MAD SCIENTIST SOFTWARE

GENERAL COMPUTER USE

Startup

1- Remove any dust covers
2- Main switch on (left rear of desk)
3- Turn disk drive on (keyboard is off)
4- Insert desired disk until it clicks into place
(Hold disk by label area, label side up, with oval "window" pointing into drive.)
5- Turn drive handle down to vertical position
6- Turn keyboard on (switch on back, extreme left)
7- Turn monitor on (green button)
8- Wait while disk "boots."
9- For a new disk, turn off & go to step #3.

Care of disks

Do not touch surface of disk itself
Do not bend disk
DO NOT set disk on monitor!
Static electricity kills disks
Do not write with a disk under the paper
REMOVE disk before turning drive off
Always put disk back in dust jacket
NO FOOD, DRINK, OR STICKY FINGERS!

General input

Menus: A menu is a screen which shows you different program options. If it says "PRESS LETTER:," then all you do is touch the letter corresponding to your choice. Other menus require that you hit the RETURN key after you type your choice.

Specific input: Occasionally the program will ask directly for a specific action, such as "Hit RETURN to continue." Just do what it says.

Directed input: The program may ask for a specific type of input, such as "CC's:". In this case, you type in the NUMBER (no letters or words) then hit the RETURN key.

String input: When the program asks, "ORDERS:", you can type in anything you please, ending in RETURN.

When things go wrong

Spastic fingers: Should you make an error, hit the "DELETE/BACK SPACE" key until you have backed up across the error. Then make your entry and hit RETURN. (You cannot back up after hitting RETURN.)

Inverse video: When the letters you are typing appear in a small box of color, you have accidentally hit the INVERSE VIDEO key (looks like a diver's flag, lower far right). The computer will not recognize your input. Just press it again, erase the inverse letters, and re-type your input.

Finishing up

Remove disk, put it back in jacket, then in box. Put box back. Turn everything off. Replace any dust covers. Put back any program manuals.

MAD SCIENTIST SOFTWARE

COMPUTER TROUBLE-SHOOTING

Find your problem in the list below. Follow each step in sequence, checking each suggestion until you identify the cause of the problem. If the problem cannot be corrected after checking each suggested cause and re-booting the system, check with the responsible party at your hospital. If no cause can be identified, and the system continues to malfunction, contact Mad Scientist Software.

NOTHING HAPPENS: No lights come on, no sounds. Check wall plug, check switch on surge protector outlet, check individual plugs and cords. There are three plugs in the main outlet. A small power jack goes into the left rear of the disk drive. A multi-pin plug brings power to the keyboard left rear. A standard electrical cord plugs into the back of the monitor. Does the outlet have power? Check reset buttom near main power switch.

"SNOW" OR BLANK MONITOR: No signal getting to monitor, or monitor out of adjustment. Green button lights when monitor is on. Check power cord, check pin plugs right side of monitor (red to video, yellow to audio). Is the multi-pin plug (to the monitor) in place in the center back of the keyboard? Is keyboard really on? [If using TV rather than monitor, are keyboard and TV on same channel (output channel select switch rear-left of keyboard)? If using VCR/computer switch, is slide set for computer?] Check brightness control on monitor (top rear).

NO SOUND, NO COLOR, OR BAD COLOR: Adjust controls under front of monitor, and on upper rear of monitor.

"READY" ON MONITOR BUT NOTHING HAPPENING: Keyboard has not gotten "AUTORUN.SYS" input from disk drive. Was keyboard turned on BEFORE disk drive? If so, turn off and start over. Is the disk drive on? Are the I/O cables (wide squarish plugs) from the rear of the keyboard to the rear of the disk drive plugged in? Do you have the correct disk in the drive?

"BOOT ERROR" APPEARING: Computer cannot find operating files (DOS) on disk. Is there a disk in the drive? Is the disk inserted correctly, label side up? Is the disk drive handle turned down to vertical? Is the disk a genuine program disk?

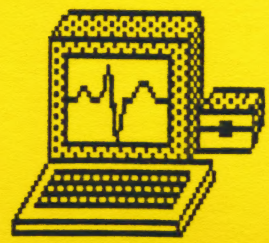
PROGRAM DIES: Did you accidentally hit the "RESET" key? Was there a power outage? Try disk again, with same program choice. If program again dies, disk is damaged. Is the disk wrinkled, smudged, or dirty? Switch to backup disk, sending original for replacement.

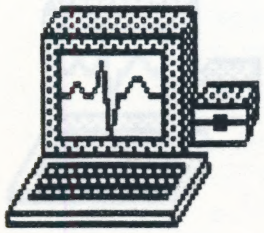
OTHER STRANGE HAPPENINGS: Turn off, then re-boot entire system with good disk. If still misbehaving, contact Mad Scientist Software.



MAD SCIENTIST SOFTWARE

SYSTEM MANUAL

SYSTEM MANUAL

Mad Scientist Software's SYSTEM USER'S MANUAL

A guide to using the Mad Scientist Software computer system.
Intended for supervisory personel.

CONTENTS PAGE

Mad Scientist Software
2063 North 820 West
Pleasant Grove, UT 84062

801-785-3028

GENERAL REFERENCE

Startup

1- Remove any dust covers
2- Main desk outlet on (left rear of desk)
3- Turn disk drive on
4- Insert desired disk until it clicks into place
(Hold disk by label area, label side up, with oval "window" pointing into drive)
5- Turn drive handle down to vertical position
6- Turn keyboard on (switch on back, extreme left)
7- Turn monitor on
8- Wait while disk "boots"
New disk: turn off keyboard, remove disk, go to #4

Care of disks

Do not touch surface of disk itself
Do not bend disk
Do not write with a disk under the paper
Do NOT put disk anywhere but in disk drive or disk box!
Static electricity kills disks
Remove disk before turning drive off
Always put disk back in dust jacket
NO FOOD, DRINK, OR STICKY FINGERS!

General use

RETURN key: To let the computer know you have finished entering your answer, press RETURN.

DELETE/BACK SPACE key: To erase spelling errors, back up over your input with the DELETE key, then type the correct entry.

INVERSE key: "Diver's flag" key on lower right reverses colors of letters. Press again to restore normal letters.

CAPS LOWER key: Press CAPS to get lower case letters; press SHIFT/CAPS for upper case.

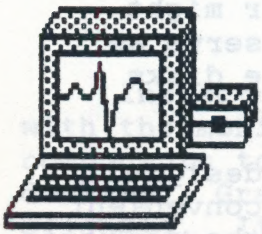
ESCAPE key: Certain programs let you return to the menu by pressing ESC.

RESET key: Crashes program, which either starts over or "locks up".

BREAK key: Stops program without completely resetting computer IF the program will allow it.

Finishing up

1- Remove disk, putting it back in the dust jacket
2- Put disk in disk box
3- Turn keyboard, disk drive, and monitor off
4- Turn off multi-outlet at rear of desktop
5- Put manuals and disks back
6- Replace any dust covers



SYSTEM MANUAL

SYSTEM INTRODUCTION

Welcome to the Mad Scientist Software teaching system. You'll find your system to be very easy to use, sturdy, and reliable.

Your system uses the Atari 800XL computer, which is based on the same microprocessor found in Apple and Commodore. It's memory includes 64K RAM, with BASIC language in ROM. The computer's output can be displayed either on TV or monitor.

The disk drive is the Atari 1050, which uses 5-1/4 inch single-sided floppy disks in either single or "double" density. The Mad Scientist Software floppies are single sided, single density. The drive operating system allows software to boot automatically to the computer without the user needing to do more than turn the keyboard on.

Your monitor is a composite color display. Color, sound, and contrast can be adjusted like a TV.

Your components (with the exception of the monitor) are mounted on a mini desktop. This desktop gives 1) relief from the usual tangle of computer cords, 2) relative security from component theft, and 3) easy transportation of the system.

The software includes the ACLS teaching system, plus other software for field testing (which you might or might not find useful). One set of disks is designed to serve as backup in case of damage to an original disk. These disks should be stored in a safe place.

The computer use guide in the vinyl jacket is designed to accompany the computer. Most hospitals find it convenient to put it on the blank area of desktop in front of the disk drive.

At first, your system will be a "new toy", in almost constant use. It may even be somewhat disruptive. Then it will go through a period where everybody's bored with it. Use will resume at a more reasonable level, with a peak of interest a month or two before ACLS courses. Consider your system a teaching resource, just as you do your video tapes and texts.

Additional manuals, flowsheets, and other supplies are available. Should any of your users want to purchase a disk for home use, they can order it directly from Mad Scientist.

SETTING IT UP

Inspect the mini-desktop. It should be in one piece, with the monitor stand solidly attached. Check the components to make sure they're firmly secured to the desktop. Grasp the keyboard and pull upward, shaking slightly. It should remain in place. Repeat this with the disk drive. From the rear, check the multi-outlet to make sure it's secure, then reach under the monitor stand and try wiggling the two power transformers.

Look at the front of the disk drive. Notice the cardboard sticking from the disk slot? Turn the handle on the front of the drive to horizontal, and take the cardboard out. Save this cardboard "disk" in case you need to ship the disk drive.

Now that you're sure the components are secure, you can move the mini-desktop around. Place it on a desk.

Next check all the wires. On the back of the keyboard, there are connectors at the left, right, and in the middle. Press in on the connectors to insure proper seating. On the back of the disk drive, you'll find a squarish I/O plug and a smaller power supply connector. Check the seating on these cables also.

The two transformers will be plugged into the multi-outlet. Somewhere nearby, you'll find a loose cable with two (or more) RCA plugs on the end. Bring the loose end of this cable out from under the monitor stand at the rear. (The other end should remain firmly plugged into the middle of the keyboard)

You're now ready to put the monitor onto the stand. Plug the monitor into the multi-outlet. Find two receptacles on the back of the monitor, labeled "audio" and "video". If, instead of "video", there are receptacles labeled "chroma" and "lumina", try "chroma".

Plug the cord from the multi-outlet into a grounded wall outlet, and you're ready to boot some software.

Switch the multi-outlet on. Turn on the disk drive by pressing the rocker switch in front. You'll hear a brief grinding sound, and the indicator light will come on.

Put a program disk in the drive by inserting the disk label side up, with the long oval window aiming straight into the drive. Push the disk in until it "clicks" and remains in place. Then turn the handle down to the vertical position.

Now start the disk booting to the computer by switching

on the keyboard. You'll find a rocker switch on the back of the keyboard at the far left. A light should glow on the keyboard, and you'll hear the disk drive start working.

Find the switch for the monitor and turn it on. You'll hear "beeps" as the program loads, which will stop when you see a "menu" screen. Don't touch any keys just yet.

Check the color. All main disk menus use the same design. The disk title will be in yellow on a dark black background. The program choices should be bright white on a deep blue background. If necessary, adjust the color and sound. Some monitors have controls "hidden" beneath a small panel.

Your system should now be ready for use. If there are problems, read the system description in this manual, and consult the trouble-shooting guide. If the computer still won't cooperate, call Mad Scientist.

USING THE COMPUTER

Normally, you will find all components, and the multi-outlet at the back, turned off. Switch on the multi-outlet. An indicator light should come on.

Next, turn on the drive by pressing the rocker switch on the front. It will make a brief grinding noise, and a light will come on.

Select your program disk from the plastic protector case. Take the disk out of its dust jacket, leaving the paper jacket in the disk case to keep it from accidentally getting wet or dirty.

Insert the disk into the drive slot, label side up, with the long oval window aiming at the back of the disk drive. Push the disk until it "clicks" and stays in place, flush with the front edge of the drive. Turn the handle on the front of the drive down to vertical to "seat" the disk.

Now turn on the computer keyboard by toggling the rocker switch at the back, far left. An indicator light will come on at the right front of the keyboard. You will hear activity in the disk drive.

Just turn on the monitor, and wait until the disk menu comes up on screen. You're ready to compute.

To change disks, wait until the disk drive is inactive, then turn the drive handle to horizontal. The disk should pop out. If it doesn't, seat the disk again, then turn the handle to horizontal again. Put your new disk in and turn the drive handle. Turn the keyboard off for a few seconds. After switching the keyboard on again, you should hear the disk booting. If not, turn the whole system off for a few seconds and start over.

To shut down, remove the disk by turning the drive handle up to horizontal. Put it back in its dust jacket in the disk box. Turn each component off, then switch off the multi-outlet.

HOW IT FITS TOGETHER

First, everything needs to get power. You should see an indicator light on the front of the disk drive, keyboard, and monitor when they are on. Ideally, your wall outlet should be on a circuit free of other sudden voltage demands. If the electrical supply is subject to sudden surges, the computer may "crash" and lose its program. If the voltage is severe enough, computer components may be physically damaged.

Monitor, disk drive, and keyboard should plug directly into a multi-outlet/circuit breaker, which in turn plugs into the wall outlet. Turning the multi-outlet off when the computer is off protects against damage to the computer, and prolongs the transformers' lifespans.

While the monitor plugs directly into the multi-outlet, the keyboard and disk drive get power through transformers. On the 800XL, the larger transformer (under the monitor stand) with the multi-pin plug goes to the keyboard. The smaller transformer with the simple plug goes to the disk drive. It's impossible to plug them in wrong. Both the keyboard and disk drive power cords plug in at the far left back of each unit.

In operation, data is transfered from the disk drive to the computer through an I/O cable. This is the large cable with large, flattened plugs which goes from the right rear of the keyboard to the back of the disk drive. It can plug into either port on the drive.

The computer output goes to the monitor through a multi-pin plug in the middle rear of the keyboard. (For TV hookup info, see that section.) At the other end, this cable divides into individual plugs. On most monitors, only two plugs are needed, audio and video. These RCA plugs attach to the appropriate places on the rear of the monitor. Color coding of the plugs varies, so incorrect attachment to the monitor is common--if it doesn't work one way, you try the other. A buzzing, blank monitor probably has the video RCA plug hooked up to "audio".

The monitor is adjusted just like a TV. You can find the appropriate controls and fiddle. Adjustment is best done while a main disk menu is on screen. The disk title should be yellow on dark black, while the menu text is white on deep blue.

It's nice to know...

When the keyboard is first turned on, it will move BASIC language into the "cartridge area" of RAM unless you are pressing the OPTION key when you turn it on. Some commercial

programs need you to hold down OPTION for a few seconds while disk loading starts. For Mad Scientist disks, you DO NOT press the OPTION key.

The computer wants to boot a disk that's in "drive #1". How does it know? There are two small sliding switches in a window at the right rear of the drive. To be "drive #1", both the black and white switches should be over towards the nearest wall of the drive. If no software at all will boot, it might be that some hotshot changed the drive number while trying to pirate some software.

THE KEYBOARD

The keyboard is organized like a typewriter, with some extra keys to confuse you. The special characters are located similarly to many typewriters, but are not in the "IBM" arrangement many of you are used to.

First, let's dispose of the special function keys: OPTION, SELECT, START, HELP, and RESET. Using the RESET key will immediately crash the program you're using. The others--OPTION, SELECT, START, and HELP--won't do anything at all unless the program tells you to use them.

At the upper right is the BREAK key, which is used to stop or abort programs. Mad Scientist programs are set up to ignore it so you won't crash the program accidentally when aiming for DELETE or RETURN.

Next to the BREAK key is the DELETE/BACK SPACE key. This is used to erase unwanted input after your fingers tangle up. There are a couple of ways a user can foul up using the BACK SPACE key: first, you can sometimes back up right over something the program wrote, and second, if you're holding down the shift key when you press BACK SPACE, you can erase a little more than you'd planned.

The RETURN key, just below the BREAK key, is just like the RETURN key on a typewriter. It's also the same thing as the "ENTER" key on some other computers. If the computer asks you a question, you press RETURN after you've typed the answer to let it know you're finished.

Below the RETURN key is the CAPS key. This works like the "shift lock" key on a typewriter, except to return to small letters you press CAPS again rather than "SHIFT". On most programs the computer starts out typing capital letters. If you want small letters, just press CAPS. To return to all capitals, hold down the SHIFT key and press CAPS. Most Mad Scientist programs will decide for themselves whether your input will appear on screen as capitals or small letters.

The "diver's flag" key below CAPS is the inverse video toggle. Pressing this key changes the letters which follow to "inverse video", meaning the colors are reversed. For example, if your typing appears as white on a blue background, after pressing the inverse video key it will appear as blue letters in small boxes of white. Press the key again to return to regular text.

The arrows on the keys to the left of RETURN and CAPS show which direction you can move the cursor with these keys. Holding down the CONTROL key, you press one of these keys to move the cursor around. Usually this is done only for word

processing or programming.

Above the arrow keys, you notice keys with "<" and ">" and "CLEAR" and "INSERT". Pressing SHIFT then CLEAR cleans text off the screen. CONTROL/INSERT and SHIFT/INSERT stuffs in spaces or lines, respectively. Not a great idea to mess with these unless you know what you're doing.

Over on the upper left, the ESCAPE key is occasionally used to stop an operation and return to a menu. But it only works if the program tells you/it will.

The CONTROL key changes the meaning of any key pressed while it's held down. If you're typing along and see a strange symbol in your text, you accidentally hit CONTROL rather than the SHIFT key.

CARE AND FEEDING

Periodic inspection

Some of your users won't tell you when something isn't working, usually because they think it's their fault. Check the system intermittently. Every couple of weeks, snug all cords into their sockets, then boot each disk in your software library to make sure it still works.

Disks

The program data is written on the UNDERSIDE of the disk. Certain environments will have a high disk death rate, especially areas with lots of dust or high static electricity, and places where employees eat.

PRECAUTIONS:
Do not touch the surface of the disk itself.
Never bend a disk!
Don't set the disk down anywhere but in the box!
Remove disk when turning off disk drive.
Put disk back in jacket.
Keep food, drink, and sticky fingers away!

COMMON DISK MURDERERS:
Writing with a disk underneath.
Bending the disk during insertion.
Static electricity.
Setting disk down on wet or dirty surfaces.

Cleaning

Keeping a dust cover over the system is a good idea. Although the 800XL isn't very sensitive to heat, covering up a computer that's left on is a no-no because of overheating risk.

The monitor, computer keyboard, and the outside of the drive may be wiped off with a lint-free cloth moistened with isopropyl alcohol.

Periodic disk drive head cleaning is also recommended, but nobody does it. Drive head cleaning is done with a kit which you probably already have in your business office. A cleaning solution is used to slightly moisten a special cleaning disk, then this disk is inserted into the drive. The keyboard is turned on to start the drive running, then turned off after 15-30 seconds. The disk is removed. Disk drive head cleaning is recommended every six months.

MOVING THE COMPUTER

Unplug the monitor from the multi-outlet and disconnect the audio/video plugs from the back, then lift it off. Pick up the mini desktop, carrying it carefully to the new location. Set the monitor back on, and plug in the power cord and audio/video jacks. Push in gently on all cables to make sure they haven't come loose during transportation.

If you're shipping the desktop, or transporting it by car, it's best to lock the drive head down. This is done by inserting the card which originally came in the drive, or a BLANK disk, into the drive and turning the handle to vertical.

Storing the desktop in a vertical position for long periods of time may loosen components on the foam-mounted desktops. It's best stored flat.

COMPUTER TROUBLE-SHOOTING

Find your problem in the list below. Follow each step in sequence, checking each suggestion until you identify the cause of the problem. If the problem cannot be corrected after checking each suggested cause and re-booting the system, check with the responsible party at your hospital. If no cause can be identified, and the system continues to malfunction, contact Mad Scientist Software.

NOTHING HAPPENS: No lights come on, no sounds. Check wall plug, check switch on surge protector outlet, check individual plugs and cords. There are three plugs in the main outlet. A small power jack goes into the left rear of the disk drive. A multi-pin plug brings power to the keyboard left rear. A standard electrical cord plugs into the back of the monitor. Does the outlet have power? Is the indicator light glowing on the multi-outlet? Check to see if there is a reset button or fuse on the outlet.

"SNOW" OR BLANK MONITOR: No signal getting to monitor, or monitor out of adjustment. Is the monitor plugged in and turned on? (Indicator light will glow.) Is the keyboard really on? Check brightness control on monitor. Check pin plugs on back of monitor (video, audio). See if they're in the right receptacles. Is the multi-pin plug (monitor cable) in place in the center back of the keyboard? [If using TV rather than monitor, are keyboard and TV on same channel (output channel select switch rear-left of keyboard)? If using VCR/computer switch, is slide set for computer?]

NO SOUND, NO COLOR, OR BAD COLOR: Adjust controls on the monitor. Depending on the type, these may be in front, upper rear, lower rear, or hidden under a panel in front.

"READY" OR SMALL WHITE SQUARE ON MONITOR BUT NOTHING HAPPENING: Keyboard has not gotten proper input from disk drive. Was keyboard turned on BEFORE disk drive? Is the disk drive on? Turn the system off a few seconds, then start up again. Are the I/O cables (wide squarish plugs) from the rear of the keyboard to the rear of the disk drive plugged in? Push in cable ends to assure proper seating. Look inside the small window at the rear of the drive. Are both switches over towards the near wall of the drive? Try again. Still no luck? The disk is probably damaged. Try another. Return any faulty disk for replacement.

"BOOT ERROR" APPEARING: Computer cannot find operating files (DOS) on disk. Is there a disk in the drive? Is the disk inserted correctly, label side up? Is the disk drive handle turned down to vertical? Is the disk a genuine program disk? If reboot is still unsuccessful, the disk is damaged.

PROGRAM DIES: Did you accidentally hit the "RESET" key? Was there a power outage? Try disk again, with same program choice. If program again dies, disk is damaged. Is the disk

wrinkled, smudged, or dirty? Switch to backup disk, sending original for replacement.

FUNNY LETTERS: Letters appearing in little boxes of white as you type means the inverse video toggle key has been pressed. Press it again (the "diver's flag" key, lower right) to toggle back to normal letters. Strange shapes appearing when a key is pressed means someone has pressed the CONTROL key while holding down the CAPS key. Just press CAPS again (wihout touching any other key) and your typing should again produce letters.

REPEATING LETTERS: Letters continuously repeating means a key is stuck (the Pepsi syndrome). Clean the keyboard until it springs up normally. If still balky, contact Mad Scientist.

OTHER STRANGE HAPPENINGS: Turn off the entire system for a minute while you snug all cables into their receptacles. Then re-boot the entire system with a good disk. Try cleaning the disk drive with a drive head cleaning kit. If still misbehaving, contact Mad Scientist Software.

OBTAINING SERVICE

Hardware service

The Atari is an excellent, well-constructed computer. The typical user can expect YEARS of trouble-free use. But just in case...

If you've purchased the system, it might be faster for you to have damaged hardware repaired through your local Atari dealer. System renters should remove the offending piece of hardware from the mini desktop and ship it to Mad Scientist. You can be forgiven if you simply send the whole desktop. We can usually have your hardware back within 14 days.

Hardware service is free to computer system renters, as the service contact price is included in the fee. You are, however, responsible for shipping costs. "Down time" due to system malfunction will be credited against the next year's rental payment.

Before shipping a computer for service, go through the trouble-shooting guide. Usually the "broken computer" turns out to be a slightly loose wire. Make sure that the problem is not merely a damaged disk. When you're convinced that the hardware is malfunctioning, call Mad Scientist for consultation. We can tell you whether to ship the whole thing, or merely a component.

To remove the keyboard or disk drive, unplug all cables. Then run a long, sturdy knife carefully through the foam on the underside of the computer. Take your time, pulling gently up on the keyboard until it comes free. Clean the remaining foam from the desktop by rubbing firmly with a rough cloth moistened slightly with paint thinner. Removing a power transformer is done identically.

Pad the component well in a sturdy box. If you're mailing a disk drive, lock the drive head down by inserting the cardboard which came in the drive (or a BLANK disk) and turning the drive handle to vertical.

Disk service

All disks will eventually die. They wear out. It depends on how much the disk has to turn during program execution, and how much dust and fumes are in the computer area. Of course, any grease or sticky stuff murders the disk outright. Static electricity will erase data, rendering the disk non-functional.

It's better to replace a disk if there's any question of

malfunction. I'd recommend that you periodically test every disk.

Replace the damaged disk with the backup copy. Throw the original into an envelope, along with the disk replacement fee, and mail it to Mad Scientist Software. You'll get your new copy within 14 days.

Consultation service

If you have a question which can't be answered by reading the system information, call Mad Scientist. We can try to get an answer for you. Questions should concern hardware or software add-ons, or hardware or software function. Sorry, we don't teach ACLS over the phone.

OTHER SOFTWARE

Many excellent programs are available on cartridge or disk for the 800XL. Unfortunately, most of these do not apply directly to medical education. Functions you might want to add include word processing, data base, spreadsheet, and telecommunications.

Carefully consider, though, whether you truly need to use your computer system for these functions, as your hospital has probably already invested a considerable sum in other computer hardware. If you don't have access to word processing/data base/spreadsheet, and need them, then you might consider adding software for this purpose.

