

Hospitalization Rates Difference of Adult Emergency Patients between Urban and Suburban in Tianjin

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Abstract

Aim: Compare the hospitalization rate of adult emergency patients within 6 h of arrival between urban and suburban hospitals in Tianjin.

Method: We analyzed a cross-sectional survey data for adult emergency patients. Fifty hospitals were divided into two groups: urban and suburban group according to geographical location. Each group was classified into two (secondary and tertiary hospital) subgroups. The emergency hospitalization rate within 6 h of arrival, gender and age of patients, Emergency Severity Index (ESI), as well as the mode of arrival and primary diagnosis, were collected and compared using Student's t-test, χ^2 test, or Fisher's exact test as appropriate between both groups and subgroups.

Results: 1) 6569 patients visited emergency departments and 494 (7.52%) were hospitalized within 6 h of arrival. 178 of 3680 (4.84%) and 316 of 2889 (10.94%) patients were hospitalized in the urban and suburban group, there was a significant difference between two groups ($P < 0.05$). 2) Concerning tertiary subgroup, 157 of 2984 (5.26%) urban and 253 of 1833 (13.80%) suburban patients were hospitalized; in secondary subgroup, 21 of 696 (3.02%) urban and 63 of 1056 (5.97%) suburban patients were hospitalized, there were a significant difference between both two subgroups ($P < 0.05$). 3) There was a significant difference in age, yet no significant difference in other aspects. 4) Injury patients in suburban hospitals were more than urban hospitals while pregnancy/childbirth patients were converse ($P < 0.05$).

Conclusions: Adult emergency patients' hospitalization rate was 7.52% in Tianjin and suburban tertiary hospitals possess the relatively higher hospitalization rate.

Introduction

The Emergency Department (ED) is often considered the 'front door' to a hospital and is a major center of operations. One important function of ED was as the route of admission to the hospital, especially for the patients with lower socioeconomic status and elderly patients [1-6]. ED overall hospitalization rate varied greatly, from 16.9% to 51% [1,3,7-12]. In addition, there was a difference of ED hospitalization rate between different geography [2,12].

Our previous study showed ED crowding, its possible causes and solutions through a cross-sectional survey in Tianjin, but there were very few published data that had considered adult ED patients' hospitalization rate within 6 h of arrival and the difference between urban and suburban hospitals. In this study, we retrospectively analyzed the cross-sectional survey data for adult (14 years or more) ED patients in Tianjin. All eligible patients were divided into two groups (urban and suburban) according to the geographical location of admitted hospital. And then each group was classified into two subgroups (secondary and tertiary) based on "hospital grading management standards". We compared ED patients' hospitalization rate within 6 h of arrival as well as gender and age of patients, Emergency Severity Index (ESI), mode of arrival, primary diagnosis between both groups and subgroups. And we wish this information may be useful for future research and policy.

Materials and Methods

Participating centers

Tianjin is a metropolis in northern coastal China and one of the six national central cities of China, with a total municipal population of 15,469,500 by the end of 2015 (<https://en.wikipedia.org/wiki/Tianjin>) and 110 hospitals (including 43 tertiary and 67 secondary hospitals) in 2016.

This cross-sectional survey was conducted in 50 hospitals, 45 were general and 5 were specialist hospital; we divided them into two groups: urban group and suburban group according to the geographic location of admitted hospital. 22 (including 13 tertiary level) hospitals (urban group) were located in urban districts with 157.35 km² (1.32%) and 4 343 040 (33.57%) population and 28 (including 14 tertiary level) hospitals (suburban group) were located in suburban districts, with 11727 km² (98.68%) and 8 595 184 (66.43%) population in 2010 (<https://en.wikipedia.org/wiki/Tianjin>). Each group was classified into two (secondary hospital and tertiary hospital) subgroups. Fifty recruited hospitals were distributed in different districts and can reflect general patients' characteristics in Tianjin (Figure 1).

Data selection and group

In this retrospective cross-sectional survey, each hospital collected data on adult patients (14 years or more) who visited EDs from 8:00 08/30/2016 to 8:00 08/31/2016 (24 h total). Patients (<14 years) were visited by children hospital or pediatric department, which were independent to ED and they were excluded in our survey.

