THE RELIABILITY OF ARRHYTHMIA DETECTION BY CORONARY CARE UNIT NURSES UTILIZING TELEMETRY

by

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SUPERVISORY COMMITTEE APPROVAL

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To the Graduate Council of The University of Utah:

I have read the thesis of Kim Iiams in its final form and have found that (1) its format, citations, and bibliographic style are consistent and acceptable; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the Supervisory Committee and is ready for submission to the Graduate School.

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ABSTRACT

The efficacy of arrhythmia detection by Coronary Care Unit (CCU) nurses monitoring patients for 24 hours via telemetry was determined utilizing simultaneous Holter monitoring as a baseline. The medical records of 45 male patients were retrospectively reviewed. A total of 257 significant arrhythmias occurred as documented by Holter monitoring of which 127 were documented by CCU nurses via telemetry, a 49.4% detection rate. Significant arrhythmias were categorized as a) Sinus (87.8% detected), b) Atrial (26.9% detected), c) Ventricular (38.1% detected), and d) Atrioventricular Block (33.3% detected). A comparison of arrhythmias detected between Holter monitoring and telemetry using a paired t-test indicated a p value less than or equal to 0.001.

Within the 45 records there were 141 physician requests for arrhythmia detection. Thirty arrhythmias actually occurred and CCU nurses documented 13 of them (43.3% detected). CCU nurses documented 114 arrhythmias which had not been requested by physician order (50.2% detected).

The sample (N=45) was divided into two groups: Group A, subjects who had never been in the CCU (N=23);

and Group B subjects who had been admitted to the CCU (N=22) prior to monitoring by telemetry and Holter monitoring. The arrhythmia detection rate for Group A was 50.4% with a detection rate of 48.4% for Group B.

Three arrhythmias were associated with symptoms recorded by subjects in their log books. CCU nurses documented two of the symptomatic arrhythmias with strip recordings but no symptoms were narrated in the patient record. A total of 275 rhythm strips was representative of 127 significant arrhythmias: 17.5% (N=48) had the rate narratively documented, 9.1% (N=25) had the rhythm identified in writing, and 0.4% (N=1) had the lead placement identified.

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CHAPTER I

INTRODUCTION

Abnormal electrical conduction patterns (arrhythmias) within cardiac muscle may result in a wide array of clinical manifestations including the absence of symptoms or sudden, unexplained death. Telemetry is a system utilized to continuously monitor electrocardiographic (ECG) activity of stable hospitalized patients whose state of illness and/or presenting symptoms place them at risk for the development of arrhythmias. By convention, continuous electrocardiographic monitoring has required the high-risk patient to be located within a specialized Coronary Care Unit (CCU) and essentially bound to a visual monitor by hard wire cables. Patients monitored by telemetry wear a transmitter which detects the electrical components of the cardiac cycle, converts them into an FM signal, and transmits them to a receiver located within a central nurses' station (Fairchild & Allen, 1971). Telemetry eliminates the necessity of cables between the patient and a machine. The patient is allowed greater freedom by physical removal from the stresses and confines of a specialized CCU. Thus telemetry patients are remote from the CCU nurses who

monitor their electrocardiographic activity continuously.

CCU nurses have traditionally been responsible for arrhythmia monitoring. They may be responsible, professionally and legally, for arrhythmia detection in patients monitored by telemetry who are on a generalized care unit, as well as providing total and direct care for patients within the CCU. During times of high stress and work demands, the CCU nurse must prioritize nursing actions. Precedence may be given to those actions directed toward meeting the needs of patients within the CCU, as opposed to those actions required for telemetry monitoring of patients on a generalized care unit. CCU nurses may have minimal knowledge of the telemetry patient's psychosocial and physiological status, thus identifying the telemetry patient only by name and an electrocardiographic tracing viewed upon as oscilloscope. This currently accepted mode of practice may "fragment" the patient and precipitate the development of conflict within a CCU nurse who values individualized, comprehensive patient care.

Potential for role conflict may not only arise in CCU nurses monitoring telemetry but may arise in generalized care unit nurses also. Generalized care unit nurses are responsible, professionally and legally, for administering total and direct care for patients monitored by telemetry without the input of electrocardio-

graphic data on a minute-to-minute basis. Lack of knowledge regarding cardiac status may result in a generalized care unit nurse unintentionally placing the patient in a life-threatening situation, a situation which reflects patient fragmentation.

Another potential source of conflict telemetry monitoring may impose is a diminished capability of the CCU nurse to associate the patient's physical activity and/or symptoms with arrhythmia activity. Possible delays in communicating observations between CCU nurses and generalized care unit nurses may contribute to the development of conflict. A final area of conflict may arise when there is a multitude of false alarms reported by CCU nurses. False alarms require the generalized care unit nurses to assess the patient for symptoms and to evaluate the function of the telemetry system.

The physical remoteness of the generalized care unit from the CCU lends to diminished and/or delayed communication between the two nursing staffs regarding patient symptoms, patient electrocardiographic activity, and accuracy of telemetric transmission. Thus in view of patient safety, potential legal liabilities and the cost of health care, nurses need to examine the efficiency and reliability of arrhythmia detection via telemetry.

Problem Statement

The purpose of this study was to describe the

reliability of arrhythmia detection by CCU nurses monitoring patients remote from a CCU utilizing telemetry. The patient's baseline electrocardiographic activity was simultaneously determined by Holter monitoring.

CHAPTER II

REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

In the past two decades, the concept of intensive coronary care has continued to develop by incorporating technical sophistication with concurrent advancement in nursing role functions. The primary objective has expanded from the prompt resuscitation of victims of cardiac arrest precipitated by arrhythmias to include monitoring and prevention of such arrhythmias. Investigators have evaluated different methods of electrocardiographic monitoring including; a) conventional, b) intermittent, c) decentralized, and d) Holter monitoring with subsequent arrhythmia detection (Bleifer, Bleifer, Hansmann, Sheppard & Karpman, 1974; Holmberg, Ryden & Waldenstrom, 1977; Romhilt, Bloomfield, Chou & Fowler, 1973; Ryden, Waldenstrom & Holmberg, 1975; Vetter & Julian, 1975). Additionally, they have explored the effects of defined routines which guide monitoring personnel in identifying arrhythmias (Breu & Gawlinski, 1981). The correlation of symptomatic complaints to electrocardiographic rhythm disturbances has also been investigated (Lipski, Cohen, Espinoza, Motro, Dack & Donoso,

1976; Zeldis, Levine, Michelson & Morganroth, 1980).

Electrocardiographic Telemetry Monitoring System

Telemetry is a method of ambulatory electrocardiographic monitoring that is utilized within the hospital setting for a variety of reasons (Table 1). Primarily, it is utilized to detect electrocardiographic rhythm disturbances occurring in stable patients who have had, or are at risk for, the development of potentially serious or life-threatening arrhythmias (Zipes & Noble, 1982). Telemetry is also employed to correlate a patient's symptomatic complaints (dizziness, syncope, light-headedness, palpitations, dyspnea, and/or chest pain) to arrhythmias. It allows the patient to ambulate and accomplish activities of daily living as close as possible to normal levels while being continually monitored for arrhythmias and without the encumbrance of being constrained by hard wire electrodes to a stationary monitor within a CCU. The components of a telemetry system including the transmitter, receiver, cardiotachometer, oscilloscope, recorder, and patient selector are shown in Figure 1.

The telemetry transmitter is a small, hand-sized unit carried by the patient in a pocket or pouch. The electrodes are attached to the patient by adhesive discs in a MCL_1 or MCL_6 lead placement array (Figure 2). The transmitter amplifies electrocardiogram signals

Table 1

Indications for Telemetry ECG Monitoring

Indications
Recording of cardiac rhythm
Documentation of suspected rhythm disturbances
Correlation of rhythm disturbances with symptoms
-Syncope
-Palpitations
-Chest pain
-Unexplained dyspnea
Mechanism of rhythm disturbances
Efficacy of antiarrhythmic therapy
Pacemaker function
Specific patients with:
-Ischemic heart disease
-Idiopathic hypertrophic subaortic stenosis
-Mitral valve prolapse
-Bradycardia-tachycardia syndrome
-Wolff-Parkinson-White syndrome
-Conduction disturbances
Recording of QRS-ST-T Pattern
Prinzmetal's variant angina
Correlation of symptoms with ST-T changes
Effort tolerance

Note. Adapted from Zipes & Noble, 1982.

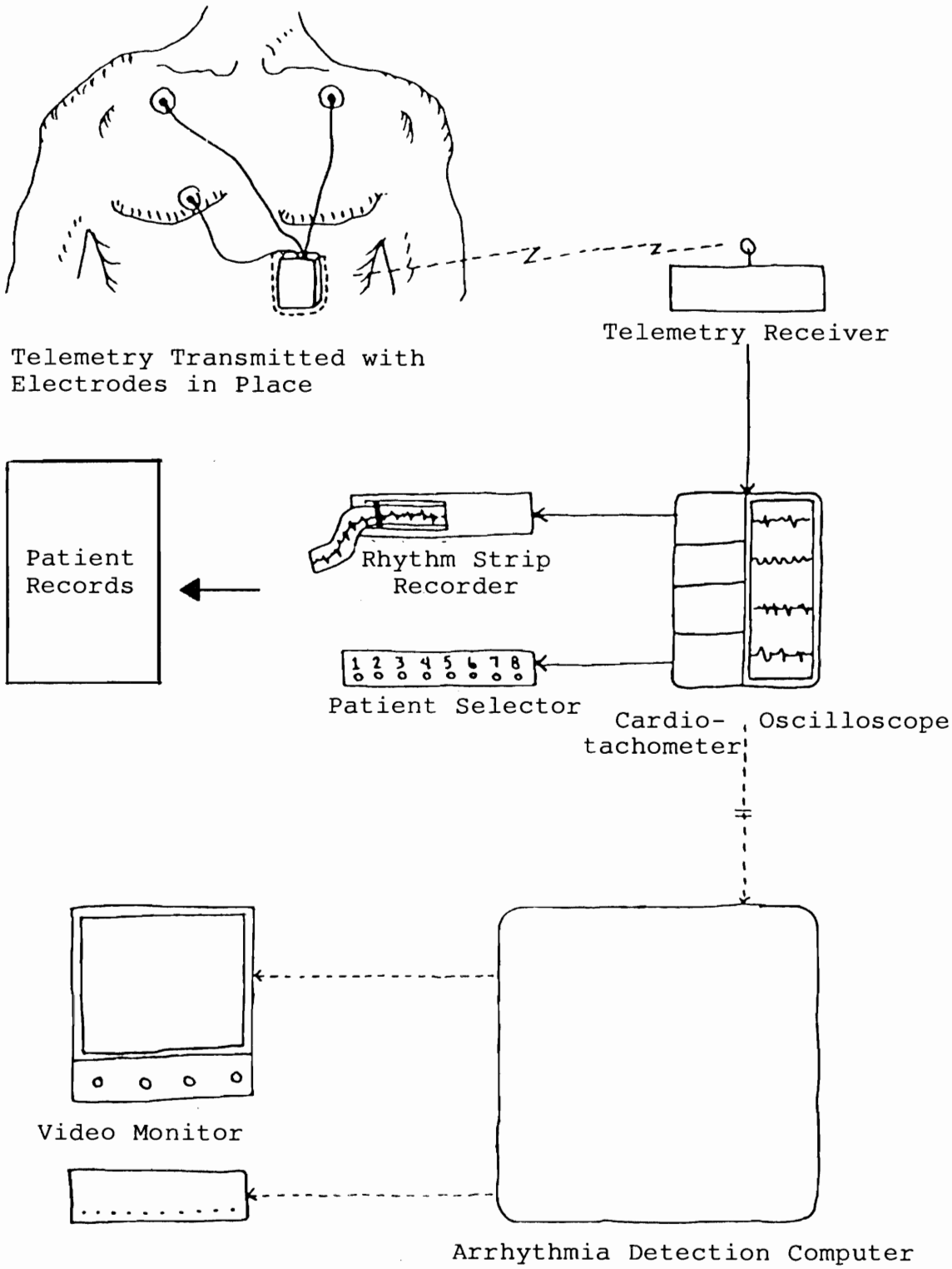


Figure 1. Electrocardiographic telemetry monitoring system.

