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Outcomes of the subquota system of Japanese medical schools for physician shortage areas and prefecture scholarship programmes for medical students: a cohort protocol



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5 Outcomes of the subquota system of Japanese medical schools for physician shortage areas and
6 prefecture scholarship programmes for medical students: a cohort protocol
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ABSTRACT

Introduction: Given the shortage of physicians, particularly in rural areas, the Japanese government has rapidly expanded the number of medical school students by adding *chiikiwaku*, subquotas, since 2008. Subquota entrants now account for 17% of all medical school entrants. Subquota entrants are usually local high school graduates who receive a scholarship from the prefecture government. In exchange, they temporarily practice in that prefecture, including its rural areas, after graduation. Many prefectures have also scholarship programmes for non-subquota students in exchange for postgraduate in-prefecture practice. The objective of this cohort study, conducted by the Japanese Council for Community-based Medical Education, is to evaluate the outcomes of the subquota admission system and prefecture scholarship programmes nationwide.

Methods and analysis: There are three groups of study subjects: subquota without scholarship, subquota with scholarship, and non-subquota with scholarship. Under the support of government ministries and the Association of Japan Medical Colleges, and participation of all prefectures and medical schools, passing rate of the National Physician License Examination, scholarship buying-out rate, geographic distribution and specialties distribution of each group are analysed. Subjects are followed by linking their baseline information to data in the government's biennial Physician Census. Results to date showed that, despite medical schools' concerns about academic quality, the passing rate of the National Physician License Examination in each group was higher than that of all medical school graduates.

Ethics and dissemination: The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences permitted this study. No individually identifiable results will be presented in conferences or published in journals. The results will be reported to concerned government ministries, associations, prefectures and medical schools as data for future policy planning.

Strengths and limitations of this study

- Subquota admission system of medical schools is one of the largest national policies ever conducted to redress maldistribution of physicians, and these entrants now constitute 17% of all medical school entrants in Japan.
- This study evaluates the outcomes of the subquota admission system and prefecture scholarship programmes for medical students by cross-sectional survey to prefectures and medical schools, and analysing cohort of subquota and scholarship subjects.
- Started in 2013, this is the first comprehensive and longitudinal study of this sort, with support from concerned ministries and the representative body of medical schools.
- All of Japan's prefecture governments and medical schools participate in this study, which yields precise information on the passing rate of the National License Examination for Physicians and scholarship buying-out rate of study subjects every year.
- Geographic and specialty distributions of all the study subjects registered in the cohort can be followed until they retire as we link the baseline data to the government's national biennial census data, though increasing the recruitment rate of subjects is a challenge.

INTRODUCTION

Geographic maldistribution of physicians in Japan

Geographic maldistribution of physicians has long been recognised as a chronic social problem in Japan. No public agencies have a legal right to decide the allocation of physicians, and thus physicians are given unrestricted freedom to practice wherever they like. There is no

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5 allocation system in which local governments or professional bodies place a cap on the number
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7 of physicians in each area as seen in other countries such as United Kingdom. In this context the
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9 concentration of physicians in urban areas and a corresponding shortage in rural areas is
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11 inevitable.¹⁻³ Article 25 of the Japanese Constitution guarantees healthy living of all citizens and
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13 obliges the government to improve public health. So redressing the geographic maldistribution
14
15 is usually recognised a responsibility of the national and local governments.
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18 The national and prefectural governments have attempted to resolve this issue in several ways.
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20 First the government constructed one medical school in each prefecture between the 1960s and
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22 1970s, founding new public medical schools in mainly rural prefectures where none had existed.
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24 Under this policy, the number of medical schools in Japan increased from 46 to 79 and the
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26 number of medical school entrants doubled.⁴ Second, in 1972, the national and prefectural
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28 governments cooperated to found a special medical school, Jichi Medical School, solely to train
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30 rural physicians.^{2 5 6} These policies increased both the number of practicing physicians
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32 nationwide and the number of rural physicians.^{7 8} It is likely that the increase in the number of
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34 rural physicians contributed to the decrease in number of country's designated *muichiku* (non-
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36 physician communities).²
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39 However, the equity of distribution of physicians has been almost unchanged; in other words
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41 the disparity between the number of urban and rural physicians has not diminished.^{7 9 10} To
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43 make matters worse, a new residency training system started in 2004. In this new system, like
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45 the residency matching system of the United States, new graduates are matched to training
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47 hospitals nationwide in order of their preferences, which changed the distribution of young
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49 physicians who previously tended to concentrate in university hospitals.¹¹ This change
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51 decreased the physician-assigning capability of university hospitals which has traditionally
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53 dispatched physicians in rural hospitals.³ Since the implementation of this new residency
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55 scheme, the geographic distribution of physicians has reportedly worsened.¹²⁻¹⁵ Then the
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5 shortage of physicians in rural areas and collapse of healthcare provision in such communities
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7 has resurfaced as a social concern.
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10 **Emergence of subquota as a national policy**

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12 The government responded by rapidly expanding the number of medical school entrants by
13 adding *chiikiwaku*, a subquota, in 2008.¹⁶ Under the subquota, applicants to a medical school, in
14 most cases, must have graduated from a high school in that prefecture. An expressed intention
15 to practice in that prefecture, preferably in one of its rural areas, is valued in the admission
16 interview. Upon admission, entrants are usually offered six-year scholarships from the
17 prefectural government in exchange for working in the prefecture, including its rural areas, for a
18 designated obligation period after graduation (Figure 1).¹⁶ The design of the subquota varies
19 substantially among medical schools. Some medical schools have subquotas without scholarship,
20 in which case the intention to practice in certain areas is valued in admission but the entrants
21 have no obligation period. Some subquotas require their students to work in rural areas or in a
22 specialty which is recognised in severe shortage in the prefecture.
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36 Currently 70 out of Japan's 80 medical schools have such subquotas. The number of entrants
37 to subquota exceeded 1500 per year, amounting to 17% of all medical school entrants (Figure
38 2).¹⁷ Historically this is one of the largest and most ambitious policies to rectify the
39 maldistribution of physicians in Japan. Evaluation of outcomes of this policy thus is needed.
40 However, the subquota has only just started to graduate students, so there is as yet no
41 comprehensive and longitudinal study to assess its effectiveness.
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49 **Prefecture scholarship for medical students independent of subquota**

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52 Aside from the subquota, many prefectures have independent scholarship programmes for
53 medical students. This scholarship is also given in exchange for postgraduate practice within the
54 prefecture, usually including rural areas. The scholarship recipients are students who entered
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5 medical schools in a usual way (non-subquota admission) or those who entered subquotas
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7 without scholarship. Similar to the subquota system, these scholarship programmes have
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9 recently expanded. Similar programmes are seen in other countries, but their outcomes are open
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11 to debate.¹⁸⁻²³ The outcomes of the prefecture scholarship programmes in Japan are not yet
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13 known.

14 15 16 **Objectives of this study**

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19 This cohort study investigates the outcome of subquota admission system of medical schools
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21 and that of prefecture scholarship programmes for non-subquota students. The cohort consists of
22
23 three groups of physicians: subquota without scholarship, subquota with scholarship, and
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25 scholarship without subquota admission (Figure 3). Passing rate of the National Physician
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27 License Examination, scholarship buying-out rate, geographic distribution, and specialty
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29 distribution of each group of subjects are evaluated and compared with those of all Japanese
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31 physicians in the same generation.
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37 **Methods and analysis**

38 39 **Study design**

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42 This study is conducted by the Japanese Council for Community-based Medical Education
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44 (JCCME). The JCCME is the network of medical school departments related with community
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46 health or rural health with its mission being promotion of community-based medical education.
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48 Many of the departments in JCCME educate and train subquota students.
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52 The outline of study design is shown in Figure 4. The study consists of three steps. In the first
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54 step, the cohort office of JCCME contacts all prefectural governments and medical schools and
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56 obtains data for the yearly cross-sectional outcomes (lower part of figure 4). In the second step,
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5 the cohort office contacts individual subjects via prefectural governments or medical schools
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7 and obtains baseline data for follow-up (upper part). Finally, in the third step the each individual
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9 subject is followed up by obtaining the corresponding individual's data in the biennial national
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11 physician census and linking it to the baseline data.
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14 The Ministry of Health, Labour and Welfare, Ministry of Education Culture, Sports, Science
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16 and Technology, and Association of Japan Medical Colleges support this study by requesting
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18 prefectures and/or medical schools to participate in the study.
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20 21 **Definitions of subquota and scholarship** 22

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24 According to this study, a subquota of medical school is one whose "geographic background
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26 or location of graduated high schools of applicants are restricted and/or working place or
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28 specialty after graduation is clearly specified." A scholarship is "given by a prefecture to a
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30 medical student which needs not to be paid back if the student works in designated areas by the
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32 prefecture for a certain period."
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35 In the subquota admission system, receiving the scholarship is often a condition for admission
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37 to the medical school. However, some medical schools have subquotas without scholarships, so
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39 entrants are not obligated to practice in certain areas of Japan. In addition, some medical
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41 students who did not enter subquotas (but did enter medical schools by passing the traditional
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43 written examination) but still hope for a prefecture scholarship. This study includes subjects of
44
45 all the three groups (Figure 3).
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48 Information on scholarship recipients with or without subquota admission are obtained from
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50 each prefecture government. Information on subjects of subquota without scholarship are
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52 obtained from each medical school.
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54 55 **Yearly cross-sectional outcomes** 56 57 58 59 60

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5 Every year the cohort office of JCCME begins this study by sending a questionnaire to each
6 prefecture government to obtain information on the number of newly graduated subjects who
7 received scholarship, number of the subjects who passed the National License Examination for
8 Physicians, and number of subjects who bought out the scholarship to refuse the obligatory
9 work. The cohort office sends a questionnaire also to each medical school to obtain information
10 on the number of subjects in subquotas without scholarship and number of the subjects who
11 passed the National License Examination for Physicians (arrows 1 and 2 in Figure 4). The
12 results are yearly cross-sectional outcomes. Some results to-date are shown later in this paper.
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22 This step of survey started in 2014 and will be conducted every year at least until 2025.
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25 **Individual baseline data**

