

Current Status of helicopter emergency medical services in China

A bibliometric analysis

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Abstract

Background: After nearly 20 years of development, China has realized some achievements in helicopter emergency medical services (HEMS). The purpose of this article is to introduce and evaluate the development and characteristics of HEMS in China by collecting and analyzing relevant literature and, in so doing, help this vital service to further develop.

Method: We conducted a Pubmed, Medline, Embase, ScienceDirect, Wanfang, CNKI, and VIP search of the literature on HEMS of China published between January 1950 and April 2017. The title, author name, number of authors, publishing date, country or region of origin, institution, type of article, study topic, funding source, and level of evidence of each article were recorded and analyzed.

Results: There were 41 papers included in the analysis. All articles were published in Chinese. The selected articles were published between 2002 and 2017. The 41 articles originated from China, but 7 different regions were represented: East China (n=14), followed by North China (n=12), Central China (n=8), Southwest China (n=3), South China (n=2), and Northwest China (n=2). The articles included 18 clinical studies, 12 reviews, and 11 clinical guidelines. Among these, 22 articles were from public hospitals; 18 were from military units and 1 came from a private hospital. One article from the public hospitals was funded by public foundations (4.5%); 11 articles from the army units received support from Army funding (61.1%). Compared with the public and private hospitals, articles from military units were more likely to receive financial support ($\chi^2 = 15.7 P < .01$). All the articles were assigned a level of evidence from 1 to 5. Level 5 (78.0%) was the most frequent level of evidence. There were 7 studies at level 4. Only 2 articles were assigned to level 3. There were no articles at levels 1 or 2.

Conclusions: China's HEMS is a relatively new service. Its level of development is low, interregional development is uneven, and cooperation has been insufficient. We need to strengthen capital investment and develop a unified guideline to further enhance the development of HEMS in China.

Abbreviations: HEMS = helicopter emergency medical services, ISTIC = Chinese core journal criterion of Institute of Scientific and Technical Information of China, PKU = Chinese core journal criterion of Peking University, RCTs = randomized control trials, SCI = Science Citation Index.

Keywords: bibliometric analysis, China, helicopter, HEMS, rescue, transport

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All data generated or analyzed during this study are included in this published article.

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1. Introduction

Helicopters are a new life-saving tool with high speed, strong mobility, and less vulnerability to climatic conditions, as may be faced in medical rescues.^[1,2] Most of the world's developed countries, particularly Germany and the United States, have developed a well-organized, command-efficient helicopter emergency medical rescue system. Germany was the first country in the world to establish a helicopter emergency medical rescue system,^[3] further, it formed a nationwide intensive air ambulance network. Patients can receive air rescue services within 15 minutes anywhere in the country.^[4-7] The United States used helicopters to transport patients as early as the 1950s (during the Korean War); this effort was a great success.^[8,9] After decades of development, the US air medical services are now highly advanced; nearly 10,000 helicopters can be deployed for rescue. It has been estimated that the United States carries out 400,000 helicopter emergency rescue missions each year.^[10,11]

In China, in contrast—notwithstanding its large population—its helicopter emergency medical services (HEMS) have lagged behind. This is due in large part to airspace control by the government, the small number of helicopters available and weak economic strength. Until the beginning of the 21st century,

missions by the HEMS were rarely carried out.^[12] After nearly 20 years of development, China has begun to see some accomplishments in HEMS. The purpose of this article is to introduce and evaluate the development and characteristics of HEMS in China by collecting and analyzing the relevant literature. By these means, the hope is to assist HEMS in China in further developing.

2. Methods

2.1. Search strategy

A computer-based literature search was conducted to identify publications relating to HEMS of China. We reviewed the Pubmed, Medline, Embase, ScienceDirect, Wanfang, CNKI, and VIP databases for literature on HEMS of China, published between January 1950 and April 2017. We combined search terms with “helicopter”, “emergency/first aid”, and “China/Chinese”. All electronic searches were conducted on a single day, April 30, 2017, to avoid changes in citation rate, to the extent possible.

