British Journal of Medicine & Medical Research
15(8): 1-8, 2016, Article no.BJMMR.25817
ISSN: 2231-0614, NLM ID: 101570965

SCIENCEDOMAIN *international*
www.sciencedomain.org

Epidemiology of Cardiac Arrests in Airports: Four Years Results of the French National Cardiac Arrest Registry

Joséphine Escutnaire[1], Philippe Bargain[2], Evgéniya Babykina[1], Karim Tazarourte[3], Carlos El Khoury[4], Christian Vilhelm[1], Jean-Baptiste Marc[5], Eric Wiel[1,5], Nicolas Segal[6], Pierre-Yves Gueugniaud[3], Hervé Hubert[1*] and On Behalf GR-RéAC[7]

[1]Public Health Department EA 2694, University of Lille, Lille, France.
[2]Roissy-Charles de Gaulle international Airport (ADP) SMUR, Roissy, France.
[3]SAMU 69, Lyon University Hospital, University of Claude Bernard-Lyon 1, Lyon, France.
[4]RESCUE (Réseau Cardiologie Médecine d'Urgence) Network, Hussel Hospital, Vienne, France.
[5]SAMU 59 and Emergency Department, Lille University Hospital, Lille, France.
[6]Assistance Publique des Hôpitaux de Paris (APHP), Lariboisière Hospital, Paris, France.
[7]Research Group on the French National Out-of-Hospital Cardiac Arrest Registry, RéAC, Lille, France.

Authors' contributions

This work was carried out in collaboration between all authors. Authors JE and HH carried out the study design, literature searches wrote the manuscript and supervised. Author PB brought expertise of medical emergency management in airports. Author EB validated the statistical analysis method. Authors KT, CEK, CV, JBM, EW, NS and PYG contributed to the manuscript proofreading and brought medical/methodological expertise. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2016/25817
Editor(s):
(1) Rui Yu, Environmental Sciences & Engineering, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, USA.
Reviewers:
(1) Neslihan Lok, Selcuk University, Turkey.
(2) Vaishali Kapoor, Washington University in St. Louis School of Medicine, USA.
(3) Kwok Wo Oi, Chinese University of Hong Kong, China.
(4) Molobe Ikenna Daniel, International Institute of Risk and Safety Management (IIRSM), Nigeria.
(5) Valery Piacherski, Mogilev Regional Hospital, Belarus.
Complete Peer review History: http://sciencedomain.org/review-history/14505

Original Research Article

Received 21st March 2016
Accepted 29th April 2016
Published 7th May 2016

**Corresponding author: E-mail: herve.hubert@univ-lille2.fr;*

ABSTRACT

Aims: To describe and analyse cardiac arrests occurring in airports, all chain of survival steps and their survival including a neurological outcome assessment at day 30 and to compare these results between airports staffed with on-site medical teams and those without.
Study Design: National multicentre cohort study on cardiac arrests occurring in airports. Subgroup comparative study between airports staffed with on-site medical teams and those without.
Place and Duration of Study: All cardiac arrests occurring in French airports, extracted from the French national cardiac arrest registry, recorded between July 2011 and September 2015 (50 months).
Methodology: 109 cardiac arrests occurring in 19 French airports were collected. The population characteristics were described by medians and interquartile ranges or frequencies. Comparison of variables between airports staffed with on-site mobile medical team and others were handled using chi-square or Fisher's exact tests and the Mann-Whitney U test. Survival differences were also compared and explained using odds-ratio.
Results: We recorded 71.4% immediate basic life support if cardiac arrest was witnessed (76.2%) and 52.4% automatic external defibrillator connexion by witnesses. First aid provider response was prompt and mobile medical teams provided an advanced cardiopulmonary resuscitation to a large majority of patients (91.4%). More than 4 victims of cardiac arrests occurring in airports on 10 were alive at hospital admission. Among them, 17.7% (17) survived at day 30. No survival difference between subgroups.
Conclusion: Cardiac arrests occurring in airports are rare events. The survival rates of cardiac arrests occurring in airports are superior to what we found in previous works and literature on general populations. These are related to the first steps of the chain of survival which are particularly strong in airports.

