

# Quality of resuscitation in hospitals

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## ABSTRACT

**There is relatively less literature available on in-hospital cardiac arrest (IHCA) as opposed to that of out-of-hospital cardiac arrest (OHCA). Although IHCA and OHCA patients may differ at baseline, they share similar factors that are associated with survival. Important variables need to be standardised for reporting. Principles such as the ‘chain of survival’ remain applicable in the response. Early escalation protocols and medical emergency teams, together with streamlined activation pathways and staff training, are crucial. Post-resuscitation care bundles should be implemented.**

**Keywords:** cardiac arrest, in-hospital, outcomes, prognosis, quality

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## INTRODUCTION

It has been 50 years since the introduction of cardiopulmonary resuscitation (CPR). Despite the many advances in CPR, the outcomes remain modest, with limited improvement over the years.<sup>(1,2)</sup> Patients suffering an in-hospital cardiac arrest (IHCA) episode represent a special group who has both similarities and differences with out-of-hospital cardiac arrest (OHCA) patients.

A fundamental difference between IHCA and OHCA patients is that former, having been hospitalised for various reasons, are more likely to have multiple pathologies, increased comorbidities and a reduced incidence of ventricular fibrillation (VF).<sup>(3,4)</sup> OHCA patients, however, are more likely to be well in the community just prior to the time of the cardiac arrest. Exceptions are recognised, such as a patient who is fit for discharge but is still in hospital for social reasons, or an ill patient who is terminally discharged with the expectation that he will pass away at home. On the other hand, some studies suggest that patients suffering an IHCA have a better chance of survival owing to better access to resuscitation and care,<sup>(5,6)</sup> whereas OHCA patients are still subject to a pre-hospital period where the quality of care delivered may be less predictable.

## EPIDEMIOLOGY

The incidence of IHCA in Singapore is unknown. In the

only published study of IHCA in Singapore in 1998, Lee reported that 38% of the 137 patients with cardiac arrests in general wards had return of spontaneous circulation (ROSC) and admission to intensive care unit, with only 10% ultimately surviving.<sup>(7)</sup> However, the study had focused only on arrests in general wards treated by a code team. Modest progress was seen in the ten years following Lee’s study. Leong et al reviewed all IHCA cases in a single hospital from June 2008 to June 2009, and reported 1,359 cardiac arrests in 1,219 patients during the study period. Resuscitation was attempted for 360 cardiac arrest events (occurring in 290 patients). ROSC occurred in 185 events (51.4%), and 38 patients (13.1%) survived to discharge.<sup>(8)</sup> These outcomes are similar to the findings of the National Registry of CPR study in the USA,<sup>(3)</sup> which also found the three most common causes of IHCA to be cardiac arrhythmia, acute respiratory insufficiency and hypotension. To date, there has been no published hospital-wide data for IHCA, let alone multicentre data, for Singapore.

## MEASURING RESUSCITATION IN HOSPITALS

The quality of in-hospital resuscitation cannot be assessed without standardised definitions and guidelines. In 1994, Ballew et al demonstrated that differences in definitions of cardiac arrest would result in different rates of survival being reported. This was clearly a call for standardised reporting of cardiac arrest data.<sup>(9)</sup> Cummins et al then developed a common set of reporting guidelines for in-hospital resuscitation according to the Utstein style.<sup>(10)</sup> This was subsequently revised in 2006 by Jacobs et al, with refined definitions of 29 core variables.<sup>(11)</sup>

Some of the important definitions are excerpted below:

- ‘Cardiac arrest’ has been defined as “the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation”.
- ‘ROSC’ is defined as when there is a palpable pulse (or systolic blood pressure  $\geq$  60 mmHg if invasive monitoring is being used) for at least 30 seconds. For IHCA, if the patient has had ROSC for  $>$  20 minutes, that is defined as ‘sustained ROSC’, and the patient is deemed to have ‘survived the event’.
- ‘End of event’ is defined as “when death is declared or spontaneous circulation is restored and sustained for 20 minutes or longer. If extracorporeal life support is being provided, then the end of event is 20 minutes

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after extracorporeal circulation has been established”.

- ‘Survival to hospital discharge’ is defined as “the point at which the patient is discharged from the hospital’s acute care unit regardless of neurological status, outcome or destination”.
- ‘Neurological outcomes’ at discharge from hospital should be reported, and the Cerebral Performance Category is a commonly used score to this end.

A proper registry of well-collected cardiac arrest data is vital to getting a better handle of in-patient cardiac arrests.<sup>(3)</sup> However, many barriers remain, preventing good documentation for in-hospital resuscitation.<sup>(12)</sup> In particular, time interval documentation has been found to be especially challenging.<sup>(13)</sup>

### FACTORS ASSOCIATED WITH SURVIVAL

Various factors have been studied in relation to survival from IHCA. These may be grouped into ‘patient factors’ and ‘event factors’.