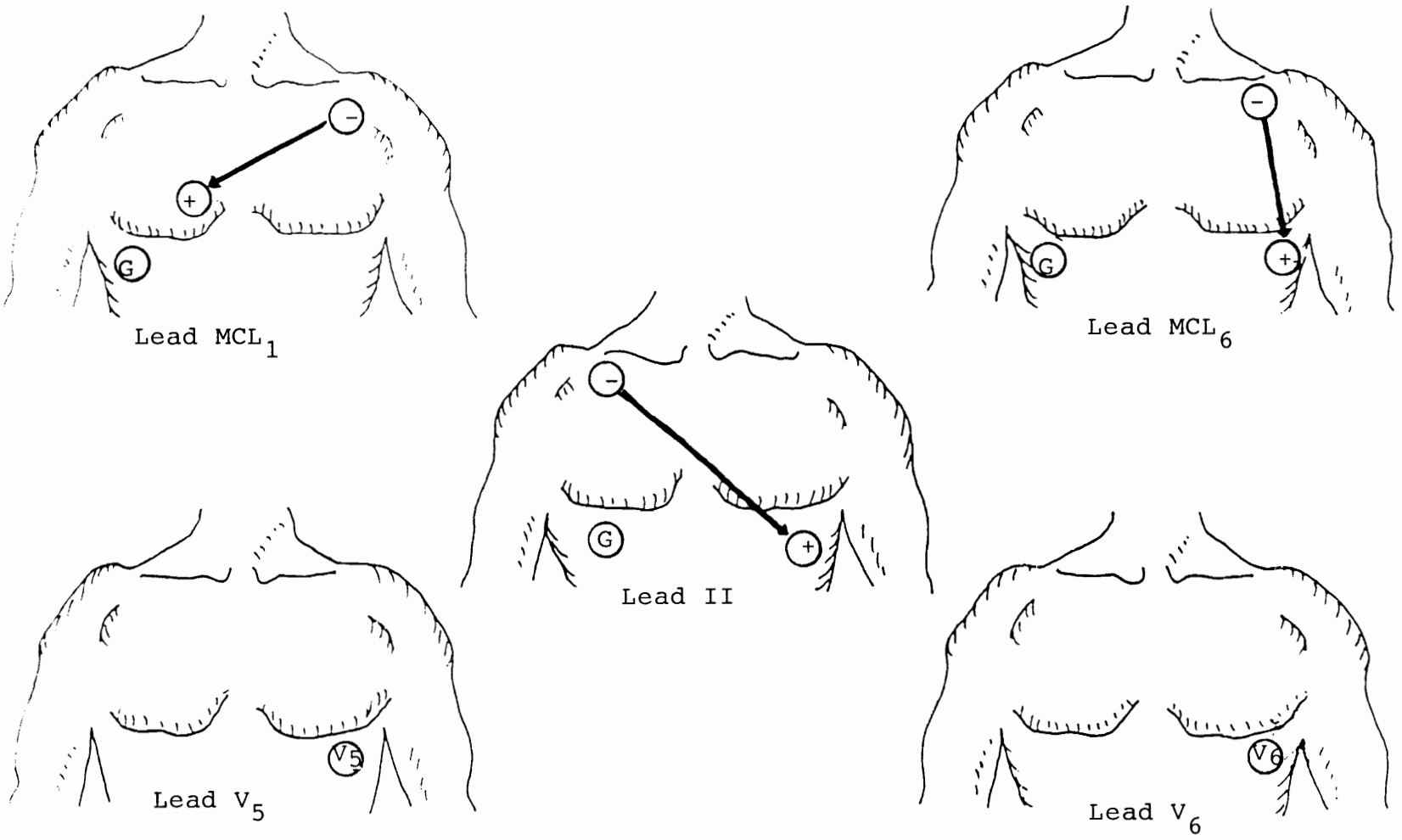


Figure 2. Chest electrode placement for telemetry and Holter monitoring.

and transmits them via radio waves, to the telemetry receiver. It translates and amplifies the radio signal into an electrocardiographic waveform.

The cardiotachometer processes the electrocardiographic waveform received from the telemetry receiver and provides a digital display of beat-per-minute heart rate and an audible and/or visual alarm system based upon a) high-low heart rate limits set by monitoring personnel, and b) inoperative alarms due to lead disconnection and/or exceeding battery range.

The oscilloscope enables the monitoring personnel to visually observe the patient's electrocardiographic tracing on a video screen once it has been processed through the cardiotachometer.

The recorder is a single-channel thermal writing instrument that graphically displays the bioelectric output from the cardiotachometer. This recorder has an automatic mode which, when an alarm signal from the cardiotachometer or patient selector is sensed, turns on the recorder and provides a ten second report of the input signal (rhythm strip) with a four second delay from the oscilloscope observation to printed record.

The patient selector detects a) patient distress alarms, b) alerts the monitoring nurse by sounding a repeating audible signal, c) identifies which patient is in distress by flashing a patient identifying numeral,

and d) activates the recorder to record a rhythm strip from the patient unit in alarm. The patient selector enables nurses to spontaneously obtain a sample rhythm strip which is automatically patient-coded at any time and then the nurse places the representative strip in the permanent medical record (Appendix A).

Holter Monitoring System

Holter monitoring as a method of long-term ambulatory electrocardiographic monitoring has expanded physicians' and nurses' capabilities to detect disturbances in cardiac rhythm and to quantify their frequency and complexity (Bleifer et al., 1974; Brodsky, Wu, Denes, Kanakis & Rosen, 1977; Clarke, Hamer, Shelton, Taylor & Venning, 1976; Gilson, Holter & Glassock, 1964; Gilson, 1965; Haughey, 1983; Hinkle, Carver & Stevens, 1969; Holter, 1961; Kennedy, 1976; Lown, Temte & Arter, 1973; Michelson & Morganroth, 1980). Holter monitoring is also utilized to correlate arrhythmias with patients' symptoms (Hindman, Last & Rosen, 1973; Lipski et al., 1976; Tzivoni & Stern, 1975; Walter, Reid & Wenger, 1970; Winkle, Lopes, Fitzgerald, Goodman, Schroeder & Harrison, 1975; Winkle, Alderman, Fitzgerald & Harrison, 1976) and to evaluate antiarrhythmic therapy (Drake, Singer, Haring & Dirnberger, 1973; Fasola, Noble & Zipes, 1977; Gradman, Winkle, Fitzgerald, Meffin, Stoner, Bell & Harrison, 1977; Harrison, Fitzgerald & Winkle, 1976;

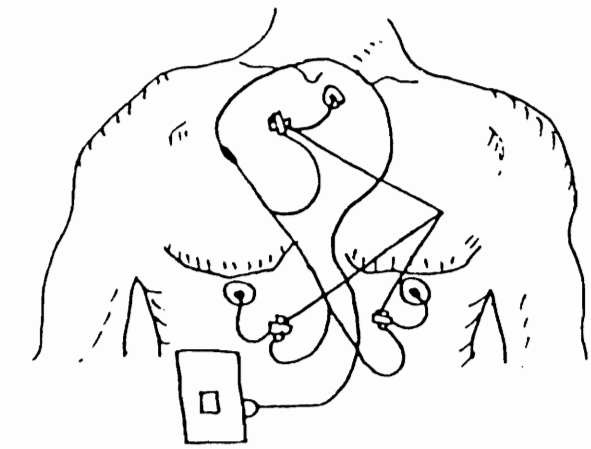
Meffin, Winkle, Blaschke, Fitzgerald & Harrison, 1977; VanDurme, Bogaert & Rosseel, 1974; Talbot, Clark, Nimmo, Nielson, Julian & Prescott, 1973; Vismara, Hughes, Kraus, Borhani, Zelis, Mason & Amsterdam, 1974; Winkle, Bell & Fitzgerald (1977). Long-term ambulatory electrocardiographic recordings are accepted as the most sensitive method for detecting spontaneously occurring arrhythmias (Kennedy, 1976; Lown & Wolf, 1971).

The Holter monitoring system is a two component system which provides for the continuous recording of electrocardiographic activity for up to 26 hours. It consists of the electrocardiographic recorder and the electrocardiographic scanner.

The electrocardiographic recorder is carried by the patient for the duration of the study and the electrodes are attached to the patient by adhesive discs in a lead II or V_{5-6} array (Figure 2), whichever configuration provides for the best possible R-wave detection. The electrocardiographic recorder produces a two-channel magnetic tape record of electrocardiographic signals at a tape speed of three and three-quarter inches per minute. The two-channel system provides the evaluators with a second electrocardiographic tracing if for some reason the first channel tracing did not record or could not be analyzed and enhances the ability to detect both atrial and ventricular activity.

The electrocardiographic scanner enables audiovisual evaluation of the magnetic tape recording at a tape speed of up to 120 times real-time (7-1/2 inches per second). The electrocardiography technician presets the electrocardiographic scanner to detect changes in R-R interval, QRS amplitude, QRS prematurity, and QRS width. Then at 60 to 120 times playback speed, an auto-scan mode charting capability is employed. Heart rate and S-T level trend is documented during an autowrite trend cycle. Electrocardiographic complex abnormalities documented by the autowrite cycle, are then validated by the technician who changes the tape speed to real-time or two times real-time speed. The autowrite capability may be employed independently of operator interaction. A temporary final report citing the baseline rhythm, highest and lowest rates, trends of ectopic activity, and representative rhythm findings is prepared by the electrocardiography technician. The temporary final report is reviewed, confirmed, edited and deemed final by a cardiologist. The final report consisting of real-time representative recordings and their analysis is then relayed to the patient's referring physician (Figure 3) and patient record.

Analysis techniques of the Holter monitor system dependent upon semiautomated computerized scanning with with operator interaction entail a five to ten percent



'Holter' Recorder with
Electrodes in Place

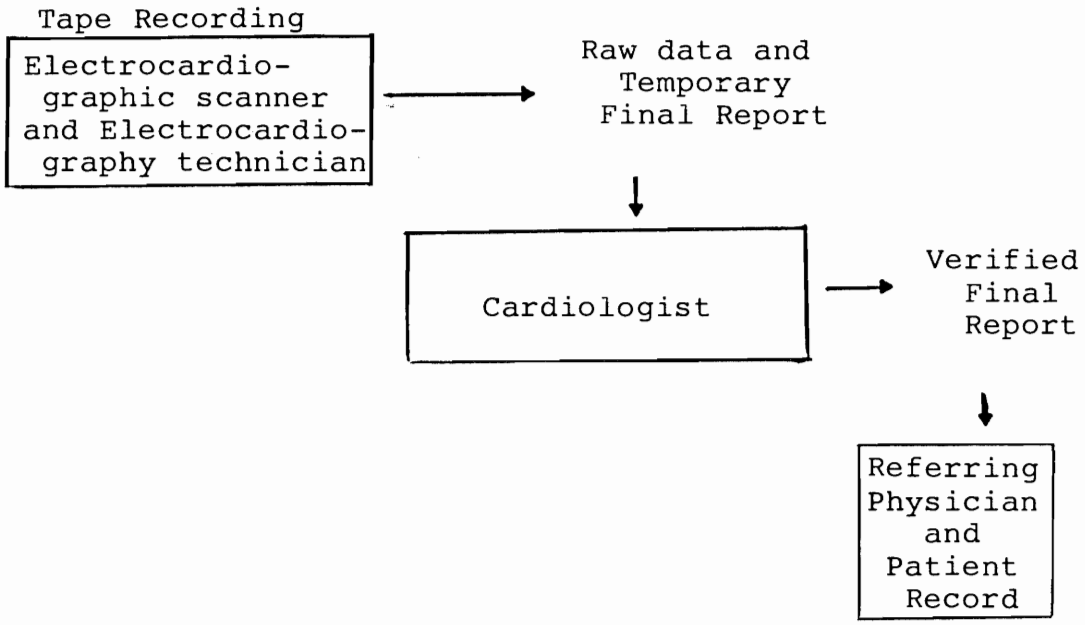


Figure 3. Holter monitoring system.
Adapted from Copen, 1981; Wenger,
Mock & Ringquist, 1980.

rate of error when compared to real-time recordings based upon estimation of the frequency and characterization of ectopic activity (Wenger et al., 1980, p. 21).

Voukydis (1978) delineated the limitations of the Holter monitor system which include: a) inability to distinguish between normal beat shape changes and ventricular ectopic beats, b) lack of low frequency components to initiate audible signals, c) multiform ventricular ectopic beats may not be distinguished, d) nondetection of couplets and short runs of ventricular tachycardia because they may look or sound like single ventricular ectopic beats--especially when occurring with a large number of single and multiform ventricular ectopic beats, e) physician review of only abnormal segments of the recording submitted by the technician with the assumption that the remaining of the record is normal, and f) observer fatigue and inattention introducing error by omission.

Boter and Van Keulen (1981) compiled a comparative evaluation of six commercial ambulatory electrocardiographic instruments for the following features: a) technical aspects to include recorder input impedance, common mode rejection, maximum input signal, minimum input signal, recorder/playback unit distortion, signal-to-noise ratio, frequency response low, and frequency response high, b) construction to include mechanical and

electrical construction and ease of maintenance, c) electrical safety to include leakage currents, dielectric strength, resistance to ground, and safety of construction, and finally d) inference sensitivity to include movement artifacts and electromagnetic interference. The six components studied were manufactured by Del Mar Avionics, Instruments for Cardiac Research, Hellige, Oxford Medical Systems, Hittman-Medcraft, and Siemens. The results were rated in five categories: very good, good, moderate, insufficient and bad, by hospital users of the equipment based upon study evaluation criteria (Table 2). All of the instruments evaluated were rated as moderate or better (Boter & Van Keulen, 1981).

