Estimation and Visualization of Hospital Demand based on Mesh System
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Abstract—We evaluated the balance of medical supply and demand in the future, simulated patients’ access to hospitals. Using this method, we were able to geographically visualize the demand for health care.

I. HEADINGS

Geographic information systems (GISs) are often used as a means of conceptualizing local characteristics. They are often applied in the field of medical informatics [1, 2].

Japan is rapidly becoming a super-aged society. In the Tokyo Metropolitan Area, both the number of elderly people and medical demand are expected to dramatically increase. However, several prefectures around Tokyo have very poor health resources compared with the national average. Therefore, it is urgent that accurate estimates of medical demand are available, in order to develop and maintain a medical care system that can use limited health resources effectively. If we can predict health care demand in local areas, we can effectively maintain health care resources, facilities, and services, such as home medical or visiting nurse care. Estimations have been made of the number of patients in cities and large areas, but not in rural or small areas. In order to develop community medicine policies effectively, policy makers would require estimations for medical services in each community.

In this study, we developed the Patient Access Area Model by using a GIS, and, in order to evaluate the balance of medical supply and demand in the future, simulated patients’ access to hospitals.

II. OTHERS

We chose Chiba prefecture, which is next to Tokyo, as the experimental region. There were three steps in the simulation. (1) Estimation of population and number of patients in the future. (2) Simulation of patients’ access to hospitals. (3) Evaluation of supply and demand.

First, the population and number of inpatients for each 500-m² area (called a mesh) every five years were calculated based on the cohort component method. Second, we set the access areas according to patients’ transit times for each hospital. The patients living in each mesh were allowed to enter hospitals only within that mesh’s access area. Because hospitals are limited in how many patients they can admit by the number of beds they have, for the evaluation of supply and demand, we defined situations where patients could not be admitted as “over-demand.” We distributed inpatients from each mesh across the hospitals.

For the evaluation of supply and demand, if patients could not be admitted to the hospitals within the accessible area, we defined the situation as “over-demand.” Similarly, “over-supply” was defined as the presence of unutilized beds at the hospitals.

The results show that hospitals will be able to accommodate all inpatients until 2020; however, in 2030 more than 3,000 patients cannot be admitted to the hospitals because of the rapidly aging population. When we mapped the over-demand for each 500 meter mesh, over-demand was concentrated in the densely populated regions along large traffic lines as shown in figure 1.

![Figure 1. Map of the number of estimated over demand](image)

This study developed an innovative method to estimate the demand for health care by integrating geographic information; using this method, we were able to geographically visualize the demand for health care. In the future, we must also consider other aspects of medical care, including emergency medicine, and acute and recovery phase medicine to evaluate situations realistically and with more precision.

REFERENCES


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