EKG Monitoring For Hospitalized Patients: Techniques and Rationale

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October 9, 2005

How General Electric StatView Works

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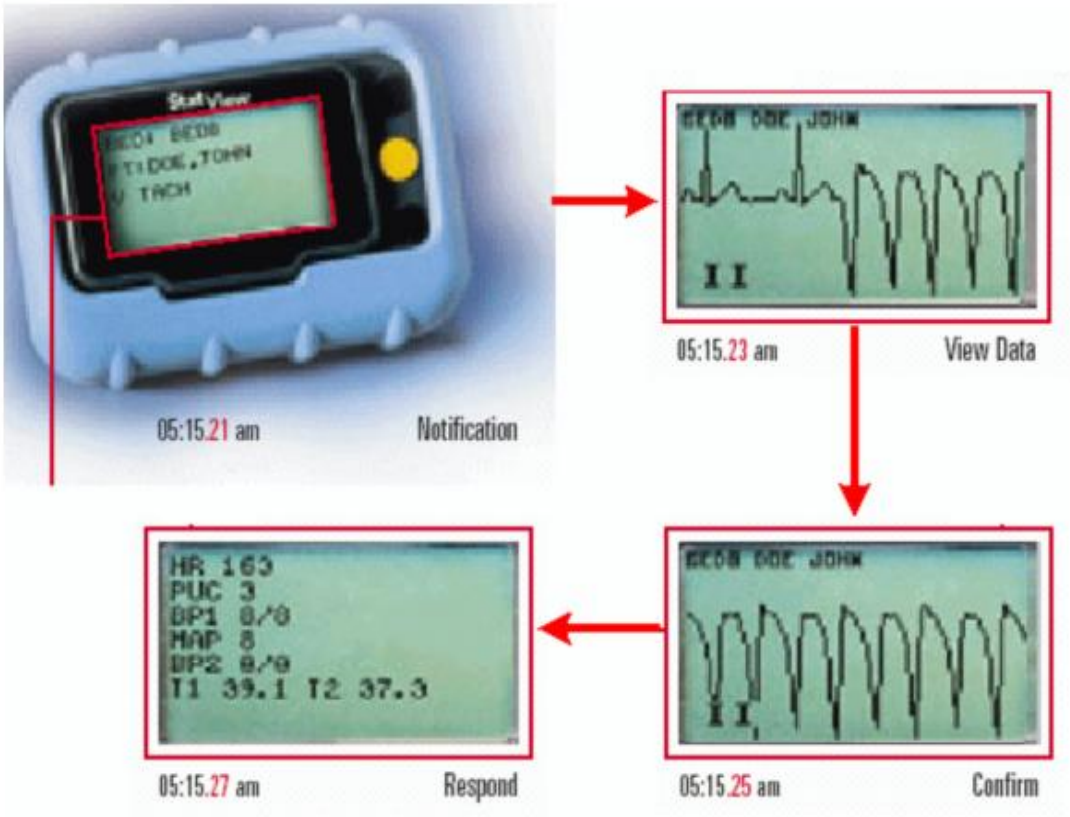
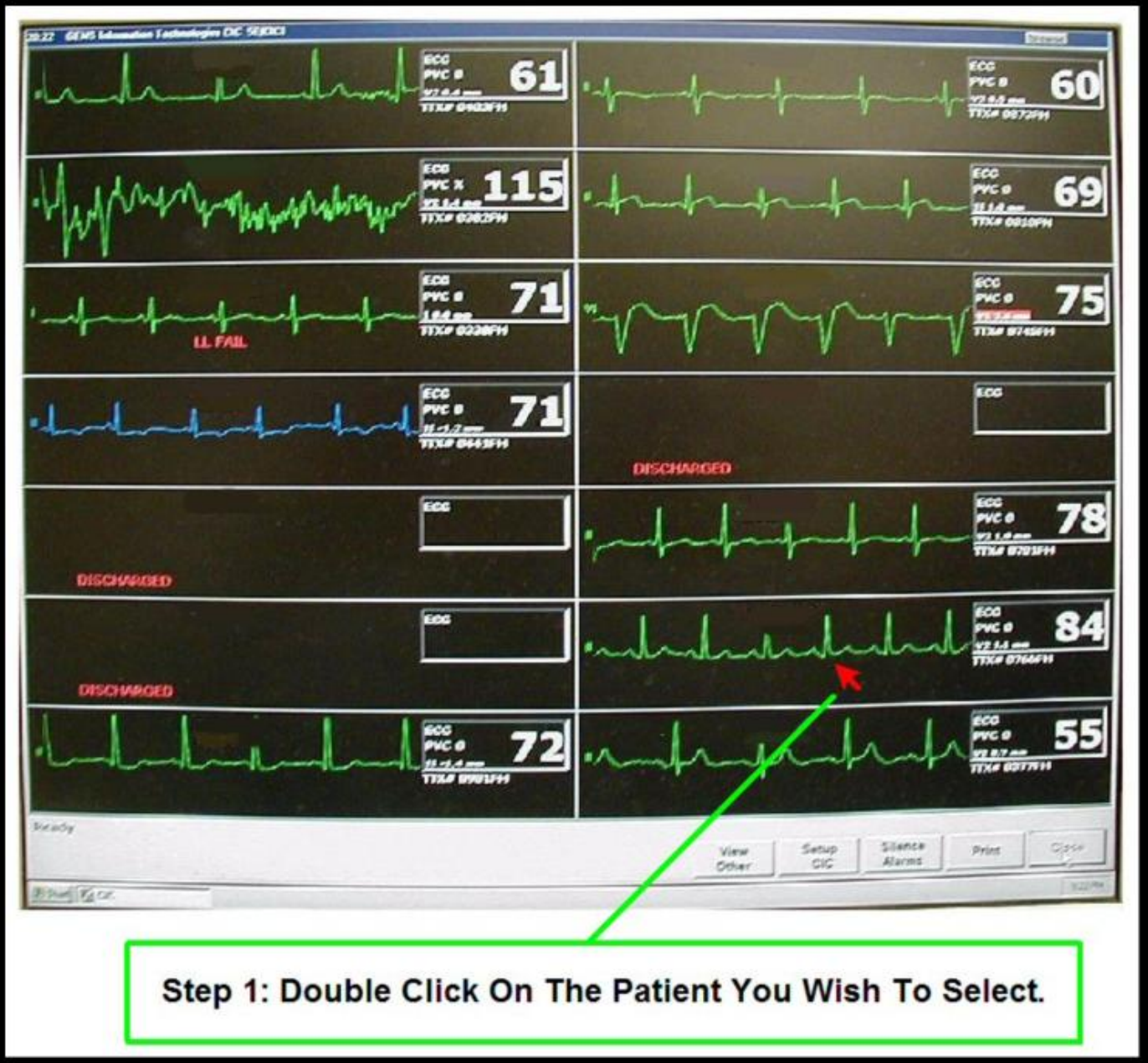