Software for the Atari is incredibly cheap compared to what you spend for "that famous company". You can expect to spend around $50 per disk or cartridge for word processing or financial/database software.

For practical purposes, you will need a printer to take advantage of word processing or spreadsheets. Figure between $200 and $800 just for the printer, depending on the fanciness and sturdiness you'll need.

WORD PROCESSING: The standard for the 800XL is AtariWriter, which is available on cartridge. AtariWriter is quite easy for the novice to use, and can be made compatable with virtually any printer. It does require some special commands to make full use of its capabilities, but comes with a good manual and rapid-reference card. An advantage of AtariWriter that you might not appreciate right away is that it works with files in standard ASCII format.

DATA BASES: A database stores your information, and then can sort, retreive, manipulate, and add this information for you. There are several good products on the market. For record keeping and analysis, Synapse products are a good bet, 1) because they're easy to use, and 2) because they're compatable with AtariWriter. Synfile is the Synapse database for the Atari. It's quick to learn, comes with a tutorial disk, and is menu-driven (meaning you don't have to memorize any commands to use it). Database output can be printed directly, or saved to disk in ASCII format for inclusion in written text through AtariWriter.

SPREADSHEETS, ETC: Spreadsheets manipulate numbers to generate "what if's". If you don't need a lot of financial analysis, don't bother. Simple "where you are now" column printouts can be made through your database. On the other hand, graph functions can be nice in making presentations. Synapse software makes analysis software which creates a full

spectrum. Syncalc, Syngraph, and Syntrend (each doing just what the name implies) are easy to use like Synfile, and are compatable with each other and with AtariWriter. VisiCalc is a another good spreadsheet product with which many users may already be familiar.

TELECOMMUNICATIONS: Modem software means you need to buy a modem (see that section). The usefullness of telephone computing is far overrated. Usually it's easier to just call someone up on a regular phone. Synapse makes a good modem program called SynComm, but you can get an excellent modem program called Amodem free.

ATTACHING TO TV

The video output from the computer can be handled several ways. You can, of course, use your monitor or any TV monitor through the monitor output port. You can attach a standard TV through the RF port. You can run the video output through a VCR, or through a tuner for a multi-TV system.

Attaching to TV or VCR

You need the special TV adapter cable and switch box. Notice that the cable is designed to go one way. Attach the cable to the RF port, found between the monitor cable (center back) and the power cable (left back). Slide the channel select switch (next to the RF port on the back of the keyboard) to either channel 2 or 3. Plug the cable into the switch box, and slide the switch to "computer".

Disconnect the antenna leads from the VHF terminals of the TV. Reattach them to the switch box if you also plan to tune in standard TV. Attach the leads from the switch box to TV terminals where you removed the antenna. Turn the TV channel selector to your chosen computer output channel, and you're ready to compute.

An alternate method. If you have a TV which is already attached to a VCR, it is very simple to put the computer's video signal onto the TV. Disconnect the computer's monitor cable from the back of the monitor. Simply insert the plugs into the audio input and video input jacks on the VCR (NOTE: these are different than the cable TV signal input and output jacks). Leave the VCR hooked up to the TV exactly as before. The computer's output will appear on the channel to which the VCR's output is set.

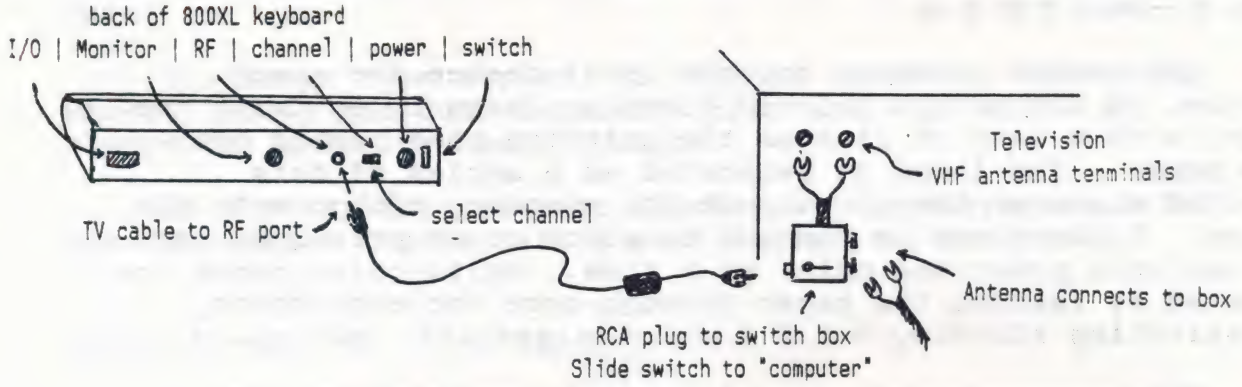
Should you wish to record a "lesson" on video tape, attach the computer video cable to the VCR video input as above, but leave the audio unattached. Instead, put the line output from a mike mixer into the audio input of the VCR. If you want computer sounds also, mix this in through the LINE or auxiliary input (NOT the microphone input) of the mike mixer. Music or other soundtrack can similarly be mixed in by patching the radio or recorder's line (auxiliary) output into the mixer's auxiliary input.

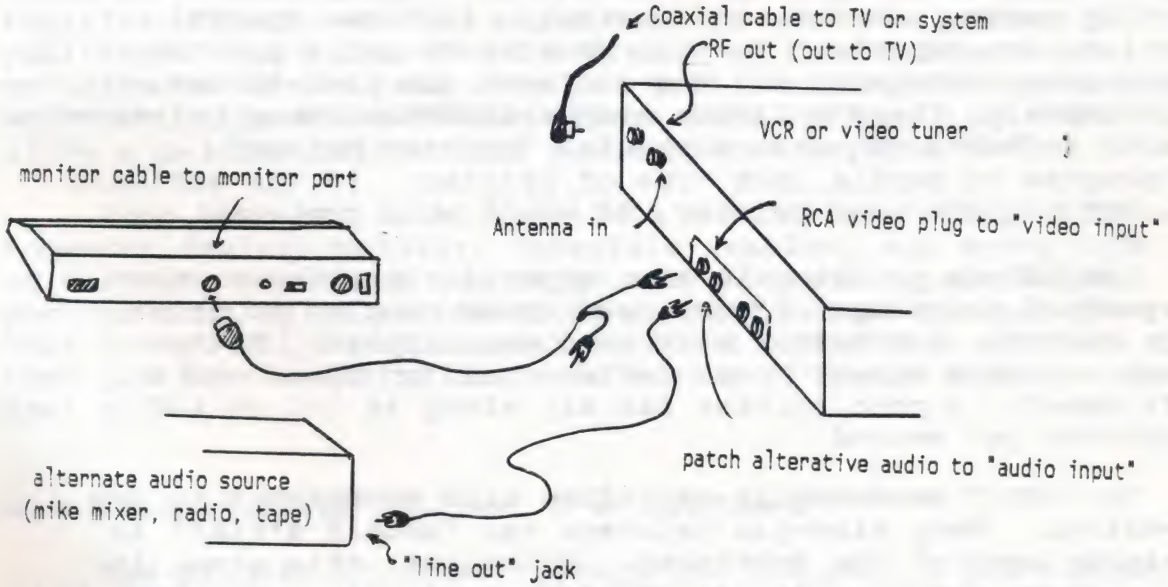
Attaching to video systems

Attaching to a hospital TV system is really not complicated. Just like a VCR, you'll find a video input and audio input jack on the tuner which drives the TV system. Just pretend it's a VCR--attach the computer's video cable to

the video input, and attach the line output of radio/recorder to the audio input jack.

If you can't find a tuner which accepts a direct video signal, you can add your computer's signal into the system through a VCR. Attach the antenna leads or coax cable carrying the TV signal to the VCR. Attach the computer's video output plug to the VCR video input jack. You'll want some nice noise, of course. Run a cable from your radio or recorder's line output jack to the VCR's audio input jack. Plug the VCR's output into wherever the TV signal was going before.





PRINTERS

So you want to add a printer. Unless you want to do something really fancy, consider printers as being only two types--dot-matrix and daisy-wheel. Which type you choose depends on whether you need speed and versatility, or just need stuff that looks typewritten.

To drive a non-Atari compatable computer, you'll need some sort of interface. You can get an interface unit for $100-$150 which will allow you to attach any printer or modem.

Dot-matrix

Dot-matrix printers are the first choice for most people. A dot-matrix printer forms an image by striking the paper with a band of pins as the printing head passes over the paper. The image is generated as a series of dots created wherever the pin struck the printing ribbon onto the paper. Ribbons can be changed to allow color printing, but it can only print one color at a time. Multi-color pages are created by feeding the paper through once for each color, substituting ribbons.

With proper software, a dot-matrix printer can make special characters, special type styles (called fonts), and can draw pictures and graphs. With dot-matrix, you can make greeting cards, banners, and posters. If these special functions are important to you, be sure to get a printer that's compatable with all the software you plan to use. Unfortunately, there's little standardization among printers, so most software requires a special "printer driver" sub-program to handle each type of printer. If the software does NOT support your printer, it won't work properly.

Dot-matrix printing is also several times faster than daisy-wheel printing. If you need speed or plan to print large amounts, dot-matrix will make you happier. Better printers have a slower "near letter-quality" speed and a draft speed. A good printer can zip along at 100 to 120 characters per second.

You don't necessarily sacrifice nice appearance to use dot-matrix. Many nine-pin printers can "double strike" to eliminate some of the dottiness. Of course, this slows it down. There are also 24-pin printers available. You have to look closely to see the difference between 24-pin and daisy-wheel. The disadvantage of 24-pin printers is that they're expensive compared to nine-pin, and aren't (as of this writing) compatable with as much software.

You can purchase a dot-matrix printer for as little as $100. A good quality 9-pin printer will run around $400, and a 24-pin printer will cost you about $800.

Daisy-wheel

Many business correspondants don't want to think of themselves as a file on the word-processor. For pure sentiment and appearance, sometimes your computer output must look hand-typed. In that case, you have to choose a daisy-wheel printer.

Daisy-wheel printers strike the ribbon with a pre-formed character, just like a typewriter. They're significantly slower than dot-matrix, 20 characters per second being a good rate.

To change type styles, you change printing heads (the wheel). Only the more expensive printers will allow you to change the printing head, though.

As a rule, the cheapest daisy-wheel printers are still more expensive than a fairly good dot-matrix printer.

Software Compatability

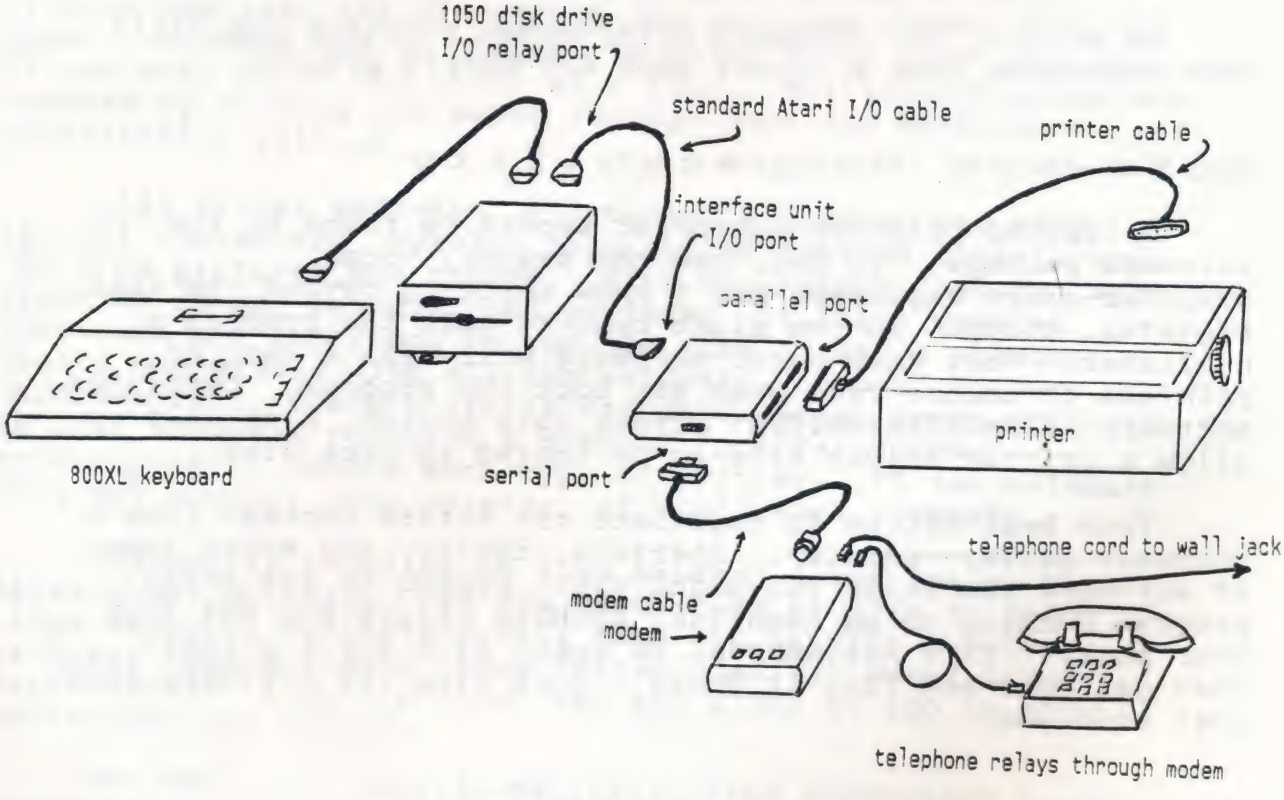
A list of printers supported should be found on the software package. If not, ask the dealer. Some computer-store employees don't know anything beyond the cash register, though, so you might need to call the program's publisher. Most disk-based software will have a menu of printers to choose from when you boot the program. Cartridge software, like ATARIWRITER, offers this option, plus will allow a printer driver file to be booted in from disk.

Your best bet is to negotiate the entire package from a computer dealer--printer, interface, cables, and every type of software you think you might use. Demand to see EVERY program running on an identical machine before you put down your money. It's not unusual to spend $400 for a printer, then get home and find it doesn't work with the software they just sold you.

Attaching the Printer

The printer attaches through the I/O port. You already have a disk drive plugged into this, so you use the I/O relay port on the back of the disk drive. Depending on the printer you've chosen, you can either plug in directly, or through an interface unit. Most popular printers will need the interface.

The illustration below shows the standard Atari I/O cable passing from the back of the 1050 drive to the 850 interface. A second special cable goes from the PARALLEL port of the interface to the printer.



CONNECTING A MODEM

A modem takes the bits of data flowing from the computer's I/O port and transmits them over the telephone line. A modem is useful for 1) dumping text from one brand of computer into an incompatable computer brand via telephone, 2) transmitting printed material rapidly across the country, 3) operating a phone-in computer information service (computer bulletin board), and 4) spending hours getting information from a computer information service that you could get in five minutes at the library.

Modems can be acoustic or purely electronic. Acoustic modems, which make beeps into a regular telephone handset, are a pain to operate and belong in museums. Modems further offer features such as auto-answer and auto-dialing, and variable data transfer rates. Unless you transmit a lot of data, you'll do fine with a 300 BAUD rate. However, I'd recommend the auto-answer and auto-dial features. Most modems with these features come with selectable 300 or 1200 BAUD. It's also nice to have your modem "Hayes compatable".

Most fancy modems will require an interface unit to work with your 800XL. Expect to pay $100 to $150 for the interface (this can be the same interface unit you bought for the printer, as long as it has a "serial port"). A standard I/O cable goes from the relay I/O port on the back of the disk drive to the interface, with another cable patching the serial port of the interface to the modem. The modem then plugs into a standard wall phone jack.

There are Atari-specific modems which will function nicely for most users. These are quite inexpensive, and do not require an interface unit. Less expensive modems cost under $80 vs. $300-$500 for the fancier ones.

Your modem will like a phone line which has no call-forwarding, call-waiting, or other fancy stuff. One beep while your computer is transmitting or receiving data will turn your data into garbage. If you're at an extension (or routinely call an extension) where you dial numbers, get another dial tone and dial again, you need a modem (and software) which can program dialing delays--or you've wasted your auto-dial money.

You'll need special software to run the modem. Modem software is not expensive, and some excellent modem programs are available for free.

COMPUTER LITERACY

You'll notice that the list of words which follows is NOT in alphabetical order. That's on purpose. The words and definitions are organized to be read from beginning to end, picking up some computer knowledge as you go.

HARDWARE. The silicon chips and electronic connections which make up your 800XL and its accessories (such as the disk drive) are called "hardware".

SOFTWARE. The hardware can behave like a word processor, a video game, a spreadsheet, or an educational simulation. It depends on the program--software--which takes control of it. Software can control the computer by directly directing the microprocessing unit (see below), or by going through a higher level language, such as BASIC, C, COBOL, or FORTRAN. Languages themselves are software, too. Software can come on magnetic tape, paper tape, punch cards, magnetic disks, or can even be encoded in a silicon chip. Thus part of your HARDWARE in the 800XL (ROM, see below) has some SOFTWARE (BASIC language) permanently encoded in it.

MICROPROCESSOR. A computer processes numbers through a central processing unit (CPU), also called a microprocessor chip. The microprocessor in your Atari 800XL is the 6502, also found in Apple and Commodore.

RAM. The microprocessor draws numbers from (and stores numbers back to) an array of memory cells, called random access memory (RAM). This memory is divided into bytes, each byte containing eight on/off switches called bits. To confuse you, RAM is often expressed in thousands by adding the letter "K". In other words, the "64K RAM" of your 800XL means it contains 64,000 bytes of random access memory..

ROM. There are certain tasks which the microprocessor must automatically perform. These instructions are permanently encoded in bytes of memory array. Because the microprocessor cannot alter this memory area, it is called read only memory (ROM). The 800XL's "operating system" and BASIC language are encoded in ROM.

ASCII. Pronounced "asskey", these letters stand for the international code by which numbers stand for letters in the computer. For example, "A" is 65. ASCII stands for... who cares, anyway?

PERIPHERALS. Everything except the guts of the computer (CPU, RAM, & ROM) is considered a peripheral device. Your monitor, the disk drive, tape drives, printers, and modems are all called peripherals. Even the keyboard itself is considered a peripheral device by the computer.

I/O. "I/O" is just a word invented by hackers to make

you feel less intelligent. It means input and output, specifically to a peripheral device like a disk drive. You can have an "I/O port", which means the hole you plug an "I/O cable" into. You can have an "I/O device", which means any peripheral which puts information into AND stores information received from the computer.

PORT. Anything that comes in or out of the computer goes through a port. Thus we have joystick ports, mouse ports, modem ports, printer ports, I/O ports.

MONITOR. A TV you can't tune to Sesame Street, because there's no channel tuner.

DISPLAY. Hacker-talk for monitor. For practical purposes, displays are either a TV or a monitor. For the 800XL, a monitor uses an untuned video signal through the monitor port, whereas a TV uses a TV signal tuned to either channel 2 or 3 through the "RF port". Note that it takes a totally different cable and outlet port to drive a TV versus a monitor.

DRIVE. You can DRIVE a device--drive the video display, drive the printer. Or you can have a thing which drives--a disk drive, a printer driver (which can be either hardware, software, or both).

CRT. CRT means "cathode ray tube", which means your monitor. And the monitor, you remember, is a TV with the channel tuner ripped out.

CARTRIDGE. You recall that software can be "burned into" a silicon chip, whereupon it becomes ROM--"read only memory". If you stick some plastic around it and add some electric contacts so it can dump its program into RAM, it's called a cartridge. To use a program on a cartridge, you stick it in the cartridge slot. Which brings us to...

SLOT. A place you plug in ROM chips and circuits. The 800XL has one slot, the cartridge slot. Owners of other computers may mention "expansion slots" and "card slots"--of which the Atari has neither.

FLOPPY. A plastic disk which can hold a magnetic field on its surface is called a "floppy disk". To protect the surface, the disk is contained inside a square jacket. The disk data is actually on the underside--which is more than just trivia; that's why you never set the disk down on the same surface you set your lunch on. The disk is read through the oval window. Your ACLS software is on 5 1/4 inch floppies.

HARD DISK. A hard disk is semi-permanently encased in a "hard disk drive", which is an expensive bit of hardware for

serious computer users. It offers extremely rapid program and data loading, and huge storage capacity.

RAMDISK. Another word you don't need to learn, but might hear, meaning a bunch of RAM set up to act as a data storage device while the computer's in operation.

SECTORS. A disk is divided up into bands, called tracks. The tracks are further broken up into areas called sectors. Then the sectors are cut up into a whole bunch of smaller pieces, each of which holds a byte (eight bits) of data. The computer uses sector and byte numbers to know where the data it's looking for will be found.

FILES. To organize data on the disk, it's stored under a file name. Like a filing cabinet, many different files may be found on the disk. A file can contain data or a program.

BOOT. A very large and sturdy type of footwear. Also a verb meaning transfering software from a storage device (like a disk drive) to the computer. The Mad Scientist programs "boot" automatically from the disk drive when the computer is switched on.

DOS. To work with a disk drive, the computer needs to load a program called DOS, disk operating system. When you turn the switch on the keyboard, it checks to see if there's a disk drive turned on, if there's a disk in it, and if that disk has a file called "DOS.SYS". That file holds the program which tells the computer how to handle the drive.

MODEM. A peripheral device which can be added, allowing the computer to transmit data over the telephone. Your 800XL can add a compatable modem through the I/O relay port on the back of the disk drive. Many popular modems require using an interface unit (below).

BAUD. When the man says he has a great "bod", assume he doesn't mean his physique. He's referring to the speed with which his modem transfers data. A modem working at 1200 BAUD is sending data four times as fast as one working at 300 BAUD.

INTERFACE. An interface is a connecting unit which allows some device (printer, modem, coffee brewer) to be connected to the computer through the I/O port. Depending on what you're trying to do, you may be able to use a peripheral device which has a built-in interface, or an interface cable, or you might need to install an electrically driven interface unit between computer and device.

DOT-MATRIX. A printer which prints as a series of small dots is called dot-matrix. It has the advantage of being able to print in various sizes and type styles, and to print

pictures and graphs (with the right software). It has the disadvantage of looking computerish when the less expensive 9-pin printers are used. 24-pin printers make fine print that almost looks like daisy-wheel.

FONT. A particular print style is called a font. For example, you might select a Roman font or Gothic font for your printing.

DAISY-WHEEL. A printer that strikes pre-formed characters like a typewriter is called a daisy-wheel printer. They're very slow, but nice when you want "hand-typed" printing.

CURSOR. Highly accurate description of the typical computer user. Also refers to the spot the computer puts on the screen to show you where the next input is needed.

LOCKUP. Computer "freezes", becoming unresponsive to user input. May result from damaged programs, or trying to RESET a "locked code" program.



MAD SCIENTIST SOFTWARE
PRESENTS . . .

PROTOCOL LEARNING

an aid to learning
Advanced Cardiac Life Support Protocols

BY BRUCE ARGYLE, MD



*** QUICK REFERENCE ***

THERAPIES USED DURING "PROTOCOL LEARNING" PRACTICES

PROCEDURES

Defibrillate
Endotracheal tube
Hyperventilation
I.V.
Observe
Thump

LAB

Blood gases

DRUGS (BOLUS)

Atropine
Bicarbonate
Bretylium
Digoxin
Epinephrine
Lidocaine
Morphine
Verapamil

DRUGS (INFUSIONS)

Epinephrine
Isoproterenol
Lidocaine

OTHER

Help

PROTOCOL LEARNING

Advanced
Cardiac Life Support
Protocol Practice

MAD SCIENTIST SOFTWARE

Bruce Argyle, MD

A medical education aid for computer.

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Distributed by:
Mad Scientist Software
2063 North 820 West
Pleasant Grove, UT 84062

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OTHER

Help

From Mad Scientist Software...

PROTOCOL LEARNING

UPDATE 1987
Resuscitation Protocols Practice Disk
Atari BASIC for 800/XL/XE. 48K RAM required.

INTRODUCTION: PROTOCOL LEARNING is part of series of disks teaching Advanced Cardiac Life Support (ACLS), but it can also be used alone. In the series, use of PROTOCOL LEARNING is encouraged after EKG TEACHING, and before the CARDIAC ARREST! simulator.

The Protocol Learning disk gives the user practice at following ACLS protocols. The protocols are based on the current "algorithms for cardiac dysrhythmias" found in the back of the American Heart Association's ACLS textbook. These algorithms change from time to time. It's your responsibility to determine when ACLS recommendations change, and to obtain updated materials from Mad Scientist. There are three practice sessions on the disk, each practice session consisting of several patients.

HOW DOES IT WORK?

The Protocol Learning programs guide the user through resuscitation efforts, one step at a time. An EKG is plotted, a situation is presented, and the computer asks for orders. The user types in his order using plain English.