Keywords: Cardiac arrest; airport; emergency; registry; care organisation.

1. INTRODUCTION

The airport industry is one of the most dynamic sectors in France and worldwide. In 2013, French airports recorded 172 million commercial passengers including about 91 million in Paris international airports [1]. Airports are also presented as examples in terms of effective prehospital emergency care and first aid [2].

In France airport medical emergencies management is different between Paris airports (Roissy Charles de Gaulle and Orly airports with respectively 65 million and 26 million passengers a year) and other French airports (other metropolitan airports and overseas airports). Indeed if all French airports are staffed with first aid professionals (firemen) who are trained to implement an effective basic support, the two Paris airports are also staffed with Emergency Medical Services (EMS) able to dispatch mobile medical teams to implement a medicalized support. Because health professionals are constantly available on airport, this kind of organisation is particularly costly in terms of human resources and in terms of financial resources. Furthermore, airports are identified as high-risk sites with important population flows. Most of airport workers are trained for handling emergency situations. Airports are considered as experimentation laboratories for risk management, including medical emergencies risks. They are indeed also often mentioned in cardiac arrest topic as laboratories for the use and effectiveness of public access automatic external defibrillators (AED). These facts were highlighted in literature [3,4].

Even if cardiac arrest is a major public health issue worldwide and is responsible for about 50,000 deaths per year in France [5], cardiac arrest occurring in airports is a seldom studied topic. Cardiac arrests occurring in airports are quite rare especially regarding the other severe pathologies management such as acute coronary syndrome, deep venous thrombosis or pulmonary embolism and regarding the annual passengers flow. The cardiac arrests occurring in airports example may be pertinent as they request a prompt, well-organized management and pose an often fatal pathology. Finally, to our knowledge, no literature covers the epidemiology and care of cardiac arrests occurring in airports.

The main objective of our study is to describe and analyse cardiac arrests occurring in airports, all the chain of survival steps and their immediate (on scene return of spontaneous circulation,

hospital admission vital status) and mid-term survival (vital status at hospital discharge or at day 30) including a neurological outcome assessment. As a secondary objective we will also describe cardiac arrests occurring in airports care and survival differentiating airports staffed with on-site mobile medical team and those without.

2. MATERIALS AND METHODS

2.1 French Airports Prehospital Emergency Care Systems

In France, there are two different organizations concerning prehospital emergency care in airports. All French airports are staffed with at least one on-site firemen station regardless of their size. When a medical emergency occurs, airports send their first aid professionals (firemen). If needed, they rely on the nearest dispatch centre ("Service d'Aide Médicale d'Urgence – SAMU) which is responsible for prehospital emergencies management [6]. They can trigger them by calling the national health emergency number "15". Each SAMU gathers at least one mobile emergency and resuscitation service including at least one mobile medical team operation on-scene. Each mobile medical team is composed of at least an emergency physician, a nurse and an emergency medical technician. The medical dispatching physicians are responsible for determining the nature of the emergency response and can give telephone-assisted instructions. The two Paris Airports are also staffed with an on-site mobile medical team available 24h/24, 365 days a year. These particular mobile medical teams are responsible for prompt intervention and advanced medical support implementation but rely most of the time on "classical" interventions triggered by nearest dispatch centres for transporting stabilized patients to hospital. All this organization is set in motion when airports are confronted to cardiac arrest care which is the most extreme emergency. In France, firemen are responsible for implementing an effective basic life support and mobile medical teams for advanced cardiac life support and to transport stabilized patients to hospital. Naturally, bystanders are encouraged to implement a prompt basic life support in order to maximize patients' survival chances.

