

Difference of achievements between physicians from public hospitals and emergency medical center in prehospital emergency

Tongtian Ni, MS^a, Min Chen, MS^a, Weijun Zhou, MD^{a,*}, Jiong Zhao, BS^b, Dan Jia, BS^b

Abstract

The benefit gained by replacing physicians in the prehospital service is still controversial. The present study compared the difference of achievements of pre-hospital emergency between the physicians from public hospitals and those from the Emergency Medical Center.

We included prehospital emergency patients who were sent to the hospital by ambulance after emergency calls from February 1 to May 31, 2016, in Shanghai (24,250,000 inhabitants). Cohort characteristics and diagnoses were described, and the data were analyzed using the Shanghai Emergency Medical Center's database software. We determined whether the physicians from public hospitals were associated with greater success rate of cardiopulmonary resuscitation (CPR) and examined the diseases category and the number of patients with cardiac arrest in prehospital emergency patients.

During February 1, 2016, to May 31, 2016, the total turnout of ambulances in the urban area of Shanghai was 107,341 times, among which, first aid was 55,053 times. The number of patients with cardiac arrest was 3012, the 3 principal causes for cardiac arrest were Unknown diagnosis (45.19%), Cardiovascular disease (28.02%) and Respiratory diseases (11.09%), and the successful rate of CPR was 1.56%. The number of critically ill patients, encountered by the physicians from public hospitals, was 10.33% as compared to those from the Emergency Medical Center, which was 11.77% ($P < .001$). Although the success rate of CPR of the physicians from public hospitals was lower than that of the physicians from the Emergency Medical Center (1.22–1.58%), it did not achieve statistical significance ($P > .05$).

Transferring the physicians from public hospitals to work in Emergency Medical Center showed no improvement in the success rates of resuscitation.

Abbreviations: ACLS = advanced cardiovascular life support, AHA = American Heart Association, BLS = basic life support, CPR = cardiopulmonary resuscitation, PHEM = prehospital emergency medicine.

Keywords: emergency medical center, physicians, prehospital emergency care

1. Introduction

Preliminary data suggest that sudden cardiac death occur at a rate of 41.8/100,000 individuals in China, accounting for over 544,000 deaths annually.^[1] In 2015, American Heart Association (AHA) guidelines re-emphasized teamwork and high-quality cardiopulmonary resuscitation (CPR) as the key to saving patients with cardiac arrest.^[2–5] Prehospital emergency medicine (PHEM), an integrated part of medical care and the social security system, plays a critical role in saving the lives of critically ill patients and

responding to emergency events.^[6,7] Administrative health departments worldwide have a major and urgent duty to establish efficient and effective prehospital emergency systems, as well as operate standardized and high-quality emergency centers fulfilling the lack of experienced emergency physicians.

As an international metropolis, Shanghai's resident population reached 2425.68 million people in 2014, with an average life expectancy of 82.29 years.^[8] With aging population and increasing demand for health care, the frequency of dispatched ambulances has increased annually, up to 310,200 times in 2014. Even with 43 first-aid sub-stations dispersed in the city center and the availability of one ambulance per 40,000 people, Shanghai's health care system does not meet the demand. Therefore, the development of Shanghai's PHEM system faces severe challenges in order to meet the needs of the residents.^[9,10] However, the development of the entire system has been bottlenecked by the shortage of emergency physicians, high turnover rates, and an increased willingness of the staffs to quit.^[11] In line with the rapid economic development of Shanghai, on December 23, 2014, the Shanghai Municipal Commission of Health and Family Planning decided to transfer physicians from public hospitals to the Emergency Medical Center and increase the number of ambulances in rotation.^[12] Physician-based prehospital emergency services are established in some countries.^[12,13] However, the benefit gained by utilizing professional physicians in the prehospital service is still controversial.^[14–16] And a report on the success rate of CPR by physicians from public hospitals in the

Editor: Abdelouahab Bellou.

The authors of this work have nothing to disclose.

Supplemental Digital Content is available for this article.

^a Department of Emergency, Rui Jin Hospital, School of Medicine, Shanghai Jiao Tong University, ^b Shanghai Medical Emergency Center, Shanghai, China.

* Correspondence: Weijun Zhou, Department of Emergency, Rui Jin Hospital, School of Medicine, Shanghai Jiao Tong University, No. 197, Ruijin er Road, Huangpu District, Shanghai 200025, China (e-mail: zhouweijun-1972@163.com).

Copyright © 2018 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

Medicine (2018) 97:44(e13070)

Received: 3 May 2018 / Accepted: 9 October 2018

<http://dx.doi.org/10.1097/MD.0000000000013070>

PHEM is absent. Meanwhile, population-based studies on the overall diseases category for patients after calling for an ambulance are scarce. Hence, high-quality epidemiological data are lacking; usually, what is known about these events is put together from anecdotal internet and news rep in Shanghai.

Therefore, the objectives of the present study were to determine whether the physicians from public hospitals were associated with greater success rate of CPR, and assess the difference of the effect in PHEM between the physicians from public hospitals and those from the Emergency Medical Center.

