



Editorial

Variation in epidemiology and outcomes from cardiac arrest



Obtaining a clear and consistent picture of the epidemiology and outcomes of a health condition is important for understanding the burden of the disease and studying the effectiveness of public health and clinical interventions. Such information is also essential for ensuring healthcare resources are used in the most effective ways. Epidemiological studies examining the incidence and outcomes of cardiac arrest show wide variations between and within countries.^{1–3} A recent systematic review of 67 prospective studies reported the incidence of EMS attended cardiac arrest varying from 20 to 186 per 100,000 person years.³ Similar variation is observed in long term survival rates with some settings reporting overall survival rates of 1–5%³ and others reporting survival in between 20 and 25%.^{4,5}

Describing the epidemiology of cardiac arrest is challenging. Cardiac arrest is not a disease in itself, but the final (often fatal) outcome of another disease process (e.g. ischaemic heart disease, trauma, asphyxiation). System level variables such as the threshold between when an attempt at resuscitation is considered viable or futile may have a profound impact in incidence and outcomes.⁶ Systems that resuscitate all cases of cardiac arrest are likely to have a higher numbers of cases and lower survival than those who have processes to withhold resuscitation when life is extinct.⁷ Whether cases successfully treated by public access defibrillation prior to EMS arrival are included in a registry may also influence event and survival rates.

In an attempt to improve standardisation of cardiac arrest reporting, a group of representatives from the American Heart Association, European Resuscitation Council, Heart and Stroke Foundation of Canada and the Australian Resuscitation Council met in Utstein Abbey in 1991 to establish uniform terms and definitions for out-of-hospital resuscitation.⁸ The outputs from this meeting, a list of standardised definitions and a standardised reporting template, became known collectively as the Utstein style for reporting out-of-hospital cardiac arrest. The original Utstein report focused on a core group of bystander witnessed cardiac arrest due to ventricular fibrillation/tachycardia of a presumed cardiac cause. In 2004, the core reporting group was revised to focus on Emergency Medical Service (EMS) treated cardiac arrests in recognition of the reducing incidence of VF and the influence that the EMS response interval would affect the proportion of cases in an initially shockable rhythm.⁹

The observation of variation in health outcomes is neither new nor limited to cardiac arrest. Lilford¹⁰ described that the variation (V) in outcomes can be expressed as the relationship

between $V(\text{definitions/data quality}) + V(\text{case-mix}) + V(\text{clinical quality of care}) + V(\text{chance})$. He goes on to suggest a hierarchical approach to exploring sources of variation starting with a review of data definitions, collection processes and data quality. Despite the wide adoption of the Utstein style^{11–13} relatively little research has taken place to formally evaluate its implementation or interpretation by different registries.

In this edition of Resuscitation, Nishiyama and colleagues go some way to filling that gap by reporting a retrospective evaluation of the process and comprehensiveness of data collection from 13 registries covering 265 EMS agencies in 13 countries.¹⁴ Each registry provided information about its structure, the data collected and a sample of anonymised patient data. The findings of the study provide valuable insights into the degree of international variability in data collection processes.

Although all registries were asked to contribute data over a 5-year period, the actual period of data submission ranged from 1 to 5 years. This could introduce bias if survival rates changed over the study period. The definition of a case varied with 5 registries including only EMS treated arrests whilst 7 included EMS assessed and/or treated cases. Eleven registries included patients treated initially by a bystander with an AED and one registry excluded patients whose cardiac arrest was traumatic in origin.

There was evidence of variation in case ascertainment processes which may introduce selection bias and lead to systematic differences between the populations of patients being evaluated in registries.¹⁵ Based on the registries estimated annual case load reported in Table 1 the number of cases submitted for analysis as a proportion of total cases ranged from 36% to 99%. Ten registries reported routinely searching for missing data of which nine updated the registry if missing cases were found. The processes for case ascertainment are not described in this report and may represent a further source of variation. In the UK we are aware of at least 5 different systems for case identification (manual search of paper records at ambulance stations, crew voluntary reporting, selection based on clinical coding, electronic search for key clinical variables, e.g. zero pulse, zero respiration, and interrogation of caller dispatch systems). As an example of the ascertainment bias this may introduce, EMS dispatch systems have a sensitivity of 60–70% for identifying cardiac arrest^{16–18} and correct identification may trigger telephone CPR instructors and more rapid EMS attendance.¹⁶ Thus reliance solely on caller dispatch systems for case identification would produce an incomplete population of patients with apparently better survival.

The quality and comprehensiveness of data also varied. The collection of core Utstein elements was modest with only 61.9% of registries collecting all core variables and only 42% collecting all core timed event variables. Most but not all registries periodically synchronised monitors/defibrillators to reduce variability in response time intervals. There was variation in how missing data were handled, with some registries combining not recorded and unknown into a single response. Overall unknown and missing data was on average 4.8% and 1.9% respectively. Whether any manual or statistical processes were employed for checking the accuracy of the data is not reported.

A final revealing feature of this report was the exclusion of 5 registries included in the initial invitation to participate due to their inability to collect outcome data. Tracking outcomes is an essential part of delivering quality assured healthcare, yet in many systems the lack of a joined up approach between EMS and hospitals is a significant barrier. The London Ambulance Service registry, as an example, has existed for 15 years.^{19,20} Despite comprehensive capture of EMS variables the process for obtaining outcome data is labour intensive and dependent on developing and maintaining personal relationships with 35 emergency departments to track patients survival status and no capacity to obtain neurological outcomes of patient reported outcomes. If the data flow between organisations was improved so that full outcome information was readily accessible, the clinical significance of EMS registries findings would be greatly enhanced. We commend Nishiyama's call for out of hospital cardiac arrest to be a reportable public health condition worldwide as a tool to enable all EMS providers to measure what they do and provide the data needed to drive improvements.

Overall this article reports both progress and scope for improvement: (a) progress through the development of an international network of investigators who are able and willing to work to a common framework and share data for collective good and (b) scope for improvement through highlighting gaps in the standardisation of case selection and breadth of data collection despite the use of a common reporting framework. Throughout 2012–2014 representatives from the International Liaison Committee on Resuscitation (ILCOR) have been working on updating the Utstein style definitions and reporting template. It is hoped that its publication within the next few months will go some way to fill some of the gaps identified in this paper.

Conflict of interest statement

The authors are members of the UK Out of Hospital Cardiac Arrest Outcomes Project Steering Committee. The views expressed are those of the authors.

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