Assess the prearrest risk factors among patients with in hospital cardiac arrest in a tertiary care teaching hospital

Akila Devi A¹, Sundaresan S², Kanniammal C¹
¹SRM College of Nursing, SRM Institute of Science and Technology, Kattankulathur, Chengelpet – 603 203, Tamil Nadu, India
²SRM Medical College and Research Centre, SRM Institute of Science and Technology, Kattankulathur, Chengelpet – 603 203, Tamil Nadu, India

Article History:
Received on: 02 Oct 2020
Revised on: 04 Nov 2020
Accepted on: 09 Nov 2020

Keywords:
In Hospital Cardiac Arrest, Prearrest factors, Pre-existing clinical conditions, Tertiary care

This study focused on the prearrest risk factors among patients with in hospital cardiac arrest. This was a prospective study with 50 cardiac arrest patients who fulfilled the inclusion criteria by using a purposive sampling technique. Data was collected on patient characteristics, pre-arrest factors with 18 years of age or above with an IHCA at the SRM General Hospital and Research Centre, Tamil Nadu from March 2019 to March 2020. Demographic variables categorized by frequencies with their percentages. Association was framed between demographic variables and Prearrest risk score was determined using Pearson chisquare test. 72% patients were men and 28% patients were women. 28% were in the age group of 51-60 years and around 50% patients were Obese. Patients with Myocardial Infarction were 84%. Metabolic and electrolyte abnormality were 90%, Arrhythmias were 62%, Diabetes Mellitus were 62% had an increased risk score to develop cardiac arrest than other patients with Renal problems, Heart failure, Sepsis, Pneumonia, Metastasis/Hematologic Malignancy, Depression, Hepatic Insufficiency. Early identification of prearrest factors should be encouraged to prevent cardiac arrest and to reduce the death rate in line with evidence-based studies.

INTRODUCTION

Utstein definition stated that cardiac arrest is a sudden stoppage of cardiac function that is absent pulse, absent or gasping breath and loss of consciousness (Sandroni et al., 2007). This study describes the basic characteristics, pre-arrest factors of patients with an IHCA at a tertiary care hospital.

Major research studies and meta analysis of rapid response systems in 41 hospitals described the occurrences of IHCA outside ICU’s is 3.66 /1000 adult admissions and 1.14 per 1000 pediatric admissions (Chan et al., 2010).

Cardiac arrest researches and cardiopulmonary resuscitation (CPR) has drastically increased in recent decades. Therefore, we sought to determine prearrest factors of an adult in patients with cardiac arrest at a tertiary hospital. (Ocen et al., 2015). Single-institution studies by using Utstein criteria have reported outsized variations in the incidence rates of adult IHCA, ranging from 3.8 to 13.1 per 1000 hospital admissions (Hodgetts et al., 2002; Motamedi et al., 2010).
Table 1: Demographic variables of patients with in hospital cardiac arrest

