

<Review>

**Establishing medical care zone from residents perspectives:
The accessibility of critical care in Kanagawa Prefecture and Iwate
Prefecture as case studies**

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Abstract

In Japan, medical facilities are broadly divided into 3 categories: facilities established by public administration such as country or prefecture, public medical facilities complied with public administration established facilities, and private medical facilities. When paying attention to the location of these facilities, it is notable that the facilities in the first two categories are located in the central area or frontier province by national policy, while the location of private medical facilities are associated with economic activities. However, in today's Japan, the national medical facilities are being forced to integrate or discontinue due to impairment of social capital.

Taking such situation into account, in order to secure equity in medical service for public, this study conducts a fundamental investigation through capturing the location of medical facilities that actually should be improved by national policy.

A relationship between the location of medical facilities and the residents receiving medical service was analyzed in integrated way using GIS (Geographic Information System). In this paper, by comparing the location of medical facilities in Kanagawa Prefecture and Iwate Prefecture, the service system of medical facilities in the big city and provincial city is discussed.

As a result, it became evident that there is a difference in medical service system between the cities. At the same time, there is also a significant difference between the systems within each city. For example, about the emergency medical, there are 50 km or more of differences of the range to a hospital between Kanagawa Prefecture and Iwate Prefecture.

This paper considers a tentative plan for national medical service system.

keywords: accessibility, the location of medical facilities, evaluation of a wide area, network distance
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I. Introduction

In Japan, medical facilities are broadly divided into: (1) facilities established by public administration such as country or prefecture; (2) public medical facilities complied with public administration established facilities; and (3) private medical facilities. When paying attention to the

location of these facilities by category, it is notable that the first two categories are located in the central area or frontier province according to the national policy, while the location of private medical facilities are associated with the economic profitability. The development of equal welfare medical service that is not in line with the economic activities has been conducted as the national policy in the postwar Japan.

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However, in today's Japan, the national medical facilities are being forced to integrate or discontinue due to impairment of social capital associated with a declining population. While many problems have been pointed out, the factors associated with such phenomenon include the policy to control the medical expense due to the worsening of fiscal conditions, the loss of medical liaison between medical education institutions and regional/rural hospitals caused by the reformation of doctor dispatch system including for residents, insufficiency in healthcare personnel, and also imbalanced medical needs and medical resources caused by widening disparity of population and age group by area. In some areas, the medical system such as emergency medical services and perinatal care have already collapsed, increasing strain on the surrounding municipals and creating a chain reaction of medical system crash.

One of the fundamental factors of these problems is a lack of perspective in the followings; a management concept in designing a medical system, a placement of medical institutions that meets the function of hospitals and intended users, and the regional difference in the "value" of medical remuneration points.

Japan is currently trying to find a new medical service system and an efficiency-oriented method to correspond to the changed or rapidly changing social structure. As one of the index to consider the sustainability of medical system in the future, the evaluation and measurement of a relationship between medical institutions and their users is suggested.

For evaluation and measurement, various methods have been established through the advanced information technology of recent years [1-3]. Different social phenomenon can be quantified which was not possible in the past.

Therefore, based on the idea in previous report [4], a relationship between medical institutions and users is evaluated and measured by a simple physical distance (spatial accessibility) in this paper. Medical care zone is considered based on this evidence.

Practically speaking, when considering healthcare delivery and its convenience in case of emergency, it becomes necessary to analyze time distance along with

spatial distance. In order to calculate this, the first step is to calculate spatial distance. Looking toward the constructive research, this paper first deals with physical distance, which is the most fundamental.

II. Spatial accessibility

The accessibility discussed in this paper is simple and physical distance (spatial distance) between medical institutions and users. The user of medical service is defined as someone who is able to use medical institutions. Therefore, this paper does not specify users based on the actual record of the present moment such as people currently receiving medical care or actual usage condition. Instead, every resident in the area is included as a potential user. Also, at the time of visiting a medical institution, a person essentially decides a destination based on multiple factors such as the size of hospital, its reputation or travel route. However, this paper considers the placement of medical institutions that meets minimum requirements. Therefore, based on the simplest model in which users choose to go to the closest medical institution, the physical distance to medical institution is measured.

The measurement method is as follows. For the measurement, GIS (Geographic Information System) was used. The target area is entire Kanagawa Prefecture and Iwate Prefecture. The outlines of both prefectures are shown in Figure 1.

