSIS, GO TO SSN/AGE/TIME PAGE.

Chest Pain Diagnosis Program

Data Entry Options:


```
┌─────────────────────────────┐
│ GO TO HISTORY PAGES         │
│ GO TO PHYSICAL EXAM PAGES   │
│ MAKE DIAGNOSIS              │
│ GO TO SSN/AGE/TIME PAGE     │
│ RETURN TO MAIN OPTION PAGE  │
└─────────────────────────────┘
```


Use the arrow keys to move the cursor to the desired postition. Push RETURN to select the desired response or '?' for more information.

Figure 4-3 Data Entry Options Page

4.1.5.1 Go to History Pages

The corpsman selects this option to proceed to the history section of the chest pain data sheet. There are 6 pages of history symptoms which replicate the paper and pencil form of the chest pain datasheet. The second page of the history section

is shown in Figure 4-4. In entering symptom data, follow the instructions listed below for Data Entry, Moving the Cursor, Proceeding to Next or Previous Symptom Pages, Correcting Errors and Definition of Symptom Categories.

```
+-----------------------------------------------------------+
|                   History              Page 2 of 6        |
+-----------------------------------------------------------+
|                                                           |
|   DURATION OF PAIN              TYPE OF PAIN               |
|   [1 h or less]                   Tight                    |
|    1 -  2 h                       Sharp                    |
|    2 -  4 h                       Hvy/press/Crush          |
|    4 - 12 h                       Gripping                 |
|    12 - 24 h                      Burning                  |
|    24 -  1 w                      Aching                   |
|    1 w or more                    Dull                     |
|                                   Stabbing                 |
|   ONSET OF PAIN                   Nagging                  |
|     Sudden                                                 |
|     Gradual                                                |
|                                 NUMBNESS                   |
|   TIME COURSE OF PAIN             Present                  |
|     Continuous                    Absent                   |
|     Intermittent                                           |
+-----------------------------------------------------------+
```
Use the arrow keys to move the cursor to the desired position. Push RETURN to select the desired response or (P)revious page, (N)ext page, or '?' for more information of that response.

Figure 4-4 Data Sheet Page from the History Section

Data Entry: To enter history symptoms into the computer, move the highlighted bar (the CURSOR) to the desired response and press the RETURN/ENTER key. Symptoms that have been entered into the computer are marked with an asterisk. Data need not be entered sequentially. The corpsman can move back and forth between categories on one page or from page to page.

Moving the Cursor: The position of the cursor is controlled by the arrow keys (UP , DOWN ,LEFT , RIGHT), by the letter key associated with each direction ((U)P, (D)OWN, (L)EFT, (R)IGHT), and by the TAB key. The arrow and letter keys move the cursor through each response in the specified direction. The TAB key moves the cursor to the initial response under each symptom category.

Proceeding to Next or Previous Pages: Press 'P' to return to the (P)revious CRT page. Press 'N' to proceed to the (N)ext display page. Pressing 'P' or 'N' while on the first or last data sheet pages respectively will return the user to the previous menu.

Correcting Errors: Errors made in data entry can be corrected in one of two
ways.

1. If the responses within a symptom category are mutually exclusive (only one
answer is logically possible), move the cursor to the desired response and press the
RETURN/ENTER key. The symptom entered in error is removed and the desired
response is starred

2. Any symptom can be removed by re-entering it. Place the cursor on the
symptom entered in error and press the RETURN/ENTER key. The star is removed
from the symptom. Use this method for categories where more than one response is
possible.

Definition of Symptom Categories: Detailed definition of symptom categories
can be obtained by placing the cursor on the symptom in question and pressing the
'?' key. The definition of the symptom category TIME COURSE OF PAIN is shown
in Figure 4-5. Pressing any key from within the definition section will return the
user to the data page.

TIME COURSE OF PAIN definition:

CONTINUOUS
INTERMITTENT

If your patient has had specific times (usually at least a few minutes
ranging up to a few hours) when he has been free of pain since the present
episode started, this is intermittent. Otherwise assess as continuous.

Beware the patient with a longer history of "intermittent" pain. If this
goes back for more than a week, you should question whether this is acute
chest pain at all.

To continue press any key

Figure 4-5 Symptom Category Definition for Time Course of Pain.

4.1.5.2 Go to Physical Exam Pages

The corpsman selects this option on the Data Entry Option page to proceed to the physical exam section of the chest pain datasheet. There are 4 pages of physical exam findings that correspond to the physical exam portion of the datasheet. The first page of the physical exam section is shown in Figure 4-6. Follow the same rules outlined for entering history symptom data.

```
┌────────────────────────────────────────────────────────────┐
│          Physical Exam - Vital Signs          Page 1 of 4   │
│  TEMPERATURE                        BP (systolic)           │
│   Normal                               < 100                │
│   Increased                         101 - 120               │
│   Decreased                         121 - 140               │
│                                     141 - 160               │
│  PULSE RATE                            > 160                │
│       < 61                                                  │
│    61 - 70                          BP (diastolic)          │
│    71 - 80                             < 71                 │
│    81 - 100                         71 - 80                 │
│       > 100                         81 - 90                 │
│                                     91 - 100                │
│  RESPIRATION                           > 101                │
│       < 20                                                  │
│         20                                                  │
│    21 - 25                                                  │
│    26 - 30                                                  │
│       > 30                                                  │
└────────────────────────────────────────────────────────────┘
Use the arrow keys to move the cursor to the desired position.  Push RETURN
to select the desired response or (P)revious page, (N)ext page, or '?' for
more information of that response.
```

Figure 4-6 Data Sheet Page from the Physical Exam Section

4.1.5.3 Make a Diagnosis

The corpsman selects this option to obtain a computer-generated diagnosis based on the symptom information entered into the computer. A mimimum number of items must be completed for the program to work. If that number is not supplied, the corpsman is asked to enter more history and physical exam data. If the minimum number of items has been entered, the program proceeds to the Corpsman's Diagnosis Page (see Section 4.1.6).

4.1.5.4 Go to SSN/Age/Time Page

Select this option to change the age or SSN of the patient, or update the date or time of the evaluation of the patient.

4.1.5.5 Return to Main Option Page

Choose this response to return to the Main Option Page.

4.1.6 Corpsman's Diagnosis Page

The Corpsman's Diagnosis Page (see Figure 4-7) asks the corpsman to enter the chest pain diagnosis which he believes to be most likely. The corpsman is asked to enter his diagnosis whenever he enters a new case or makes changes to a previous case.

```
             CORPSMAN'S DIAGNOSIS

    ┌─────────────────────────────────────┐
    │ MYOCARDIAL INFARCTION                │
    │ ANGINA                               │
    │ NONSPECIFIC CHEST PAIN               │
    │ PNEUMONIA/INFECTION                  │
    │ OTHER                                │
    │                                      │
    │                                      │
    └─────────────────────────────────────┘




    Use the arrow keys to move the cursor to the desired position.  Push RETURN
    to select the desired response or '?' for more information.
```

Figure 4-7 Corpsman's Diagnosis Page

The computer will compare the diagnosis provided by the corpsman to the computer derived diagnosis. The computer tells the corpsman whether or not it agrees with his diagnosis. If the computer and corpsman are in agreement, the program proceeds to the Diagnostic Summary Page. If not, the computer displays key answers on which

the computer and corpsman disagreed, and it asks the corpsman if he wants to review or change any of his symptom entries. If the corpsman wants to make changes, he enters 'Y' (for YES) and is returned to the previous menu where changes can be made to the history, physical exam or the SSN/Age/Time. If the corpsman doesn't want to review his entries or make any changes, then he types 'N' (for NO) and continues on to the Diagnostic Summary Page. This procedure was put in the program to remind the corpsman, again, that he alone is responsible for the diagnosis. Agreement between the symptoms and signs he records, and his diagnosis, is checked to warn the corpsman of any possible inconsistencies between his data and his decision.

4.1.7 Diagnostic Summary Page

Figure 4-8 is the Diagnostic Summary Page. The graph on the left shows the computed probability for each diagnostic category. The tallest bar corresponds to the most likely diagnosis. The program is "most sure" of the diagnosis when the probability is greater than 90% and "less certain" when the diagnosis is less than 90%. To help you keep this in mind, a line is drawn across the graph at the 90% level.
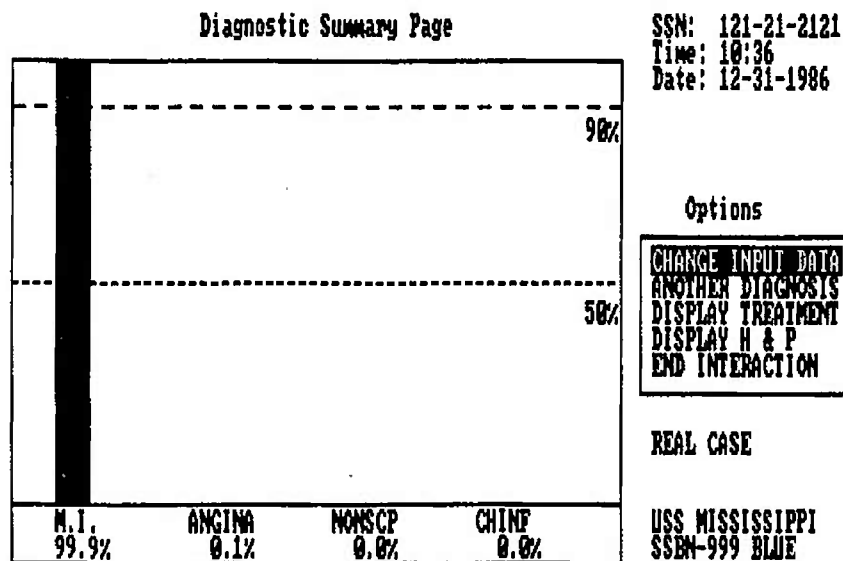
Figure 4-8 Diagnostic Summary Page

The date and time of the exam are listed in the upper right hand corner. If the case is real, the patient's SSN will also be listed there. The type of case, real or simulated, is shown in the lower right hand corner along with the name of the vessel.

On the right side of the diagnostic summary page are 5 options available to the corpsman. These are:

4.1.7.1 Change Input Data

Select this option to review or change any symptom entries relating to the present case. The corpsman can make changes to the history, physical exam, or SSN/Age/Time portions of the present case.

4.1.7.2 Another Diagnosis

Select this option to enter another case either real or simulated. The case just entered will be saved, if real, or deleted, if simulated, and the data display pages will be cleared. The program returns to the main option page described in section 4.1.4 (see Figure 4-2).

4.1.7.3 Display Treatment Protocols

Select this option to access a treatment protocol. Treatment protocols exist for each of the four chest pain diagnoses: Myocardial Infarction, Angina, Non-specific Chest Pain, and Chest Infection. Each treatment protocol consists of 5 sections: Discussion, Differential Diagnosis, Treatment, Usual Course with Treatment, and Complications and Their Management. The treatment protocols are suggestions to be adapted by the corpsman in light of his knowledge of the patient. They are easy to access and summarize treatment suggestions from a wide range of sources. In addition, protocols are brief, practical, and take into consideration the medications available for use on board the submarine. They have been reviewed by a hospital-based internist and a Submarine Qualified medical officer who instructs corpsmen in submarine medicine. Other Navy approved references should be used to supplement these protocols when indicated.

Hard copies of the entire protocol or any section of it can be obtained by pressing the SHIFT and PRTSC keys when the desired section is displayed on the computer screen. Treatment protocols for the four diseases are included in Appendix C for easy reference.

