The Current Shortage and Future Surplus of Doctors: A Simulation modelling of the Future Growth of the Japanese Medical Workforce

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Abstract

Background
Starting in the late 1980s, the Japanese government has decreased the number of students accepted into medical school each year in order to reduce healthcare spending. The result of this policy is a serious shortage of doctors in Japan today, which has become a social problem in recent years. To help solve this problem, the Japanese government decided in 2007 to increase the medical student quota from 7,625 to 8,848. Furthermore, the Democratic Party of Japan (DPJ), Japan's ruling party after the 2009 election, promised in their manifesto to increase the medical student quota to 1.5 times what it was in 2007, in order to raise the number of medical practitioners to more than 3.0 per 1,000 persons. It should be noted, however, that this rapid increase in the medical student quota may bring about a serious doctor surplus in the future, especially because the population of Japan is decreasing.

Purpose of this research is to project the future growth of the Japanese medical doctor workforce from 2008 to 2050.

Methods
Simulation modelling of the Japanese medical workforce, taking into account recent increases in medical school capacity.

Results
Even if the additional increase in the medical student quota promised by the DPJ fails, the number of practitioners is projected to increase from 286,699 (2.25 per 1,000 persons) in 2008 to 365,533 (over the national numerical goal of 3.0 per 1,000) in 2024. The number of practitioners per 1,000 persons is projected to further increase to 3.10 in 2025, to 3.71 in 2035, and to 4.69 in 2050. If the additional increase in the medical student quota promised by the DPJ is realised, the total workforce is
projected to rise to 392,331 (3.29 per 1,000 persons) in 2025, 464,296 (4.20 per 1,000 persons) in 2035, and 545,230 (5.73 per 1,000 persons) in 2050.

**Conclusions**
Though the plan to increase the medical student quota will effectively solve the current doctor shortage problem, it will bring about a serious doctor surplus in the long run.

**Background**
Starting in the late 1980's, the Japanese government has decreased the number of students accepted into medical school each year in order to reduce healthcare spending. Student quotas for medical schools were decreased by 7.8% from 1986 to 2006. The resulting shortage of doctors in Japan has inevitably led to deterioration in the quality of care [1,2], and has recently become a serious social problem [3-7].

The per-capita number of medical practitioners in Japan is low compared with those in other developed countries. Japan ranks 59th among WHO's 193 member states in terms of number of medical practitioners per 1,000 persons [8]. The number of medical practitioners per 1,000 persons in Japan was 2.29 in 2009; this is smaller than the figures for the United States (2.56 in 2000) and the United Kingdom (2.30 in 1997). Among the member countries of the Organisation for Economic Cooperation and Development (OECD), Japan falls into the category with the fewest doctors per capita, together with Mexico, South Korea and Turkey. The doctor shortage is compounded by Japan's particularly great demand for physicians. Healthcare utilisation in Japan is particularly high: the number of consultations per capita is higher in Japan than in any other OECD country [9], and the rates of hospital
utilisation are high as well. These trends have made the shortage of physicians quite obvious.

To help solve this problem, the Japanese government decided to increase the medical student quota starting in 2007. The Democratic Party of Japan (DPJ), Japan's ruling party since the 2009 election, has promised to further increase the medical student quota, raising the number of medical practitioners over 3.0 per 1,000 population [10]. Because the number of births in Japan (Figure 1) and the total population of Japan (Figure 2) are both decreasing [11], this rapid increase in the number of medical students may result in a serious doctor surplus problem, especially after most of the baby boomers die.

The purpose of this study is to predict the impact of the planned increase in the number of medical students in Japan. We projected the resulting increase in medical practitioners through computer simulation under the following scenarios.

Scenario 1: Maintaining the current medical student quota (8,848 per year).
Scenario 2: Increasing the quota by 50% starting in 2013, as promised by the DPJ.

**Methods**
Our model was based on free public data from government and public institutions in Japan. Our baseline year was 2008, and projections were made for the future through 2050. The number of anticipated graduations from medical schools per year was added to the baseline for each year, and the number of anticipated deaths among doctors per year was subtracted (Figure 3).
The model incorporates data from a wide range of sources which have not previously been drawn together for this type of analysis (Table 1). Key assumptions are summarised in Table 2. The main outcome measure was the number of medical practitioners per 1,000 persons.