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The primary end point was emergency hospitalization rate within 6 h of arrival, including two situations: “directly admit to the hospital” or “admit to the observation unit, then hospitalized” with 6 h of arrival. In addition, Gender and age of patients (classify into ≥ 65 years and <65 years group), ESI, as well as the mode of arrival, primary diagnosis (based on ICD-10 CM codes: <http://www.icd10data.com/ICD10CM/Codes>) of hospitalization patients were collected. These data were uploaded to Tianjin Emergency Quality Control Center after the end of the investigation and were checked by researcher Wang LJ and Yu MM. If the two authors had different pieces of advice, professor Shou ST would recheck and drew the final conclusion.

Statistics

Data were presented as mean \pm standard deviation for numerical variables and as frequency (%) for categorical variables. Data analyses were performed by SPSS Statistics (version 16.0, SPSS Inc., Chicago, IL, USA). Student’s *t*-test was used to compare the difference of numerical

variables (such as age), whereas the Chi-squared test or Fisher’s exact test was employed to compare categorical variables (such as emergency hospitalization rate within 6 h of arrival; ESI of patients, as well as the mode of arrival, primary diagnosis) between groups or their subgroups as appropriate. Analyses were presented as two-sided comparisons. The *P* value less than 0.05 was considered to be significant.

Results

Hospitalization rate between two groups

There were total 6569 eligible ED patients on survey day, including 3680 urban and 2889 suburban samples. Four hundred ninety-four patients were hospitalized without 6 h of arrival and the ED overall patients’ hospitalization rate was 7.52% (494/6569). Among them, 178 (4.84%) were admitted to urban hospitals and 316 (10.94%) were admitted to suburban hospitals. There was a significant difference between two groups ($\chi^2=86.623$, $P<0.05$) (Table 1).

Hospitalization rate between two subgroups

Of 3680 urban ED patients, 2984 (81.09%) and 696 (18.91%) patients were from the tertiary and secondary subgroup, respectively. While among 2889 suburban ED patients, 1833 (63.45%) and 1056 (36.55%) patients were from the tertiary and secondary subgroup, respectively. Concerning tertiary subgroups hospitalization rate, 157 of 2984 (5.26%) urban ED patients and 253 of 1833 (13.80%) suburban ED patients were admitted. On the other hand, 21 of 696 (3.02%) urban patients and 63 of 1056 (5.97%) suburban patients were admitted to secondary subgroups, there were significant differences between both two subgroups (χ^2 value was 106.38 and 7.99, $P<0.05$) (Table 1).

Primary diagnosis

According to ICD-10 CM codes, primary diagnosis was composed of circulatory/digestive/respiratory/genitourinary system disease, injury as well as pregnancy/childbirth and poisoning. In addition, some ED patients’ situation was very complex, they still didn’t have a clear diagnosis when hospitalized and were classified into “diagnosis of unknown origin”. Primary diagnosis of ED hospitalization patients was listed in Table 1 and Figure 2.

Among all patients, circulatory system disease took the largest fraction in both two groups, with total patients of 180 (36.44%), which

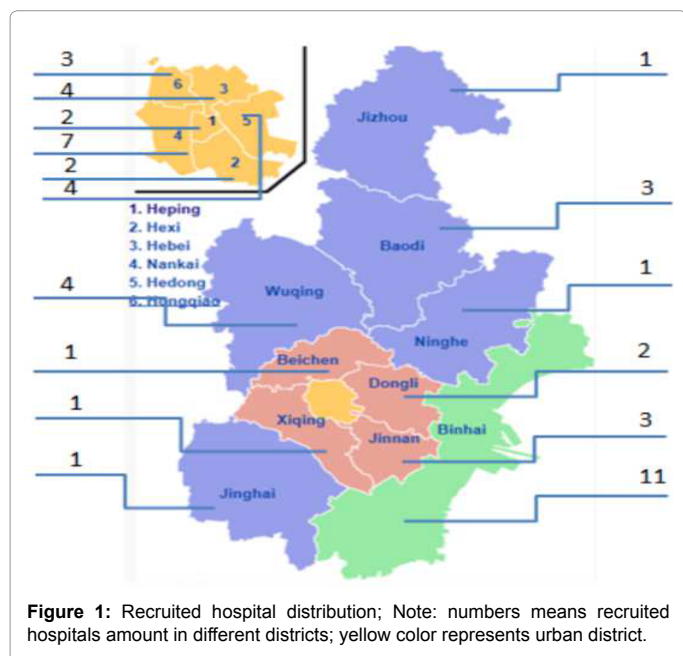


Figure 1: Recruited hospital distribution; Note: numbers means recruited hospitals amount in different districts; yellow color represents urban district.