4.1.7.4 Display H & P

Select this response to list the history and physical exam indicants for this case. History symptoms are given on one page (see Figure 4-9) and physical exam findings are given on another page. If a printer is connected to the computer, a hard copy of

the indicant entries can be obtained (while they are displayed on the computer screen) by pressing the SHIFT key and the PRTSC key at the same time. After the symptom listing is completed, the program returns to the Diagnostic Summary Page.

```
History Summary (Real case)          SSN: 121-21-2121      10:36   12-31-1986
-----------------------------------------------------------------------------
AGE 30-39                            PND ABSENT
SITE OF PAIN ACROSS                  REFLUX ABSENT
RADIATION LT. ARM                    NAUSEA PRESENT
DURATION < 1 H                       VOMITING ABSENT
SUDDEN ONSET                         APPETITE NORMAL
CONTINUOUS PAIN                      NORMAL BOWELS
TYPE OF PAIN ACHING                  PREVIOUS CHEST PAIN
NUMBNESS ABSENT                      PREV. CARDIO-RESP ILL.
SEVERE PAIN                          PREV. MAJOR SURGERY
MOVEMENT AGGRAVATES                  SMOKER
PROGRESS WORSE                       HX. OF ANGINA
NITRO RELIEVES
MORPHINE RELIEVES
DYSPNEA ABSENT
COUGH ABSENT
SPUTUM ABSENT
ORTHOPNEA ABSENT

-----------------------------------------------------------------------------
```

Figure 4-9 Listing of History Symptoms

4.1.7.5 End Interaction

Select this option to exit the program and end your interaction with the computer. You will return to the operating system of the computer so that you may run other programs.

4.2 Overview of the Training Module

The training program presents patient narratives. Based on the narrative, the corpsman completes the paper and pencil form of the chest pain data sheet, enters the symptom findings into the computer and arrives at a computer derived diagnosis. The program scores the corpsman's accuracy in abstracting data from the patient narrative. No permanent record is maintained of the corpsman's performance on the training program.

4.2.1 Case Narrative

You may choose from 50 case narratives. The cases do not change, so each case will always have the same narrative from session to session. After entering the number of the desired case, you will be shown a page of history and another page of physical findings. You can toggle back and forth from one to the other. Based on the narrative, record your findings on a chest pain data sheet.

4.2.2 Enter Data

After completing the data sheet, choose this option to enter your findings. You will be taken to the Data Entry Options Page where you can enter history and physical exam data. After entering symptom findings and a diagnosis for the case, the Training Diagnostic Summary Page will be displayed. This page is like the Diagnostic Summary Page except in two regards. First, a score is displayed in the upper right quadrant. This scores reflects the accuracy of the data entered for the case. It is based on both the number of items missed as well as the number of incorrect items. Second, missed and incorrect findings can be displayed by selecting the option - SHOW MISSED ITEMS.

4.2.3 Exit Training Program

This option exits the training module and returns the user to the Main Option Page.

4.3 Overview of the SF-600 Generation Module

The SF-600 generation module allows you to print the medical record entry for the patient whose data you entered into the program. The output of the program is in the form of a SOAP note except that the letters "S", "O", "A", and "P" are not used. The date and time on the SF-600 will correspond to the date and time when the case was entered into the diagnostic module. The name and hull number of the vessel will be printed on the first line of the entry.

4.3.1 Output

The medical record entry can be sent to any one of three locations. It can be sent to the display screen, to a file where you can modify it with a word processing program, or directly to a printer. If you are sending the output to a printer, the computer assumes that the printer is using the actual SF-600 form, and so it will ask you if the printing is to begin on the front or back of the SF-600. You should always insert the form into the printer so that printing begins at the top of either the

front or back page of the form. Otherwise, the computer will be unable to determine how many lines are to be printed on a particular side. Single spacing is used if the output is sent to the screen or to a file. If the output is sent to the printer, double spacing is used.

4.3.2 Selection of a Real Case

Only cases that have been saved as real cases can be used in the SF-600 Generation Module. First, a list of the real cases will be displayed by SSN, date, and time of exam. Use the arrow keys to move the cursor to the desired case and press ENTER/RETURN key to select it.

4.3.3 Modifying Vital Sign Values

Since the vital signs are entered into the program as ranges, you are given the option of entering actual values for these findings. If you would prefer to have the range printed, press the ENTER/RETURN key by the appropriate item. If you do not want to have the item listed on the medical narrative, enter the letter "X" by the item.

4.3.4 Additional Information for Selected Items

You are given the opportunity to add to some of the categories in the history and physical examination sections. This allows for a more complete description of items for which "other" is offered as an alternative, e.g. site of pain, location of radiation, etc. You are also given the opportunity to comment on previous cardio-respiratory illness, previous major surgery, the location of decreased breath sounds, and abnormal heart sounds. As for Vital Signs, you may omit the response (enter 'X'), or use the default response (press ENTER/RETURN) given in the diagnostic module.

4.3.5 Additional Information for History or Physical Exam

You are given the opportunity to enter additional information for both the history and physical examination. You enter the information in a free text form at the end of the respective sections of the medical entry.

4.3.6 Final Diagnosis

Enter the final diagnosis that you want recorded on the SF-600 medical record.

4.3.7 Treatment Plan

You have two options for entering the patient's treatment plan. You can enter it line by line, or you can use a plan which is already stored in a file on the disk. The second method allows you to store standardized plans for illnesses on the disk, and then access these plans for printing on the medical entry. To create and store standardized plans on the disk you will need to use a word processing program. If you are not familiar with one, get someone who has one to assist you.

4.3.8 Changing the Printer Format

If the medical record entry is not reproduced correctly on your printer, you will probably need to modify the file SETUP.DAT where the printer parameters are kept. This is an ASCII file so you should be able to modify the parameters with any word processor or text editor that is available for you computer, such as the one included with MS-DOS. To make changes in the parameters, exit the Chest Pain Diagnostic Program by selecting the Exit Program option on the Main Option Page (4.1.4.8) or the End Interaction option on the Diagnostic Summary Page (4.1.7.5). Then, follow the instructions accompanying your word processor program or text editor to edit the file SETUP.DAT. A sample SETUP.DAT file is:

```
0
0
0
0
44
56
66
```

The first line (0) is the setting of the left margin of the front page of the SF-600. The second line (0) is the left margin of the back page. The third line (0) is the number of lines in the top margin of the front page and the fourth line (0) is the same number for the back page. The fifth line (44) is the bottom margin of the front page and the sixth line (56) is the bottom margin of the back page. The last line (66) is the number of characters across the page.

You may need to experiment to determine which settings work best with your printer. Be sure to check the revision number on the SF-600 form. There are a number of different revisions available and the size of the form may vary.

APPENDIX A
DIAGNOSTIC CATEGORIES

MYOCARDIAL INFARCTION

Myocardial Infarction (M.I.) is a leading cause of mortality and morbidity in the population of the western, affluent world. In the United States, the annual incidence is approximately 1,000,000 cases weighted towards a middle or older age group. Pre-hospital mortality approaches 50%. M.I. is acute necrosis of myocardium secondary to a sudden interruption or decrease of blood supply. Major risk factors are hypertension, hyperlipidemia, and smoking. Diabetes and angina are related risk factors unlikely to be present in the submarine population.

A history of acute onset of crushing substernal chest discomfort radiating to the left arm and accompanied by diaphoresis, nausea, and a sense of impending doom is classic. The pain lasts longer than 20 minutes and is unrelieved by rest and nitroglycerin. Physical exam ranges from near normal to obvious shock. An electrocardiogram (ECG) taken early in the course is abnormal less than 50% of the time, but may show ST elevation, T wave inversion, or left ventricular hypertrophy. Q waves appear later. Although useful, cardiac enzyme determinations are not available aboard submarines at this time (winter 1987-1988). Variations in the presentation are legion and well-documented. Diagnosis must be made on clinical grounds incorporating risk factors, the history and physical exam, the ECG (if available), and the practitioner's impression of the patient's overall condition.

ANGINA

Relative myocardial ischemia from an imbalance in myocardial oxygen supply versus demand is believed to be the basis for angina pectoris. Risk factors are the same as for M.I. Angina (ANGINA) is commonly described as substernal chest pain, pressure, tightness, or burning sensation that may radiate to the left arm (or elsewhere). The discomfort is relieved within 1-5 minutes of resting and/or by nitroglycerin.

The physical exam is usually normal. Cardiac examination, during an episode of pain, may reveal an S3, a mitral regurgitant murmur, or a systolic bulge that disappears as the pain subsides. The ECG is usually normal but may show ST depression which later resolves. If measured, cardiac enzymes would be found to be normal.

Diagnosis is made on the assessment of risk factors, the history and physical exam, the ECG (if available), and the response to rest and nitroglycerin.

Variant or "rest" angina, also known as Prinzemetal's angina, is due to coronary artery spasm. There is a good response to nitroglycerin but not to rest. The ECG may show transient ST elevation.

Recurrent and frequent episodes of angina may be harbinger of impending M.I. The episodes may occur given less cardio-pulmonary stress and be less responsive to rest and nitroglycerin than typical episodes.

NON-SPECIFIC CHEST PAIN

Non-specific chest pain (NONSCP) is intended to encompass those disorders which are not serious and not a cause for medical evacuation. Pain in this category is often more annoying than worrisome to patients. This aspect is helpful in diagnosis.

The likelihood of chest pain being due to non-specific causes varies with the age of the patient and clinical circumstances of the case. In a young adult without previous or recent medical illness, a serious cause of chest pain is unlikely.

Non-specific causes of chest pain include: a) musculoskeletal pain; b) costochrondritis (Tietze's syndrome); c) esophagitis; d) esophageal spasm ("esophageal angina"); e) hyperventilation syndrome; f) psychoneurotic disorder; g) epigastric lesions (cholelithiasis, peptic ulcer. etc.).

Musculoskeletal pain and costochrondritis denote muscle, rib, or cartilage pain due to inflammation or trauma. The pain is often sharp, of moderate intensity, localized to the chest wall, and reproduced by direct manipulation of the affected area.

Esophagitis and esophageal spasm are felt substernally in the mid-chest and/or epigastrum. Esophagitis is caused by direct irritation from food or drink, by reflux of gastric contents, or by infection (the latter is uncommon in healthy people). There is a good response to liquid antacids, a fact which assists in diagnosis. Esophageal spasm may follow a meal and is accompanied by dysphagia. The pain is relieved by nitrogylcerin, making differentiation from classic angina difficult. The concommitant dysphagia and lack of relationship to exercise may be helpful in diagnosis.

Hyperventilation syndrome is a relatively common cause of chest discomfort in an (already) anxious person. The accompanying breathlessness, palpitations, weakness, and response to re-breathing techniques are diagnostic.

In psychoneurotic disorders no physical etiology for chest pain is found. This diagnosis is best made by those skilled in psychiatric evaluation. It should be assumed that crewmembers with chest pain have a physical etiology for chest pain.

Disorders that present with epigastric pain such as gastritis, peptic ulcer, pancreatitis, and cholelithiasis may occasionally be confused with chest pain disorders. In most of these disorders, the abdominal exam is revealing -- any abdominal tenderness points to a non-chest source of the pain. The key issue is to avoid overlooking an atypical presentation of M.I. The assessment of risk factors, the history and physical exam (chest and abdominal), and the ECG (if available) are helpful in this regard.

CHEST INFECTION

This category comprises not only chest infections, primarily pneumonia, but also pneumothorax.

