Trends in mortality of emergency departments patients in China

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BACKGROUND: Emergency medical service system (EMSS) in China is becoming more important. However, studies on mortality of emergency departments (EDs) patients in tertiary hospitals and on the trends in mortality of ED patients all over China are stagnant. The objective of this study was to quantify and describe the trends in mortality of ED patients in China.

METHODS: Nine tertiary teaching hospitals were selected from tertiary teaching hospitals in different regions. The annual numbers of ED visits and deaths of these hospitals in 2004, 2009 and 2014 were recorded and analyzed. Chi-square test was used to compare the mortality of the EDs’ visits. Moreover, data on the mortality of ED patients in China from 2005 to 2015 were summarized and analyzed from the China Health and Family Planning Statistical Yearbooks (2006–2016).

RESULTS: From 2004 to 2014, the overall annual mortalities in EDs increased among the tertiary hospitals (P<0.001). However, the overall annual mortality in EDs all over China decreased from 0.12% in 2005 to 0.08% in 2015. And the mortalities of EDs patients in the eastern, central and western regions of China all decreased. In addition, the average mortality of EDs patients in northern China was obviously higher than that in southern China (P<0.05).

CONCLUSION: The ED mortality was increased in tertiary hospitals while decreased all over China during the past decade, which may be partly caused by some critical challenges faced by China’s EMSS, such as overcrowding and long length of stay in EDs of tertiary hospitals.

KEY WORDS: Mortality; Emergency departments; Tertiary hospitals; Trends

INTRODUCTION

Due to the rising incidence of acute cardiovascular diseases, frequent traffic accidents and the improvement of the social medical insurance system during the past decade, emergency medical service systems (EMSS) in China are becoming more and more important. In 2015, China’s emergency departments (EDs) managed an estimated 138.8 million visits with the annual mortality as 0.08%, and the need for high quality acute and critical care services is likely to continue to increase exponentially. However, the study on mortality of EDs patients
in tertiary hospitals is stagnant, and no systematic description on the trends in mortality of EDs patients all over China is available.

In this study, we aimed to quantify and describe the trends of mortalities of China’s EDs visits during the past decade in detail, hoping to provide a theoretical basis to improve emergency care quality in China and share some experience and lessons for the development of EMSS around the world, especially for other developing countries with similar conditions, since China is an important and classic developing country with a huge population in the world.

**METHODS**

**Study design and setting**

The multicenter retrospective investigation was approved by the ethics committee of Qilu Hospital of Shandong University. Considering the geographic areas, population density and economic conditions, nine tertiary teaching hospitals in eight provinces were selected from the tertiary teaching hospitals in different regions within mainland China, excluding military hospitals, hospitals of traditional Chinese medicine and specialized hospitals (Figure 1). The tertiary teaching hospitals were Qilu Hospital of Shandong University, the Second Affiliated Hospital of Xi’an Jiaotong University, the First Affiliated Hospital of Harbin Medical University, Xin Hua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine, Beijing Chao-yang Hospital, the Second Affiliated Hospital of Zhejiang University School of Medicine, China-Japan Friendship Hospital, West China Hospital of Sichuan University, and General Hospital of Tianjin Medical University.

**Data collection and processing**

In the retrospective investigation, the annual numbers of visits and deaths in the EDs of these hospitals in 2004, 2009 and 2014 were counted, recorded and analyzed, according to patients registration of EDs and annual reports of each hospital. The mortality in EDs is defined as the total number of deaths in the EDs each year divided by the annual number of EDs visits of these hospitals.

In addition, data on the overall annual mortalities of the EDs visits in China were got from the *China Health and Family Planning Statistical Yearbooks (2006–2016)*. The Yearbooks included statistical data on the development of health and family planning and the health status of residents in China in the previous year, involving 31 provinces, autonomous regions and municipalities in mainland China. We assessed all hospitals in China but excluded specialized prevention stations, maternal and child health hospitals, and sanatoria. Moreover, the hospitals were stratified into three official economic-geographical regions- eastern, central and western regions.

The overall annual mortalities of the EDs visits of hospitals in China and in different regions (eastern, central and western) were got from the Yearbooks 2006–2016 and the Yearbooks 2008–2016, respectively. And the mortalities of EDs patients in different provinces in southern China and in northern China in 2015 were extracted from the Yearbook 2016 and further analyzed.

