AMBULANCE UTILIZATION IN METROPOLITAN AND RURAL AREAS IN TAIWAN

Chien-Hua Huang, Wen-Jone Chen, Mathew Huei-Ming Ma, Chao-Lun Lai, Fang-Yue Lin, and Yuan-Teh Lee

Background and purpose: Emergency medical services (EMS) have expanded rapidly in the Asian developing countries recently. However, the patterns of ambulance utilization in the rural and urban areas of these countries have not been thoroughly described. This study investigated the patterns of ambulance utilization in two urban areas and the larger rural area of Taiwan formerly designated Taiwan Province.

Methods: We studied a total of 304,368 ambulance missions during 1997 in Taiwan. We analyzed the differences in the characteristics of emergency calls and the interventions performed on the scene in two urban areas, Taipei City and Kaohsiung City, and in the rural area formerly designated Taiwan Province.

Results: The call volume and percentage of non-transport calls were higher in the more developed of the two urban areas, Taipei City, than in Kaohsiung ($p < 0.01$). The incidence of calls with trauma-related causes was higher in both urban areas. However, the percentage of calls placed for trauma-related reasons was higher in the rural area ($p < 0.01$). More calls for acute medical illness were placed in Taipei City ($p < 0.01$) than in the rural area. The number of interventions performed by ambulance staff was higher in Taipei City and Kaohsiung City than in the rural area ($p < 0.01$). The availability of acute illness management was generally lower than needed in all areas.

Conclusions: Call volume and the number of interventions performed were higher in the urban area, whereas the percentage of trauma-related calls was higher in the rural area. These findings suggest that EMS use patterns in Taiwan are transitioning towards a pattern characteristic of a more developed country. The differences in ambulance utilization patterns must be considered in plans to further develop EMS services in these areas.

Emergency medical services (EMS) have been expanding rapidly all over the world [1–5]. The ambulance service is one of the major components of the EMS system. EMS systems in developing countries have diverse characteristics [6–11], and the organization and coordination of ambulance use vary considerably. Some developing countries in Southeast Asia have no organized prehospital care and EMS systems [6, 8, 9]. Thailand has a partially organized, but not coordinated, EMS system [10]. Singapore, a developed Southeast Asian country, has a relatively well-organized EMS system [11], but the simple geographic characteristics of Singapore are different from other countries.

Taiwan, an Asian Pacific island country, lies in the east island rim of the Pacific Ocean with an area of 36,000 km² and a population of 21.6 million. Taiwan is a developing country and the second most densely populated nation in the world [12]. The per capita gross domestic product of Taiwan was 13,449 US dollars in 1997, compared to 30,276 US dollars for the USA in 1997 [13].
Taipei City is the biggest and most highly industrialized city in Taiwan, with a population of 2.6 million and an area of 272 km² (population density 9,560/km²) [14]. Kaohsiung City is the second largest city in Taiwan, with a population of 1.4 million and an area of 154 km² (population density 9,550/km²). The rural area formerly designated Taiwan Province comprises a population of 18 million and covers an area of 35,580 km². The population density is only 496/km² [14]. Its main economic activity includes industry and agriculture.

The leading causes of death in Taiwan are malignancy, followed by cerebral vascular accidents, accident, and coronary heart disease [15]. In 1995, the National Health Insurance system was founded. About 96% of the country’s population is insured by the system. Because there are no compulsory referral regulations for visiting doctors or hospital admission, people can choose to receive care from any hospital or medical center with only slight differences in fees.

Ambulance utilization in Taiwan is developing and growing. In 1990, the government divided Taiwan into 17 regional EMS authorities, and directed the fire department to train fire fighters to serve as emergency medical technicians (EMTs) as a means of developing an integrated EMS system. The fire department was formerly a subsidiary of the police department. In 1995, the fire administration split from the police department, and was established as a separate entity. As Taiwan develops, the effects on ambulance use patterns in regions with different geographic, educational, and socioeconomic characteristics become more apparent. Programs and planning of emergency services systems and ambulance missions should be designed according to differences in the patterns of utilization in these areas [16].

Ambulances in Taiwan are dispatched without a prioritization policy, and EMTs respond to all calls. Ambulance use is free of charge in Taiwan. EMTs are the first responders in the EMS and serve as firefighters as well. EMTs receive both didactic and skills training followed by written and skills tests and an emergency department practicum before active service. EMT-I trainees receive at least 60 hours of a training. After passing the certification examination, the EMT-I is qualified to take EMT-II training. The EMT-II training program includes 264 hours of didactic and skills teaching and an emergency department practicum.