Pneumonia

Pneumonia is an alveolar infection caused by a bacterium, virus, or other non-bacterial pathogen. Pneumococcal (bacterial) pneumonia is most likely in the isolated case. Mycoplasma and viral pneumonia (both are non-bacterial) are more common in outbreaks of pneumonia involving groups of people who are ill. Chest pain as a component of pneumonia is due to pleural or bronchial irritation. The pain may be felt anywhere in the thorax and is exacerbated by coughing or deep breathing. The pleuritic component to the pain distinguishes it from M.I. or ANGINA. Additionally, pneumonia is characterized by coexisting or recent upper respiratory tract symptoms, malaise, anorexia, fever, chills, cough, and sputum production. Dyspnea, tachypnea, and tachycardia may be present.

Physical exam reveals varying degrees of vocal fremitus, egophony, dullness to percussion, rhonchi, and rales. These signs are worse with bacterial pneumonia and generally less severe in cases of a non-bacterial etiology.

A lung infiltrate is usually visible on chest roentgenogram, but this study is unavailable aboard some ships. The white blood cell count is elevated in bacterial pneumonia, but near-normal or depressed otherwise. Mycoplasma pneumonia is common in young adults and varies in appearance from the milder illness of a viral pneumonia to the more serious bacterial pneumonia. A right lower lobe pneumonia will occasionally present as abdominal discomfort in a younger person. A compatible history and rales in the lung field, that do not clear with cough, are the best indicators of the presence of pneumonia. The ECG is normal except for sinus tachycardia.

Pneumothorax

Pneumothorax involves a degree of collapse of a lung secondary to entrance of air into the potential space between visceral and parietal pleura. Spontaneous pneumothorax develops de novo from rupture of an existing pulmonary bleb or occurs during respiratory infection. Cough or another mechanism whereby intra-alveolar pressure is elevated may be a precipitating factor. Penetrating chest trauma, rib fracture, and barotrauma from diving or flying accidents are other causes.

There is an acute onset of chest discomfort on the side of the pneumothorax, with a pleuritic quality to the discomfort. Dyspnea, tachypnea, and cyanosis may be present with a large pneumothorax.

Physical exam reveals absent breath sounds and tympany overlying the pneumothorax. The trachea may be deviated away from the affected side. There is no fever or accompanying respiratory infection, unless pre-existent. Subcutaneous emphysema may be present in the chest wall or neck area if the parietal pleura is torn. The ECG will show sinus tachycardia.

The pneumothorax is visible on chest roentgenogram, although this study is unavailable on some ships. White blood cell count is normal unless there is acute distress, whereupon it might be elevated moderately. Occasionally, a "one-way valve" effect exists leading to the life-threatening tension pneumothorax. Usually, the non-tension pneumothorax stabilizes within a few minutes.

APPENDIX B

DATASHEET DEFINITIONS

SITE OF PAIN definition:

> CENTRAL
> CHEST
> ACROSS
> LT. SIDE
> RT. SIDE
> EPIGASTRIC
> OTHER

Get the patient to bare his chest and ask him to indicate with one finger where the pain is. Choose a category which fits best. Remember that larger areas take precedence over smaller ones. Record the widest area you note. For example, if the pain is right across the chest, do not record the 'left' and 'right' side separately, record 'across' the chest.

RADIATION OF PAIN definition:

> NONE   NECK
> LT. ARM   JAW
> RT. ARM   THROAT
> BOTH ARMS   FINGER/HANDS
> BACK   EPIGASTRIC
> CHEST   OTHER
> SHOULDERS

RADIATION is pain spreading from a primary site such as the chest to other areas. Patients often describe this pain as 'moving' or 'striking' or 'shooting' to the area in question. Ask specifically about each of the possible choices above. As with the primary site of pain, the categories should be mutually exclusive. For example, if the pain goes down both arms record 'both arms', do not record 'left arm' and 'right arm' separately.

DURATION OF PAIN definition:

1 H OR LESS	12 - 24 H
1 - 2 H	24 - 1 W
2 - 4 H	1 W OR MORE
4 - 12 H	

In assessing DURATION OF PAIN, we are interested in the length of time since the pain began. We are interested only in the present episode of illness.

If the patient has had previous episodes of pain weeks (or months) ago, do not include this in the durration of the present episode, but note under "Previous Chest Pain."

ONSET OF PAIN definition:

SUDDEN
GRADUAL

Determine how long it took the pain to develop fully. Usually if this took less than two minutes you should note "sudden" - if it took more than two minutes it should be "gradual."

It is often a good plan to ask a patient what he was doing when the pain began. If the patient can remember this vividly, it indicates a sudden onset (though a vague answer tells you nothing).

TIME COURSE OF PAIN definition:

CONTINUOUS
INTERMITTENT

If your patient has had specific times (usually at least a few minutes ranging up to a few hours) when he has been free of pain, since the present episode started, the pain is intermittent. Otherwise, assess as continuous.

Beware of the patient with a long history of "intermittent" pain. If this goes back for more than a week, you should question whether this is acute chest pain at all.

TYPE OF PAIN definition:

TIGHT	GRIPPING	DULL
SHARP	BURNING	STABBING
HVY/PRESS/CRUSH	ACHING	NAGGING

These are subjective categories. Ask the patient to describe the TYPE OF PAIN using one of these nine adjectives.

NUMBNESS definition:

> PRESENT
> ABSENT

This refers to the present illness only. Your patient may describe an absence of sensation or a 'tingling' in some areas. This is a subjective phenomenon. Some people call it "pins and needles."

Ask the patient if he feels any numbness/tingling/pins and needles in any area of the body. Ask particularly about the trunk and arms, especially the arms and hands.

SEVERITY OF PAIN definition:

> MODERATE
> SEVERE

Do not ask the patient directly and do not expect to rely on the answer if you do. If the pain is obviously intense and is causing obvious distress such as sweating or shivering, then it is severe, otherwise it is moderate. The difficulty in distinguishing between mild and moderate pain is so great that we prefer to call all pain moderate or severe. Be especially wary of relying on the patient's description since the threshold for pain varies greatly between people. A patient with mild or moderate pain may make a great deal of fuss about it. The patient who is quiet may be in severe pain. Use your own judgment.

AGGRAVATING FACTORS definition:

> MOVEMENT
> COUGH
> BREATHING
> SITTING
> LYING DOWN/REST
> LEANING FORWARD
> OTHER
> NONE

This category refers to activities which make the pain worse. Ask about each of the above items in a natural manner, e.g. "Does 'X' affect your pain."

Remember that patients tend to say "yes." It is best to ask the patient to do something (e.g. take a deep breath) and if this appears to cause pain remember to ask where the pain is felt. For example, pain on deep breathing has a totally different significance if felt in the lateral side of the chest or in the RUQ of the abdomen.

PROGRESS definition:

> BETTER
> SAME
> WORSE

This refers to the overall progress of pain since the start of the present episode. Ask yourself, from the patient's description of his symptoms, if, in general, the pain is getting better, staying the same, or getting worse.

RELIEVING FACTORS definition:

> NITRO
> REST
> WALKING
> MORPHINE
> OTHER DRUGS
> OTHER

This refers to patient activities which ease the pain. Ask about each of the above items in a natural manner, e.g. "Does X affect your pain."

Remember we are only talking about the present episode. For example, pain usually eased by a nitroglycerin tablet put under the tongue, but not on this occasion, should be recorded as "no relieving factors."

DYSPNEA definition:

> ABSENT
> THIS ILLNESS
> CHRONIC

This is shortness of breath while not engaged in any activity. Ask "Have you felt unusually short of breath, especially while resting." It is also important to distinguish between chronic dyspnea and dyspnea which has started recently.

In general, it is wise (though not relevant to the computer program) to distinguish between dyspnea on moderate activity (such as climbing stairs or walking uphill), dyspnea on mild activity (walking about on the flat), and dyspnea at rest. Also, be particularly wary of shortness of breath which occurs when the patient lies down flat for this may indicate pulmonary congestion of a serious degree.

COUGH definition:

> ABSENT
> THIS ILLNESS
> CHRONIC

Here it is important to distinguish between a chronic cough and a cough which has recently started. As part of a complete history, you should also distinguish

between a dry cough and a productive cough (this is one which is accompanied by sputum).

SPUTUM definition:

PRESENT
ABSENT

Sputum is fluid coughed up from the respiratory tract. The consistency and color may vary. In acute heart failure or after a pulmonary embolus, the sputum is often frothy and white - or tinged with red. In chest infection, it is more usually viscid (thicker) and may be either yellow or green in color. Only put PRESENT if sputum is a recent development.

ORTHOPNEA definition:

PRESENT
ABSENT

Orthopnea is breathlessness which occurs when the patient is lying flat, so that it prevents the patient from lying down comfortably. The patient has to be propped up in bed (usually with several pillows) or has to sit upright in a chair. The breathlessness usually signifies left sided heart failure. When the patient lies flat, fluid builds up in the lungs due to poor performance by the left side of the heart, impairing respiratory interchange and causing breathlessness.

PND - PAROXYSMAL NOCTURNAL DYSPNEA definition:

PRESENT
ABSENT

Attacks of breathlessness at night. The patient usually awakes with a feeling of suffocation and gasps for breath. It is commonly associated with wheezing which can indicate a bronchospasm. It differs from Orthopnea in that the symptoms are not usually relieved by sitting up.

REFLUX definition:

PRESENT
ABSENT

Regurgitation of acid and peptic juices from the stomach. This causes a bitter (sour) tasting fluid to enter the mouth from the throat (in quite small amounts). Needs to be carefully distinguished from VOMITING (which is accompanied by retching, often nausea, and consists of partly digested food) and SPUTUM (which is coughed up from the lungs and air passages).

NAUSEA definition:

PRESENT
ABSENT

The presence of NAUSEA means your patient is feeling sick to his stomach. NAUSEA may be accompanied by weakness, sweating, and profuse salivation. It may, or may not, be accompanied by vomiting.

VOMITING definition:

PRESENT
ABSENT

VOMITING means the patient is being sick to his stomach with an appreciable amount of stomach contents expelled. This should be distinguished from "burping" up small amounts of acid material, which is not vomiting, but reflux.

APPETITE definition:

NORMAL
DECREASED

In assessing appetite, you should be interested in RECENT change in appetite. Determine what is normal or usual for this patient and then assess if there has been a recent change in the patient's desire to eat.
Only if there has been a recent decrease in the patient's desire to eat should you mark "decreased", otherwise mark "normal."

BOWELS definition:

NORMAL
CONSTIPATED
DIARRHEA

Here we are interested in recent change. Ask about the patient's normal bowel habits and then ask about the last 24-48 hours. If there has been a marked decrease in the number of stools, circle constipated - and if a marked increase circle diarrhea. Remember to distinguish between loose and watery stools in your record and diagnosis. If you are unsure it is best to indicate normal, since bowel habits in the normal population tend to vary widely.

PREVIOUS CHEST PAIN definition:

YES
NO

Check carefully for times in the past when your patient has experienced chest pain. Incidents may be forgotten and sometimes they are concealed by the patient.

It is especially relevant to ask about two types of pain:
1) previous episodes in the past similar to the present attack, and
2) episodes of vague chest pain in the weeks prior to the present incident.

Only the first is relevant to the computer program, but the second is important to your evaluation of the patient, irrespective of the program output. Many doctors feels that this vague "prodroma" may be a forerunner of cardiac problems.

PREVIOUS CARDIO-RESPIRATORY ILLNESS definition:

YES
NO

This refers only to a significant illness involving the cardio-vascular or respiratory systems. Ask about, and check the patient's health record for, major illnesses in the past such as high blood pressure, angina, pericarditis, pneumonia, pnemothorax, pulmonary embolism, asthma.

PREVIOUS MAJOR SURGERY definition:

YES
NO

This refers to major surgery of any kind. Ask about, and check health records for, major surgery in the past.

