Visualization of Hospital Demand Change in Super Aging Society in Japan

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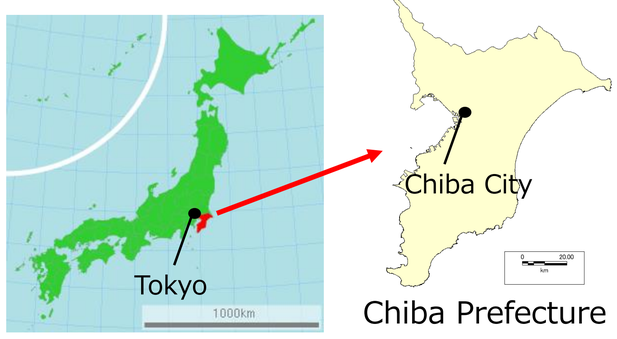
Abstract

In this study, we suggest defining the patient's access area Model by using a Geographic information system (GIS), and, in order to evaluate the balance of medical supply and demand in the future in small areas, simulated patients' access to hospitals. We set the accessible area by patients' transit time for each hospital. The patients living in each 500-meter-square mesh were allowed to enter hospitals only within the access area. The hospitals have its limit to admit patients based on their actual numbers of beds. We distributed inpatients from each mesh across hospitals. For the evaluation of demand, if patients could not be distributed to the hospitals within the accessible area, we defined the situation as "over-demand." As a result, although it was expected that over 9000 inpatients will not receive inpatient care in a southwest area region in the studied prefecture, most of the over-demand is in the densely regions along large traffic lines in 2030. Using this model, we can know demand for local health resources more clearly. This method is very useful to plan geographical resource allocation in medical services.

Materials and Methods

Materials

- The target field was set to a 500-meter-square area (called a mesh) in Chiba Prefecture, which is one of the commutable areas with capital.
- The frequency and duration of research was determined to be every five years from 2010 to 2035.
- The number of meshes in Chiba Prefecture is 20238.
- The target of the estimation of the medical demand is the number of in-patients.



Chiba Pref. Information

1. Population : 6,216,289
2. Rate of over 65 yeas people : 21.5%
3. Area : 5156.61km^2

Methods

Estimation of number of future in-patients

We calculated the future population every five years from 2015 to 2035 in each mesh according to the cohort component method. Using calculated population and consultation rate, we estimated number of future inpatients for each gender and five-year age group.

Simulation of patients' access to hospitals

We defined patient's access area with each hospital according to it's scale and the range of patient's access area is set the time that is able to reach by car. Sometimes a mesh belongs to the access area of several hospitals. Then we allocated the in-patients to one of the hospitals. The number of patients whom we were able to distribute was dependent on the algorithm of the distribution of in-patients. In this study, after we had examined several algorithms, we selected the one that allowed for the distribution of the maximum number of in-patients. However, for each hospital, there is a limit to how many patients they could admit based on the number of beds they have.

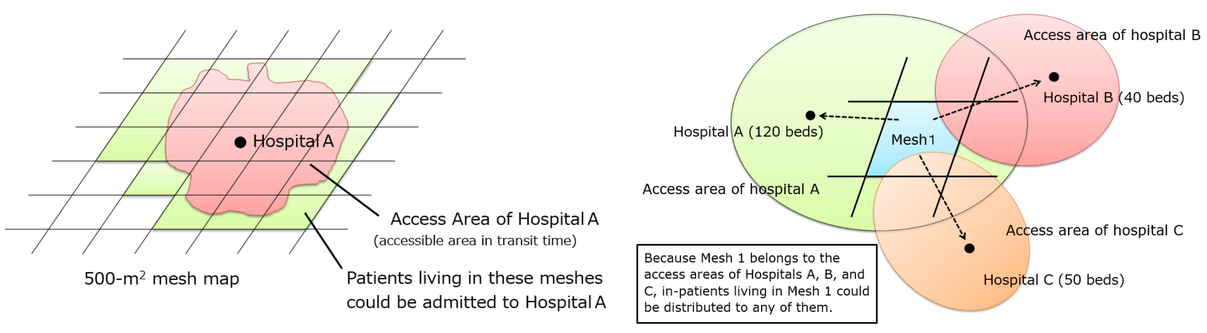


Fig. Overview of patient's access area

Evaluation of medical supply and demand

For the evaluation of supply and demand, if the patients could not be admitted to the hospitals within the accessible area, then we defined the situation as "over-demand." Similarly, "over-supply" was defined as the presence of unutilized beds in the hospitals. Finally, We tried to place marks for over-demand areas on the map in order to visualize the areas of over-demand in Chiba Prefecture

Results

The number of in-patients will continue to increase due to an aging population and will reach its peak of 51824 people per day in 2030. This is 1.38 times the number of in-patients in 2010. If the number of beds in the Chiba Prefecture is maintained at only 43363 beds, then there will be a shortage of beds after 2020.