2. Methods

2.1. Study design

On December 23, 2014, the Shanghai Municipal Commission of Health and Family Planning and Shanghai Municipal Human Resources and Social Security Bureau jointly developed “Recommendations on the Continued Encouragement of Clinical Physicians from Public Medical Institutions to Regularly Work in Primary Medical Institutions.”^[12] Clinical physicians in the Emergency Department or anesthesiologists in the public hospitals, aged <50 years, were required to work at the Emergency Medical Center for 6 months before being promoted to a senior professional title. After a short training and 2 weeks of practice, all physicians were randomly assigned to ambulances to provide emergency medical services. Also, the first author in this study participated in providing emergency medical services.

2.1.1. Survey content. In this descriptive study, the data of prehospital emergencies between February 1, 2016, and May 31, 2016, were retrieved from the Shanghai Emergency Medical Center’s electronic database. Data with complete records were selected for the analysis.

2.2. Statistical analysis

The data were analyzed using the Emergency Medical Center’s database software and SPSS 19.0 statistical software (SPSS, Inc., Chicago, IL). The categorical variables were presented as proportions, and a Chi-square test (χ^2) was used for comparisons. The success rate of CPR between the groups was tested using a Fisher exact test. $P < .05$ was considered statistically significant.

2.3. Ethics

The study plan was reviewed and approved by the ethics committee of Rui Jin Hospital that is affiliated with Shanghai Jiao Tong University School of Medicine. Written informed consent was obtained from each patient or their family members.

3. Results

3.1. Subject of study

Between February 1, 2016, and May 31, 2016, ambulances were dispatched in the urban area of Shanghai for a total of 107,341 times, with an average of 887 turnout per day. The average response time was 39 seconds, and the average time of arrival of the ambulance was 12 minutes and 16 seconds. The average on-site consultation time was 12 minutes and 16 seconds, and the mean transit time was 14 minutes and 26 seconds; data are summarized in Supplemental Table 1, <http://links.lww.com/MD/C597>. An overview of the turnout of ambulances in different districts of Shanghai is shown in Fig. 1.

In all of the 80,954 effective turnout, which excluded 26,387 invalid turnout including a cancellation or loss of calls, 25,901 cases were not required on-site emergency treatment and excluded from the study. Therefore, first-aid was administered

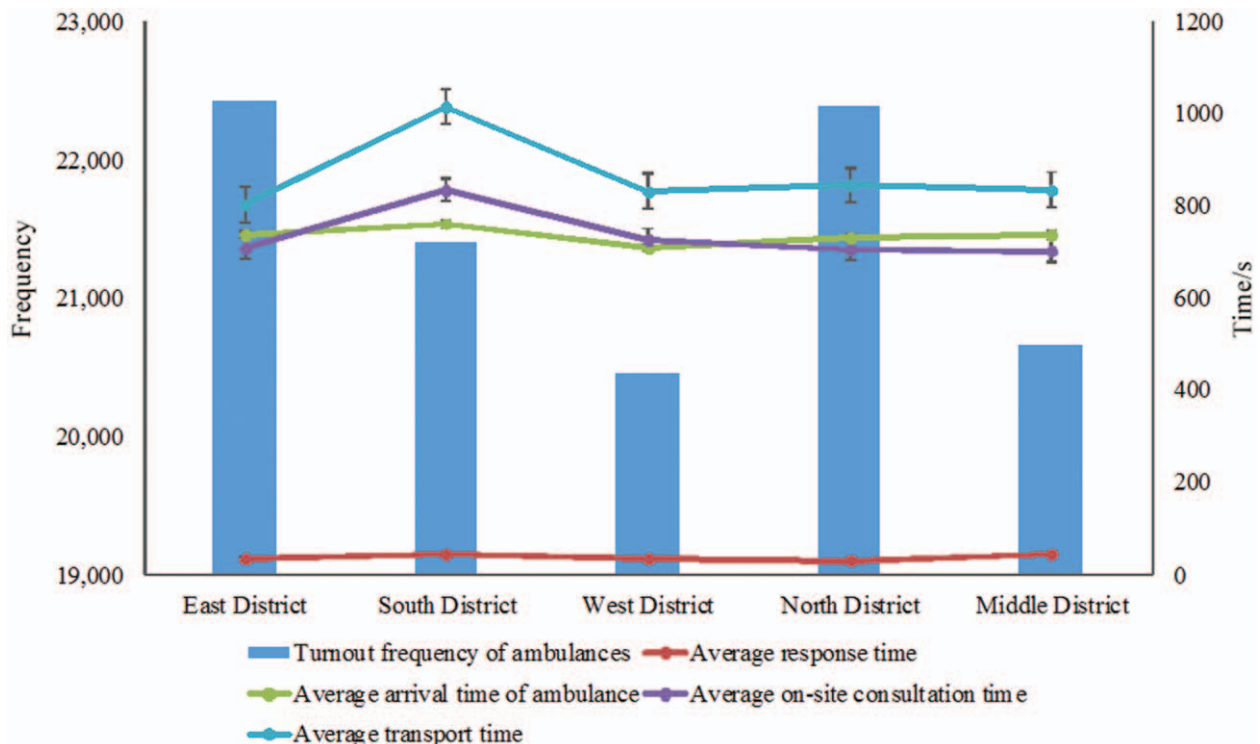


Figure 1. The overview of the turnout of ambulances in different districts of Shanghai.