1. Assessing the location of medical institutions

The location of target medical institutions was assessed. Referring to the disclosed addresses, the location by different medical department was confirmed. In this paper, only the critical care is shown from the various measurements.

2. Setting of users

Considering the preconditions as described previously, although the residence of users must be confirmed to measure the distance to users in a precise sense, it is difficult. Also, by using the result of urban planning baseline survey that includes building classification such as

Table 1 the Outline of Target region

	Population (person)	Population Structure (person)			Population/Area
		Age: 0 - 14	Age: 15 - 64	Age: 65 -	
Iwate	1,330,147	168,804	795,780	360,498	87.1
Kanagawa	9,048,331	1,187,743	5,988,857	1,819,503	3,746.7
	Area (km ²)	Ratio of Population Structure (%)			Number of Emergency Medical centers
		Age: 0 - 14	Age: 15 - 64	Age: 65 -	
Iwate	15,278	12.7	60.1	27.2	3
Kanagawa	2,415	13.2	66.6	20.2	12

detached houses, collective housings, stores and business offices, it is possible to create virtual urban space in GIS where the population is allocated to buildings in a dispersive manner that proportionally distribute the population of relevant address to the gross floor area of each residences. However, the information in the urban planning baseline survey is only for metropolitan areas and urban area. If the entire country is a measurement target or the regions are outside of metropolitan areas, the information is not available. Therefore, for the analysis of this paper, the basic unit block data from the National Census in 2005 is used to grasp the level of concentration in the district of residence, and analysis is made on the virtual urban space.

3. Measurement of distance

In Japan, there have been many arguments about medical care zone related to the location of medical institutions and accessibility of residents. Most of the analysis in medical care zone has been conducted by measuring the relationship between medical facilities and their users with straight-line distance, or by outlined distance in which the

population is concentrated in median point of area. However, through such a method, it is difficult to fully understand the actual state of accessibility of residents to the medical institutions. Therefore, in this paper, the virtual urban space mentioned above and the actual road network were incorporated to measure the distance between medical institutions and users by a road distance that is close to the actual traveling distance. For the road network, the numerical map25000 from 2002 was modified to create the original road network that includes the newly constructed roads in recent years.

III. Analysis result

The relationship between the distance to critical care and users in both prefectures are shown in Figure 1 and 2. In Figure 1 and 2, the distance is the horizontal axis and virtual number of users who live in the distance zone is the vertical axis. Also, Figure 3 and 4 show the distribution of distance zone around the critical care medical facilities.

A comparison of two graphs clearly shows a major difference in the healthcare provision system between the

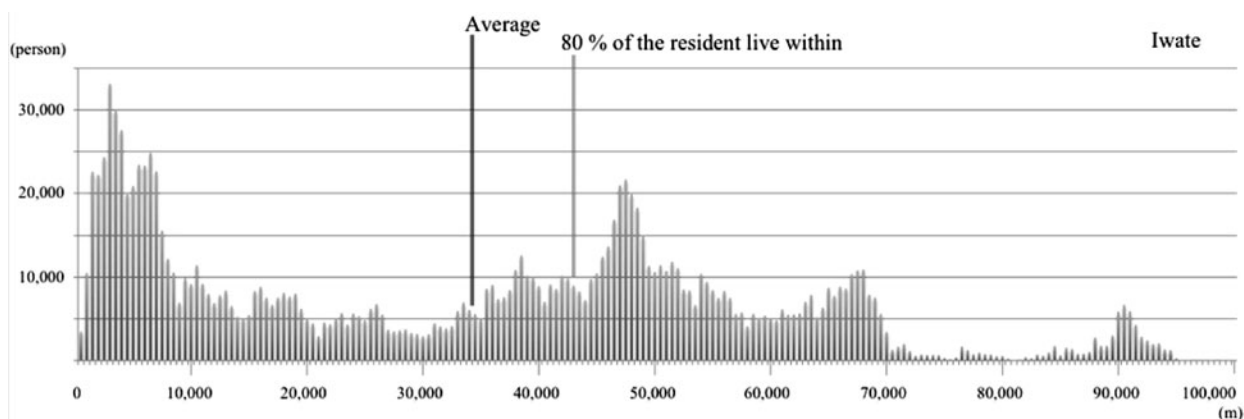


Figure 1 the Result of IWATE Pre.