2.2. Study selection

Articles were reviewed by 2 independent reviewers (DX and PL) by reading the abstracts. When it was necessary, the full texts were acquired from Pubmed, Medline, Embase, ScienceDirect, Wanfang, CNKI, or VIP. The Wanfang, CNKI, and VIP were the 3 databases of Chinese periodicals used. Only studies focusing on HEMS of China as the main topic were included. The exclusion criteria were:

- (1) articles in languages other than English or Chinese and
- (2) articles focused on topics other than HEMS of China.

Any disagreement between the 2 reviewers was resolved through discussion with a third reviewer (SL).

2.3. Data extraction

Two authors (DX and PL) independently extracted data with a structured data collection form. Discrepancies were resolved by discussion with the senior investigator (SL). The following information was sought from each article:

- (1) authors and authorship (first, second, and corresponding authors),
- (2) publication year and language,
- (3) title,
- (4) country or region of origin and the unit of author (first and corresponding authors).

If there were authors from multiple countries or regions, the country or region of origin was determined using the country or region of the corresponding author. Articles that received funding were identified. Level of evidence for clinical studies was also identified and was evaluated based on the levels of evidence introductory document from the Oxford Centre for Evidence-based Medicine.^[13] In addition, the name of journal and the situation about article be collected by core journals were also extracted. There was 100% agreement between the 2 authors.

2.4. Evaluating the included studies

Based on included study design, research setting and goals, the selected articles were grouped into 5 categories: clinical guidelines, review, meta-analysis, basic research, and clinical research

(including observational and randomized control trials, RCTs). Prospective, retrospective and case series were all categorized as observational studies. RCTs included both single-blind and double-blind studies.

2.5. Statistical analysis

One-way ANOVA was used to compare numeric data between the groups, while χ^2 test was used for non-numerical data. Statistical analysis was processed with the software SPSS 20.0 (SPSS, Chicago, IL), and a *P* value of less than .05 was considered significant.

3. Results

A total of 278 papers were identified after the initial search in the period from January 1950 to April 2017. One hundred seven papers came from Wanfang, 6 papers were found in CNKI and 165 articles were searched out in VIP. There were no papers from Pubmed, Medline, Embase, ScienceDirect. The 87 duplicates were removed using EndNote X8 (Thomson Reuters, New York City, NY), leaving 191 studies. The titles and abstracts were reviewed to eliminate studies that were unrelated to HEMS of China; 101 articles were thereby removed. We then reviewed the full text of the remaining studies to eliminate 49 more articles. Ultimately, 41 papers were included in the analysis (see Fig. 1; Table 1). All final articles were published in Chinese.

The selected 41 articles were published between 2002 and 2017. The greatest number of papers were published in 2015 (*n* = 6); no articles were published in 2007. Thirty-3 articles were included in Chinese core journal criterion of Institute of Scientific and Technical Information of China (ISTIC), and 6 articles were included both in Chinese core journal criterion of Peking University (PKU) and ISTIC. Eight articles were not included in any of the core journals; no articles were Included in Science Citation Index (SCI).

3.1. Publishing journals of the articles

The 41 articles were published in 22 journals (Table 2), predominantly in Chinese general medical journals. The largest number of articles were published in the China Journal of Emergency Resuscitation and Disaster Medicine (*n* = 8), followed by the Chinese Journal of Aerospace Medicine (*n* = 6) and the Chinese Journal of Critical Care Medicine (*n* = 4). The China Journal of Emergency Resuscitation and Disaster Medicine and Chinese Journal of Aerospace Medicine were included in ISTIC, and Chinese Journal of Critical Care Medicine was included in both ISTIC and PKU.

3.2. Authorship, origins, and institutions

The majority (60.9%) of 41 articles were produced by teams involving >3 authors. A list of the most frequently appearing authors is presented in Table 3. It was clearly dominated by Xiangrui Xu, who authored 6 articles (first and corresponding author: 5; other author: 1) and Yingzhou Ding, who authored 3 articles (corresponding author: 3).