| Demographic variables     | Number of patients | of patients | Percentage |
|---------------------------|--------------------|-------------|------------|
| Age                       |                    |             |            |
| < 50 years                | 13                 | 26.0%       |
| 51 - 60 years             | 14                 | 28.0%       |
| 61 - 70 years             | 12                 | 24.0%       |
| > 70 years                | 11                 | 22.0%       |
| Gender                    |                    |             |            |
| Male                      | 36                 | 72.0%       |
| Female                    | 14                 | 28.0%       |
| Marital status            |                    |             |            |
| Married                   | 43                 | 86.0%       |
| Unmarried                 | 2                  | 4.0%        |
| Widow                     | 5                  | 10.0%       |
| BMI                        |                    |             |            |
| Obese                     | 26                 | 52.0%       |
| Non obese                 | 24                 | 48.0%       |
| Treatment for BP          |                    |             |            |
| Yes                       | 42                 | 84.00%      |
| No                        | 8                  | 16.00%      |
| Treatment for Diabetes    |                    |             |            |
| Yes                       | 25                 | 50.00%      |
| No                        | 25                 | 50.00%      |
| History of smoking        |                    |             |            |
| Never smoked              | 34                 | 68.00%      |
| Ex smoker                 | 11                 | 22.00%      |
| Current smoker            | 5                  | 10.00%      |
| Hours of sleep            |                    |             |            |
| < 6 hours                 | 12                 | 24.00%      |
| 6-8 hours                 | 19                 | 38.00%      |
| > 8 hours                 | 19                 | 38.00%      |
| History of alcoholism     |                    |             |            |
| Never consumed            | 28                 | 56.00%      |
| Current consumer          | 0                  | 0.00%       |
| Occasional drinker        | 19                 | 38.00%      |
| Regular drinker           | 3                  | 6.00%       |
| Do you experience         |                    |             |            |
| Snoring                   | 6                  | 12.00%      |
| Breathing difficulty      | 18                 | 36.00%      |
| Sleeplessness             | 9                  | 18.00%      |
| Interrupted sleep         | 17                 | 34.00%      |
| History of Fried food     |                    |             |            |
| Less than week            | 18                 | 36.00%      |
| 1-2 times a week          | 17                 | 34.00%      |
| 3-6 times a week          | 8                  | 16.00%      |
| Every day                 | 7                  | 14.00%      |
| Activities                |                    |             |            |
| Meditation/Prayer         | 17                 | 34.00%      |
| Yoga/Exercise             | 14                 | 28.00%      |
| Social activities         | 12                 | 24.00%      |
| Sports /Play with Pets    | 7                  | 14.00%      |
| Parents experience of     |                    |             |            |
| Heart Attack              | Yes                | 8           | 16.00%     |
|                           | No                 | 42          | 84.00%     |
MATERIALS AND METHODS

This was a prospective study. Data was collected from 50 In Hospital cardiac arrest patients who fulfilled the inclusion criteria by using purposive sampling technique. Data was collected on patient characteristics, pre-arrest factors with 18 years of age or above with an IHCA at the SRM General Hospital and Research Centre, Tamilnadu from March 2019 to March 2020. Demographic variables in categories were given in frequencies with their percentages. Prearrest risk score determined by mean and standard deviation. Association was framed between demographic variables and level of Prearrest risk score by using pearson chisquare test. Generalization of Prearrest risk score was calculated by using mean difference with 95% CI and proportion with 95% CI. All statistical tests are two tailed tests.

RESULTS

Table 1: shows that 36(72%) patients were men and 14 (28%) patients were women. More number of patients (28%) in the age group of 51-60years. Most of the patients were married ( 86%) and around fifty percent of patients were obese. 84% of the patients are taking treatment for Blood Pressure.50% of the patients are taking treatment for Diabetes Mellitus.68% of the patients are not having smoking habit.24% of the patients having sleep less than 6 hours.56% of the patients are not having habit of alcoholism.36% of the patients are having breathing difficulty.36% of the patients are having history of consuming fried foods less than a week.34% of the patients were performing medita- tion/prayer activities.16% of the patient’s parents experienced heart attack.

Table 2: shows that more number of patients (54%) were between 140-159 mm of Hg Systolic Blood Pressure. More number of patients (38%) were between 190-109 mm of Hg Diastolic Blood Pressure. More number of patients (38%) were between 200-239 mmHg Total cholesterol Level. Nearly 50% of patients (50%) were between 40-60 mmHg HDL Level. More number of patients (46%) were between 160-189 mmHg LDL Level. Two third of the patients (64%) were between 201-500 mmHg Triglycerides Level. The incidence of cardiac arrest parallels the load of cardiovascular illnesses, with cardiac arrest as the ground of death in >60% of patients with known coronary artery disease (Murugiah et al., 2014).