How General Electric Clinical Information Center (CIC) Works


61
60
115
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LL FAIL
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DISCHARGED
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72
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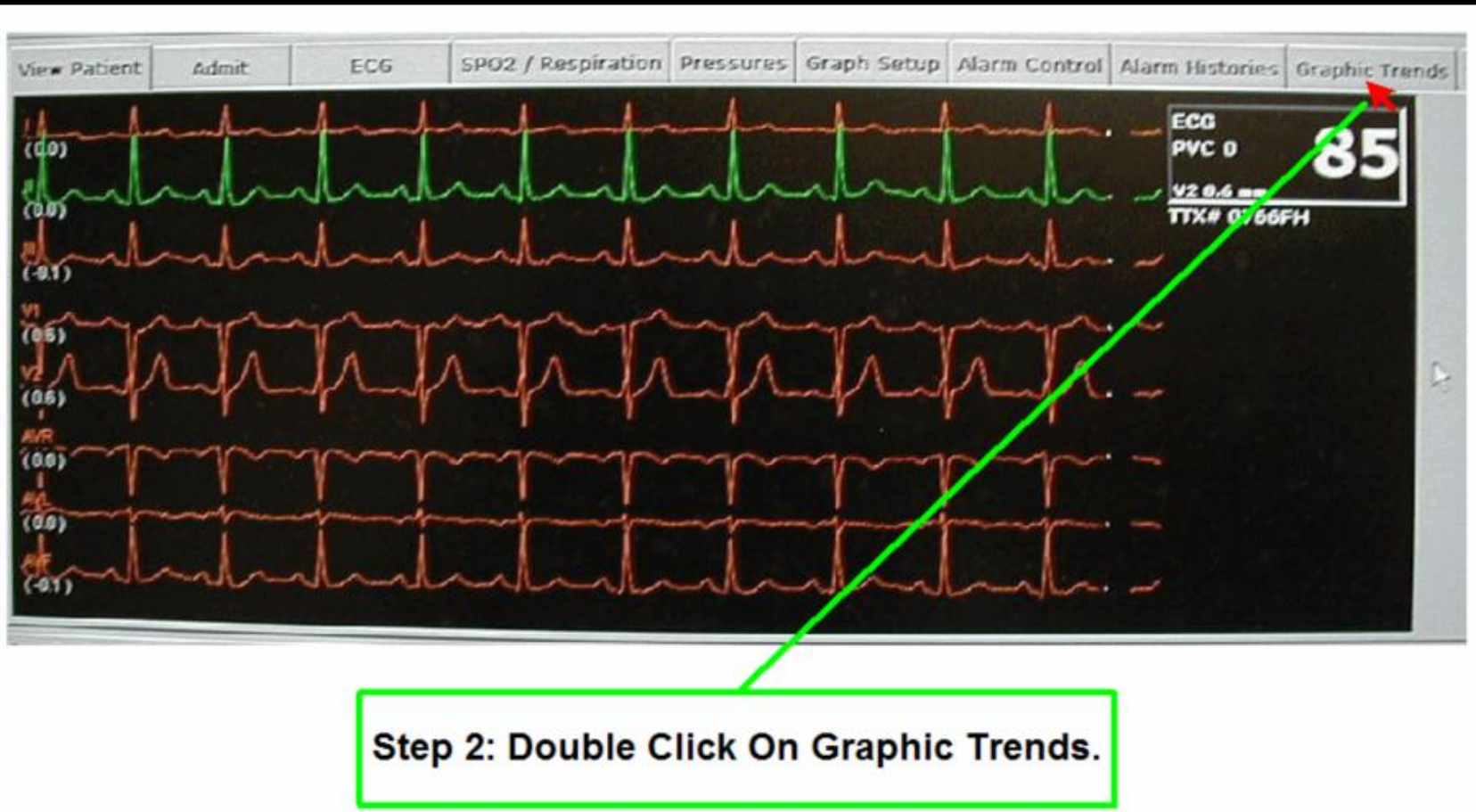
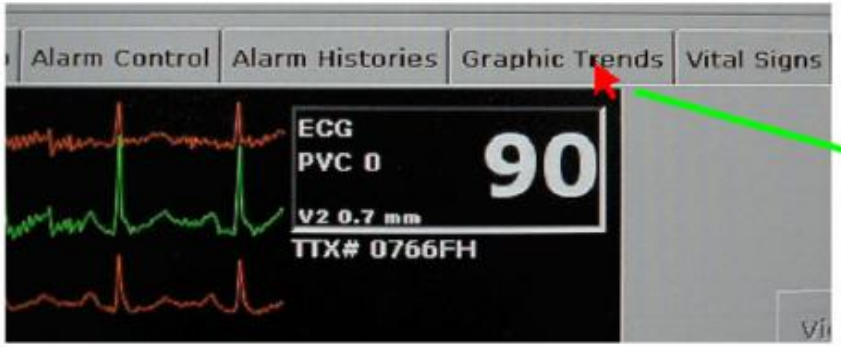
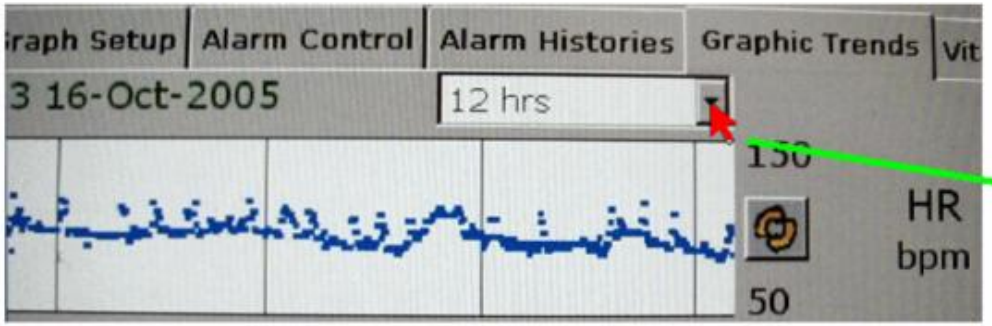
View Other
Setup CIC
Silence Alarms
Print
Step 1: Double Click On The Patient You Wish To Select.