Electrocardiographic Monitoring Methods

Arrhythmia detection is commonly performed by CCU nurses observing a continuous oscilloscope display at the bedside and central nurses' station. Alarms are based upon changes in heart rate and/or QRS morphology. Nurses responsible for the surveillance of the oscilloscope display usually document observations by obtaining representative rhythm strips according to institutional policy. This method of arrhythmia detection is referred to as "conventional." The conventional mode of arrhythmia detection within the CCU can be unreliable and many arrhythmias escape detection (Crawford, O'Rourke, Ramak-

Table 2

Evaluation of Six Commercial Recording Systems

Manufacturer	Features				
	Technical Aspects	Construction	Safety	Interference	Channels
Del Mar Avionics	=	+	=	++	2
Instruments for Cardiac Research	+	++	+	++	1(2)
Hellige	+	+	+	+	1
Oxford Medical Systems	=	++	=	++	4
Hittman-Medcraft	+	+	+	+	1(2)
Siemens	++	++	+	+	2

Note. ++: very good; +: good; =: moderate; -: insufficient; --: impermissible; parentheses ( )enclose number of channels of new models. Adapted from Boter & Van Kuelen, 1981.

rishna & Ross, 1974; Day & Avril, 1966; Julian, Valentine & Miller, 1964; Kimball & Killip, 1968; Lown, Vassaux, Hood, Fakhro, Kaplinsky & Roberge, 1967; Oliver, Nolle, Tiefenbrunn, Kleiger, Martin, Krone, Miller & Cox, 1974; Spann, Moellering, Haber & Wheeler, 1964; Stock, Goble & Sloman, 1967; Vetter & Julian, 1975; Whalen, Ramo & Wallace, 1971). Failure to detect arrhythmias by conventional monitoring systems is highest for prodromal, serious ventricular arrhythmias from which ventricular fibrillation may ensue (Lown et al., 1967). If transient, this group of arrhythmias may not cause enough change in the rate tachometer to trigger the alarm of the CCU monitor, thus possible nonrecognition ensues.

Romhilt and associates (1973) conducted a five day study of 31 patients with uncomplicated, verified acute myocardial infarction within the setting of two CCUs. The purpose of the study was to evaluate the reliability of conventional CCU electrocardiographic monitoring. All patients were monitored with standard electrocardiographic monitoring equipment consisting of a rate meter with an alarm, bedside oscilloscope, and an additional oscilloscope at the central nurses' station. Rate meter alarm limits were generally set at 60 to 120 beats per minute. One unit utilized a defined routine of obtaining printed one minute electro-

cardiogram tracings every hour with subsequent arrhythmia tabulation. The other unit tabulated arrhythmias based upon electrocardiographic tracings obtained due to frequent observation of the oscilloscopes by nursing personnel. The patient's electrocardiographic activity was simultaneously recorded with a Holter-Avionics tape recorder (Hinkle, Meyer, Stevens & Carver, 1967) attached to the bedside monitor. Analysis of the tape recordings was done with a Hewlett-Packard automated arrhythmia detection system (Romhilt, Bloomfield, Lipicky, Welch & Fowler, 1972). Arrhythmia recognition was based upon two criteria: a) changes in the R-R interval was greater than 20%, and b) widening of the QRS complex by more than 0.015 seconds as compared with the average of four normal QRS complexes for that patient. All arrhythmias were verified visually by the investigators.

Data collected from both CCUs were combined as no significant difference between the two CCUs in the recognition of arrhythmias by conventional monitoring was found. Premature ventricular contractions were recognized only 64.5% of the time by conventional monitoring in the CCUs as compared with 100% occurrence as detected by the automated arrhythmia detection system. In the case of serious ventricular arrhythmias, the degree of disparity in arrhythmia detection was greater (16.1% vs. 93.5%), especially multifocal premature ventri-

cular contractions (6.5% vs. 87.1%) and consecutive premature ventricular contractions (13.0% vs. 77.4%).

Premature atrial contractions were detected only 45.2% of the time by conventional CCU monitoring as opposed to 96.8% by the automated arrhythmia detection systems. Atrioventricular dissociation with junctional rhythm or idioventricular tachycardia was found to occur intermittently in 16.1% of the patients studied by the automated arrhythmia detection system, but was not recognized at all by the conventional monitoring system.

Incidences of ventricular fibrillation, asystole, atrial fibrillation, complete heart block, and junctional tachycardia were infrequent and were recognized with equal frequency by both conventional CCU monitoring and the automated arrhythmia detection system.

The time delay from first occurrence as detected by the automated arrhythmia detection system to recognition by conventional electrocardiographic monitoring in the CCU averaged 18 hours for premature ventricular contractions, ten hours for serious ventricular arrhythmias, and 23 hours for premature atrial contractions. No time delay was found for the recognition of asystole, ventricular fibrillation, atrial fibrillation, junctional tachycardia, and complete heart block.

The results of this study confirmed the low reliability of conventional monitoring in detecting transient,

potentially serious arrhythmias. Thus, on-line use of arrhythmia detection systems was recommended for the earliest detection of arrhythmias within the CCU.

The study by Vetter and Julian (1975) of arrhythmia detection in the CCU also concluded that conventional electrocardiographic monitoring is unreliable when compared to computerized on-line arrhythmia detection systems. The study consisted of 64 patients who were consecutively admitted into two specified cubicles within an eight-bed CCU. In one cubicle, patients were monitored by the conventional electrocardiographic mode of arrhythmia detection. No formal routine for oscilloscope observation was followed, but nurses were expected to watch for arrhythmias when free to do so. Patients admitted to the other cubicle were monitored for arrhythmias utilizing the same oscilloscope display. However, the rate-dependent alarm system and delay loop for printouts were replaced by a commercially available analog-hybrid arrhythmia computer (Nielsen, 1971). This computer had three graded alarm groups based upon arrhythmia groupings: a) supraventricular tachycardia, bradycardia, and frequent ventricular ectopic beats, b) close-coupled ventricular ectopic beats and ventricular tachycardia, and c) asystole, ventricular tachycardia at a rate greater than 150 beats per minute, or ventricular fibrillation. When the alarms were triggered, a ten second rhythm

strip was automatically recorded. All patients' electrocardiographic activities were simultaneously recorded continuously on a 24-hour magnetic tape recording system. Again, verification of arrhythmias was done by a cardiologist after scanning by a computerized arrhythmia analyzer.

The reliability of the two systems was determined by the ability of the CCU staff to detect episodes of clinically significant arrhythmias within a specified time interval between time of arrhythmia onset and its detection. The nurses were expected to recognize the first occurrence of each arrhythmia but not necessarily all episodes in a patient known to be having large numbers of a particular arrhythmia. An arrhythmia was regarded as successfully detected only if its presence had been documented by a nurse. Utilizing the conventional mode of electrocardiographic monitoring with the CCU only 36% of all arrhythmias occurring were detected as opposed to 98% detection of arrhythmias by computer monitoring.

Timeliness of antiarrhythmic therapy institution based upon recognition of ventricular tachycardia and ventricular ectopic beats which were paired or closely coupled (premonitory arrhythmias) was also utilized to evaluate the efficiency of both monitoring systems. Utilizing the conventional mode of electrocardiographic monitoring, only 17% of the 23 patients exhibiting pre-

monitory arrhythmias received immediate antiarrhythmic therapy, 30% of the time treatment was delayed approximately nine hours, and 52% of the time no treatment was given. On the other hand, 99% of premonitory ventricular arrhythmias were detected by the computer of which 95% received prompt treatment. The results of this study demonstrated the unreliability of conventional monitoring systems based upon arrhythmia detection and subsequent institution of antiarrhythmic therapy.

Dreifus and Pennock (1975) suggest that efficient continuous monitoring of oscilloscopes by personnel is difficult to achieve. One factor speculated to diminish arrhythmia detection is the turning off or disconnection of alarm systems. Artifact and noise trigger the alarms which activate the strip recorder, thereby wasting paper. Therefore the staff may deactivate the alarms. Development of automatic recording and alarming devices which would eliminate the unreliability of intermittent oscilloscope observation was encouraged.

Ryden and associates (1975) studied 52 patients admitted to the CCU with confirmed or suspected acute myocardial infarction to determine the reliability of intermittent electrocardiograph sampling in arrhythmia detection. All subjects received lidocaine either as an intravenous bolus injection followed by a constant infusion or as an intramuscular injection. A three-

hour electrocardiogram was obtained on all subjects starting with the lidocaine injection and were then analyzed on a minute-to-minute basis to obtain the true arrhythmia content. Each one minute interval was examined to determine the presence or absence of ventricular tachyarrhythmias. When ventricular arrhythmias, specifically (premature) ventricular contractions (PVC) were present, they were classified into one of the six following groups: a) one to five PVC per minute, b) greater than five PVCs per minute, c) R on T PVC, d) multifocal PVCs, e) paired PVCs, and f) ventricular tachycardia defined as three or more sequential PVCs at a rate of greater than 100 beats per minute. Intermittent electrocardiographic sampling was simulated by analyzing the first, first two, and first five minutes of every 15-minute electrocardiogram segment and the first two minutes of every 30-minute electrocardiogram segment. The segments were analyzed in the same manner as described previously and then compared to the true arrhythmia content obtained from the analysis of all the one minute segments. Approximately 80% of the five minute long electrocardiogram samples contained ventricular tachyarrhythmias. In examining the one minute long electrocardiogram samples, the detection rate diminished to about 50% and only 10% of low frequency (transient) arrhythmias such as paired and multifocal PVCs were

found. Ryden concluded that intermittent electrocardiographic sampling leads to low detection rates for infrequent arrhythmias and lends to the risk of possible overemphasizing or underestimating the arrhythmia occurrence. Thus, intermittent electrocardiographic sampling is an unreliable method of arrhythmia detection, specifically for the evaluation of antiarrhythmic drugs.

Holmberg and associates (1977) simultaneously studied the efficiency of arrhythmia detection by nurses within a CCU utilizing a decentralized monitoring system, as Ryden and associates (1975) studied the efficiency of intermittent electrocardiographic sampling. The same study population and baseline three-hour continuous electrocardiogram recordings were utilized. All patients were additionally monitored by a decentralized monitoring system which consisted of oscilloscopic displays and recording capabilities for all six patients within the CCU located at each bedside and at the central nurses station. Thus, nurses were permitted to monitor every patient's electrocardiographic activity and to record abnormalities observed while working about the CCU. A defined routine for documenting detected arrhythmias was followed. Every half hour all arrhythmias were coded and documented on standardized forms. Absence of arrhythmias were also documented. The accuracy of the nurse-based detection of ventricular arrhythmias

was examined for the following subgroups: a) "benign" arrhythmias: one to five PVCs per minute; b) "warning" arrhythmias: greater than five PVCs per minute, multifocal PVCs, paired PVCs, R on T PVCs, or ventricular tachycardia; c) "malignant" arrhythmias: multifocal, paired PVCs, R on T PVCs, or ventricular tachycardia; or d) ventricular tachycardia. The data were then analyzed to determine the relationship between total and detected ventricular tachyarrhythmias for each patient (patient-related analysis) and for each half-hour period (time-related analysis). The results of the patient-related analysis demonstrated that in 70% of the patients exhibiting benign arrhythmias in at least one, one-minute segment, the arrhythmias were detected within the first half-hour in which it occurred. Fourteen percent of the time the arrhythmia was not detected by the nurses. Warning arrhythmias were detected 76% of the time in the first half-hour, 11% of the time detection was delayed, and 13% of the time the arrhythmia failed to be detected. Of those patients exhibiting ventricular tachycardia, 42% were detected, all within the first half-hour. The arrhythmia detection rates by nurses, in all subgroups increased when utilizing patients who exhibited the specified arrhythmia in at least three one-minute segments in a half-hour period.

Time-related analysis revealed the ventricular

tachyarrhythmias occurred in 55% (166) of the total 287 half-hour periods. Benign arrhythmias occurred in 63 half-hour periods of which 81% were detected by the nurses. Warning arrhythmias occurred in 103 half-hour periods of which 74% were detected. Malignant arrhythmias occurred in 85 half-hour periods and 62% were detected. Finally, ventricular tachycardia occurred in 21 of the half-hour periods of which 29% were detected.