#### Patient factors

*Age:* Increased age has been found in several studies to be associated with poorer outcomes.<sup>(7,14)</sup>

*Gender and ethnicity:* Most studies do not find any difference in survival for gender.<sup>(14)</sup> Outcomes based on race in Singapore are unknown at present.

*Pre-existing illness and comorbidities:* Sepsis, renal failure, stroke and cancer have been reported to be associated with increased mortality.<sup>(15-17)</sup> However, attempts at prognosticating outcomes have not been met with much success. The Pre-Arrest Morbidity score, Prognosis After Resuscitation score, as well as APACHE II and III scores all have only limited predictive value, and cannot be reliably used to guide resuscitation decisions.<sup>(18-20)</sup>

#### Event factors

*Initial rhythm:* Shockable rhythms such as VF or pulseless ventricular tachycardia (VT), as with OHCA, are typically associated with greater survival, as compared with non-shockable rhythms like asystole or pulseless electrical activity.<sup>(3,21,22)</sup> Unfortunately, only about a quarter of IHCAs have an initial rhythm that is VF or pulseless VT.<sup>(21)</sup>

*Response timings and intervals:* The oft-quoted ‘chain of survival’ for OHCA remains just as applicable for IHCA, and includes early recognition and access, early CPR, early defibrillation, early advanced and post-resuscitation care. Accordingly, early CPR<sup>(23)</sup> and defibrillation<sup>(3)</sup> have both been demonstrated to be associated with improved survival outcomes for IHCA.

*Circadian rhythm:* In a study by d’Avila et al, data stored in automated implantable cardiac defibrillators showed that

more shocks were delivered in the early morning,<sup>(24)</sup> while Herlitz et al<sup>(23)</sup> found that survival after office hours was poorer.

*Setting:* Smith et al found differing survival patterns of IHCA in different wards.<sup>(25)</sup> In a study from Taiwan, wards with more than five cardiac arrests per year were found to have better survival rates.<sup>(26)</sup> Herlitz et al found in his study that patients in monitored areas had a better rate of survival to discharge (43.2% vs. 31.1%).<sup>(27)</sup>

### IMPROVING THE QUALITY OF HOSPITAL RESUSCITATION

This should be multi-pronged, with efforts targeting all the rings in the chain of survival.

#### Early identification and access

Efforts to improve the quality of resuscitation should begin with identification of the unstable patient even before the cardiac arrest takes place. Ill patients should be identified early, have resuscitation plans or end of life discussions conducted and transferred to monitored settings in a timely fashion. In a study of 150 patients in a single centre, about two-thirds of patients had documented deterioration in condition about six hours prior to the cardiac arrest.<sup>(28)</sup> Early escalation protocols must be set in place so as to identify and act on patients whose condition is worsening. Medical Emergency Teams have been tried, but the results have been mixed.<sup>(29,30)</sup>

#### Quality of CPR

Good quality CPR is paramount in resuscitating cardiac arrest patients. In a study by Abella et al,<sup>(31)</sup> the quality of CPR by hospital providers was found to be inconsistent, often failing to meet recommended guidelines. Compression rates tended to be inadequate, while hyperventilation was common. Mechanical CPR devices hold promise for possibilities to increase survival,<sup>(32)</sup> and they have the advantage of consistent delivery of CPR that meets guidelines without fatigue. Operational issues, such as time to set up in order to minimise delays in starting CPR, will need to be addressed with team training.<sup>(33)</sup>

#### Post-resuscitation care

A post-resuscitation care bundle has been proposed,<sup>(34)</sup> comprising the following: early coronary reperfusion and haemodynamic optimisation; control of ventilation to avoid hyperventilation or hyperoxygenation; blood glucose control to avoid hyperglycaemia; temperature control and therapeutic hypothermia; and treatment of seizures. These are now recognised to be important in the management of the newly recognised entity dubbed the “Post Cardiac Arrest

Syndrome".<sup>(35)</sup> In particular, therapeutic hypothermia, now established in the post-resuscitation care of the OHCA survivor, is believed to improve neurological recovery and survival for IHCA patients as well.<sup>(36)</sup>

### Organisation and training

The organisation of the hospital response to a cardiac arrest event is heavily reliant on people. Although not conclusively proven to lead to improved outcomes, well-exercised workflows and activation pathways with clear task allocation are critical.<sup>(37,38)</sup> A non-randomised trial has found that the appointment of a resuscitation training officer was associated with improved survival.<sup>(39)</sup>

### CONCLUSION

Much is already known about factors associated with survival. Many antecedents to IHCA are actually preventable, but despite these advances, there remains much to be done to improve the quality of in-hospital resuscitation. Good quality data is crucial in guiding future efforts and should be a starting point from which our efforts may be measured.

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