View Patient
Admit
ECG
SPO2 / Respiration
Pressures
Graph Setup
Alarm Control
Alarm Histories
Graphic Trends
ECG
PVC 0
85
Step 2: Double Click On Graphic Trends.

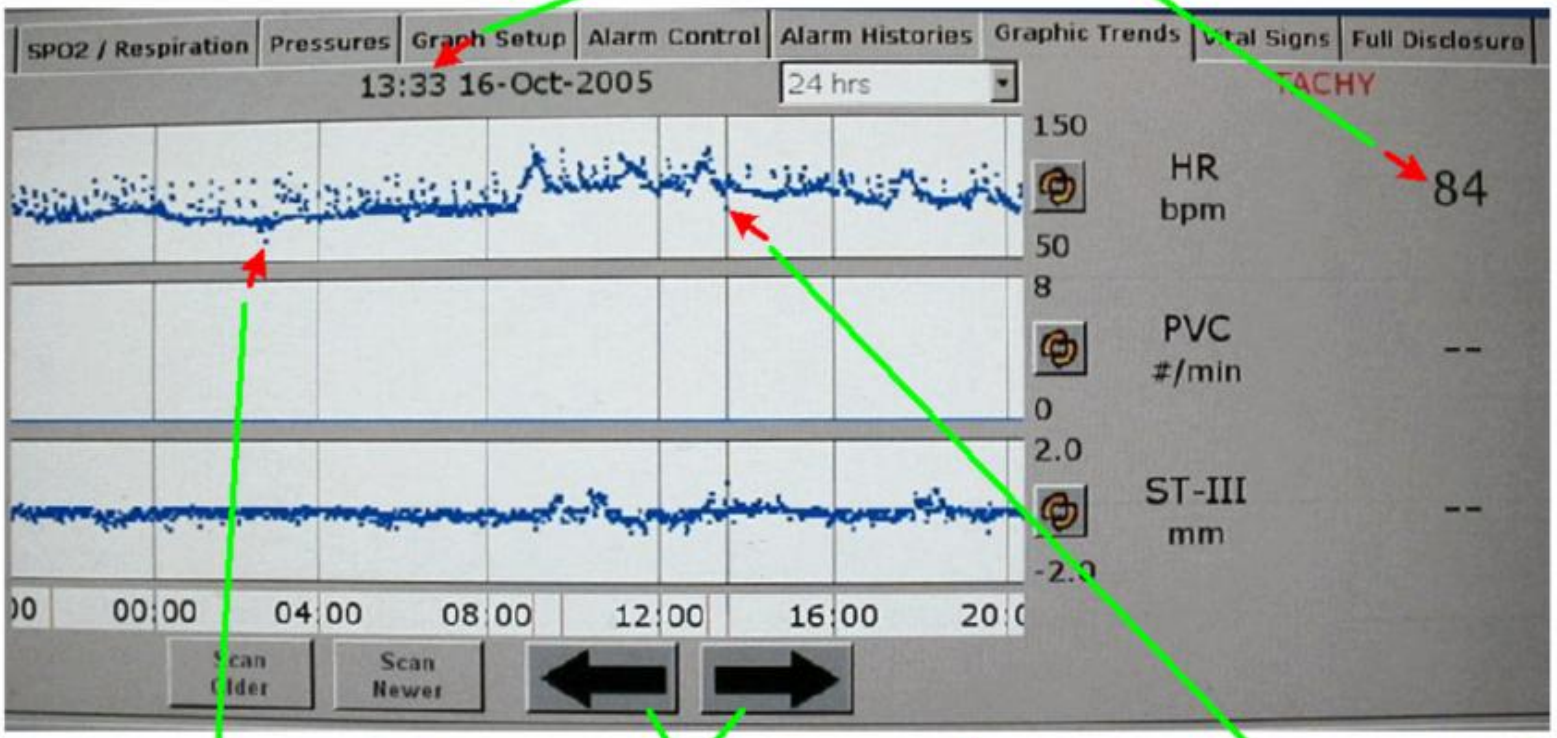


You Have Already Clicked on Graphic Trends.



Step 3: Click the down arrow to select time span.

Step 4: Click on "24 hours".