SMOKER definition:

YES
NO

A smoker is defined as a person who smokes 10 or more cigarettes per day.

POSITIVE HISTORY FOR definition:

MI
ANGINA
BRONCHITIS
HYPERTENSION
DIABETES

This refers to a relevant history of chest problems either pain, cough or breathlessness which has been treated by a physician. Ask the patient about each item specifically.

TEMPERATURE definition:

     NORMAL
     INCREASED (> 99.6 F)
     DECREASED (< 97.8 F)

Select the appropriate category.

PULSE RATE definition:

```
        <   61
61  -   70
71  -   80
81  - 100
        > 100
```

Select the appropriate category.

RESPIRATION definition:

```
        <  20
20
21  -  25
26  -  30
        >  30
```

Select the appropriate category.

BLOOD PRESSURE (systolic) definition:

```
         < 100
101  - 120
121    140
141  - 160
         > 160
```

Select the appropriate category.

BLOOD PRESSURE (diastolic) definition:

```
        <  71
71  -  80
81  -  90
91  - 100
        > 100
```

Select the appropriate category.

ECG definition:

ST ELEVATION
T DEPRESSION
Q WAVES
ST DEPRESSION
ARRHYTHMIA
WITHIN NORMAL LIMITS

ST Elevation: The ST segment is the section of the tracing between the QRS complex and the T wave. It is elevated, if, with respect to the T-P segment, the ST segment rises more than 1 mm in the standard leads or more than 2 mm in the chest leads. In shape, the normal ST curves gently into the proximal limb of the T wave. A strictly horizontal ST which forms a sharp angle with the proximal limb of the T wave is called "plane depression" and is strongly indicative of myocardial ischemia.

T Depression: The T wave follows the QRS complex and represents the repolarization phase of the ventricles. In adults, T waves are normally upright in leads I, II, and V3 - V6; inverted in aVR; and variable (upright or inverted) in III, aVL, aVF, V1, and V2.
Mark T waves depressed if the T waves are inverted in leads I, II, or chest leads V3 - V6.

Q Waves: The Q wave is thought to be caused by the initial depolarization of the ventricular septum. When present, the Q waves is the first downward or negative deflection after the P wave. Very small, insignificant Q waves may be present normally in certain leads (I,II,V5, V6).
A significant Q wave is 1 mm wide (.04 sec) or one-third the size of the QRS complex. The presence of significant Q waves is diagostic of myocardial infarction. Scan all leads (except lead aVR for which Q wave data may be unreliable) for the presence of Q waves.

ST Depression: The ST segment is the section of the tracing between the QRS complex and the T wave. It is depressed if the ST segment is below the T-P segment by more than 1 mm in the standard leads or by more than 2 mm in the chest leads.
ST segment depression can be caused by digitalis, acute posterior infarction (depression in V1 or V2), sub-endocardial infarction (flat depression of the ST segment), or ventricular strain (moderate depression)

Arrhythmia: An arrhythmia is any variation from the normal rhythm of the heart. 13 abnormalities are defined and depicted in the chest pain program. They are: 1st Degree Heart Block, 2nd Degree Heart Block (Type I and Type II), 3rd Degree Heart Block, Atrial Flutter, Atrial Fibrillation, Ventricular Tachycardia, Ventricular Fibrillation, Asystole, Sinus Tachycardia, NSR with Occasional PVC's, NSR with Occasional PAC's, and Sinus Bradycardia. For your information, NSR and NSR with 60 HZ interference are also depicted.

Within Normal Limits: By definition, the scope of Within Normal Limits is too broad to be encompased within this paper. For any questions, please refer to appropriate textbooks. Mark this response only if the definition is met.

References:

American Heart Association, Textbook of Advanced Cardiac Life
    Support, AMA National Center, Dallas, TX., 1983.

Dubin, D., Rapid Interpretaion of EKG's, third edition, Cover
    Publishing Co., Tampa, 1978.

Marriott, Henry J. L., Practical Electrocardiography, sixth edition,
    The Williams & Williams Co., Baltimore, 1977.

SGOT definition:

$$
\begin{array}{rcl}
  & < & 25 \\
25 & - & 50 \\
51 & - & 100 \\
100 & - & 200 \\
  & > & 200
\end{array}
$$

Serum Glutamic Oxaloacetic Transaminase was the first enzyme to be widely used as a laboratory diagnostic aid. It begins to rise 12 hours post injury, peaks at 2-4 times normal at 24 hours, and returns to normal in 4-7 days. It is also released from an injured liver and other cells and is thus a sensitive but non-specific indicator. The current terminology is "AST" or aspartate transferase. Facilities for measurement may not be available at sea.

MOOD definition:

NORMAL
ANXIOUS
DISTRESSED
IN SHOCK

If the patient is experiencing significant physical symptoms (such as pain, nausea or vomiting), circle DISTRESSED. If the patient is primarily worried about his illness, circle ANXIOUS.

Shock is an acute hemodynamic disturbance including hypoxia and inadequate tissue perfusion. As such, the term is difficult to precisely define. However, shock is also a well used clinical syndrome and reflects the clinical manifestations of these hemadynamic disturbances. Patient's with shock tend to have some or all of the following: rapid pulse, low volume pulse, diminished blood presure (systolic below 95mm hg), pallor, sweating and anxiety. A patient with a majority of these symptoms would usually be said to be IN SHOCK.

COLOR definition:

> NORMAL
> PALE
> FLUSHED
> CYANOTIC

Check especially for pallor (unusual absence of color), flushing (unusual ruddiness), or cyanosis (blueness). In blacks, also check the extremities and mucus membranes, e.g. nailbeds, nose, lips, conjunctivae. Remember that studies have shown that patients tend to appear pale or cyanotic under artificial light (especially fluorescent light).

Remember also that a cold environment may cause peripheral cyanosis (extremities) but not central cyanosis.

EDEMA definition:

> ABSENT
> ANKLES
> OTHER

Excessive accumulation of fluid in body tissues. The commonest mode of presentation is swollen ankles - usually noticed towards the end of the day, and often resolved by elevation of the legs and a night's rest. In patients who are confined to bed, it may present over the sacrum or lower back. If heart failure is far advanced edema can even become generalized.

There are two types of edema, "pitting" (which indicates heart failure) and "non-pitting" (which indicates blockage of lymphatics). ONLY THE FORMER is significant in acute chest pain. To elicit "pitting" edema, press your thumb fairly hard on top of the swollen area. It will sink in somewhat. Wait 30 seconds, then release. In "pitting" EDEMA, a MARKED depression (or pit) will remain in the skin, for at least 10-15 seconds.

SWEATING definition:

> YES
> NO

Self-explanatory. We assume that the sweating is not due to an obvious cause (such as hot environment or heavy exercise).

SHIVERING definition:

> YES
> NO

Self-explanatory. We assume that the shivering is not due to a cold compartment. Beware of a diagnosis of hysteria in patients who are shivering and

anxious. Many patients with heart disease experience severe anxiety. Thus if the patient is shivering without obvious cause, record "YES".

RESPIRATORY MOVEMENT definition:

> NORMAL
> ABNORMAL

To examine for respiratory movement you should check the amount and pattern of chest expansion. Check for two things:

    a) At the level of the nipples measure the amount of chest expansion with a tape measure or string. If the difference between full inspiration and full expiration is less than two inches, circle ABNORMAL (don't draw the tape tightly enough to push in on the skin).

    b) Have the patient sit up and stand behind him. Place both your hands on the patient's back with your thumbs horizontal and meeting in the midline, the fingers spread fan-wise. Have the patient breathe in deeply and note (1) whether the tips of the thumbs move apart as the chest expands and (2) whether this expansion is equal on both sides. If obviously different or reduced, record "ABNORMAL" and indicate which side, if either, is reduced.

PERCUSSION definition:

> NORMAL
> DULL
> HYPER-RESONANT

Be sure to carefully percuss both the front and back of the chest. The best method is to compare sides as you go, left with right. If the sides don't sound the same, there may be an abnormality. The lungs should normally sound somewhat resonant. If an area sounds markedly less resonant than normal, circle DULL; if an area is markedly more resonant than normal, circle HYPER-RESONANT, otherwise circle NORMAL.

CAUTION: When percussing anteriorly right and left sides are normally different in two areas: 1) dullness should be present to the left of the lower sternum over the heart and 2) when percussing below the level of the xiphoid (tip of the sternum) there is usually hyper-resonance to the patient's left (over the gastric bubble of the stomach). So pay particular attention to differences you note in percussing posteriorly.

CHEST SOUNDS definition:

> NORMAL
> RHONCHI
> RALES
> DECREASED

Listen with the diaphragm of your stethoscope to your patient's back. Listen over the upper part of the chest and also over the bases of the lungs at the bottom of the rib cage. Have the patient breathe deeply through his mouth and compare right and left sides. If one side is markedly decreased, write DECREASED.

Rales are discrete, non-continuous (crackling) sounds produced by moisture in airways of the lung. Fine rales sound like the rubbing of a lock of hair between your fingers near your ear. Rales are usually heard late in inspiration. If you suspect heart failure, fine rales should be checked for by listening to the lung bases (about 2 finger widths below each scapula) and having your patient cough, then breathe deeply. Coraser rales can be heard elsewhere in the lung in conditions such as pneumonia.

Rhonchi are continuous, musical sounds that range from high-pitched wheezes to lower-pitched moaning. Rhonchi can be both inspiratory and expiratory although they are often more prominent in expiration. They can be heard anywhere over the lungs. Rhonchi are usually heard with infections such as bronchitis or pneumonia, or with airway spasm (asthma).

It is a good idea if you hear suspicious sounds to ask the patient to cough. If the sounds persist, they are usually significant.

COLD/CLAMMY definition:

> YES
> NO

The patients skin feels cold (clammy) to the touch.

CALF TENDERNESS definition:

> YES
> NO

Calf tenderness is pain felt on pressure over either calf. (The calf is the thick muscular area over the back of the lower leg.)

In trying to elicit this sign, pay special attention to the MIDLINE - run your fingers down from the back of the knee to about 3 inches above the ankle, pressing moderately hard every 3-5 cm. If this causes definite pain, or if dorsi-flexion of the foot causes pain in the same area at the back of the calf (Homan's sign), calf tenderness is PRESENT.

CHEST WALL TENDERNESS definition:

      YES
      NO

Refers to tenderness anywhere in the chest, on light to moderate pressure by the examiner's hand.

After TRAUMA, this sign has a totally different significance (it may indicate a fractured rib). LEAVE OUT this category if there is any suspicion of previous recent trauma.

JUGULAR VENOUS PRESSURE (J.V.P.) definition:

      NORMAL
      RAISED
      LOW

Standing on your patient's right, have your patient reclining at a 45 degree angle, his chin turned about 30 degrees to the left, with a light shining at an angle across his neck so that his right neck vein casts a shadow. It is important to distinguish the external jugular vein from the carotid artery pulse. This can be accomplished by pressing lightly but firmly against the vein at the base of the neck; the vein pulsation will be stopped by this maneuver while the arterial pulsation will not be (since artery pressure is higher).

With the patient in this position and the external jugular vein identified, check in the following way: if the meniscus of the vein is seen more than one half of the distance from the clavicle to the chin, circle RAISED. Otherwise, circle NORMAL. If you're not sure, omit this entry.

Just occasionally (in a shocked patient usually) you will be unable to locate any trace of the external jugular vein - even when the patient is lying completely flat. This is usually because the vein is empty and the walls have collapsed. Under these circumstances, circle LOW; and check the patient carefully for the other signs of clinical shock.