Table 3: shows the patients with Myocardial Infarction 42(84%), Metabolic and electrolyte abnormality 45(90%), Arrhythmias 31(62%), Diabetes Mellitus 31(62%) are having more increased risk score to develop cardiac arrest than other patients with Renal problems, Heart failure, Sepsis, Pneumonia, Metastasis/ Hematologic Malignancy, Depression, Hepatic Insufficiency, Stroke. (Figure 1: Represents the mean score of prearrest score and pre existing conditions)

The prevalence, outcomes and factors associated with adult in hospital cardiac arrests in a tertiary hospital. The prevalence of IHCA in the ICU was 34.5 % (95 % CI: 22.5–48.1 %), in operating theatres was 0.4 % (95 % CI: 0.2–0.8 %), and in the emergency wards was 3.0 % (95 % CI: 2.0–2.7 %). Trauma
Table 2: Clinical variables of patients with in hospital cardiac arrest

| Clinical variables          | Number of patients | %     |
|----------------------------|--------------------|-------|
| **Systolic BP (mmHg)**     |                    |       |
| < 80                       | 0                  | 0.00% |
| 80 -120                    | 0                  | 0.00% |
| 120 -139                   | 8                  | 16.00%|
| 140 -159                   | 27                 | 54.00%|
| 160 -180                   | 12                 | 24.00%|
| >180                       | 3                  | 6.00% |
| **Diastolic BP (mmHg)**    |                    |       |
| < 60                       | 0                  | 0.00% |
| 60 -79                     | 3                  | 6.00% |
| 80 -89                     | 5                  | 10.00%|
| 90 -99                     | 16                 | 32.00%|
| 100-109                    | 19                 | 38.00%|
| >110                       | 7                  | 14.00%|
| **Total cholesterol Level (mg/dl)** |            |       |
| < 200                      | 5                  | 10.00%|
| 200 -239                   | 28                 | 56.00%|
| >240                       | 17                 | 34.00%|
| **HDL (mg/dl)**            |                    |       |
| < 40                       | 20                 | 40.00%|
| 40-60                      | 25                 | 50.00%|
| >60                        | 5                  | 10.00%|
| **LDL (mg/dl)**            |                    |       |
| < 100                      | 0                  | 0.00% |
| 100 -129                   | 4                  | 8.00% |
| 130 -159                   | 17                 | 34.00%|
| 160 -189                   | 23                 | 46.00%|
| >190                       | 6                  | 12.00%|
| **Triglycerides (mg/dl)**  |                    |       |
| < 150                      | 7                  | 14.00%|
| 151-200                    | 32                 | 64.00%|
| 201-500                    | 11                 | 22.00%|
| >500                       | 0                  | 0.00% |