In summary, the reliability of ventricular tachyarrhythmia detection by nurses in basically higher than other studies (Romhilt et al., 1973; Vetter & Julian, 1975) and is postulated to be due to established, well-defined routines for arrhythmia documentation and the utilization of decentralized electrocardiographic displays. Breu and Gawlinski (1981) determined that efficiency of arrhythmia detection by nursing personnel observing conventional electrocardiograph monitors increased when the documentation policy was changed. Policy was changed from obtaining a rhythm strip every eight hours and as needed with rhythm changes (Phase I) to obtaining a rhythm strip every two hours and as needed with rhythm changes (Phase II). Each patient's electrocardiogram could be observed from oscilloscope banks at the central nurses station and at each end of the ten bed CCU. Single monitors enabling visualization of the patient's individual rhythm were at each

patient's bedside. For the purpose of this study, the investigators determined baseline arrhythmia activity in Phase I by utilizing arrhythmia observers who were experienced coronary care registered nurses who had successfully passed a standard arrhythmia examination. The observer noted all arrhythmias exhibited by any given patient within a three hour time frame. Documentation was done by rhythm strips and compared to the documentation of arrhythmias by staff nurses in the nurses' notes. The arrhythmia observers had a 93% efficiency rate determined by comparing their arrhythmia documentation to simultaneously continuous electromagnetic recordings of two randomly selected patients.

Before instituting the change in documentation policy (Phase II), the results of Phase I were presented to the nursing personnel. Patient baseline electrocardiographic activity for Phase II was determined by obtaining continuous electromagnetic recordings via the main monitor bank of two randomly selected patients and compared to those documented in the nurses' notes. The efficiency rate for arrhythmia detection was the number of arrhythmias documented by the nursing staff as compared to those documented by methods of continuous observation. In Phase I the efficiency rate was 39% as opposed to 63% in Phase II. Arrhythmia detection increased from Phase I to Phase II in all major arrhythmia categories

to include: a) sinus, b) atrial, c) blocks, and d) ventricular arrhythmias.

Muirhead (1980) compared three systems of electrocardiograms in the CCU, subsequent arrhythmia detection efficiency, and cost effectiveness. The conventional monitoring system costs $2,000 per bed over and above the basic central desk monitoring equipment. The "monitor nurse" was conventional monitoring with the addition of a specially trained nurse of technician to provide continuous and simultaneous surveillance of all electrocardiographic waveforms. This system was estimated to cost $83,603 per year in addition to that of conventional monitoring. The third system, computer monitoring, was employed with a cost of approximately $60,000 above basic monitoring costs. In conclusion, Muirhead states that conventional monitoring is the most economical system. However in looking at previous studies (Romhilt, 1973) conventional monitoring was found to be an inadequate system for arrhythmia detection. The monitor nurse system has a large annual cost and does not eliminate the problems of human surveillance such as distraction and fatigue (Bergstrom, Gillberg & Arnbert, 1973). The use of a computerized monitoring system is recommended as the most cost effective system and offers the most efficient means of arrhythmia detection as supported by Romhilt and associates (1973).

Uhley (1980) suggested utilizing monitoring technicians to monitor oscilloscope displays which would allow nurses to provide direct patient care while maintaining continuous human surveillance for the interpretation and/or validation of arrhythmia alarms.

Jarmon and Yesalis (1976) performed a study of the electrocardiogram diagnostic skills of 25 emergency department nurses, 23 intensive care unit nurses, 34 cardiac technicians, and 37 physicians. All participants in the study were self-selected. The purpose of the study was to document the efficiency of nurses, technicians, and physicians in performing consultations from which acute cardiac care is given by Emergency Medical Services personnel. Ten slides of six-second rhythm strips were shown to the group of providers for 30 seconds each. The participant upon viewing the slide was asked to write down the diagnosis of the electrocardiogram pattern and the therapeutic intervention which should ensue. The rhythm strips included sinus bradycardia with PVC, loose leads, regular sinus rhythm with PVC, atrial flutter, third degree heart block, regular sinus rhythm with PVC, flat line, ventricular fibrillation, inverted leads, and ventricular tachycardia. Physicians as a group performed poorly in recognizing loose leads (54%), inverted leads (6%), flat line (38%), and regular sinus rhythm with PVC (49%). The misdiagnosis

of regular sinus rhythm with PVC was postulated to be due to the physicians' looking for a more unusual diagnosis. The physicians as a group scored high on recognizing ventricular fibrillation (81%), ventricular tachycardia (70%), and atrial flutter (70%). The average score for physicians was 52%. Intensive care unit nurses as a group had the highest performance of all four groups with an 84% overall average score. The lowest scores were due to misdiagnosis of inverted leads (26%) and sinus bradycardia with PVC (61%). High scores were received in recognition of ventricular tachycardia (100%), loose leads (100%), third degree heart block (100%), ventricular fibrillation (96%), and atrial flutter (91%). Regular sinus rhythm with PVCs were scored at 87 and 91% by the intensive care unit nurses. Grossly inappropriate therapeutic regimens were prescribed based upon the diagnoses made from the simulated cardiac consultations. This study confirms the intensive care unit nurses' capabilities in detecting arrhythmias when observing the oscilloscope.

Symptomatic Complaints as Correlated to Arrhythmias

Correlations between symptoms and arrhythmias are often difficult to establish with long-term Holter monitor recordings. It is common to detect important arrhythmias that have no associated symptoms. The arrhythmia

may have actually been asymptomatic or the patient may have simply neglected to enter the symptoms into the diary (Wenger et al., 1980, p. 28). Perceptions of abnormal cardiac beating by patients are often described as "skipped beats," heart "jumping," "pounding," "thumping," or "palpitations." These complaints may be associated with specific cardiac abnormalities of impulse formation, conduction disturbances, or they may be psychophysiologic. Most patients do not perceive the majority of documented cardiac ectopic beats.

Complaints of "dizziness," "lightheadedness," "faintness," "giddy," "passing out," or "syncope" are suggestive of cerebral ischemia. Abnormal cardiac impulse formation and conduction or other noncardiac primary mechanisms are also possible causes of these symptomatic complaints. Common symptoms frequently warranting follow-up are those suggestive of transient abnormal heart beating, cerebral ischemia, and transient unprovoked or unpredictable chest pain and discomfort (Kennedy & Caralis, 1977, p. 731).

Lipski and associates (1976) performed 24-hour electrocardiographic monitoring in 55 patients with syncope (20 patients), dizziness (13 patients), palpitations (11 patients), or a combination of symptoms (11 patients). The average age of the study population was 64.1 years. Forty-five percent (25/55) of the pa-

tients were found to have no arrhythmias which accounted for their symptoms. For the remaining 30 patients (55%) with symptoms, arrhythmias were indicated as being responsible. Bradyarrhythmias accounted for the majority of arrhythmias including sinus bradycardia (rates of 34 to 55 beats per minute), periods of sinus arrest up to five seconds, and periods of second degree atrioventricular block with Wenckeback phenomenon. Seventeen percent (N=5) of the symptomatic patients were documented to have tachycardia-bradycardia syndrome. The remaining four patients (13%) had episodic arrhythmias without bradycardia including atrial fibrillation with rapid ventricular response (7%), slow ventricular tachycardia (3%), and cardiac pacemaker failure (3%). In 60% (N=15) of patients without arrhythmias, no cause of symptoms by Holter monitoring was documented. The other ten patients were shown to have cerebral vascular insufficiency, aortic stenosis, hypotension secondary to nitroglycerine, labarynthitis, trifacicular block, and "floppy" mitral valve. In summary, Lipski indicates that long periods of monitoring may be needed to make a causal diagnosis in patients with only sporadic symptoms.

Zeldis and associates (1980) reviewed 518 patients' 24-hour electrocardiographic Holter monitor recordings to determine the relationship between clinical complaints of dyspnea, syncope, palpitations, chest pain, or dizzi-

ness and significant arrhythmias. Significant arrhythmias were defined as ventricular ectopy greater than ten per hour, atrial ectopy greater than 200 per hour, ventricular tachycardia, ventricular couplets, multifocal complexes, and supr ventricular tachycardias. Ventricular tachycardias, ventricular couplets, multifocal complexes, and supraventricular tachycardias were considered to be major significant arrhythmias. Significant arrhythmias were found in 53% and major significant arrhythmias in 38%. No particular symptom or diagnosis was more likely to predict a significant arrhythmia or major significant arrhythmia. Three hundred and seventy-one of 518 patients completed log books acceptable for analysis. Thirteen percent of the patients were found to have symptoms correlating significant arrhythmias, 34% had symptoms which did not correlate with the occurrence of any significant arrhythmia, 51% had significant arrhythmias, (41%) major significant arrhythmias without concurrent symptoms and only 2% had no significant arrhythmias or symptoms. Thus the concurrences between symptoms and presence of significant arrhythmias were found to be poor.

Studies which specifically address arrhythmia detection via telemetry for patients remote from the CCU and investigations of the conflict of responsibilities within the CCU nurses monitoring telemetry while caring

for patients within the CCU have not been done.

Chart Audit

Chart audit is a retrospective method of data collection utilizing descriptive design. Once the data to be retrieved from the medical record have been identified, the reviewer systematically examines the medical record for evidence of health care providers meeting the established criteria. Reviewers should be skilled in utilizing criteria, reading chart entries, and deciding if documentations meet the specified criteria (Mayers, Norby & Watson, 1977). Decisions should be consistent from medical record to medical record. Interpretation should also be consistent from reviewer to reviewer.

The retrospective chart audit enables the investigator to identify achievements, trends, and problems relevant to total or specific patient populations, as well as evaluate the application and execution of nursing procedures and techniques (Phaneuf, 1976, p. 3).

Documentation of arrhythmias detected via telemetry monitoring is accomplished by CCU nurses placing a rhythm strip of the observed arrhythmia on a progress note every four hours and as needed with changes in rhythm (Appendix A). Upon discontinuation of telemetry monitoring, the collection of rhythm strips is placed in the permanent medical record located on the generalized care unit. CCU nurses may record, in writing, any obser-

vations deemed relevant in addition to documenting by rhythm strips. The final Holter monitor report is also part of the patient's permanent medical record.

There are several limitations of retrospective chart audits. One limitation is that the medical record is kept for an overall record of patient care and progress and not for the primary purpose of research; therefore, informational gaps may be present (Verhonick, 1971, p. 13). The investigator must assume the records reviewed are accurate accounts of events which have taken place (Mayers et al., 1977; Verhonick, 1971, p. 13). Finally, the investigator is unable to control and/or ascertain intervening variables which may have affected the subject matter being studied. Causal relationships are unable to be determined, only postulated (Polit & Hungler, 1978, pp. 177-185).

Summary

In summary, physicians frequently prescribe telemetry as a method of continuous electrocardiographic monitoring for the purpose of documenting cardiac arrhythmias and/or to associate symptoms with arrhythmias. Often, patients are located on a generalized care unit remote from the CCU where CCU nurses are responsible for observing the oscilloscopic display and subsequently documenting the occurrence of arrhythmias. Meanwhile, general care unit nurses are held responsible for mainte-

nance of the telemetry unit (attachment of the electrodes to the patient, battery integrity, etc.), as well as the assessment of the patient (Figure 4). This system may contribute to patient fragmentation within the health care setting. Assessment data once gathered and identified by the general care unit nurse are utilized to formulate an effective nursing care plan which guides the general care unit nurse's interventions. Assessment data for telemetry patients include their electrocardiographic activity as documented by the CCU nurse. This system is dependent upon effective communication between the CCU nurses and nurses on the general care unit. In completing the nursing process, an evaluation of interventions must take place to include correlation and/or noncorrelation of symptomatic complaints to significant arrhythmias, effectiveness of pharmocological agents, and tolerance of activity.

In view of patient fragmentation, nursing's responsibility for holistic nursing care, and legal and professional liabilities, one must question the reliability of arrhythmia detection by CCU nurses monitoring patients remote from a CCU utilizing telemetry.

Research Questions

1. Are significant arrhythmias recorded by Holter monitoring also identified by CCU nurses simultaneously monitoring arrhythmias by telemetry?