**Statistical analysis**

All statistical analyses were performed with SPSS 22.0 (IBM cooperation, Chicago, USA). Categorical variables were presented as frequencies or percentages. Chi-square test was used to compare the mortality of the EDs’ visits of the tertiary teaching hospitals in 2004 and 2014. Student’s t-test was used for comparing the mortalities of EDs patients in southern China and in northern China in 2015. *P*<0.05 was considered statistically significant.

**RESULTS**

We analyzed the trend of mortalities in EDs of 9 tertiary teaching hospitals in 2004, 2009 and 2014, and demonstrated that the overall annual mortality increased by 16.7%, from 0.24% in 2004 to 0.28% in 2014 in these EDs (*P*<0.001, *χ*²=17.58) (Figure 2A). However, the overall annual mortality in EDs all over China decreased by 33%, from 0.12% in 2005 to 0.08% in 2015 (Figure 2B), through summarizing and analyzing data from the Yearbooks.

Moreover, the mortalities of EDs patients in the eastern, central and western regions of China decreased by 33%, 30% and 22% from 2007 to 2015, respectively (Figure 2C). Geographically, the average mortality of EDs patients in northern China was 0.13% in 2015,
which was obviously higher than that in southern China as 0.05% \((P<0.05)\) (Figure 3).

**DISCUSSION**

In this study, we described and quantified the trends in mortality for EDs patients from 2005 to 2015 in China, and found that the ED mortality was steady and even slightly increased in tertiary hospitals while decreased all over China during the past decade.

Since 1980s, the policies on China’s EMSS were initially developed. Since 1980s, China’s EMSS made little progress during the first twenty years, but improved relatively quickly for the past decade. The annual incidence of virtually all major acute and critical illnesses is rising in China, with increasing ED visits among all levels of hospitals, from 52 million in 2007 to 138.8 million in 2015. In response to the rapid increases in demand and to several public health emergencies, substantial resources have been allocated to improve quality and efficiency of China’s EMSS. Due to the increasing medical resources, the overall annual mortality of emergency patients decreased by 33%, from 0.12% in 2005 to 0.08% in 2015, which was obviously lower than that in some other low- and middle-income countries. A systematic review of emergency care in 59 low- and middle-income countries reported that the median mortality within EDs was 1.8%. In India, the mortality of emergency patients ranged from 0.6% to 1.7% in three sites in 2014, partially due to the underutilization of prehospital therapeutics and Indian EMSS in most places still fragmented without a centralized system across all of the state.

Though the overall annual mortality of emergency patients decreased in China during the past decades, there was no significant change on the mortality of ED patients in tertiary hospitals, which still kept steady and even slightly increasing. The relatively minor changes in mortality among tertiary hospitals’ ED patients may partly result from more complex cases with higher probabilities of non-survival drawn to tertiary hospitals, and the rising demand for acute and critical care services by lower acuity patients with newly acquired access to hospital-based emergency care and by high acuity patients, which is an emblem of the increasingly chronic illness burden in China. In addition, several substantial challenges faced by China’s EMSS such as...
as overcrowding, long length of stay in EDs, frequent ambulance diversion, work exhaustion and consequent instability of emergency physicians and nurses, should be the key reasons for the steady and even slightly increasing mortality in the tertiary hospitals’ EDs, which are pending problems of China and also other developing countries, even the developed world.

CONCLUSIONS
During the past decade, the ED mortality was increased in tertiary hospitals while decreased all over China, which may be partly caused by some critical challenges faced by China’s EMSS such as overcrowding and long length of stay in EDs of tertiary hospitals. The limitation of our study was that a number of important covariates were not included in our analysis, which were important for determining the differences between the tertiary and other hospitals, since our data on mortalities were mainly got from the Yearbooks, and in the retrospective investigation only the annual numbers of visits and deaths in the EDs of these hospitals were recorded. But the study should provide the theory basis for improving the quality of EMSS in China, and share some lessons and experience for the world’s EMSS development, especially for other developing countries.

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Competing interest: None declared.

Contributors: CP and XH contributed equally to this study. FX and YC had the original idea, designed the paper structure and drafted the paper. CP, XH, JP and KC reviewed the literature, did the information collection, analyze data, prepared the references, and produced the figures. All authors reviewed and approved the final version.

REFERENCES

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