**Data analysis**
Our computer simulation incorporated the following criteria:

1. In each year, the number of medical school graduates was assumed to be equal to the medical student quota that had been in place 6 years earlier (medical school in Japan takes 6 years to complete). Medical student quotas were set according to the two scenarios described below.

2. Pass rates for the national examination for medical practitioners were assumed to be constant and to be, on average, equal to the average pass rate during the last decade (2000-2009).

3. The male/female ratio among new medical school graduates was assumed to be constant and to be, on average, equal to the average ratio during the last decade (2000-2009).

4. The number of practitioners stratified by sex and age in 2008 was established based on the 2008 MHLW survey.

5. Practitioners were assumed to die in accordance with the death probabilities reported for persons of the same sex and age category in the Complete Life Table.

6. Projections concerning future population size were based on the projections published by the National Institute of Population and Social Security Research.

**Simulation Scenarios**
We used this simulation to project the number of medical practitioners under each of the following two scenarios:
Results

Scenario 1: Maintaining the current medical student quota (i.e., 7,625 through 2007 and 8,848 starting in 2008).

Scenario 2: Increasing the quota by 50% as promised by the DPJ (i.e., 7,625 through 2007, 8,848 from 2008 to 2012, and 12,000 starting in 2013).

In 2008, there were 286,699 doctors in the Japanese medical workforce (2.25 per 1,000 persons). Our simulation projected that this figure would reach 365,533 (3.05 per 1,000 persons) by 2024. This represents an average annual growth rate of 1.53% per year from 2008 to 2024. Thus, even if the DPJ's proposed additional increase of the medical student quota is not realised, the number of practitioners is projected to rise beyond the national numerical goal of 3.0 per 1,000 persons in 2024.

After 2024, however, the annual growth rate of the total medical workforce will decrease, but the number of medical practitioners per 1,000 persons will continue to increase, because the total population will be decreasing. By 2035, there will be 410,999 doctors (3.71 per 1,000 persons), and by 2050, there will be 446,050 (4.69 per 1,000 persons).

Scenario 2: Increasing the quota by 50% starting in 2013, as promised by the DPJ

The projected results of Scenario 2 are shown in Figure 5.
Our simulation projected that the number of doctors in the Japanese medical workforce would reach 368,196 (3.03 per 1,000 persons) by 2022. This represents an average annual growth rate of 1.80% per year from 2008 to 2022. Thus, if the DPJ's proposed additional increase of the medical student quota is realised, the number of practitioners is projected to exceed the national numerical goal two years earlier.

After 2022, the number of medical practitioners per 1000 persons will continue to increase as the total population decreases. By 2035, the number of medical practitioners will reach 464,296 (4.20 per 1,000 persons); by 2050, it will reach 545,230 (5.73 per 1,000 persons).

**Comparison of the two scenarios**
Figure 6 compares the two scenarios' results in terms of the numbers of medical practitioners per 1,000 persons throughout the projection period.

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**Discussion**
The Japanese government is facing a dilemma. The doctor shortage in Japan is currently a serious problem, and one that is hard to solve in the short term even if the medical student quota is increased. On the other hand, the decreasing population of Japan guarantees that we will eventually face a doctor surplus problem in the long term, even if the medical student quota is not increased.

Increasing the medical school quota as proposed by the DPJ may diminish the academic performance of the average medical student. Although admission to medical school requires exceptional academic achievement in high school, in the future, more and more students will be able to pass the examination for admission to medical
school, because the birthrate in Japan is decreasing. If the medical student quota is maintained at its current level, the percentage of all high school students that qualify for medical school will increase as the population decreases; if the quota is increased, the percentage of qualified students will be even greater. Such a reduction in the level of academic achievement required to become a medical student may reduce the quality of doctors and that of medical treatment.

Furthermore, an increase in the medical student quota may reduce the number of science and engineering students or their average academic performance. Many students who wish to enter medical school are accomplished in science and mathematics; those who do not qualify for medical school often choose to become scientists or engineers instead. If more of the students who are drawn to science and mathematics are able to become doctors, Japan may find itself with fewer or less-qualified scientists and engineers as a result. Therefore the DPJ's proposed increase may be detrimental to the economic potential of Japan in the long term.