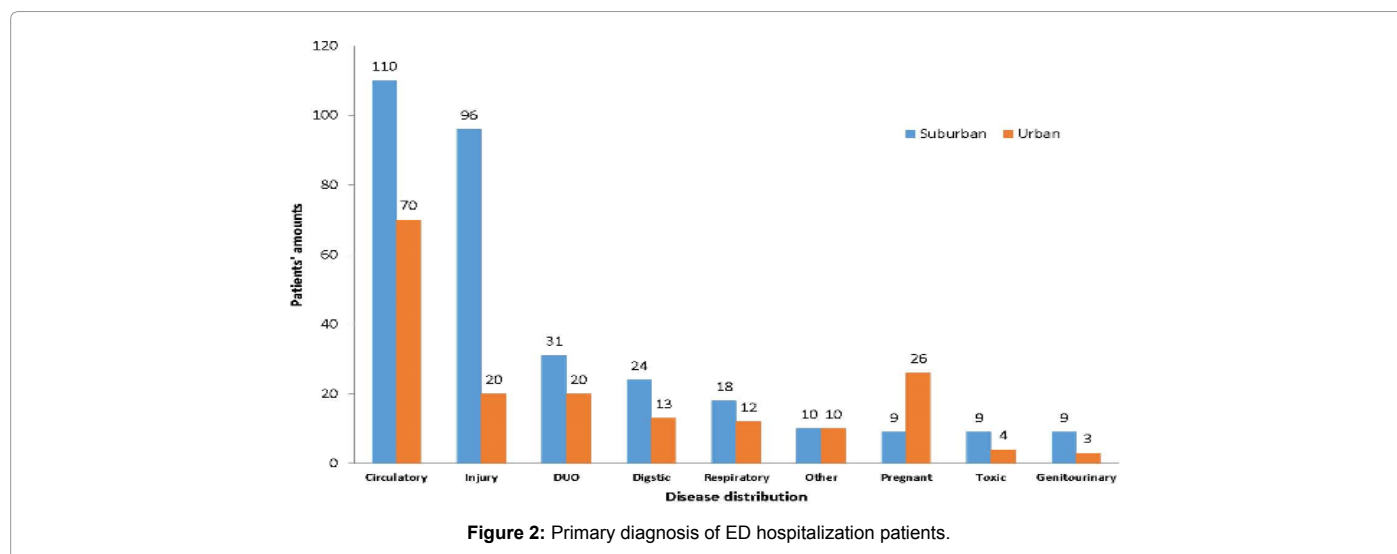


Figure 2: Primary diagnosis of ED hospitalization patients.

included ischemic heart disease (n=75, 41.67%), cerebrovascular disease (n=75, 41.67%), heart failure (n=9, 5%) and others (n=21, 11.67%). Among 180 patients, 110 (36.30%) were admitted in suburban hospitals (14 and 96 patients were to secondary and tertiary hospitals, respectively) and 70 (36.64%) of them in urban hospitals (6 and 64 patients were to secondary and tertiary hospitals, respectively). There was no significant difference between both two groups and subgroups in admitting circulatory system disease patients (χ^2 value was 1.003, 0.35 and 0.324, $P>0.05$).

There were 116 (23.48%) ED hospitalization patients due to injury, which occupied the second largest fraction in the suburban group (n=96, 31.68%) and the third largest fraction in the urban group (n=20, 10.47%). Moreover, 52 patients (including suburban group 42 and urban group 10) were due to road traffic accident, which was the main reason for injury, with a proportion of 44.83%. On the other hand, compared to the urban group, suburban group possessed higher ED hospitalization rate ($\chi^2=23.224$, $P<0.05$). As for subgroups, there were 81 (25.63%) suburban patients and 20 (11.24%) urban patients in the tertiary subgroup and 15 suburban patients and no urban patient in the secondary subgroup. There was a significant difference between both two subgroups (χ^2 value was 19.046 in the tertiary subgroup, $P<0.05$).