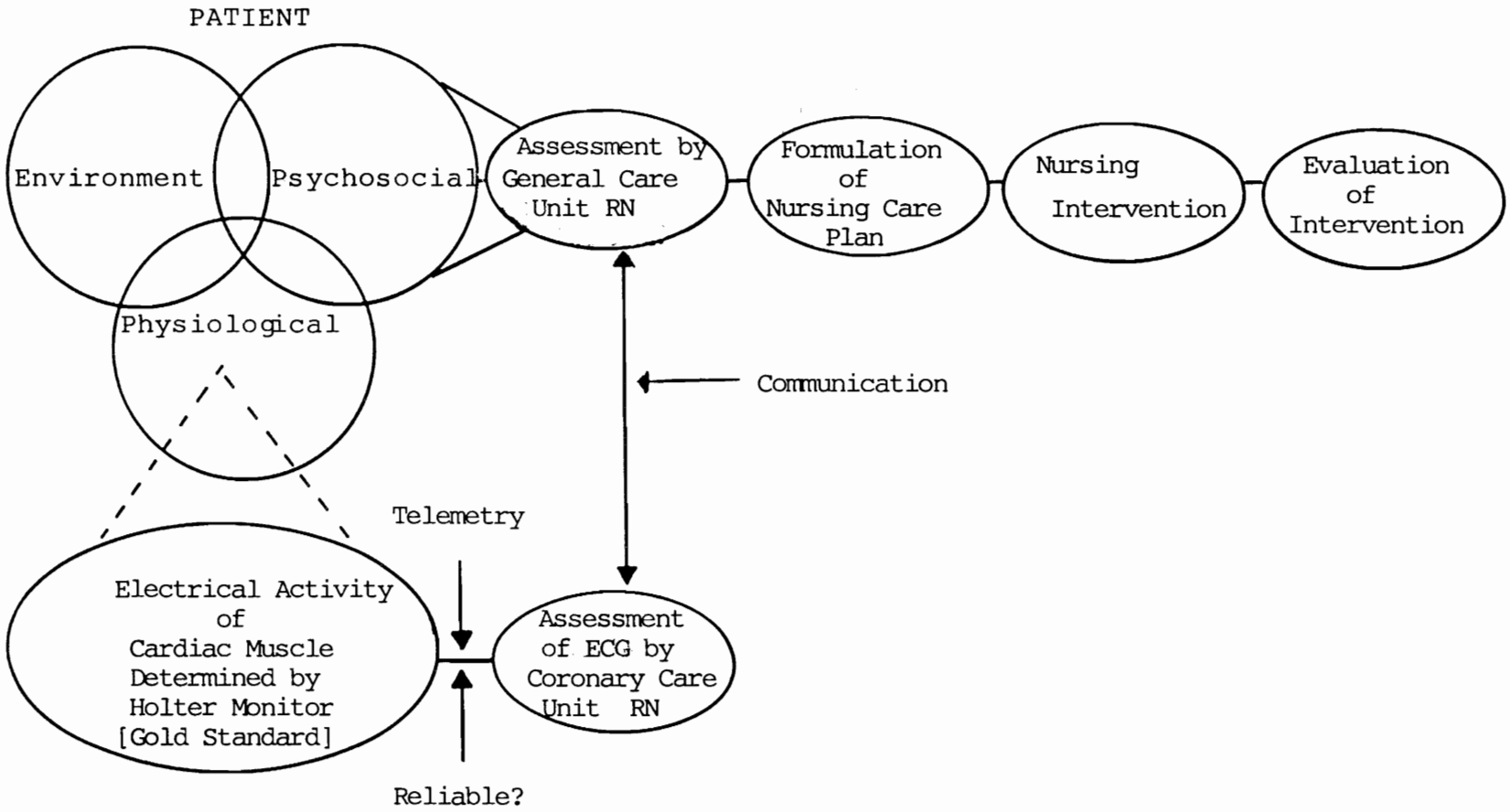


Figure 4. Conceptual framework: Holistic nursing care.

2. Is telemetry monitoring of arrhythmias documented as prescribed by physician's order and/or institutional policy?

3. Is there a difference in documentation of significant arrhythmias by telemetry among patients who were transferred out of the CCU as opposed to patients who were never admitted to the CCU?

4. Are symptomatic arrhythmias evidenced by Holter monitor documented by CCU nurses simultaneously monitoring arrhythmias per telemetry?

Operational Definitions

Significant Arrhythmias

Arrhythmias occurring in a 24-hour period on a Holter recording as identified by a computerized arrhythmias scanner system and electrocardiography technician with verification by a cardiologist were defined as significant arrhythmias.

Symptomatic Arrhythmias

Symptomatic arrhythmias were defined as electrocardiographic activity associated with complaints of abnormal sensations as reported by the patient within the patient's Holter activity log book and/or documented by nurses within the progress notes or flow sheet.

Institutional Policy

Institutional policies were defined as written

documents which provide hospital personnel with guidelines for action in all areas of practice, specifically telemetry operation (Appendix B).

Physician's Orders

Statements written by a physician within the medical record under "physician's orders," which direct patient care were defined as physician's orders (Appendix B).

Telemetry

A small, light-weight, battery-operated transmitter unit attached to the patient by three standard electrocardiogram electrodes in a MCL_1, MCL_6, or Lead II array was considered telemetry. The receiver and data display system were located within the CCU which enabled CCU nurses to monitor the patient's electrocardiographic activity in an instantaneous, continuous manner while the patient remained remote from the CCU.

Holter Monitoring

Holter monitoring was defined as a small, light-weight, battery-operated, reel-to-reel tape recorder worn by the patient utilizing a special shoulder strap or waist belt. Five standard electrocardiogram electrodes are attached to the chest for continuous recording of electrocardiographic signals on two channels for up to 26 hours in a Lead II or V_{5-6} array. Each recorder has a patient activated event-marker signal that enables

the patient to time-designate symptoms as they occur. The patient is instructed to write time and symptoms down in the Holter activity log book along with physical activity engaged in for the duration of the recording, as well as activating the event marker for use in correlating patient symptoms or activity to arrhythmia activity. Patients are also instructed to inform the nurse when abnormal sensations are felt.

Assumptions

The following assumptions were made in this investigation:

1. Arrhythmias observed per telemetry are recognized and documented by the CCU nurses.

2. Telemetry and Holter monitoring units are functional throughout the 24-hour period of study.

3. Cardiotachometer alarms are set at functional levels (50-100 beats per minute) and turned on.

4. Patients who are symptomatic communicate symptoms to nurse at time of symptom occurrence.

5. Patients are instructed to inform nurse of symptoms when they occur and the nurse records symptoms on the patient record.

6. Holter recordings are accurate reflections of a patient's electrocardiographic activity.

7. Arrhythmias recorded by the Holter monitor are simultaneously displayed on the oscilloscope within

the CCU.

8. Patients are within radiotransmission range of telemetry receivers unless otherwise documented.

9. Technicians are skilled in setting the electrocardiographic scanner parameters effectively and appropriately.

CHAPTER III

METHODOLOGY

Design

The design was a retrospective descriptive study of arrhythmia detection by CCU nurses monitoring electrocardiographic activity via telemetry as compared to arrhythmia detection by Holter recordings. A chart audit was employed to collect information relevant to the study questions.

Setting of Study

Data were collected from the medical records of patients previously admitted to a public hospital within the Salt Lake City area.

Study Population

Forty-five medical records of patients who were simultaneously monitored by telemetry and Holter monitor for a 24-hour period from August 1980 to July 1983 were selected for inclusion in the study. A medical record was excluded if there was indication that telemetry and Holter monitoring were not done simultaneously and continuously for at least 24 hours. If a patient was simultaneously monitored by telemetry and Holter monitor

for a 24-hour period more than once during the same admission, the investigator utilized only the first monitoring period for inclusion in the study.

Methodology

The study sample was obtained by reviewing the daily log book within the cardiology department to identify potential records for study inclusion. A list of potential records was then submitted to the Medical Records Department personnel to obtain access to the medical records. Upon acquisition of the records and establishment of eligibility for inclusion, the investigator systematically reviewed the medical records to document the following factors: arrhythmias identified as significant and symptomatic via Holter monitor recordings as documented within the final, cardiologist-reviewed report; arrhythmias observed via telemetry by CCU nurses as evidenced by rhythm strips and/or nurses' notes; and symptoms or complaints expressed by the patient as evidenced within the patient's Holter activity log book and/or the nurses' notes. The data were then systematically recorded on a data collection form. All rhythm strips were diagnostically verified by a cardiologist responsible for verifying the Holter monitor report. All rhythm strips were also verified by a Cardiovascular Nurse Specialist.

The procedures employed in documenting arrhythmia

via Holter monitoring and telemetry monitoring methods were consistent with the procedures described earlier.

Instrument

Data Collection Form

A data collection form was devised for the systematic collection of demographic information and documentation of arrhythmia data (Appendix C).

CHAPTER IV

RESULTS

Data were analyzed utilizing primarily descriptive statistics. T-tests were implemented to determine differences between arrhythmia detection by different monitoring methods and sample groupings.

Sample

The mean age of the total sample of 45 males was 60 years (se ± 1.5) with a range of 35 to 82 years (Table 3). Fifty-one percent (N = 23) of the total sample was never admitted to the CCU prior to the period of time selected for study and was designated as Group A. Forty-nine percent (N = 22) of the total sample was admitted to the CCU prior to the period of study and was designated as Group B. The time period selected for study spanned over 30 months from January 1981 to July 1982 (Table 4).

Eighty-three percent (N = 19) of Group A were initially admitted to the generalized care unit (GCU) which cares for telemetry patients. Seventeen percent (N = 4) of Group A was not initially admitted to the generalized care unit but was transferred to the unit

Table 3

Study Population Characteristics

Demographic Variables	Total Sample (N=45)	Group A[a] (N=23)	Group B[b] (N=22)
Age (in years)			
Mean (± se)	60(±1.5)	61(±2.1)	58(±2.2)
Range	35 - 82	45 - 82	35 - 76
Total Hospital Days			
Mean (± se)	17.2(±2.1)	14.6(±3.2)	20.0(±2.7)
Range	2 - 71	1 - 71	6 - 54
Total Telemetry Days			
Mean (± se)	7.9(±0.8)	6.1(±0.9)	9.6(±1.2)
Range	2 - 23	2 - 18	2 - 23
Days Postadmit Telemetry Instituted			
Mean (± se)	4.8(±1.1)	1.7(±0.7)	8.0(±2.1)
Range	0 - 45	0 - 11	0 - 45
Holter Instituted			
Mean (± se)	8.1(±1.3)	4.7(±0.9)	11.6(±2.2)
Range	1 - 51	1 - 17	2 - 51
Telemetry Days Before Holter			
Mean (± se)	4.2(±0.5)	3.3(±0.6)	5.1(±0.8)
Range	1 - 16	1 - 13	1 - 16

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

Table 4

Time Periods of Cases Selected for Study

Time Periods	Total Sample (N=45)	Group A[a] (N=23)	Group B[b] (N=22)
		Frequency	
1981			
January - March	1	0	1
April - June	1	1	0
July - September	3	2	1
october - December	7	4	3
	12(27%)	7	5
1982			
January - March	5	4	1
April - June	5	2	3
July - September	6	4	2
October - December	6	3	3
	22(49%)	13	9
1983			
January - March	5	2	3
April - June	5	1	4
July - September	1	0	1
	11(24%)	3	8

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

when telemetry monitoring was instituted. Sixty-eight percent (N = 15) of Group B were initially admitted to the CCU. The remaining 32% (N = 7) were not initially admitted to the CCU, but at some point during hospitalization their physical status declined and warranted admission to the CCU. The mean duration of time spent in the CCU was 3.5 (se ± 0.4) days with a range of one-half to eight days.

Duration of hospitalization for the total sample was a mean of 17.2 (se ± 2.1) days (Table 3). Telemetry was instituted 4.8 (se ± 1.1) days after admission to the hospital and was employed for a duration of 7.9 (se ± 0.8) days. Holter monitoring was initiated 8.1 (se ± 1.3) days after admission to the hospital and 4.2 (se ± 0.5) days after telemetry had been instituted.

Fifty-six percent (N = 25) of the total sample was discharged with a primary diagnosis of Organic Heart Disease (Table 5). Myocardial infarction (N = 4) and arrhythmias (N = 4) collectively accounted for 18% of the primary discharge diagnoses. The remainder of the sample included numerous diagnoses as delineated in Table 5.

Eighteen percent (N = 8) of the total sample was discharged with a secondary diagnosis of Organic Heart Disease (Table 6). Thus Organic Heart Disease was identified in 73% (N = 33) of the total sample as either the

Table 5

Primary Discharge Diagnosis

Primary Discharge Diagnosis	Total Sample (N=45)	Group A[a] (N=23)	Group B[b] (N=22)
	Frequency (%)	Frequency	Frequency
Organic Heart Disease	25 (56)	13	12
Myocardial Infarction	4 (9)	0	4
Arrhythmias	4 (9)	3	1
Syncope	2 (4)	1	1
Cardiomyopathy	2 (4)	1	1
Angina	1 (2)	0	1
Digitalis Toxicity	1 (2)	1	0
Anoxic Brain Damage	1 (2)	1	0
Cerebral Vascular Accident	1 (2)	1	0
Chronic Obstructive Lung Disease	1 (2)	0	1
Carotid Vertebral Insufficiency	1 (2)	1	0
Quinidine Induced Photosensitive Rash	1 (2)	1	0
Atherosclerotic Heart Disease with Peripheral Manifestations	1 (2)	0	1

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

Table 6

Secondary Discharge Diagnosis

Secondary Discharge Diagnosis	Total Sample (N=45)	Group A[a] (N=23)	Group B[b] (N=22)
	Frequency (%)	Frequency	Frequency
Organic Heart Disease	8 (18)	4	4
Arrhythmias	5 (11)	2	3
Other	30 (67)	16	14
No Secondary Discharge Diagnosis	2 (4)	1	1

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

primary or secondary discharge diagnosis. Sixty-seven percent (N=30) of the secondary discharge diagnoses included a variety of disease entities.