The 41 articles all originated in China but from 7 different regions (Fig. 2). The highest number (*n* = 14), came from East China, which has 400 million inhabitants; followed by North China (*n* = 12), which has 168 million inhabitants; Central China (*n* = 8) which has 223 million inhabitants; Southwest China

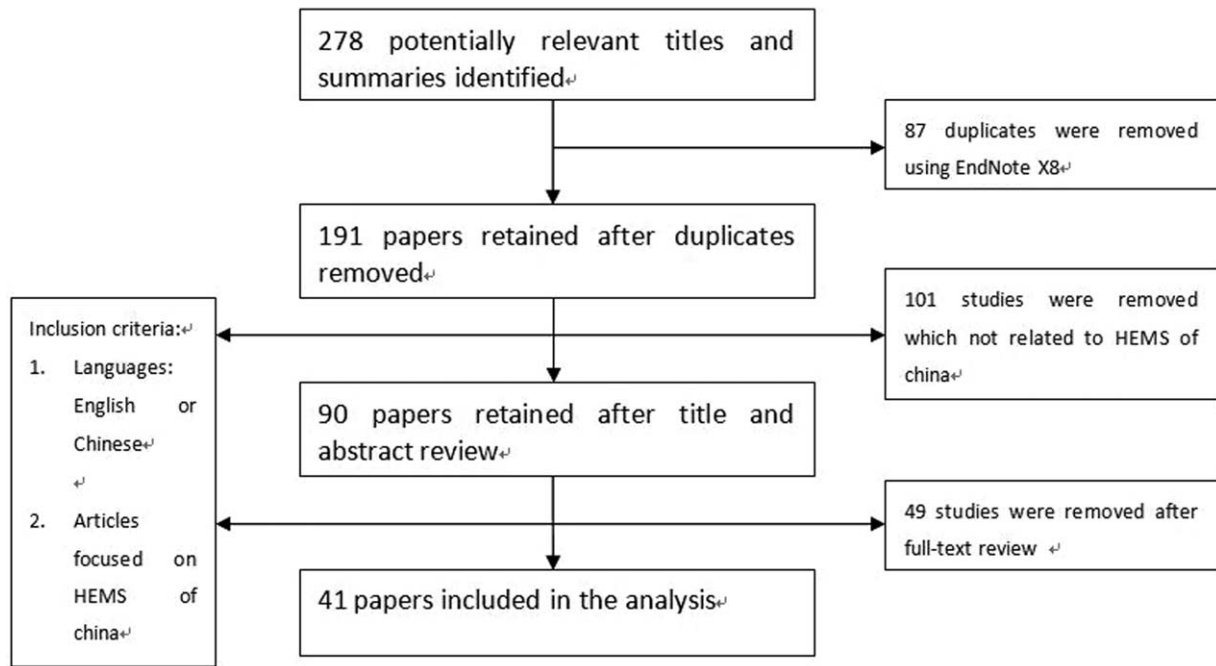


Figure 1. Flow diagram for selection and inclusion of studies.

(n=3), which has 199 million inhabitants; South China (n=2), which has 169 million habitants and Northwest China (n=2), which has 100 million inhabitants. All other regions had no publications, as shown in Figure 2. Of the total 41 articles, the leading institution with the greatest number of articles was the Emergency Centre of Qingdao City (Qingdao, Shandong province; n=7). The second was the Emergency Centre of Wuhan City (Wuhan, Hubei province; n=4). The third was People’s Liberation Army 252 Hospital (Baoding city, Hebei province; n=3).

3.3. Publication type, funding source, and level of evidence

The 41 articles included 18 clinical studies, 12 reviews, and 11 clinical guidelines. Among the 41 articles, 22 were from public hospitals, 18 were from military units and 1 came from a private hospital. One article (4.5%) from the public hospitals was funded by public foundation, 11 articles from the army units (61.1%) received support from Army funding, and the article from a private hospital had no funding (see Table 4). Compared with the public and private hospitals, articles from military units were more likely to receive financial support ($\chi^2=15.7, P<.01$). The disclosed funding supported by the Army was 91.6% of all funds; that supported by public foundations constituted only 8.3%.