Unlike the Cardiac Arrest! simulator (also from Mad Scientist Software), the Protocol Learning programs demand that you order the appropriate step in the resuscitation protocol every time. If in doubt, you can call up a screen which shows you the appropriate protocol. If you don't make a correct order after three tries, the program tells you what it expected and goes on.

Protocol Learning is designed for use after the user has learned ACLS drugs and EKG interpretation. Hospitals using the entire ACLS teaching system should encourage the use of Protocol Learning as the step immediately before the Cardiac Arrest! simulator.

START-UP: With the keyboard off, turn on the drive, then insert the disk. Turn the keyboard on, and the disk will boot to the menu automatically. 800XL and 130XE users should NOT hold down the OPTION key during disk boot. 800 and 1200XL users should insert the BASIC cartridge prior to booting the disk.

PROGRAM CHOICE: The user can choose to review program instructions, or go to the first, second, or third practice sessions simply by pressing the highlighted first letter of the menu entry. There will be a brief delay while the program loads. Each program has three or four patients for protocol practice. The user try these patients in any order, or repeat one patient as many times as desired. At the end of each practice patient, there's an opportunity to return to the main disk menu for another program choice.

HOW TO USE THE MANUAL

As you resuscitate your patient, keep the manual handy. If you're just learning cardiac resuscitation, read the manual all the way through, preferably twice. Study the information in the appendixes. If you already know advanced cardiac life support (ACLS), scan through the following instructional section. See what the computer wants you to do, then practice saving a life.

Look at the sample EKG on the screen. What's the rhythm? Not sure? Look through "SAMPLE ELECTROCARDIOGRAMS" in Appendix G. As a rule, the PROTOCOL LEARNING patients are fairly simple, and you will need only to identify the rhythm in Part I of Appendix G.

Read about the rhythm under "SOME SPECIFIC PROBLEMS" in Appendix E. More advanced users may need only to look at "A SIMPLIFIED APPROACH", APPENDIX C. Of course, you can get the same information as in Appendix C on screen by typing "HELP". "HELP" also can give other information when it's needed, such as the formula for calculating bicarbonate replacement

therapy.

Big words getting to you? Look them up in "GLOSSARY," which is Appendix K.

Now you've read about the abnormal rhythm. What do you do first? "A GENERAL LOOK AT TREATMENT" (Appendix B) can give you a feel for the approach. Refer to Appendix C or type "HELP" to begin learning the protocol. You can read about any treatment you plan under "TREATMENT OPTIONS" in Appendix F. Treatments are listed under procedures, lab, or drugs. Understand WHY you're using a particular treatment.

LEARNING THE PROTOCOLS

The user is confronted with a sample EKG and a very brief narrative description of the patient. No further history or patient information will be available. There is no way, for example, to find out how much a child weighs if you didn't pay attention when you were first told.

When asked for orders, type in an order in plain English, then hit RETURN. You'll see words which are recognized by the program echoed back to the screen. If the order is impossible to execute, or incomplete, you'll be told what's wrong. Once the computer has assembled a meaningful order, it checks it against the protocol. The program is looking for a specific action or specific drug, within a narrow "correct" dosage range. Your order may be completely appropriate, but still be refused because it wasn't exactly what the program wanted.

You have three tries to get the correct protocol step. Otherwise the computer tells you what it wanted and goes on. Pressing RETURN three times is a quick way of advancing on to the correct order.

You can look over the appropriate protocol anytime just by typing "HELP". To encourage the use of grey matter, however, some patients don't quite fit the protocol chart--for example, when the I.V. can't be started right away.

At the end of the practice patient, you're given a rating to indicate how you did. Don't take it too seriously--the scale is just an incentive to do better. You can then return to the patient menu to pick another patient for practice, or exit back to the main disk menu.

ENTERING YOUR ORDERS

You may order any proceedure, drug, or test which is in the CARDIAC ARREST! vocabulary, using regular English. A listing of treatments which might be needed is found in Appendix F. You never need to order chest compressions, oxygen, or artificial respirations, because these "basic life support" steps are done automatically by your "team" when needed. You might, however, need to ask that the patient be hyperventilated in certain circumstances.

Orders should consist of a single step. Be careful not to make your order too complex, or the computer will get

confused. The computer can accept only one proceedure or one drug, one numerical value (dose), one route (IV vs endotracheal), one unit of measure (cc vs mg), and one adjective (pediatric vs adult strength) per order. For example: "GIVE BICARBONATE, 1.5 PEDIATRIC AMPULES I.V." contains one drug (bicarbonate), one dose (1.5), one adjective (pediatric), one unit of measure (ampules), and one route (IV).

Doses MUST be given in NUMBERS, not words. Be sure to leave a space between each word, AND a space between the dose and the units. For example, the order "2CC EPINEPHRINE IV" will be refused--the program will not recognize "CC" as a unit of measure because no space was left between "2" and "CC." (When an order is refused because it's incomplete, you'll be told what's missing, but you should re-enter the entire order.)

For drips (infusions), simply order the drug by name (for example, "ISUPREL DRIP"). The nurse will prepare a standard solution and ask you for the rate of infusion (usually in micrograms per kilogram of body weight). You can't order the drip and specify the rate at the same time, because the program considers setting up the drip and adjusting the rate as two separate steps. The computer will NOT honor any special mixing instructions you give it.

If you don't specify a route for a drug (such as I.V., endotracheal, or infusion), it will be assumed that you want the drug given IV bolus. You can't give drugs subcut., I.M., or P.O.

The computer accepts most abreviations and slang terms. Just order your drug or procedure in your usual way, and almost always the computer will accept it.

The program has some features to try to head off errors. If your "reasonable" order has the computer hissing at you, simplify it down to the bare essence. Watch as the vocabulary search echoes the words back to the screen. If you don't see a word, it is either misspelled or not in the program's vocabulary, or you haven't left a space between the word and an adjacent word or dose. Check your spelling.

EXAMPLES OF ORDERS: Scan through the orders listed below. Don't spend a lot of time worrying about what the program will or won't accept--just try it.

Acceptable orders:

DEFIBRILLATE AT 200 JOULES
BRETYLIUM 350 MG
.3 CC EPI BY VEIN
DRAW ARTERIAL BLOOD GASES
HYPERVENTILATE THE PATIENT
EPI 1 AMP BY E.T. TUBE
START AN IV, PLEASE
OBSERVE 15 MINUTES
LIDOCAINE DRIP
I NEED HELP
BICARB 25 CC IV
PLACE ENDOTRACHEAL TUBE

Incorrect orders:

LIDOCAINE, 5 CC OF 2% SOLUTION
(contains more than one number)
ONE AMP EPI (dose not in numbers: order "1 AMP EPI")
BRETYLIUM 5 MG PER KG (the "nurse" will not calculate anything for you)
EPINEPHRINE 3CC (no space between dose and units)
GIVE 1 AMP EPI THEN DEFIBRILLATE
(two orders)
2 AMPS ISUPREL IN 500 CC, 20 DROPS PER MINUTE
(just order ISUPREL DRIP)
LIDOCAINE 75 MG THEN HANG DRIP
(two orders)

Just remember ONE STEP, DOSES ARE NUMBERS, and LEAVE A SPACE. That's about all you need to remember to make the Protocol Learning programs understand you.

APPENDIX A

WHAT HAPPENS DURING RESUSCITATION

First, the diagnosis of cardiac arrest is made based on unresponsiveness, absent respirations, and absent pulse. The resuscitation team rushes to begin their duties. The team members are: a triage nurse; medication nurse; recording clerk or nurse; a nurse or EMT to give chest compressions; and a respiratory therapist to give artificial respirations. The emergency physician interprets the EKG, gives orders, and performs certain proceedures.

A "crash cart" is rolled up to the patient. It contains the drugs used in cardiac resuscitation, plus supplies such as endotracheal tubes. An EKG monitoring screen often sits on top of the cart, with a defibrillator.

One team member begins chest compressions. The sternum is pushed down about 2 inches to pump blood through the chest. This pumping, however, does not provide enough blood to keep the patient alive for long, so it is important to get the heart beating again.

Another team member is providing respirations, either with a bag and mask, or through the endotracheal tube after it is passed. In some hospitals, the chest compressions and respirations are done by a machine called a "Thumper."

Electrical cables on the patient transmit the heart's electrical activity to the EKG monitor. An IV is started.

The medication nurse prepares and administers medicines when ordered, and charges the defibrillator (since it usually sits on top of the crash cart containing the medicines).

The triage nurse assists in seeing that the physician's orders are carried out smoothly, helping with medication and supplies. This nurse "directs traffic."

The recorder jots down medication and proceedures, noting the time each order is carried out. He/she may remind the doctor if the patient is ready for another bicarb or epi dose.

The emergency specialist's main job is to gather the facts, think, and order. He decides when the patient is doing well enough to transfer. He may order the resuscitation stopped and declare the patient dead if the situation is looking hopeless. Usually resuscitation efforts are kept up at least 30 minutes.

APPENDIX B

A GENERAL LOOK AT TREATMENT

FIX THE ABNORMAL RHYTHM AS QUICKLY AS POSSIBLE. Don't even think about the underlying cause of a cardiac arrest until you have tried to restore the heart rhythm to normal. Go through the therapeutic plan while waiting for tests to come back. Slow rhythms get drugged, fast rhythms get shocked. In the patient is in V-fib, defibrillation is the first thing you do. Remember, though, if an abnormal rhythm produces a good pulse and a decent blood pressure, DON'T "fix" it. In that case you get lab tests, stabilize the problems, THEN convert the rhythm back to normal.

EVERY CARDIAC ARREST PATIENT NEEDS AN IV. An IV is essential to give the patient the medication he needs. Ordering the IV started should be the first thing you do for the patient with a slow rhythm (see "A Simplified Approach"). If the patient has a rapid rhythm as a cause of cardiac arrest, such as ventricular fibrillation, you try defibrillating first.

STIMULATE THE HEART. Stimulate the heart and constrict the blood vessels with epinephrine (adrenaline). In every type of cardiac arrest (NO PULSE!), epinephrine is the first drug used. The epinephrine is repeated every 5 minutes until a blood pressure is obtained. An epinephrine drip is a good way of delivering adrenaline to the patient who continues to need it.

IF THE PATIENT ISN'T BREATHING ON HIS OWN, INTUBATE. A tube put through the mouth into the lungs gives control of the airway. The endotracheal tube allows better artificial respirations, makes CPR more efficient, and prevents vomit from getting into the lungs. One does not, however, delay immediately beneficial steps in order to get the ET tube in. For example, if a patient is in ventricular fibrillation, you don't spend your first minute intubating--you grab the paddles, and a few seconds later the patient is alive and well. But if the cardiac arrest continues, intubate as soon as practical. Generally, intubation is done at the same time the IV is started, or as the first drugs are given IV.

TREAT IRRITABILITY. If the patient keeps going back into V-fib or V-tach, or can't be shocked out of the bad rhythm, treat the irritability of the heart with drugs. Then see if the cause of the irritability is one you can fix--such as acidosis.

ORDER LAB TESTS. Order electrolytes and blood gases promptly. They don't do much good if the results come back after you've given up and called the mortuary. Blood gases should be repeated as often as necessary to keep the serum pH near normal.

CORRECT ANY ACIDOSIS. The patient may not respond at all to your efforts if he has acid buildup (acidosis).

Although routine use of bicarbonate is no longer recommended, consider using it on the patient who was "down" a long time before CPR was started and is not responding to the usual treatment. Otherwise, use blood gases to help you decide if extra bicarbonate is needed.

FIX WHAT NEEDS FIXING. Blood volume and blood chemistry should be corrected if possible. A word of caution: it's best to leave MILD abnormalities alone. You can do the patient a lot of harm by trying to treat something which isn't bothering him at all.

OBSERVE. After cardiac arrest, the organs take a little while to get going again. The patient will take a few minutes to wake up. In this simulation, observe at least 10 minutes after the patient gets a pulse to see how much he will recover.

FOLLOW THE REGULAR GAME PLAN. Stick to the treatment instructions. Do exactly what is needed for the patient--no more, no less. If you can't think of anything to do at the moment, continue CPR while awaiting tests. In the simulation, just hit [RETURN] to advance one minute. Don't be tempted to give a drug which you haven't PROVEN a need for just because you think you "have to do something". You won't help your patient by "shooting from the hip."

KEEP A RECORD. Keep a "flowsheet" on which you record each order, and the time of the order. Record also lab tests as they return. The flowsheet helps prevent errors. You might want to start your flowsheet with key data from the history: date, time, age, weight, important history.

APPENDIX C

A SIMPLIFIED APPROACH
Part I: Rhythm too fast

DIAGNOSE CARDIAC ARREST by absent pulse and respirations
(note V-tach WITH pulse is treated differently!)

↓

Witnessed arrest? try immediate precordial thump

↓

RHYTHM TOO SLOW, OR TOO FAST?

↓ TOO FAST (V-fib, V-tach)

↘ TOO SLOW? next page

↓

Defibrillate immediately 200 joules (child 2 j/kg)
No change?
Defibrillate again, 200-300 joules
No change?
Defibrillate at 360 joules (child 4 j/kg)

↓

Start I.V. (intubate if ANY delay)
Epinephrine 1 mg (child .01 mg/kg)
(may give endotracheally if no IV)
Intubate (if possible and not already done)
Defibrillate 360 joules
No change?

↓

Lidocaine 1 mg/kg (may give endotracheally if no IV)
Defibrillate 360 joules (child 4 j/kg)
No change?

↓

Bretylium 5 mg/kg IV
IF UNWITNESSED, consider bicarbonate 1 mEq/kg IV
Defibrillate 360 joules
No change?

↓

Bretylium 10 mg/kg IV
Defibrillate 360 joules
No effect?

↓

Continue efforts
Epinephrine 1 mg (child .01 mg/kg) every 5 minutes
Repeat lidocaine or bretylium
Keep trying to defibrillate
Await results of ABG, lytes

Part II--Rhythm too slow

DIAGNOSE CARDIAC ARREST (absent pulse and respirations)
Diagnose asystole, block, or bradycardia
(Note bradycardia WITH pulse is treated differently!)

↓

Start IV (intubate if IV delayed)
Epinephrine 1 mg (child .01 mg/kg)
(may be given endotracheally if necessary)

↓

Intubate (if possible and not already done)

↓

PULSE IS STILL TOO SLOW?
(asystole, bradycardia, block)

↓

Atropine 1 mg (child .01 mg/kg)
(may be given endotracheally if necessary)

↓

No effect?
Repeat Atropine up to 2 mg (child, 3 doses)

↓

IF UNWITNESSED, consider bicarbonate 1 mEq/kg IV

↓

Epinephrine 1 ampule (child 0.1 cc/kg) every five minutes
Consider defibrillating (possible fine V-fib)

↓

Await results of ABG, lytes
Consider epinephrine drip .05-1 mcg/kg/min
Consider isoproterenol drip .03 to .2 mcg/kg/min
Set up for pacemaker

Part III--V-tach with pulse

Unstable vs. Stable

Stable?

↓

Start IV
Lidocaine 1 mg /kg

↓

Lidocaine 0.5 mg/kg every 8 minutes
until V-tach resolves, or total 3 mg/kg given

↓

Procainamide 20 mg/min, up to 1000 mg
No effect?

↓

Cardioversion

Unstable

(chest pain, dyspnea, hypotension, congestive heart failure, ischemia, or infarction)

↓

Start IV
Sedation if not hypotensive or unconscious

↓

Cardiovert 50 joules
No change?

↓

Cardiovert 100 joules
No change?

↓

Cardiovert 200 joules
No change?

↓

Cardiovert 360 joules

↓

If recurrent or resistant
Lidocaine 1 mg/kg
Cardiovert

↓

Bretylium (if hypotensive or unconscious)
Procainamide (all others)

Part IV--PSVT
(Paroxysmal Supraventricular Tachycardia)

Stable vs. unstable
Unstable: Synchronized cardioversion, start 75-100 joules and increase similar to V-tach. If unsuccessful, add Verapamil and cardiovert again.

Stable

↓
Vagal maneuvers
↓
Verapamil 5 mg IV
No change in 15 minutes?
↓
Verapamil 10 mg IV
No change in 15 minutes?
↓
Consider:
Digoxin 0.25 mg up to 1 mg IV
Cardioversion
Overdrive pacing

Part V--Suppressing PVC's

Treatable cause?
(potassium abnormality, digoxin toxicity, bradycardia, acidosis, drugs)
↓
Lidocaine 1 mg/kg IV
Not suppressed?
↓
Lidocaine 0.5 mg/kg every 2-5 minutes until response or 3 mg/kg given
Not suppressed?
↓
Procainamide 20 mg/min until effective or 1000 mg given
Not suppressed?
↓
Bretylium 5 to 10 mg/kg

PVC's resolved after:

Lidocaine 1 mg/kg --> lidocaine drip 2 mg/min
Lidocaine 1-2 mg/kg --> lidocaine drip 3 mg/min
Lidocaine 2-3 mg/kg --> lidocaine drip 4 mg/min
Procainamide --> procainamide drip 1-4 mg/min
Bretylium --> bretylium drip 2 mg/min

Part VI--Bradycardia w. pulse

No signs or symptoms?
2nd degree type II or 3rd degree --> pacemaker
Others --> observe

Signs or symptoms present?

↓

Start I.V.

↓

Atropine 0.5 to 1 mg (child .01 mg/kg)
Not improved?

↓

Atropine repeat up to 2 mg
Not improved

↓

CONSIDER:
Isoproterenol drip .03 to .2 mic/kg/min
Epinephrine drip .05 to .1 mic/kg/min
External pacemaker

↓

Transvenous pacemaker

- - -

AFTER RESOLUTION OF SIGNS/SYMPTOMS

2nd degree type II or 3rd degree --> pacemaker
others --> observe

APPENDIX D

REFERENCE VALUES FOR PROTOCOL LEARNING

VITAL SIGNS

above 150 severe tachycardia
above 100 tachycardia
Pulse: NORMAL 60-100
below 60 bradycardia
below 45 severe bradycardia

severe hypertension above 160/110
hypertension greater than 140/90
Blood pressure: NORMAL 120/80, range 140/90 to 100/70
hypotension less than 100/70
severe hypotension below 60/20

above 106 hyperthermia (heatstroke)
Temperature: NORMAL 98.6
below 94 hypothermia
below 89 severe hypothermia

ARTERIAL BLOOD GASES

severe acidosis below 6.9
moderate acidosis below 7.2
mild acidosis below 7.35
pH: NORMAL 7.35 to 7.45
alkalosis above 7.45
severe alkalosis above 7.6

Oxygen (O2): NORMAL above 70 (higher on 100% O2)
hypoxemia below 70
severe hypoxemia below 50

inadequate respirations above 40
Carbon dioxide (CO2): NORMAL 35-40
hyperventilation below 35

severe alkalosis above 45
alkalosis above 30
Bicarbonate (HCO3-): NORMAL 24-28
acidosis below normal
moderate acidosis below 15
severe acidosis below 5

above 15 concentrated blood/dehydration
Hemoglobin (Hgb): NORMAL 12-15
below 12 anemia
below 9 severe anemia

APPENDIX E

SOME SPECIFIC PROBLEMS

Acidosis. Acid builds up in the blood stream when the tissues do not get enough oxygen-rich blood delivered to them. In the patient who is alive, acidosis can result from kidney failure, diabetic ketoacidosis, poisonings (like cyanide), and shock. Any patient in cardiac arrest becomes acidotic. Acid makes the heart more irritable and makes it pump less effectively. This acid buildup can be neutralized with sodium bicarbonate if it's severe. Bicarbonate is NOT given routinely any more--consider the situation, then give it only if you think it's needed. A typical starting dose of bicarbonate is 1 mEq per kg. Monitor the acid-base status with blood gases (ABG). You can calculate the amount of bicarbonate needed from the base excess (B.E.). An approximate bicarbonate replacement dose is one tenth of the person's weight in kilograms times the base excess (Additional bicarb = 0.1 x (weight in kg) x B.E.). Overcorrecting the pH (alkalosis) may be harmful, so be careful. Leave a mild acidosis (pH above 7.25) alone.

Agonal rhythm. Occasional wide, abnormal electrical waves are seen, but there is no pulse. This rhythm means trouble. It usually means that the patient has already suffered such severe heart damage that there is no hope of recovery. Treat it essentially like asystole (see below).

Asystole. No electrical activity at all on the monitor usually means a grim future. It very rare for anyone in asystole to leave the hospital alive. No electrical activity means a very severely affected heart. If it results from electrolyte problems, you may save the patient. Get the pH as close to normal as possible. While awaiting lab, make sure that epinephrine is given frequently. Give atropine up to the maximum dose. Give maximum doses of epinephrine (consider an epinephrine drip). Try an isoproterenol infusion as a last resort. A pacemaker may be tried, but is not available (or required) in this program. Try defibrillating just in case the asystole is really very fine ventricular fibrillation.

Bradycardia. A heart rate which is much too slow does not provide good blood flow. (On the other hand, if there's no pulse at all, treat it just like asystole.) Bradycardia often results from a heart attack or drugs, but can also be seen in hypothermia or electrolyte problems. If the blood pressure is good, do not treat the bradycardia (except to prepare for a pacemaker for certain types). See the protocol in Appendix C. Treat bradycardia first with atropine, up to the maximum dose. Epinephrine provides temporary stimulation if the patient has a poor or absent pulse. If still severe, try an isoproterenol infusion. Alternatively, an epinephrine

infusion may be tried. A pacemaker should be prepared if the patient requires more than atropine for the bradycardia, but this program does not allow you to use it.

Conduction block. When the impulses from the atrium are being stopped from reaching the ventricle, the heart rate can slow enough to cause shock or cardiac arrest. If the impulses are merely being slowed (first degree AV block) but not stopped from reaching the ventricle, this requires no treatment. Conduction block can be caused by heart attack, drugs, hypothermia, or electrolyte problems. Atropine is the first choice--give the maximum amount before trying anything else. An isoproterenol drip is the second choice. Epinephrine is worth a try, and may be very useful in the hypotensive patient. An artificial pacemaker is the next step (for educational purposes, this program requires that you rely on drugs).

Electromechanical dissociation. This means the electrical activity looks OK, but there's no pulse. It usually means something is very wrong--either a severe chemical derangement, a severely damaged heart, or a physical problem in the chest.

Irritability (PVC's or recurrent fibrillation): Many problems, including most heart attacks, make the heart prone to abnormal rhythms. If the heart keeps reverting back to V-fib or V-tach, we call this irritability. Think first of any chemical abnormality: acidosis or an electrolyte abnormality may be the cause. If you have not overlooked an obvious cause, then give a lidocaine bolus. Defibrillate if necessary, then draw ABG and lytes. Start a lidocaine drip. See the protocol in Appendix C.

Paroxysmal supraventricular tachycardia. Often in otherwise healthy people, a "short circuit" develops in the AV node area. This creates a circular electrical circuit which fires the ventricle at a rapid rate. Verapamil is the first choice therapy, unless the patient is unstable (endangered by the abnormal rhythm), in which case you use electrical shocks. See the protocol in Appendix C.

Premature Ventricular Contractions. Occasionally harmless, frequent PVC's occurring in a diseased heart often warn of impending V-fib or V-tach. Usually more than 6 per minute means trouble. Follow the protocol in Appendix C.

Ventricular fibrillation. Unorganized electrical activity in the ventricle can result from heart attack, electrolyte abnormality, abnormal acid-base balance, or hypothermia. The heart cannot pump at all. When confronted with ventricular fibrillation, you immediately try defibrillating to see if you can restore a normal rhythm. Fibrillation which resists the shocks is treated first with epinephrine, then with

lidocaine. For the exact protocol sequence, see the protocol in "A Simplified Approach". If fibrillation still proves resistant, bretylium is added. Get lab tests and keep trying to defibrillate while waiting. A higher setting gives a better chance of conversion to normal rhythm, so all defibrillations after the first two should be at the maximum setting (4 joules/kg in children). Recurrent V-fib (irritability) should be treated with lidocaine, while you look for any treatable problem such as acidosis which could be causing the irritability.

Ventricular rhythm. If slow and accompanied by hypotension or cardiac arrest, treat it as you would a severe conduction block (see above), while setting up for a pacemaker. If the blood pressure is good, leave the rhythm alone.

Ventricular tachycardia. Caused by factors similar to V-fib, V-tach is a more organized, regular ventricular rhythm which can occasionally give a pulse. Even with a fair blood pressure, V-tach often degenerates into V-fib. Treatment depends on whether the patient is 1)fine, 2)unstable, or 3)pulseless. A patient who is not suffering any harm from the V-tach is treated with lidocaine to try to chemically convert the rhythm. If the patient is unstable (for example, low blood pressure), defibrillate--but at a lower starting dose than for V-fib (see protocol chart in Appendix C). V-tach with NO pulse is treated just like V-fib. Resistant or recurrent V-tach is treated with lidocaine.