HEART SOUNDS definition:

      NORMAL
      ABNORMAL

With the diaphram of your stethoscope listen carefully to the first and second heart sounds (LUB-DUB, LUB-DUB). These should be clearly audible and regular. If you can hear anything else, or if the heart sounds are irregular, circle ABNORMAL. Otherwise circle NORMAL.

Sometimes changing your patient's position makes auscultation easier. Have him sit up, lean forward, or lie on the left side, as needed.

If the heart is irregular, try and correlate the rhythm with the patient's respiration. Remember that in young healthy men the heart can speed up and slow down in time with respiration. This is called sinus arrythmia and is normal.

APPENDIX C

TREATMENT PROTOCOLS

MYOCARDIAL INFARCTION

DISCUSSION

Myocardial Infarction (M.I.) is a leading cause of mortality and morbidity in the population of western, affluent civilization. In the United States, the annual incidence is approximately 1,000,000 cases weighted towards a middle aged or older group. Pre-hospital mortality approaches 50%. M.I. is acute necrosis of myocardium secondary to a sudden interruption or decrease of blood supply. Major risk factors are hypertension, hyperlipidemia, and smoking. Diabetes and angina are related risk factors unlikely to be present in the submarine population.

A history of acute onset of crushing substernal chest discomfort radiating to the left arm and accompanied by diaphoresis, nausea, and a sense of impending doom is classic. The pain lasts longer than 20 minutes and is unrelieved by rest and nitroglycerin. Physical exam ranges from near-normal to obvious shock. An electrocardiogram (ECG) taken early in the course is abnormal less than 50% of the time, but may show ST elevation, T wave inversion, or evidence of left ventricular hypertrophy. Q waves appear later. Although useful, cardiac enzymes determinations are not available aboard submarines at this time, winter 1987-1988. Variations in the presentation are legion and well-documented. Diagnosis must be made on clinical grounds incorporating risk factors, the history and physical exam, the ECG (if available), and the practitioner's impression of the patient's overall condition. Early mortality is most feared and is due to a lethal dysrhythmia. After 24 hours, the death rate declines steadily.

DIFFERENTIAL DIAGNOSIS

Among other diagnoses which can commonly mimic symptoms of myocardial infarction are:

a) Pulmonary embolus
b) Pericarditis
c) Aortic dissection
d) Acute pancreatitis
e) Spontaneous mediastinal emphysema
f) Angina - see ANGINA

a) Pulmonary embolus is heralded by an acute onset of dyspnea, pleuritic chest pain, apprehension, cough, and occasionally hemoptysis. Substernal chest pain is present in less than 5% of the cases. Upon exam, tachypnea, tachycardia, diaphoresis, and rales may be noted. Differentiation from M.I. may be difficult but the dyspnea and tachypnea are prominent, whereas in M.I. pain is the chief complaint. If thrombophlebitis (calves, thighs) is noted, pulmonary embolism is most likely. The ECG will be normal or show tachycardia with or without T wave changes. Bedrest, O_2, leg elevation, pain medication, and anticoagulation are necessary until MEDEVAC can be effected. Anticoagulation cannot be accomplished safely aboard ship.

b) Pericarditis is characterized by mild to severe precordial chest pain with fever, leukocytosis, and a pericardial rub. The pain is relieved somewhat by sitting up and leaning forward. High dose aspirin and bed rest are therapeutic. Occasionally, fever and/or leukocytosis are absent or minimal. Pericarditis can be caused by infection, trauma, or neoplasm, or can be of unknown cause (idiopathic pericarditis).

c) Aortic dissection is a medical/surgical emergency characterized by the acute onset of severe substernal chest pain radiating to the back. The patient may present in extremis. A diastolic heart murmur and significantly different upper extremity blood pressure readings may be noted. Treatment consists of bed rest with IV fluids, pain medication and immediate MEDEVAC. Blood pressure should be maintained with saline or Ringer's lactate through two large bore IV catheters.

d) Acute pancreatitis is characterized by moderate to severe epigastric pain radiating to the back. It is often associated with ulcer disease, cholecystitis, trauma, or alcoholism and may occasionally be confused with M.I. The abdominal exam will reveal epigastric tenderness not found with M.I. The ECG may be normal or show sinus tachycardia. Treatment consists of bowel rest, IV fluids, pain medication, and, perhaps, antibiotics.

e) Spontaneous mediastinal emphysema, while common in divers, is otherwise uncommon. The presentation involves precordial chest pain with, perhaps, a plueritic component in an otherwise healthy-appearing individual. Subcutaneous emphysema may be palpable and a mediastinal crunch is noted upon auscultation. The ECG is normal. Treatment with an analgesic and reassurance is adequate.

f) Angina - see ANGINA.

TREATMENT

The goals of treatment of M.I. are to: 1) relieve the pain; 2) control dysrhythmias; 3) minimize infarct extension; and 4) compensate for compromised cardiac function. The patient should be placed in bed and an IV of D5W at KVO rate started.

Relief of pain is accomplished with bed rest and IV morphine sulfate 1-4 mg every 2-5 minutes as needed for pain relief up to a maximum of 10-15 mg in every 3 hour period. Dosages above this amount are rarely necessary and may be associated with CNS depression and hypotension. Morphine should probably be withheld if the systolic blood pressure is below 100 mm Hg. While there is no harm in trying sublingual nitroglycerin (NTG) initially, classically the pain of M.I. is unrelieved by NTG. If full relief is obtained with NTG, angina is a more likely diagnosis. Other narcotics (i.e. Demerol) also relieve the pain of M.I., but are not discussed here.

CAUTION : Whenever IV narcotics are used, the opioid antagonist naloxone (Narcon), should be immediately available. If the patient becomes unconscious while injecting morphine, 1-2 ampules (0.4-0.8 mg) of naloxone should be given IV and the ABC's of resuscitation employed as necessary. If the episode is due to narcotic overdose, consciousness will return within a minute or two. The pain will likely return and can be treated with morphine. The 10-15 mg maximum morphine every 3 hours may then have to be judiciously overstepped. NOTE : the duration of action of naloxone is less than of morphine. Such patients must be monitored for 3 or more hours.

Control of ventricular dysrhythmias is accomplished through adequate dosage of lidocaine HCl. While in the past lidocaine was used only at the onset of an arrhythmia, the current weight of evidence points toward its use in the prophylaxis of dysrhythmia as well. The protocol is outlined below:

1) For documented PVC's or V-tach :
   a) 75 mg IV over 2 min at time zero
   b) Start 2 mg/min drip
   c) Re-bolus with 50 mg over 2 min at time 6 min,
      time 11 min, time 16 min (thus the boluses equal
      75+50+50+50=225 mg)

2) For prophylaxis:
   a) 75 mg IV over 2 min at time zero
   b) start 2 mg/min drip
   c) May administer another 75 mg IV over 2 min at
      time 6 min.

The extent of the infarct is limited by bed rest, control of pain and (perhaps) by the use of supplemental O_2. The latter can be supplied at 2 liters/min by nasal

cannula. Straining to have a bowel movement should be avoided. A Surfak(R) capsule po bid is used. Valium 5 mg po bid-qid may be used for control of anxiety in the awake, alert patient.

Loss of myocardial tissue leads to varying degrees of impairment of myocardial function. If rales are not heard upon chest exam and peripheral edema is absent, the impairment is (at least temporarily) adequately compensated.

USUAL COURSE WITH TREATMENT

Response to the therapeutic regimen will generally be good. Recurrence of pain with declining morphine blood level is common and treated by readministration of morphine IV. Transient ventricular dysrhythmia may occur but is less common when lidocaine prophylaxis is given. Resolution of pain over the first 12-48 hours is accompanied by an increasing appetite, desire to ambulate, and (often) denial of the seriousness of the condition. The initial "ice-chip" diet can be advanced from clear liquids to a regular diet over 1-2 days as seems appropriate. Ambulation may begin on day 2 (minimal) and gradually advance to out-of-bed ad lib by day 7. Ladders should probably not be climbed until day 7, and then sparingly. Lidocaine, morphine, and the IV may be discontinued at 48 hours. Three weeks of no duty is reasonable, with a gradual return to light duty. NTG should be available for post-infarction angina. A medical officer ashore should be consulted upon return from sea.

NOTE :   a) The use of subcutaneous heparin until fully ambulatory is controversial. Heparin 5000 units subcutaneously q12h is generally safe and minimizes the chance of deep venous thrombosis.

b) It is advisable to draw a blood sample (10cc) daily, for 5 days, spin it down, and freeze the serum for possible enzyme analysis upon return. The analysis is possible even months after the event.

c) An ECG should be taken daily for 5 days. A previously non-diagnostic strip may later show an infarction or become normal, clarifying the initial impressions.

COMPLICATIONS AND THEIR MANAGEMENT

Uncontrolled dysrhythmias and cardiogenic shock are the complications of concern. Bursts of PVC's (or more than 5 per minute) and V-tach (3 successive beats) denote ventricular irritability which must be treated to minimize the chance of ventricular fibrillation or degenerating cardiac output. A 50 mg bolus of lidocaine over 2 min and an increase in the drip rate to a maximum of 4 mg/min is indicated. An additional 50 mg bolus in 5 min is safe if:

a) the dysrhythmia continues and
b) less than 300 mg of lidocaine have been given by bolus
    in the past 20 min. Administration of amounts greater
    than 300 mg over 20 minutes is potentially toxic with
    seizures the most worrisome problem.

The cardiac compromise due to M.I. may be manifested by minimal rales and dyspnea or massive pulmonary edema with shock. LasixR is the diuretic most used ashore for pulmonary congestion but it is not on the AMAL. It is recommended that it be obtained from the Squadron Medical Officer and used as outlined below. Fluid administration should be minimized.

First, sit patient up and administer O_2 by face mask at 5 liter/min, and if:

a) minimal rales - Lasix 20 mg IV push
b) moderate rales (halfway up the back) - Lasix 40 mg IV
    push
c) pulmonary edema (pinkish froth from mouth and rales
    throughout lung fields) - Lasix 40 mg IV push,
    consider rotating extremity tourniquets.

The input and outputs should be monitored with a urinary catheter (indwelling type preferable). If Lasix is unavailable, morphine works well, with or without rotating tourniquets. For example:

a) minimal rales - morphine 5 mg IV over 1-5 min
b) moderate rales - morphine 5-10 mg IV over 1-5 min
c) pulmonary edema - morphine 10 mg IV over 1-5 min,
    consider rotating tourniquets.

There may be a fine balance between unacceptable levels of hypotension caused by morphine or Lasix (sys BP < 100 mmHg) and pulmonary edema from cardiac failure.

Patients presentating with pulmonary edema and hypotension should be treated with O_2, rotating tourniquets, and Lasix 40 mg IV push. The upright posture is contraindicated if the patient is unconscious, otherwise a 30 degree sitting angle is reasonable. Morphine will exacerbate the hypotension but may be tried if Lasix is unavailable. Fluids to correct the hypotension may worsen the pulmonary edema, but they have been tried (100-300 cc Saline over 15-30 minutes). Needless to say, these individuals are gravely ill and have an in-hospital mortality of 80%. Aminophylline 5mg/kg (i.e. about 350 mg) in minimal dilutent (D5W) given over 15 min may help. Aminophylline is not on the AMAL for submarines.

ANGINA

DISCUSSION

Relative myocardial ischemia from an imbalance in myocardial oxygen supply versus demand is believed to be the basis for angina pectoris. Risk factors are the same as for M.I. Angina (ANGINA) is commonly described as substernal chest pain, pressure, tightness, or burning sensation that may radiate to the left arm (or elsewhere). The discomfort is relieved within 1-5 minutes of resting and/or by nitroglycerin.