All the articles were assigned a level of evidence from 1 to 5. Level 5 (78.0%) was the most frequent level of evidence; there were 7 studies at level 4. Only 2 articles were assigned to level 3. There were no articles at levels 1 or 2.

The number of times the article was cited.

The most cited in all articles was Discussion on Helicopter Emergency Transport Process (n=11). The next was Actuality and development of helicopter emergency medical service (n=10). The third was Retrospect and Prospect of Helicopter

Emergency Medical Rescue and Improve the city first aid function by Helicopters to transport critically ill patients (n=8).

4. Discussion

This study is the first to identify, rank and characterize the articles in the field of China’s HEMS. The results of the research show the current status and characteristics of China’s development in this area and provide information necessary for scholars in related fields to further promote the development of HEMS in China.

Bibliometric analysis is a tool that can quantify the characteristics and scholarly impact of citations in a given area of study.^[14] Understanding the characteristics of highly cited studies in relevant journals may help authors who wish to submit and publish effectively.^[15]

All articles examined came from China and were written in Chinese. This suggests that foreign experts and scholars may not have the means to understand the status of China’s HEMS. This is one of the primary goals of this study: to enable foreign scholars to understand China’s HEMS programme and thereby further assist in its development. Articles originated mainly from the eastern, northern, and central regions of China. In considering the reasons for this, it is worth pointing out: HEMS needs a higher capital investment compared with the ground vehicle first aid programme.^[16-19] Thus the development of HEMS has a higher demand in terms of local economic strength. East China is at the forefront of China’s reform and economic opening; its economic development is the most robust. North China contains the capital of China, Beijing, where a large number of scientific publications and colleges are located. Central China has a large population. This region contributes a great deal to the overall economy.

With regard to the institutions that served as the source of the articles, the top 3 were the Emergency Centre of Qingdao City, the Emergency Centre of Wuhan City and People’s Liberation

Table 1

Bibliometric information associated with 41 articles of helicopter emergency medical services of China.