APPENDIX F

TREATMENT OPTIONS

USEFUL TERMS IN MAKING ORDERS
(Words within parentheses are equivalent)

Units of measure
- MG (MILLIGRAMS, MILLIGRAM)
- GRAM (G, GRAMS, GM)
- CC (CC'S, ML, MILLILITER, MILLILITERS, C.C.)
- AMP (AMPS, AMPULE, AMPULES)
- MEQ (MILLIEQUIVALENT, MILLIEQUIVALENTS) (Bicarbonate only)

Routes drugs can be given
- IV (I.V., BY VEIN, INTRAVENOUS)
- ET (ENDOTRACHEAL, ENDOTRACHEALLY, E.T.)
- INFUSION (INFUSE, DRIP, IVAC, PUMP)

Strengths of medication
- PEDIATRIC (PEDI, SMALL, NEONATAL)
- REGULAR (ADULT, LARGE)

Adjusting dosage
- STOP (DC, D.C., D/C, CANCEL, HOLD)
- DECREASE (DOWN, SLOW)
- INCREASE (UP)

PROCEDURES

DEFIBRILLATE (DEFIB, CARDIOVERT, CARDIOVERSION, SHOCK): Defibrillation means giving a brief direct-current shock across the heart. The strength of this shock is measured in joules or watt-seconds (a joule and watt-second are exactly the same thing). The defibrillator is charged, then the shock is given by two paddles. One paddle is placed just above and to the right of the heart, the other placed lower and around to the left. 200 watt-seconds (joules) is the recommended starting setting to defibrillate a normal adult. The stronger the setting, the greater the chances of converting the patient to a normal heart rhythm. In ventricular fibrillation, increase the setting to the maximum if the first two tries are unsucessful. The maximum for our defibrillator is 360. For children, use a setting of about two joules per kilogram of weight, increasing four joules per kilogram if the first two tries are not successful.

Indications: V-fib. Also use for V-tach or atrial fib if there is absent pulse or significant hypotension. Worth a try for asystole IF it is in reality very fine V-fib.

Actions: Electrically "fires" all of the heart at once, stopping abnormal "short circuits." Often the heart will then resume a normal rhythm.

Precautions: Excessively high settings will "electrocute" some of the heart muscle.

SAMPLE ORDERS:
DEFIBRILLATE AT 50 JOULES
SET TO 360 AND SHOCK HIM

ENDOTRACHEAL TUBE (ET TUBE, E.T. TUBE, INTUBATE): You (or the paramedic or anesthesiologist) place a breathing tube down into the patient's trachea. In many situations, you would not want to delay giving important drugs in order to intubate. But as soon as possible, place the ET tube (unless the patient is conscious). Usually intubation is done about the same time the IV is started.

Indications: Intubate any patient in cardiac arrest or coma.

Actions: Prevents aspiration of stomach contents into lungs. Provides better oxygenation of blood. Makes CPR more effective (yes, the program takes that into account, too).

Precautions: Do not delay life-saving actions in order to get the ET tube in. The patient should be oxygenated well by mask beforehand.

SAMPLE ORDERS:
PLACE ET TUBE
LET'S INTUBATE HIM NOW
REMOVE E.T. TUBE

HELP (CHART, CHEAT): Gives you the appropriate protocol flowchart for the patient's current rhythm. Find the place the resuscitation has progressed to on the HELP chart, then order the next appropriate step.

SAMPLE ORDERS:
SHOW ME THE CHART
HELP

HYPERVENTILATION (HYPERVENTILATING, HYPERVENTILATE): Rapid ventilation of the comatose patient temporarily lowers the acid in the blood stream, as well as supplying increased oxygen and protecting the brain. This will especially make a difference when there is delay getting an IV in place to give bicarbonate. The acid balance returns back to pre-existing values when the hyperventilation is stopped.

Indications: Probably useful for any patient in cardiac arrest, particularly helpful if unable to give bicarbonate.

Actions: Temporarily raises blood pH by blowing off carbon dioxide.

Precautions: Will make a patient with normal pH somewhat alkalotic.

SAMPLE ORDERS:
HYPERVENTILATE
STOP HYPERVENTILATING

IV (I.V., INTRAVENOUS LINE): Medication nurse starts an IV. Occasionally, the IV cannot be easily started. This gives you practice at giving drugs endotracheally. You do not need to keep asking that the IV be started--the med. nurse keeps working at it until it is running, then tells you. The IV is always Dextrose 5% in water (D5W) unless you specify saline or ringer's. If you're running fluids, you can order the IV rate increased or decreased. You can even D/C the IV.

Indications: only route by which most drugs used in resuscitation can be given. Fluid can be given if needed. An IV must be started on every patient.

SAMPLE ORDERS:
PLACE IV
START I.V. WITH LACTATED RINGER'S
TURN UP THE IV

THUMP: Back into the protocol is the precordial thump. For a witnessed arrest (no pulse), you immediately thwack the precordial area with your fist.

SAMPLE ORDER:
PRECORDIAL THUMP

LAB

BLOOD GASES (ABG, GAS, ABGS, ABG'S, PH): Arterial blood is tested for pH, oxygen, CO2, bicarbonate, and hemoglobin. The respiratory therapist sticks a needle directly into an artery to get the sample, then runs off to test it. Normal values, plus the words used to describe abnormalities, are found in the REFERENCE VALUE section. Use ABG to guide your bicarbonate therapy wherever possible.

DRUGS

ATROPINE blocks the effects of a specific body chemical and a specific nerve which can slow the heart and increase conduction block. It therefore usually will speed the heart and decrease the blockage in the AV node.

Supplied: AMPULE = 10 CC = 1 MG

Usual dose: adult--0.5 to 1 MG, repeated up to 2 mg total

child--.01 mg/kg, repeated up to three times

May be given ENDOTRACHEALLY.

Indications: bradycardia or high-grade atrioventricular (AV) conduction block, unless blood pressure is good.

Actions: speeds up atrial pacemaker, decreases blockage within AV node.

Precautions: doses lower than those recommended may actually slow the heart further. Increased heart rate may make a diseased heart work harder, resulting in a larger area of heart damage.

SAMPLE ORDER:
ATROPINE .1 MG ET
10 CC ATROPINE

BICARBONATE (BICARB) neutralizes acid. It's used to reverse the acidosis which results from cardiac arrest, but isn't recommended as part of routine resuscitation efforts. Use it for proven severe acidosis on arterial blood gases, or where you strongly suspect severe acidosis due to a long "down" time before CPR was started.

Supplied: AMPULE = 50 CC = 50 MEQ

PEDIATRIC AMPULE = 10 CC = 10 MEQ

Usual dose: 1 MEQ/kg initially (Give this initial dose only if the patient has been in cardiac arrest without CPR for several minutes). You can then give 1/2 MEQ/kg every ten minutes until a blood pressure is achieved, however, you're better off monitoring the need for bicarbonate with blood gases.

Acute replacement dosage:

bicarb = 0.1 x (-base excess) x (weight in kg)

Indications: suspected or proven severe acidosis.

Actions: directly neutralizes acid.

Precautions: if given in excess, alkalosis results, which is very difficult to treat. Use of an immediate dose in a brand-new cardiac arrest will guarantee severe alkalosis. Use ABG to guide therapy.

SAMPLE ORDER:

20 CC OF BICARB IV

BICARBONATE 2 AMPS

BRETYLIUM (BRETYLOL) is useful in resistant V-fib. After use, the heart can often be successfully defibrillated when it could not before. Bretylium also lowers blood pressure, which may be a problem in some patients.

Supplied: AMPULE = 500 MG = 10 CC

Usual dose: 350 mg or 5 mg/kg, repeat at double dose (10 mg/kg) if not effective.

Indications: Ventricular fibrillation resistant to defibrillation, as a second-line drug to lidocaine. Remember that you still have to defibrillate after giving Bretylium.

Actions: allows easier conversion to sinus rhythm. Also blocks nerves which affect blood vessels, reducing blood pressure somewhat.

Precautions: may exacerbate cardiogenic shock

SAMPLE ORDER:

BRETYLIUM 350 MG

EPINEPHRINE (EPI, ADRENALINE) stimulates the heart, and constricts blood vessels. It raises blood pressure, increases the heart rate, and increases the heart's irritability. It is used during cardiac arrest because 1) it is an extremely potent cardiac stimulator, and 2) it makes fibrillation more course and easier to convert to sinus rhythm. It is not used routinely to raise blood pressure except in anaphyllactic (allergic) shock. This drug occurs naturally in the body, and is degraded over several minute's time.

Supplied: AMPULE = 10 CC = 1 MG
or custom infusion

Usual dose: adult--1 amp every five minutes until pulse and blood pressure achieved. To sustain beneficial effects, an infusion of .05 to .1 micrograms/kg/min may be given.
child--.1 cc/kg every five minutes until pulse and B.P.

May be given ENDOTRACHEALLY in bolus form.

Indications: cardiac arrest, anaphyllactic shock.
Actions: potent cardiac stimulant, blood vessel constrictor.
Precautions: stop use when blood pressure obtained. If B.P. falls as Epi wears off, use an epinephrine drip, or dopamine.
SAMPLE ORDER:
EPI 1 AMP
10 CC ADRENALINE ENDOTRACHEALLY
START EPINEPHRINE INFUSION

DIGOXIN (LANOXIN) has two uses: 1) increasing heart contractility, and 2) increasing AV block to slow the heart rate. It increases the force of contraction in the sick heart, and reduces the heart rate of the patient in atrial fibrillation. The drug has substantial hazards, but is widely used because it offers unique benefits.
Supplied: adult AMPULE = 2 CC = .5 MG
pediatric AMPULE = 1 CC = .1 MG
Usual dose: .25 to .5 mg to start (children, .005 mg/kg), titrating up to effect, not to exceed .025 mg/kg.
Indications: atrial fib with rapid heart rate, conversion of PSVT (PAT) as second-choice after Verapamil, heart failure.
Actions: increases effectiveness of cardiac muscle, slows AV node conduction
Precautions: makes heart more prone to abnormal rhythms, narrow "safe" dosage range
SAMPLE ORDER:
0.25 MG DIGOXIN IV

ISOPROTERENOL (ISUPREL) is a cardiac stimulant, somewhat similar to epinephrine. It raises the heart rate, reduces any conduction block, and increases the force of contraction. It has little effect on blood vessels. It causes a major increase in cardiac irritability and oxygen need.
Supplied: mixed as an infusion. Protocols vary, so order in mcg/kg/min.
Usual dose: start around .03 micrograms/kg/min, increase until effects are seen, avoid exceeding .3 mcg/kg/min.
Indications: second choice drug after atropine for refractory bradycardia, high degree AV block.
Actions: cardiac stimulant which affects primarily heart rate and conduction.
Precautions: may increase the size of an infarct. Increases probability of fibrillation.
SAMPLE ORDER:
ISUPREL DRIP

LIDOCAINE (XYLOCAINE) is a local anesthetic which is also useful in treating abnormal heart rhythms. Of course, if the patient is in V-fib, a shock must still be given after the drug to restore a normal rhythm. Blood concentrations of lidocaine fall off over about 20 minutes, so a second bolus

and/or an infusion is necessary. Lidocaine is also valuable in preventing abnormal rhythms before one has ever occurred. Many experts recommend giving lidocaine routinely to any patient who has had a heart attack. You will probably come out ahead in this simulation if you do so. A bolus of lidocaine should always be followed by a lidocaine drip to keep the level from falling.

Supplied: AMPULE = 5 CC = 100 MG

Usual dose: adult--75 mg bolus. For irritability, repeat doses of 0.5 mg/kg given up to 3 mg/kg. Follow with drip of 2 to 4 mg/min. (If the patient is in trouble, don't waste your "minute" starting the drip right after the bolus--do more important things, then remember to start the drip in a few minutes)

child--1 mg/kg bolus. Cardiac irritability in a child is almost always due to acidosis or electrolyte abnormality, but if a drip is required, use .01 mg/kg/min.

Effective ENDOTRACHEALLY.

Indications: recurrent or resistant V-tach or V-fib, treatment of cardiac irritability. Prevention of fibrillation in heart attack patients.

Actions: reduces risk of rhythm disturbance.

Precautions: excess doses can cause low blood pressure, seizures. Bolus will wear off unless followed by a drip.

SAMPLE ORDER:
LIDOCAINE 75 MG BOLUS
START LIDOCAINE DRIP

VERAPAMIL (CALAN, ISOPTIN) has complex actions. Its primary use is to treat abnormal, rapid atrial rhythms (PSVT--paroxysmal supraventricular tachycardia). It decreases heart rate when in sinus rhythm, increases block in the AV node, and may lower blood pressure somewhat. It is the drug of choice for PSVT when the patient has good blood pressure. It has little utility, though, in the patient in cardiac arrest.

Supplied: 5 mg ampule

Usual dose: 5 mg, then 10 mg after 15 minutes if not effective

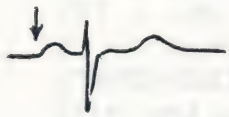
Indications: paroxysmal supraventricular tachycardia, rate reduction in atrial fibrillation

Actions: increase AV block, decreases sinus rate, relaxes blood vessels

Precautions: may predispose to bradycardia and hypotension. Not to be given together with propranolol IV

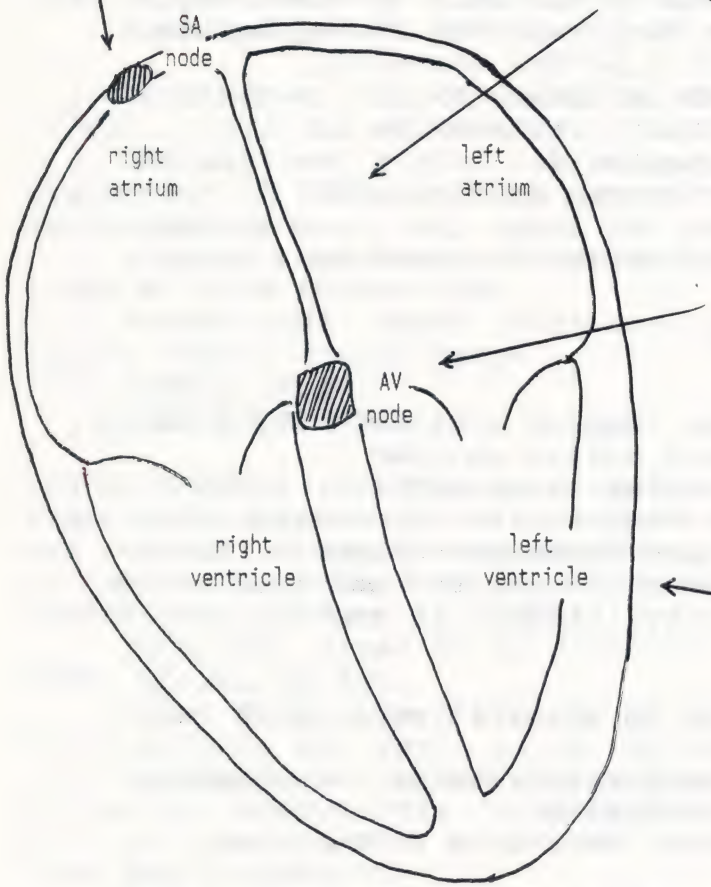
SAMPLE ORDER:
VERAPAMIL, 5 MG IV

UNDERSTANDING THE ELECTROCARDIOGRAM

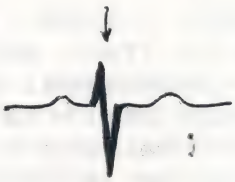


1. Sinoatrial (SA) node fires. (not seen on EKG)

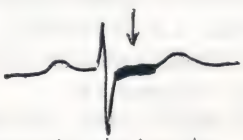
2. Impulse spreads over atrium, causing P wave.



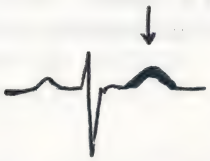
3. Inpulse delayed in atrioventricular (AV) node, causing PR interval. Atrium is contracting.



4. Impulse conducted rapidly over ventricle, creating QRS complex.

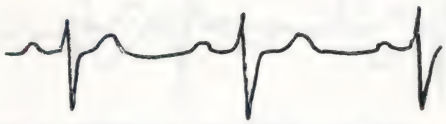


5. Heart is contracting during the ST segment. No current is flowing unless the heart is injured.



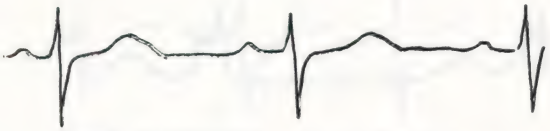
6. The heart electrically recharges itself, creating the T wave.

SAMPLE ELECTROCARDIOGRAMS
Part 1: Rhythms

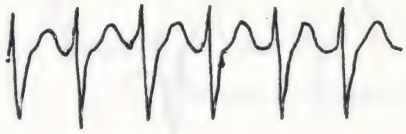


SINUS RHYTHM: Every QRS preceded by a P wave, rate 60 to 100 normally.

SINUS TACHYCARDIA: Every QRS preceded by a P wave, rate over 100.

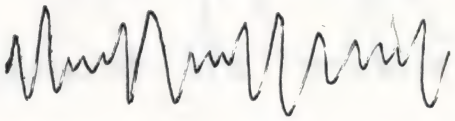


SINUS BRADYCARDIA: P wave before every QRS, rate less than 60.



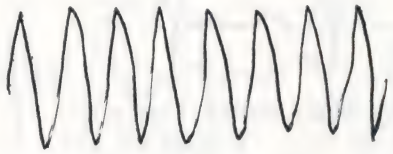
ATRIAL TACHYCARDIA: Regular rhythm, rate 130 to 180, no P waves seen, QRS is narrow.

ATRIAL FIBRILLATION: irregularly spaced QRS complexes, 'wiggling' baseline, no P waves. Rate varies with AV block.



VENTRICULAR FIBRILLATION, coarse: Erratic, wide swings of electrical activity, irregular, no pulse.

VENTRICULAR FIBRILLATION, fine: Erratic, irregular 'wiggling' EKG, with no QRS, no pulse.



VENTRICULAR TACHYCARDIA: Perfectly regular tachycardia, rate above 200, wide QRS, may cause a pulse.

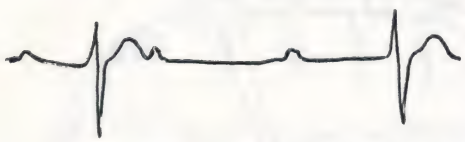
ASYSTOLE: No electrical activity at all, except for slight waving of the baseline.

AGONAL RHYTHM: Very slow, wide QRS complexes, without P waves, often without T waves. No pulse.

SAMPLE ELECTROCARDIOGRAMS
Part 1: Rhythms (continued)

FIRST DEGREE ATRIOVENTRICULAR BLOCK: Regular sinus rhythm with every P wave causing a QRS after a long PR interval.

SECOND DEGREE ATRIOVENTRICULAR BLOCK: Some P waves are blocked out from the ventricle, leaving a P without a QRS.



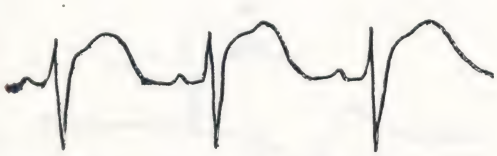
THIRD DEGREE ATRIOVENTRICULAR BLOCK: All P waves are blocked, with the QRS complexes unrelated to the P waves.

VENTRICULAR RHYTHM: Rhythm is paced entirely from the ventricle, with no P waves seen at all.

Part 2: Specific Problems

RIGHT BUNDLE BRANCH BLOCK: Conduction delayed to the right. Widened QRS with second upward peak.

LEFT BUNDLE BRANCH BLOCK: Conduction delayed to the left. Widened QRS with broad, deep S wave.



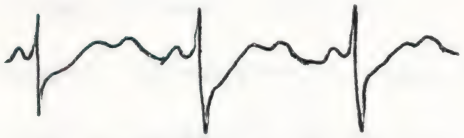
HEART ATTACK: EKG may be normal, or ST segment elevation or depression, or abnormal shape of T wave.

SEVERE HEART ATTACK: QRS may be wide, elevated ST segment, possible loss of the R wave.

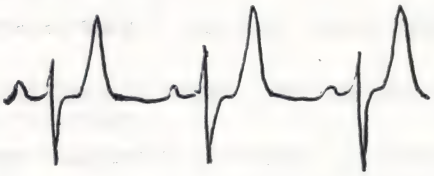
SAMPLE ELECTROCARDIOGRAMS
Part 2: Problems (continued)

HYPOTHERMIA: ALL intervals prolonged, ST segment depressed, long ST and T wave, often right bundle branch block.

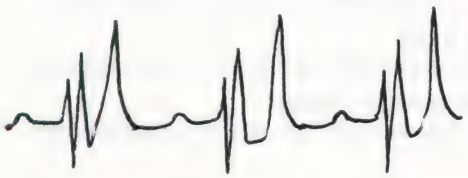
HYPOKALEMIA: Prolonged T wave, possible U wave.



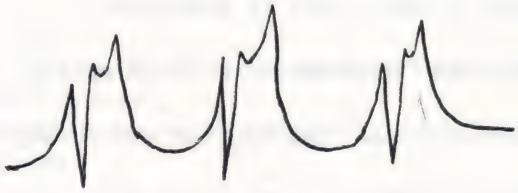
SEVERE HYPOKALEMIA: ST depression, prominent U wave, PR interval fairly short.



HYPERKALEMIA: Tall, peaked T wave.



MODERATE HYPERKALEMIA: Long PR, wide QRS, ST depression, tall peaked T wave.

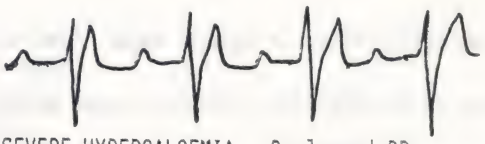


SEVERE HYPERKALEMIA: Disappearance of P wave, wider QRS, may slur into tall T wave.

HYPOCALCEMIA: Short PR interval, prolonged ST segment, wide T wave, possible U wave.

SEVERE HYPOCALCEMIA: Very short PR, prolonged ST, very wide T, possible inverted U wave.

HYPERCALCEMIA: Short ST segment, short T wave.



SEVERE HYPERCALCEMIA: Prolonged PR, short ST, short T wave. Ususally tachycardia is present.