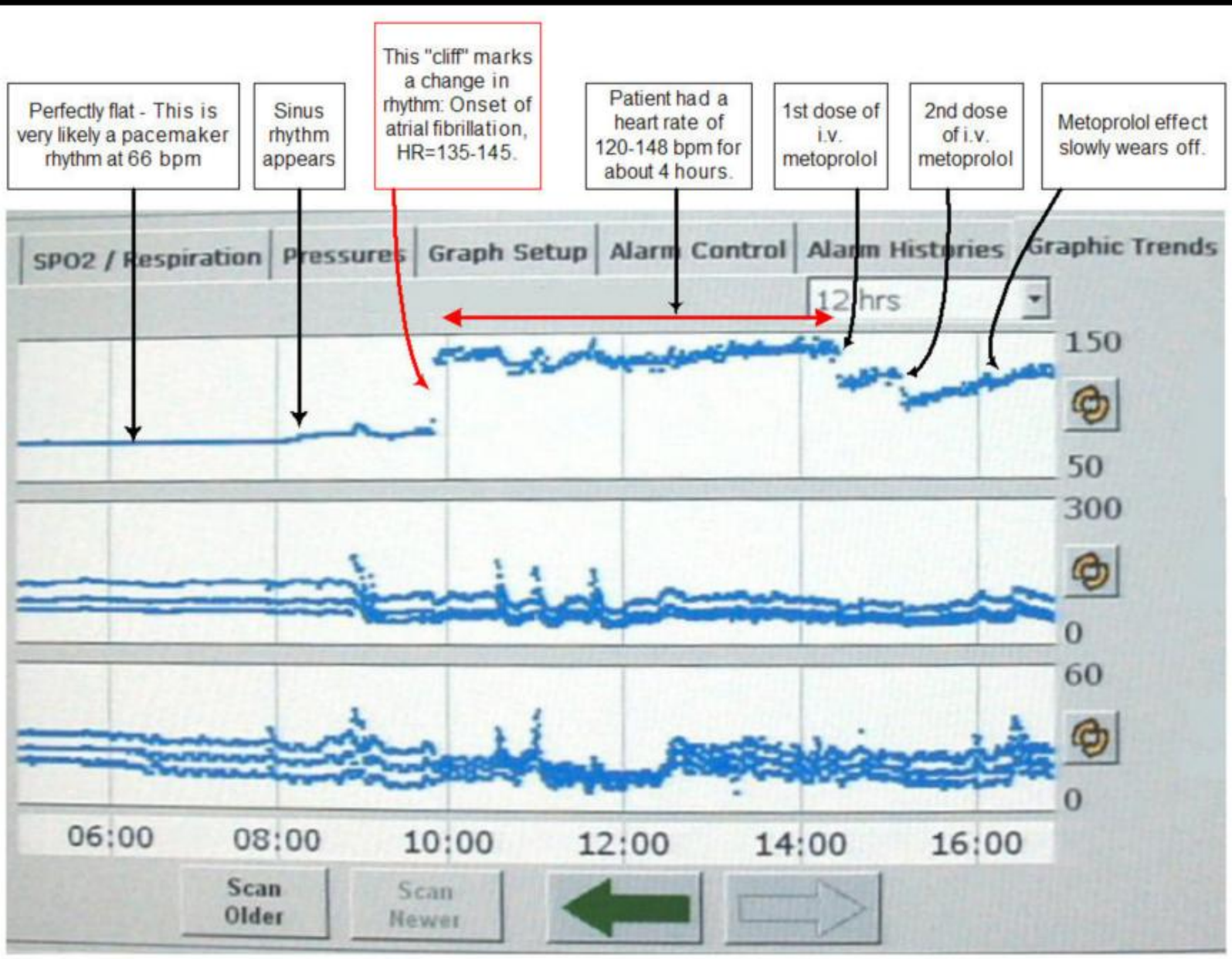


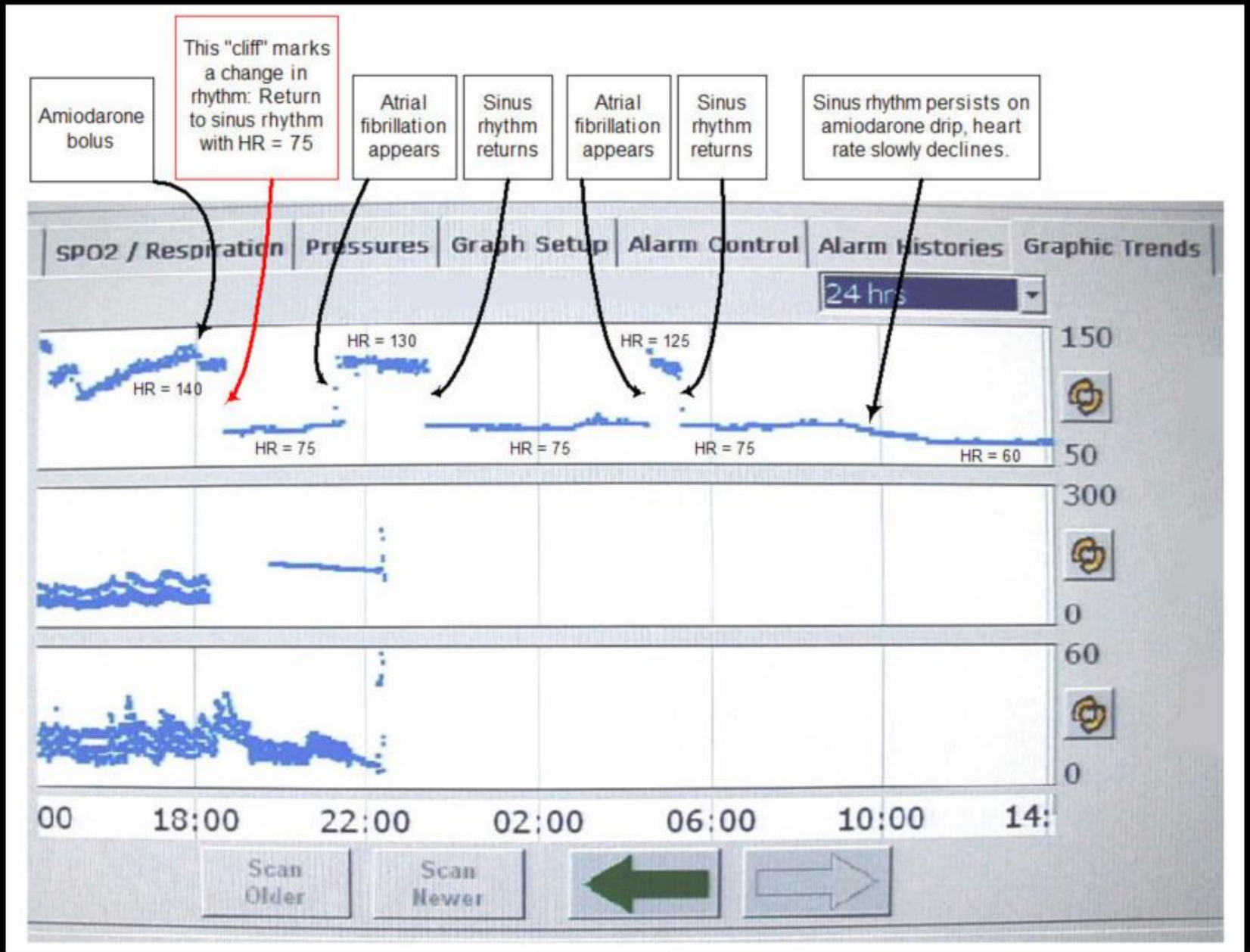
Select a point by clicking on it. That point's Heart Rate and Time will be displayed.

Each point is the average heart rate for one minute.

You can move the selector in 1-minute intervals by clicking on these arrows.

In this example, the average heart rate for 13:33 has been selected. The heart rate then was 84 beats per minute.