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28 In the second step, the cohort office requests each prefecture and medical school to forward a
29 questionnaire (arrow 3 in Figure 4) and the prefecture and medical school forward the
30 questionnaire to each potential study subject (arrow 4). Each subject then sends back the
31 answered questionnaire to the cohort office (arrow 5). Then the cohort office obtains the
32 baseline data on each subject. The subjects consist of either of the three groups shown in Figure
33 3 and are all newly licensed physicians.
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41 The questionnaire for each subject in the group of subquota with scholarship and in the group
42 of scholarship alone includes information on whether the subject was admitted to a subquota,
43 physician identification number, name of the graduated medical school, graduation year, home
44 prefecture, term of scholarship, length of postgraduate obligation period required by the
45 scholarship, and length of rural service or service in a designated specialty during the obligation
46 period. The questionnaire for each subject in the group of subquota without scholarship includes
47 information on physician identification number, name of the graduated medical school,
48 graduation year, home prefecture, and conditions for admission to the subquota. The validity
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5 and easiness to answer the questions were pre-checked using sample subjects (subquota
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7 students) in selected medical schools before the study started.
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10 This step in the survey also started in 2014 and will be conducted every year at least until
11
12 2025.
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14 **Follow-up of individual subjects**

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17 The third step is to follow up the subjects. The baseline individual data obtained in the second
18 step is connected, through physician identification number, to the national census data of the
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20 “Survey of Physicians, Dentists and Pharmacists” (Physician Census) conducted by Ministry of
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22 Health, Labour and Welfare every two years (Figure 5). All licensed physicians in Japan are
23
24 obligated to register in the Physician Census. The Physician Census includes information on
25
26 practice location, type of medical facility, work contents, specialty, and board certification
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28 status. The connection between the baseline data and the data in Physician Census enables
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30 comparison of geographic distribution among the three subject groups and between each subject
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32 group and a control group of all physicians in the same generation in Japan. The cohort office
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34 will request the Ministry of Health, Labour and Welfare to provide individualised data of
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36 Physician Census every two years since 2016 in which data of 2014 Census will be available.
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41 In this way, once the physician identification numbers are stored, the subjects can be followed
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43 up almost permanently (until the subjects retire or stop practicing in Japan). The end of the
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45 follow-up is thus not determined.
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47 **Analysis**

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50 Based on the data obtained directly from the prefectures and medical schools (arrow 2 in
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52 Figure 4), passing rates of the National License Examination for Physicians in the three groups
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54 of subjects are calculated. These rates are compared with the passing rate of the entire medical
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56 school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.
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5 Also based on the data from the prefectures, scholarship buying-out rates of subjects in the
6 groups of subquota with scholarship and scholarship alone are calculated. The buying-out rate is,
7 in other words, the number of subjects who refuse to comply with the conditions accompanied
8 by receiving scholarship and thus pay back the awarded money.
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14 Based on the data obtained from individual subjects (arrow 5 in Figure 4) and its linkage to
15 Physician Census data, municipality (city, town, and village)-level distribution, Gini
16 coefficients, proportion of those in rural areas, proportion of those in specialties that are
17 reportedly in shortage nationwide (such as obstetrics and paediatrics) among the subjects in
18 each group are evaluated. These values are compared with those of all the physicians in the
19 same generation in the Census (control). Proportion of those who are retained in their home
20 prefectures in each group is also calculated and will be compared with the proportion of other
21 newly licensed physicians that has been or will be reported elsewhere.^{17 24} Also the associations
22 between baseline characteristics of subjects (such as sex and length of obligation period) and
23 their geographic distribution are analysed using multivariate models. These results are
24 longitudinally compared among different postgraduate years in the same cohort generation.
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37 **Obtained results to date**

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40 Although follow-up data has yet to be obtained as data of 2014 Physician Census is still
41 unavailable, cross-sectional outcomes in 2014 and 2015 have already been obtained.
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45 In 2014, 38 of Japan's 47 prefectures had study subjects who met the subject definitions. All
46 of the 38 prefectures responded to our questionnaire (response rate 100%). The number of new
47 medical graduates who are from subquota with scholarship was 144, and among them, 141
48 passed the National License Examination for Physicians (passing rate 97.9%). The number of
49 those with scholarship alone was 322, of whom 305 (94.7%) passed the License Examination.
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55 Among all 80 medical schools in Japan, the number of those which had study subjects was 21.
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5 All of the 21 medical schools (100%) responded to our questionnaire. The number of new
6 graduates who are from subquota without scholarship was 166; among them, 160 (96.4%)
7 passed the License Examination. These passing rates of the three groups of subjects were higher
8 than the passing rate of all new medical graduates in Japan: 93.9%.

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14 In 2015, 45 prefectures had study subjects, and all (100%) responded to the questionnaire. The
15 number of new graduates who are from subquota with scholarship was 305, and 295 (96.7%)
16 passed the License Examination. The number of those with scholarship alone was 391, of whom
17 377 (96.4%) passed the License Examination. Twenty-two medical schools had study subjects,
18 and all of the schools (100%) responded to our questionnaire. The number of new graduates
19 who are from subquota without scholarship was 253, and 244 (96.4%) passed the License
20 Examination. This year again the passing rates of the all groups were higher than that of all new
21 medical graduates in Japan: 94.5%.²⁵

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31 The passing rates in the two years are shown in Figure 6. These results are rather unexpected,
32 taking into account the concern about academic capability of subquota students which was and
33 still remains among both the general population and medical school faculty members.

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38 The number of 2014 licensed subjects who bought out their scholarship as of June 2015 was 9
39 (2.0%) out of all 446 scholarship awardee subjects. The comparable figure of 2015-licensed
40 subjects was 4 (0.6%) out of 672.

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45 As for recruitment of individual subjects, in 2014 the cohort office sent a questionnaire, via
46 prefecture or medical school to 603 subjects. Among them 241 (response rate 40.0%) responded.
47 In 2015 the questionnaire was sent to 929 subjects and 398 (42.8%) responded to it. These
48 respondents were registered as the cohort subjects.

49 50 51 52 53 54 **Strengths and limits of the study**

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5 The first strength of this study is that this is the first nationwide and comprehensive
6
7 longitudinal study on the subquota admission system and the prefecture scholarship programme.
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9 The second is that, with the help of two related ministries and the national representative body
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11 of medical schools, all the prefecture governments and medical schools did and will participate
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13 in this study, which enables us to obtain precise information on the number of potential subjects,
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15 passing rate of the License Examination, and scholarship buying-out rate every year. In addition,
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17 with the full cooperation of prefectures and medical schools, the cohort office can send the
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19 questionnaire to all the potential individual subjects. The third strength of this study is that
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21 almost 100% of subjects registered in the cohort can be followed up until they either retire or
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23 stop practicing in Japan and drop out of the Physician Census. Using the national census data as
24
25 a way of follow-up costs less money, time, and effort than usual follow-up in which the cohort
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27 office contacts each subject numerous times in the future.
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30 One limitation of this study is that the participation of an individual subject is voluntary and
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32 thus recruiting all the potential subjects is quite difficult. This is particularly so because the
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34 questionnaire includes personal information such as physician identification number. The
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36 participation rate of subjects in 2014 was 40.0% and that in 2015 was 43%. We thus cannot
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38 exclude a selection bias of the registered cohort subjects, which might create a biased result on
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40 the geographic and specialities distribution of these subjects shown in the future.
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43 **Impact on global, national, and local policies**

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46 The special admission systems of medical schools aiming to improve the shortage of
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48 physicians in rural areas are conducted worldwide.²⁶⁻²⁸ Also financial incentive programmes for
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50 return of service in underserved areas exist in many countries.^{22 23} The results of this study will
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52 add evidence to show the effectiveness of these systems and programmes.
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5 The expansion of medical school entrants by adding subquota is continued, under a national
6 law, until 2019. But after 2019, the future of the subquota system is unknown. The government,
7 prefectures, and medical schools have four options: expanding the system, continuing it as it is,
8 restricting its scale, and abolishing it entirely. The results of this study, such as geographic
9 distribution, specialty distribution, buying-out rate, and national examination passing rate of
10 subquota graduates, will enable the stakeholders to make the most informed choice. Moreover,
11 the results of this study in each prefecture will enable the prefecture to consider what to do with
12 its scholarship programme.
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24 25 **ETHICS AND DISSEMINATION**

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28 The Ethics Committee for epidemiological research of Hiroshima University and the Research
29 Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences gave
30 permission for this study. The cohort office explains in a document to all the prefectures,
31 medical schools, and individual subjects that all the information in the questionnaire is used
32 only for the research purpose and the data provided by an individual can be deleted any time
33 when the individual requests the cohort office to do so. The response to the sent questionnaire is
34 voluntary.
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43 The cohort data is collected and stored in the cohort office (Department of Community-based
44 Medical System, Hiroshima University) without personal name of each individual subject
45 (completely anonymous data). Individually unidentifiable results will be presented in
46 conferences or published in journals. The results also will be reported to concerned government
47 ministries, associations, and prefectures.
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56 57 **Contributors**

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5 MM contributed to the study design, tools, study administration, data collection, analysis,
6 interpretation of data, and writing the draft. KT and TM contributed to the study design, tools,
7 study administration, data interpretation, and writing the draft. JT, ST and KI contributed to the
8 study design, interpretation of data, and writing the draft. TO and SI contributed to the study
9 administration, data collection, and draft writing.
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17
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23

24 **Competing interests**

25
26 None
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29 **Ethics approval**

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31 Ethical approval was granted by the Ethics Committee for epidemiological research of
32 Hiroshima University (ref no. 778) and the Research Ethics Committee of Nagasaki University
33 Graduate School of Biomedical Sciences (ref no. 13091342).
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39 **Data sharing statement**

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41 Conditions of the ethical approvals permit the cohort office (Department of Community-
42 Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University) and
43 the sub-office (Department of Community Medicine, Nagasaki University Graduate School of
44 Biomedical Science) to share the cohort data. Aggregated data are shared with stakeholders or
45 other researchers.
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Figure legends

Figure 1. Example of rural subquota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own subquota system (yr, year; med, medical).

Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).¹⁷

Figure 3. Study subjects

Figure 4. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).