APPENDIX H

GLOSSARY

...brief definitions with a pronunciation guide...

acidosis (ass-id-OH-siss), excess acid in body

agonal (A-gun-uhl), slow useless rhythm indicating a dying heart

alkalosis (al-ka-LOH-siss), excess bicarbonate in body

ampule (AM-pule), single-use container of drug, often a pre-filled syringe

anemia (uh-NEEM-ee-uh), deficient in blood or hemoglobin

asystole (ay-SISS-toll-ee), absense of electrical activity

atrial (AY-tree-uhl), pertaining to the upper heart chamber

atropine (A-troh-peen), cardiac drug

bicarb (BY-karb), short for bicarbonate

bicarbonate (by-CAR-bun-uht or by-CAR-bun-ATE), alkaline chemical in blood

bradycardia (brad-i-CAR-dee-uh or bray-dih-CAR-dee-uh), abnormally slow heart rhythm

bretylium (bre-TILL-ee-um), cardiac drug

CPR, cardio-pulmonary-resuscitation

calcium (KAL-see-um), chemical in blood and bones

cardiac (CAR-dee-ack), pertaining to the heart

cardiogenic (CAR-dee-oh-JENN-ik), caused by a heart condition

chloride (KLOR-ide), blood chemical

coma (KOH-muh), unconscious and not responding to pain

defibrillate (dee-FIB-rill-ate), shocking the heart to restore normal rhythm

dehydration (DEE-hy-DRAY-shun), body fluid deficit

dextrose (DEX-trohss), a type of sugar injected IV

diabetes (DIE-a-BEET-iss), abnormal sugar metabolism due to lack of insulin

diabetic (DIE-a-BET-ik), condition of, or person with, diabetes

diazoxide (dy-a-ZOX-ide), blood pressure drug

digoxin (di-JOX-in), cardiac drug

dobutamine (doh-BUTE-a-meen), cardiac stimulant drug

dopamine (DOH-puh-meen), cardiac stimulant and blood pressure drug

electrolytes (ee-LEKT-row-lights), chemicals (ions) in the blood

endotracheal (EN-doh-TRAY-kee-uhl), into the trachea

epi (EH-pee), short for epinephrine

epinephrine (e-pi-NEF-rin), cardiac stimulant drug

fibrillation (FIB-rill-AY-shun), erratic unorganized electrical activity

glucose (GLUE-kohss), blood sugar

hemoglobin (HEE-moh-glow-bin), pigment in blood which carries oxygen

hemolysis (hee-MAW-luh-siss), red blood cells bursting

hemorrhage (HEM-or-rij), bleeding

hypercalcemia (HY-per-kal-SEEM-ee-uh), excess calcium in blood

hyperglycemia (HY-per-GLY-SEEM-ee-uh), excess sugar (glucose) in blood

hyperkalemia (HY-per-kay-LEEM-ee-uh), excess potassium in blood

hypertension (HY-per-ten-shun), abnormally high blood pressure

hyperthermia (HY-per-THERM-ee-uh), body too hot, heatstroke

hypocalcemia (hy-POH-kal-SEEM-ee-uh), abnormally low calcium in blood

hypoglycemia (hy-POH-gly-SEEM-ee-uh), abnormally low blood sugar

hypokalemia (hy-POH-kay-LEEM-ee-uh), abnormally low blood potassium

hypotension (HY-poh-ten-shun), abnormally low blood pressure, shock

hypothermia (hy-po-THERM-ee-uh), low body temperature

hypovolemia (hy-po-vohl-EEM-ee-uh), low blood volume

hypoxemia (hy-pox-EEM-ee-uh), low blood oxygen

infarction (in-FARK-shun), death of tissue due to lack of oxygen

infusion (in-FUZJ-un), steady flow of drug into the patient

insulin (IN-suhl-in), sugar-lowering drug

intravenous (in-truh-VEE-nus), by vein

isoproterenol (IE-soh-proh-TER-en-awl), cardiac stimulant drug

ketoacidosis (KEE-toh-ASS-id-OH-siss), excess acid plus ketones, diabetes

kilogram (KILL-a-gram), 2.2 pounds

lavage (luh-VAWJ as in corsage or triage), flushing fluid in and out

lidocaine (LIE-doh-cane), cardiac irritability drug

milliequivalent (MILL-i-ee-QUIV-uh-lent), unit of ionic activity

milligram (MILL-i-gram), unit of weight, 1/1000 gram

milliliter (MILL-i-LEE-ter), unit of volume, 1 cc, 1/1000 liter

morphine (MORE-feen), narcotic

myocardial (my-oh-CARD-ee-uhl), pertaining to the heart muscle

naloxone (nal-OX-ohn), narcotic antidote

nasogastric (NAY-zoh-GAS-trick), through the nose into the stomach

neurological (NUHR-uh-LOJ-i-kuhl), pertaining to the brain or nervous system

PVC's (pee-vee-sees) premature ventricular contractions

potassium (poh-TASS-ee-um), blood chemical

propranolol (proh-PRAN-uh-loll), cardiac blocking drug

pulmonary (PULL-mun-air-ee), pertaining to the lungs

resuscitation (ree-suss-i-TAY-shun), efforts at restoring life

ringer's (RING-erz), altered salt solution to expand blood volume

saline (SAY-leen), salt solution to expand blood volume

shock (shock), sufficiently low blood pressure to cause damage

sinus (SINE-us), referring to place where normal rhythm originates

tachycardia (tack-i-CAR-dee-uh), abnormally rapid heart rate

triage (TREE-awj as in corsage), deciding who needs treatment first

urea (you-REE-uh), chemical measured in BUN

ventricle (VENN-trick-uhl), lower heart chamber

ventricular (venn-TRICK-you-ler), pertaining to the lower heart chamber

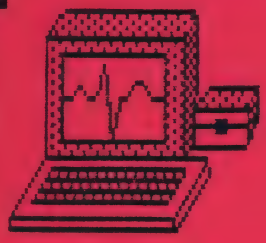
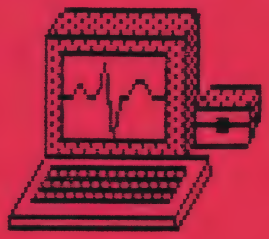
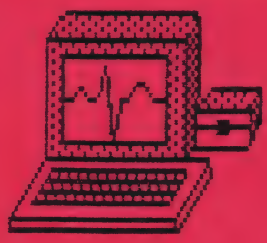
verapamil (ver-AP-uh-mil), cardiac drug

PROTOCOL LEARNING FLOWSHEET

Sample--This page may be copied

Date:_____ Time:_____ I.V.:_____ ET tube:_____
Patient description:_____
Pertinent history:_____
Age:_____ Weight:_____ Estimated time of arrest:_____

Time	Pulse	B.P.	Resp	Neuro	Orders/lab values/notes

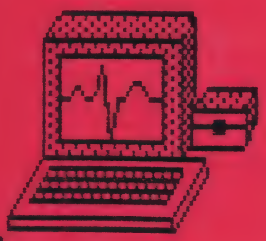
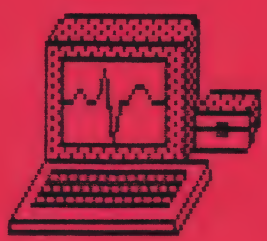




MAD SCIENTIST SOFTWARE
PRESENTS . . .

CARDIAC ARREST!

the incredible
CARDIAC RESUSCITATION SIMULATOR

BY BRUCE ARGYLE, MD


*** QUICK REFERENCE ***

PROCEDURES

Cooling
Defibrillate
Endotracheal tube
Hyperventilate
I.V.
Nasogastric tube
Precordial thump
Transfer
Warming

LAB

Blood gases
Dextrostix
Electrolytes
Temperature

DRUGS (BOLUS)

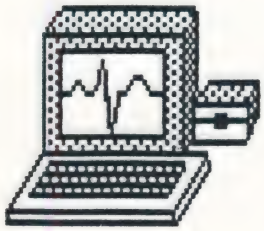
Atropine
Bicarbonate
Bretylium
Calcium
Dextrose
Diazoxide
Digoxin
Epinephrine
Insulin
Lidocaine
Morphine
Naloxone
Propranolol
Verapamil

DRUGS (INFUSIONS)

Dobutamine
Dopamine
Epinephrine
Insulin-glucose
Isoproterenol
Lidocaine
Potassium
Saline

OTHER

Help
History
Observe
Quit



CARDIAC ARREST!

* *

*

* Advanced *

* Cardiac Life Support *

* Simulation Program *

*

* MAD SCIENTIST SOFTWARE *

* Copyright 1986 *

* Bruce Argyle, MD *

* *

An educational simulation for computer.

TABLE OF CONTENTS:

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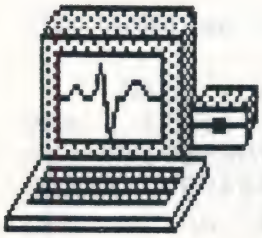


CARDIAC ARREST!

For ATARI 800/XL/XE computers
REQUIRES: 48K RAM, BASIC Language.

Update 1987

INTRODUCTION: You are the emergency specialist in the local hospital emergency room. You've just treated a broken arm and are looking forward to a bite to eat, when the nurse shouts for you. Your next patient awaits you. But this patient is, well, dead.

Whether this "dead" patient can be revived depends entirely on your efforts. You call the shots. You have at your disposal a highly trained team. They'll automatically begin "basic life support," artificially breathing oxygen into the patient and compressing the chest to circulate the blood. But further treatment awaits your orders. Don't blow it.

This is not a program for kiddies. The patients are real patients; the drugs you use are real drugs. Proper use of drugs and proceedures will save a life--inappropriate use of a drug or therapy may kill the patient. With the help of the manual and some practice, a person who knows nothing about medicine can soon begin to "save lives." The more difficult patients would present a challenge even to the emergency specialist.

Although every effort has been made to ensure that this manual and the Cardiac Arrest! simulator are accurate, no guarantee of medical correctness is made. These materials are not designed to replace ACLS education. The application of clinical knowledge is the responsibility of the user.

CARDIAC ARREST! has supporting programs, including EKG TEACHING and PROTOCOL LEARNING which are designed to help the user learn advanced cardiac life support (ACLS).

HOW DOES IT WORK?

Place the disk in the drive, then turn the keyboard on (800 and 1200XL users need to insert the BASIC cartridge first). The disk will boot automatically.

NOTE: DO NOT WRITE-PROTECT the disk, or it will not function properly. The disk needs to remain in the drive for the program to function fully.

From the main disk menu, you can choose a patient either by category (easy, difficult, pediatric), by specific problem (hypothermia, hypocalcemia, asystole), or at random. There are 45 patients on the disk. However, a patient will behave differently each time he is resuscitated.

After the resuscitation program and patient data load, you'll see the patient's history. Pay attention. Often there are powerful clues to the patient's problems. Of course, just like in real life, there are occasional tantalizing bits of history which have nothing whatsoever to do with the patient's problem.

The computer determines the patient's heart rhythm and vital signs, printing out a sample electrocardiogram, pulse rate, blood pressure, quality of breathing, and level of alertness. Then it asks you for orders.

CARDIAC ARREST! is a "free-form" simulator. You type in an order in regular English. Be sure words and numbers are separated by spaces. The computer scans your order to see if it means anything. You'll see the words that are in the program's vocabulary echoed back to the screen. If the program can assemble something meaningful from what you typed in, it acts on that order, and advances the simulation one "minute" in time.

As you re-evaluate your patient, you must understand that this is NOT a knee-jerk, IF/THEN-type program. You may do exactly the right thing, but because of the patient's illness, the next screen may show him to be worse than before. The computer determines the patient's status by calculating cardiac parameters (contractility, irritability, functional blood volume, etc) from base variables (cardiac damage, serum potassium, sensitivity to hypoxia, etc). It arrives at a "probability" of various rhythms, then rolls the dice.

After twenty cycles, you can transfer the patient to the Intensive Care Unit (ICU). The patient should have a good blood pressure and rhythm at that time. You may give up at any time, however, by using the word "QUIT." After 45 cycles

the program will cut off automatically.

When you exit the simulator program, the computer gives you a final outcome for your patient, and informs you of any special problems it detected. You can try the same patient again, or return to the main menu. Unlike real life, every patient on the disk can be saved IF you do things right.

A FOOTNOTE FOR PURISTS:

The program does not exactly duplicate real life. First, a home computer simply does not have enough memory to follow every single variable and "what if." If you play around, throwing in every drug you can think of, you might see an effect which has no relation to real life. Because my wife put the computer in the fish pond after I had spent a mere 15,000 hours "fine tuning" this program, there are undoubtedly some quirks that I haven't found yet. Secondly, real life is too boring. Certain factors in the program have been deliberately exaggerated for educational purposes. So things happen faster and more dramatically than in real life.

Yes, one should never try to diagnose such things as electrolyte abnormality and heart attack from the monitor screen. You need a twelve-lead EKG. But here you have only one sample tracing (Modified Lead II, like you'd see from standard monitoring). Allow the sample EKG to SUGGEST a problem (such as hypocalcemia) to you, but confirm your suspicion with tests before you inject anything dangerous into the patient.

HOW TO USE THE MANUAL

As you resuscitate your patient, keep the manual handy. If you're just learning cardiac resuscitation, read the manual all the way through, preferably twice. Study Appendixes A,B,C, and D. If you already know advanced cardiac life support (ACLS), scan through these first instructional sections. See what the computer will allow you to do, then go kill a patient.

Look at the sample EKG on the screen. What's the rhythm? Not sure? Look through "SAMPLE ELECTROCARDIOGRAMS" in Appendix J. Does it look a little funny in other ways? Look further in "SAMPLE ELECTROCARDIOGRAMS." You'll find a hint about other problems.

Read about the rhythm under "SOME SPECIFIC PROBLEMS" in Appendix D. Is some other problem suggested by the EKG? Read about that problem also under "SOME SPECIFIC PROBLEMS." Do you need to order a test to confirm that problem? Are there problems evident in the vital sign printout which are NOT explained by the rhythm alone? Examples would be low blood pressure (hypotension), or coma persisting DESPITE a good cardiac rhythm. If so, look it up in Appendix D. As your lab tests come back, compare them to "REFERENCE VALUES FOR THIS SIMULATION," Appendix H. If something's out of line, then read about that problem under, you guessed it, "SOME SPECIFIC PROBLEMS" in Appendix D.

Big words getting to you? Look them up in "GLOSSARY," which is Appendix K.

Now you've read about the problems. Which do you treat first? If you don't know, read "A GENERAL LOOK AT TREATMENT" in Appendix C. More advanced users might just refer to "A SIMPLIFIED APPROACH," Appendix I. No idea what to do? Read about the problems again in "SOME SPECIFIC PROBLEMS." Treatments are outlined there. You can read about any treatment you plan in the order listing, under "PROCEDURES" (Appendix E), "LAB TESTS" (Appendix F), or "DRUGS" (Appendix G). Pay attention to the paragraphs "Indications" and "Precautions." "Indications" means proper reasons for use of a drug or proceedure.

GENERAL INFORMATION ON ORDERS

You may order any proceedure, drug, or test which is in the CARDIAC ARREST! vocabulary, using regular English. A listing of options can be found in "Quick Reference." There's a discussion of each possible order in Appendixes E, F, and G. You will notice that most orders cost you one "minute" of resuscitation time. This forces you to determine priorities.

Besides lab tests and therapies, you can ask to cheat ("HELP" will show you the patient's diagnosis and/or teaching points) or ask to re-read the HISTORY. You never need to order chest compressions, oxygen, or artificial respirations, because these "basic life support" steps are done automatically by your "team" when needed. Towards the end, you can OBSERVE the patient while waiting for lab test results or for treatments to have an effect. When you think you're finished, you order TRANSFER TO ICU for the patient, or QUIT in disgust.

Orders should consist of a single step. Be careful not to make your order too complex, or the computer will get confused. The computer can accept only one proceedure or one drug, one numerical value (dose), one route (IV vs endotracheal), one unit of measure (cc vs mg), and one adjective (pediatric vs adult strength) per order. For example: "GIVE NALOXONE, 2 PEDIATRIC AMPULES I.V." contains one drug (naloxone), one dose (2), one adjective (pediatric), one unit of measure (ampules), and one route (IV).

If you stick to the form found in the sample order which follows each individual drug or proceedure in Appendixes E, F, and G, you shouldn't go wrong. Extra words in the order are ignored by the computer, but if you accidentally throw in a word which the computer recognizes, it may think you meant something else. It may refuse the order or do something you didn't intend. For example, if you say, "HOLD HIM DOWN AND START AN I.V." the program will recognize "HOLD" (as in "STOP") and "DOWN" (as in "TURN DOWN"). It'll tell you there isn't an IV to turn down.

Doses MUST be given in NUMBERS, not words. You must leave a space between each word, AND a space between the dose and the units. For example, the order "2CC EPINEPHRINE IV" will be refused--the program will not recognize "CC" as a unit of measure because no space was left between "2" and "CC." (When an order is refused because it's incomplete, you'll be told what's missing, but you should re-enter the entire order.)

For drips (infusions), simply order the drug by name

(for example, "DOPAMINE DRIP"). The nurse will prepare a standard solution and ask you for the rate of infusion (usually in micrograms per kilogram of body weight). You can't order the drip and specify the rate at the same time, because the program considers setting up the drip and adjusting the rate as two separate steps. The computer will NOT honor any special mixing instructions you give it.

If you don't specify a route for a drug (such as I.V., endotracheal, or infusion), it will be assumed that you want the drug given IV bolus. You can't give drugs subcut., I.M., or P.O., 1) because you shouldn't give them that way in cardiac arrest, and 2) because I was too lazy to work out the pharmacokinetics.

The program has some features to try to head off errors. This will prevent the computer from killing your patient just because you ordered something a little differently. If your "reasonable" order has the computer hissing at you, simplify it down to the bare essence. Watch as the vocabulary search echoes the words back to the screen. If you don't see a word, it is either misspelled or not in the program's vocabulary, or you haven't left a space between the word and an adjacent word or dose. Check your spelling. If all else fails, read the manual.

What can't the program do? Any drug (such as dexamethasone) which takes a long time to have an effect is not available in CARDIAC ARREST! Also, drugs which are rarely used in the ER have been eliminated in order to save time and computer memory. For most of these "refused" orders, the program will acknowledge your order but will tell you it's NOT going to do it.

The computer accepts most abreviations and slang terms, but a couple of drugs must be ordered in a specific way because of the way the "intelligence" in the program works--for example, 50% dextrose must be ordered as "1 AMP DEXTROSE" rather than "1 AMP D50." You'll find any precautions discussed in the individual drug listing (Appendix G).

A pacemaker isn't included in CARDIAC ARREST! in order to give practice with drug therapy for bradycardia and asystole. Realize that a new external cardiac pacemaker would be an excellent treatment for many patients on the disk, but forgive me for having "all available pacemakers in use in the ICU."

You're allowed only a routine IV (this gives you practice with endotracheal medication when the IV is delayed). So cutdowns and subclavians won't be performed by the computer, nor will it allow intracardiac injection.

EXAMPLES OF ORDERS: Scan through the orders listed below. You'll get an idea of the capabilities of the CARDIAC ARREST! simulator.

Acceptable orders:

OBSERVE FOR 10 MINUTES
RECTAL TEMPERATURE
DEFIBRILLATE 200 JOULES
ELECTROLYTES
SHOW ME THE HISTORY AGAIN
SALINE INFUSION
.3 CC EPI BY VEIN
DEXTROSE 1 AMP
HYPERVENTILATE THE PATIENT
WARM NASOGASTRIC LAVAGE
EPI 1 AMP BY E.T. TUBE
START AN IV, PLEASE
DOPAMINE DRIP
WHAT'S THE DIAGNOSIS?
BICARB 25 CC IV
LET'S QUIT, HE'S DEAD.
PEDIATRIC NARCAN, 2 AMPULES
PLACE ENDOTRACHEAL TUBE

Incorrect orders:

LIDOCAINE 1 MG/KG IV PUSH (the "nurse" will not calculate bolus drug doses for you)
CALCIUM 5 CC OF 10% SOLUTION (contains more than one number)
ONE AMP EPI (dose not in numbers: order "1 AMP EPI")
EPINEPHRINE 3CC (no space between dose and units)
GIVE 1 AMP EPI THEN DEFIBRILLATE (two orders)
2 AMPS ISUPREL IN 500 CC, 20 DROPS PER MINUTE (just order ISUPREL DRIP)
LIDOCAINE 75 MG THEN HANG DRIP (two steps)
INSULIN AND GLUCOSE DRIP (see INSULIN-GLUCOSE in drug listing)

Just remember ONE STEP, DOSES ARE NUMBERS, and LEAVE A SPACE. That's about all you need to remember to make the CARDIAC ARREST! simulator understand you.

SO WHAT'S THE PLAN?

Your purpose in using the CARDIAC ARREST! simulator is to save the patient's life while preserving as many of his brain cells as possible. While random chance may play a significant role, your best plan is to follow the standard ACLS protocols where possible. You can practice the protocols on the PROTOCOL LEARNING disk (also from Mad Scientist Software). Approach the patient as you would a real one--the program is weighted to "punish" you if you "shoot from the hip."

Order lab tests (blood gases and electrolytes) at the earliest optimum moment. This optimum time is usually immediately. However, since the lab can't run two samples at once, if you plan to give bicarbonate you might wait until after it's been given to order ABG's.

Another helpful hint to improve your patient's outcome is to order hyperventilation right at first. It doesn't take up any time, and decreases the rate of brain damage. Come to think of it, that's not such a bad idea for real patients, either.

You might be tempted to put off intubation in favor of something which seems more immediately helpful, such as lidocaine and another try at defibrillation. I wouldn't. Brain cells and cardiac muscle cells die faster when you don't control the airway. Many other sneaky program functions are designed to insure that the best approach to these "simulated patients" is the same as for a real patient. Try to follow the ACLS treatment protocols as closely as possible.

Particularly with the difficult patent category, stop and think about what clues you've been given in the history. Remember that you can review the history by typing "CHART" or "HISTORY." Here you may need to deviate from the "cookbook" protocols, asking for a body temperature, dextrostix, or special therapies. Consider these extra steps as "inserted" into the protocol, continuing on with the standard approaches.

Although the program will refuse to allow you to cheat during the first few minutes, you might want to check the patient's diagnosis sometime by typing "HELP." Some patients have general treatment hints as well. This is different than on the "PROTOCOL LEARNING" disk, where typing "HELP" gets you a complete protocol flowchart.

Some of the more difficult patients present a treatment dilemma. For example, one such dilemma is the patient who can be defibrillated into a pulseless bradycardia, then slips

back into fibrillation. You can waste a lot of valuable treatment time going around in circles. Once you recognize the problem, fix the problems (irritability, conduction block), THEN go back and try to fix the rhythm.

If you succeed in preventing death, stabilize your patient in every way possible before ordering the patient transferred. That means raise a low blood pressure, replace suspected fluid losses, treat continued irritability of the heart. If you don't adequately fix these things, you may find that your patient died in the ICU a few hours later. Assume that the "internist on call" might not get to your patient right away. While you're waiting for IV fluid replacement, or some other therapy, you can just say "OBSERVE 10 MINUTES" to pass the time.

When the evaluation program looks at your performance, keep two things in mind. First, remember that the program only detects SOME problems. It doesn't detect deviation from protocol or less-than-perfect performance. What the evaluation program looks for are gross therapeutic errors and failure to address the patient's underlying problems. For testing how well you apply the ACLS protocols to clinical situations, try the PROTOCOL LEARNING disk. Second, be aware that the program may criticize something which really was the best thing to do under the circumstances. This will be quite rare.

With good management, every patient on the disk can be returned to a useful existence. A couple of the more extremely sick patients may do poorly even with perfect management if "Lady Luck" turns against you. Just try again.

The remainder of the manual consists of appendixes designed as references to be used as needed. You'll find them helpful.

APPENDIX A

A BASIC UNDERSTANDING OF CARDIAC ARREST

The heart is a pump. If it's pumping enough blood around, the heart's owner is alive. If the heart doesn't pump enough blood, the person's organs become damaged from lack of oxygen. If the lack of blood flow lasts long enough, the damage to the brain becomes permanent. The heart is also quite sensitive to lack of oxygen, and becomes damaged permanently.

If there's no blood flow at all, we call this cardiac arrest. There's no pulse, and the patient is unconscious and not breathing. Cardiac arrest doesn't mean one specific rhythm (like ventricular fibrillation or asystole); it means that the heart isn't pumping well enough to cause a pulse.

If there's a little blood flow, but not enough to prevent tissue damage, we call it "shock." Shock is diagnosed by a low blood pressure (hypotension). A pulse can be felt. The tissue damage doesn't occur very quickly with shock compared to cardiac arrest, because the organs are getting SOME blood flow.

WHAT'S GOING ON? There are several reasons why the heart might not pump enough blood. For the purposes of this computer simulation, these reasons are 1) abnormal heart rhythm, 2) too little blood to pump around, 3) too much heart damage (severe heart attack) for the heart to pump effectively, 4) effects of drugs on the heart and blood vessels, and 5) abnormalities of blood chemistry or body temperature which affect the heart's function.

1) Abnormal rhythm: The heart has an electrical system which makes it pump just over once a second. This pacing system can become out-of-order because of heart attack, drugs, cold, or abnormal blood chemistry. A pace which is too fast or one which is too slow can prevent the heart muscle from pumping blood effectively. If an abnormal rhythm results in low blood pressure, it needs to be treated. If the blood pressure is O.K., don't treat the rhythm itself, but consider what problem might be developing that the rhythm disturbance is warning you about.

2) Too little blood: If the blood volume is very low, then the heart cannot get blood to vital organs even if it's working perfectly. The blood volume may be decreased because of bleeding, or may be decreased because of dehydration. Fluid may be lost from the blood stream through drugs (water

pills), vomiting or diarrhea, uncontrolled diabetes, or prolonged lack of drinking. Lack of blood volume is treated by giving fluids by vein.

3) Heart damage: When enough of the heart muscle is damaged by lack of oxygen (heart attack), the heart can't pump effectively even if everything else is normal. We call this "cardiogenic shock." This can be helped somewhat by giving the heart more fluid to pump, drugs to help the remaining heart muscle contract more effectively, and drugs which raise blood pressure by constricting blood vessels. All of these measures, however, have hazards and must be used carefully.

4) Drugs: Drugs can disturb the heart rhythm, decrease the ability of the heart to pump, and can dilate the blood vessels so that less blood comes back to the heart (blood vessel dilation deprives the heart of blood just like bleeding). Some such drug effects can be reversed with other drugs, but others will last as long as the drug is in the body.

5) Chemical and temperature changes: The heart uses potassium, calcium, and sodium for its electrical activity and pumping action. Too much or too little of any electrolyte (the name given to any normal body chemical which affects electrical activity) can make the heart malfunction. Too much acid or too much bicarbonate in the blood stream also prevents normal heart activity. Abnormally low temperature slows the heart, then finally upsets the rhythm.

APPENDIX B

WHAT HAPPENS DURING RESUSCITATION

First, the diagnosis of cardiac arrest is made based on unresponsiveness, absent respirations, and absent pulse. The resuscitation team rushes to begin their duties. The team members are: a triage nurse; medication nurse; recording clerk or nurse; a nurse or EMT to give chest compressions; and a respiratory therapist to give artificial respirations. The emergency physician interprets the EKG, gives orders, and performs certain proceedures.

A "crash cart" is rolled up to the patient. It contains the drugs used in cardiac resuscitation, plus supplies such as endotracheal tubes. An EKG monitoring screen often sits on top of the cart, with a defibrillator.