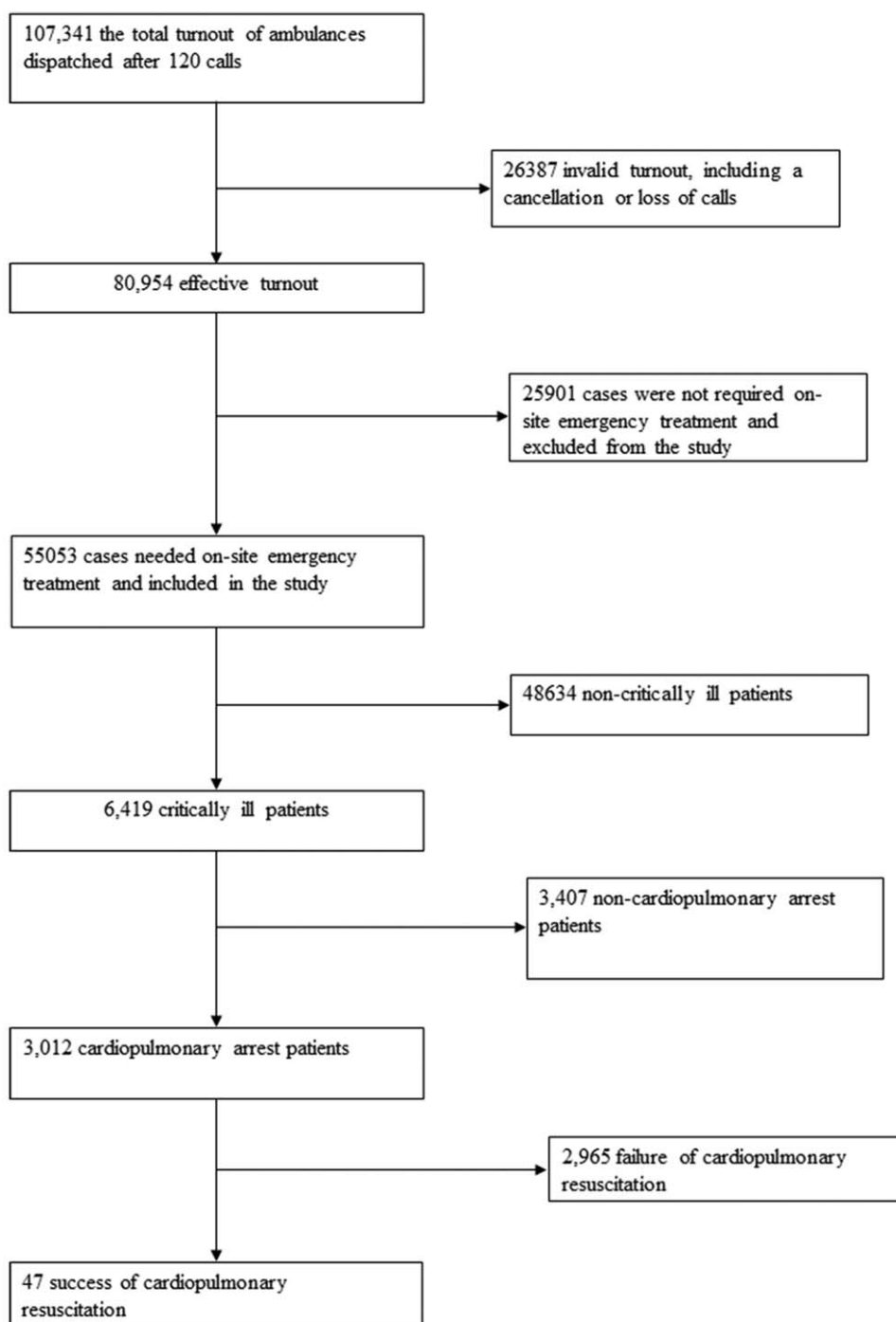


Figure 2. Flow chart describing the patients between February 1 and May 31, 2016, in Shanghai.

55,053 cases, which was 68.01% of the total effective turnout (Fig. 2).

3.2. Inclusion of patients

Among 55,053 cases that needed on-site emergency treatment, the number of noncritically ill patients encountered was 48,634 (88.34%), and the number of critically ill patients was 6419 (11.66%). The number of patients with cardiac arrest was 3012 (5.47%); the successful rate of CPR was 1.56% (n=47), as shown in Fig. 2.