Figure 5. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)

Figure 6. Passing rates of the National Licence Examination for Physicians. Control data were from the Ministry of Health, Labour and Welfare.²⁵

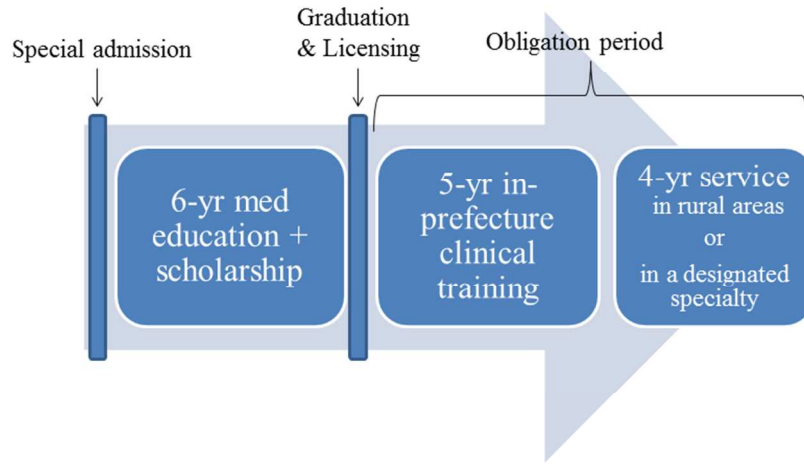


Figure 1. Example of rural subquota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own subquota system (yr, year; med, medical). 254x190mm (96 x 96 DPI)

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Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).
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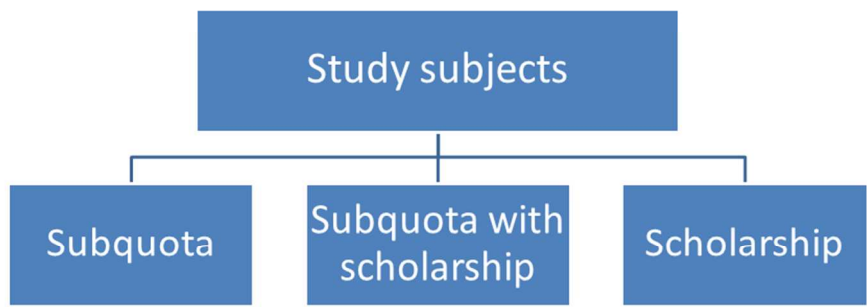


Figure 3. Study subjects
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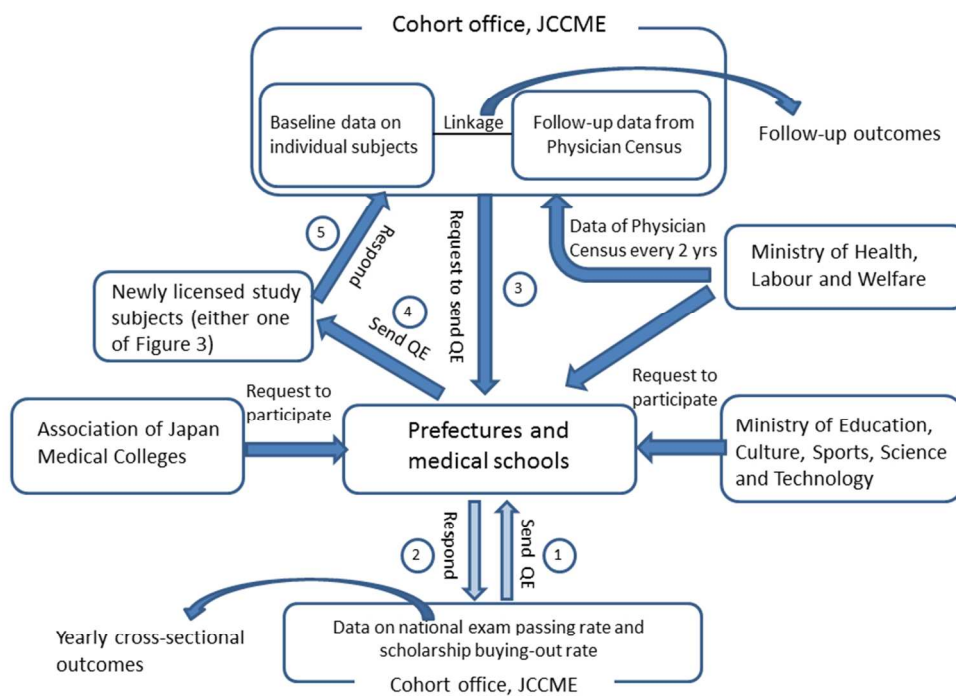


Figure 4. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).
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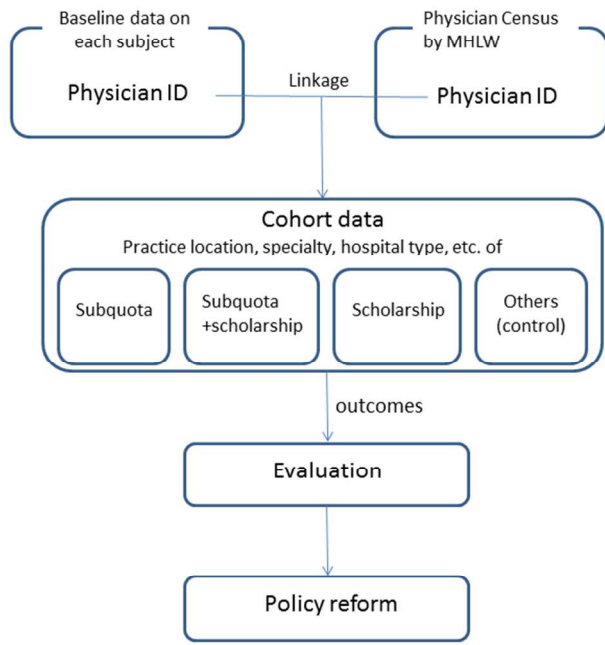


Figure 5. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)
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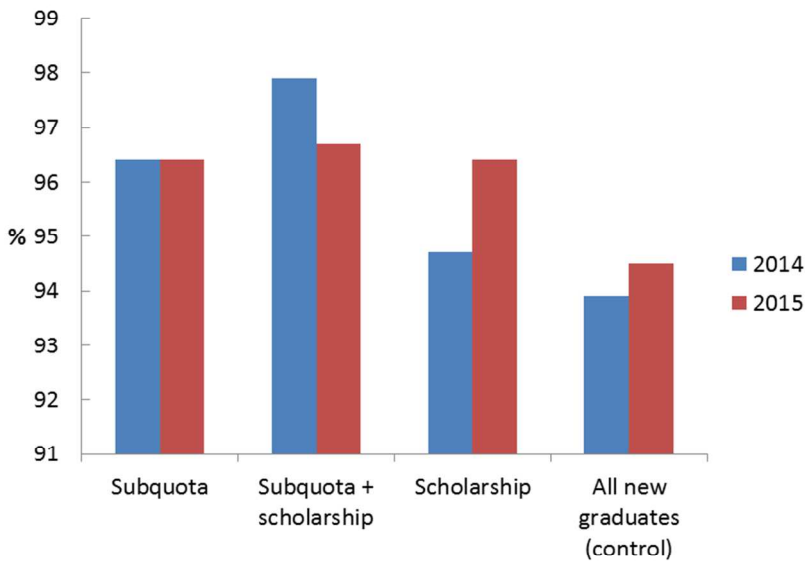


Figure 6. Passing rates of the National Licence Examination for Physicians. Control data were from the Ministry of Health, Labour and Welfare.
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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cohort studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	✓
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	✓
		(b) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	not needed
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	✓
		(b) Describe any methods used to examine subgroups and interactions	✓
		(c) Explain how missing data were addressed	✓
		(d) If applicable, explain how loss to follow-up was addressed	✓
		(e) Describe any sensitivity analyses	
Results			not needed

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	✓
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	unknown ✓
Outcome data	15*	Report numbers of outcome events or summary measures over time	no data yet as this is a protocol
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	paper
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLOS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: a study protocol

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Primary Subject Heading:	Health policy
Secondary Subject Heading:	Medical education and training
Keywords:	physicians, geography, MEDICAL EDUCATION & TRAINING, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Japan

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5 Follow-up study of the regional quota system of Japanese medical schools and prefecture
6 scholarship programmes: a study protocol
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50 Keywords: physicians; geography; medical education; health policy; Japan
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ABSTRACT

Introduction: Given the shortage of physicians, particularly in rural areas, the Japanese government has rapidly expanded the number of medical school students by adding *chiikiwaku* (regional quotas) since 2008. Quota entrants now account for 17% of all medical school entrants. Quota entrants are usually local high school graduates who receive a scholarship from the prefecture government. In exchange, they temporarily practice in that prefecture, including its rural areas, after graduation. Many prefectures have also scholarship programmes for non-quota students in exchange for postgraduate in-prefecture practice. The objective of this cohort study, conducted by the Japanese Council for Community-based Medical Education, is to evaluate the outcomes of the quota admission system and prefecture scholarship programmes nationwide.

Methods and analysis: There are three groups of study subjects: quota without scholarship, quota with scholarship, and non-quota with scholarship. Under the support of government ministries and the Association of Japan Medical Colleges, and participation of all prefectures and medical schools, passing rate of the National Physician License Examination, scholarship buying-out rate, geographic distribution and specialties distribution of each group are analysed. Subjects who voluntarily participated are followed by linking their baseline information to data in the government's biennial Physician Census. Results to date showed that, despite medical schools' concerns about academic quality, the passing rate of the National Physician License Examination in each group was higher than that of all medical school graduates.

Ethics and dissemination: The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences permitted this study. No individually identifiable results will be presented in conferences or published in journals. The aggregated results will be reported to concerned government ministries, associations, prefectures and medical schools as data for future policy planning.

Strengths and limitations of this study

- Regional quota admission system of medical schools is one of the largest national policies ever conducted to redress maldistribution of physicians, and these entrants now constitute 17% of all medical school entrants in Japan.
- This study evaluates the outcomes of the quota admission system and prefecture scholarship programmes for medical students by cross-sectional survey to prefectures and medical schools, and analysing cohort of quota and scholarship subjects.
- Started in 2013, this is the first comprehensive and longitudinal study of this sort, with support from concerned ministries and the representative body of medical schools.
- All of Japan's prefecture governments and medical schools participate in this study, which yields precise information on the passing rate of the National License Examination for Physicians and scholarship buying-out rate of study subjects every year.
- Geographic and specialty distributions of all the study subjects voluntarily registered in the cohort can be followed until they retire as we link the baseline data to the government's national biennial census data, though increasing the recruitment rate of subjects is a challenge.