One team member begins chest compressions. The sternum is pushed down about 2 inches to pump blood through the chest. This pumping, however, does not provide enough blood to keep the patient alive for long, so it is important to get the heart beating again.

Another team member is providing respirations, either with a bag and mask, or through the endotracheal tube after it is passed. In some hospitals, the chest compressions and respirations are done by a machine called a "Thumper."

Electrical cables on the patient transmit the heart's electrical activity to the EKG monitor. An IV is started.

The medication nurse prepares and administers medicines when ordered, and charges the defibrillator (since it usually sits on top of the crash cart containing the medicines).

The triage nurse assists in seeing that the physician's orders are carried out smoothly, helping with medication and supplies. This nurse "directs traffic."

The recorder jots down medication and proceedures, noting the time each order is carried out. He/she may remind the doctor if the patient is ready for another bicarb or epi dose.

The emergency specialist's main job is to gather the facts, think, and order. He decides when the patient is doing well enough to transfer. He may order the resuscitation stopped and declare the patient dead if the situation is looking hopeless. Usually resuscitation efforts are kept up at least 30 minutes.

APPENDIX C

A GENERAL LOOK AT TREATMENT

FIX THE ABNORMAL RHYTHM AS QUICKLY AS POSSIBLE. Don't even think about the underlying cause of a cardiac arrest until you have tried to restore the heart rhythm to normal. Go through the therapeutic plan while waiting for tests to come back. Slow rhythms get drugged, fast rhythms get shocked. In the patient is in V-fib, defibrillation is the first thing you do. Remember, though, if an abnormal rhythm produces a good pulse and a decent blood pressure, DON'T "fix" it. In that case you get lab tests, stabilize the problems, THEN convert the rhythm back to normal.

EVERY CARDIAC ARREST PATIENT NEEDS AN IV. An IV is essential to give the patient the medication he needs. Ordering the IV started should be the first thing you do for the patient with a slow rhythm (see "A Simplified Approach"). If the patient has a rapid rhythm as a cause of cardiac arrest, such as ventricular fibrillation, you try defibrillating first.

STIMULATE THE HEART. Stimulate the heart and constrict the blood vessels with epinephrine (adrenaline). In every type of cardiac arrest (NO PULSE!), epinephrine is the first drug used. The epinephrine is repeated every 5 minutes until a blood pressure is obtained. An epinephrine drip is a good way of delivering adrenaline to the patient who continues to need it.

IF THE PATIENT ISN'T BREATHING ON HIS OWN, INTUBATE. A tube put through the mouth into the lungs gives control of the airway. The endotracheal tube allows better artificial respirations, makes CPR more efficient, and prevents vomit from getting into the lungs. One does not, however, delay immediately beneficial steps in order to get the ET tube in. For example, if a patient is in ventricular fibrillation, you don't spend your first minute intubating--you grab the paddles, and a few seconds later the patient is alive and well. But if the cardiac arrest continues, intubate as soon as practical. Generally, intubation is done at the same time the IV is started, or as the first drugs are given IV.

TREAT IRRITABILITY. If the patient keeps going back into V-fib or V-tach, or can't be shocked out of the bad rhythm, treat the irritability of the heart with drugs. Then see if the cause of the irritability is one you can fix--such as acidosis.

ORDER LAB TESTS. Order electrolytes and blood gases promptly. They don't do much good if the results come back after you've given up and called the mortuary. Blood gases should be repeated as often as necessary to keep the serum pH near normal.

CORRECT ANY ACIDOSIS. The patient may not respond at all to your efforts if he has acid buildup (acidosis). Although routine use of bicarbonate is no longer recommended, consider using it on the patient who was "down" a long time before CPR was started and is not responding to the usual treatment. Otherwise, use blood gases to help you decide if extra bicarbonate is needed.

FIX WHAT NEEDS FIXING. Blood volume and blood chemistry should be corrected if possible. A word of caution: it's best to leave MILD abnormalities alone. You can do the patient a lot of harm by trying to treat something which isn't bothering him at all.

OBSERVE. After cardiac arrest, the organs take a little while to get going again. The patient will take a few minutes to wake up. In this simulation, observe at least 10 minutes after the patient gets a pulse to see how much he will recover.

FOLLOW THE REGULAR GAME PLAN. Stick to the treatment instructions. Do exactly what is needed for the patient--no more, no less. If you can't think of anything to do at the moment, continue CPR while awaiting tests. In the simulation, just hit [RETURN] to advance one minute. Don't be tempted to give a drug which you haven't PROVEN a need for just because you think you "have to do something". You won't help your patient by "shooting from the hip."

KEEP A RECORD. Keep a "flowsheet" on which you record each order, and the time of the order. Record also lab tests as they return. The flowsheet helps prevent errors. You might want to start your flowsheet with key data from the history: date, time, age, weight, important history.

APPENDIX D

SOME SPECIFIC PROBLEMS

Acidosis. Acid builds up in the blood stream when the tissues do not get enough oxygen-rich blood delivered to them. In the patient who is alive, acidosis can result from kidney failure, diabetic ketoacidosis, poisonings (like cyanide), and shock. Any patient in cardiac arrest becomes acidotic. Acid makes the heart more irritable and makes it pump less effectively. This acid buildup can be neutralized with sodium bicarbonate if it's severe. Bicarbonate is NOT given routinely any more--consider the situation, then give it only if you think it's needed. A typical starting dose of bicarbonate is 1 mEq per kg. Monitor the acid-base status with blood gases (ABG). You can calculate the amount of bicarbonate needed from the base excess (B.E.). An approximate bicarbonate replacement dose is one tenth of the person's weight in kilograms times the base excess (Additional bicarb = 0.1 x (weight in kg) x B.E.). Overcorrecting the pH (alkalosis) may be harmful, so be careful. Leave a mild acidosis (pH above 7.25) alone.

Agonal rhythm. Occasional wide, abnormal electrical waves are seen, but there is no pulse. This rhythm means trouble. It usually means that the patient has already suffered such severe heart damage that there is no hope of recovery. Treat it essentially like asystole (see below).

Alkalosis. Too much bicarbonate in the blood stream usually results from too much bicarbonate being given by vein. It can occur also by prolonged vomiting up of stomach acid or severe hyperventilation. Alkalosis is very difficult to treat. Since there is nothing on the usual "crash cart" to treat it, this program gives you no way to save the patient if you give an overdose of bicarbonate. Alkalosis makes the heart very difficult to defibrillate and makes the delivery of oxygen from the red blood cells less effecient. If the pH is above 7.25, be happy and don't risk alkalosis by giving extra bicarb.

Anaphyllactic shock. A severe allergic reaction sometimes causes dilation of all blood vessels in the body. This results in low or absent blood pressure and coma. The rhythm is usually sinus tachycardia. Treatment with epinephrine usually gives immediate, dramatic improvement. By constricting all the body's blood vessels, epinephrine gives back to the heart the blood which has pooled in the dilated arteries and veins.

Anemia. See Hemorrhage.

Asystole. No electrical activity at all on the monitor usually means a grim future. It very rare for anyone in

asystole to leave the hospital alive. No electrical activity means a very severely affected heart. If it results from electrolyte problems, you may save the patient. Get the pH as close to normal as possible. While awaiting lab, make sure that epinephrine is given frequently. Give atropine up to the maximum dose. Give maximum doses of epinephrine (consider an epinephrine drip). Try an isoproterenol infusion as a last resort. A pacemaker may be tried, but is not available (or required) in this program. Try defibrillating just in case the asystole is really very fine ventricular fibrillation.

Atrial fibrillation. Unorganized activity in the upper chamber (atrium) can allow electrical impulses to get into the lower chamber irregularly. It's recognized by irregularly spaced QRS complexes, and an irregular baseline between beats. If the rate is close to normal and there is a good blood pressure, then leave it alone. If there is no pulse or very low blood pressure, then defibrillate. If the rate is rapid but there is a fair blood pressure, treat with drugs which increase conduction blockage (digoxin, verapamil).

Atrioventricular conduction block. see conduction block.

Block. see conduction block or bundle branch block.

Bradycardia. A heart rate which is much too slow does not provide good blood flow. It often results from a heart attack or drugs, but can also be seen in hypothermia or electrolyte problems. If the blood pressure is good, do not treat the bradycardia. Treat bradycardia first with atropine, up to the maximum dose. Epinephrine provides temporary stimulation if the patient has a poor or absent pulse. If still severe, try an isoproterenol infusion. Alternatively, an epinephrine infusion may be tried. A pacemaker should be prepared if the patient requires more than atropine for the bradycardia, but this program does not allow you to use it.

Bundle branch block. Part of the conducting system is not working right. It may occur because of electrolyte problems, heart attack, or hypothermia while the rest of the conducting system is still working. While it may alert you to a problem, by itself it requires no treatment. Often, however, bundle branch block is accompanied by AV conduction block which DOES require treatment (see below, conduction block).

Cardiogenic shock. When enough heart muscle is damaged, the heart can no longer pump effectively. When the blood pressure stays low despite a good rhythm, with no cause other than a heart attack, consider cardiogenic shock. If there is some reason to think that the patient has low blood volume, such as use of diuretics (water pills), carefully try a

little saline infusion (about 500 cc over 15 minutes--remember to tell the nurse to turn the thing off). Dopamine or dobutamine can help raise blood pressure, but also must be used carefully. Dopamine increases the irritability of the heart, so in the case of a heart attack, you might want to give lidocaine beforehand. Depending on how much "reserve" the patient has, if over 40 to 45% of the heart muscle has been destroyed, the patient will ultimately die. Sorry, fans, but nitroprusside (Nipride) is not available in this version of Cardiac Arrest!

Coma. Coma means unconsciousness. It may be temporary following cardiac arrest, in which case the patient will become conscious within a few minutes. Prolonged or unexplained coma may be due to brain damage, drugs such as narcotics, severe hypoglycemia, heat stroke, hypothermia, or electrolyte problems. A standard approach to unexplained coma is to draw lab, then give DEXTROSE and NALOXONE (NARCAN) I.V.

Conduction block. When the impulses from the atrium are being stopped from reaching the ventricle, the heart rate can slow enough to cause shock or cardiac arrest. If the impulses are merely being slowed (first degree AV block) but not stopped from reaching the ventricle, this requires no treatment. Conduction block can be caused by heart attack, drugs, hypothermia, or electrolyte problems. Atropine is the first choice--give the maximum amount before trying anything else. An isoproterenol drip is the second choice. Epinephrine is worth a try, and may be very useful in the hypotensive patient. An artificial pacemaker is the next step (for educational purposes, this program requires that you rely on drugs).

Dehydration. Loss of fluid from the blood stream can result in shock, but it usually does not result in cardiac arrest until other problems develop (acidosis, electrolyte abnormality). When dehydration develops, there is usually a loss of electrolytes along with the fluid (usually potassium). Dehydration can result from use of diuretics, severe vomiting or diarrhea, kidney disease, hormone abnormalities, diabetes, losses through the skin (burns or severe sweating), or reduced fluid intake. Clues to dehydration will be found in the history, but also watch for a higher than normal hemoglobin concentration on the ABG, and hypotension with tachycardia. Treat by replacing fluids with saline or ringer's until the blood pressure is normal. Watch the electrolytes.

Drug overdose. See narcotic overdose, overdose.

Fibrillation. See ventricular fibrillation, atrial fibrillation.

Heart attack. See myocardial infarction.

Heatstroke. See hyperthermia.

Hemorrhage. Hemorrhage is loss of blood through bleeding. It may not be obvious if the bleeding is into the chest or abdomen. There should be a history of trauma or obvious blood loss. The blood hemoglobin (Hgb) will fall as the body puts other fluids into the blood stream to try to keep the total blood volume up. Expect tachycardia, then falling blood pressure as shock develops. Treatment is to support the blood pressure with fluids. Support of the blood pressure with dopamine may help, but this only buys time--it does not "fix" the problem. Ultimate treatment is blood transfusion, with an operation if the bleeding is internal. Blood transfusion is not available on this version of Cardiac Arrest!

Hypercalcemia. Too much calcium in the blood stream can result from hormone problems, cancer in the bones, or kidney trouble. Calcium effects the electrical system of the heart, lengthening the PR interval, shortening the ST interval, and shortening the T wave. The heart becomes more irritable. A patient with severe hypercalcemia will usually also be severely dehydrated. Deliberately causing a MILD hypercalcemia by giving calcium by vein helps stabilize the heart when too much potassium is present (see hyperkalemia). Treatment for hypercalcemia is to treat heart block (if present) with atropine, reduce irritability (see below) if present, and to start a rapid saline infusion to correct dehydration and to flush the calcium out the kidneys (assuming the kidneys work). The program does not allow you enough time to see the calcium level fall.

Hyperglycemia. A high blood glucose is called hyperglycemia. Do not treat mild hyperglycemia. A severely high blood sugar by itself does not cause cardiac arrest, but the dehydration which it causes can cause shock, with cardiac arrest following. Diabetic acidosis (called ketoacidosis if ketones are present in the blood) is diagnosed by glucose above 250 and low pH. There is usually tachycardia, plus hyperventilation if the patient is breathing on his own. There may be a lack of potassium as well, even though the potassium may appear normal on an initial electrolyte test. Keep in mind that diabetic ketoacidosis often is caused by a major stress, such as a heart attack. Treatment is insulin, rapid fluid infusion, and bicarbonate if needed. Watch the electrolytes.

Hyperkalemia. High blood potassium is called hyperkalemia. It can result from kidney failure, certain drugs, crushed muscles, hemolysis (red blood cells bursting in the blood), or potassium-containing pills or liquids. As the potassium increases, one first sees tall, peaked T waves, then at a

potassium level of around 6.8 to 7.5 the QRS widens, and conduction block or bundle branch block may develop. The P wave may disappear. The heart becomes prone to fibrillation. Treatment is calcium (this changes some of potassium's effects on the heart) and enough bicarbonate to make the patient a little alkalotic (pH about 7.5). The serum potassium varies inversely with the pH: if the patient is acidotic, the potassium is higher; if alkalotic the potassium level decreases somewhat. A glucose-insulin infusion drives potassium into the cells, decreasing the blood level. Use it carefully, watching the potassium level.

Hypertension. High blood pressure should not be treated on an emergency basis unless complications of the high blood pressure are evolving (intracerebral bleeding, dissecting aortic aneurism, worsening heart attack, etc). A high blood pressure increases the work of the heart, and therefore makes it need more oxygen. Hypertension may worsen a heart attack. It may be treated in various ways, most of which you might later regret. But if the patient needs it, you can lower blood pressure with PROPRANOLOL, DIAZOXIDE, VERAPAMIL, or MORPHINE. In the setting of a heart attack, relieving the pain with morphine is a desireable goal, and will usually also bring the blood pressure down. If MORPHINE alone is not effective to stop the hypertension, then DIAZOXIDE is the next choice. Be careful. PROPRANOLOL and VERAPAMIL are best avoided if possible, but there may be a situation where one of these might be needed.

Hyperthermia. Heatstroke can occur when exercizing in a hot environment. Dehydration or underlying medical problems make heatstroke more likely. Diagnosis is by finding an altered mental status with rectal temperature above 106 degrees. There may be other problems present also. Treat any immediate instability, then dunk the patient in an ice bath. Monitor the temperature so you don't freeze the patient.

Hyperventilation. A conscious patient may hyperventilate because of pain, anxiety, or acidosis. A low carbon dioxide (CO2) gives the diagnosis. Treat only the underlying cause. A somewhat low CO2 is common during CPR because of the artificial respirations.

Hypocalcemia. A deficit of calcium can result from hormone abnormalities, bowel disease, or dietary deficiency. The heart is affected electrically, and cannot contract as strongly, finally becoming more prone to fibrillation. EKG clues are a shortened PR interval with a long ST segment and long T wave. A second "U" wave just after the T wave may be seen--this wave can also be inverted. Treatment (assuming that the patient is in trouble because of it) is calcium by vein. Give about 10 mg per kg for every 1 unit rise desired in serum calcium. Do not treat a low serum calcium unless you think it is affecting the patient's heart.

Hypoglycemia. The brain and heart need sugar to operate. Severe hypoglycemia, an extremely low blood sugar, can cause coma. If the coma is deep enough that the patient stops breathing, cardiac arrest can result. Any patient in undiagnosed coma should get an ampule of dextrose IV (order electrolytes first so you'll know what the original blood sugar was).

Hypokalemia. A lack of potassium in the blood is called hypokalemia. It usually results from diuretics (water pills), but can also occur with hormone problems, or with various causes of dehydration (vomiting, diarrhea). The heart becomes more irritable, and more sensitive to digoxin side effects. The T wave widens, then an extra wave (U) appears after it. Below a level of 2, the ST segment becomes depressed. Treatment of severe hypokalemia (causing cardiac problems) is potassium by vein. Usually this is added into the I.V. fluids. Reorder electrolytes frequently.

Hypotension. Low blood pressure (shock) slowly starves the tissues. As the heart and blood vessels become affected by the hypotension, a vicious circle develops--the heart pumps more poorly and the blood vessels cannot contract to maintain the pressure, so the blood pressure drops further and the heart and blood vessels function even more poorly. Try to treat the CAUSE of the low blood pressure. If low blood pressure results from a rhythm disturbance (either too slow or too fast), then treat that rhythm. Look for any chemical abnormality, and consider the possibility of a drug overdose. If the history hints at fluid loss (dehydration) or blood loss, start replacing lost fluids. Cardiogenic shock is low blood pressure resulting from a severe heart attack (see above). If there is no "fixable" cause (or while waiting for enough fluid to be given IV) support the blood pressure with a DOPAMINE INFUSION. For causes of hypotension, see anaphyllactic shock, cardiogenic shock, dehydration, hemorrhage, hypothermia, narcotic overdose.

Hypothermia. An abnormally low body temperature is called hypothermia. It results from exposure--drunks or addicts out in the cold, drowning victims, newborns exposed to cool air. These victims often seem stiff, cold, and dead. No person with a low body temperature is dead until they are warm and dead. Diagnosis is by rectal temperature (usually below 92) using an electric thermometer. EKG typically shows sinus bradycardia with everything slowed down--prolonged PR, wide QRS, depressed and prolonged ST segment, long T wave. There is hypotension, progressing to acidosis and cardiac arrest. Treatment of hypothermia is "core" warming. The center of the body is warmed using warm NG lavage (or peritoneal dialysis), and warmed air through the ET tube.

Hypovolemia. Low blood volume. See hemorrhage, dehydration.

Irritability. Many problems, including most heart attacks, make the heart prone to abnormal rhythms. If the heart keeps reverting back to V-fib or V-tach, we call this irritability. Think first of any chemical abnormality: acidosis or an electrolyte abnormality may be the cause. If you have not overlooked an obvious cause, then give a lidocaine bolus. Defibrillate if necessary, then draw ABG and lytes. Start a lidocaine drip.

Myocardial infarction. Death of heart tissue from lack of oxygen is called myocardial infarction, or "heart attack." The dead and dying tissue causes irritability (see above) and decreased efficiency of heart pumping. The larger the area of damage, the bigger the problems which it can cause. To prevent ventricular fibrillation, give lidocaine automatically to any heart attack victim.

Narcotic overdose. One automatic response to an unexplained coma is to give a full dose of Naloxone (Narcan). This completely reverses any narcotic effects, without any concern of side effects. Hypotension, shallow respirations, and coma are clues that there might be a narcotic coma. There are no EKG signs. Narcotic coma can progress to cardiac arrest when the dose is high enough to stop the patient from breathing.

Overdose. An oral overdose of medication requires that the stomach be emptied. In a stuporous, comatose, or unstable patient, this means placing an NG tube to suck out any remaining medicine. Specific measures for a particular drug may be required, but the most important first steps are: 1) get control of the patient's airway by placing an ET tube, 2) place an IV, and 3) empty the stomach. Charcoal and laxatives usually follow, but those options are not available in the simulation.

Premature Ventricular Contractions. Occasionally harmless, frequent PVC's occurring in a diseased heart often warn of impending V-fib or V-tach. Usually more than 6 per minute means trouble. Suppress frequent PVC's with lidocaine.

Right bundle branch block. See bundle branch block.

Sinus bradycardia. See bradycardia.

Sinus tachycardia. Sinus tachycardia usually results from overstimulation of the heart. If the blood pressure is normal, leave it alone. Never try to slow sinus tachycardia when the blood pressure is low--the tachycardia is merely a reaction to some other problem, such as hemorrhage or anaphyllactic shock. If the blood pressure is quite high, both the blood pressure and the tachycardia can be treated with a drug like propranolol, but you might want to wait a few minutes until the last dose of epinephrine wears off to

see if the epi is the cause.

Shock. See hypotension.

Ventricular fibrillation. Unorganized electrical activity in the ventricle can result from heart attack, electrolyte abnormality, abnormal acid-base balance, or hypothermia. The heart cannot pump at all. When confronted with ventricular fibrillation, you immediately try defibrillating to see if you can restore a normal rhythm. Fibrillation which resists the shocks is treated first with epinephrine, then with lidocaine. For the exact protocol sequence, see the protocol in "A Simplified Approach". If fibrillation still proves resistant, bretylium is added. Get lab tests and keep trying to defibrillate while waiting. A higher setting gives a better chance of conversion to normal rhythm, so all defibrillations after the first two should be at the maximum setting (4 joules/kg in children). Recurrent V-fib (irritability) should be treated with lidocaine, while you look for any treatable problem such as acidosis which could be causing the irritability.

Ventricular rhythm. If slow and accompanied by hypotension or cardiac arrest, treat it as you would a severe conduction block (see above), while setting up for a pacemaker. If the blood pressure is good, leave the rhythm alone.

Ventricular tachycardia. Caused by factors similar to V-fib, V-tach is a more organized, regular ventricular rhythm which can occasionally give a pulse. Even with a fair blood pressure, V-tach often degenerates into V-fib. Treatment depends on whether the patient is 1)fine, 2)unstable, or 3)pulseless. A patient who is not suffering any harm from the V-tach is treated with lidocaine to try to chemically convert the rhythm. If the patient is unstable (for example, low blood pressure), defibrillate--but at a lower starting dose than for V-fib (see protocol chart in Appendix I). V-tach with NO pulse is treated just like V-fib. Resistant or recurrent V-tach is treated with lidocaine.

APPENDIX E

PROCEDURES AND COMMANDS

Order list, equivalent terms, and explanations

COOLING (COOL, ICE, COLD): A patient with heat stroke (delirious or in coma with rectal temperature above 106) needs rapid cooling. Cooling can be both external (in contrast to the use of heat in hypothermia) or internal and still be effective.

Indications: heat stroke or impending heat stroke

Actions: lowers temperature by 1/4 to 1/2 degree per minute, depending on patient status

Precautions: Be sure to check the temperature frequently and stop the cooling when the temperature nears normal, or you will also get practice at treating hypothermia

SAMPLE ORDERS:

STAT ICE BATH

COLD NASOGASTRIC LAVAGE

D/C COOLING

DEFIBRILLATE (DEFIB, CARDIOVERT, CARDIOVERSION, SHOCK): Defibrillation means giving a brief direct-current shock across the heart. The strength of this shock is measured in joules or watt-seconds (a joule and watt-second are exactly the same thing). The defibrillator is charged, then the shock is given by two paddles. One paddle is placed just above and to the right of the heart, the other placed lower and around to the left. The defibrillator is set at 200 watt-seconds as resuscitation begins. If you want another setting, you must specify. The defibrillator will be at this new setting the next time you order defibrillation. 200 watt-seconds (joules) is the recommended starting setting to defibrillate a normal adult. The stronger the setting, the greater the chances of converting the patient to a normal heart rhythm. In ventricular fibrillation, increase the setting to the maximum if the first two tries are unsucessful. The maximum for our defibrillator is 360. For children, use a setting of 2 to 4 joules per kilogram of weight, rounding up to the nearest multiple of 25.

Indications: V-fib. Also use for V-tach or atrial fib if there is absent pulse or significant hypotension. Worth a try for asystole IF it is in reality very fine V-fib.

Actions: Electrically "fires" all of the heart at once, stopping abnormal "short circuits." Often the heart will then resume a normal rhythm.

Precautions: Excessively high settings will "electrocute" some of the heart muscle.

SAMPLE ORDERS:

DEFIB (will use 200 if no other setting specified previously)

DEFIBRILLATE AT 50 JOULES

SET TO 360 AND SHOCK HIM

ENDOTRACHEAL TUBE (ET TUBE, E.T. TUBE, INTUBATE): You (or the paramedic or anesthesiologist) place a breathing tube down into the patient's trachea. In many situations, you would not want to delay giving important drugs in order to intubate. But as soon as possible, place the ET tube (unless the patient is conscious).

Indications: Intubate any patient in cardiac arrest or coma.

Actions: Prevents aspiration of stomach contents into lungs. Provides better oxygenation of blood. Makes CPR more effective (yes, the program takes that into account, too).

Precautions: Do not delay life-saving actions in order to get the ET tube in.