3.3. Diseases category and mortality in patients

Figure 3 illustrated the diseases category for 55,053 patients included in the study. The 6 principal causes for 55,053 patients included in the study were Trauma (n=11,889, 21.60%), Cardiovascular diseases (n=7509, 13.64%), Unknown diagnosis (symptoms and abnormal findings not classified elsewhere) (n=6617, 12.02%), Respiratory disease (n=6236, 11.33%), Cerebrovascular diseases (n=5833, 10.60%), and Digestive diseases (n=4806, 8.73%) as summarized in Table 1. The first disease with a high rate of cardiopulmonary arrest was unknown

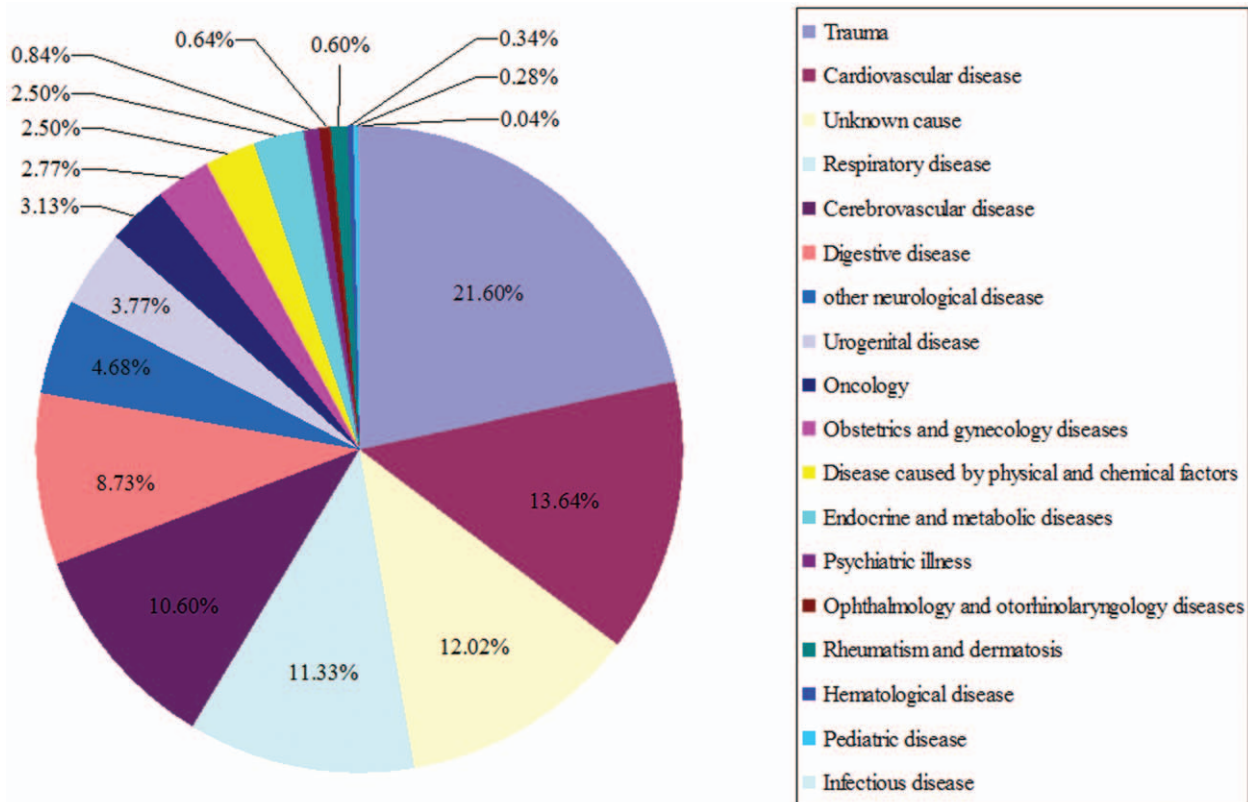


Figure 3. Type of diseases for 55,053 patients included in the study.

diagnosis. The second and third causes were Cardiovascular disease and Respiratory diseases respectively, as shown in Fig. 4. Table 2 described classification of diseases in CPR. The most successful cases of CPR was cardiovascular disease (n=27).

Difference of the effect in PHEM between the physicians from public hospitals and those from the Emergency Medical Center: 445 of 4307 critically ill patients were treated by physicians from public hospitals, and 5974 of 50,746 critically ill patients treated by physician of emergency medical centers. The percentage of critically ill patients treated by physicians from public hospitals was 10.33% and that treated by physicians from the Emergency Medical Center was 11.77%. This difference was statistically significant ($P=.005$) (Fig. 5). One hundred sixty-three cardiac arrest patients were treated by physicians from public hospitals, and 2849 cardiac arrest patients were treated by physician of emergency medical centers. The percentage of patients with cardiopulmonary arrest treated by physicians from public

hospitals was 3.78% (163 of 4307) and 36.63% (163 of 445), respectively, and the percentage of patients with cardiopulmonary arrest treated by the Emergency Medical Center was 5.61% (2849 of 50,746) and 47.69% (2849 of 5974), respectively (Tables 3 and 4), suggesting that the difference varied significantly between the 2 groups ($P<.001$). Two of 163 CPRs were conducted successfully by physicians from public hospitals, and 45 of 2849 were conducted by physicians of emergency medical centers. No obvious difference between the physicians from public hospitals and those from the Emergency Medical Center was observed with respect to the success rate of CPR ($P>.05$) (Fig. 6).