2.2 French National Cardiac Arrest Registry

The French national cardiac arrest registry (RéAC) form meets the requirements of French EMS organizations and is structured according to the Utstein universal style [7-9]. The data are reported in the RéAC secured database (www.registreac.org). If the patient is alive at hospital admission, a follow-up record sheet must be filled in. Several quality controls are performed in real time during data input to detect inconsistencies or out-of-bound values. Offline tests are performed to detect other types of errors that require verification from the participating mobile emergency and resuscitation service. Randomly chosen records are assessed by a clinical research associate in order to identify other inconsistencies or errors that should be included in the automated tests (on- or off-line).

2.3 Ethical Approval

The study was approved by the French advisory committee on information processing in health research (CCTIRS) and the French National Data Protection Commission (CNIL, authorisation number 910946). This study was approved as a medical assessment registry without a requirement for patient consent.

2.4 Study Design

We prospectively included in our baseline study population all cardiac arrests occurring in French airports (2 Paris airports and 17 French airports (excluding Paris)) recorded in the French national cardiac arrest registry between July 2011 and September 2015.

We excluded the records corresponding to dead bodies' discovery.

The distribution of all variables was tested using the Kolmogorov–Smirnov test. Since data was not normally distributed we used nonparametric statistics tests. The baseline population characteristics were described by medians and interquartile ranges (IQR) for quantitative variables and frequencies were given for qualitative variables. Comparison of variables between airports staffed with on-site mobile medical team and others were handled using chi-square or Fisher's exact tests for qualitative variables and the Mann-Whitney U test for quantitative variables. Survival differences were also compared and explained using odds-ratio. The difference was declared significant when the p-value was <0.05. Analyses were performed by using IBM SPSS Statistics© V19.0 (IBM Inc., USA).

3. RESULTS AND DISCUSSION

3.1 Results

Data on 47,197 cardiac arrests recorded between July 2011 and September 2015 were extracted from the RéAC database. These data contained 109 cardiac arrests in airports. Four records corresponding to mobile medical team intervention leading to a discovery of dead body were excluded from the analysis. Consequently this study concerned 105 records on cardiac arrest located in airports (Fig. 1).

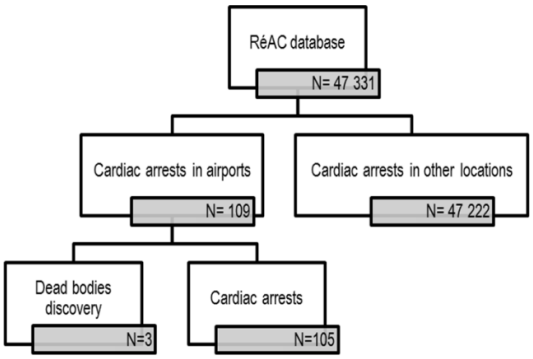

Fig. 1. Study flow-chart

Victims of cardiac arrest at airports were often men (76.2%) and had a median age of 64. Recorded cardiac arrests occurring in airports mainly occurred in the two Paris airports (64.8%) followed by provincial airports (28.5%) and French overseas departments and collectivities airports (6.7%). Most of them occurred in witnesses' presence (76.2% in a presence of a bystander other than professional first aid provider or health professional and 12.4% in firemen and/or mobile medical team presence). Most were of medical aetiology (95.2% of which 19.0% were suspected of cardiac cause). When cardiac arrests occurring in airports were witnessed, 72.4% benefited from an immediate basic life support resulting in a median no-flow duration of 0[0-7] minutes. Professional rescuers response time was 5[0-10] minutes and 86.7% had already basic life support by firemen at mobile medical team arrival. Mobile medical team median response time was 18[10-24] minutes and 91.4% of cardiac arrests occurring in airports victims had an advanced cardiac life support. The majority of victims had a non-shockable rhythm at mobile medical team arrival (64.7%) but 24.5% of patients had already sustained a return of spontaneous circulation (ROSC) (Table 1).

Among patients who benefited from an advanced cardiac life support, 41.7% sustained a ROSC. All survived transport and were still alive at hospital admission. Among these patients, 17.7% were still alive at day 30 or hospital discharge. Most of them (82.4%) had a good neurological outcome (CPC 1-2) (Table 2).