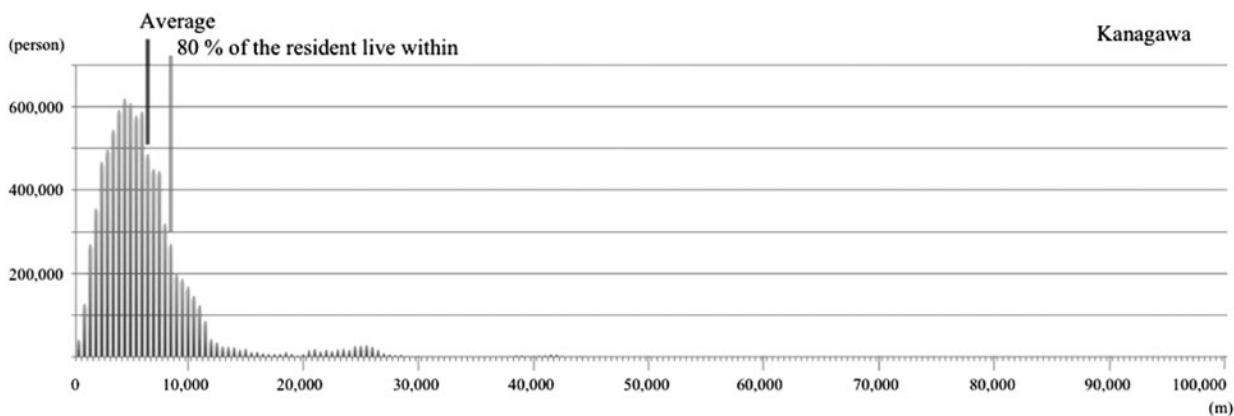


Figure 2 the Result of KANAGAWA Pre.

cities. There is a difference in distance to the emergency hospitals for users, which is within 48km for Kanagawa Prefecture and about 100km for Iwate Prefecture. Moreover, for the population in each distance zone, the

maximum number of Kanagawa Prefecture is 0.61 million people while it is about 33,000 people for Iwate Prefecture.

IV. Discussion

- Medical Service System as a National Policy

In order to secure equity in medical service for public as a national policy, it is necessary to reduce the distance difference between these prefectures. In regional prefectures with many mountains like Iwate Prefecture, it is necessary to have many medical facilities due to limited roads through the mountains. However, this method is not realistic considering the current situation in Japan where the social security payments will decrease in the future. Instead of placing medical facilities, it is essential to provide an emergency medical service system without a center such as an ambulance or a helicopter emergency medical service. However, this does not mean continuous capability of providing emergency medical service. There has been an argument that it is necessary to consider finding balance in the finite social security payments and spatial development such as a policy for shrinking cities or inducing residence area.

- The Significance of Medical Center

The comparison between Kanagawa Prefecture and Iwate Prefecture shows an enormous difference in the intended resident population for one medical center. It is about 754,000 people in Kanagawa Prefecture and about 443,000 people in Iwate Prefecture, showing obvious difference. In the current Japanese medical system, the number of medical facility users instead of intended residents population determines the significance. However, due to a