Perfectly flat - This is very likely a pacemaker rhythm at 66 bpm
Sinus rhythm appears
This "cliff" marks a change in rhythm: Onset of atrial fibrillation, HR=135-145.
Patient had a heart rate of 120-148 bpm for about 4 hours.
1st dose of i.v. metoprolol
2nd dose of i.v. metoprolol
Metoprolol effect slowly wears off.
SPO2 / Respiration
Pressures
Graph Setup
Alarm Control
Alarm Histories
Graphic Trends
12 hrs
150
50
300
0
60
0
06:00
08:00
10:00
12:00
14:00
16:00
Scan Older
Scan Newer


Amiodarone bolus
This "cliff" marks a change in rhythm: Return to sinus rhythm with HR = 75
Atrial fibrillation appears
Sinus rhythm returns
Atrial fibrillation appears
Sinus rhythm returns
Sinus rhythm persists on amiodarone drip, heart rate slowly declines.
SPO2 / Respiration
Pressures
Graph Setup
Alarm Control
Alarm Histories
Graphic Trends
24 hrs
HR = 140
HR = 75
HR = 130
HR = 75
HR = 125
HR = 75
HR = 60
150
50
300
0
60
0
00
18:00
22:00
02:00
06:00
10:00
14:
Scan Older
Scan Newer

Is Non-ICU Monitoring a Potemkin Village?

"In the 18th century, Grigori Aleksandrovich Potemkin reportedly created elaborate fake village facades in the Ukraine and Crimea for Catherine the Great's tours, giving the illusion of prosperity. A 'Potemkin Village' is now defined as something that appears elaborate and impressive but in actuality lacks substance."

ACC Practice Guidelines

1991. **Recommended Guidelines for In-Hospital Cardiac Monitoring of Adults for Detection of Arrhythmia.** ACC Practice Guidelines. Emergency Cardiac Care Committee. JACC 18 (6):1431-3, 1991. It is useful to note that the ACC has not seen the need to update these guidelines, which are now 14 years old. It is reasonable to say that there have been substantial advances in our understanding of arrhythmias and monitoring since 1991. At least one of the Class I indications (monitoring for at least 24 hours after PCI) is probably ignored every day at every angioplasty center in the US.

1993. **Frequency of unfavorable cardiac events documented by routine telemetry monitoring after uncomplicated percutaneous transluminal coronary angioplasty**. Jones EB et al. Am J Cardiol 71:1229-1230, 1993. (Medical College of Virginia) Even in the pre-stent era, it was recognized that the vast majority of PCI complications occur in the catheterization laboratory or in the recovery room immediately post-angioplasty. Patients had a 24-hour Holter after PCI in addition to being monitored on a 40-bed step-down floor. "Staff registered nurses were expected to observe the monitors and to respond to all alarms in addition to their regularly assigned duties." Of 100 patients evaluated, there were no life-threatening arrhythmias. There were no arrhythmias discovered likely to have changed therapy (except for one patient with paroxysmal atrial fibrillation), and it appeared that the only arrhythmias detected were found by Holter monitor, not by telemetry.

1995. **Role of telemetry monitoring in the non-intensive care unit. Estrada CA. Am J of Cardiol** 76:960-965, 1995. (Henry Ford Hospital, Detroit) Prospective data collected on 2,240 patients admitted to a telemetry unit. Telemetry was "useful but did not alter management" in 5.7%, led to management change in 7%, 0.8% of all patients (=18 patients, 1/124 admits) were transferred to ICU due to telemetry findings. "**The role of telemetry in guiding patient management may be overestimated by physicians**, since it detected significant arrhythmias that led to change in medications or urgent interventions in a small fraction of patients."

1997. **Are monitored telemetry beds necessary for patients with nontraumatic chest pain and normal or nonspecific electrocardiograms? Hollander JE. Am J Cardiol 79:1110-1001, 1997**. (University Medical Center, Stony Brook, NY) Prospective observational study of 460 chest pain patients, of which 261 (the study group) had a normal or nonspecific electrocardiogram. No patient in the study group had an arrhythmia on telemetry that required treatment.

1997. **Effect of dedicated monitor watchers on patients' outcomes. Funk M. Am J Crit Care 6:318-323, 1997**. (Yale-New Haven Hospital) "In 55% of progressive care units, someone is assigned to watch the cardiac monitors at all times, but the effect of this practice on patients' outcomes has not been examined." 1185 patients were observed in 1993 when there was a monitor watcher on a telemetry unit, 1198 patients were observed in 1994 when there was no monitor watcher. There was no significant difference in mortality, or frequency of transfer to ICU. The monitor watcher detected fewer episodes of ventricular tachycardia, but more bradyarrhythmias. "The presence of a monitor watcher was not associated with lower rates of most adverse outcomes evaluated."

1998. **Arrhythmia detection and response in a monitoring technician and pocket paging system. Zweig FH. Prog Cardiovasc Nurs 13:16-22, 1998**. (St. Luke's Medical Center, Milwaukee) On a cardiac medical unit, a monitoring technician continuously observed rhythms. On a general medical unit, the monitoring technician was eliminated and a computer-interfaced pocket pager system was used for notifying the nurses of arrhythmias. 100-hour samples were taken from each unit. All arrhythmia events activated an alarm by the computerized arrhythmia detection system. Length of time to notify the nurse was within 0 to 1 minute for both systems. The no-monitor-technician approach was felt to be viable.

1998. **Telemetry outside critical care units: patterns of utilization and influence on management decisions. Chittur A. Clin Cardiol 21:503-505, 1998** (VA Hospital Oklahoma City, OU Medical School). 61 patients were evaluated to assess the contribution of EKG monitoring during their time on a telemetry floor. The ACC Guidelines for Cardiac Monitoring (1991) were assessed in relation to these patients. Only 4% of telemetry events resulted in patient management changes. None of the patients who had significant telemetry events were in ACC Class III. "Telemetry findings in patients outside the critical care units are not usually responsible for major therapeutic changes. **The value of telemetry in such patients may be overrated**."

2000. **Continuous electocardiographic monitoring and cardiac arrest outcomes in 8,932 telemetry ward patients. Schull MJ. Acad Emerg Med 7:687-688, 2000**. (University of Toronto) Of the 8932 patients, 20 (0.22%, **2.2 patients per thousand**) suffered cardiac arrest. Telemetry monitors signaled the onset of cardiac arrest in 56% of monitored arrests. 3 of the cardiac arrest patients survived to discharge, and in 2 of these the arrest was signaled by the monitor. This yields a monitor-signaled survival rate among telemetry ward patients of 0.022% (**2.2 patients per 10,000 were saved by telemetry**). "Routine telemetry offers little cardiac arrest survival benefit to most monitored patients, and a more selective policy for telemetry use might safely avoid ECG monitoring for many patients."