The comparative study between airports staffed with on-site medical teams and those without highlighted some differences in terms of care and timings. On populations statistically similar, like in terms of age, gender and cardiac arrest aetiology, 20.0% of cardiac arrest occurred in front of first aid professionals or mobile medical team in airports staffed with on-site medical teams vs. none in others (p=0.004). First aid providers arrived quicker (4 vs. 8 minutes; p=0.039) as well as mobile medical team (12 vs. 25 minutes; p<0.001) in airports staffed with on-site medical teams. For this group times to orotracheal intubation and epinephrine injection were also shorter (respectively 16 vs. 26 minutes; p=0.048 and 16 vs. 26 minutes; p=0.039). There were no statistical differences in terms of survival between airports staffed with on-site medical teams and those without with respectively 47.5% vs. 31.4% ROSC on scene (p=0.123). None of patients who had sustained a ROSC died during transport or at hospital admission. Finally, 19.7% vs. 14.3% survived at hospital discharge or 30 days after admission (p=0.813). Most of survivors had a good neurological outcome (91.7% vs. 60.0%) although not statistically different (p=0.119).

3.2 Discussion

To the best of our knowledge, this study is one of the rare works carried out specifically on case of cardiac arrest located in airports and the only one to globally describe their epidemiology, care and survival (not only one single aspect like the use of AED).

Globally the proportion of men was higher than in cardiac arrest population recorded in the RéAC regardless of the cardiac arrest location [10] or in other national cardiac arrest registries like the All Japan Utstein Registry [11]. A huge majority of cardiac arrests occurring in airports victims were immediately cared by witnesses (72.4%), which is about two to three times more often than in the general population [10-13]. The first obvious difference between airport microcosm and general cardiac arrest population including cardiac arrest in public locations such as malls and stations is linked to bystanders' implication in

chain of survival [14]. Indeed their commitment into basic life support implementation is far more intense than in the general population we can study in our national registry. This fact may be linked to the particular airport passengers' behaviour. Indeed, people are unceasingly moving and hurrying in most of public places (i.e in order to catch a train) while in airports passengers are often required to arrive a few hours ahead of time and waiting. Passengers consequently may be more likely to take time to care for this kind of situation and act. Bystanders also connected AED ten times more often than in the general population [10]. Indeed, the density of AED is so important that there is seldom a long way to go in order to catch one, increasing the proportion of AED use. This established fact is in accordance with literature dealing with presence and use of AED in public places and high-risk sites [15-17].