Table 3: Pre existing conditions of patients with in hospital cardiac arrest

| Pre existing conditions                               | N   | Yes % | No %  |
|-------------------------------------------------------|-----|-------|-------|
| Renal                                                 | 18  | 36.00%| 64.00%|
| Arrhythmias                                           | 31  | 62.00%| 38.00%|
| DM                                                    | 31  | 62.00%| 38.00%|
| Hypotension                                           | 25  | 50.00%| 50.00%|
| Heart Failure                                         | 18  | 36.00%| 64.00%|
| MI                                                    | 42  | 84.00%| 16.00%|
| Metabolic Electrolyte Abnormality                     | 45  | 90.00%| 10.00%|
| Sepsis                                                | 7   | 14.00%| 86.00%|
| Pneumonia                                             | 11  | 22.00%| 78.00%|
| Metastasis/ Hematologic Malignancy                    | 3   | 6.00% | 94.00%|
| Depression                                            | 4   | 8.00% | 92.00%|
| Hepatic Insufficiency                                 | 5   | 10.00%| 90.00%|
| Stroke                                                | 7   | 14.00%| 86.00%|
| Demographic variables          | Level of Prearrest risk factors | n   | Chi square test |
|--------------------------------|---------------------------------|-----|-----------------|
|                                | Decreased risk                  |     |                 |
|                                | N  | %    | Moderate risk   | N  | %    | Increased risk | N  | %    |
| Treatment for BP               | Yes | 33   | 78.57%          | 19.05% | 1  | 2.38%          | 42  | x²=1.89 |
|                                | No  | 6    | 75.00%          | 12.50%  | 1  | 12.50%         | P=0.39(NS) |
| Treatment for Diabetes         | Yes | 16   | 64.00%          | 32.00%  | 1  | 4.00%          | 25  | x²=6.70  |
|                                | No  | 23   | 92.00%          | 4.00%   | 1  | 2.38%          | 25  | P=0.05*(S) |
| History of smoking             | Never smoked                    | 27  | 79.41%          | 17.65%  | 1  | 2.94%          | 34  | x²=1.07  |
|                                | Ex smoker                       | 8   | 72.73%          | 18.18%  | 1  | 9.09%          | P=0.87 |
|                                | Treated for BP                  | Yes | 33   | 78.57%          | 19.05%  | 1  | 2.38%          | 42  | x²=1.89  |
|                                | No                            | 6   | 75.00%          | 12.50%  | 1  | 12.50%         | P=0.39(NS) |
| History of Diabetes            | Yes | 16   | 64.00%          | 32.00%  | 1  | 4.00%          | 25  | x²=6.70  |
|                                | No                            | 23  | 92.00%          | 4.00%   | 1  | 2.38%          | 25  | P=0.05*(S) |
| History of smoking             | Never smoked                    | 27  | 79.41%          | 17.65%  | 1  | 2.94%          | 34  | x²=1.07  |
|                                | Ex smoker                       | 8   | 72.73%          | 18.18%  | 1  | 9.09%          | P=0.87 |
| History of alcoholism          | Never consumed                  | 24  | 85.71%          | 14.29%  | 0  | 0.00%          | 28  | x²=14.68 |
|                                | Current consumer                | 1   | 100.00%         | 0.00%   | 0  | 0.00%          | 28  | x²=14.68 |
|                                | Occasional Drinker              | 15  | 78.95%          | 21.05%  | 0  | 0.00%          | 19  | x²=14.68 |
|                                | Regular Drinker                 | 0   | 0.00%           | 100.00% | 0  | 0.00%          | 19  | x²=14.68 |
| Do you experience              | Snoring                        | 3   | 50.00%          | 33.33%  | 1  | 16.67%         | 6   | x²=8.52  |
|                                | Breathing difficulty            | 12  | 66.67%          | 27.78%  | 1  | 5.56%          | P=0.20 |
| History of Fried food          | Sleeplessness                   | 8   | 88.89%          | 11.11%  | 0  | 0.00%          | 9   | (NS)     |
|                                | Interrupted Sleep              | 16  | 94.12%          | 5.88%   | 0  | 0.00%          | 17  | (NS)     |
|                                | Less than week                 | 14  | 77.78%          | 22.22%  | 0  | 0.00%          | 18  | x²=4.31  |
|                                | 1-2 times a week               | 14  | 82.35%          | 17.65%  | 0  | 0.00%          | 14  | x²=4.31  |
| Activities                     | 3-6 times a week               | 7   | 87.50%          | 12.50%  | 0  | 0.00%          | 8   | (NS)     |
|                                | Every day                      | 4   | 66.67%          | 33.33%  | 0  | 0.00%          | 14  | (NS)     |
|                                | Meditation/Prayer              | 13  | 76.47%          | 23.53%  | 0  | 0.00%          | 16  | x²=4.84  |
|                                | Yoga/Exercise                  | 11  | 78.57%          | 21.43%  | 0  | 0.00%          | P=0.57(NS) |
|                                | Social activities              | 8   | 66.67%          | 33.33%  | 0  | 0.00%          | 12  | (NS)     |
|                                | Sports / Play with Pets        | 7   | 100.00%         | 0.00%   | 0  | 0.00%          | 7   | (NS)     |
| Parents experience             | Yes                           | 6   | 75.00%          | 25.00%  | 0  | 0.00%          | 8   | x²=0.65  |
|                                | No                            | 33  | 78.57%          | 16.67%  | 2  | 4.76%          | P=0.72(NS) |
| Heart Attack                   | Yes                           | 6   | 75.00%          | 25.00%  | 0  | 0.00%          | 8   | x²=0.65  |
|                                | No                            | 33  | 78.57%          | 16.67%  | 2  | 4.76%          | P=0.72(NS) |
## Table 5: Association between prearrest risk factors and the clinical variables