2000. **Does in-patient ECG monitoring have an impact on medical care in chronic heart failure patients? Opasich C. Eur J Heart Fail 2:281-5, 2000**. (Pavia, Italy) 711 patients admitted to a Heart Failure Unit from 3/96 to 9/97. Treatment was guided by telemetry results in only 33 cases (4.6% of this high-risk group). **Although physicians perceived telemetry as helpful in 70% of cases, "medical decisions are rarely guided by the telemetry findings."**

2000. **Evaluation of guidelines for the use of telemetry in the non-intensive-care setting. Estrada CA. J Gen Intern Med 15:51-55, 2000.** (Henry Ford Hospital, Detroit) 2,240 patients were studied prospectively upon admission to a telemetry unit. Telemetry detected an arrhythmia resulting in transfer to an intensive care unit in 0.4% (4 patients per thousand) in patients with an ACC Class I indication for monitoring, and 1.6% of patients with an ACC Class II indication. 0.4% of patients (**4 patients per thousand**) had sustained ventricular tachycardia or ventricular fibrillation. "These findings indicate that when the ACC guidelines are reexamined, consideration should be given to changing them so they are more useful in non-intensive-care settings." **Specifically, they proposed that patients with an initial diagnosis of arrhythmia be categorized as Class I and patients hospitalized with chest pain be categorized as Class II.**

2001. **Emergency department admission to inpatient cardiac telemetry beds: a prospective cohort study of risk stratification and outcomes. Lakshmi D. Am J Med 110:7-11, 2001**. (Cook County Hospital and Rush Medical College, Chicago) A prospective cohort study of 1033 consecutive adult patients admitted to an inpatient telemetry unit. 2 patients suffered cardiac arrest (0.2%, **2 patients per thousand**) **and both died in spite of CPR**. The prediction rule of Goldman was used to predict likelihood of major complications, and that rule was found to be effective.

2002. **Is telemetry monitoring necessary in low-risk suspected acute chest pain syndromes? Snider A. Chest 122:517-523, 2002.** (North Shore University Hospital, Manhasset, NY) 414 consecutive patients admitted with suspected acute coronary syndromes were studied. 3 patients died. Only 2% of patients were transferred to ICU. Patients with atypical chest pain, and normal ECG findings "represent a subset of patients with low risk for life-threatening arrhythmia. Use of telemetry monitoring in this subset of patients should be reevaluated." "It is perceived that telemetry provides a higher level of care than can be provided on a general ward. However, this level of care is maintained by an increased cost of nursing, telemetry technicians and equipment…Unnecessary admissions to telemetry translate into unnecessary added costs."

2002. **A nurse practitioner intervention model to maximize efficient use of telemetry resources. Gross PA. Jt Comm J Qual Improv 28:566-573, 2002**. (Hackensack University Medical Center, Hackensack, NJ) The demand for floating telemetry at Hackensack University Medical Center had equaled or exceeded the telemetry availability virtually 100% of the time, even after local guidelines had been disseminated in 1998. In the study, an Advanced Practical Nurse (identical to a nurse practitioner) carried out concurrent monitoring and intervened with the attending physician when patients were on telemetry for longer than 48 hours and did not meet the local telemetry guidelines. This resulted in mean hours monitored per patient declining from 65.2 to 49.6, a 34% decrease.

2002 Impact of a Clinical Decision Rule on Hospital Triage of Patients With Suspected Acute Cardiac Ischemia in the Emergency Department.

Reilly BM. (Cook County Hospital) *JAMA.* 2002;288:342-350.

Among patients admitted from the emergency department (ED) with possible acute cardiac ischemia, only one quarter are diagnosed with unstable angina or acute myocardial infarction (MI), and less than 5% experience a life-threatening complication. In this study of 1009 pts., a previously validated clinical decision rule was adopted as the standard of care in the ED. (Please see next slide for details of that rule.) The rule predicts major cardiac complications within 72 hours after evaluation in the ED and stratifies patients' risk of major complications into 4 groups—high, moderate, low, and very low—according to electrocardiographic findings and presence or absence of 3 clinical predictors in the ED. Use of the clinical decision rule had a favorable impact on physicians' hospital triage decisions. Efficiency improved without compromising safety. Use of the rule increased admissions to an observation unit, decreased telemetry bed admissions and had no effect on ICU admissions, compared with a run-in comparison period. <1% of Very Low Risk group patients (48% of the entire study group) had a major cardiac complication in the first 72 hours. (Among 300 consecutive R/O ischemic pain patients NOT included in this study, who were given a non-ischemic diagnosis and sent home from the ED, there were NO complications or deaths.)

2002. **Prognostic judgments and triage decisions for patients with acute congestive heart failure. Smith WR. Chest 121:1610-1617, 2002.** (Virginia Commonwealth University) 1032 patients admitted to a VA hospital with CHF. The observed prevalence of death or severe complications was 4.2%, but the admitting physicians' judgment of the probability of death or severe complications was 32%. Physicians consistently overestimated patient risk. "**Physicians drastically overestimated the probability of a severe complication** that would require critical care for patients with acute CHF who were candidates for ICU admission."

2002 **Physicians' judgments of survival after medical management and mortality risk reduction due to revascularization procedures for patients with coronary artery disease. Poses RM. Chest 122:122-133, 2002**. (Brown University) At conferences conducted in 1996-1997, the authors acquired 164 physician surveys to determine their estimate of survival rate with medical therapy, CABG and PTCA for 2-vessel and 3-vessel coronary artery disease. Physicians tended to be excessively pessimistic about medical therapy and overly optimistic about CABG and PTCA. It was speculated that these attitudes were in part reflective of the public's attitude that revascularization is life-saving, which has been promoted in a variety of celebrity reports of saved life after revascularization (e.g., Dan Reeves, football coach). **It was also suspected that many physicians are unfamiliar with the quantitative evidence** regarding the effects of medication and revascularization therapies on life expectancies in coronary artery disease. There is a tendency to believe that "bigger is better" or "more is more", when in fact that is not always the case.

2004 Lack of utility of telemetry monitoring for identification of cardiac death and life-threatening ventricular dysrhythmias in low-risk patients with chest pain.
Hollander JE. Hospital of the University of Pennsylvania.
Ann Emerg Med. 2004 Jan;43(1):71-6.