SAMPLE ORDERS:
PLACE ET TUBE
LET'S INTUBATE HIM NOW
REMOVE E.T. TUBE

HELP (DIAGNOSIS, CHEAT): Gives you the stored diagnosis and teaching points for the patient you are resuscitating. The program will not allow you access to this information until several "minutes" into the resuscitation. You are charged one minute for this information.

SAMPLE ORDERS:
WHAT'S THE DIAGNOSIS
HELP

HISTORY (CHART): You can review the history at any time. You are charged one minute of resuscitation time. This is useful if you've forgotten the patient's weight, or are searching for clues about what's going on.

SAMPLE ORDERS:
CAN I SEE THE CHART AGAIN?
HISTORY

HYPERVENTILATION (HYPERVENTILATING, HYPERVENTILATE): Rapid ventilation of the comatose patient temporarily lowers the acid in the blood stream, as well as supplying increased oxygen and protecting the brain. This will especially make a difference when there is delay getting an IV in place to give bicarbonate. The acid balance returns back to pre-existing values when the hyperventilation is stopped.

Indications: Probably useful for any patient in cardiac arrest, particularly helpful if unable to give bicarbonate.

Actions: Temporarily raises blood pH by blowing off carbon dioxide.

Precautions: Will make a patient with normal pH somewhat alkalotic.

SAMPLE ORDERS:
HYPERVENTILATE
STOP HYPERVENTILATING

IV (I.V., INTRAVENOUS LINE): Medication nurse starts an IV. Occasionally, the IV cannot be easily started. This gives you practice at giving drugs endotracheally. You do not need to keep asking that the IV be started--the med. nurse keeps working at it until it is running, then tells you. The IV is always Dextrose 5% in water (D5W) unless you specify saline or ringer's. If you're running fluids, you can order the IV rate increased or decreased. You can even D/C the IV.

Indications: only route by which most drugs used in resuscitation can be given. Fluid can be given if needed. An IV must be started on every patient.

SAMPLE ORDERS:
PLACE IV
START I.V. WITH LACTATED RINGER'S
TURN UP THE IV

NASOGASTRIC TUBE (NG TUBE, N.G. TUBE): A tube is placed through the nose into the stomach by the team leader or med. nurse. In this simulation, this will be most useful for those patients suspected of drug overdose. The NG lavage removes the remaining drug before it can get into the blood stream.

Indications: This relieves pressure and reduces risk of aspiration if the stomach becomes distended with air. Also useful to suck something out of the stomach (like an overdose of drugs). It can also provide a quick route for warm fluids in hypothermia.

Actions: empties stomach
SAMPLE ORDERS:
PASS AN NG TUBE
NASOGASTRIC TUBE TO SUCTION
D/C NG TUBE

OBSERVE (WATCH, WAIT, NOTHING): If no orders are planned, you may simply hit RETURN without entering anything. Hitting RETURN advances one minute. If you want several minutes to pass while you are waiting for lab or for improvement, you can order a specific number of minutes of observation. There will still be an EKG and vital signs printed out for each minute. The program will override your observation order if the patient's blood pressure or rhythm is bad, lab tests come back, or an IV is started, allowing you to enter new orders. If you want to stop the observation, simply hit any key.

Indications: waiting for lab, waiting until the ICU is ready, waiting to see how a patient improves after treatment.

Actions: advances simulation until specified number of minutes has passed, until blood pressure falls markedly, until lab tests are returned, or until a key is pressed (whichever comes first).

SAMPLE ORDERS:
[RETURN] (hitting return key advances 1 minute)
WAIT 5 MINUTES
OBSERVE 3 MINUTES
WATCH HIM DIE

M.A.S.T. (MAST): Medical anti-shock trousers squeeze the legs and abdomen to help raise the blood pressure. MAST application is especially useful in hypovolemic shock, but there are some arguments for using MAST in cardiac arrest. This is not widely done, and is not part of accepted protocol.

Indications: hypovolemic shock

Actions: gives more effective blood volume to the heart.

Precautions: may precipitate pulmonary edema if fluid volume is normal or increased. Once on, it is dangerous to remove them until blood volume is replaced.

SAMPLE ORDER:
PLACE MAST
D/C MAST

QUIT: see TRANSFER

THUMP: A precordial thump is recommended immediately for a WITNESSED cardiac arrest (no pulse). This involves bashing the victim on the chest with your fist.

SAMPLE ORDER:
PRECORDIAL THUMP

TRANSFER (QUIT): These orders will end the simulation and boot the evaluation program. To TRANSFER, you must have completed at least 20 cycles. QUIT exits the program any time, but you may not get a full critique of your performance. The evaluation program gives you an outcome for your patient, a listing of any problems detected by the computer, and a chance to try the same patient again.

SAMPLE ORDERS:
TRANSFER TO ICU
THIS GUY'S DEAD, LET'S QUIT

WARM (WARMING): A patient who is hypothermic requires "core" warming. To save memory and time, the computer assumes that if you use the word WARM, you are ordering "core" warming (warm NG lavage, warm peritoneal dialysis, warm humidified air via ET tube) and NOT merely warm blankets (which are actually harmful in true hypothermia). So, even though you may get the right effect through the wrong order, order the correct type of warming or your monitor screen will break.

Indications: significant hypothermia (temperature below 94).

Actions: raises rectal temperature by about 1/4 degree per minute if in cardiac arrest, or about 1/2 degree if the patient has a good blood pressure.

Precautions: stop the warming when the temperature is normal.

SAMPLE ORDERS:
CORE WARMING MEASURES
WARM NASOGASTRIC LAVAGE

APPENDIX F

LAB TESTS, TEMPERATURE

Order list, equivalent terms, and explanations

BLOOD GASES (ABG, GAS, ABGS, ABG'S, PH): Arterial blood is tested for pH, oxygen, CO2, bicarbonate, and hemoglobin. The respiratory therapist sticks a needle directly into an artery to get the sample, then runs off to test it. The values are returned to you after five minutes (five program cycles). Normal values, plus the words used to describe abnormalities, are found in the REFERENCE VALUE section. Use ABG to guide your bicarbonate therapy wherever possible (see acidosis under "SOME SPECIFIC PROBLEMS").

DEXTROSTIX (FINGERSTICK GLUCOSE): The nurse sticks a finger, puts a drop of blood on a stick, and tells you what the approximate serum glucose is. It takes one minute. Its advantage over the glucose in the electrolyte panel is that it is back 9 minutes sooner.

ELECTROLYTE PANEL (LYTES, CHEMISTRY, ELECTROLYTES): Blood is drawn from a vein and tested for sodium, potassium, chloride, bicarbonate, glucose, urea nitrogen, and calcium. The test takes ten minutes (ten cycles) to run. The values can be compared to those given in the REFERENCE VALUE table. The significance of any abnormality can be found under "SOME SPECIFIC PROBLEMS." Every patient should have an electrolyte panel drawn. Order the whole panel--do not order a specific electrolyte (serum calcium, for example) or the computer will get confused.

TEMPERATURE (TEMP): Someone will tell you the patient's temperature if you ask. Blood gases may be inaccurate in a cold or feverish patient if someone assumes that the temperature is normal. If the history suggests the possibility of hypothermia or hyperthermia, check the temperature.

SAMPLE ORDERS:
GET A TEMPERATURE
RECTAL TEMP
GET LYTES
DRAW AN ABG
ORDER ELECTROLYTES
DEXTROSTIX

APPENDIX G--PART 1

ORDERING DRUGS

General information: If the drug is to be given as a single injection (bolus), then you must give the computer all the needed information when you enter the order. That means you should give the name of the drug, the dose (in numbers), and the units of measure (CC, MG, AMP). If the drug is to be given endotracheally, you must also specify that. If no route is specified, the program assumes that you want the drug given IV. If you are ordering the drug in pediatric strength, you must also specify that in the order.

If the drug is to be given as an infusion (a constant, steady rate of IV administration), simply state the drug name and specify INFUSION or one of its equivalents (below). Only specific drugs can be ordered as an infusion. After the infusion is set up, you will be asked what rate of drug administration you want (based on a standard mix). To change the rate of an infusion, simply order it increased or decreased, and the medication nurse will ask you what rate of drug infusion you want. To stop an infusion, order it stopped.

If a reasonable order is not being recognized or is being treated differently than you expect, first check your spelling. Make sure that you are using an acceptable word or abbreviation. Check to see if you are using some other word which the computer recognizes as an order.

USEFUL TERMS IN ORDERING DRUGS
(Words within parentheses are equivalent)

Units of measure
- MG (MILLIGRAMS, MILLIGRAM)
- GRAM (G, GRAMS, GM)
- CC (CC'S, ML, MILLILITER, MILLILITERS, C.C.)
- AMP (AMPS, AMPULE, AMPULES)
- MEQ (MILLIEQUIVALENT, MILLIEQUIVALENTS) (Bicarbonate only)
- UNITS (UNIT) (Insulin only)

Routes drugs can be given
- IV (I.V., BY VEIN, INTRAVENOUS)
- ET (ENDOTRACHEAL, ENDOTRACHEALLY, E.T.)
- INFUSION (INFUSE, DRIP, IVAC, PUMP)
- NG (NASOGASTRIC, N.G.) (warm lavage only)

Strengths of medication
- PEDIATRIC (PEDI, SMALL, NEONATAL)
- REGULAR (ADULT, LARGE)

Adjusting dosage
- STOP (DC, D.C., D/C, CANCEL, HOLD)
- DECREASE (DOWN, SLOW)
- INCREASE (UP)

APPENDIX G--PART 2

DRUG LISTING

Order list, equivalent terms, and explanations:

ATROPINE blocks the effects of a specific body chemical and a specific nerve which can slow the heart and increase conduction block. It therefore usually will speed the heart and decrease the blockage in the AV node.

Supplied: AMPULE = 10 CC = 1 MG

Usual dose: adult--0.5 to 1 MG, repeated up to 2 mg total

child--.01 mg/kg, repeated up to three times

May be given ENDOTRACHEALLY.

Indications: bradycardia or high-grade atrioventricular (AV) conduction block, unless blood pressure is good.

Actions: speeds up atrial pacemaker, decreases blockage within AV node.

Precautions: doses lower than those recommended may actually slow the heart further. Increased heart rate may make a diseased heart work harder, resulting in a larger area of heart damage.

SAMPLE ORDER:
ATROPINE .1 MG ET
10 CC ATROPINE

BICARBONATE (BICARB) neutralizes acid. It's used to reverse the acidosis which results from cardiac arrest, but isn't recommended as part of routine resuscitation efforts. Use it for proven severe acidosis on arterial blood gases, or where you strongly suspect severe acidosis due to a long "down" time before CPR was started.

Supplied: AMPULE = 50 CC = 50 MEQ
PEDIATRIC AMPULE = 10 CC = 10 MEQ

Usual dose: 1 MEQ/kg initially (Give this initial dose only if the patient has been in cardiac arrest without CPR for several minutes). You can then give 1/2 MEQ/kg every ten minutes until a blood pressure is achieved, however, you're better off monitoring the need for bicarbonate with blood gases.

Acute replacement dosage:
bicarb = 0.1 x (-base excess) x (weight in kg)

Indications: suspected or proven severe acidosis.

Actions: directly neutralizes acid.

Precautions: if given in excess, alkalosis results, which is very difficult to treat. Use of an immediate dose in a brand-new cardiac arrest will guarantee severe alkalosis. Use ABG to guide therapy.

SAMPLE ORDER:
20 CC OF BICARB IV
BICARBONATE 2 AMPS

BRETYLIUM (BRETYLOL) is useful in resistant V-fib. After use, the heart can often be successfully defibrillated when it could not before. Bretylium also lowers blood pressure, which may be a problem in some patients.

Supplied: AMPULE = 500 MG = 10 CC

Usual dose: 350 mg or 5 mg/kg, repeat at double dose (10 mg/kg) if not effective.

Indications: Ventricular fibrillation resistant to defibrillation. Remember that you still have to defibrillate after giving Bretylium.

Actions: allows easier conversion to sinus rhythm. Also blocks nerves which affect blood vessels, reducing blood pressure somewhat.

Precautions: may exacerbate cardiogenic shock

SAMPLE ORDER:

BRETYLIUM 350 MG

CALCIUM is supplied as calcium chloride. Calcium stimulates the heart, resulting in stronger contractions. It has been shown, however, to do more harm than good when used in cardiac resuscitation. Its uses are: correction of significant hypocalcemia (enough to cause a disturbance of heart rhythm or pumping), and temporary improvement of cardiac disturbances caused by severe hyperkalemia.

Supplied: AMPULE = 10 CC = 1000 MG

Usual dose: .1 cc/kg, repeated once if necessary.

Indications: hypocalcemia which is causing rhythm disturbance, severe hyperkalemia (NO LONGER indicated for electromechanical dissociation (this means a good EKG but no pulse)

Actions: raises the serum calcium, increases the force of cardiac contraction. Counteracts the effects of excess potassium on the conducting system.

Precautions: hypercalcemia may develop. May be detrimental to the ultimate fate of the heart and brain.

SAMPLE ORDER:

CALCIUM 4 CC

1 AMP CALCIUM CHLORIDE

DEXTROSE in this simulation means 50% dextrose. This is a form of sugar. It provides energy for the brain and heart when the blood glucose is low. Although often refered to in the ER as "D50," do not call it "D50" in this simulation, or the nurse will not understand you.

Supplied: AMPULE = 50 CC = 25 GRAMS = 25000 MG

Usual dose: adult--1 amp
child--1 cc/kg

Indications: any undiagnosed coma, suspected hypoglycemia, probably should be used routinely in infants in cardiac arrest.

Actions: raises blood sugar quickly.

Precautions: Although not harmful, electrolytes taken after injection will show a very high blood sugar which could

be confused with diabetes. Draw lab first.
SAMPLE ORDER:
DEXTROSE 25 GRAMS
13 CC DEXTROSE IV STAT

DIAZOXIDE (HYPERSTAT) is used to lower blood pressure. It is a fairly long-lasting drug, and is not to be used except in severe hypertensive emergencies. It is rarely used in a cardiac arrest situation, but is included as an option because it is contained in most "crash carts."
Supplied: AMPULE = 300 MG = 20 CC
Usual dose: 1 to 3 mg/kg, up to a total of 150 mg
Indications: hypertensive crisis
Actions: drops blood pressure quickly
Precautions: may drop blood pressure severely, expecially in patients with sick hearts. Causes a reflexive increase in heart rate.
SAMPLE ORDER:
DIAZOXIDE 100 MG IV

DIGOXIN (LANOXIN) is used to increase the force of the heart's pumping in a person with a sick heart, or to reduce the heart rate of a person in atrial fibrillation by increasing AV block. The drug has substantial hazards but is still widely used because it offers unique benefits. The need for digoxin should be weighed carefully in the cardiac arrest situation.
Supplied: regular--AMPULE = 2 CC = .5 MG
pediatric--AMPULE = 1 CC = .1 MG
Usual dose: start about .005 mg/kg (.25 to .5 in an adult) and titrate up to effect, not to exceed .02 mg/kg
Indications: atrial fibrillation with rapid ventricular rate (consider also verapamil), conversion of PSVT (paroxysmal supraventricular tachycardia) as second-choice drug after VERAPAMIL, heart failure, cautious use in cardiogenic shock
Actions: increases effectiveness of cardiac muscle, partially blocks AV node, some effect on SA node
Precautions: may slow sinus rate. Makes heart more prone to abnormal rhythms. Safe dosage range is very narrow--harmful effects may occur even at usual doses. May produce complete heart block if the AV node is already partially blocked.
SAMPLE ORDER:
.5 CC PEDIATRIC STRENGTH LANOXIN
DIGOXIN .25 MG

DOBUTAMINE (DOBUTREX) increases the heart's contractility similar to dopamine (below), but does not constrict the blood vessels nor raise the blood pressure to the same degree. Used mostly for congestive heart failure in the ICU. Not very useful for cardiogenic shock, but may help in a "borderline" situation where a little extra contractility is desired without the increase in heart work and irritability

that dopamine would cause.

Supplied: must be mixed as infusion. Protocols vary.

Usual dose: start at about 2.5 micrograms/kg/min and increase as needed. Best not to exceed 20 to 30 mcg/kg/min.

Indications: rarely used in the E.R. Limited use where increased heart contraction force is desired.

Actions: stimulates the heart to contract more forcefully.

Precautions: may waste time when dopamine would be more effective. At higher doses, increased heart rate and increased heart irritability occur.

SAMPLE ORDER:
DOBUTAMINE INFUSION

DOPAMINE (INTROPIN) is useful for raising low blood pressure. It stimulates the heart, resulting in a more rapid rate and more forceful contractions. It constricts blood vessels, raising the pressure. These effects increase the heart's need for oxygen (which can increase the severity of a heart attack) and make it more prone to abnormal rhythms. It is usually the first choice drug for all forms of shock.

Supplied: must be mixed as an infusion. Protocols vary from hospital to hospital, but all have charts which show how a specific dosage in mcg/kg/min translates into cc/hour or drops/minute.

Usual dose: begin in the range of 1 to 5 micrograms/kg/min (depending on the severity of shock), and increase until the desired effects are seen. Best not to exceed 30 to 40 mcg/kg/min.

Indications: shock. Fluids should also be given IV if the shock is due to low blood volume.

Actions: stimulates the heart, increasing heart rate, force of contraction, and irritability of the heart. Constricts blood vessels. Raises blood pressure.

Precautions: increases the risk of fibrillation. May increase the severity of a heart attack (but persistantly severe low blood pressure will do more damage).

SAMPLE ORDER:
DOPAMINE DRIP

EPINEPHRINE (EPI, ADRENALINE) stimulates the heart, and constricts blood vessels. It raises blood pressure, increases the heart rate, and increases the heart's irritability. It is used during cardiac arrest because 1) it is an extremely potent cardiac stimulator, and 2) it makes fibrillation more course and easier to convert to sinus rhythm. It is not used routinely to raise blood pressure except in anaphyllactic (allergic) shock. This drug occurs naturally in the body, and is degraded over several minute's time.

Supplied: AMPULE = 10 CC = 1 MG
or custom infusion

Usual dose: adult--1 amp every five minutes until pulse and blood pressure achieved. To sustain beneficial effects,

an infusion of .05 to .1 micrograms/kg/min may be given.
child--.1 cc/kg every five minutes until pulse and B.P.

May be given ENDOTRACHEALLY in bolus form.

Indications: cardiac arrest, anaphyllactic shock.

Actions: potent cardiac stimulant, blood vessel constrictor.

Precautions: stop use when blood pressure obtained. If B.P. falls as Epi wears off, use an epinephrine drip, or dopamine.

SAMPLE ORDER:
EPI 1 AMP
10 CC ADRENALINE ENDOTRACHEALLY
START EPINEPHRINE INFUSION

INSULIN is a natural hormone which moves sugar into cells. The lack of insulin causes diabetes. Too much insulin results in low blood sugar. Only regular (fast acting) insulin is available, and its use is limited to IV bolus in this program (the E.R. doesn't have time to set up those fancy infusions. Leave it to the ICU).

Supplied: drawn up from vial as needed, different strengths per cc, therefore ordered in "UNITS."

Usual dose: .2-.4 UNITS/kg IV bolus, repeated in 10-20 minutes.

Indications: diabetic ketoacidosis, or severe hyperglycemia.

Actions: lowers blood sugar

Precautions: may cause hypoglycemia, lowers potassium somewhat.

SAMPLE ORDER:
10 UNITS INSULIN IV

INSULIN-GLUCOSE (INSULIN/GLUCOSE, GLUCOSE-INSULIN, GLUCOSE/INSULIN) is an infusion which takes advantage of a side effect of insulin, the lowering of serum potassium. A mixture of regular insulin and 10% glucose is run, with rapid lowering of potassium. The order for the mixture must be entered as above rather than as two words.

Supplied: mixed when ordered.

Usual dose: no fixed dose. Just run it and watch the potassium.

Indications: severe hyperkalemia.

Actions: drives potassium into cells.

Precautions: may provoke hypoglycemia, may overshoot and cause abnormally low serum potassium.

SAMPLE ORDER:
INFUSE INSULIN-GLUCOSE MIXTURE
GLUCOSE/INSULIN BY PUMP

ISOPROTERENOL (ISUPREL) is a cardiac stimulant, somewhat similar to epinephrine. It raises the heart rate, reduces any conduction block, and increases the force of contraction. It has little effect on blood vessels. It causes a major

increase in cardiac irritability and oxygen need.

Supplied: mixed as an infusion. Protocols vary, so order in mcg/kg/min.

Usual dose: start around .03 micrograms/kg/min, increase until effects are seen, avoid exceeding .3 mcg/kg/min.

Indications: second choice drug after atropine for refractory bradycardia, high degree AV block.

Actions: cardiac stimulant which affects primarily heart rate and conduction.

Precautions: may increase the size of an infarct. Increases probability of fibrillation.

SAMPLE ORDER:
ISUPREL DRIP

LIDOCAINE (XYLOCAINE) is a local anesthetic which is also useful in treating abnormal heart rhythms. Of course, if the patient is in V-fib, a shock must still be given after the drug to restore a normal rhythm. Blood concentrations of lidocaine fall off over about 20 minutes, so a second bolus and/or an infusion is necessary. Lidocaine is also valuable in preventing abnormal rhythms before one has ever occurred. Many experts recommend giving lidocaine routinely to any patient who has had a heart attack. You will probably come out ahead in this simulation if you do so. A bolus of lidocaine should always be followed by a lidocaine drip to keep the level from falling.

Supplied: AMPULE = 5 CC = 100 MG

Usual dose: adult--75 mg bolus. For irritability, repeat doses of 0.5 mg/kg given up to 3 mg/kg. Follow with drip of 2 to 4 mg/min. (If the patient is in trouble, don't waste your "minute" starting the drip right after the bolus--do more important things, then remember to start the drip in a few minutes)

child--1 mg/kg bolus. Cardiac irritability in a child is almost always due to acidosis or electrolyte abnormality, but if a drip is required, use .01 mg/kg/min.

Effective ENDOTRACHEALLY.

Indications: recurrent or resistant V-tach or V-fib, treatment of cardiac irritability. Prevention of fibrillation in heart attack patients.

Actions: reduces risk of rhythm disturbance.

Precautions: excess doses can cause low blood pressure, seizures. Bolus will wear off unless followed by a drip.

SAMPLE ORDER:
LIDOCAINE 75 MG BOLUS
START LIDOCAINE DRIP

MORPHINE is a potent narcotic used to relieve the pain of a heart attack. It tends to lower the likelihood of fibrillation and reduce the ultimate amount of cardiac damage in an uncomplicated heart attack. It also lowers blood pressure, and therefore should not routinely be used in a patient in shock or post-cardiac arrest. By causing blood to pool in the veins, this blood pressure-lowering effect can be

helpful if the patient is in pulmonary edema (lungs full of water because of a failing heart).

Supplied: order in MG

Usual dose: 6 to 10 MG for an adult, (start about .1 mg/kg for children) may be increased as necessary.

Indications: Pulmonary edema, pain of myocardial infarction.

Actions: Relaxes walls of blood vessels, lowering blood pressure, reducing the "work" of the heart, depresses the central nervous system.

Precautions: may cause shock in certain patients, may cause stupor or coma in high doses. Brain effects of morphine can be reversed with NARCAN.

SAMPLE ORDER:
MORPHINE 10 MG I.V.

NALOXONE (NARCAN) reverses the effects of narcotics, without any harmful effects of its own.

Supplied: regular--AMPULE = 1 CC = .4 MG
neonatal--AMPULE = 2 CC = .04 MG

Usual dose: adult or child--2 amps. If Darvon (propoxyphene) is suspected, up to 10 amps may be given.
infant--.01 mg/kg.

May be given ENDOTRACHEALLY.

Indications: known narcotic overdose, any undiagnosed coma or delirium.

Actions: directly antagonizes narcotics.

Precautions: none.

SAMPLE ORDER:
NARCAN 2 AMPULES

POTASSIUM (KCL) is a body electrolyte. Severe lack of potassium can upset the heart's electrical system. Only when the lack of potassium is causing rhythm disturbances should potassium be given by a fairly rapid IV infusion. When the EKG disturbance clears, the potassium should be stopped or slowed while awaiting electrolytes.

Supplied: Ordered in MEQ, added to I.V. fluid.

Usual dose: never more rapid than 1 MEQ per minute for an adult. Usually 20-40 MEQ added per liter I.V. fluid is safe. Higher concentrations require close monitoring.

Indications: severe hypokalemia with impending rhythm disturbance.

Actions: raises blood potassium.

Precautions: rapid infusions are extremely hazardous--may overshoot and cause hyperkalemia. Rapid injection can cause cardiac arrest.

SAMPLE ORDER:
ADD POTASSIUM TO IV
KCL INFUSION

PROPRANOLOL (INDERAL) does the opposite of isoproterenol. It slows the heart, slightly increases conduction block, and decreases the force of contraction. It is almost never used

in cardiac arrest. Its primary use is for lowering blood pressure and heart rate. It is sometimes helpful in controlling the rapid heart rate of atrial fibrillation.