INTRODUCTION

Geographic maldistribution of physicians in Japan

Geographic maldistribution of physicians has long been recognised as a chronic social problem in Japan. No public agencies have a legal right to decide the allocation of physicians, and thus physicians are given unrestricted freedom to practice wherever they like. There is no

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5 allocation system in which local governments or professional bodies place a cap on the number
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7 of physicians in each area as seen in other countries such as United Kingdom. In this context the
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9 concentration of physicians in urban areas and a corresponding shortage in rural areas are likely
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11 to occur,¹⁻³ and initiatives in Japan up to this time have yet to redress the maldistribution of
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13 physicians. Article 25 of the Japanese Constitution guarantees healthy living of all citizens and
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15 obliges the government to improve public health. So redressing the geographic maldistribution
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17 is usually recognised a responsibility of the national and local governments.
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21 The national and prefectural governments have attempted to resolve this issue in several ways.
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23 First the government constructed one medical school in each prefecture between the 1960s and
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25 1970s, founding new public medical schools in mainly rural prefectures where none had existed.
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27 Under this policy, the number of medical schools in Japan increased from 46 to 79 and the
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29 number of medical school entrants doubled.⁴ Second, in 1972, the national and prefectural
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31 governments cooperated to found a special medical school, Jichi Medical School, solely to train
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33 rural physicians.^{2 5 6} These policies increased both the number of practicing physicians
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35 nationwide and the number of rural physicians.^{7 8} It is likely that the increase in the number of
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37 rural physicians contributed to the decrease in number of country's designated *muichiku* (non-
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39 physician communities).²
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42 However, the equity of distribution of physicians has been almost unchanged; in other words
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44 the disparity between the number of urban and rural physicians has not diminished.^{7 9 10} To
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46 make matters worse, a new residency training system started in 2004. In this new system, like
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48 the residency matching system of the United States, new graduates are matched to training
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50 hospitals nationwide in order of their preferences, which changed the distribution of young
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52 physicians who previously tended to concentrate in university hospitals.¹¹ This change
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54 decreased the physician-assigning capability of university hospitals which has traditionally
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56 dispatched physicians in rural hospitals.³ Since the implementation of this new residency
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5 scheme, the geographic distribution of physicians has reportedly worsened.¹²⁻¹⁵ The shortage of
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7 physicians in rural areas and collapse of healthcare provision in such communities has
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9 resurfaced as a social concern.

10 11 12 **Emergence of regional quotas as a national policy**

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15 The government responded by rapidly expanding the number of medical school entrants by
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17 adding *chiikiwaku*, a regional quota, in 2008.¹⁶ Under the quota, applicants to a medical school,
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19 in most cases, must have graduated from a high school in that prefecture. An expressed
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21 intention to practice in that prefecture, preferably in one of its rural areas, is valued in the
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23 admission interview. Upon admission, entrants are usually offered six-year scholarships from
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25 the prefectural government in exchange for working in the prefecture, including its rural areas,
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27 for a designated obligation period after graduation (Figure 1).¹⁶ The design of the quota varies
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29 substantially among medical schools. Some medical schools have quotas without scholarship, in
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31 which case the intention to practice in certain areas is valued in admission but the entrants have
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33 no obligation period. Some quotas require their students to work in rural areas or in a specialty
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35 which is recognised in severe shortage in the prefecture.

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38 Currently 70 out of Japan's 80 medical schools have such quotas. The number of entrants to
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40 quota exceeded 1500 per year, amounting to 17% of all medical school entrants (Figure 2).¹⁷
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42 Historically this is one of the largest and most ambitious policies to rectify the maldistribution
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44 of physicians in Japan. Evaluation of outcomes of this policy thus is needed. However, the
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46 quota has only just started to graduate students, so there is as yet no comprehensive and
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48 longitudinal study to assess its effectiveness.

49 50 51 **Prefecture scholarship for medical students independent of quota**

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54 Aside from the quota, many prefectures have independent scholarship programmes for
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56 medical students. This scholarship is also given in exchange for postgraduate practice within the
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5 prefecture, usually including rural areas. The scholarship recipients are students who entered
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7 medical schools in a usual way (non-quota admission) or those who entered quotas without
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9 scholarship. Similar to the quota system, these scholarship programmes have recently expanded.
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11 Similar programmes are seen in other countries, but their outcomes are open to debate.¹⁸⁻²³ The
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13 outcomes of the prefecture scholarship programmes in Japan are not yet known.
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15 16 **Objectives of this study**

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19 This cohort study investigates the outcome of the quota admission system of medical schools
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21 and that of prefecture scholarship programmes for non-quota students. The cohort consists of
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23 three groups of physicians: quota without scholarship, quota with scholarship, and scholarship
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25 without quota admission. Passing rate of the National Physician License Examination,
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27 scholarship buying-out rate, geographic distribution, and specialty distribution of each group of
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29 subjects are evaluated and compared with those of all Japanese physicians in the same
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31 graduating year.
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33 34 35 36 37 **Methods and analysis**

38 39 40 **Study design**

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43 This study is conducted by the Japanese Council for Community-based Medical Education
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45 (JCCME). The JCCME is the official association of medical school departments which engage
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47 in community or rural health education and research. The mission of JCCME is promotion of
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49 community-based medical education. Many of the departments in JCCME educate and train
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51 quota students.
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54 The outline of study design is shown in Figure 3. The study consists of three steps. In the first
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56 step, the cohort office of JCCME contacts all prefectural governments and medical schools and
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5 obtains data for the yearly cross-sectional outcomes (lower part of figure 3). In the second step,
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7 the cohort office contacts individual subjects via prefectural governments or medical schools
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9 and obtains baseline data for follow-up (upper part). Finally, in the third step the each individual
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11 subject is followed up by obtaining the corresponding individual's data in the biennial national
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13 physician census and linking it to the baseline data.
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16 The Ministry of Health, Labour and Welfare, Ministry of Education Culture, Sports, Science
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18 and Technology, and Association of Japan Medical Colleges support this study by requesting
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20 prefectures and/or medical schools to participate in the study.
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22 23 **Definitions of quota and scholarship**

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25 According to this study, a quota of medical school is one whose "geographic background or
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27 location of graduated high schools of applicants are restricted and/or working place or specialty
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29 after graduation is clearly specified." A scholarship is "given by a prefecture to a medical
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31 student which needs not to be paid back if the student works in designated areas by the
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33 prefecture for a certain period."
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37 In the quota admission system, receiving the scholarship is often a condition for admission to
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39 the medical school. However, some medical schools have quotas without scholarships, so
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41 entrants are not obligated to practice in certain areas of Japan. In addition, some medical
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43 students who did not enter quotas (but did enter medical schools by passing the traditional
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45 written examination) but still hope for a prefecture scholarship. This study includes subjects of
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47 all the three groups.
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50 Information on scholarship recipients with or without quota admission are obtained from each
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52 prefecture government. Information on subjects of quota without scholarship are obtained from
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54 each medical school.
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56 57 **Yearly cross-sectional outcomes**

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5 Every year the cohort office of JCCME begins this study by sending a questionnaire to each
6 prefecture government to obtain information on the number of newly graduated subjects who
7 received scholarship, number of the subjects who passed the National License Examination for
8 Physicians, and number of subjects who bought out the scholarship to refuse the obligatory
9 work. The cohort office sends a questionnaire also to each medical school to obtain information
10 on the number of subjects in quotas without scholarship and number of the subjects who passed
11 the National License Examination for Physicians (arrows 1 and 2 in Figure 3). The results are
12 yearly cross-sectional outcomes. Some results to-date are shown later in this paper.
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22 This step of survey started in 2014 and will be conducted every year at least until 2025.
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25 **Individual baseline data**

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28 In the second step, the cohort office requests each prefecture and medical school to forward a
29 questionnaire (arrow 3 in Figure 3) and the prefecture and medical school forward the
30 questionnaire to each potential study subject (arrow 4). Each subject then voluntarily sends back
31 the answered questionnaire to the cohort office (arrow 5). Then the cohort office obtains the
32 baseline data on each subject. The subjects consist of either of the three groups (quota alone,
33 quota with scholarship, and scholarship alone) and are all newly licensed physicians.
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41 The questionnaire for each subject in the group of quota with scholarship and in the group of
42 scholarship alone includes information on whether the subject was admitted to a quota,
43 physician identification number, name of the graduated medical school, graduation year, home
44 prefecture, term of scholarship, length of postgraduate obligation period required by the
45 scholarship, and length of rural service or service in a designated specialty during the obligation
46 period. The questionnaire for each subject in the group of quota without scholarship includes
47 information on physician identification number, name of the graduated medical school,
48 graduation year, home prefecture, and conditions for admission to the quota. Demographic data
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5 such as age, sex, marital status are not included in any questionnaire. The easiness to answer the
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7 questions was pre-checked using sample subjects (quota students) in selected medical schools
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9 before the study started. The precision of the answers they filled in was also pre-checked by
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11 faculty members of the selected schools.
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14 This step in the survey also started in 2014 and will be conducted every year at least until
15
16 2025.
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18 19 **Follow-up of individual subjects**

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21 The third step is to follow up the subjects. The baseline individual data obtained in the second
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23 step is connected, through physician identification number, to the national census data of the
24
25 “Survey of Physicians, Dentists and Pharmacists” (Physician Census) conducted by Ministry of
26
27 Health, Labour and Welfare every two years (Figure 4). All licensed physicians in Japan are
28
29 obligated to register in the Physician Census. The Physician Census includes information on
30
31 practice location, type of medical facility, work contents, specialty, and board certification
32
33 status. The connection between the baseline data and the data in Physician Census enables
34
35 comparison of geographic distribution among the three subject groups and between each subject
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37 group and a control group of all physicians in the same generation in Japan. The cohort office
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39 will request the Ministry of Health, Labour and Welfare to provide individualised data of
40
41 Physician Census every two years since 2016 in which data of 2014 Census will be available.
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45 In this way, once the physician identification numbers are stored, the subjects can be followed
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47 up almost permanently (until the subjects retire or stop practicing in Japan). The end of the
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49 follow-up is thus not determined.
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51 52 **Analysis**