There is no EMT-paramedic training in Taiwan. Taiwanese law did not allow electrical cardioversion by EMTs in 1997, and carrying an automatic external defibrillator (AED) is not routine during ambulance missions. The first responder must have completed at least EMT-I training. Each ambulance is staffed by two EMTs (EMT-I or EMT-II, randomly) and stationed at their assigned fire station between calls. Ambulances are sent out by a central dispatch center only. Run reports are completed by the ambulance crew and checked by an emergency department nurse. The reasons for each call and any intervention performed at the scene, and vital signs, are also recorded in each run report.

The objective of this study was to determine the characteristics of ambulance use and the EMS of the two major cities and larger rural area of Taiwan.

Materials and Methods

From January 1, 1997, to December 31, 1997, we collected data on ambulance missions from the National Fire Administration report recorded for every incidence of ambulance use in three areas. We retrospectively studied the data separately from the EMS of the metropolitan areas of Taipei City and Kaohsiung City and the rural area formerly designated Taiwan Province.

We analyzed the differences in the reasons for calls and interventions performed at the scene between Taipei City, Kaohsiung City, and the rural area. Non-transport calls included no event at the scene, wrong location, patient’s refusal to accept service, and instances in which another service transported the patient. The reasons for calls were categorized as traffic accident, fall/violence, acute medical illness, drunk/found unresponsive, impending labor, suicide, disaster, and others. The interventions provided by the EMTs included hemostasis/wrapping, neck collar, fixation/immobilization (including splinting and spine fixation), airway maintenance (including suction), oxygen supplementation, Heimlich maneuver, labor assistance, cardiopulmonary resuscitation, nitroglycerine use, oral glucose water use, and others. Traffic accident and fall/violence were defined as trauma-related.

Call volume, EMT manpower, non-transport call rate, reasons for call, and interventions performed were compared among the three different districts. Chi-square and Poisson tests were used for statistical analysis. A p value of less than 0.01 was considered statistically significant.

Results

Table 1 shows the characteristics of EMS in Taipei City, Kaohsiung City, and the rural area formerly designated Taiwan Province. The average call volume for every 100 persons per year (% total population/year) was significantly higher in Taipei City than in Kaohsiung.
Ambulance Use in Different Districts in Taiwan

Table 1. Population density and characteristics of emergency medical services in Taipei City, Kaohsiung City, and the rural area formerly designated Taiwan Province

<table>
<thead>
<tr>
<th></th>
<th>Taipei City</th>
<th>Kaohsiung City</th>
<th>Taiwan Province</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density (persons/km²)</td>
<td>9,560</td>
<td>9,349</td>
<td>496</td>
<td></td>
</tr>
<tr>
<td>Call volume (% total population/yr)</td>
<td>2.39</td>
<td>1.75</td>
<td>1.23</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Trauma call volume (calls/1,000/yr)</td>
<td>10.7</td>
<td>9.7</td>
<td>7.6</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Total number of EMTs</td>
<td>1,040</td>
<td>491</td>
<td>4,181</td>
<td></td>
</tr>
<tr>
<td>Number of EMTs/10,000 population</td>
<td>4</td>
<td>3.5</td>
<td>2.3</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>EMT manpower (call/EMT/yr)</td>
<td>59.6</td>
<td>51.1</td>
<td>51.9</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>False alarms (%)</td>
<td>43.61</td>
<td>37.52</td>
<td>29.50</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

EMT = emergency medical technician.

City and the rural area formerly designated Taiwan Province (p < 0.01) (Table 1). Similarly, the EMT manpower and percentage of non-transport calls were significantly greater in Taipei City than in Kaohsiung City and the rural area of Taiwan (both p < 0.01). The number of total interventions performed by EMTs was highest in Kaohsiung City (81.9 %) and lowest in the rural area (44.9 %), with a significant difference between these two districts (p < 0.01).

The reasons for ambulance calls were different in these three districts (Table 2). Traffic accidents accounted for 50.5% of the calls in the rural area and only 30.7% in Taipei City (p < 0.01). In Taipei City, the most frequent reason for calls for help was acute medical illness, which was higher than in the other two areas (p < 0.01). The call incidence for trauma-related causes was also higher in the urban areas (Table 1). However, the percentage of calls placed for trauma-related reasons was higher in the rural area. More calls for acute medical illness, drunkenness and those found unresponsive were placed in Taipei City than in the rural area. In Kaohsiung City, most calls for help were for traffic accidents or acute illness.