Table 1. Patients and care characteristics

	ACA N=105	**CA in A-MERS+ N=67**	**CA in A-MERS- N=38**	**P**
Age (*M[IQR]*)	64[51-71]	62[50-69]	65[51-75]	0.233
Gender				
Male *(%)*	76.2	81.9	67.6	0.126
Female *(%)*	23.8	19.1	32.4	
Airport type				
Paris international airport *(%)*	64.8	NA	NA	NA
Other metropolitan airport *(%)*	28.5			
Overseas airport *(%)*	6.7			
Witness presence (not rescue prof.) *(%)*	76.2	68.6	86.9	0.430
Firemen/MMT presence *(%)*	12.4	20.0	0.0	0.004
"15" Caller identity				0.015
Victim *(%)*	1.0	1.5	0.0	
Family/Friend *(%)*	7.6	5.9	10.8	
Health/Aid professional *(%)*	18.8	20.6	43.2	
Passerby (airport staff or passenger) *(%)*	57.1	70.5	32.4	
Unknown *(%)*	5.7	1.5	13.6	
Cardiac arrest aetiology				
Medical (cardiac) *(%)*	76.2	80.9	67.6	0.126
Medical (non-cardiac) *(%)*	19.0	14.7	27.0	
Traumatic *(%)*	4.8	4.4	5.4	
Immediate BLS (if witness) *(%)*	72.4	67.2	81.6	0.112
No-flow duration (*M[IQR]) (min)*	0[0-7]	0[0-7]	0[0-5]	0.937
Low-flow duration (*M[IQR]) (min)*	17[1-32]	10[1-30]	20[5-34]	0.363
BLS by witness *(%)*	71.4	67.2	81.1	0.130
AED connexion by witness *(%)*	52.4	61.3	47.2	0.176
AED shock by witness (if connected) *(%)*	41.8	39.5	47.0	0.250
Professional rescuers BLS before MMT *(%)*	86.7	88.2	83.8	0.522
Professional rescuers response time (*M[IQR]) (min)*	5[0-10]	4[0-9]	8[4-12]	0.027
AED connexion by professional rescuers *(%)*	66.7	70.6	59.5	0.787
AED shock by professional rescuers *(%)*	5.7	6.3	4.5	1.000
First recorded rhythm (at MMT arrival)				
Non-shockable *(%)*	64.7	59.4	73.7	0.449
Shockable *(%)*	10.8	10.9	10.5	
Spontaneous Cardiac Activity (%)	24.5	29.7	15.8	
MMT ACLS *(%)*	91.4	91.0	92.1	0.852
MMT response time (*M[IQR]) (min)*	18[10-24]	12[6-20]	25[16-31]	$<10^{-3}$
MMT ventilation	83.2	79.0	90.9	0.141
Time from '15' call to orotracheal intubation (*M[IQR]) (min)*	20[14-28]	16[14-28]	26[15-29]	0.048
MMT defibrillator shock *(%)*	20.5	22.8	16.1	0.458
MMT epinephrine injection *(%)*	64.8	62.7	68.4	0.554
Time from '15' call to first epinephrine injection (*M[IQR]) (min)*	20[14-29]	16[11-28]	26[19-30]	0.039

ACA: cardiac arrests occurring in airports; CA: cardiac arrest; A-MERS+: airports staffed with on-site medical teams; A-MERS-: airports without on-site medical teams; M[IQR]: medians[interquartile ranges]; MMT: Mobile Medical Team; BLS: Basic Life Support; AED: Automated External Defibrillator; ACLS: Advanced Cardiac Life Support

Table 2. Patients survival (on ACLS patients)

	ACA N=96	CA in A-MERS+ N=61	CA in A-MERS- N=35	P	OR
Return of spontaneous circulation on scene (n)%	(40)41.7	(29)47.5	(11)31.4	0.123	0.50[0.21;1.21]
Transported alive (n)%	(40)41.7	(29)47.5	(11)31.4	0.123	0.50[0.21;1.21]
Survival at hospital admission (n)%	(40)41.7	(29)47.5	(11)31.4	0.123	0.50[0.21;1.21]
Day 30 survival (n)%	(17)17.7	(12)19.7	(5)14.3	0.813	0.84[0.20;3.42]
CPC 1-2 at Day 30 (on alive patients) (n)%	(14)82.4	(11)91.7	(3)60.0	0.119	7.33[0.48;111.18]

ACA: cardiac arrests occurring in airports; CA: cardiac arrest; A-MERS+: airports staffed with on-site medical teams; A-MERS-: airports without on-site medical teams; ROSC: Return of Spontaneous Circulation; CPC: Cerebral Performance Categories

Firemen arrived quickly, fact obviously linked to the location of their bases directly on-site, and were then relayed by the medical teams. In Paris international airports timings were globally shorter with extremely prompt response time of first aid professionals and mobile medical team. The mobile medical team presence on-site in these airports enabled them to arrive twice as fast than in other provincial and overseas airports. We can also note than even if there was no statistical differences in terms of advanced cardiac life support implementation between airports staffed with on-site medical teams and those without, technical manoeuvres like orotracheal intubation and epinephrine injection were carried out faster.