In addition, there were 35 pregnancy/childbirth patients in our survey. Nine (2.85%) of them admitted to suburban hospital and the other 26 (14.61%) admitted to the urban hospital. There also was a significant difference between two groups ($\chi^2=23.915$, $P<0.05$).

There were no significant differences between both groups and their subgroups ($P>0.05$) in the ED hospitalization patients with digestive/respiratory/genitourinary system disease, as well as poisoning and "diagnosis of unknown origin" (Table 1).

Gender and age

In our survey, 174 male and 142 female were included in the suburban group, 86 male and 92 female in the urban group, there was no significant difference in gender between two groups ($\chi^2=2.080$, $P>0.05$). As for the patients' age, it was (59.65 ± 20.39 , 95% CI: 56.63-62.66) years old in the urban group and (55.34 ± 17.81 , 95% CI: 53.37-57.31) years old in the suburban group. It indicated that patients in the urban group were older than suburban group ($t=2.448$, $P<0.05$). The advanced study showed the number of ≥ 65 years' patients was 99 (urban group) and 83 (suburban group), there also was a significant difference ($\chi^2=11.455$, $P<0.05$).

Emergency severity index

ESI was a five-level tool for use in ED triage, from level 1 (most urgent) to level 5 (least resource intensive) and patient with $ESI \geq 3$ level was stable. In our survey, patients were divided into $ESI < 3$ and $ESI \geq 3$ group. Of 69 $ESI < 3$ patients, there were 37 (53.62%) and 32 (46.38%) from suburban and urban hospital, respectively. And as for 425 $ESI \geq 3$ patients, 230 (63.71%) and 131 (36.29%) were from suburban and urban hospital, respectively. There was no significant difference in ED hospitalization patients' severity between groups ($\chi^2=3.724$, $P>0.05$).

Ambulance patients

There were two definitive modes going to ED in our survey, ambulance, and non-ambulance. Among 352 ambulance patients, 177 and 175 went to the urban and suburban hospital, respectively. At last, 133 (37.78%) patients were hospitalized, 47 (26.55%) and 86 (49.14%) went to the urban and suburban hospital, respectively. It showed that

there was a higher ED ambulance patients hospitalization rate in the suburban group ($\chi^2=19.101$, $P<0.05$). And there were identical statistical results between two subgroups (χ^2 was 45.287 in the tertiary subgroup, $P<0.05$).

Discussion

This study has identified that adult ED overall hospitalization rate was about 7.44% and it was higher in the suburban hospital (10.94%) than the urban hospital (4.84%) in Tianjin city. Advanced statistical analysis indicated that tertiary hospital in the suburban district (13.80%) possessed highest ED patients' hospitalization rate.

There were at least three functions in the healthcare system supplied by ED: it provided primary care services for certain groups of patients [2]; it was a source of emergency care for patients with sudden and serious illness and most important, it served as the route of admission to the hospital [2,3,13]. ED overall hospitalization rate varied greatly, from 16.9% to 51% [1,3,7-12]. Surprisingly, it was much lower in our survey and there may be following reasons:

Firstly, there was a growing need for the emergency medical system in the world due to increasing ED volume, especially in China [6,13,14]. Between 2000 and 2010, outpatient visits to health facilities more than doubled from 2.1 to 5.8 billion in China, and EDs patients gradually increased from founded and up to 79 million in 2010 [14]. The patient volume of an urban ED typically ranged from 150 000 to 200 000 per year. Patients often overflowed into the hallways and the hospital lobby area in sometimes [15]. In the USA, EDs visits soared, increasing by one-third during the fifteen-year period of 1995 to 2010, from 96 million to 130 million [15]. In 2011, the ED visit rate in the United States was 42.1 visits per 100 persons [2]. American Hospital Association reported that 33%-69% of EDs were operating at or over capacity [16].

Apart from this, there were other factors aggravating ED volume. For example, ignore of preventive care; ED required insisting on primary responsibility; insufficient medical service provided by basic general hospitals as well as no threshold restriction in ED [6,15,17].

