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Clinical paper

# The impact of telemetry on survival of in-hospital cardiac arrests in non-critical care patients☆

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ABSTRACT

*Objective:* Since the introduction of telemetry over a half century ago, it has expanded to various units and wards within health care institutions outside of the traditional critical care setting. Little is known on whether routine telemetry use is beneficial in this patient population. The aim of this study was to determine the impact of telemetry monitoring on survival of in-hospital cardiac arrests in patients admitted to non-critical care units.

*Methods:* A retrospective study of cardiac arrests in patients admitted to non-critical care units within the Winnipeg Regional Health Authority from 2002 to 2006 inclusive was performed. Baseline demographic, cardiac arrest, and outcome data were collected.

*Results:* Of the total 668 patients, the mean age was 70 ± 14 years with 404 (61%) males. Patients presenting with asystole or pulseless electrical activity (PEA) demonstrated an increased mortality as compared to those presenting with ventricular tachycardia (VT) or ventricular fibrillation (VF). Overall, 268 of 668 patients (40%) survived their initial arrest, 66 (10%) survived to hospital discharge and 49 (7%) survived transfer to another facility. Patients on telemetry vs. no telemetry had higher survival rates immediately following cardiac arrest (66% vs. 34%, OR = 3.67, $p = 0.02$), as well as higher survival to hospital discharge (30% vs. 6%, OR = 7.17, $p = 0.01$). Finally, patients with cardiac arrest during the night and early morning benefited proportionally the greatest from telemetry use.

*Conclusion:* Regardless of whether cardiac arrest was witnessed or unwitnessed, telemetry use was an independent and strong predictor of survival to hospital discharge.



## 1. Introduction

Coronary artery disease is the leading cause of sudden cardiac death, with approximately 45,000 cardiac arrests occurring in Canada each year [1,2]. While ventricular arrhythmias are the most common arrhythmias associated with sudden death, both ventricular tachycardia (VT) and ventricular fibrillation (VF) have a greater rate of survival as compared to pulseless electrical activity (PEA) or asystole [3]. Immediate recognition and defibrillation of a ventricular arrhythmia is associated with survival rates up to 75%, with a 10% decrease in chance of survival for every minute that defibrillation is delayed [4]. Cardiac monitoring is expected to offer the opportunity to immediately recognize life threatening arrhythmias in unwitnessed cardiac arrests and improve the rate of survival [5].

Continuous electrocardiographic monitoring, or telemetry, has been utilized in coronary care units (CCU) since the 1960's [6], contributing to a 30% reduction in mortality rates.[3] This decrease in mortality is largely due to the development of external defibrillators and the ability to quickly recognize arrythmias by specially trained staff. Since the introduction of telemetry use, it has expanded to various units and wards within health care institutions outside of the traditional critical care setting. Cardiac monitoring in these non-critical care units is frequently used in patients with suspected ischemic heart disease and increased risk of arrhythmias, and to decrease the demand for beds in intensive care and coronary care units [5]. Little is known, however, on whether current routine telemetry use is beneficial in non-critical patients with cardiac arrests outside of the critical care setting [3,7,8].

A delay in cardiac defibrillation decreases the chance of survival to discharge from hospital after a cardiac arrest [9]. Although

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patients with un-witnessed cardiac arrests have a significant increase in mortality rates as compared to those with witnessed arrests, telemetry use may improve the chance of survival in both groups of patients [8]. The objective of the current study was to determine the impact of telemetry monitoring on survival of in-hospital cardiac arrests in patients admitted to non-critical care units.

## 2. Methods

### 2.1. Patient population

A retrospective review of all in-hospital cardiac arrests in patients admitted to the Winnipeg Regional Health Authority (WRHA) hospitals from 2002 to 2006 inclusive was performed. The WRHA acute care facilities included six teaching hospitals, two of which are tertiary care centers, including Health Sciences Centre and St. Boniface General Hospital. These six hospitals provide the majority of tertiary care support for Manitoba, Northwestern Ontario, and Nunavut. Of the total 2150 beds, 97 (4.5%) have telemetry monitoring capabilities.

### 2.2. Study approval

The study protocol was approved by the University of Manitoba research ethics board H2004:031.

### 2.3. Inclusion and exclusion criteria

The inclusion criteria of the study were as follows: individuals >18 years of age; admitted to one of six acute care facilities within the WRHA between 2002 and 2006; and were in any non-critical care patient care unit with a cardiac arrest code (ICD 9 code 427.5). Hospital areas which had both monitored and unmonitored beds were otherwise included, including the emergency rooms (ER's) and the cardiology wards. The catheterization lab, operating rooms, intensive care unit (ICU) and coronary care unit (CCU) were all part of the exclusion criteria for the current study as telemetry monitoring was routinely used in these areas. Additional exclusion criteria included: less than 18 years of age; false alarms, elective cardioversions; do not resuscitate (DNR) cases.