| Clinical variables        | Level of Prearrest risk factors | N   | %   | Decreased risk | Moderate risk | Increased risk | N   | %   | Chi square test |
|--------------------------|--------------------------------|-----|-----|---------------|---------------|---------------|-----|-----|----------------|
|                          |                                |     |     |               |               |               |     |     |                |
| **Systolic BP (mmHg)**   |                                |     |     |               |               |               |     |     |                |
| < 80                     | 0                              | 0   | 0.00% | 0             | 0.00%         | 0             | 0   | 0.00% | $x^2=14.74$ |
| 80 - 120                 | 0                              | 0   | 0.00% | 0             | 0.00%         | 0             | 0   | 0.00% | $P=0.02*(S)$ |
| 120 - 139                | 8                              | 8   | 100.00% | 0             | 0.00%         | 0             | 8   | 0.00% |               |
| 140 - 159                | 24                             | 24  | 88.89% | 3             | 11.11%        | 0             | 27  | 0.00% |               |
| 160 - 180                | 7                              | 7   | 58.34% | 4             | 33.33%        | 1             | 12  | 8.33% |               |
| > 180                    | 0                              | 0   | 0.00% | 2             | 66.67%        | 1             | 33.33% | 3 |               |
| **Diastolic BP (mmHg)** |                                |     |     |               |               |               |     |     |                |
| < 60                     | 0                              | 0   | 0.00% | 0             | 0.00%         | 0             | 0   | 0.00% | $x^2=16.21$ |
| 60 - 79                  | 3                              | 3   | 66.67% | 0             | 0.00%         | 0             | 0   | 0.00% |               |
| 80 - 89                  | 5                              | 5   | 100.00% | 0             | 0.00%         | 0             | 0   | 0.00% | $P=0.05*(S)$ |
| 90 - 99                  | 14                             | 14  | 87.50% | 2             | 12.50%        | 0             | 16  | 0.00% |               |
| 100 - 109                | 15                             | 15  | 78.95% | 4             | 21.05%        | 0             | 19  | 0.00% |               |
| > 110                    | 2                              | 2   | 28.57% | 3             | 42.86%        | 3             | 28.57% | 7 |               |
| **Total cholesterol**    |                                |     |     |               |               |               |     |     |                |
| < 200                    | 3                              | 3   | 60.00% | 1             | 20.00%        | 1             | 20.00% | 5 | $x^2=4.68$ |
| 200 - 239                | 23                             | 23  | 82.14% | 4             | 14.29%        | 1             | 3.57% | 28 | $P=0.32(\text{NS})$ |
| > 240                    | 13                             | 13  | 76.47% | 4             | 23.53%        | 0             | 0.00% | 17 |               |
| **HDL (mg/dl)**          |                                |     |     |               |               |               |     |     |                |
| < 40                     | 16                             | 16  | 80.00% | 4             | 20.00%        | 0             | 0.00% | 20 | $x^2=6.94$ |
| 40 - 60                  | 21                             | 21  | 84.00% | 3             | 12.00%        | 1             | 4.00% | 25 | $P=0.14(\text{NS})$ |
| > 60                     | 2                              | 2   | 60.00% | 2             | 40.00%        | 1             | 20.00% | 5 |               |
| **LDL (mg/dl)**          |                                |     |     |               |               |               |     |     |                |
| < 100                    | 0                              | 0   | 0.00% | 0             | 0.00%         | 0             | 0.00% | 0 | $x^2=6.85$ |
| 100 - 129                | 2                              | 2   | 50.00% | 1             | 25.00%        | 1             | 25.00% | 4 | $P=0.33(\text{NS})$ |
| 130 - 159                | 14                             | 14  | 82.35% | 2             | 11.76%        | 1             | 5.88% | 17 |               |
| 160 - 189                | 18                             | 18  | 78.26% | 5             | 21.74%        | 0             | 0.00% | 23 |               |
| > 190                    | 5                              | 5   | 83.33% | 1             | 16.67%        | 0             | 0.00% | 6 |               |
| **Triglycerides (mg/dl)**|                                |     |     |               |               |               |     |     |                |
| < 150                    | 4                              | 4   | 57.14% | 2             | 28.57%        | 1             | 14.29% | 7 | $x^2=3.34$ |
| 151 - 200                | 26                             | 26  | 81.25% | 5             | 15.63%        | 1             | 3.13% | 32 | $P=0.50(\text{NS})$ |
| 201 - 500                | 9                              | 9   | 81.82% | 2             | 18.18%        | 0             | 0.00% | 11 |               |
| > 500                    | 0                              | 0   | 0.00% | 0             | 0.00%         | 0             | 0.00% | 0 |               |