All previously described results are characteristic of an effective implementation of the chain of survival. Indeed we found a prompt and effective care by bystander, a frequent and early use of public-access AED and short intervention delays of first-aid professionals and mobile medical team. These elements explain why survival rates and neurological outcome are globally better than in the general population [10,18,19]. Indeed cardiac arrests occurring in airports ROSC rates were twice superior and J30 survival rates three times superior to our global French rates.

When we compared airports staffed with on-site medical teams to those without, in spite of faster interventions of firemen, mobile medical teams and a quicker implementation of technical manoeuvres, we did not recorded any statistically significantly difference in terms of immediate or Day30 survival and neurological outcome between patients cared in airports staffed with on-site medical teams and those without. Nevertheless, even if these results are non-significant, with almost one-on-two patients in airports staffed with on-site medical teams vs. one-on-three patients in airports without on-site medical teams sustaining a ROSC and finally 19.7% of which 91.7% with good neurological outcome survival vs. 14.3% with 60.0%, we can anyway discern a trend in favour of airports staffed with on-site medical teams organization.

The first limitation of this study is the sample size. Indeed even if the RéAC exists since 2011 we recorded a hundred victims of cardiac arrest specifically in airports. This may be related to the fact that airports are just transit points. The small size associated with the low survival rates also led to non-significant differences, which we can potentially be able to rework in our upcoming studies. Even if 109 cardiac arrests occurring in airports for more than 150 million passengers per year in French airports may seem anecdotic, cardiac arrest may be seen as “example pathology”. Indeed if cardiac arrest care is acute and efficient it can be a key element for considering other pathologies care in airports which are more current and also need prompt and efficient response like acute coronary syndromes, deep venous thrombosis or pulmonary embolism.

Next, this study consists in a simple description of cardiac arrests occurring in airports. A continuation of our work around cardiac arrest in public places will concern the comparison of cardiac arrest in airports to cardiac arrest occurring in other types of public places like health facilities, stations [14] or restaurants.

4. CONCLUSION

The survival rates of our study are superior to what we found in previous works and literature on general populations. These are related to the first steps of the chain of survival which are particularly strong in airports. Indeed bystanders started cardiopulmonary resuscitation manoeuvres promptly and associated them with

prompt defibrillation, leading to a strongly effective bystander basic life support. Cardiopulmonary resuscitation training courses for the lay public are essential to improve out-of-hospital cardiac arrests survival rates. The presence of firemen bases directly in airports enabled them to arrive quickly in order to substitute the bystanders for basic life support. We can also note the trend to higher survival rates in patients cared in airports staffed with on-site medical teams in which most of timings were shorter with quicker mobile medical team response time, epinephrine injection and orotracheal intubation. Even if these results are not statistically significant, this trend enables us to postulate on the positive aspect of an on-site mobile medical team presence in airports. Cardiac arrest is not the most represented pathology in terms of prehospital medical emergencies cared in airports and is treated in our study as an indicator. If this trend is confirmed on other pathologies and on cardiac arrest on a bigger size sample, it would be a key element for discussing the utility of attributing resources to such facilities in a context of health promotion budget limitation. We found this particular organisation of PEMS with on-site mobile medical team only in the two Parisian airports, which record biggest passenger affluence. With such an indicator we may be able to define which airports should benefit from such an organization regarding their size, location and passenger affluence.

ACKNOWLEDGEMENTS

This work was supported by the French Society of Emergency Medicine (SFMU); a patient foundation – “Fédération Francaise de Cardiologie”; a support research foundations – “Fondation Cœur et Artères”; the Mutuelle Générale de l’Education Nationale (MGEN); Lyon University Hospital; Lille 2 University; the French northern region and the European community via FEDER funds.