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54 Based on the data obtained directly from the prefectures and medical schools (arrow 2 in
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56 Figure 3), passing rates of the National License Examination for Physicians in the three groups
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5 of subjects are calculated. These rates are compared with the passing rate of the entire medical
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7 school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.
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9 Also based on the data from the prefectures, scholarship buying-out rates of subjects in the
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11 groups of quota with scholarship and scholarship alone are calculated. The buying-out rate is, in
12
13 other words, the number of subjects who refuse to comply with the conditions accompanied by
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15 receiving scholarship and thus pay back the awarded money.
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18 Based on the data obtained from individual subjects (arrow 5 in Figure 3) and its linkage to
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20 Physician Census data, municipality (city, town, and village)-level distribution, Gini
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22 coefficients, proportion of those in rural areas, proportion of those in specialties that are
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24 reportedly in shortage nationwide (such as obstetrics and paediatrics) among the subjects in
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26 each group are evaluated. These values are compared with those of all the physicians in the
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28 same graduating year in the Census (control). Proportion of those who are retained in their
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30 home prefectures in each group is also calculated and will be compared with the proportion of
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32 other newly licensed physicians that has been or will be reported elsewhere.^{17 24} Also the
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34 associations between baseline characteristics of subjects (such as sex and length of obligation
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36 period) and their geographic distribution are analysed using multivariate models. These results
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38 are longitudinally compared among different postgraduate years in the cohort of the same
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40 graduating year.
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43 In short, the results are created based on the data which comprise an annual census of school-
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45 and prefectural-level statistics for the subjects, an incomplete annual census of the subjects
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47 themselves and a biennial national physician census.
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49 50 **Results**

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53 Although follow-up data has yet to be obtained as data of 2014 Physician Census is still
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55 unavailable, cross-sectional outcomes in 2014 and 2015 have already been obtained.
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In 2014, 38 of Japan's 47 prefectures had study subjects who met the subject definitions. All of the 38 prefectures responded to our questionnaire (response rate 100%). Among all 80 medical schools in Japan, the number of those which had study subjects was 21. All of the 21 medical schools (100%) responded to our questionnaire. The results of the National Licence Examination for Physicians among the subjects are shown in Table 1. The passing rates of all the three groups of subjects were higher than the passing rate of all new medical graduates in Japan: 93.9%.

In 2015, 45 prefectures and 22 medical schools had study subjects, and all (100%) responded to the questionnaire. As shown in Table 1, this year again the passing rates of the all groups were higher than that of all new medical graduates in Japan: 94.5%.²⁵

Table 1. Passing rates of the National Licence Examination for Physicians. Control data were from the Ministry of Health, Labour and Welfare.²⁵

	2014			2015		
	New graduates	Passers	Passing rate	New graduates	Passers	Passing rate
Quota without scholarship	166	160	96.4%	253	244	96.4%
Quota with scholarship	144	141	97.9%	305	295	96.7%
Non-quota with scholarship	322	305	94.7%	391	377	96.4%
All new graduates in Japan (control)	7749	7275	93.9%	8250	7798	94.5%

These results are rather unexpected, taking into account the concern about academic capability of quota students which was and still remains among both the general population and medical school faculty members.

The number of 2014 licensed subjects who bought out their scholarship as of June 2015 was 9 (2.0%) out of all 446 scholarship awardee subjects. The comparable figure of 2015-licensed subjects was 4 (0.6%) out of 672.

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5 As for recruitment of individual subjects, in 2014 the cohort office sent a questionnaire, via
6 prefecture or medical school to 603 subjects. Among them 241 (response rate 40.0%) responded.
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8 In 2015 the questionnaire was sent to 929 subjects and 398 (42.8%) responded to it. These
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10 respondents were registered as the cohort subjects.
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13 14 **Strengths and limits of the study**

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17 The first strength of this study is that this is the first nationwide and comprehensive
18 longitudinal study on the quota admission system and the prefecture scholarship programme.
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20 The second is that, with the help of two related ministries and the national representative body
21 of medical schools, all the prefecture governments and medical schools did and will participate
22 in this study, which enables us to obtain precise information on the number of potential subjects,
23 passing rate of the License Examination, and scholarship buying-out rate every year. In addition,
24 with the full cooperation of prefectures and medical schools, the cohort office can send the
25 questionnaire to all the potential individual subjects. The third strength of this study is that
26 almost 100% of subjects registered in the cohort can be followed up until they either retire or
27 stop practicing in Japan and drop out of the Physician Census. Using the national census data as
28 a way of follow-up costs less money, time, and effort than usual follow-up in which the cohort
29 office contacts each subject numerous times in the future.
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42 One limitation of this study is that the participation of an individual subject is voluntary and
43 thus recruiting all the potential subjects is quite difficult. This is particularly so because the
44 questionnaire includes personal information such as physician identification number. The
45 participation rate of subjects in 2014 was 40.0% and that in 2015 was 43%. We thus cannot
46 exclude a selection bias of the registered cohort subjects, which might create a biased result on
47 the geographic and specialities distribution of these subjects shown in the future.
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5 Another limitation is that the baseline data of the subjects do not include the content of
6 undergraduate medical education, which makes it impossible to evaluate the effect of
7 undergraduate education, such as rural community-based clinical training, on workforce
8 distribution.
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13 **Impact on global, national, and local policies**

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17 The special admission systems of medical schools aiming to improve the shortage of
18 physicians in rural areas are conducted worldwide.²⁶⁻²⁸ Also financial incentive programmes for
19 return of service in underserved areas exist in many countries.^{22 23} The results of this study will
20 add evidence to show the effectiveness of these systems and programmes.
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26 The expansion of medical school entrants by adding quota is continued, under a national law,
27 until 2019. But after 2019, the future of the quota system is unknown. The government,
28 prefectures, and medical schools have four options: expanding the system, continuing it as it is,
29 restricting its scale, and abolishing it entirely. The results of this study, such as geographic
30 distribution, specialty distribution, buying-out rate, and national examination passing rate of
31 quota graduates, will enable the stakeholders to make the most informed choice. Moreover, the
32 results of this study in each prefecture will enable the prefecture to consider what to do with its
33 scholarship programme.
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46 **ETHICS AND DISSEMINATION**

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49 The Ethics Committee for epidemiological research of Hiroshima University and the Research
50 Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences gave
51 permission for this study. The cohort office explains in a document to all the prefectures,
52 medical schools, and individual subjects that all the information in the questionnaire is used
53 only for the research purpose and the data provided by an individual can be deleted any time
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5 when the individual requests the cohort office to do so. The response to the sent questionnaire is
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7 voluntary.
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10 The cohort data is collected and stored in the cohort office (Department of Community-based
11 Medical System, Hiroshima University) without personal name of each individual subject
12 (completely anonymous data). Aggregated results will be presented in conferences or published
13 in journals. The aggregated results also will be reported to concerned government ministries,
14 associations, and prefectures.
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20 21 22 23 24 **Contributors**

25 MM contributed to the study design, tools, study administration, data collection, analysis,
26 interpretation of data, and writing the draft. KT and TM contributed to the study design, tools,
27 study administration, data interpretation, and writing the draft. JT, ST and KI contributed to the
28 study design, interpretation of data, and writing the draft. TO and SI contributed to the study
29 administration, data collection, and draft writing.
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45 46 **Competing interests**

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48 None
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50 51 **Ethics approval**

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5 Ethical approval was granted by the Ethics Committee for epidemiological research of
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7 Hiroshima University (ref no. 778) and the Research Ethics Committee of Nagasaki University
8
9 Graduate School of Biomedical Sciences (ref no. 13091342).
10

11 **Data sharing statement**

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14 Conditions of the ethical approvals permit the cohort office (Department of Community-
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16 Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University) and
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18 the sub-office (Department of Community Medicine, Nagasaki University Graduate School of
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20 Biomedical Science) to share the cohort data. Aggregated data are shared with stakeholders or
21
22 other researchers.
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Figure legends

Figure 1. Example of regional quota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own quota system (yr, year; med, medical).

Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).¹⁷

Figure 3. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).

Figure 4. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)

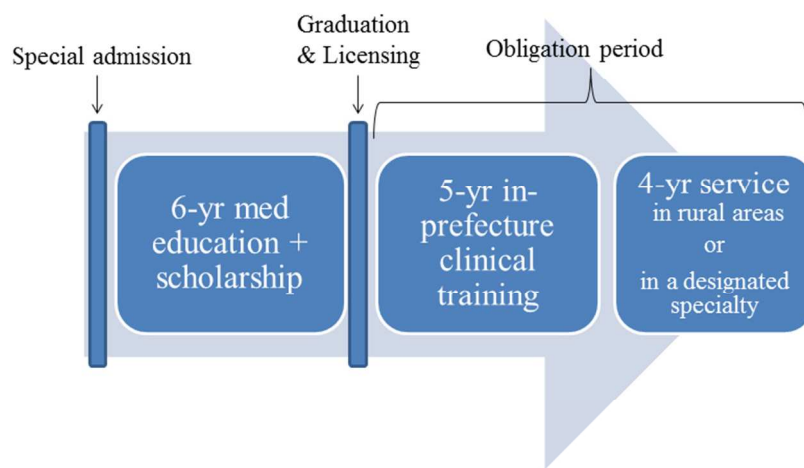


Figure 1
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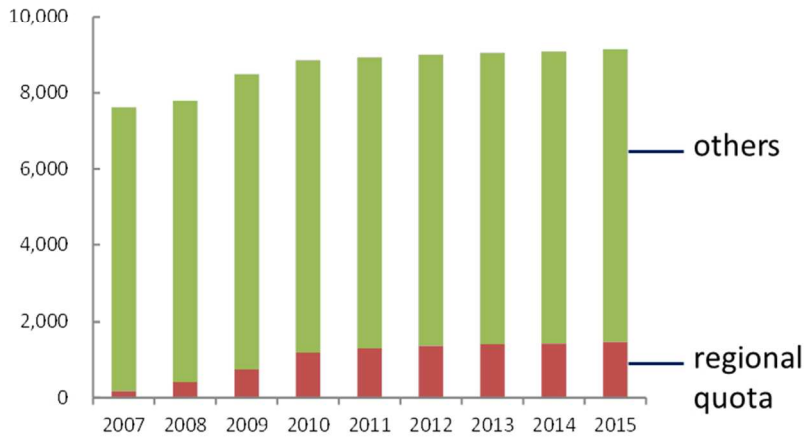