was considered to be the most common diagnosis (58%) with 76.9 percent of all trauma cases were severe head injuries. Following Trauma, conditions like sepsis, heart disease, central nervous system disease, diabetes mellitus, hypertension and liver disease increases the chance of IHCA. Comorbidity illness was registered in 62 patients. HIV infection, hypertension, cancer, diabetes mellitus, kidney, liver and CNS diseases constituted 45, 22, 14, 13, 2, 2, and 2 %, respectively (Ocen et al., 2015).

Table 4 shows that obese patients had an increased risk score than others. Diabetic treatment taking patients had an increased risk score than others. Patients taking sleep less than 6 hours had an increased risk score than others. Drinking habit patients had an increased risk score than others. Statistical significance was calculated using chi square test.

Table 5 shows that >160 mm Hg Systolic Blood Pressure patients had an increased risk score than others. Patients with >100 mm Hg Diastolic Blood Pressure had an increased risk score than others. Statistical significance was calculated using chi square test.

DISCUSSION

Prospective study to assess the prearrest risk factors among patients with in hospital cardiac arrest was conducted. Compared with many literatures, our hospital has moderate incidence of IHCA. The prevalence rate was higher than previously reported rates of 1–6 cardiac arrests per 1000 hospital admis-
sions (Motamedi et al., 2010; Chakravarthy et al., 2012). Circadian variation in cardiopulmonary arrest of in-hospital patients affects the survival to discharge. It is noted that there is a need for an adequate patient monitoring system to distinguish those at risk of in hospital cardiac arrest (Jones-Crawford et al., 2007).

The death of ICU’s in low-income hospital has been well documented in numerous studies (Kwizera et al., 2012; Cox et al., 2012; Vincent et al., 2014). The interventions to improve an outcome that is early identification of IHCA and timely initiation of CPR also cost the smallest amount to Hospitals (Adhikari, 2013). In this study, we also noted that, a lack of identification with regards to the detection of pre-existing conditions and risk factors related to cardiac arrest. This contributed to the importance of conducting this study.

In most studies, most of the patients were young adults of age less than 50 years (Sandroni et al., 2007; Bonnin et al., 1993). In addition, the most of our patients were mainly young males. Our study was equivalent with preceding reports that most of males are cardiac arrest patients in the ICU (Kutsogiannis et al., 2011). The most common connected diagnoses in this study were Myocardial Infarction 42(84%), Metabolic and electrolyte abnormality 45(90%), Arrhythmias 31(62%), Diabetes Mellitus 31(62%) are having more increased risk score to develop cardiac arrest than other patients with Renal problems, Heart failure, Sepsis, Pneumonia, Metastasis/ Hematologic Malignancy, Depression, Hepatic Insufficiency, Stroke.

Demographic variables were given in frequencies with their percentages. Prearrest risk score was given in mean and standard deviation. Association between demographic variables and level of Prearrest risk score was determined using pearson chisquare test. Generalization of Prearrest risk score was analyzed using and mean difference with 95% CI and proportion with 95% CI. Simple bar diagram represents the data. P<0.05 was considered statistically significant. All statistical tests were two-tailed tests

CONCLUSIONS

Early recognition and identification of warning signs of cardiac arrest may facilitate the hospital for treatment and prevent patient deterioration. All tertiary hospitals should be encouraged to provide patient care with resuscitation services and decrease the death rate that occurs out of cardiac illness.

ACKNOWLEDGEMENT

This study is part of Ms. Akila Devi’s Ph.D study. Dr. Sunderesan, Ph.D is a guide and Dr. C. Kaniammal, Dean is the HOD of the Department of Nursing who has assisted in the progression of this research project.