The physical exam is usually normal. Cardiac examination, during an episode of pain, may reveal an S3 or S4, a mitral regurgitant murmur, or a systolic bulge that disappears as the pain subsides. The ECG is usually normal, but may show ST depression which later resolves. Cardiac enzymes are normal, although such testing is unavailable at sea.

Diagnosis is made on the assessment of the risk factors, the history and physical exam, the ECG, and the response to rest and nitroglycerin.

Variant or "rest" angina, also known as Prinzmetal's angina, is due to coronary artery spasm. There is a good response to nitroglycerin but not to rest. The ECG may show transient ST elevation.

Recurrent and frequent episodes of angina may be a harbinger of impending M.I. These episodes may occur given less cardiopulmonary stress than was present at the initial attack and the symptoms may be less responsive to rest and nitroglycerin than in typical stable angina.

DIFFERENTIAL DIAGNOSIS

Typical angina is occasionally simulated by these other categories of chest pain:

a) Myocardial Infarction - see M.I.
b) Esophageal spasm
c) Other causes of chest pain - see NONSCP

b) Esophageal spasm - The pain of esophageal spasm is felt substernally in the midchest or epigastrium. The pain may follow a meal and is accompanied by dysphagia. The pain is often relieved by NTG, making differentiation from classic angina difficult. The concommitant dysphagia and lack of relationship to exercise may be helpful in diagnosis.

TREATMENT

Angina is readily treated with rest and sublingual (SL) NTG. With the patient sitting up, a 0.4 mg ("1/150 grains") tablet is given SL. The resulting sublingual burning sensation and (occasionally) throbbing headache are accompanied by a gradual easing of pain over 1-5 minutes. If relief is incomplete, the dosage may be repeated at 5 min intervals to a total of 3 tablets.

USUAL COURSE WITH TREATMENT

The pain of angina often resolves within 5 minutes of rest and NTG administration. A residual nagging substernal discomfort of low grade intensity may persist and should be treated with continued rest and NTG administration. Headache from NTG can be treated with acetaminophen 650 mg po q4h.

One day of rest and observation is sufficient if there is no recurrence of pain and a follow-up ECG is normal. Light duty should be recommended for the remainder of the deployment. Smoking and heavy exertion are to be avoided. Caffeine intake (coffee, colas) and meal amounts should be diminished. Blood pressure, if elevated, should be controlled with hydrochlorothiazide 50mg po qd and reduced salt.

COMPLICATIONS AND THEIR MANAGEMENT

Hypotension from repeated administration of NTG is a possibility. It is easily treated by placing the patient in the Trendelenberg position (head down, legs up). If necessary, a 300 cc bolus of saline can be administered IV. The short duration of action of NTG leads to normalization of the BP within 5-10 minutes.

If, after days of relief from pain, there is a gradual return of chest pain, the patient should be re-examined. If the history and physical point to angina and there is relief with rest and NTG, there is no cause for alarm. The 24-hour bed rest and limitation of physical effort (with elimination of smoking, etc.) should be reinstituted. A follow-up ECG may be useful as in the initial evaluation, but needn't be repeated for each episode of angina.

Occasionally, there will be a rapid return of chest pain following an initial period of relief. If the pain returns after the 24-hour period of bed rest, or after three doses of NTG, or if no more than an hour has passed since the initial pain subsided, then infarction may be impending or occuring. The treatment suggestions for M.I. should now be employed: bed rest, IV D5W KVO, morphine for pain, dysrhythmia prophylaxis, etc.

NON-SPECIFIC CHEST PAIN

DISCUSSION

Non-specific chest pain (NONSCP) is intended to encompass those disorders which are not serious and not a cause for medical evacuation. This pain more often annoys than frightens the patient. This aspect is helpful in diagnosis.

The likelihood of chest pain being due to non-specific causes varies with the age of the patient and clinical circumstances of the case. In a young adult without previous or recent medical illness, a serious cause for chest pain is unlikely.

Common non-specific causes for chest pain include: a) musculoskeletal pain; b) costochrondritis (Tietze's syndrome); c) esophagitis; d) esophageal spasm ("esophageal angina"); e) hyperventilation syndrome; f) psychoneurotic disorder; g) epigastric lesions (cholelithiasis, peptic ulcer, etc.).

Musculoskeletal pain and the pain of costochondritis denote muscle, rib, or cartilage pain due to inflammation or trauma. The pain is often sharp, of moderate intensity, localized to the chest wall, and reproduced by direct manipulation of the affected area. The lung exam is normal. Treatment includes mild analgesics, heat therapy, and, perhaps, rest.

The pain of esophagitis and esophageal spasm is felt substernally in the mid-chest and/or epigastrium. Esophagitis is caused by direct irritation from food or drink, by reflux of gastric contents, or by infection (the latter is uncommon in healthy people). There is a good response to liquid antacids, a fact which assists in diagnosis. Esophageal spasm may follow a meal and is accompanied by dysphagia. The pain is relieved by nitroglycerin, making differentiation from classic angina difficult. The concommitant dysphagia and lack of relationship to exercise may be helpful in diagnosis.

Hyperventilation syndrome is a relatively common cause of chest discomfort in an (already) anxious person. The accompanying breathlessness, palpitations, weakness, and response to re-breathing techniques are diagnostic. The lung exam is normal.

In psychoneurotic disorders, no physical etiology for chest pain is found. This diagnosis is best made by those skilled in psychiatric evaluation. It should be assumed that crewmembers with chest pain have a physical etiology for chest pain.

Disorders that present with epigastric pain such as gastritis, peptic ulcer, pancreatitis, and cholelithiasis may occasionally be confused with chest pain disorders. In most of these disorders, the abdominal exam is revealing. Any abdominal tenderness points to a non-chest source of the pain. The key issue is to avoid overlooking an atypical presentation of M.I. The assessment of risk factors, the history and physical exam (chest and abdominal), and the ECG are helpful in this regard.

DIFFERENTIAL DIAGNOSIS

Non-specific chest pain is occasionally confused with:

a) Myocardial Infarction - see M.I.
b) Angina - see ANGINA

In general, vital signs are normal in non-specific chest pain disorders. A good appearance coupled with normal blood pressure, pulse, respiration, and temperature suggest a non-alarming etiology of the discomfort. A normal ECG or a finding of sinus tachycardia is typical.

TREATMENT

Most of these disorders respond well to symptomatic therapy. Musculoskeletal pain responds well to aspirin and heat. Costochondritis may require a more effective anti-inflammatory agent than aspirin for optimal treatment (i.e., indomethacin, not on the submarine AMAL). It may, however, be managed with aspirin, 3 tabs po q4h. Codeine 30-60mg po q4h may be added, if necessary.

Esophagitis is treated with (preferably) a liquid antacid regimen, 1 oz po q1-4h prn, with about a 7 oz maximum per day. Coffee intake and smoking should be eliminated.

Esophageal spasm responds to NTG and a liquid or soft diet. Food should be chewed well and taken with fluid, although this offers no guarantee of non-recurrence. The NTG should be used sparingly, and a medical consult obtained when ashore. Sometimes the spasm resolves without medication in minutes to hours of simply "waiting it out."

Hyperventilation responds to reassurance and bag re-breathing. Fifteen minutes of both will usually calm the individual. Rarely is medication indicated. If neccessary, Valium 5 mg po may be given. Parenteral medication and oxygen therapy are unnecessary. The patient should be encouraged to treat recurrences with re-breathing on his own.

Treatment of epigastric disorders is addressed by the abdominal pain program and your medical library.

USUAL COURSE WITH TREATMENT

Most non-specific chest pain disorders stabilize and improve following diagnosis. The simple reassurance that the disorder is not serious will lead many individuals to improve with modest therapy.

COMPLICATIONS AND THEIR MANAGEMENT

Musculoskeletal pain, costochondritis, and esophagitis are uncomplicated. Epigastric disorders can be complicated (i.e., bleeding ulcer, cholecystitis). Your abdominal pain program and medical library should be consulted in these cases.

Esophageal spasm can become nearly disabling requiring esophageal dilation by a specialist. If episodes become frequent and poorly responsive to NTG or a "waiting period," then a liquid diet may help.

Recurrent, prolonged hyperventilation episodes alarm the patient and surrounding personnel. They should not be ignored. Valium 5 mg po tid and an appropriate modification of duty may be necessary for a few days.

CHEST INFECTION

This category comprises not only chest infections, primarily pneumonia, but also pneumothorax. The database does not contain enough cases of pneumothorax to allow a separate category, so pneumothorax may be diagnosed by the computer as a chest infection. Due to limited space, the following treatment section will discuss only pneumonia and pneumothorax. Please refer to available texts for the treatment of other chest infections.

PNEUMONIA

DISCUSSION

Pneumonia is an alveolar infection caused by a bacterium, virus, or other non-bacterial pathogen. Pneumococcal (bacterial) pneumonia is most likely in the isolated case. Mycoplasma and viral pneumonia (both are non-bacterial) are more common in outbreaks of pneumonia involving groups of people who are ill. Chest pain as a component of pneumonia is due to pleural or bronchial irritation. The pain may be felt anywhere in the thorax and is exacerbated by coughing or deep breathing. The pleuritic component to the pain distinguishes it from M.I. or ANGINA. Additionally, pneumonia is characterized by coexisting or recent upper respiratory tract symptoms, malaise, anorexia, fever, chills, cough, and sputum production. Dyspnea, tachypnea, and tachycardia may be present.

Physical exam reveals varying degrees of vocal fremitus, egophony, dullness to percussion, rhonchi, and rales. These signs are worse with bacterial pneumonia and generally less severe in case of a non-bacterial etiology.

A lung infiltrate is usually visible on chest roentgenogram, but this study is unavailable aboard submarines. The white blood cell count is elevated in bacterial pneumonia, but near-normal or depressed otherwise. Mycoplasma pneumonia is common in young adults and varies in appearance from the milder illness of a viral pneumonia to the more serious bacterial pneumonia. A right lower lobe pneumonia will occasionally present as abdominal discomfort in a younger person. A compatible history and rales in the lung field, that do not clear with cough, are the best indicators of the presence or absence of pneumonia. The ECG is normal except for sinus tachycardia.

DIFFERENTIAL DIAGNOSIS

Pneumonia is clinically distinguishable from other chest pain syndromes. The complex of malaise, anorexia, fever, cough, sputum production, rales, rhonchi, tachypnea, tachycardia, and pleuritic chest discomfort is diagnostic.

Once the diagnosis of pneumonia has been made, the major differential diagnostic challenge is to distinguish a bacterial from a non-bacterial pneumonia. The sputum gram stain is invaluable in this regard. For this reason, microscopic analysis of a gram-stained sputum specimen should be performed. The sputum should be collected after coughing and should not have the appearance of saliva. A precleaned slide should be liberally smeared with purulent sputum, allowed to air dry, heat-fixed, gram-stained, and examined first under low power (to select a suitable area for viewing) then under high power. Only slides with rare or no epithelial cells should be accepted for viewing. Multiple epithelial cells denote a poor sputum specimen; if this is seen a new specimen should be obtained.

Interpretation of the nuances of a sputum smear requires experience. Basically, one is looking for: A) white cells (appear red) with minimal or no bacteria, or B) white cells with a plethora of bacteria. In instance "A" a non-bacterial (viral or mycoplasma) pneumonia is likely. In instance "B" a bacterial pneumonia is likely. A smear with white cells and bacteria requires further differentiation into a gram positive cocci-laden smear or a gram negative bacilli-laden smear. A smear with predominantly gram negative cocci or gram positive bacilli usually suggests a contaminated (poor) specimen since these are common organisms in the upper respiratory tract but rarely cause pneumonia.