Figure 2
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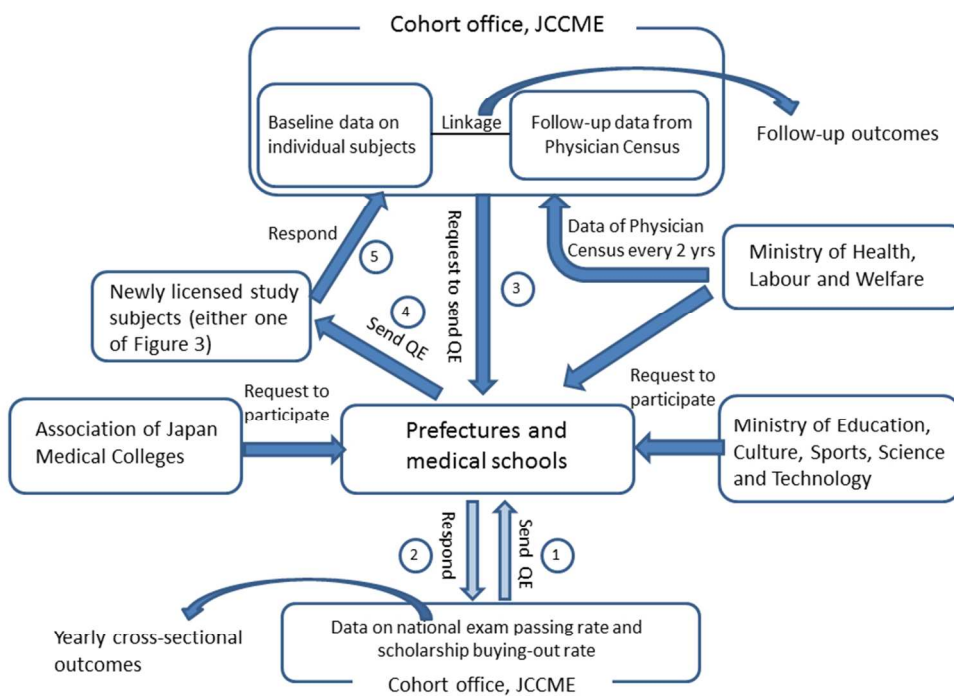


Figure 3
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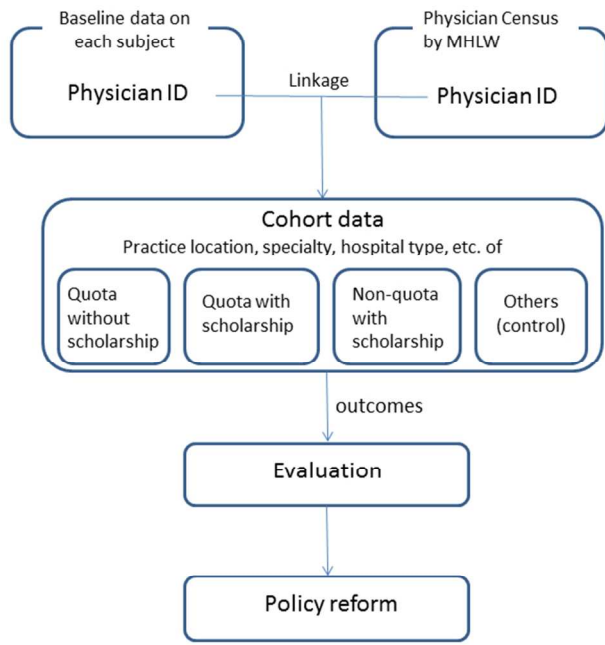


Figure 4
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BMJ Open

Follow-up study of the regional quota system of Japanese medical schools and prefecture scholarship programmes: a study protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-011165.R2
Article Type:	Protocol
Date Submitted by the Author:	23-Mar-2016
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Primary Subject Heading:	Health policy
Secondary Subject Heading:	Medical education and training
Keywords:	physicians, geography, MEDICAL EDUCATION & TRAINING, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Japan

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5 Follow-up study of the regional quota system of Japanese medical schools and prefecture
6 scholarship programmes: a study protocol
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50 Keywords: physicians; geography; medical education; health policy; Japan
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54 Word count: 3206
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ABSTRACT

Introduction: Given the shortage of physicians, particularly in rural areas, the Japanese government has rapidly expanded the number of medical school students by adding *chiikiwaku* (regional quotas) since 2008. Quota entrants now account for 17% of all medical school entrants. Quota entrants are usually local high school graduates who receive a scholarship from the prefecture government. In exchange, they temporarily practice in that prefecture, including its rural areas, after graduation. Many prefectures have also scholarship programmes for non-quota students in exchange for postgraduate in-prefecture practice. The objective of this cohort study, conducted by the Japanese Council for Community-based Medical Education, is to evaluate the outcomes of the quota admission system and prefecture scholarship programmes nationwide.

Methods and analysis: There are three groups of study subjects: quota without scholarship, quota with scholarship, and non-quota with scholarship. Under the support of government ministries and the Association of Japan Medical Colleges, and participation of all prefectures and medical schools, passing rate of the National Physician License Examination, scholarship buy-out rate, geographic distribution and specialties distribution of each group are analysed. Subjects who voluntarily participated are followed by linking their baseline information to data in the government's biennial Physician Census. Results to date showed that, despite medical schools' concerns about academic quality, the passing rate of the National Physician License Examination in each group was higher than that of all medical school graduates.

Ethics and dissemination: The Ethics Committee for epidemiological research of Hiroshima University and the Research Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences permitted this study. No individually identifiable results will be presented in conferences or published in journals. The aggregated results will be reported to concerned government ministries, associations, prefectures and medical schools as data for future policy planning.

Strengths and limitations of this study

- Regional quota admission system of medical schools is one of the largest national policies ever conducted to redress maldistribution of physicians, and these entrants now constitute 17% of all medical school entrants in Japan.
- This study evaluates the outcomes of the quota admission system and prefecture scholarship programmes for medical students by cross-sectional survey to prefectures and medical schools, and analysing cohort of quota and scholarship participants.
- Started in 2013, this is the first comprehensive and longitudinal study of this sort, with support from concerned ministries and the representative body of medical schools.
- All of Japan's prefecture governments and medical schools participate in this study, which yields precise information on the passing rate of the National License Examination for Physicians and scholarship buy-out rate of study subjects every year.
- Geographic and specialty distributions of all the study subjects voluntarily registered in the cohort can be followed until they retire as we link the baseline data to the government's national biennial census data, though increasing the recruitment rate of participants is a challenge.

INTRODUCTION

Geographic maldistribution of physicians in Japan

Geographic maldistribution of physicians has long been recognised as a chronic social problem in Japan. No public agencies have a legal right to decide the allocation of physicians, and thus physicians are given unrestricted freedom to practice wherever they like. There is no

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5 allocation system in which local governments or professional bodies place a cap on the number
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7 of physicians in each area as seen in other countries such as United Kingdom. In this context the
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9 concentration of physicians in urban areas and a corresponding shortage in rural areas are likely
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11 to occur,¹⁻³ and initiatives in Japan up to this time have yet to redress the maldistribution of
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13 physicians. Article 25 of the Japanese Constitution guarantees healthy living of all citizens and
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15 obliges the government to improve public health. So redressing the geographic maldistribution
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17 is usually recognised a responsibility of the national and local governments.
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21 The national and prefectural governments have attempted to resolve this issue in several ways.
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23 First the government constructed one medical school in each prefecture between the 1960s and
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25 1970s, founding new public medical schools in mainly rural prefectures where none had existed.
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27 Under this policy, the number of medical schools in Japan increased from 46 to 79 and the
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29 number of medical school entrants doubled.⁴ Second, in 1972, the national and prefectural
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31 governments cooperated to found a special medical school, Jichi Medical School, solely to train
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33 rural physicians.^{2 5 6} These policies increased both the number of practicing physicians
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35 nationwide and the number of rural physicians.^{7 8} It is likely that the increase in the number of
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37 rural physicians contributed to the decrease in number of country's designated *muichiku* (non-
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39 physician communities).²
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42 However, the equity of distribution of physicians has been almost unchanged; in other words
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44 the disparity between the number of urban and rural physicians has not diminished.^{7 9 10} To
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46 make matters worse, a new residency training system started in 2004. In this new system, like
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48 the residency matching system of the United States, new graduates are matched to training
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50 hospitals nationwide in order of their preferences, which changed the distribution of young
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52 physicians who previously tended to concentrate in university hospitals.¹¹ This change
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54 decreased the physician-assigning capability of university hospitals which has traditionally
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56 dispatched physicians to rural hospitals.³ Since the implementation of this new residency
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5 scheme, the geographic distribution of physicians has reportedly worsened.¹²⁻¹⁵ The shortage of
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7 physicians in rural areas and collapse of healthcare provision in such communities has
8
9 resurfaced as a social concern.
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11 **Emergence of regional quotas as a national policy**

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15 The government responded by rapidly expanding the number of medical school entrants by
16
17 adding *chiikiwaku*, a regional quota, in 2008.¹⁶ Under the quota, applicants to a medical school,
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19 in most cases, must have graduated from a high school in that prefecture. An expressed
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21 intention to practice in that prefecture, preferably in one of its rural areas, is valued in the
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23 admission interview. Upon admission, entrants are usually offered six-year scholarships from
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25 the prefectural government in exchange for working in the prefecture, including its rural areas,
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27 for a designated obligation period after graduation (Figure 1).¹⁶ The design of the quota varies
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29 substantially among medical schools. Some medical schools have quotas without scholarship, in
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31 which case the intention to practice in certain areas is valued in admission but the entrants have
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33 no obligation period. Some quotas require their students to work in rural areas or in a specialty
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35 which is recognised to be in severe shortage in the prefecture.
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38 Currently 70 out of Japan's 80 medical schools have such quotas. The number of entrants to
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40 quota exceeded 1500 per year, amounting to 17% of all medical school entrants (Figure 2).¹⁷
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42 Historically this is one of the largest and most ambitious policies to rectify the maldistribution
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44 of physicians in Japan and evaluation of outcomes of this policy thus is needed. However, the
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46 quota has only just started to graduate students, so there is as yet no comprehensive and
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48 longitudinal study to assess its effectiveness.
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50 **Prefecture scholarship for medical students independent of quota**