Rank	Authors	Title	Journals	Years	Core journal
1	Xiangrui Xu et al	The implementation of medical emergency in the cabin of helicopter in flight	Chinese Journal of Critical Care Medicine	2002	PKU ISTIC
2	Xiangrui Xu et al	Research on the implementation of medical emergency in helicopter flight	Chinese Journal of Aerospace Medicine	2002	ISTIC
3	Xiangrui Xu et al	Medical first aid practice with helicopter	He Bei Medicine	2002	ISTIC
4	Yingchun Wang et al	Pre-flight training of Helicopter aviation rescue team	Chinese Journal of Aerospace Medicine	2003	ISTIC
5	Xiangrui Xu et al	Application of Field Blood Transfusion in Helicopter Stereoscopic First Aid	Chinese Journal of Critical Care Medicine	2003	PKU ISTIC
6	Fei Wang et al	Exploration on the configuration of emergency medical equipment in emergency cabin of helicopter	Journal of Clinical Emergency	2004	ISTIC
7	Yuean Xiong et al	Improve the city first aid function by Helicopters to transport critically ill patients	Chinese Journal of Critical Care Medicine	2004	PKU ISTIC
8	Yong Zou et al	Discussion on Helicopter Emergency Transport Process	Chinese General Practice	2005	PKU ISTIC
9	Maoxing Yue	Seriously injured by Special weapons with helicopter ambulance	People's Military Surgeon	2005	ISTIC
10	Xiangrui Xu et al	Practice of Air Rescue in Acute Trauma Patients	Chinese Journal of Aerospace Medicine	2005	ISTIC
11	Haizhong Shao	Application of Helicopter Airborne Ambulance in Pre - hospital Emergency	Journal of Clinical Emergency	2005	ISTIC
12	Shan Zhao	Construction of Urban Stereoscopic Rescue and Rescue System	Chinese Hospital Management	2006	ISTIC
13	Meijiao Chen	Nursing of a large number of special - burn burners after military helicopter shunt	Military Medical Journal of Southeast China	2006	ISTIC
14	Haifeng Xiao	Development of Plateau Emergency Medical Treatment System Mounted on Helicopter	Chinese Medical Equipment Journal	2008	ISTIC
15	Hai Hu et al	Experience of transfer of 760 trauma patients with helicopter after the Wenchuan Earthquake	Chinese Journal of Critical Care Medicine	2008	PKU ISTIC
16	Xiaohua Li et al	Process Design of transshipment by helicopter first aid	Chinese Hospital Management	2009	ISTIC
17	Taihu Wu et al	Design of integrated Emergency Medical Treatment System mounted on helicopter	Chinese Medical Equipment Journal	2009	ISTIC
18	Haiming Shi et al	Actuality and development of helicopter emergency medical service	Chinese Journal of Aerospace Medicine	2010	ISTIC
19	Junyong Zhang et al	Concept of developing helicopter emergency medical assistance in military hospital	China Journal of Emergency Resuscitation and Disaster Medicine	2011	ISTIC
20	Xiaojuan Zheng	Preliminary Discussion on Aviation Helicopter Aid Work of Shanghai	China Medicine and Pharmacy	2011	—
21	Jianru Gu et al	Retrospect and Prospect of Helicopter Emergency Medical Rescue	China Journal of Emergency Resuscitation and Disaster Medicine	2011	ISTIC
22	Xukun Liu	Application and Development of Fire Fighting Team in Emergency Rescue	China Emergency Rescue	2011	—
23	Meijing Zhang et al	The Characteristics and Inspiration of Foreign Helicopter Emergency Rescue	China Journal of Emergency Resuscitation and Disaster Medicine	2011	ISTIC
24	Yiming Lu	Helicopters and the Urban Trauma System	Practical Journal of Clinical Medicine	2012	ISTIC
25	Yi Fei et al	Thoughts on the Construction of China 's Health Aircraft System	Chinese Journal of Aerospace Medicine	2013	ISTIC
26	Jian Liu et al	Strategy and Experience of Rescue Helicopter in Shenzhen - 9 Spacecraft Medical Security	Journal of Aerospace Medicine	2013	—
27	Yaohua Zhang	Problems and Countermeasures of First - aid Integration Construction in Wuhan City Circle	China Journal of Emergency Resuscitation and Disaster Medicine	2013	ISTIC
28	Ping Hu et al	Discussion on the Construction of China 's Social Forces in Air Emergency Rescue System	China Journal of Emergency Resuscitation and Disaster Medicine	2014	ISTIC
29	Lei Yang et al	The Establishment of Helicopter Air Ambulance System	China Journal of Emergency Resuscitation and Disaster Medicine	2014	ISTIC
30	Baijiang Tao et al	The establishment of China's helicopter air "120" Rescue system is imperative	Chinese Journal of Injury Repair and Wound Healing	2014	ISTIC
31	Bing Wang et al	Analysis of 34 medical cases rescued by helicopter at sea	Chinese Journal of Aerospace Medicine	2015	ISTIC
32	Maoxing Yue et al	Points and improvement measures of Medical rescue helicopter implementation of aviation medical rescue	Chinese Journal of Hygiene Rescue (Electronic Edition)	2015	—
33	Zhiying Lu et al	Exploration on the Construction of Nursing Management Model of Helicopter Air Emergency System	World Latest Medicine Information	2015	—
34	Xinlei Zhang et al	Implement teamwork to locate rescue mode training to improve the effectiveness of cardiopulmonary resuscitation in air rescue	Chinese General Practice Nursing	2015	—
35	Xinlei Zhang et al	Experience of 27 cases of critically ill patients transported by air	Today Nurse	2015	—
36	Siyan Ma	Analysis of Helicopter emergency support system program	Management Observer	2016	—
37	Bing Liu et al	Current situation of domestic aviation medical rescue	China Journal of Emergency Resuscitation and Disaster Medicine	2016	ISTIC
38	YanJun He et al	Study on the Transmutation of Wartime Survivors in Plateau Cold Area	Military Medical Journal of Southeast China	2016	ISTIC
39	Jiangzhou Ding et al	Research on the maritime helicopter medical system	Chinese Journal of Nautical Medicine and Hyperbaric Medicine	2016	PKU ISTIC
40	Liexing Xie et al	Application and thinking of Helicopter Emergency Rescue Service (HEMS) in Healthcare work	Chinese Journal of Health Care and Medicine	2017	ISTIC
41	Jiale Yuan et al	Current situation and prospect of helicopter medical rescue	China Journal of Emergency Resuscitation and Disaster Medicine	2017	ISTIC