Smears with: C) no white cells but many bacteria, or D) some white cells and a mix of different bacteria, both represent non-diagnostic smears. Another smear should be made in these cases.

In some instances, the patient cannot produce an adequate sputum specimen or the smear cannot be easily categorized as "A" or "B". The following clinical generalities may help differentiate a bacterial from non-bacterial pneumonia when smear results are inconclusive.

Clinical generalities:

1. Scanty sputum seen more often in non-bacterial pneumonia.
2. A normal or minimally elevated temperature (<101 F oral) seen more often in non-bacterial pneumonia.
3. Myalgias and headache commonly found in mycoplasmal or viral pneumonia, less commonly in bacterial pneumonia.
4. Rusty brown sputum seen in pneumococcal (a bacterial) pneumonia.
5. Pleuritic chest pain suggests bacterial pneumonia.
6. Severe shaking chills seen in bacterial pneumonia.

TREATMENT

The treatment of pneumonia consists of bed rest, hydration, adequate nutrition, an antipyretic, an antitussive, an antibiotic, and, possibly, an analgesic if pleuritic chest discomfort is disabling. Smoking is proscribed. Patients with dyspnea should receive supplemental humidified oxygen, the method of delivery and the flow rate dependent upon the degree of dyspnea.

Bed rest is essential for 48-96 hours, perhaps longer. Brief walks are advised; ladders are best avoided because of the often profound weakness accompanying pneumonia. Fluids, 16 oz po qid, help to maintain fluid respiratory secretions. At least one half-normal meal per day is needed. Aspirin or acetaminophen, 650 mg po q4h (when awake) relieve fever, headache and general discomfort. An antitussive (not quaifenesin - an expectorant) is appreciated by patients and is not harmful. If Robitussin DM , or its equivalent is not available (not on submarine AMAL) then codeine 7.5-15 mg po q4h can be added to quaifenesin 1-2 tsp po q4h.

An antibiotic is not indicated in viral pneumonia but is usually used in mycoplasma pneumonia and is always used in bacterial pneumonia. Viral and mycoplasma pneumonia are not distinguishable on clinical exam (chest x-ray, cold agglutinis, etc. are used ashore). Since an antibiotic is usually used in adults for mycoplasma pneumonia, it is best to start therapy when pneumonia is diagnosed at sea. Erythromycin 250-500 mg po qid (1st line) or Tetracycline 350-500 mg po qid (2nd choice) is used. Duration of therapy is 10-14 days.

For a gram positive bacterial pneumonia, penicillin 500 mg po qid is satisfactory. If the patient appears particularly ill, Penicillin G Procaine 500,000 units may be given IM, followed by the oral regimen. The penicillin-allergic patient should receive erythromycin 500 mg po qid. Duration of therapy is 10-14 days. It may require an extension of 7-14 days in some cases.

Gram negative bacterial pneumonia is unusual in a previously healthy person. The gram stain of the sputum should be repeated with a fresh specimen to reaffirm the diagnosis. If the staining and decolorizing procedure were carefully accomplished and the sputum sample was good, then treatment must be initiated with this diagnosis. The gram negative rod pneumonias are serious. Antibiotic therapy should be given parenterally. A two drug regimen of penicillin and gentamycin will cover a) most gram negative organisms and b) most gram positive organisms should there be a misleading gram stain. An example is as follows:

Penicillin-Gentamycin Regimen:
   Penicillin 4-6 million units/day (depending on patient
      weight) by IV. Dilute and infuse per package
      insert.
   Gentamycin 1.5 mg/kg q8h IV (or IM). (For IV, dilute
      with 50-200 ml of IV solution and infuse over 1/2
      to 1 hr).

Erythromycin 500 mg po qid or cephapirin sodium 100
mg IV (or IM) q4-6h may be substituted for
penicillin in the penicillin-allergic patient.
Cephapirin should only be used if the patient is
quite ill and cannot tolerate oral erythromycin
because of the 5-10% cross allergenicity with
penicillin.
Parenteral therapy should be continued for 14 days. Monitoring the WBC count
every 24-48 hours may help in assessing the adequacy of therapy. The IV site
should be changed every 72 hours during this period. A medical consult should be
obtained when ashore as this illness is unusual in healthy people.

Pleuritic chest pain can be quite disabling if left untreated, leaving the patient
reluctant to cough or breathe deeply. Aspirin 650-975 mg po q4h will help
somewhat. Codeine 15-60 mg po q4h may be added to the aspirin, if necessary.
Ideally, Motrin 400 mg po q4-6h or Indocin 50 mg po q8h should be used (if
available) rather than aspirin or codeine. Both medications may be obtained from
the Squadron Medical Officer. With the latter, sufficient pain relief requires dosages
more likely to cause GI side effects and over-inhibition of coughing.

USUAL COURSE WITH TREATMENT

Viral and Mycoplasma pneumonia are generally self-limiting illnesses regardless
of therapy. In 1-2 weeks the patient is well and may return to duty. Fatigue may
persist for another 1-2 weeks, so continued rest is important. Half-shifts may be
recommended at first until strength is normal.

Gram positive pneumonias respond well to the general measures plus an
antibiotic. A classic defervescence occurs after a few days of antibiotic therapy.
This is marked by a return of a feeling of well-being and recovery. Sufficient rest
and limited duty are handled as above.

Gram negative pneumonias respond more slowly to antibiotic therapy as the
patient is generally sicker to begin with. A modification of therapy should not be
undertaken for at least 48-72 hours unless the course continues downhill. Gradual
recovery of 10-14 days is usual but not guaranteed. If recovery seems near complete
at 14 days, there isn't a need to continue antibiotic therapy. Such patients should be
carefully monitored for another two weeks with rest and limited duty.

COMPLICATIONS AND THEIR MANAGEMENT

Complications from pneumonia are generally prevented by early institution of
appropriate antibiotic therapy. Those complications that may occur can be separated
into two categories: a) progression of the pneumonic infection; b) development of an
empyema.

Progression of the pneumonic infection is marked by worsening cough, fever, tachycardia, dyspnea, tachypnea, cyanosis, and impaired consciousness. Humidified oxygen should be delivered by a face mask at 5-10 liters/min. Antibiotic therapy should be switched to and given intravenously as follows:

Penicillen-Gentamycin Regimen:
Penicillin 4-6 million units/day (depending on patient weight) by IV. Dilute and infuse per package insert.

Gentamycin 1.5 mg/kg q8h IV (or IM). (For IV, dilute with 50-200 ml of IV solution and infuse over 1/2 to 1 hr).

Erythromycin 500 mg po qid or cephapirin sodium 1000 mg IV (or IM) q4-6h may be substituted for penicillin in the penicillin-allergic patients. Cephapirin should only be used if the patient cannot tolerate oral erythromycin, because of the 5-10% cross-allergenicity with penicillin.

Fluid intake should be monitored and limited to about 2-3 liters per day (total po + IV) unless clear evidence of dehydration is present. Fever and tachypnea increase the fluid requirements. The patient should be sitting up at a 30-45 degree angle to assist breathing.

As it is now mandatory to isolate the causative organism and administer specific therapy, arrangements for MEDEVAC should be made at once.

Empyema refers to a purulent exudate in the pleural cavity. In the setting of pneumonia, it occurs by extension of the pulmonary infection into the pleural space. It is seen clinically as relapse following an initial improvement or as a failure to improve after several days of antibiotic therapy. This is in contrast to the progressive downhill course in fulminant infection due to an antibiotic-resistant organism. Empyema is a complication of 5-15% of the cases of pneumonia, is generally caused by the original infectious agent, and is generally responsive to higher doses of an appropriate antibiotic. Surgical drainage through repeated needle aspirations or chest tube placement is occasionally necessary.

Chest roentgenogram, clinical appearance, and analysis of a sample of pleural exudate are used ashore for diagnosis. Of these measures, only clinical appearance and physical exam can be employed at sea. If persistent fever, leukocytosis, and ill appearance are present with (usually) unilaterally decreased breath sounds and dullness to percussion at the lung base, empyema should be assumed to be present. Most organisms causing bacterial empyema are sensitive to penicillin. High doses by the intravenous route must be employed.

The regimen employed is:
Penicillin G 3 million units IV q4h (12 million units
per day). Dilute and infuse per package insert.

The therapy should continue for 10-14 days from diagnosis. In the penicillin-allergic patient, it is probably best to use Cephapirin 2 grams IV q4h (12 grams per day). The risk of inadequate treatment with an oral antibiotic is great compared to the small chance of anaphylaxis from an allergic reaction. However, if an allergic reaction occurs, it can lead to death in minutes. One should be prepared to handle a severe allergic reaction by:

a) having two large bore (16G-18G) catheters in place
   with two 1000cc bags of saline hung;
b) having a syringe with 0.3-0.5 mg epinephrine and
   another with 50 mg Bendaryl ready for IV usage;
c) having standby help available
d) starting with a small test dose (e.g. 0.1%-1% of
   anticipated dose).

Should the patient already be on other antibiotics for the initial pneumonia syndrome, these may be continued. There is no firm rule for handling this complication.

If improvement on high dose penicillin is not seen in 48-72 hours, the need for surgical drainage is likely. Consideration for MEDEVAC should be made in this instance.

PNEUMOTHORAX

DISCUSSION

Pneumothorax involves a degree of collapse of a lung secondary to entrance of air into the potential space between visceral and parietal pleura. Spontaneous pneumothorax develops de novo from rupture of an existing pulmonary bleb or occurs during respiratory infection. Cough or another mechanism whereby intra-alveolar pressure is elevated may be a precipitating factor. Penetrating chest trauma, rib fracture, and barotrauma from diving or flying accidents are other causes.

There is an acute onset of chest discomfort on the side of the pneumothorax, with a pleuritic quality to the discomfort. Dyspnea, tachypnea, and cyanosis may be present with a large pneumothorax.

Physical exam reveals absent breath sounds and tympany overlying the pneumothorax. The trachea may be deviated away from the affected side. There is no fever or accompanying respiratory infection, unless pre-existent. Subcutaneous emphysema may be present in the chest wall or neck area if the parietal pleura is torn. The ECG will show sinus tachycardia.

The pneumothorax is visible on chest roentgenogram, although this study is unavailable on some ships. White blood cell count is normal unless there is acute distress, whereupon it might be elevated moderately. Occasionally, a "one-way valve" effect exists leading to the life-threatening tension pneumothorax. Usually, the non-tension pneumothorax stabilizes within a few minutes.

DIFFERENTIAL DIAGNOSIS

Other diagnoses which can mimic symptoms of pneumothorax are those in which an element of pleuritic chest pain and/or dyspnea are present.

a. Musculoskeletal pain
b. Pleurisy
c. Pulmonary embolus
d. Spontaneous mediastinal emphysema

a) Musculoskeletal chest pain is due to inflammation or trauma. The pain is often sharp, of moderate intensity, localized to the chest wall, and reproduced by direct manipulation of the affected area. While deep breathing may exacerbate the pain, there is no dyspnea and the lung exam is normal. Treatment includes mild analgesics, heat therapy, and, perhaps, rest.

b) Pleurisy denotes inflammation of the pleura. It is seen in the setting of bronchitis or pneumonia; the symptoms of both assist in differentiating pleurisy from pneumothorax. Chest discomfort is pleuristic. Unless there are signs of pneumonia, lung exam is normal except for a friction rub. Treatment includes rest, analgesics and an antitussive medication.

c) Pulmonary embolus is heralded by an acute onset of dyspnea, pleuritic chest pain, apprehension, cough, and occasionally hemoptysis. Upon exam, tachycardia, tachypnea, diaphoresis and rales may be noted. There will be no areas of absent breath sounds, a fact which helps to differentiate this syndrome from a pneumothorax. Treatment includes bed rest, O_2, leg elevation, pain medication, and anticoagulation. Anticoagulation cannot be accomplished safely aboard ship.

d) Spontaneous mediastinal emphysema, while common in divers, is otherwise uncommon. The presentation involves precordial chest pain with, perhaps, a pleuritic component in an otherwise healthy-appearing individual. Subcutaneous emphysema may be palpable and a mediastinal crunch is noted upon auscultation. Treatment with an analgesic and reassurance is adequate.