Research Question One

Research question one stated:

> Are significant arrhythmias recorded by Holter monitoring also identified by CCU nurses simultaneously monitoring arrhythmias by telemetry?

A total of 257 arrhythmias occurred as documented by Holter monitoring of which 127 were documented by CCU nurses via telemetry. The overall detection rate by telemetry monitoring (detection rate in percent = number of arrhythmias documented via telemetry/number of arrhythmias documented via Holter monitoring X 100) was 49.4% (Table 7). All arrhythmias were categorized into one of four categories: a) Sinus Arrhythmias, b) Atrial Arrhythmias, c) Ventricular Arrhythmias, and d) Atrioventricular Block Arrhythmias. Appendix C illustrates the specific arrhythmias included in each category. Sinus Arrhythmias had the highest percent of detection (87.8%) as opposed to Atrial Arrhythmias which had the lowest percent of detection (26.9%). Although Ventricular Arrhythmias had the highest frequency of occurrence (N=113) only 43 (38.1% detection) were documented by telemetry as occurring.

The mean number of significant arrhythmias per

Table 7

Documentation of Significant Arrhythmias by CCU Nurses

Type of Arrhythmia	Total Sample Arrhythmias (N=257)			Group A Arrhythmias[a] (N=131)			Group B Arrhythmias[b] (N=126)		
	N	Documented	% Detected[c]	N	Documented	% Detected	N	Documented	% Detected
Sinus	74	65	87.8	36	31	86.1	38	34	89.5
Atrial	67	18	26.9	42	12	28.6	25	6	24.0
Ventricular	113	43	38.1	51	22	43.9	62	21	33.9
AV Block	3	1	33.3	2	1	50.0	1	0	0.0
Total	257	127	(49.4)	131	66	(50.4)	126	61	(48.4)

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

[c]Detection rate in percent = $\frac{\text{number of arrhythmias documented via telemetry}}{\text{number of arrhythmias documented via Holter}}$ X 100.

patient documented by Holter monitor was 5.7 (se ± .03). This is compared to a mean of 2.8 (se ± 0.3) arrhythmias as documented by CCU nurses monitoring telemetry (Table 8).

Table 9 presents a comparison of the means between arrhythmia documentation methods for the total sample and subgroupings. The p-value was less than or equal to 0.001.

Research Question Two

Research question two stated:

> Is telemetry monitoring of arrhythmias documented as prescribed by physician's order and/or institutional policy?

While implementing telemetry monitoring, physicians ordered monitoring for 141 arrhythmias which required CCU nurses to notify the physician if the arrhythmia occurred (Tables 10 and 11). Overall, 30 arrhythmias occurred of which 13 (43.3%) were documented by CCU nureses. The 30 arrhythmias with specific orders requesting physician notification were 11.7% of all occurring significant arrhythmias (N = 257).

Physicians most frequently requested notification for the occurrence of Ventricular Arrhythmias (N = 78). Ventricular Arrhythmias were the most frequently occurring (N = 15). However, only 33.3% of Ventricular Arrhythmias requiring physician notification were detected via telemetry. Sinus Arrhythmias had the highest detection

Table 8

Descriptive Statistics of Arrhythmia Documentation

Monitoring Method	Total Sample (N=45)	Group A[a] (N=23)	Group B[b] (N=22)
	Arrhythmias Documented		
Holter			
Mean (± se)	5.7 (±0.3)	5.7 (±0.4)	5.7 (±0.4)
Range (Minimum-Maximum)	7.0(2.0-9.0)	7.0(2.0-9.0)	6.0(3.0-9.0)
Telemetry			
Mean (± se)	2.8 (±0.2)	2.9 (±0.4)	2.8 (±0.3)
Range (Minimum-Maximum)	6.0(1.0-7.0)	6.0(1.0-7.0)	5.0(1.0-6.0)

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

Table 9

Comparison of the Means Between Arrhythmia Documentation Methods Utilizing Paired *t*-Test

Grouping	Mean	± *se*	*t*	*df*	*p*-value
Total Sample (*N*=45)					
Holter Arrhythmias	5.7	0.3	10.6	44	≤0.001
Telemetry Arrhythmias	2.8	0.2			
Group A[a] (*N*=23)					
Holter Arrhythmias	5.7	0.4	7.4	22	≤0.001
Telemetry Arrhythmias	2.9	0.4			
Group B[b] (*N*=22)					
Holter Arrhythmias	5.7	0.4	7.2	21	≤0.001
Telemetry Arrhythmias	2.8	0.3			

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

Table 10

Documentation of Arrhythmias Which Required Physician Notification

Type of Arrhythmia	Physician Requests for Notification of Arrhythmia Occurrence	Arrhythmia Occurrence Documentation Method		
		Holter	Telemetry	
	Frequency	Frequency	Frequency	% Detected[a]
Sinus	46	11	8	72.7
Atrial	13	3	0	0.0
Ventricular	78	15	5	33.3
AV Block	4	1	0	0.0
Total	141	30	13	(43.3)

Note. [a] % detected = $\frac{\text{arrhythmias documented by telemetry monitoring}}{\text{arrhythmias documented by Holter monitoring}}$ X 100.

Table 11

Documentation of Arrhythmias Which Required Physician Notification Obtained from Telemetry Order Sheet

Type of Arrhythmia for which Physician Requested Notification	Frequency		
	Requested	Occurred	Detected
Sinus			
Rate Parameters			
< 40 Beats Per Minute	8	0	0
< 50 " " "	11	3	3
< 60 " " "	2	1	1
>110 Beats Per Minute	2	2	1
>120 " " "	9	3	2
>130 " " "	3	0	0
>140 " " "	3	0	0
>150 " " "	5	1	0
>175 " " "	1	0	0
Pauses >3 Seconds	2	1	1
	46	11	8
Atrial			
Atrial Tachycardia	1	1	0
Atrial Flutter	2	0	0
Atrial Fibrillation	4	0	0
Supraventricular Tachycardia	3	1	0
Junctional Tachycardia	1	0	0
1:1 Conduction	1	0	0
Runs of 3 or more	1	1	0
	13	3	0
Ventricular			
Ventricular Tachycardia	23	5	1
Ventricular Fibrillation	9	0	0
Premature Ventricular Depolarization			
Multifocal	5	2	1
Couplets/Back-to-Back	9	4	1
Runs 2	2	0	0
Triplets	1	1	0
Runs 3	2	0	0
Runs of 4-5	1	0	0
Runs	2	0	0
Bigeminy	2	0	0
Trigeminy	1	0	0

Table 11 Continued

Type of Arrhythmia for which Physician Requested Notification	Frequency		
	Requested	Occurred	Detected
Frequent	1	0	0
R on T	1	0	0
> 5	1	1	1
> 6	2	1	0
> 5 in a Row	1	0	0
> 5 per minute	6	1	1
> 6-8 per minute	4	0	0
> 10-12 per minute	4	0	0
Asystole	2	0	0
	79	15	5
Antrioventricular Dissociation/Block			
AV Dissociation	1	0	0
AV Block	1	0	0
AV Second/Third Degree Block	2	1	0
	4	1	0

rate of 72.7%. However, Sinus Arrhythmias were the second most frequently occurring arrhythmia which required physician notification (N = 11).

CCU nurses monitoring telemetry documented 114 arrhythmias for which physician notification had not been requested (Table 12). This represents an overall detection rate of 50.2%. Generally, all arrhythmia categories had higher detection rates than those arrhythmias whose occurrence required physician notification.

Documentation by institutional policy implied that a minimum of 270 rhythm strips (45 patients x 6 observations/24 hours) would be documented; 275 rhythm strips were actually documented within the patient records. Documentation, as guided by institutional policy, implied that 100% of all occurring arrhythmias would be documented. In actuality, only 49.4% were documented (Table 7).

Research Question Three

Research question three stated:

> Is there a difference in documentation of significant arrhythmias by telemetry among patients who were transferred out of the CCU as opposed to patients who were never admitted to the CCU?

Table 13 presents a comparison of the means of arrhythmias documented between Group A and Group B by Holter monitoring and by CCU nurses monitoring telemetry. The p-value for Holter monitoring was ≤ 0.9. The p-

Table 12

Nurse Documentation of Arrhythmias For Which Physicians Did Not Request Notification of Occurrence

Type of Arrhythmia	Documentation by Holter Frequency	Documentation by Telemetry Frequency	% Detection
Sinus	63	57	90.5
Atrial	64	18	28.1
Ventricular	98	58	38.8
AV Block	2	1	50.0
Total	227	114	(50.2)

Note. Detection = $\frac{\text{arrhythmias documented by telemetry monitoring}}{\text{arrhythmias documented by Holter monitoring}}$ X 100.

Table 13

Comparison of the Means of Arrhythmia Documentation Between Group A[a] and Group B[b] per Two Different Methods Utilizing an Independent *t*-Test (Equal Variance)

Grouping	Mean	± *se*	*t*	*df*	*p*-value
Holter Monitoring					
Group A Arrhythmias	5.7	0.4	-0.05	43	≤ 0.9
Group B Arrhythmias	5.7	0.4			
Telemetry Monitoring					
Group A Arrhythmias	2.9	0.4	0.2	43	≤ 0.8
Group B Arrhythmias	2.8	0.3			

Note. [a]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[b]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

value for telemetry monitoring was ≤ 0.8.

A comparison of the means of individual detection rates between Group A and Group B yielded a p-value of 0.6 (Table 14).

Research Question Four

Research question four stated:

> Are symptomatic arrhythmias evidenced by Holter monitor documented by CCU nurses simultaneously monitoring arrhythmias per telemetry?

The incidence of arrhythmias associated with patient symptomatology is exhibited in Table 15. CCU nurses monitoring telemetry documented two out of three (66.7%) arrhythmias which produced symptoms. However, no symptoms were narrated in the patient record. The generalized care unit nurses did not record either the arrhythmia occurrence or the symptom in all the cases.

Evaluation of the Holter monitor activity books yielded five categories: a) not submitted (N = 13), b) submitted blank (N = 2), c) submitted without cardiac symptoms (N = 16), d) submitted with cardiac symptoms and without associated arrhythmias (N = 11), and e) submitted with cardiac symptoms associated with arrhythmias (N = 3). Thus, 68.8% (N = 31) of the 45 patients can be assumed to have had no cardiac symptoms (Table 16).

Additional Findings

A total of 275 rhythm strips representing 127 sig-

Table 14

Comparison of Mean Detection Rates[a] Between Group A[b] and Group B[c] Utilizing an Independent *t*-Test (Equal Variance)

Grouping	*N*	Mean Detection Rates in Percent	± *se*	*t*	*df*	*p*-value
Group A	23	50.0	10	0.5	43	0.6
Group B	22	50.0	0.001			

Note. [a]Detection rate in percent = $\frac{\text{arrhythmias documented by telemetry monitoring}}{\text{arrhythmias documented by Holter monitor}} \times 100$

[b]Group A: subjects included in this group were never admitted to the CCU prior to the period of time selected for study.

[c]Group B: subjects included in this group were admitted to the CCU prior to the period of time selected for study.

Table 15

Association of Arrhythmias to Patient Complaints

Source of Documentation	Symptomatic Arrhythmia Occurrence	Narrative Symptom Occurrence
Holter Monitor/Patient	3	3
Coronary Care Unit (CCU)	2	0
Generalized Care Unit Nurse	0	0

Table 16

Evaluation of Holter Monitor Activity Log Book

Holter Activity Log Book	N
Not Submitted	13
Submitted Blank	2
Submitted Without Cardiac Symptoms	16
Submitted With Cardiac Symptoms Without Association to Arrhythmias	11
Submitted With Cardiac Symptoms With Association to Arrhythmias	3
Total	45

nificant arrhythmias was mounted in 45 patient records by the CCU nurses monitoring telemetry. All rhythm strips were labeled with the patient's name and time of arrhythmia occurrence. Only 17.5% (N = 48) of the 275 rhythm strips had the rate documented in numeric form and 0.4% (N = 1) had the lead placement identified. Although not required by institutional policy, 9.1% (N = 25) had the rhythm identified in writing.