Supplied: AMPULE = 1 CC = 1 MG

Usual dose: adult--1 mg repeated up to a total dose of 5 mg if necessary.

child--.01 mg/kg, repeated x 4 if required.

Indications: rapid lowering of blood pressure or heart rate. Second-line drug to control the rate in atrial fibrillation.

Actions: blocks stimulation of the heart, increases AV block.

Precautions: avoid if possible in cardiac arrest situations.

SAMPLE ORDER:
INDERAL 1 MG

SALINE (NS, N.S., RINGERS, RINGER'S) is a volume expander to increase blood volume. Although different in composition, saline and ringer's are treated the same in this simulation.

Supplied: IV bottles, ordered as an infusion.

Usual dose: if the patient is truly volume depleted (for example severe hemorrhage) with hypotension, a rate of 2000 to 4000 cc/hr (50-80 cc/kg/hr) until the blood pressure responds is not unreasonable. For the cardiac arrest patient whom you suspect to have slight hypotension because of low blood volume, give about 500 cc over an hour while watching the blood pressure, and watching for complications.

Indications: initial support of hemorrhage with shock, hypovolemia due to fluid loss.

Actions: expands blood volume.

Precautions: excess fluids in a patient with a major heart attack can flood the lungs with water.

SAMPLE ORDER:
SALINE INFUSION
START IV NS

VERAPAMIL (CALAN, ISOPTIN) has complex actions. Its primary use is to treat abnormal, rapid atrial rhythms (such as paroxysmal atrial tachycardia). It decreases heart rate when in sinus rhythm, increases AV block, and may lower blood pressure somewhat. There is evidence that it may protect the heart and brain from oxygen lack. It is rarely used in a cardiac arrest situation.

Supplied:

Usual dose: adult--5 mg, repeated at 10 mg if no effect.

Indications: paroxysmal atrial tachycardia. Decreases the ventricular rate in atrial fibrillation.

Actions: increases AV block, decreases sinus rate, relaxes blood vessels.

Precautions: may predispose to bradycardia and hypotension. Absolutely not to be given with Propranolol.

SAMPLE ORDER:
VERAPAMIL 5 MG

APPENDIX H

REFERENCE VALUES FOR THIS SIMULATION

VITAL SIGNS

above 150 severe tachycardia
above 100 tachycardia
Pulse: NORMAL 60-100
below 60 bradycardia
below 45 severe bradycardia

severe hypertension above 160/110
hypertension greater than 140/90
Blood pressure: NORMAL 120/80, range 140/90 to 100/70
hypotension less than 100/70
severe hypotension below 60/20

above 106 hyperthermia (heatstroke)
Temperature: NORMAL 98.6
below 94 hypothermia
below 89 severe hypothermia

ARTERIAL BLOOD GASES

severe acidosis below 6.9
moderate acidosis below 7.2
mild acidosis below 7.35
pH: NORMAL 7.35 to 7.45
alkalosis above 7.45
severe alkalosis above 7.6

Oxygen (O2): NORMAL above 70 (higher on 100% O2)
hypoxemia below 70
severe hypoxemia below 50

inadequate respirations above 40
Carbon dioxide (CO2): NORMAL 35-40
hyperventilation below 35

severe alkalosis above 45
alkalosis above 30
Bicarbonate (HCO3-): NORMAL 24-28
acidosis below normal
moderate acidosis below 15
severe acidosis below 5

above 15 concentrated blood/dehydration
Hemoglobin (Hgb): NORMAL 12-15
below 12 anemia
below 9 severe anemia

ELECTROLYTES

Sodium (Na): NORMAL 134-144

above 7.5 severe hyperkalemia
above 6.5 moderate hyperkalemia
above 5 hyperkalemia
Potassium (K): NORMAL 3.5-5
below 3.5 hypokalemia
below 2.5 moderate hypokalemia
below 1.9 severe hypokalemia

Chloride (Cl): NORMAL 80-100

Bicarbonate (HCO3): see above under ABG

above 20 kidney failure or dehydration
Blood urea nitrogen (BUN):NORMAL 5-20

above 250 severe hyperglycemia (diabetes)
mild hyperglycemia expected with stress or IV
Glucose (Glu): NORMAL 70-100
below 70 mild hypoglycemia
below 40 moderate hypoglycemia
below 20 severe hypoglycemia

above 17 severe hypercalcemia
above 14 moderate hypercalcemia
above 10 hypercalcemia
Calcium (Ca): NORMAL 8-10
below 8 hypocalcemia
below 5 moderate hypocalcemia
below 3 severe hypocalcemia

APPENDIX I

A SIMPLIFIED APPROACH
Part I: Rhythm too fast

DIAGNOSE CARDIAC ARREST by absent pulse and respirations
(note V-tach WITH pulse is treated differently!)

↓

Witnessed arrest? try immediate precordial thump

↓

RHYTHM TOO SLOW, OR TOO FAST?

↓ → TOO SLOW? next page

TOO FAST
(V-fib, V-tach)

↓

Defibrillate immediately 200 joules (child 2 j/kg)
No change?
Defibrillate again, 200-300 joules
No change?
Defibrillate at 360 joules (child 4 j/kg)

↓

Start I.V. (intubate if ANY delay)
Epinephrine 1 mg (child .01 mg/kg)
(may give endotracheally if no IV)
Intubate (if possible and not already done)
Defibrillate 360 joules
No change?

↓

Lidocaine 1 mg/kg (may give endotracheally if no IV)
Defibrillate 360 joules (child 4 j/kg)
No change?

↓

Bretylium 5 mg/kg IV
IF UNWITNESSED, consider bicarbonate 1 mEq/kg IV
Defibrillate 360 joules
No change?

↓

Bretylium 10 mg/kg IV
Defibrillate 360 joules
No effect?

↓

Continue efforts
Epinephrine 1 mg (child .01 mg/kg) every 5 minutes
Repeat lidocaine or bretylium
Keep trying to defibrillate
Await results of ABG, lytes

Part II--Rhythm too slow

DIAGNOSE CARDIAC ARREST (absent pulse and respirations)
Diagnose asystole, block, or bradycardia
(Note bradycardia WITH pulse is treated differently!)

Start IV (intubate if IV delayed)
Epinephrine 1 mg (child .01 mg/kg)
(may be given endotracheally if necessary)

↓

Intubate (if possible and not already done)

↓

PULSE IS STILL TOO SLOW?
(asystole, bradycardia, block)

↓

Atropine 1 mg (child .01 mg/kg)
(may be given endotracheally if necessary)

↓

No effect?
Repeat Atropine up to 2 mg (child, 3 doses)

↓

IF UNWITNESSED, consider bicarbonate 1 mEq/kg IV

↓

Epinephrine 1 ampule (child 0.1 cc/kg) every five minutes
Consider defibrillating (possible fine V-fib)

↓

Await results of ABG, lytes
Consider epinephrine drip .05-1 mcg/kg/min
Consider isoproterenol drip .03 to .2 mcg/kg/min
Set up for pacemaker

Part III--V-tach with pulse

Unstable vs. Stable

Stable?

↓

Start IV
Lidocaine 1 mg /kg

↓

Lidocaine 0.5 mg/kg every 8 minutes
until V-tach resolves, or total 3 mg/kg given

↓

Procainamide 20 mg/min, up to 1000 mg
No effect?

↓

Cardioversion

Unstable

(chest pain, dyspnea, hypotension, congestive heart failure, ischemia, or infarction)

↓

Start IV
Sedation if not hypotensive or unconscious

↓

Cardiovert 50 joules
No change?

↓

Cardiovert 100 joules
No change?

↓

Cardiovert 200 joules
No change?

↓

Cardiovert 360 joules

↓

If recurrent or resistant
Lidocaine 1 mg/kg
Cardiovert

↓

Bretylium (if hypotensive or unconscious)
Procainamide (all others)

Part IV--PSVT
(Paroxysmal Supraventricular Tachycardia)

Stable vs. unstable
Unstable: Synchronized cardioversion, start 75-100 joules and increase similar to V-tach. If unsuccessful, add Verapamil and cardiovert again.

Stable

↓

Vagal maneuvers

↓

Verapamil 5 mg IV
No change in 15 minutes?

↓

Verapamil 10 mg IV
No change in 15 minutes?

↓

Consider:
Digoxin 0.25 mg up to 1 mg IV
Cardioversion
Overdrive pacing

Part V--Suppressing PVC's

Treatable cause?
(potassium abnormality, digoxin toxicity, bradycardia, acidosis, drugs)

↓

Lidocaine 1 mg/kg IV
Not suppressed?

↓

Lidocaine 0.5 mg/kg every 2-5 minutes
until response or 3 mg/kg given
Not suppressed?

↓

Procainamide 20 mg/min until effective
or 1000 mg given
Not suppressed?

↓

Bretylium 5 to 10 mg/kg

PVC's resolved after:

Lidocaine 1 mg/kg --> lidocaine drip 2 mg/min
Lidocaine 1-2 mg/kg --> lidocaine drip 3 mg/min
Lidocaine 2-3 mg/kg --> lidocaine drip 4 mg/min
Procainamide --> procainamide drip 1-4 mg/min
Bretylium --> bretylium drip 2 mg/min

Part VI--Bradycardia w. pulse

No signs or symptoms?
2nd degree type II or 3rd degree --> pacemaker
Others --> observe

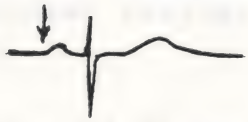
Signs or symptoms present?
↓
Start I.V.
↓
Atropine 0.5 to 1 mg (child .01 mg/kg)
Not improved?
↓
Atropine repeat up to 2 mg
Not improved
↓
CONSIDER:
Isoproterenol drip .03 to .2 mic/kg/min
Epinephrine drip .05 to .1 mic/kg/min
External pacemaker
↓
Transvenous pacemaker

- - -

AFTER RESOLUTION OF SIGNS/SYMPTOMS

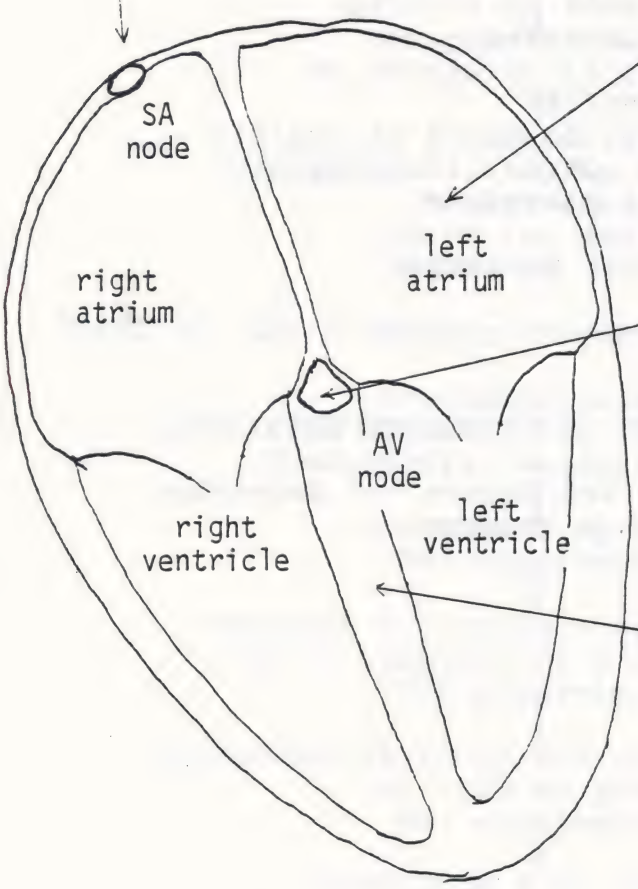
2nd degree type II or 3rd degree --> pacemaker
others --> observe

UNDERSTANDING THE ELECTROCARDIOGRAM

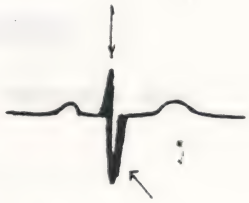


1. Sinoatrial (SA) node fires. (not seen on EKG)

2. Impulse spreads over atrium, causing P wave.



3. Inpulse delayed in atrioventricular (AV) node, causing PR interval. Atrium is contracting.

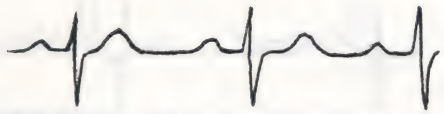


4. Impulse conducted rapidly over ventricle, creating QRS complex.

5. Heart is contracting during the ST segment. No current is flowing unless the heart is injured.

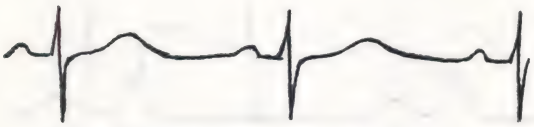
6. The heart electrically recharges itself, creating the T wave.

SAMPLE ELECTROCARDIOGRAMS
Part 1: Rhythms

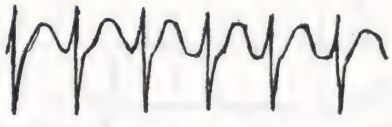


SINUS RHYTHM: Every QRS preceded by a P wave, rate 60 to 100 normally.

SINUS TACHYCARDIA: Every QRS preceded by a P wave, rate over 100.

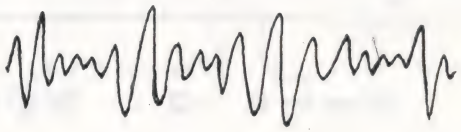


SINUS BRADYCARDIA: P wave before every QRS, rate less than 60.



ATRIAL TACHYCARDIA: Regular rhythm, rate 130 to 180, no P waves seen, QRS is narrow.

ATRIAL FIBRILLATION: irregularly spaced QRS complexes, 'wiggling' baseline, no P waves. Rate varies with AV block.



VENTRICULAR FIBRILLATION, coarse: Erratic, wide swings of electrical activity, irregular, no pulse.

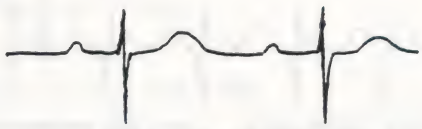
VENTRICULAR FIBRILLATION, fine: Erratic, irregular 'wiggling' EKG, with no QRS, no pulse.

VENTRICULAR TACHYCARDIA: Perfectly regular tachycardia, rate above 200, wide QRS, may cause a pulse.

ASYSTOLE: No electrical activity at all, except for slight waving of the baseline.

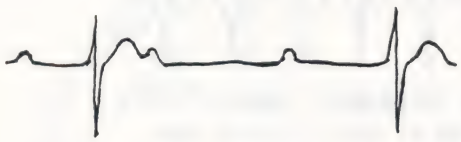
AGONAL RHYTHM: Very slow, wide QRS complexes, without P waves, often without T waves. No pulse.

SAMPLE ELECTROCARDIOGRAMS
Part 1: Rhythms (continued)



FIRST DEGREE ATRIOVENTRICULAR BLOCK: Regular sinus rhythm with every P wave causing a QRS after a long PR interval.

SECOND DEGREE ATRIOVENTRICULAR BLOCK: Some P waves are blocked out from the ventricle, leaving a P without a QRS.

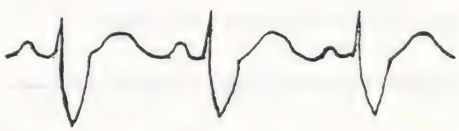


THIRD DEGREE ATRIOVENTRICULAR BLOCK: All P waves are blocked, with the QRS complexes unrelated to the P waves.

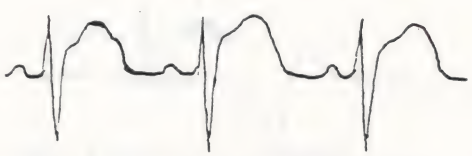
VENTRICULAR RHYTHM: Rhythm is paced entirely from the ventricle, with no P waves seen at all.

Part 2: Specific Problems

RIGHT BUNDLE BRANCH BLOCK: Conduction delayed to the right. Widened QRS with second upward peak.



LEFT BUNDLE BRANCH BLOCK: Conduction delayed to the left. Widened QRS with broad, deep S wave.



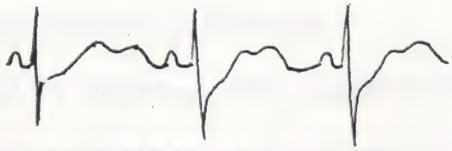
HEART ATTACK: EKG may be normal, or ST segment elevation or depression, or abnormal shape of T wave.

SEVERE HEART ATTACK: QRS may be wide, elevated ST segment, possible loss of the R wave.

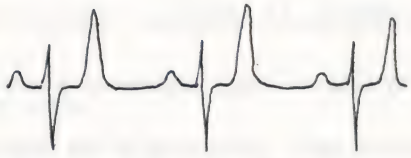
SAMPLE ELECTROCARDIOGRAMS
Part 2: Problems (continued)

HYPOTHERMIA: ALL intervals prolonged, ST segment depressed, long ST and T wave, often right bundle branch block.

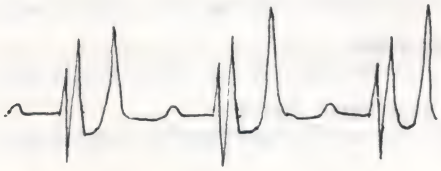
HYPOKALEMIA: Prolonged T wave, possible U wave.



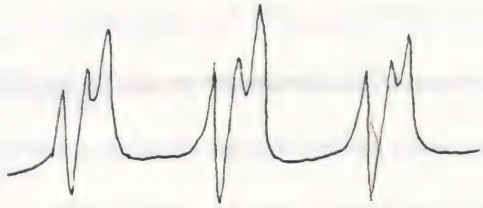
SEVERE HYPOKALEMIA: ST depression, prominent U wave, PR interval fairly short.



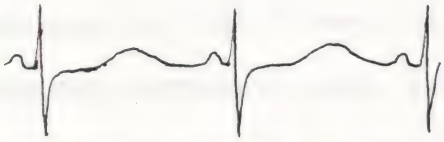
HYPERKALEMIA: Tall, peaked T wave.



MODERATE HYPERKALEMIA: Long PR, wide QRS, ST depression, tall peaked T wave.



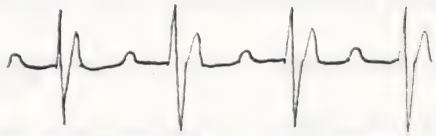
SEVERE HYPERKALEMIA: Disappearance of P wave, wider QRS, may slur into tall T wave.



HYPOCALCEMIA: Short PR interval, prolonged ST segment, wide T wave, possible U wave.

SEVERE HYPOCALCEMIA: Very short PR, prolonged ST, very wide T, possible inverted U wave.

HYPERCALCEMIA: Short ST segment, short T wave.



SEVERE HYPERCALCEMIA: Prolonged PR, short ST, short T wave. Ususally tachycardia is present.

APPENDIX K

GLOSSARY

...brief definitions with a pronunciation guide...

acidosis (ass-id-OH-siss), excess acid in body

agonal (A-gun-uhl), slow useless rhythm indicating a dying heart

alkalosis (al-ka-LOH-siss), excess bicarbonate in body

ampule (AM-pule), single-use container of drug, often a pre-filled syringe

anemia (uh-NEEM-ee-uh), deficient in blood or hemoglobin

asystole (ay-SISS-toll-ee), absense of electrical activity

atrial (AY-tree-uhl), pertaining to the upper heart chamber

atropine (A-troh-peen), cardiac drug

bicarb (BY-karb), short for bicarbonate

bicarbonate (by-CAR-bun-uht or by-CAR-bun-ATE), alkaline chemical in blood

bradycardia (brad-i-CAR-dee-uh or bray-dih-CAR-dee-uh), abnormally slow heart rhythm

bretylium (bre-TILL-ee-um), cardiac drug

CPR, cardio-pulmonary-resuscitation

calcium (KAL-see-um), chemical in blood and bones

cardiac (CAR-dee-ack), pertaining to the heart

cardiogenic (CAR-dee-oh-JENN-ik), caused by a heart condition

chloride (KLOR-ide), blood chemical

coma (KOH-muh), unconscious and not responding to pain

defibrillate (dee-FIB-rill-ate), shocking the heart to restore normal rhythm

dehydration (DEE-hy-DRAY-shun), body fluid deficit

dextrose (DEX-trohss), a type of sugar injected IV

diabetes (DIE-a-BEET-iss), abnormal sugar metabolism due to lack of insulin

diabetic (DIE-a-BET-ik), condition of, or person with, diabetes

diazoxide (dy-a-ZOX-ide), blood pressure drug

digoxin (di-JOX-in), cardiac drug

dobutamine (doh-BUTE-a-meen), cardiac stimulant drug

dopamine (DOH-puh-meen), cardiac stimulant and blood pressure drug

electrolytes (ee-LEKT-row-lights), chemicals (ions) in the blood

endotracheal (EN-doh-TRAY-kee-uhl), into the trachea

epi (EH-pee), short for epinephrine

epinephrine (e-pi-NEF-rin), cardiac stimulant drug

fibrillation (FIB-rill-AY-shun), erratic unorganized electrical activity

glucose (GLUE-kohss), blood sugar

hemoglobin (HEE-moh-glow-bin), pigment in blood which carries oxygen

hemolysis (hee-MAW-luh-siss), red blood cells bursting

hemorrhage (HEM-or-rij), bleeding

hypercalcemia (HY-per-kal-SEEM-ee-uh), excess calcium in blood

hyperglycemia (HY-per-GLY-SEEM-ee-uh), excess sugar (glucose) in blood

hyperkalemia (HY-per-kay-LEEM-ee-uh), excess potassium in blood

hypertension (HY-per-ten-shun), abnormally high blood pressure

hyperthermia (HY-per-THERM-ee-uh), body too hot, heatstroke

hypocalcemia (hy-POH-kal-SEEM-ee-uh), abnormally low calcium in blood

hypoglycemia (hy-POH-gly-SEEM-ee-uh), abnormally low blood sugar

hypokalemia (hy-POH-kay-LEEM-ee-uh), abnormally low blood potassium

hypotension (HY-poh-ten-shun), abnormally low blood pressure, shock

hypothermia (hy-po-THERM-ee-uh), low body temperature

hypovolemia (hy-po-vohl-EEM-ee-uh), low blood volume

hypoxemia (hy-pox-EEM-ee-uh), low blood oxygen

infarction (in-FARK-shun), death of tissue due to lack of oxygen

infusion (in-FUZJ-un), steady flow of drug into the patient

insulin (IN-suhl-in), sugar-lowering drug

intravenous (in-truh-VEE-nus), by vein

isoproterenol (IE-soh-proh-TER-en-awl), cardiac stimulant drug

ketoacidosis (KEE-toh-ASS-id-OH-siss), excess acid plus ketones, diabetes

kilogram (KILL-a-gram), 2.2 pounds

lavage (luh-VAWJ as in corsage or triage), flushing fluid in and out

lidocaine (LIE-doh-cane), cardiac irritability drug

milliequivalent (MILL-i-ee-QUIV-uh-lent), unit of ionic activity

milligram (MILL-i-gram), unit of weight, 1/1000 gram

milliliter (MILL-i-LEE-ter), unit of volume, 1 cc, 1/1000 liter

morphine (MORE-feen), narcotic

myocardial (my-oh-CARD-ee-uhl), pertaining to the heart muscle

naloxone (nal-OX-ohn), narcotic antidote

nasogastric (NAY-zoh-GAS-trick), through the nose into the stomach

neurological (NUHR-uh-LOJ-i-kuhl), pertaining to the brain or nervous system

PVC's (pee-vee-sees) premature ventricular contractions

potassium (poh-TASS-ee-um), blood chemical

propranolol (proh-PRAN-uh-loll), cardiac blocking drug

pulmonary (PULL-mun-air-ee), pertaining to the lungs

resuscitation (ree-suss-i-TAY-shun), efforts at restoring life

ringer's (RING-erz), altered salt solution to expand blood volume

saline (SAY-leen), salt solution to expand blood volume

shock (shock), sufficiently low blood pressure to cause damage

sinus (SINE-us), referring to place where normal rhythm originates

tachycardia (tack-i-CAR-dee-uh), abnormally rapid heart rate

triage (TREE-awj as in corsage), deciding who needs treatment first

urea (you-REE-uh), chemical measured in BUN

ventricle (VENN-trick-uhl), lower heart chamber

ventricular (venn-TRICK-you-ler), pertaining to the lower heart chamber

verapamil (ver-AP-uh-mil), cardiac drug

CARDIAC ARREST! FLOWSHEET

Sample--This page may be copied

Date:_____ Time:_____ I.V.:_____ ET tube:_____
Patient description:_____
Pertinent history:_____
Age:_____ Weight:_____ Estimated time of arrest:_____

Time	Pulse	B.P.	Resp	Neuro	Orders/lab values/notes