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54 Aside from the quota, many prefectures have independent scholarship programmes for
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56 medical students. This scholarship is also given in exchange for postgraduate practice within the
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5 prefecture, usually including rural areas. The scholarship recipients are students who entered
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7 medical schools in a usual way (non-quota admission) or those who entered quotas without
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9 scholarship. Similar to the quota system, these scholarship programmes have recently expanded.
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11 Similar programmes are seen in other countries, but their outcomes are open to debate.¹⁸⁻²³ The
12
13 outcomes of the prefecture scholarship programmes in Japan are not yet known.
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15 16 **Objectives of this study**

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18 This cohort study investigates the outcome of the quota admission system of medical schools
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20 and that of prefecture scholarship programmes for non-quota students. The cohort consists of
21
22 three groups of physicians: quota without scholarship, quota with scholarship, and scholarship
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24 without quota admission. Passing rate of the National Physician License Examination,
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26 scholarship buy-out rate, geographic distribution, and specialty distribution of each group of
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28 subjects are evaluated and compared with those of all Japanese physicians in the same
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30 graduating year.
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33 34 35 36 37 **Methods and analysis**

38 39 40 **Study design**

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42 This study is conducted by the Japanese Council for Community-based Medical Education
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44 (JCCME). The JCCME is the official association of medical school departments which engage
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46 in community or rural health education and research. The mission of JCCME is promotion of
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48 community-based medical education. Many of the departments in JCCME educate and train
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50 quota students.
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54 The outline of study design is shown in Figure 3. The study consists of three steps. In the first
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56 step, the cohort office of JCCME contacts all prefectural governments and medical schools and
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5 obtains data for the yearly cross-sectional outcomes (lower part of figure 3). In the second step,
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7 the cohort office contacts individual subjects via prefectural governments or medical schools
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9 and obtains baseline data for follow-up (upper part). Finally, in the third step the each individual
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11 is followed up by obtaining the corresponding individual's data in the biennial national
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13 physician census and linking these data to the baseline data.
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16 The Ministry of Health, Labour and Welfare, Ministry of Education Culture, Sports, Science
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18 and Technology, and Association of Japan Medical Colleges support this study by requesting
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20 prefectures and/or medical schools to participate in the study.
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22 23 **Definitions of quota and scholarship**

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25 According to this study, a quota of medical school is one whose "geographic background or
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27 location of graduated high schools of applicants are restricted and/or working place or specialty
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29 after graduation is clearly specified." A scholarship is "given by a prefecture to a medical
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31 student which needs not to be paid back if the student works in designated areas by the
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33 prefecture for a certain period."
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36 In the quota admission system, receiving the scholarship is often a condition for admission to
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38 the medical school. However, some medical schools have quotas without scholarships, so
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40 entrants are not obligated to practice in certain areas of Japan. In addition, some medical
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42 students who did not enter quotas (but did enter medical schools by passing the traditional
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44 written examination) but may obtain prefecture scholarships. This study includes subjects in all
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46 the three groups.
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49 Information on scholarship recipients with or without quota admission are obtained from each
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51 prefecture government. Information on subjects of quota without scholarship are obtained from
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53 each medical school.
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55 56 **Yearly cross-sectional outcomes**

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5 Every year the cohort office of JCCME begins this study by sending a questionnaire to each
6 prefecture government to obtain information on the number of newly graduated subjects who
7 received scholarship, number of the subjects who passed the National License Examination for
8 Physicians, and number of subjects who bought out the scholarship to refuse the obligatory
9 work. The cohort office also sends a questionnaire to each medical school to obtain information
10 on the number of subjects in quotas without scholarship and number of the subjects who passed
11 the National License Examination for Physicians (arrows 1 and 2 in Figure 3). The results are
12 yearly cross-sectional outcomes. Some results to-date are shown later in this paper.
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22 This step of survey started in 2014 and will be conducted every year at least until 2025.
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25 **Individual baseline data**

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28 In the second step, the cohort office requests each prefecture and medical school to forward a
29 questionnaire to each potential study participant (arrow 3 and 4 in Figure 3). Each participant
30 then voluntarily sends back the answered questionnaire to the cohort office (arrow 5). The
31 cohort office then obtains the baseline data on each participant. The participants are members of
32 one of the three groups (quota alone, quota with scholarship, and scholarship alone) and are all
33 newly licensed physicians.
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41 The questionnaire for each participant in the group of quota with scholarship and in the group
42 of scholarship alone includes information on whether the participant was admitted to a quota,
43 physician identification number, name of the graduated medical school, graduation year, home
44 prefecture, term of scholarship, length of postgraduate obligation period required by the
45 scholarship, and length of rural service or service in a designated specialty during the obligation
46 period. The questionnaire for each participant in the group of quota without scholarship includes
47 information on physician identification number, name of the graduated medical school,
48 graduation year, home prefecture, and conditions for admission to the quota. Demographic data
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5 such as age, sex, or marital status, are not included in the questionnaire. The ease in answering
6
7 the questions was pre-checked using sample participants (quota students) in selected medical
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9 schools before the study started. The precision of answers they provided was also assessed by
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11 faculty members of the selected schools.
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14 This step in the survey also started in 2014 and will be conducted every year at least until
15
16 2025.
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18 19 **Follow-up of individual participants**

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21 The third step is to follow up the participants. The baseline individual data obtained in the
22
23 second step are connected, through physician identification number, to the national census data
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25 of the “Survey of Physicians, Dentists and Pharmacists” (Physician Census) conducted by
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27 Ministry of Health, Labour and Welfare every two years (Figure 4). All licensed physicians in
28
29 Japan are obligated to register in the Physician Census. The Physician Census includes
30
31 information on practice location, type of medical facility, work contents, specialty, and board
32
33 certification status. The connection between the baseline data and the data in Physician Census
34
35 enables comparison of geographic distribution among the three participant groups and between
36
37 each participant group and a comparison group of all physicians in the same graduating year in
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39 Japan. The cohort office will request the Ministry of Health, Labour and Welfare to provide
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41 individualised data of Physician Census every two years beginning in 2016 at which time data
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43 of 2014 Census will be available.
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47 In this way, once the physician identification numbers are stored, the participants can be
48
49 followed up almost permanently (until the participants retire or stop practicing in Japan).
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51 52 **Analysis**

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54 Based on the data obtained directly from the prefectures and medical schools (arrow 2 in
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56 Figure 3), passing rates of the National License Examination for Physicians in the three groups
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5 of subjects are calculated. These rates are compared with the passing rate of the entire medical
6 school graduates in Japan reported every year by the Ministry of Health, Labour and Welfare.
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8 Also based on the data from the prefectures, scholarship buy-out rates of subjects in the groups
9 of quota with scholarship and scholarship alone are calculated. The buy-out rate is derived from
10 the number of subjects who refuse to comply with the conditions accompanied by receiving of
11 the scholarship and thus return the awarded money.
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18 Based on the data obtained from individual participants (arrow 5 in Figure 3) and its linkage
19 to Physician Census data, municipality (city, town, and village)-level distribution, Gini
20 coefficients, proportion of those in rural areas, proportion of those in specialties that are
21 reportedly in shortage nationwide (such as obstetrics and paediatrics) among the participants in
22 each group are evaluated. These values are compared with those of all the physicians in the
23 same graduating year in the Census (comparison group). The proportion of those who are
24 retained in their home prefectures in each group will be calculated and will be compared with
25 the proportion of other newly licensed physicians that has been or will be reported elsewhere.¹⁷
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²⁴ Also the associations between baseline characteristics of participants (such as sex and length
of obligation period) and their geographic distribution are analysed using multivariate models.
These results are longitudinally compared among different postgraduate years in the cohort of
the same graduating year.

In short, the results are created based on the data which comprise an annual census of school-
and prefectural-level statistics for the subjects, an incomplete census of the cohort participants
themselves and a biennial national physician census.

Results

Although follow-up data has yet to be obtained as data of 2014 Physician Census is still
unavailable, cross-sectional outcomes in 2014 and 2015 have already been obtained.

In 2014, 38 of Japan's 47 prefectures had study subjects who meet the study definitions. All of the 38 prefectures responded to our questionnaire (response rate 100%). Among all 80 medical schools in Japan, 21 had study subjects and all 21 schools (100%) responded to our questionnaire. The results of the National Licence Examination for Physicians among the subjects are shown in Table 1. The passing rates of all the three groups of subjects were higher than the passing rate of all new medical graduates in Japan: 93.9%.

In 2015, 45 prefectures and 22 medical schools had study subjects, and all (100%) responded to the questionnaire. As shown in Table 1, this year again the passing rates of the all groups were higher than that of all new medical graduates in Japan: 94.5%.²⁵

Table 1. Passing rates of the National Licence Examination for Physicians. Comparison data were from the Ministry of Health, Labour and Welfare.²⁵

	2014			2015		
	New graduates	Passers	Passing rate	New graduates	Passers	Passing rate
Quota without scholarship	166	160	96.4%	253	244	96.4%
Quota with scholarship	144	141	97.9%	305	295	96.7%
Non-quota with scholarship	322	305	94.7%	391	377	96.4%
All new graduates in Japan (comparison)	7749	7275	93.9%	8250	7798	94.5%

These results were unexpected, taking into account the concern about academic capability of quota students which was and still remains among both the general population and medical school faculty members.

The number of 2014 licensed subjects who bought out their scholarship as of June 2015 was 9 (2.0%) out of all 446 scholarship awardee subjects. The comparable figure of 2015-licensed subjects was 4 (0.6%) out of 672.