ISTIC=core journal criterion of Institute of Scientific and Technical Information of China, PKU=chinese core journal criterion of Peking University.

Table 2
Journals in which the 41 articles were published.

Journals	Numbers of articles	Core journal
Chinese Journal of Critical Care Medicine	4	PKU ISTIC
Chinese Journal of Aerospace Medicine	6	ISTIC
He Bei Medicine	1	ISTIC
Journal of Clinical Emergency	2	ISTIC
Chinese General Practice	1	PKU ISTIC
People's Military Surgeon	1	ISTIC
Chinese Hospital Management	2	ISTIC
Military Medical Journal of Southeast China	2	ISTIC
Chinese Medical Equipment Journal	2	ISTIC
China Journal of Emergency Resuscitation and Disaster Medicine	8	ISTIC
China Medicine and Pharmacy	1	—
China Emergency Rescue	1	—
Practical Journal of Clinical Medicine	1	ISTIC
Journal of Aerospace Medicine	1	—
Chinese Journal of Injury Repair and Wound Healing	1	ISTIC
Chinese Journal of Hygiene Rescue (Electronic Edition)	1	—
World Latest Medicine Information	1	—
Chinese General Practice Nursing	1	—
Today Nurse	1	—
Management Observer	1	—
Chinese Journal of Nautical Medicine and Hyperbaric Medicine	1	PKU ISTIC
Chinese Journal of Health Care and Medicine	1	ISTIC

ISTIC=core journal criterion of Institute of Scientific and Technical Information of China, PKU=chinese core journal criterion of Peking University.

Army 252 Hospital. Qingdao is a coastal open city located in the east of China; it is also the home base of the Yellow Sea Fleet of the Chinese People's Liberation Army. The sailing project competition of the 2008 Beijing Olympic Games was held in Qingdao. Because of its geographical location and special military factors, its HEMS programme was carried out earlier and bore the characteristics of military and civilian combination. Wuhan city, in central China, was the first city to carry out HEMS in China;^[12] there were more reports about its HEMS than that of other provinces. People's Liberation Army 252 Hospital is a military unit with a large number of advantages over the public hospitals. In China, a great amount of helicopter resources have been deployed in the army, particularly the Army Air Force (often deployed in large cities).^[20] Military hospitals can carry out HEMS successfully with this support. Hongli Hospital is a private hospital which is worth our special attention. It is the only private hospital found that carries out HEMS.^[21]

This shows that HEMS has been generally recognized as a viable programme—not only at national public hospitals but also at private hospitals.

We found that China's HEMS started late compared to Western developed countries. The earliest HEMS literature reports from Western countries can be traced back to the 1940s.^[22] In China, the first article about HEMS appeared in 2002. The total number of articles was also small; it was less than 50 after development of nearly 15 years. It also led to fewer citations of these articles. The most one was only 11 times to be cited. Some articles had not even been cited. There was a huge difference in the number of published articles per year. Our study further found that the appearance and development of HEMS in China closely tracked large national events. As an example, Beijing's successful bid for the Olympic Games was in July 2001, the Shanghai World Expo was held in 2010 and the 22nd APEC meeting was held in 2014. After these important years, the number of articles about HEMS increased significantly. The first report of HEMS in Shanghai was in 2011. It reported that Medical Emergency Centre of Qingpu District in Shanghai successfully completed several helicopter medical emergency missions during the Expo.^[23]

We found that there has been no cross-regional clinical study thus far that analyzed all 41 articles. Most of the cooperation regarding the articles still remain in the provincial units. In Hubei province, Wuhan city (as the center) carried out cooperation with the surrounding cities in that region.^[24] However, there has been a lack of unified norms and systems for HEMS in the country as a whole.