A prospective cohort study of 1029 emergency department (ED) patients with chest pain with a Goldman risk score of less than 8%, a normal initial creatine kinase-MB level, and a negative initial troponin I level admitted to non-ICU monitored beds. (This was 59% of all chest pain telemetry admissions.) During hospitalization, there were **no** patients with sustained ventricular tachycardia/ventricular fibrillation requiring treatment on the telemetry service. There were 2 deaths: neither was cardiovascular in nature or preventable by monitoring. CONCLUSION: **The routine use of telemetry monitoring for low-risk patients with chest pain is of limited utility.**

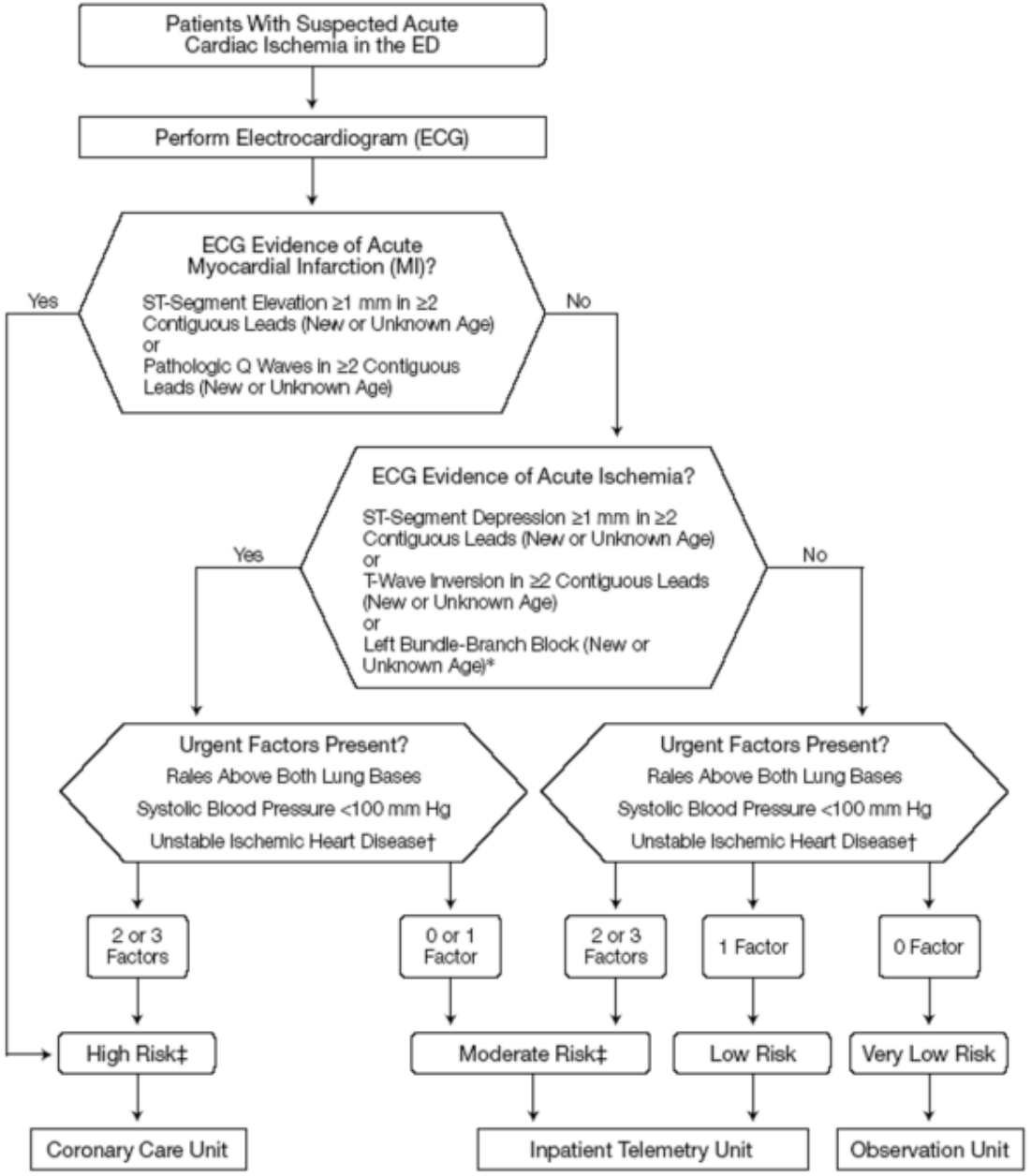
2006. Nadkarni VM et al. JAMA. 2006;295:50-57. (University of Pennsylvania and the National Registry of Cardiopulmonary Resuscitation Investigators.)

In a study of 36,902 adult in-hospital cardiac arrests and 880 pediatric in-hospital cardiac arrests, the prevalence of VF or pulseless VT as the first documented pulseless electrocardiographic rhythm was 14% in children and 23% in adults. (Cardiac arrests occurring in the delivery department, neonatal intensive care unit, and in the out-of-hospital setting were excluded.) Although these data support the authors' hypothesis that shockable rhythms are more common as initial cardiac arrest rhythms in adults than in children, they also indicate that ***most adult in-hospital cardiac arrests are not due to sudden shockable rhythms*** and many pediatric cardiac arrests are due to shockable rhythms.

Most cardiac arrests in both adults and children were not sudden "shockable" cardiac arrhythmias, VF or pulseless VT. ***Instead, most of these arrests were associated with progressive respiratory failure, circulatory shock, or both***. The prevalence of asystole was 40% (350) in children and 35% (13,024) in adults, whereas the prevalence of PEA was 24% (213) in children and 32% (11,963) in adults. Initial rhythm was undocumented in 23% of children's arrests and 10% of adult arrests.

In adults, the immediate cause(s) of the event included hypotension (44%), acute respiratory insufficiency (41%), arrhythmia (65%), metabolic and electrolyte disturbance (11%), airway obstruction (2%), acute pulmonary edema (3%), acute myocardial infarction or ischemia (11%), toxicological problem (1%), and acute pulmonary embolism (2%).

"Most in-hospital cardiac arrests in adults and children were due to preexisting conditions, progressive respiratory failure, or shock and not due to sudden cardiac arrhythmia."



*Modification to Goldman's prediction rule: Left bundle-branch block not known to be old was also considered evidence of ischemia on ECG.

†Unstable ischemic heart disease was defined as a worsening of previously stable angina, the new onset of postinfarction angina or angina after a coronary revascularization procedure, or pain that was the same as that associated with a prior MI.

Cardiology consultation in the ED (for possible admission to the coronary care unit) was recommended for patients stratified as high risk, which included patients who had experienced a major complication in the ED (e.g., cardiogenic shock).