Finally, a record of care by the generalized care unit registered nurse for the 24-hour period of study was found for 26 of the 45 patients (57.8%).

CHAPTER V

DISCUSSION OF FINDINGS AND IMPLICATIONS FOR NURSING

Discussion of Findings

This study described the reliability of arrhythmia detection by CCU nurses monitoring patients remote from the CCU utilizing telemetry. Arrhythmia detection by telemetry was based upon the number of arrhythmias documented by rhythm strips within the patient's hospital record.

Detection of arrhythmias by telemetry was dependent upon several factors including the initial observation of arrhythmias by CCU nurses via the oscilloscopic display. The overall detection rate of 49.4% may be due to nonobservation of the oscilloscope by the CCU nurses. The CCU nurses had direct patient care responsibilities in addition to monitoring the electrocardiographic activity of telemetry patients. Depending upon the acuity of the patients and the nurse/patient staffing ratios within the CCU, a nurse may or may not have been available to frequently observe the oscilloscopic displays. The CCU nurses may have regarded telemetry patients as being electrocardiographically and

physically stable thus not requiring constant surveillance compared to patients within the CCU. If patients within the CCU had a high need for nursing care, the nurses may have viewed their primary responsibility as providing direct patient care. Secondary responsibilities would then include monitoring telemetry patients.

Detection of arrhythmias was also dependent upon the clarity and continuity of the electrocardiographic display as produced by the various components of the telemetry system. Lead faults, false high-low alarms, and artifact displays may have been common due to: a) mobility of the population in which telemetry monitoring was employed, b) inadequate connections between the lead wire and electrode pad, and c) diminished electrode pad to skin interface. The occurrence of lead faults, false high-low alarms, and artifact displays may have motivated monitoring nurses to turn the audible alarms off with a resultant decrease in oscilloscope observation and rhythm strip production.

Nonrecognition of arrhythmias by the CCU nurses may have also been a factor contributing to the low overall detection rate. The telemetry system utilized for this study allowed electrocardiographic monitoring in one lead configuration only, most likely MCL_1 (Personal Communication, Quaal, October, 1983). Monitoring in MCL_1 allows for enhanced visuali-

zation of ventricular activity.

Holter monitoring employs a two lead system thus proliferating the ability to detect both atrial and ventricular activity. The difference between one and two lead monitoring capabilities may account for the difference in the number of arrhythmias documented by Holter monitoring compared to CCU nurses monitoring telemetry. Atrial activity if abnormal may not be accentuated in MCL_1, thus not recognized by CCU nurses. Holter monitor technicians inspect different lead configurations in order to obtain the best possible tracing of atrial as well as ventricular activity. The CCU nurses may not have done the inspection, thus resulting in the lower atrial arrhythmia detection rate (26.9%). The low detection rate of ventricular arrhythmias (38.1%) is most troublesome as ventricular arrhythmias may be life-threatening and frequently necessitate pharmocological intervention.

The low detection rates may have been due to the CCU nurse observing the arrhythmia but not mounting the rhythm strip in the hospital record. If CCU nurses notified the generalized care unit nurses to evaluate the patient and if the patient's vital signs were stable and cardiac complaints denied, the CCU nurse may have chosen not to document the arrhythmia occurrence.

Approximately 90% of the study population's baseline electrocardiographic activity was a sinus rhythm. This

implies that at least 40 of 45 patients would most consistently exhibit a normal sinus rhythm on the oscilloscope. Thus nurses observing the oscilloscope intermittently would have a greater probability of observing a sinus arrhythmia (72.7% detection rate) as opposed to sporadically occurring arrhythmias such as atrial, ventricular, and atrioventricular block arrhythmias. The reliability of detecting atrioventricular block arrhythmias for the purpose of this study is difficult to evaluate due to the low incidence of occurrence.

Nonrecognition may have been due to lack of knowledge about arrhythmia detection by the CCU nurses. However, all the CCU nurses at the time of the study had successfully completed at Intermediate ECG Course and intensive care unit nurses can accurately detect arrhythmias when observing the oscilloscope (Jarmon & Yesalis, 1976). The detection rate of 49.4% identified for this study was similar to Vetter and Julian's (1975) overall detection rate of 36%, and to Breu and Gawlinski's (1981) efficacy rate in studies of conventional monitoring modes.

Actual documentation of detected arrhythmias may be influenced by institutional policy, physician's orders, and the nurse's independent judgment. Institutional policy directing nurses to obtain rhythm strips at four-hour intervals, or more often with changes in rhythm,

may have facilitated intermittent observation of the oscilloscope. Lown et al. (1967) implied that inconsistent observation of the oscilloscope diminished the ability to detect sporadically occurring arrhythmias. The portion of institutional policy directing nurses to obtain a rhythm strip with each change in electrocardiographic activity may have been viewed as unrealistic by the CCU nurses. Therefore, the CCU nurses may have documented only rhythm strips representing trends of electrocardiographic activity.

Nonadherence to institutional policy is also reflected by nondocumentation of lead placement on the rhythm strip. This may indicate lack of information regarding lead placement on patients remote from the CCU.

Physicians' orders directed the nurse to document types of arrhythmias. CCU nurses documented 43.3% of arrhythmias requiring physician notification. The relatively low detection rate may be a reflection of inappropriate requests, unrealistic expectations, or outdated orders on the part of physicians. Inappropriate requests and unrealistic expectations may be rooted in the CCU's identity as a teaching facility. Medical students and house staff are in the process of learning, thus inappropriate requests may have been made. Physicians' orders may not have been updated in writing to coincide with changes in the patient's

clinical condition and/or verbal orders. What appears to be low compliance in documenting arrhythmias as ordered by physicians may have been due in part to physician oversights. CCU nurses may have independently judged that observed arrhythmias were irrelevant to the patient's clinical or therapeutic regimen.

The CCU nurses' perceptions of the physician's goal of telemetry monitoring may have also influenced the reliability of arrhythmia detection. The detection of trends in electrocardiographic activity may have been the perceived goal. If this was the case, the CCU nurses may have only verbally relayed the observed trends to the physician as opposed to documenting within the medical record. Another perceived goal may have been associating arrhythmia activity with abnormal cardiac symptoms. No symptoms, cardiac complaints, or assessment data were recorded by either the CCU nurse or generalized care nurses for two of the three arrhythmias having patient documentation of symptoms. The lack of cardiac complaints associated with arrhythmias by both nursing staffs may have been due to a) physical remoteness of the patient from the oscilloscope monitoring station, b) communication delays between the two nursing staffs, c) patient may have recorded symptoms within the log book and not communicated with the nursing staff, and d) the nurses and patients unfamiliarity with arrhythmias

known to contribute to symptomatology and the specific symptoms of cardiac disease.

The rate of return of the Holter monitor activity log books was comparable to Zeldis and associates' (1978) study. The high frequency of patients (68.8%) who: a) did not submit their Holter monitor activity log book, b) submitted it blank, or c) submitted it without evidence of cardiac symptoms may have been due to a lack of patient education on the part of the Holter monitor electrocardiography technician. The technician instructed patients in activity regimen, responsibilities for documenting symptoms within the Holter monitor activity log book, and care for the Holter monitor during the time of the test. The generalized care unit nurses may have placed a low priority on patient education regarding cardiac disease symptomology in comparison to direct physical care.

A perceived goal of early observation and intervention of potentially lethal arrhythmias in a high risk population may have influenced arrhythmia detection. It would seem that familiarity with a patient and his health history would have motivated nurses to maintain a high "index-of-suspicion" for changes in electrocardiographic activity. This in turn would promote a closer observation of the oscilloscopic display and increase documentation as a result. However, there was no differ-

ence in arrhythmia documentation by CCU nurses via telemetry whether or not the patient had been in the CCU. The CCU nurses may have assumed the patient was stable and did not require continuous observation when discharged from the CCU to the generalized care unit. The CCU nurses may also have believed it was the responsibility of the generalized care unit nurses to monitor the patient's electrocardiographic activity. However, within the physical and philosophical constraints of the telemetry system utilized in this study, generalized care unit nurses were unable to assume this responsibility.

Fifty-eight percent of patients were assessed by a generalized care unit registered nurse during the 24-hour period of study. The lack of documented assessment in 42% of the patients' records may be due to patient acuity and staffing patterns within the generalized care unit, as well as institutional policy. The generalized care unit may not have documented the patient assessment when the patient appeared stable due to lack of time. The patient assessment may have been viewed as a low priority for documenting, or the nurses may have lacked expertise in the art of physical assessment.

Implications for Nursing

In light of this study's findings, current procedures employed for telemetry monitoring should be evaluated with regard to efficacy of patient care and cost

effectiveness. Three areas of concern are: a) the system of telemetry monitoring and the policies which influence its utilization, b) the present and future education of nursing and medical personnel, and c) patient education.

Within the current system, two nursing staffs are responsible for assessing one patient. If this practice is continued, provisions for improved communication systems between the two nursing staffs should be made. Movement of the oscilloscopic monitoring station within the physical locale of the generalized care unit and the integration of computerized arrhythmia detection systems should be considered. When contemplating system revision, institutional policies should be brought into a defined, realistic realm and provisions with regard to staffing patterns which allow for continual oscilloscope surveillance should be made. The study implies that nurses documented with greater reliability when utilizing their independent judgment. Thus, the necessity of institutional policies and physician's orders to guide nursing practice should be examined.

Nursing personnel should continually upgrade their professional skills and expertise in evaluating arrhythmias and physical assessment. Nursing personnel must be educated to adhere to the policies which direct their practice. If such policies are unrealistic, then change

should be initiated, rather than continue what appears to be noncompliant, ineffective, and inefficient practice. Physicians should precisely communicate their expectations. The expectations should be realistic as well as appropriate with regard to continuous ambulatory electrocardiographic monitoring. Physicians should examine the rationale for employing a monitoring system of which they are skeptical. Finally, physicians need to continually incorporate the data obtained from telemetry into the therapeutic regimen prescribed for patients.

Patients should be routinely educated in the recognition of cardiac disease symptomatology and the importance of seeking assistance early in the onset of such symptoms.

The concept of continuous ambulatory monitoring via telemetry has the possibility of expediting and enhancing therapeutic outcomes for patients in the acute care setting. Telemetry allows for continued or early mobilization of patients who otherwise would be confined to a bed within the intensive care unit. Telemetry also allows for the continued surveillance trends in electrocardiographic activity and the development of potentially life-threatening arrhythmias.

The reliability of a telemetry system was examined in this study. The employment of such a system for

ambulatory real-time continuous electrocardiographic monitoring and the continued expenditure of health care monies on equipment and staff must be evaluated based upon the reliability in detecting arrhythmias.

Summary

The purpose of this study was to describe the reliability of arrhythmia detection by CCU nurses monitoring hospitalized patients' remote from the CCU utilizing telemetry. The patient's baseline electrocardiographic activity was simultaneously determined by Holter monitor. No studies addressing efficacy of arrhythmia detection via telemetry monitoring were found within the literature.

The medical records of 45 male patients were retrospectively reviewed. The mean age was 60 years with a range of 35-82 years. All electrocardiographic patterns observed by telemetry and Holter monitor were considered as significant arrhythmias and categorized into: a) Sinus Arrhythmias, b) Atrial Arrhythmias, c) Ventricular Arrhythmias, and d) Atrioventricular Block Arrhythmias. A total of 257 significant arrhythmias occurred as documented by Holter monitoring. One hundred twenty-seven were documented by telemetry, rendering an overall 49.4% detection rate. Sinus arrhythmias were detected 87.8% of the time, and atrial arrhythmia, 26.9%. Although ventricular arrhythmias were the most frequently occurring, they were detected only 38.1% of the time. A comparison of the

means between Holter monitoring and telemetry revealed a p-value less than or equal to 0.001 using the paired t-test.

The overall detection rates of arrhythmias which required physician notification of occurrence (43.3%) and arrhythmias documented which did not require physician notification (50.2%) were comparable to the overall detection rate of all significant arrhythmias (49.4%). Thus, it appears nurses documented a greater number of arrhythmias based upon their own judgment as opposed to being guided by institutional policy and/or physician orders.

Familiarity with patients and their health history did not appear to influence detection rates by CCU nurses.

Although CCU nurses were able to document 66.7% of arrhythmias responsible for symptomatic complaints of patients, no association to symptoms was made. No symptoms were narratively documented by either the CCU nurse or the generalized care unit nurse.

The relatively low detection of arrhythmias by CCU nurses monitoring patients remote from the CCU may have been due to several factors including:

1. Nonobservation of oscilloscope due to direct patient care responsibilities and nonfunctioning alarms.

2. Nondocumentation of oscilloscopic observations due to independent judgment and/or assessment of the patient as being stable.