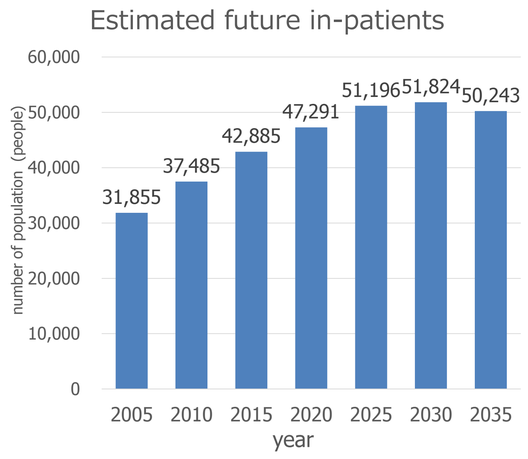
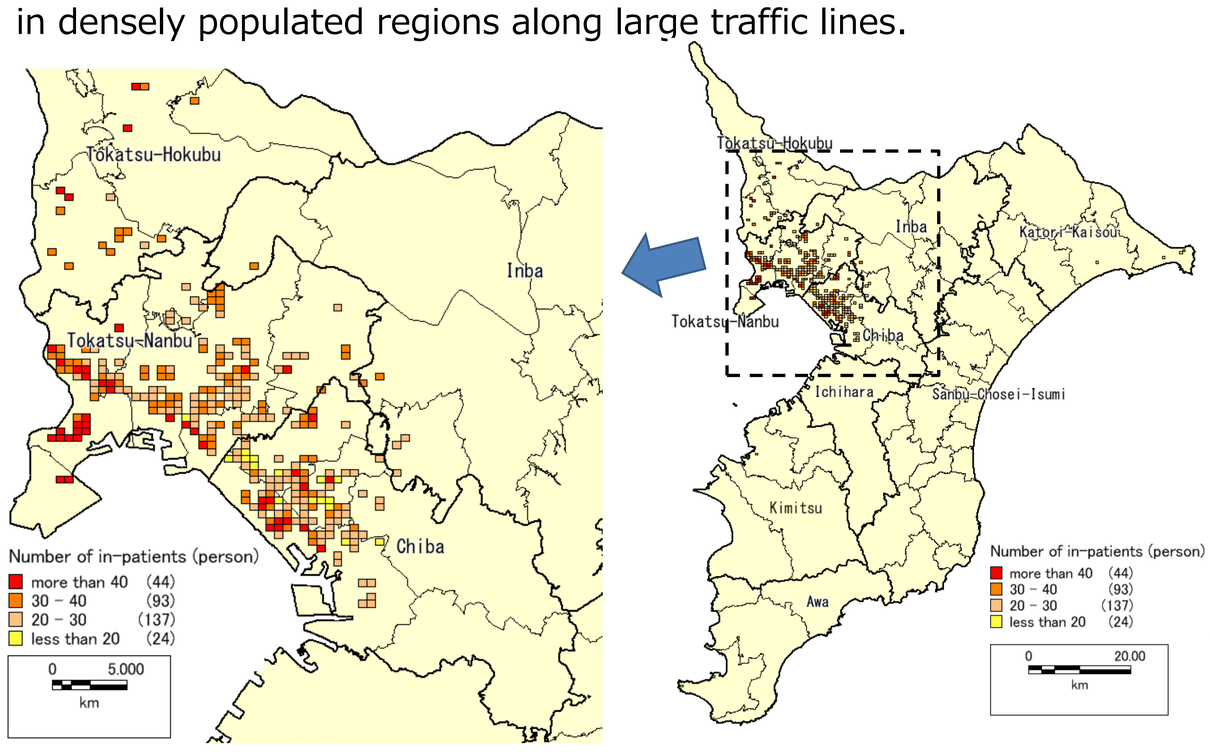


Figure shows the meshes where the number of in-patients who had not been admitted into hospitals will appear in 2030. In 2030, it will peak and reach over 9000 in-patients per day. Specifically, over-demand will increase dramatically in the northwest part of Chiba Prefecture. In contrast, over-demand will hardly appear in the east and south part of Chiba Prefecture. it would not be distributed uniformly across these regions; most of the them will be concentrated in densely populated regions along large traffic lines.



Discussion

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 this research, we chose Chiba Prefecture as an example; however, this method could be applied to estimate supply and demand in other urban areas as well. Because geographic information systems are becoming increasingly more affordable, policy makers and subsequent researchers will be able to verify and expand on our analysis. In 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.

Conclusion

We developed the Patient Access Area Model to evaluate the balance of supply and demand for future medical care in small areas. Using this model, we can get a clearer understanding of the demand for local health resources. This method will likely be very useful for planning resource allocation for medical services.