AUTHORS CONTRIBUTION

Author prepared the problem statement by reviewing the published articles and received the institutional ethical committee clearance. Obtained formal approval from hospital before author involved in data collection. Data was completely analyzed by the author with the help of statistician to meet the objectives.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest for this study.

FUNDING SUPPORT

The authors declare that they have no funding support for this study.

REFERENCES

Adhikari, N. K. J. 2013. Patient safety without borders: measuring the global burden of adverse events. BMJ Quality & Safety, 22(10):798–801.

Bonnin, M., Pepe, P. E., Clark, P. S. 1993. Survival in the elderly after out-of-hospital cardiac arrest, city of Houston center for resuscitation and emergency medical services. Critical Care Medicine, 21(11):1645–1651.

Chakravarthy, M., Mitra, S., Nonis, L. 2012. Outcomes of in-hospital, out of intensive care and operation theatre cardiac arrests in a tertiary referral hospital. Indian Heart Journal, 64(1):7–11.

Chan, P. S., Jain, R., Nallmothu, B. K., Berg, R. A., Sasson, C. 2010. Rapid Response Teams: A systematic review and meta-analysis. Archives of Internal Medicine, 170(1):18–26.

Cox, J. A., Lukande, R. L., Nelson, A. M., Mayanja-Kizza, H., Colebunders, R., Marck, E. V., Manabe, Y. C. 2012. An Autopsy Study Describing Causes of Death and Comparing Clinico-Pathological Findings among Hospitalized Patients in Kampala, Uganda. PLoS ONE, 7(3):e33685–e33685.

Hodgetts, T. J., Kenward, G., Vlackonikolis, I., Payne, S., Castle, N., Crouch, R., Ineson, N., Shaikh, L. 2002. Incidence, location and reasons for avoidable inhospital cardiac arrest in a district general hospital. Resuscitation, 54(2):115–123.

Jones-Crawford, J. L., Parish, D. C., Smith, B. E., Dane, F. C. 2007. Resuscitation in the Hospital: Circadian...
Variation of Cardiopulmonary Arrest. *The American Journal of Medicine*, 120(2):158–164.

Kutsogiannis, D. J., Bagshaw, S. M., Laing, B., Brindley, P. G. 2011. Predictors of survival after cardiac or respiratory arrest in critical care units. *Canadian Medical Association Journal*, 183(14):1589–1595.

Kwizera, A., Dünser, M., Nakibuuka, J. 2012. National intensive care unit bed capacity and ICU patient characteristics in a low income country. *BMC Research Notes*, 5(1):1–6.

Motamedi, M. H., Piryaie, M., Rafati, H., Saghafi, A., Jalali, A., Madani, S., Kolahdehi, R., Saghaﬁnia, M. 2010. Survival after in-hospital cardiopulmonary resuscitation in a major referral center. *Saudi Journal of Anaesthesia*, 4(2):68–68.

Murugiah, K., Chen, S. I., Dharmarajan, K., Nuti, S. V., Wayda, B., Shojaee, A., Ranasinghe, I., Dreyer, R. P. 2014. Most Important Outcomes Research Papers on Cardiac Arrest and Cardiopulmonary Resuscitation. *Circulation: Cardiovascular Quality and Outcomes*, 7(2):335–345.

Ocen, D., Kalungi, S., Ejoku, J., Luggya, T., Wabule, A., Tumukunde, J., Kwizera, A. 2015. Prevalence, outcomes and factors associated with adult in hospital cardiac arrests in a low-income country tertiary hospital: a prospective observational study. *BMC Emergency Medicine*, 15(1):1–6.

Sandroni, C., Nolan, J., Cavallaro, F., Antonelli, M. 2007. In-hospital cardiac arrest: incidence, prognosis and possible measures to improve survival. *Intensive Care Medicine*, 33(2):237–245.

Vincent, J.-L., Marshall, J. C., Namendys Silva, S. A., François, B., Martin-Loeches, I., Lipman, J., Reinhart, K., Antonelli, M., Pickkers, P., Njimi, H., Jimenez, E., Sakr, Y. 2014. Assessment of the worldwide burden of critical illness: the Intensive Care Over Nations (ICON) audit.