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5 As for recruitment of individual participants, in 2014 the cohort office sent a questionnaire,
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7 via prefecture or medical school to 603 subjects and received 241 responses (40.0%). In 2015
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9 the questionnaire was sent to 929 subjects and 398 (42.8%) responded. These respondents were
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11 registered as the cohort participants.
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13 14 **Strengths and limits of the study**

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17 The first strength of this study is that this is the first nationwide and comprehensive
18
19 longitudinal study on the quota admission system and the prefecture scholarship programme.
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21 The second is that, with the help of two related ministries and the national representative body
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23 of medical schools, all the prefecture governments and medical schools did and will participate
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25 in this study, which enables us to obtain precise information on the number of potential subjects,
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27 passing rate of the License Examination, and scholarship buy-out rate every year. In addition,
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29 with the full cooperation of prefectures and medical schools, the cohort office can send the
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31 questionnaire to all the potential individual subjects. The third strength of this study is that
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33 almost 100% of participants registered in the cohort can be followed up until they either retire or
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35 stop practicing in Japan and drop out of the Physician Census. Using the national census data as
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37 a way of follow-up costs less money, time, and effort than usual follow-up in which the cohort
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39 office contacts each potential subject numerous times in the future.
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43 One limitation of this study is that the participation of an individual subject is voluntary and
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45 thus recruiting all the potential subjects is quite difficult. This is particularly so because the
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47 questionnaire includes personal information such as physician identification number. The
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49 participation rate of subjects in 2014 was 40.0% and that in 2015 was 43%. We thus cannot
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51 exclude a selection bias of the cohort participants, which might create a biased result on the
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53 geographic and specialities distribution of the participants in future analyses.
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5 Another limitation is that the baseline data of the participants do not include the content of
6 undergraduate medical education, which makes it impossible to evaluate the effect of
7 undergraduate education, such as rural community-based clinical training, on workforce
8 distribution.
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13 **Impact on global, national, and local policies**

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17 The special admission systems of medical schools aiming to improve the shortage of
18 physicians in rural areas are conducted worldwide.²⁶⁻²⁸ Also financial incentive programmes for
19 return of service in underserved areas exist in many countries.^{22 23} The results of this study will
20 add evidence to show the effectiveness of these systems and programmes.
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26 The expansion of medical school entrants by adding quota is continued, under a national law,
27 until 2019. But after 2019, the future of the quota system is unknown. The government,
28 prefectures, and medical schools have four options: expanding the system, continuing it as it is,
29 restricting its scale, and abolishing it entirely. The results of this study, such as geographic
30 distribution, specialty distribution, buy-out rate, and national examination passing rate of quota
31 graduates, will enable the stakeholders to make the most informed choice. Moreover, the results
32 of this study in each prefecture will enable the prefecture to consider what to do with its
33 scholarship programme.
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46 **ETHICS AND DISSEMINATION**

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49 The Ethics Committee for epidemiological research of Hiroshima University and the Research
50 Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences gave
51 permission for this study. The cohort office explains in a document to all the prefectures,
52 medical schools, and individual participants that all the information in the questionnaire is used
53 only for the research purpose and the data provided by an individual can be deleted any time
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5 when the individual requests the cohort office to do so. The response to the sent questionnaire is
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7 voluntary.
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10 The cohort data are collected and stored in the cohort office (Department of Community-
11 based Medical System, Hiroshima University) without personal name of each individual
12 participant (completely anonymous data). Aggregated results will be presented in conferences or
13 published in journals. The aggregated results also will be reported to concerned government
14 ministries, associations, and prefectures.
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20 21 22 23 24 **Contributors**

25
26 MM contributed to the study design, tools, study administration, data collection, analysis,
27 interpretation of data, and writing the draft. KT and TM contributed to the study design, tools,
28 study administration, data interpretation, and writing the draft. JT, ST and KI contributed to the
29 study design, interpretation of data, and writing the draft. TO and SI contributed to the study
30 administration, data collection, and draft writing.
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39
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44

45 46 **Competing interests**

47
48 None
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50 51 **Ethics approval**

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5 Ethical approval was granted by the Ethics Committee for epidemiological research of
6
7 Hiroshima University (ref no. 778) and the Research Ethics Committee of Nagasaki University
8
9 Graduate School of Biomedical Sciences (ref no. 13091342).
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11 **Data sharing statement**

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14 Conditions of the ethical approvals permit the cohort office (Department of Community-
15 Based Medical System, Institute of Biomedical and Health Sciences, Hiroshima University) and
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17 the sub-office (Department of Community Medicine, Nagasaki University Graduate School of
18
19 Biomedical Science) to share the cohort data. Aggregated data are shared with stakeholders or
20
21 other researchers.
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Figure legends

Figure 1. Example of regional quota system of a Japanese medical school (Hiroshima University School of Medicine and Hiroshima Prefecture). Each school designs its own quota system (yr, year; med, medical).

Figure 2. Number of entrants to Japanese medical schools (data from Ministry of Education, Culture, Sports, Science and Technology).¹⁷

Figure 3. Overview of study design (QE, questionnaire; JCCME, Japanese Council for Community-based Medical Education; yrs, years; exam, examination).

Figure 4. Creation of follow-up data (MHLW, Ministry of Health, Labour and Welfare; ID, identification number)

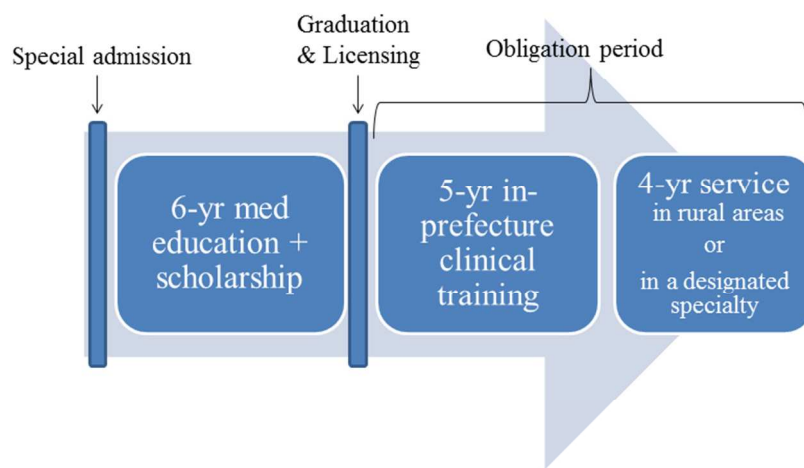


Figure 1
254x190mm (96 x 96 DPI)

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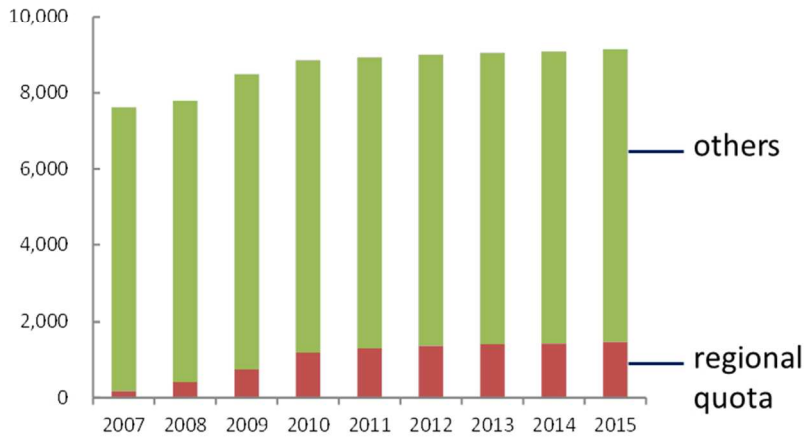


Figure 2
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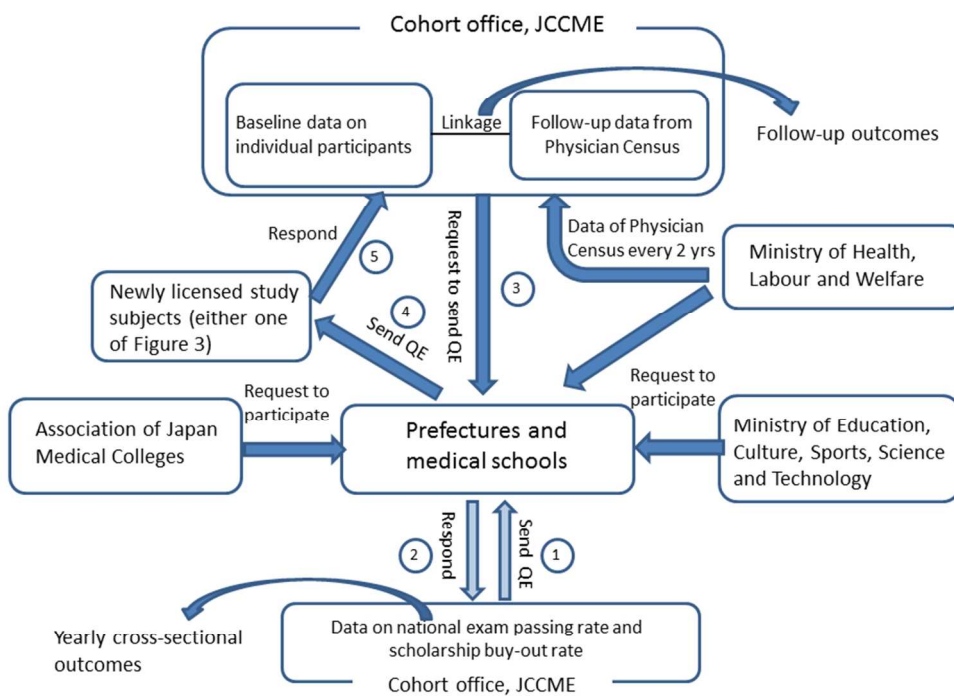


Figure 3
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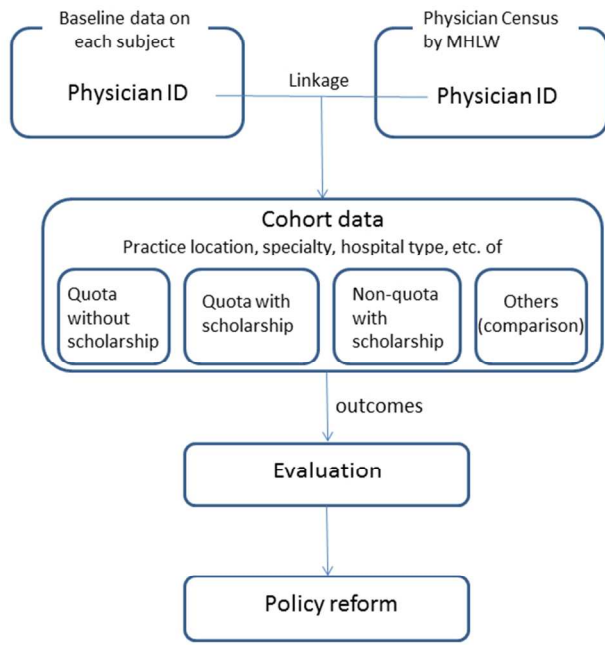


Figure 4
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