TREATMENT

Most cases of pneumothorax stabilize within minutes or so, leaving a degree of pleuritic chest pain, dyspnea, tachypnea, and tachycardia. The extent of symptomatology depends upon the extent of the pneumothorax. In a young, healthy person, simple bed rest, reassurance, and a mild analgesic suffice. Oxygen at 2 liters/min. by nasal cannula should be used for up to 24 hours. An antitussive (i.e., codeine 15 mg po q4h) should be added if a cough is problematic. Monitoring the patient every 15 minutes for the first few hours of symptoms is important. If stable for 6 hours, less frequent monitoring (qid x 1 day) is fine. It is wise to limit duty until symptoms resolve and the breath sounds are normal. This may take 2-7 days.

USUAL COURSE WITH TREATMENT

Most cases of pneumothorax require close observation for a few hours, minimal treatment, then limited duty for several days until symptoms clear.
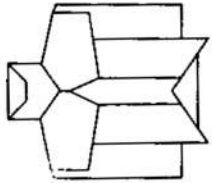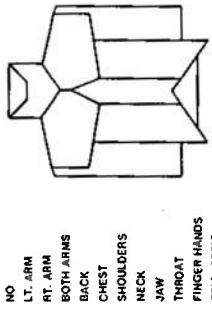
COMPLICATIONS AND THEIR MANAGEMENT

The complications of a pneumothorax are: a) respiratory distress due to an extensive pneumothorax; and b) tension pneumothorax. Healthy adults can sustain complete collapse of one lung without threat to life. The complete collapse may occur at once or as an extension of a smaller pneumothorax. Symptoms will be severe dyspnea at presentation (or worsening dyspnea if due to extension of smaller pneumothorax), tachypnea, tachycardia, and pleuritic chest pain. Absent breath sounds and hyper-resonance throughout one lung field are noted. A non-deviated trachea, lack of cyanosis, and a stable (normal) blood pressure may be found. Treatment includes bed rest, O2 by face mask at 5-10 liters/min and frequent re-evaluation in the early stages. An antitussive is best avoided. Since morbidity is greatly prolonged without chest tube placement, and since the placement of a tube is not a trivial procedure, a recommendation to MEDEVAC should be made. If the patient labors too long in attempting to breathe, respiratory muscle fatigue may ensue. If this situation occurs prior to MEDEVAC, while maximal O2 therapy has been used, then the protocol below (tension pneumothorax treatment) should be employed as a last resort.

Tension pneumothorax is a life threatening complication of a simple pneumothorax. It results from a "one-way valve" effect wherein air enters the pleural space with each inspiration but cannot be expelled with expiration. The pressure in the pleural space exceeds atmospheric pressure and the lung collapses.

APPENDIX D
CHEST PAIN DATA SHEET

History Section

CHEST PAIN DATA SHEET

HISTORY

PATIENT NAME: _____ DATE TIME: _____

SSN: _____ AGE: _____

SITE OF PAIN:
- CENTRAL
- CHEST
- ACROSS
- LT. SIDE
- RT. SIDE
- EPIGASTRIC
- OTHER

RADIATION:
- YES
- NO
- LT. ARM
- RT. ARM
- BOTH ARMS
- BACK
- CHEST
- SHOULDERS
- NECK
- JAW
- THROAT
- FINGER HANDS
- EPIGASTRIC
- OTHER

DURATION OF PAIN:
- 1 H OR LESS
- 1 - 2 H
- 2 - 4 H
- 4 - 12 H
- 12 - 24 H
- 24 H - 1 WK
- 1 WK OR MORE

ONSET OF PAIN:
(sudden < 2 min; gradual > 2 min)
- SUDDEN
- GRADUAL

TIME COURSE OF PAIN:
(at times free of pain = intermittent; everything else = continuous)
- CONTINUOUS
- INTERMITTENT

SEVERITY OF PAIN:
(do not ask: obvious distress = severe; everything else = moderate)
- MODERATE
- SEVERE

AGGRAVATING FACTORS:
- MOVEMENT
- COUGH
- BREATHING
- SITTING
- LYING DOWN REST
- LEANING FORWARD
- OTHER
- NONE

TYPE OF PAIN:
- TIGHT
- SHARP
- HVY PRESS CRUSH
- GRIPPING
- BURNING
- ACHING
- DULL
- STABBING
- NAGGING

NUMBNESS:
- PRESENT
- ABSENT

PROGRESS OF PAIN:
- BETTER
- SAME
- WORSE

RELIEVING FACTORS:
(ask about each)
- NITRO
- REST
- WALKING
- MORPHINE
- OTHER DRUGS
- OTHER
- NONE

OTHER SYMPTOMS:

DYSPNEA:
(recent = this illness; chronic = habitual)
- ABSENT
- THIS ILLNESS
- HABITUAL

COUGH:
(recent = this illness; chronic = habitual)
- ABSENT
- THIS ILLNESS
- HABITUAL

SPUTUM:
- PRESENT
- ABSENT

NAUSEA:
- PRESENT
- ABSENT

VOMITING:
- PRESENT
- ABSENT

ORTHOPNEA:
(inability to breathe except when upright)
- PRESENT
- ABSENT

PND:
(paroxysmal nocturnal dyspnea)
- PRESENT
- ABSENT

REFLUX:
- PRESENT
- ABSENT

APPETITE:
(recent change)
- NORMAL
- DECREASED

BOWELS:
(recent change)
- NORMAL
- CONSTIPATED
- DIARRHEA

PAST HISTORY

PREVIOUS CHEST PAIN:
- YES
- NO

PREVIOUS CARDIO-RESPIRATORY ILLNESS:
- YES
- NO

PREVIOUS MAJOR SURGERY:
- YES
- NO

SMOKES:
- YES
- NO

POSITIVE HISTORY FOR:
- MI
- ANGINA
- BRONCHITIS
- HYPERTENSION
- DIABETES

(PLEASE TURN OVER FOR PHYSICAL EXAM PORTION)

Physical Exam Section

PHYSICAL EXAM

VITAL SIGNS

TEMPERATURE:
- NORMAL
- INCREASED (>99.6° F)
- DECREASED (<97.6° F)

PULSE RATE:
- < 61
- 61 - 70
- 71 - 80
- 81 - 100
- > 100

RESPIRATION:
- < 20
- 20
- 21 - 25
- 26 - 30
- > 30

BLOOD PRESSURE (SYSTOLIC):
- < 100
- 101 - 120
- 121 - 140
- 141 - 160
- > 160

BLOOD PRESSURE (DIASTOLIC):
- < 71
- 71 - 80
- 81 - 90
- 91 - 100
- > 100

EXAMINATION

EDEMA:
- ABSENT
- ANKLES
- OTHER

SWEATING: (sweating not due to environment or exercise)
- YES
- NO

SHIVERING: (shivering not due to environment or exercise)
- YES
- NO

COLD/CLAMMY:
- YES
- NO

CALF TENDERNESS:
- YES
- NO

CHEST WALL TENDERNESS:
- YES
- NO

RESPIRATORY MOVEMENT: (abnormal = diff. between full inspir & full expir. is < 2 inches or expansion is unequal between sides; everything else is normal)
- NORMAL
- ABNORMAL

PERCUSSION: (percuss both front & back; dull = less resonant than normal; hyper-resonant = markedly more resonant than normal; everything else is normal)
- NORMAL
- DULL
- HYPER-RESONANT

CHEST SOUNDS: (compare left to right side; rhonchi = cont. musical sounds; rales = discrete, non-cont. sounds; decreased = 1 side markedly dec.)
- NORMAL
- RHONCHI
- RALES
- DECREASED

JUGULAR VENOUS PULSE: (pt. reclines at 45 deg. chin at 90 deg. to left; measure more than 1-2 dist. from clavicle to chin = elevated; everything else = normal)
- NORMAL
- RAISED
- LOW

HEART SOUNDS: (listen with stethoscope to 1st & 2nd heart sounds; normal = lub-dup, lub-dup; everything else = abnormal)
- NORMAL
- ABNORMAL

LAB

EKG:
- ST ELEVATION
- T DEPRESSION
- Q WAVES
- ST DEPRESSION
- ARRYTHMIA
- NO APPARENT DISTRESS

SGOT:
- < 25
- 25 - 50
- 51 - 100
- 101 - 200
- > 200

GENERAL EXAM

MOOD: (don't ask; obvious distress or physical symptoms = distressed; concern about illness = anxious)
- NORMAL
- ANXIOUS
- DISTRESSED
- IN SHOCK

COLOR: (consider environmental temp; check conjunctiva & palms on black & oriental)
- NORMAL
- PALE
- FLUSHED
- CYANOTIC

CORPSMAN'S EVALUATION

MARK YOUR DIAGNOSIS
- ( ) MYOCARDIAL INFARCTION
- ( ) ANGINA
- ( ) NON-SPECIFIC CHEST PAIN
- ( ) CHEST INFECTION

MARK YOUR EVALUATION
- ( ) EVACUATION
- ( ) NO EVACUATION

YOUR TREATMENT:
- ( ) OBSERVE ONLY
- ( ) MEDICATE
- ( ) PROCEDURE

DATA SHEET SEEN BY C.O.?
- ( ) YES
- ( ) NO

RECOMMENDATION OF MEDICAL OFFICER
- ( ) EVACUATION
- ( ) CHEST PAIN TREATMENT
- ( ) TREATMENT FOR OTHER
- ( ) RETURN TO DUTY
- ( ) NOT CONSULTED

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(Note. Letters refer to Appendices A-D. Numbers underlined identify division headings.)

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    At sea, the Independent Duty Corpsman (8402) is responsible for the diagnosis and management of illnesses which arise. He must decide whether to treat the patient onboard the ship, or, if necessary, make recommendations regarding the evacuation of the patient. The corpsman's laboratory facilities are limited and, in most instances, he is unable to communicate with shore-based medical facilities.

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

A computer based medical support system has been developed at the Naval Submarine Medical Research Laboratory (NSMRL), Groton, CT, to assist the corpsman in the diagnosis, triage, and management of patients who present at sea. When completed, the system will consist of programs for acute abdominal pain, acute chest pain, dental complaints, psychiatric disorders, and trauma. The computer programs are designed for use on an IBM PC or an IBM PC compatible computer.

The computer based chest pain program is intended for use with males, between the ages of 17 and 79, and provides medical support for 4 causes of acute chest pain. They are myocardial infarction, angina, chest infection, and non-specific chest pain. The program consists of a diagnostic module, which provides diagnostic and treatment suggestions for each of the chest pain diseases, a training module, which tests the corpsman's accuracy in abstracting data from patient narratives, and a SF-600 generation module, which prints medical record entries based on patient data entered into the program.

This report is a manual designed to train the Independent Duty Corpsman in the use of the chest pain decision support system. It is written for the person with little or no prior experience with computers. The manual describes the hardware and software needed to run the computer program and discusses in detail each of the chest pain modules. After reading the manual, the user should be skilled in the use of the program without the need for supplementary training.