Regarding funds, public hospitals are very different from military hospitals. We can find that military units have paid more attention to HEMS research; further, HEMS in local public and private hospitals need to be further strengthened.

As a Chinese article, if it was included in both PKU and ISTIC, this indicates that the quality of the article was relatively high. Thirty-three articles were included in the ISTIC; the article quality, based on our assessment, was medium. All the articles were written in Chinese, so no articles were included in the SCI. In general, the quality of the articles about HEMS is not high. With regard to classification of the articles, most involved clinical research, review or clinical guidelines. Clinical research articles were mainly reported in the form of case reports, controlled and cohort studies. Review was descriptive and lacked meta-research. Clinical guidelines were mainly based on personal advice and guidance. There was a lack of uniform guideline with respect to treatment.

In general, the level of evidence of the articles was low. Studies about HEMS in China were lacking both in quality and evidence

Table 3
Authors with 2 or more articles.

Rank	Author	Institution	Number of articles	First	Correspond	Other
1	Xiangrui Xu	Emergency Center of Qingdao City	6	5	5	1
2	Maoxing Yue	People's Liberation Army 306 Hospital	2	2	2	—
3	Xinglei Zhang	Beijing Red Cross emergency rescue center	2	2	2	—
4	Yingchun Wang	Emergency Center of Qingdao City	2	1	1	1
5	Haifeng Xiao	Third Military Medical University	2	1	1	1
6	Taihu Wu	Military Academy of Medical Sciences	2	1	1	1
7	Meijing Zhang	Equipment commanding technical college	2	1	—	1
8	Yingzhou Ding	People's Liberation Army 252 Hospital	3	—	3	—



Figure 2. Numbers of articles in different areas of China.

level. This may be related to the relatively recent start of China’s HEMS and lack of a large number of cases. We believe that the quality and evidence level of the articles will improve with the further development of HEMS in China.

A total of 8 articles referred to the costs of HEMS. For example, the cost of HEMS in Wuhan City Emergency Centre was 1000 US dollars per hour. In Qingdao City Emergency Centre the cost was 1500 US dollars each time. In general, the cost of HEMS was high. In recent years, Beijing has introduced commercial insurance. The patient has the right to reimburse the cost of HEMS after paying an annual insurance fee. The annual insurance fee is 50 to 150 US dollars per year.

5. Conclusion

China’s HEMS has only recently started. Compared with Europe and the United States, its level of development is low, interregional development is uneven, and cooperation is

insufficient. We need to strengthen capital investment and develop a unified guideline to further enhance the development of HEMS in China.

Author contributions

DX searched the scientific literature and drafted the manuscript. PL contributed to conception, design and data interpretation. SL helped to collect the data and performed statistical analyses. FH, H-C P and RP contributed to conception, design, data interpretation, manuscript revision for critical intellectual content and supervision of the study. All authors read and approved the manuscript.

Data curation: Ding Xu.

Formal analysis: Sheng Li.

Methodology: Peng Luo.

Project administration: Roman Pfeifer.

Software: Peng Luo.

Supervision: Frank Hildebrand, Hans-Christoph Pape.

Writing – original draft: Ding Xu.

Writing – review & editing: Ding Xu.

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Table 4

The situation of the funding of different units.

	Numbers	Funding, N	Funding/numbers
Military units	18	11	61.1%
Public units	22	1	4.54%
Private units	1	0	0%
statistics		$\chi^2=15.7$	$P<.01$

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