### 2.4. Definitions

The standard definition for resuscitation and documentation per the Utstein report was used [10]. Cardiac arrest was defined as a sudden cessation of cardiac function, precipitated by VT, VF, PEA or asystole [3–5,7]. Ventricular fibrillation was defined as the need for any defibrillator shock [3–5,7].

### 2.5. Demographics

During each cardiac arrest within the WRHA, there is a designated nurse at the time of the cardiac arrest who is responsible for charting the events. The data was collected by a trained abstractor who recorded data for the research project (Appendix I). Patient charts and Code Blue resuscitation records were reviewed to obtain the applicable information. Data collection information included: age and sex of patient; patient care area where the arrest occurred; and if the patients were monitored pre-arrest. The cardiac arrest information included: date and time when the Code Blue was called to the time of arrival of the resuscitation team; and the initial cardiac rhythm. Outcome data recorded included the proportion of patients following cardiac arrest admitted to the ICU; the proportion that survived to hospital discharge; and the disposition of survivors. The data was collected using a specially designed data collection form, based on American Heart Association Guidelines for reporting of in-hospital resuscitation [10]. The cardiac arrests were run either by members of the critical care team or ER team depending on the hospital and the location of the arrest. The critical care team or ER members at each individual hospital would include an ICU/ER attending, fellows, residents, nursing and respiratory technicians.

### 2.6. Statistics

Data entry and analysis was performed using Microsoft Access and Statistical Analysis System 8.01 (SAS Institute, Cary, NC). Data were expressed as mean (standard deviation) or number (percentage). Using $2 \times 2$ contingency tables, statistical analysis was performed using either Chi-Square or Fisher exact probability test to test for differences of proportions. Multiple regression analysis was used to adjust for different variables. Results were considered significant if the p value was less than 0.05.

## 3. Results

Of the total 2267 cardiac arrests recorded within the WRHA between 2002 and 2006, 668 patients fulfilled the inclusion criteria (Fig. 1). The baseline population characteristics are listed in Table 1. The mean age was $70 \pm 14$ years with 404 (61%) males. Cardiac arrests occurred more frequently on the medical (59%) and surgical (21%) wards, specifically in elderly male patients over the age of 70 (42%). Overall, 268 of 668 patients (40%) survived their initial arrest. In 61 (9%) patients, there was no documented rhythm at the time of the cardiac arrest. Only 66 (10%) survived to hospital discharge and 49 (7%) survived to transfer to another facility outside the WRHA including personal care homes and rehabilitation facilities. A total of 356 (53%) arrests were described as witnessed.

The survival data among cardiac arrests on telemetry as compared to arrests not on telemetry is summarized in Tables 2 and 3. Out of the total 668 patients, 122 (18%) were on telemetry and 544 (81%) were not monitored. Patients on telemetry had higher survival rates immediately following cardiac arrest (65.6% vs. 34.2%, OR = 3.67, $p = 0.02$), as well as higher survival to hospital discharge (29.5% vs. 5.5%, OR = 7.17, $p = 0.01$). At the time of cardiac arrest, the most common initial rhythm was either PEA (34.4%) or asystole (37.4%), while VT/VF only accounted for 19.2% of cases. Patients with initial VT/VF on telemetry were more likely to survive to discharge than patients without telemetry (Table 2). Although there was no difference in overall survival rate when stratifying weekday vs. weekend arrest, patients on telemetry were more likely to survive than those not on telemetry (Table 3, Fig. 2). Finally, patients with cardiac arrest during the night and early morning (23:30–07:30) appeared to benefit proportionally the greatest from

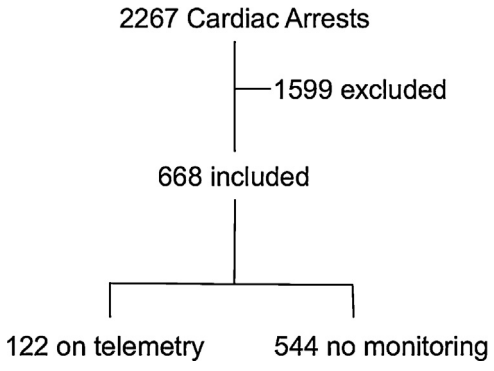


**Fig. 1.** Study population.