It will be difficult to resolve this dilemma without the help of foreign countries. In general, a national shortage or surplus of specialists is corrected through international exchange: when a particular specialty is in short supply, specialists are invited into the home country from abroad; in the event of a surplus, the home country's specialists seek work elsewhere. The international exchange of specialists is motivated not by government action but by individual specialists' own desire for better employment.

Most developed countries resolve shortages of health professionals by actively recruiting doctors from other countries. In the 1990s, for example, when the U.K. was
facing a shortage of doctors, the National Health Service (NHS) actively recruited large numbers of health professionals from abroad, particularly from sub-Saharan Africa, to fill workforce gaps [14, 15]. The resulting flow of medical practitioners into the U.K. was so large that the recruitment policy was criticised for causing shortages of medical professionals in developing countries [16]. In response to this criticism, the Commonwealth has since introduced guidelines for the recruitment of health workers from abroad [17].

In Japan, however, it is currently more difficult to recruit medical practitioners from abroad because the international recruitment of health professionals is regulated by the government and the recognition of foreign licenses is tightly limited.

**Conclusions**

We conclude that an increase in the medical student quota such as that proposed by the DPJ will not be sufficient to resolve the current doctor shortage and will exacerbate the doctor surplus of the future. It would be more constructive to accelerate the flow of medical doctors from other countries into Japan. We propose that Japan should accelerate the incoming flow of medical practitioners through agreements with other countries permitting early mutual recognition of medical practitioners' licenses, with periodic assessment of source countries to ensure the quality of immigrant doctors. An international comparative study on this matter will be our next research topic.

**Competing interests**

All authors declare that they have no competing interests. The paper has not been published elsewhere nor submitted for publication to another journal.
Authors' contributions

All authors designed the study. Hideaki Takata carried out the analyses and drafted the different versions of the manuscript. Hiroki Nogawa and Hiroshi Nagata supervised the data analysis. Hiroshi Nagata and Hiroshi Tanaka supervised the different versions of the manuscript. All authors read and approved the final manuscript.

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Figure 2 - Projected changes in the Japanese population and age distribution.

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Projected changes in the total number of births in Japan

Figure 1
Projected changes in the Japanese population and age distribution

Figure 2
Summary of our model for the future growth of the medical workforce

Baseline: Current supply stratified by sex and age (2008)

Addition

Number of New Doctors Passing National Exam

Subtraction

Predictions: Future supply stratified by sex and age (2009-2050)

Number of Deaths Among Doctors, based on Complete Life Table

Figure 3
Scenario 1: Maintaining the current medical student quota

Figure 4
Scenario 2: Increasing the medical student quota by 50% starting in 2013

Figure 5
Comparison of the two scenarios

- Scenario 1
- Scenario 2

Figure 6
### Data sources for the simulation model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current workforce in baseline year (2008)</td>
<td>The number of physicians reported by the Ministry of Health, Labour and Welfare of Japan (MHLW) in 2008 [12]. Physicians in Japan report to the MHLW every two years, and the MHLW publishes data based on these reports.</td>
</tr>
<tr>
<td>Pass rate for Japanese national examination for medical practitioners</td>
<td>Announcement about national examination for medical practitioners (from 94th to 103rd).</td>
</tr>
<tr>
<td>Male/female ratio of new medical graduates</td>
<td>Announcement about national examination for medical practitioners (from 94th to 103rd).</td>
</tr>
<tr>
<td>The probability that practitioners die</td>
<td>20th Complete Life Table of Japan published in 2007 by MHLW [13].</td>
</tr>
</tbody>
</table>
### Key assumptions of the base simulation model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Key assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>New medical graduates</td>
<td>Only domestic students are counted. The number of medical school graduates is equal to the government’s medical student quota.</td>
</tr>
<tr>
<td>The probability that practitioners die</td>
<td>Practitioners die according to death probabilities calculated using the Complete Life Table.</td>
</tr>
<tr>
<td>Male/female ratio of new medical graduates</td>
<td>Male/female ratios of new medical graduates remain constant at the ratio seen in the last decade (2000-2009).</td>
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**Table 2**