4. Discussion

To the best of our knowledge, this is the first study investigating the difference of the success rate of rescue in PHEM between the physicians from public hospitals and those from the Emergency Medical Center. The important finding of this study showed no significant difference in the success rates of CPR between physicians from public hospitals and Emergency Medical Center personnel ($P>.05$).

Our study showed that in 2016 from February 1 to May 31, the total turnout number of ambulances in downtown Shanghai was 107,341 times, among which the effective turnout was 80,954 times, and first-aid was 55,053 times (68.01%). The 6 principal causes for calling ambulance service in Shanghai were Trauma, Cardiovascular diseases, Unknown diagnosis, Respiratory disease, Cerebrovascular diseases, and Digestive diseases. The overall mortality varied according to the diagnosis, with the

Rank	Diseases for ambulance call (category)	Total number of classified ambulance calls n (%)
1	Trauma	11,889 (21.60)
2	Cardiovascular diseases	7509 (13.64)
3	Unknown diagnosis	6617 (12.02)
4	Respiratory diseases	6236 (11.33)
5	Cerebrovascular diseases	5833 (10.60)
6	Digestive diseases	4806 (8.73)

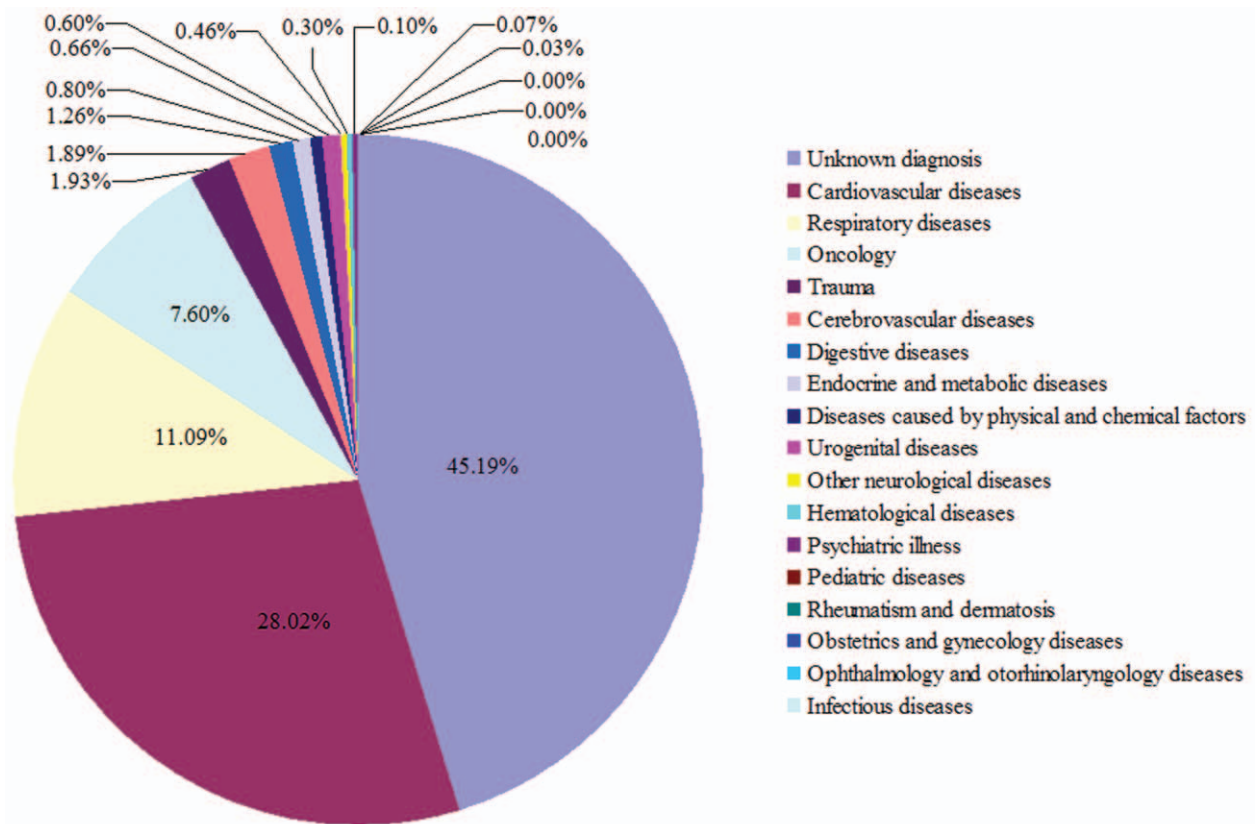


Figure 4. Classification of diseases in cardiopulmonary arrest patients (N=3012).

highest mortality for patients with cardiovascular disease, respiratory diseases as well as Unknown diagnosis. This observation is almost consistent with previous studies.^[17-20] The large proportion of unknown diagnosis found here is in

Table 2
Classification of diseases in cardiopulmonary resuscitation (N=3012).