The types of interventions provided by EMTs were also different in these three areas (Table 3). The percentage of hemostasis/wrapping performed on trauma patients was highest in Taipei City (p < 0.01). The percentage of airway maintenance and oxygen supplementation was highest in Kaohsiung City and lowest in the rural area (p < 0.01). Cardiopulmonary resuscitation was more common in Taipei City and Kaohsiung City than in the rural area (p < 0.01). Nitroglycerine was used only twice in Taipei City and once in Kaohsiung City, but 11 times in the rural area. Electrical cardioversion, which was performed by doctors in the field or in the ambulance, was used only six times in Taipei City, five times in the rural area, and not at all in Kaohsiung City. The use of oral glucose water was recorded only 29 times in Taipei City, 11 times in Kaohsiung City, and 69 times in the rural area.

Discussion

The pattern of ambulance utilization was different in the three regions of Taiwan evaluated in this study. The average call volume was highest in Taipei City, which is the most industrialized, densely populated, and highly educated of the three regions. The rate of non-transport calls was also significantly higher in Taipei City than in the other two areas.

These findings are similar to previous findings from Western countries [17–19]. However, even for Taipei

Table 2. Reasons for calls to emergency medical services in Taipei City, Kaohsiung City, and the rural area formerly designated Taiwan Province

<table>
<thead>
<tr>
<th>Reason for call</th>
<th>Taipei City</th>
<th>Kaohsiung City</th>
<th>Taiwan Province</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic accident</td>
<td>11.8 (30.7)</td>
<td>6.5 (39.3)</td>
<td>79.9 (50.5)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Fall/violence</td>
<td>4.7 (12.1)</td>
<td>2.2 (13.4)</td>
<td>14.0 (8.8)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Acute illness</td>
<td>18.6 (48.2)</td>
<td>6.2 (37.6)</td>
<td>44.0 (27.8)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Drunk/found unresponsive</td>
<td>2.2 (5.8)</td>
<td>0.9 (5.5)</td>
<td>7.1 (4.5)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Others</td>
<td>1.2 (3.2)</td>
<td>0.8 (4.9)</td>
<td>8.5 (5.4)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38.5</td>
<td>16.4</td>
<td>158.2</td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Interventions provided in Taipei City, Kaohsiung City, and the rural area formerly designated Taiwan Province

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Taipei City</th>
<th>Kaohsiung City</th>
<th>Taiwan Province</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For total patients (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airway maintenance</td>
<td>19.6</td>
<td>25.8</td>
<td>10.1</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>O₂ supplement</td>
<td>11.4</td>
<td>16.6</td>
<td>7.8</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>CPR</td>
<td>2.9</td>
<td>2.8</td>
<td>1.4</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>For trauma patients (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemostasis/wrapping</td>
<td>41.3</td>
<td>36.6</td>
<td>26.5</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Neck collar</td>
<td>2.9</td>
<td>7.0</td>
<td>3.5</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>External fixation</td>
<td>13.2</td>
<td>22.7</td>
<td>9.2</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

CPR = cardiopulmonary resuscitation.

City, which had the highest percentage of calls per population, 23.9 for 1,000 people per year, was relatively low compared to rates in the USA of 31 to 48 for 1,000 people per year, as reported by Cadigan and Bugarin [19], and of 84.5 for 1,000 people per year reported by Braun et al [17]. The non-transport rates in Taipei City (43.6 %) and Kaohsiung City (37.5%) were similar to numbers reported by Cadigan and Bugarin (16%–42%) and by Braun et al (38%). The low call incidence in the rural area reveals differences in the attitude and knowledge of inhabitants toward ambulance use. The higher number of calls for help placed by bystanders in the urban areas also explains the higher incidence of non-transport calls in these areas. A higher ambulance utilization in an urban region than in a rural region and a higher non-transport rate in an urban area has been previously reported in the Tainan area of Taiwan [20] and by a study using data from one hospital [21]. However, a different pattern was reported in Sweden [18], with fewer false alarms and more trauma calls in the urban area than in the rural area, and a slightly lower false alarm call incidence in the rural area (28%) than that in the USA. The trauma call incidence in Sweden was much lower than that in all three areas of Taiwan evaluated in this study.