‡Modification to Goldman's prediction rule: **Cardiology consultation** for possible coronary care unit admission was also recommended for 2 subgroups of patients: (1) patients stratified as moderate risk by the original prediction rule because they had acute pulmonary edema or ongoing angina despite maximal medical therapy in the ED, and (2) patients presenting with unstable angina within 2 weeks of acute MI or within 6 months of coronary revascularization. Patients stratified as moderate risk who also had a high probability of significant coronary artery disease (using the Diamond and Forrester criteria[25]) were recommended for **cardiology consultation**.

Reilly BM et al. (Cook County)
JAMA 288:342, 2002.

IHC Cardiovascular Clinical Program Guidelines for Diagnosis and Management of

Acute Coronary Syndrome (ACS)

presenting to the **LDS Hospital Emergency Department**

DIAGNOSIS *Assign patient to an ACS-probability category (1-4) based on signs and symptoms*

	❶ **STEMI** *ST-Elevation MI*	❷ **High-probability ACS** *Non ST-Elevation MI (NSTEMI) OR definite unstable angina (UAP)*	❸ **Moderate-probability ACS**	❹ **Low-probability ACS**
Symptoms?	Typical of ischemia/infarction	Strongly suggestive of ischemia/infarction	Strongly suggestive of ischemia	Suggestive—but atypical—for ischemia
EKG?	■ Ischemic ST elevation in 2 or more contiguous leads **OR** ■ Hyperacute T-waves **OR** ■ Signs of acute posterior MI **OR** ■ BBB obscuring ST segment analysis—with MI history	■ ST depression >1 mm or ■ Deep T-wave inversion	Normal or non-specific, with or without pain	Normal or non-specific, with or without pain
Cardiac enzymes? (CK-MBRI, troponin)	May or may not be elevated at 0 hours, typically elevated at 6 hours	■ If normal: Definite UAP ■ If elevated (with or without EKG changes): NSTEMI	Normal at 0, 6, 12, and 24 hours	Normal at 0 and 6 hours
High-risk indicators for adverse CV event? *Presence of risk indicators may warrant moving patient to a higher ACS-probability category.*	■ Anteroseptal MI ■ Hypotension, cardiogenic shock ■ ST changes of inferoposterolateral MI ■ RV infarction ■ New significant arrhythmia or heart block ■ Heart failure ■ Age >75	■ Hypotension ■ Dynamic EKG changes with pain ■ Prolonged ischemic pain or recurrent pain after initial relief ■ New significant arrhythmia or heart block ■ >2 anginal events within the prior 24 hours ■ Elevated troponin ■ Heart failure ■ Age >75	■ ≥3 traditional risk factors for CAD ■ Prior coronary stenosis >50% ■ Use of ASA within past 7 days ■ Recurrence of pain after initial relief ■ >2 anginal events within the prior 24 hours ■ Heart failure ■ Age >75	■ ≥3 traditional risk factors for CAD ■ Prior coronary stenosis >50% ■ Use of ASA within past 7 days ■ Recurrence of pain after initial relief ■ >2 anginal events within the prior 24 hours ■ Heart failure ■ Age >75

MANAGEMENT *Admit and treat patient based on ACS-probability category (1-4).*

	❶ STEMI *ST-Elevation MI*	❷ High-probability ACS *Non ST-Elevation MI (NSTEMI) OR definite unstable angina (UAP)*	❸ Moderate-probability ACS	❹ Low-probability ACS
Admit status	Cath Lab/CCU	CCU	Inpatient Telemetry	ER/Observation
Diagnostic/ therapeutic care	**Urgent Reperfusion** ■ Primary PCI in <90 minutes door-to-balloon time ■ Thrombolytic <30 minutes if primary PCI not available in <90 minutes ■ EKG and cardiac enzymes at 0, 6, 12, and 24 hours	■ EKG and cardiac enzymes at 0, 6, 12, and 24 hours ■ Lipids and hsCRP ■ Cath with LV function within 48 hrs (preferably <12 hours—immediately if ongoing pain)	■ EKG and cardiac enzymes at 0, 6, 12, and 24 hours ■ Lipids and hsCRP ■ If low-moderate risk: imaging stress test ■ If higher risk: cath/PCI within 48 hours (preferably <12 hours)—immediately if ongoing pain	EKG and cardiac enzymes at 0 and 6 hours
Initial medications/ treatment	■ ASA ■ Beta blocker ■ Morphine ■ NTG ■ O_2 ■ Eptifibatide if PPCI ■ Heparin (ACS dosage)	■ ASA ■ Beta blocker ■ Morphine ■ NTG ■ O_2 ■ Eptifibatide ■ Heparin (ACS dosage)	■ ASA ■ Beta blocker ■ Morphine ■ NTG ■ O_2 ■ Lovenox 1 mg/kg SCQ BID	Medications as indicated
Adjunct care	■ Statin ■ ACEI (or ARB) when BP stable	■ Statin ■ ACEI (or ARB) when BP stable	■ Statin ■ ACEI (or ARB) when BP stable	As indicated
Subsequent care	■ If primary PCI: Eptifibatide ■ If thrombolytic: Cath <24 hours ■ If ongoing pain: "Rescue" PCI ■ If pain-free: Cath 24-48 hours ■ Clopidogrel for >3-6 months after PCI/CABG	Clopidogrel for >3-6 months after PCI/CABG	Clopidogrel for >3-6 months after PCI/CABG	■ If low-moderate risk, and stable vital signs: Consider discharge and imaging stress test within 72 hours ■ If higher risk: Imaging stress test before release or within 48 hours

Last updated June 30, 2004

1975 **Pascal's wager and the hanging of crepe. Siegler M. NEJM 293:853-857, 1975**. (University of Chicago) Hanging of crepe refers to one type of strategy employed by physicians in communicating prognoses to families of critically ill patients. This approach offers the bleakest, most pessimistic prediction of the patient's outcome, presumably in an effort to lessen the family's suffering if the patient dies of his illness. Certain similarities exist between this technique and that used by Pascal, the 17th-century philosopher, in formulating his wager on the belief in God, in that both attempt to develop "no-lose" strategies, in which chances for "winning" are maximized. A detailed analysis of these strategies indicates that neither is truly "no-lose," and that both contain inherent disadvantages. Prognostication, an alternative approach to physician-family communication, appears to be strategically and morally superior to the hanging-of-crepe strategy.