Secondly, there were a great many non-urgent patients in ED visiting, which was another possible contributor to much lower ED hospitalization rate in our survey [18,19]. Durand et al. concluded that the proportions of non-urgent ED visits were 4.8%-90%, with a median of 32% [20]. This proportion was up to 71.33% in our previous survey, 74.39% of all ED visitors will go home after treatment and didn't need. Easily seeking an appointment with general practitioners or specialists, the convenience of the ED compared to alternatives as well as time-flexibility, higher quality and multidisciplinary care in ED, all of them resulted in non-urgent patient ED visiting [21,22].

Thirdly, there was a high level of inpatient bed occupancy [23,24]. When the hospital was in a full-capacity state, they would admit low-risk patients to hospital hallways and high-risk patients preferentially tend to stay in the ED longer [15,25]. This may be because patients admitted via the EDs used far more resources (longer stay and higher charges) than patients with the same diagnosis by other means [3]. As a result, serious ED patients were more and more difficult to be admitted, especially to urban comprehensive hospital [25]. But providing more beds alone may not be the optimal solution. Metcalfe MA et al. recommended there was an urgent need for more appropriate admission and discharge criteria now [26].

Usually, the decision to hospitalize a patient mainly depended on disease condition [12,26]. However, some factors unrelated to patients'

condition, such as median household income, insurance status as well as ED affiliated hospital type, play an important role in the decision to admit ED patients to hospitals [27]. Moreover, the performance inspection systems of hospitals were responsible for the access block in China. Some factors, such as bed rotation rate, drug cost ratio, patient satisfaction, and mortality were included in the performance inspection regardless of the disease severity and other circumstances of the patients [17]. What was more only half of ED doctors had the priority to send ED patients to the wards in China [17].

Hospital located in a different place may have a different ED admission [10,12,28,29]. Some researchers indicated that urban hospital was higher ED overall admission rate than rural hospital (33.35% vs. 21.74%) [28,29], while Pines et al. indicated that hospitals in counties with fewer primary care physicians per capita, more inpatient beds, and higher county-level ED admission rates had higher ED hospitalization rates [10].

Now in Tianjin, more superior medical resources were distributed in urban, meanwhile plenty of patients surged into urban comprehensive hospitals. Therefore, urban hospitals became overcrowding. In contrast, the ability of suburban hospital, especially tertiary hospital, may have an equal medical quality to their urban counterpart. Meanwhile, inpatient environment they provided was more comfortable and their beds did not crowd like the urban hospital. This may be the reason suburban hospital represented a higher overall hospitalization rate [30].

Concerning the primary diagnosis, Circulatory disease, including ischemic heart disease, cerebrovascular disease, and heart failure, was the most frequently ED admitted conditions (overall 36.44%) in either urban or suburban hospitals in our survey. This result was identical to a previous study [31] but was a little different with other authors [1,32]. Venkatesh et al. indicated the most frequently ED admitted condition was pneumonia [1], while Hall et al. showed childbirth was the most frequently ED admitted disease [32]. This may be related to different study periods (ours 1 day vs. others 1 year).

The factor of injury may play an important role in ED admission rate difference of urban and suburban group [33]. In our survey, of 116 injury patients, 96 (82.76%) were admitted to suburban hospital. With the rapid development of economic, more and more factories, highways as well as buildings were founded in suburban districts, which attracted a great deal of younger people working and living these places and meanwhile, it led to an increased incidence of injuries sustained in road traffic accidents [14]. In addition, their relative lower socioeconomic status leads to more injury, especially traffic accidents [34,35].

There are some limitations need to be taken into account. Firstly, unlike other quantifying of the scoring standards, ESI triage criteria may result in bias due to its strong subjectivity. Secondly, data we analyzed does not include whole emergency department in our city. Thirdly, our survey period was only one day and the long period survey will be done in order to better reflect emergency patients' hospitalization rate.

Conclusion

Limited data in our survey has identified that adult ED overall hospitalization rate was about 7.44% and it was higher in the suburban hospital than the urban hospital in Tianjin city. Advanced analysis indicated that tertiary hospital in suburban district possessed highest ED patients' hospitalization rate.

Acknowledgement

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Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Consent for Publication

All the patients or next of kin (as appropriate) signed the consent form for publication of their individual details and accompanying images in this manuscript. The statement was conserved in Tianjin Emergency Quality Control Center and the authors can provide them for review if necessary.

Ethics Approval and Consent to Participate

Each participating institution obtained approval from their hospitals' ethics committee for this cross-section survey. All patients were informed about the study and consented to participate.

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