The authors declare that the funding sources had no role in the conduct, analysis, interpretation or writing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Union des Aéroports Français. Résultats d'activité des aéroports français 2013. Statistiques de trafic. Paris; 2014. FRENCH.
2. Cwinn AA, Dinerman N, Pons PT, Marlin R. Prehospital care at a major international airport. Ann Emerg Med. 1988;17:1042-8.
3. Bartimus HA, Rea TD, Eisenberg MS. Prevalence of automated external defibrillators at cardiac arrest high-risk sites. Prehosp Emerg Care. 2004;8:280-3.
4. MacDonald RD, Mottley JL, Weinstein C. Impact of prompt defibrillation on cardiac arrest at a major international airport. Prehosp Emerg Care. 2002;6:1-5.
5. Nicolas G, Lecomte D. [Sudden cardiac death in adults. Epidemiology]. Bull Acad Natl Med. 1999;183:1573-9.
Discussion 9-80. FRENCH.
6. Adnet F, Lapostolle F. International EMS systems: France. Resuscitation. 2004; 63:7-9.
7. Chamberlain DA. Guidelines for cardiopulmonary resuscitation working papers for ACLS group of the resuscitation council of the United Kingdom 1989 (revised 1991): Introduction. Resuscitation. 1991;22:151.
8. Jacobs I, Nadkarni V, Bahr J, Berg RA, Billi JE, Bossaert L, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: Update and simplification of the Utstein templates for resuscitation registries: A statement for healthcare professionals from a task force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian Resuscitation Council, New Zealand Resuscitation Council, Heart and Stroke Foundation of Canada, Inter American Heart Foundation, Resuscitation Councils of Southern Africa). Circulation. 2004;110:3385-97.
9. Perkins GD, Jacobs IG, Nadkarni VM, Berg RA, Bhanji F, Biarent D, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: Update of the utstein resuscitation registry templates for Out-of-hospital cardiac arrest: A statement for healthcare professionals from a task force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian and New Zealand Council on Resuscitation, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa,

Resuscitation Council of Asia); and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. Circulation. 2015;132:1286-300.

10. Hubert H, Tazarourte K, Wiel E, Zitouni D, Vilhelm C, Escutnaire J, et al. Rationale, methodology, implementation, and first results of the French out-of-hospital cardiac arrest registry. Prehosp Emerg Care. 2014;18:511-9.
11. Hasegawa K, Tsugawa Y, Camargo Jr CA, Hiraide A, Brown DFM. Regional variability in survival outcomes of out-of-hospital cardiac arrest: The All-Japan utstein registry. Resuscitation. 2013;84:1099-107.
12. Hamasu S, Morimoto T, Kuramoto N, Horiguchi M, Iwami T, Nishiyama C, et al. Effects of BLS training on factors associated with attitude toward CPR in college students. Resuscitation. 2009; 80:359-64.
13. Iwami T, Kawamura T, Hiraide A, Berg RA, Hayashi Y, Nishiuchi T, et al. Effectiveness of bystander-initiated cardiac-only resuscitation for patients with out-of-hospital cardiac arrest. Circulation. 2007;116:2900-7.
14. Marijon E, Bougouin W, Tafflet M, Karam N, Jost D, Lamhaut L, et al. Population movement and Sudden cardiac arrest location. Circulation; 2015.
15. MacDonald RD, Mottley JL, Weinstein C. Impact of prompt defibrillation on cardiac arrest at a major international airport. Prehospital Emergency Care. 2002;6:1-5.
16. Bartimus HA, Rea TD, Eisenberg MS. Prevalence of automated external defibrillators at cardiac arrest high-risk sites. Prehospital Emergency Care. 2004;8:280-3.
17. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, Hiraide A. Nationwide public-access defibrillation in Japan. New England Journal of Medicine. 2010;362:994-1004.
18. Wissenberg M, Hansen CM, Folke F, Lippert FK, Weeke P, Karlsson L, et al. Survival after out-of-hospital cardiac arrest in relation to sex: A nationwide registry-based study. Resuscitation. 2014;85:1212-8.
19. Lai H, Choong CV, Fook-Chong S, Ng YY, Finkelstein EA, Haaland B, et al. Interventional strategies associated with improvements in survival for out-of-hospital cardiac arrests in Singapore over 10 years. Resuscitation. 2015;89:155-61.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/14505