Classification of diseases	Failure (n, %)	Success (n, %)	Total
Unknown diagnosis	1356 (99.63)	5 (0.37)	1361
Cardiovascular disease	817 (96.80)	27 (3.20)	844
Respiratory disease	326 (97.60)	8 (2.40)	334
Oncology	226 (98.69)	3 (1.31)	229
Trauma	58 (100)	0 (0)	58
Cerebrovascular disease	55 (96.49)	2 (3.51)	57
Digestive disease	37 (97.37)	1 (2.63)	38
Endocrine and metabolic diseases	23 (95.83)	1 (4.17)	24
Disease caused by physical and chemical factors	20 (100)	0 (0)	20
Urogenital disease	18 (100)	0 (0)	18
Other neurological disease	14 (100)	0 (0)	14
Hematological disease	9 (100)	0 (0)	9
Psychiatric illness	3 (100)	0 (0)	3
Pediatric disease	2 (100)	0 (0)	2
Rheumatism and dermatosis	1 (100)	0 (0)	1
Obstetrics and gynecology diseases	0 (100)	0 (0)	0
Ophthalmology and otorhinolaryngology diseases	0 (100)	0 (0)	0
Infectious disease	0 (100)	0 (0)	0
Total	2965 (98.44)	47 (1.56)	3012

agreement with the findings of a recent large cohort study in Denmark.^[21]

Another valuable finding of this study was that the percentage of critically ill patients (including cardiopulmonary arrest) treated by physicians from public hospitals was 10.33%, which was significantly less than 11.77% treated by the Emergency Center physicians ($P < .001$). This difference could be related to the distribution of bonuses for saving patients. For saving a patient, an

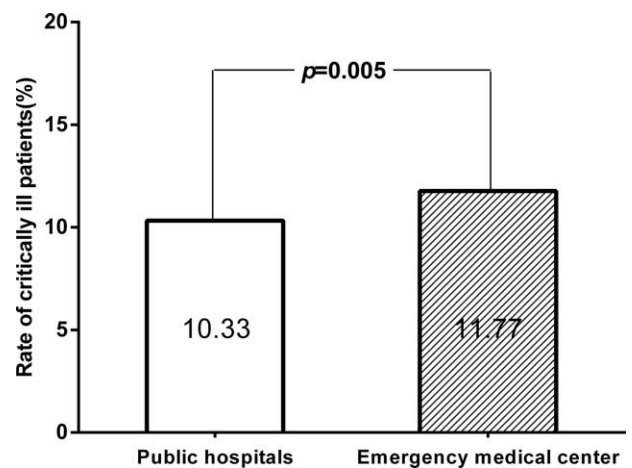


Figure 5. Critically ill patients treated by physicians from public hospitals or Emergency Center. Note: Data are shown as percentages. The significance of difference was test by Chi-square test.

Table 3

Cardiopulmonary arrest of inclusion of patients treated by physicians from public hospitals or Emergency Center.

	Number of noncardiopulmonary arrest patients (n, %)	Number of cardiopulmonary arrest patients (n, %)	Total	Chi-squared test
Physicians from public hospitals	4144 (96.22)	163 (3.78)	4307	$\chi^2=25.699$ $P<.001$
Physicians of Emergency Medical Center	47,897 (94.39)	2849 (5.61)	50,746	
Total	52,041 (94.53)	3012 (5.47)	55,053	

Data are shown as percentages.

Table 4

Cardiopulmonary arrest of critically ill patients treated by physicians from public hospitals or Emergency Center.

	Number of noncardiopulmonary arrest patients (n, %)	Number of cardiopulmonary arrest patients (n, %)	Total	Chi-squared test
Physicians from public hospitals	282 (63.37)	163 (36.63)	445	$\chi^2=20.344$ $P<.001$
Physicians of Emergency Medical Center	3125 (52.31)	2849 (47.69)	5974	
Total	3407 (53.08)	3012 (46.92)	6419	

Data are shown as percentages.

Emergency Center physician receives a higher bonus than a public hospital physician. The physicians from public hospitals, because of the work arrangements, have no desire to complete the basic task of the job rather than the voluntary work of the physicians in the Emergency Center. With respect to the patients, those with milder conditions will be given priority by the public hospital physicians in order to avoid medical malpractice. Such tendency is particularly evident in treating patients who may require CPR; the percentage of patients with cardiopulmonary arrest treated by physicians from public hospitals was 3.78%, which was significantly lower than the percentage treated by the Emergency Center physicians ($P < .001$).

The public hospital physicians will try to avoid critically ill patients, and hence, the number of patients with cardiopulmonary arrest encountered is significantly decreased.

Heavy workloads, difficult working conditions, limited reimbursements, and lack of recognition and respect from colleagues, contribute toward the difficulty in recruiting emergency physicians in Shanghai.^[11] With little potential for advancement and promotion within the system, this negative phenomenon would continue. Therefore, a regional plan should foresee these negative factors and afford excellent promotion opportunities and upper-level PHEM positions.