The pattern of reasons for calls for help were different in the rural and metropolitan areas. In Taipei City, the percentage of medical calls was higher than that for trauma calls. In the rural area, the percentage of trauma calls was higher than recorded in Taipei City. The difference was due to the higher number of medical calls in Taipei City. The total call volume was higher in Taipei City than in the rural area (23.9 vs 12.3 for 1,000 people per year). The trauma-related call volume was also a little higher in Taipei City than in the rural area (10.7 vs. 7.6 for 1,000 people per year). Although the percentage of trauma calls in Taipei City was less than the figures reported in 1993 by Hu et al (42.8% vs 49.7%) [22], there was a greater number of medical calls in Taipei City and a lower percentage of trauma calls than in the rural area. A pattern of more medical calls has also been observed in the USA [23], so this finding may illustrate that Taiwan is transitioning from a less developed country to a more developed one. The lower number of medical calls in the rural area is due to the rare use of an ambulance by this population. A study in a community in the area previously designated Taiwan Province showed an unmet need for ambulance use with the proportion of those in need of an ambulance who did not use one as high as 58% [23]. A previous study in I-Lan, a rural county in Taiwan, also showed a similar EMS pattern to our study [24]. In our study, a pattern of more trauma calls and less total call volume in the rural area compared to the urban area was also evident. Many individuals transported medical patients to the hospital themselves, even though the use of an ambulance is free. These findings suggest that there is a major unmet need for ambulance service in this developing country and that the pattern of calls is changing from more trauma calls to more medical calls as the country develops.

The characteristics of interventions performed at the scene were different in the three areas. Fewer interventions were performed in the rural area, including airway maintenance, oxygen supplementation, and resuscitation, and the same pattern was seen for trauma intervention. The number of EMT-II trained personnel in the rural service was less than those in Taipei City and Kaohsiung City. In the rural Taiwan area, although the workload for each EMT was not very heavy, there were more fire stations with fewer EMTs in each station than in the urban areas. Occasionally, there was only one EMT on an ambulance mission, especially in some distant and mountainous locations. This explains why fewer interventions were performed in the rural area. It is expected that as the number of trained EMT-II personnel increases, interventions on the scene will improve in both number and quality.

Rare medical interventions such as nitroglycerine use, oral glucose water use, and electrical cardioversion...
were performed in all three districts. Taiwanese law permits nitroglycerine and oral glucose water use only by EMT-II trained personnel. Considering that the rate of calls due to chest discomfort is 1.89% of total calls in Taipei city [22, 25], the use of nitroglycerine seems inadequate in the field in 1997. In 1997, only doctors were allowed to perform electrical cardioversion, and AEDs were not available in ambulances in Taiwan. In 2001, AEDs are available in some ambulances and can be used by EMT-II trained personnel. Training of more skilled EMT-II personnel is urgently needed. The introduction of AEDs is needed to treat the high percentage of cardiopulmonary arrest incidents currently encountered on calls.

The different patterns of ambulance utilization in the rural and urban areas of Taiwan suggest a transition pattern of the EMS system. With continued development, the patterns of ambulance use in rural areas may become increasingly similar to urban areas, with a persistence in the shortage of well-trained EMS personnel.

The study had several limitations. For the purpose of recording and study, the on-scene interventions were classified into preset categories, such as wrapping and external fixation. The completeness of the procedures used was checked only by the emergency department nurses, so the classification of the interventions may have not been precise for some calls. Although the run reports were recorded by EMTs and checked by nurses in the emergency department, it was difficult to avoid variation among different recorders. To lessen the impact of this problem, we studied obvious and easily defined items, such as the incidence of calls, transport or non-transport call, reason for call (not the final diagnoses), and the interventions performed.

Although the socioeconomic status, population density, and education level are different in the three areas studied, the categorization of Taipei City and Kaohsiung City as urban areas and of the area formerly designated Taiwan Province as a rural area remains subjective. Whatever methods we use to categorize, the definitions of rural and urban area remain somewhat arbitrary. The development of the EMS system depends on available government resources. As a result, analysis that considers current administrative divisions is essential for the development of programs to improve the EMS service.

In conclusion, the pattern of ambulance use is different in rural and urban areas in Taiwan. There are more medical calls and total call volume in the urban areas; however, the percentage of trauma calls is still higher in rural areas. As urban areas such as Taipei City develop, the medical calls increase and exceed the number of trauma calls, since urban inhabitants tend to be more knowledgeable about when and how to use ambulances, while rural inhabitants tend to arrive without professional assistance. The ambulance use patterns in Taiwan are increasingly similar to those of a developed country. More interventions are performed in urban areas than in rural areas. However, the number of interventions performed, especially medical interventions, remains inadequate in all three areas studied. Further training of skilled EMTs is necessary because of the current shortage and the further increase in call volume anticipated as the country develops, especially for medical calls. The use of data on the transition and differences in patterns of ambulance use is important in planning and designing further EMS programs as Taiwan continues its economic development.

References

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