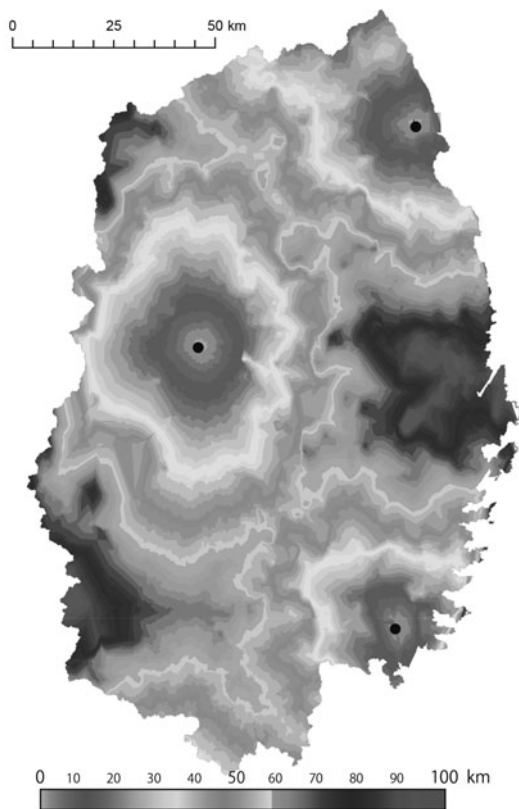


Figure 3 the Visualized Result of IWATE

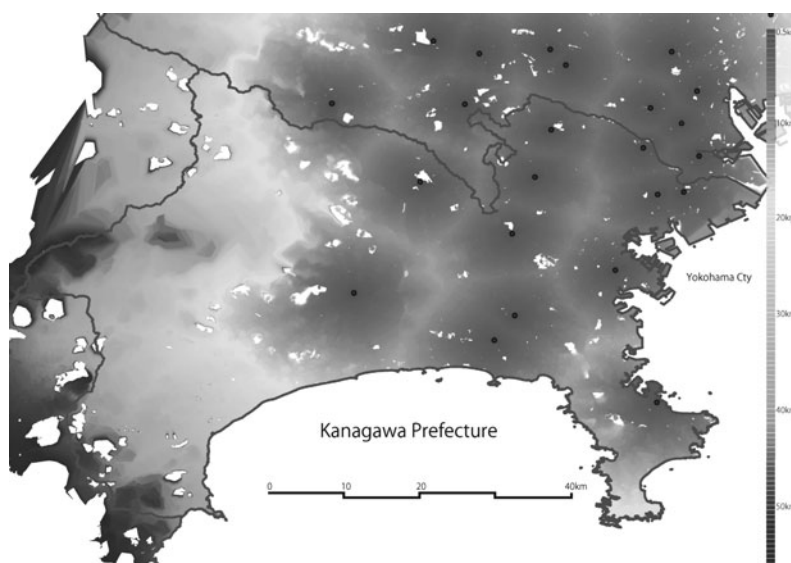


Figure 4 the Visualized Result of KANAGAWA

major difference in the initial intended population, the significance of medical centers with less intended population will decrease if the event probability of people in need for emergency medical care is the same. In Figure 3, the significance of medical centers in Iwate Prefecture is shown with an indication that every center plays an important role and shutting any of them down will cause a problem. Therefore, it is necessary to make some kind of correction to the evaluation of medical centers such as a major correction on the additional local rates, which does not depend on medical service fee.

V. Conclusion

In this paper, through evaluating the emergency medical service system of Kanagawa Prefecture in the metropolitan area and Iwate Prefecture in the provincial area by distance, the following issues were clarified based on the numerical evidence.

- In the provincial area with weak medical service system, it is necessary to develop a service without medical centers instead of improving service standards by facilities.
- It is necessary to redress the evaluation standards of existing medical centers.
- Discuss the balance in spending of the social security payments and spatial development.

Finally, in order to show a path toward solving the problem, evaluating the location of medical facilities by

accessibility in somewhat businesslike manner or quantitative way is considered beneficial. When examining medical resource distribution, provision method of service that takes the city structure into account and the their cost-effective, it is possible to make evaluation and analysis based on the evidence.

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住民視点による医療圏の設定 —神奈川県と岩手県の3次救急のアクセシビリティを事例に—

抄録

現在の日本では、人口減に連動した社会的資本の減少から、国策による医療施設が、統合、廃止に追い込まれる状況にある。それらの背景には、財政悪化に伴い医療費抑制政策がとられる一方で、研修医を含む医師派遣制度の変革による医療教育機関と地域・地方病院との医療提携の喪失、医療従事者の不足、また地域の人口及び居住者年齢層の格差の拡大に伴う医療ニーズ／医療資源の不均衡など数々の問題が指摘されている。すでに一部地域においては、救急医療や周産期などの医療体制が瓦解し、その周囲の自治体に負担が増すという医療システム崩壊の連鎖が生じている。これらの問題の根幹のひとつには医療制度の設計に際しての経営の概念、病院の機能と利用予測に即した医療機関配置、医療点数の「価値」の地域差、といった視点が欠落していることが挙げられる。

我が国はいま、変化した、または急速に変化しつつある社会構造に対応し、かつ効率性が重視された新たな医療提供体制及びその手法を模索している段階だと言える。今後、医療システムがいかに持続しうるかを考えるための一つの指標として、医療機関とその利用者の関係性を評価・測定することが挙げられる。

評価・測定においては、近年の情報技術の発達により様々な手法が確立されつつある。従来数値化できなかった種々の社会現象を数値化することが可能である。

そこで本稿においては、医療機関と利用者の関係を、単純で物理的な距離（空間的アクセシビリティ）によって評価・測定し、それを基底としたエビデンスに基づく医療圏を考究する。

キーワード：アクセシビリティ、医療施設立地、広域評価、道路距離

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