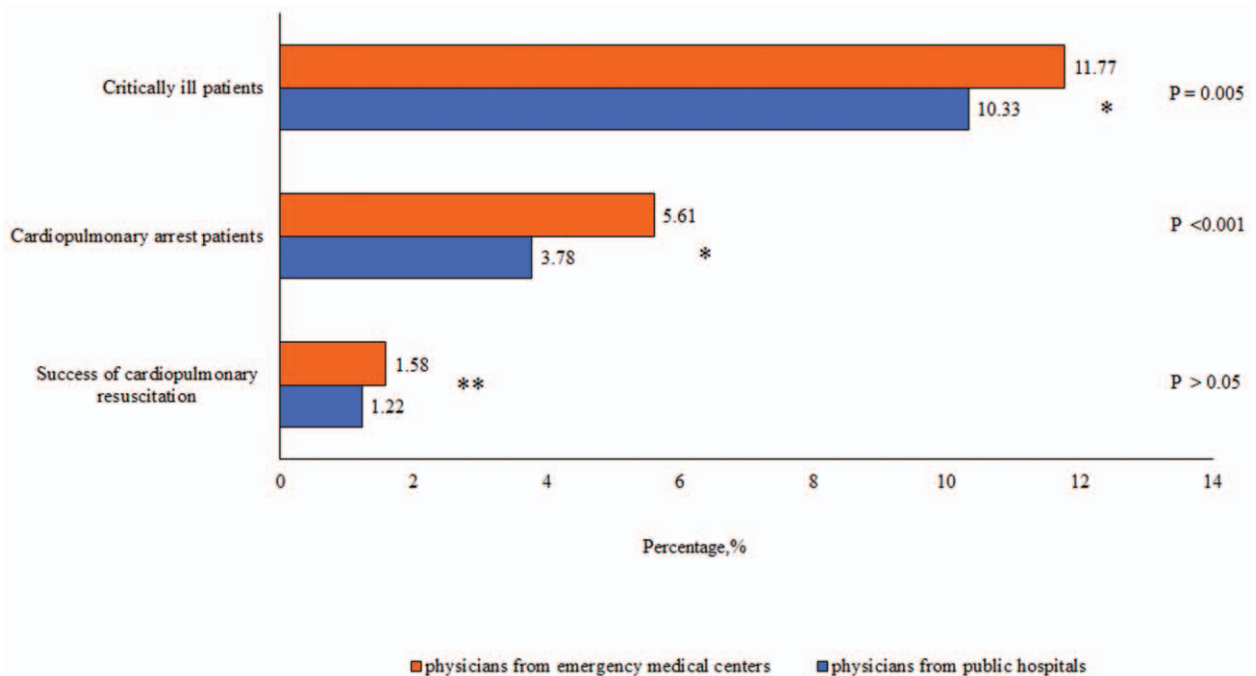


Figure 6. Difference of the effect in PHEM between the physicians from public hospitals and those from the Emergency Medical Center. Note: Data are shown as percentages. *The significance of difference was tested by Chi-square test. **The significance of difference was tested by Fisher test.

However, the current results show that transferring the attending physicians from public hospitals to the PHEM led to no improvement in the success rates of resuscitation. The success rate of CPR was 1.56% in 3012 patients, which was lower than that of the other countries.^[22,23] In addition, the success rate of CPR by public hospital physicians (1.22%) was lower than that of physicians working in Emergency Center (1.58%), although it did not achieve statistical significance.

The reasons for the low success rates of resuscitation are as follows.

First, even in developed cities such as Shanghai, the prevalence of ACLS (advanced cardiovascular life support) and BLS (basic life support) training in the hospitals is not very high; many physicians did not undergo standardized training. In addition, the training time in the emergency center was extremely short for standardized training and did not reach the appropriate level to perform high-quality CPR.^[24]

Second, insufficient teamwork, which rendered prolonged the coping of the public hospital physicians with the other staff of the Emergency Center. If they could match each other well, the public hospital physicians might leave the Emergency Center. For many physicians who work in PHEM, emergency medicine was not their initial choice of specialty. Thus, it significantly affects the quality of prehospital care and patient outcome. The process to strengthen the national standards of personnel training and practice will continue to constitute the significant challenge.

5. Limitations

As the author had only been at the Shanghai Emergency Medical Center for half a year, we investigated and analyzed only part of the data collected in Shanghai. However, the validity of the data is acceptable. One of the major strengths of the study is the population-based design, as it covered the whole city of Shanghai, which is one of the largest cities in the world. Another major strength is the availability of data, which were retrieved from the Shanghai Emergency Medical Center's electronic database. Apart from the diseases category and mortality, the data such as length of hospitalization, patient outcome are significant indicators for planning of prehospital.

6. Conclusion

Transferring the physicians from public hospitals to work in Emergency Medical Center showed no improvement in the success rates of resuscitation, and we analyzed the relevant reasons at the same time. Thus, a study focusing on these issues could provide insights into the disease burden and staffing of the health systems, thereby stimulating discussions about the future development of PHEM globally.