4. Nonadherence to physicians orders and/or institutional policy due to potentially unrealistic expectations demanded.

5. Poor oscilloscopic display due to lead faults, patient mobility, and artifact.

In conclusion, the results of this study generate many areas of concern which need to be addressed in future studies.

Limitations

Limitations of the study include the inability to control or account for several intervening variables such as:

1. The number of nurses on duty within the generalized and CCUs.

2. The number of patients in the CCU and their acuity of illness.

3. The number of patients in the generalized care unit and their acuity of illness.

4. The nurses' familiarity and compliance with the institutional policy regarding oscilloscope monitoring, alarm limit settings, lead placement, and documentation.

5. The possibility of incorrect information documented within the medical record.

6. The loss of data from the records.

7. The functionality of the equipment.

One licensed practical nurse was employed within the CCU and was responsible for monitoring telemetry. All other nurses were registered.

Recommendations for Further Study

1. A prospective study which allows for the control and/or accountability of the aforementioned intervening variables are required to obtain a baseline description of arrhythmia detection via telemetry.

2. A prospective study which implements various physical layouts of the monitoring station upon the generalized care unit and their resultant effects on arrhythmia detection.

3. A prospective study which implements various provisions for continued oscilloscope monitoring to include electrocardiograph technicians, full time nurses, alternating periods of oscilloscope observation with patient care duties by nurses.

4. A prospective study which implements various institutional policy changes to include continual observation, observation at sporadic intervals, and observation at specified time, i.e., one and two hour intervals and compares the resultant documentation of arrhythmias by telemetry.

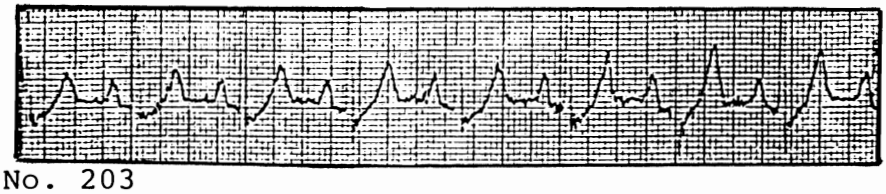
5. A prospective study which compares the reliability of arrhythmia detection when nurses document

according to institutional policy, physician's orders or independent judgment.

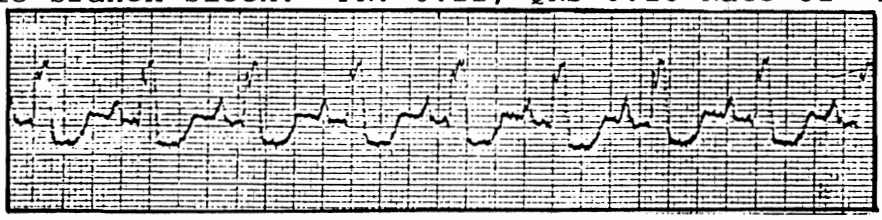
APPENDIX A

EXAMPLES OF DATA LABELED ON RHYTHM STRIPS BY CCU NURSES

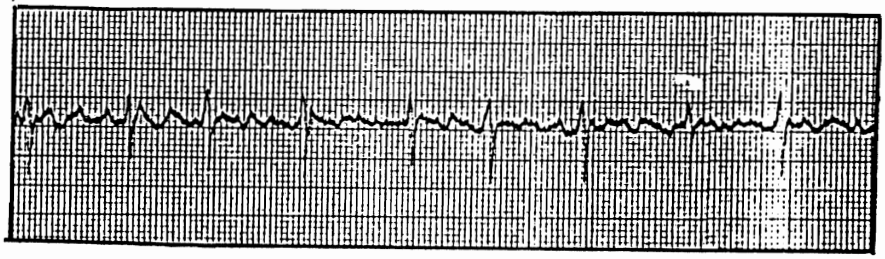
Case No. 102
Sinus Rhythm: PR 0.18, QRS 0.06 Rate 80
10/8/82 9 AM



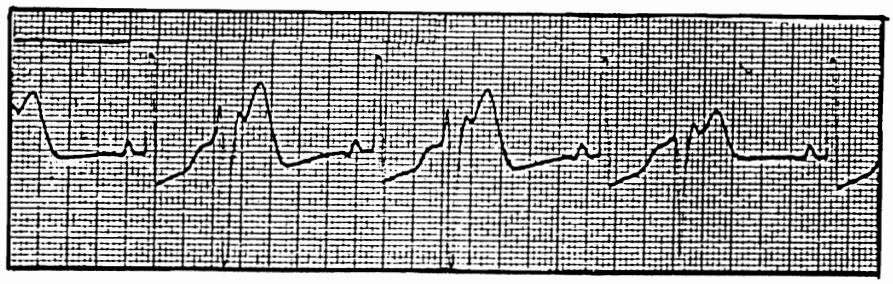
Case No. 203
Sinus Rhythm with first degree atrioventricular block and bundle branch block: PR: 0.22, QRS 0.16 Rate 81 9/8/82 10 PM



Case 202
6/23/82 9:40 AM



Case No. 207
8/23/82 11 AM



APPENDIX B

TELEMETRY POLICIES

I. Purpose:

To provide guidelines for the monitoring of patients on telemetry outside the MICU/CCU.

II. Medical Responsibility:

The clinical responsibility for patients monitored on telemetry units with regard to admission, transfer and discharge is delegated to the MICU/CCU medical staff, through the administrative channels from the Chief, Medical Service.

A. Physicians orders: Doctor's orders VA Form 10-1158 overprinted with Telemetry orders must be completed in duplicate prior to telemetry monitoring. The original is placed in the patient's chart on the telemetry ward and a copy is retained in MICU/CCU on the patient's clipboard. Orders must be rewritten every 48 hours.

B. Patients placed on telemetry must be located in areas wired with telemetry antennas.

III. Nursing Responsibility:

A. The provision for comprehensive nursing care for the patients on telemetry is the responsibility of the telemetry ward nursing staff.

B. Upon initiation of telemetry monitoring, the telemetry ward nurses are responsible for the placement of electrodes in an MCL, MCL_6, or Lead II array and for the replacement of electrodes as necessary to assure clear, artifact-free EKG tracings.

C. The monitoring and documentation of the patient's EKG will be the responsibility of the nurses in MICU/CCU. Rhythm strips will be taken on initiation of monitoring, then at four-hour intervals; or more frequently as necessary to document rhythm changes. Labeling of the strips will include the patient's name, the time, date and the lead. These strips will be mounted on a clipboard in MICU/CCU.

D. When telemetry is discontinued, the strips which have been mounted on the clipboard in MICU/CCU will be transferred to the patient's medical record.

E. MICU/CCU nurses will notify the telemetry ward nurses of any arrhythmia they observe on telemetry patients, including an explanation of the arrhythmia and the possible effects to the patient. Telemetry ward nurses will then notify the appropriate physician immediately and observe the patient for any symptomatology.

F. For follow-up concerning the arrhythmia, the physician will observe the patient clinically and check with the MICU/CCU nurses for documentation and further comments.

IV. Emergency Standing Orders

A. In a crisis, in the absence of a physician, Emergency Standing Orders will be instituted by the MICU/CCU nurses. The physician will be notified immediately by the telemetry ward nurses (see attached Emergency Standing Orders).

B. The current Medical Center policy for cardiac resuscitation will be followed in all cases of cardiopulmonary arrest. The nurses on the patient's ward will be responsible for beginning basic life support measures (CPR) and notification of the Cardiac Arrest team.

V. Equipment Maintenance

A. The telemetry units will be kept on the telemetry ward. These units should be stored without batteries when not being used.

B. Batteries for the telemetry units are stored in the refrigerator on the telemetry ward.

C. Battery strength will be checked before use with the voltmeter on the telemetry ward and batteries will be returned to SPD when found to be weak.

DOCTOR'S ORDERS

Date and Time	Pros No	TELEMETRY ORDERS	X	Nurse's Signature
DATE		Orders must be dated, timed and signed; rewrites due every 48		
TIME		hours. Patients will not be placed on telemetry until orders		
ROOM NO.		are written. All patients will have hep. lock or I.V.		
		PATIENT PROFILE: Include adm, dx.		
		age, rhythm on adm., underlying diseases and current meds.		
		REASON FOR TELEMETRY: Please up-		
		date prn (at least qod) and in- clude changes in pt. status as		
		well as treatments instituted for arrhythmias.		
		ARRHYTHMIAS FOR WHICH H.O. IS TO		
		BE NOTIFIED: Notify Dr. _____ for following: (i.e., PVDs over		
		five/min. rate under 40 or over 150 etc.).		
		Tolerable arrhythmias (if applic-		
		able)		

Original to be placed on chart, copy in ICU.

Medical Record
DOCTOR'S ORDERS

APPENDIX C

DATA COLLECTION FORM

Demographic Data:

Subject Code Number ____ Admitting Diagnosis _____
Age_____ Sex _____ _____
Admission Date _____ Discharge Diagnosis _____
Admission Unit _____ _____
Date of Holter _____ Date Telemetry On ___ Off___

Current Medications: _____
_____

Telemetry Orders:

Patient Profile: _____
_____
Reason for Telemetry: _____
_____
Notify H.O. For: _____
_____
Tolerable Arrhythmias: _____
_____

Nursing Documentation (CCU):

Rhythm Strips

Date	Time	Lead	Rate	PR	Int.	QRS	Sx/Sx	Actions Taken

Nurses' Notes

Date	Time	Comment

Nursing Documentation (General Care Unit):

Flow Sheet and/or Progress Notes

Date	Time	T	P	R	BP	Sx/Sx	Actions Taken	Off Floor

Physician Documentation:

Progress Notes and/or Discharge Summary

Date	Comment

Date Holter Ordered _____ Duration of Holter _____

Holter Documentation:

Base Rhythm _____ Maximum Rate _____

PR Interval _____ Minimum _____

PADs _____ PVDs _____ QRS Duration _____

___Sinus rhythm
___Sinus arrest
___Sinur arrhythmia
___Sinus bradycardia
___Sinus tachycardia
___Pulse gen. irregular
___No capture
___Int. capture
___Improper sense
___Sick sinus syndrome
___Wenckebach
___AV Dissociation
___AV Block I, II, III
___Ectopic atrial rhythm
___Multifocal atrial tach
___ST-T changes
___T changes
___QRS changes
___P changes
___PADs
___PADs with aberration
___Atrial fibrillation
___Atrial flutter

___PAT
___AV nodal rhythm
___Blocked PADs
___Sinus pause
___Ventricular escape beats
___JUnctional escape beats
___Junctional rhythm
___PVDs
___Unifocal
___Multifocal
___Paired
___Ventricular tachycardia
___Ventricular flutter
___Ventricular parasystole
___Supraventricular tachy-cardia
___Acceler, idio-vent. rhythm
___Ventricular bi-geminy
___Ventricular tri-geminy
___Ventricular quadra-geminy
___Parasystole
___Fusion beats
___Interpolated PVDs

Patient Log Book:

Time	Symptoms	Arrhythmia Correlate

APPENDIX D

CATEGORIZATION OF SIGNIFICANT ARRHYTHMIAS

Sinus Arrhythmias

- Sinus Rhythm
- Sinus Arrhythmia
- Sinus Bradycardia
- Sinus Tachycardia
- Sinus Pauses

Atrial Arrhythmias

- Premature Atrial Depolarizations
  - Multifocal
  - Blocked
  - Bigeminal Pattern
  - Nonconducted
  - With Aberration
  - Consecutive
- Multifocal Atrial Tachycardia
- Supraventricular Tachycardia
- Atrial Fibrillation With Rapid Ventricular Response
- Aberrantly Conducted Supraventricular Beats
- Atrial Flutter With Variable Ventricular Response (2:1, 1:1)
- Junctional Escape Beats With Premature Atrial Depolarizations
- Ectopic Atrial Tachycardia
- Atrial Idioventricular Rhythm
- Atrial Tachycardia
- Junctional Tachycardia
- Ashman Beats

Ventricular Arrhythmias

- Premature Ventricular Depolarizations
  - Multifocal
  - Unifocal
  - Couplets
  - Triplets
  - Bigeminal Pattern
  - Trigeminal Pattern
  - Quadrigeminal Pattern
  - Couples With Fusion Beats
  - Interpolated
  - Every Sixty Beat
- Multifocal Tachycardia
- Asystole
- Ventricular Escape Beats
- Ventricular Tachycardia (Four, Seven, and Nine Beat)
- Quadruplet Premature Ventricular Depolarizations
- Nonconducted Sinus P Wave
- Idioventricular Rhythm
- Sinus Tachycardia With ST-T Depression

Ventricular Arrhythmias (continued)

Torsades DePoint
R-On-T Premature Ventricular Depolarization
Ventricular Fibrillation

Atrioventricular Block Arrhythmias

Wenckebach
Atrioventricular Dissociation
First Degree Atrioventricular Block

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