Author contributions

Conceptualization: Tongtian Ni, Weijun Zhou.

Data curation: Tongtian Ni, Weijun Zhou.

Formal analysis: Tongtian Ni, Min Chen.

Investigation: Tongtian Ni, Weijun Zhou.

Methodology: Tongtian Ni.

Resources: Jiong Zhao, Dan Jia.

Software: Min Chen.

Supervision: Min Chen, Weijun Zhou.

Writing – original draft: Tongtian Ni, Weijun Zhou.

Writing – review & editing: Tongtian Ni, Weijun Zhou.

References

- [1] Hua W, Zhang LF, Wu YF, et al. Incidence of sudden cardiac death in China: analysis of 4 regional populations. *J Am Coll Cardiol* 2009;54:1110–8.
- [2] Neumar RW, Shuster M, Callaway CW, et al. Part 1: executive summary: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2015;132(18 suppl 2):S315–67.
- [3] Hazinski MF, Nolan JP, Aickin R, et al. Part 1: executive summary: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Circulation* 2015;132(16 suppl 1):S2–39.
- [4] Nolan JP, Hazinski MF, Aickin R, et al. Part 1: executive summary: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation* 2015;95:e1–31.
- [5] Kleinman ME, Brennan EE, Goldberger ZD, et al. Part 5: Adult Basic Life Support and Cardiopulmonary Resuscitation Quality: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2015;132(18 suppl 2):S414–35.
- [6] Brice JH, Garrison HG, Evans AT. Study design and outcomes in out-of-hospital emergency medicine research: a ten-year analysis. *Prehosp Emerg Care* 2000;4:144–50.
- [7] Sutton RM, Case E, Brown SP, et al. A quantitative analysis of out-of-hospital pediatric and adolescent resuscitation quality: a report from the ROC epistry-cardiac arrest. *Resuscitation* 2015;93:150–7.
- [8] Shanghai Statistics Bureau. *Shanghai Statistical Yearbook*. China Statistics Press, Beijing; 2015.
- [9] Gui L, Gu S, Lu F, et al. Confronting the challenges of emergency medical service in Shanghai. *Resuscitation* 2011;82:788–9.
- [10] Peng X. China's demographic history and future challenges. *Science* (New York, NY) 2011;333:581–7.
- [11] Pei YV, Xiao F. Emergency medicine in China: present and future. *World J Emerg Med* 2011;2:245–52.
- [12] Gries A, Zink W, Bernhard M, et al. Realistic assessment of the physician-staffed emergency services in Germany. *Der Anaesthetist* 2006;55:1080–6.
- [13] Kruger AJ, Lossius HM, Mikkelsen S, et al. Pre-hospital critical care by anaesthesiologist-staffed pre-hospital services in Scandinavia: a prospective population-based study. *Acta Anaesthesiol Scand* 2013;57:1175–85.
- [14] Mikkelsen S, Kruger AJ, Zwisler ST, et al. Outcome following physician supervised prehospital resuscitation: a retrospective study. *BMJ Open* 2015;5:e006167.
- [15] Lerner EB, Maio RF, Garrison HG, et al. Economic value of out-of-hospital emergency care: a structured literature review. *Ann Emerg Med* 2006;47:515–24.
- [16] Botker MT, Bakke SA, Christensen EF. A systematic review of controlled studies: do physicians increase survival with prehospital treatment? *Scand J Trauma Resusc Emerg Med* 2009;17:12.
- [17] Zhang ZQ, Chen WB, Chen WY, et al. [The epidemiological characteristic of 97,823 cases of pre-hospital medical care in Guangzhou city]. *Zhongguo Wei Zhong Bing Ji Jiu Yi Xue* 2011;23:99–103.
- [18] Fischer M, Kamp J, Garcia-Castrillo Riesgo L, et al. Comparing emergency medical service systems: a project of the European Emergency Data (EED) Project. *Resuscitation* 2011;82:285–93.
- [19] Wang T, Zhang J, Wang F, et al. Changes and trends of pre-hospital emergency disease spectrum in Beijing in 2003–12: a retrospective study. *Lancet* (London, England) 2015;386:S39–139.
- [20] Christensen EF, Larsen TM, Jensen FB, et al. Diagnosis and mortality in prehospital emergency patients transported to hospital: a population-based and registry-based cohort study. *BMJ Open* 2016;6:e011558.
- [21] Vest-Hansen B, Riis AH, Sorensen HT, et al. Acute admissions to medical departments in Denmark: diagnoses and patient characteristics. *Eur J Intern Med* 2014;25:639–45.
- [22] Sasson C, Rogers MA, Dahl J, et al. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Quality Outcomes* 2010;3:63–81.
- [23] Hasselqvist-Ax I, Riva G, Herlitz J, et al. Early cardiopulmonary resuscitation in out-of-hospital cardiac arrest. *N Engl J Med* 2015;372:2307–15.
- [24] Bhanji F, Donoghue AJ, Wolff MS, et al. Part 14: Education: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2015;132(18 suppl 2):S561–73.