Distribution of health care resources in Mongolia using the Gini coefficient

Oyunchimeg Erdenee, Sekar Ayu Paramita, Chiho Yamazaki and Hiroshi Koyama*

Abstract

Background: Attaining the perfect balance of health care resources is probably impracticable; however, it is possible to achieve improvements in the distribution of these resources. In terms of the distribution of health resources, equal access to these resources would make health services available to all people. The aim of this study was to compare the distributions of health care resources in urban, suburban, and rural areas of Mongolia.

Methods: We compared urban and rural areas using the Mann–Whitney U test and further investigated the distribution equality of physicians, nurses, and hospital beds throughout Mongolia using the Gini coefficient—a common measure of distribution derived from the Lorenz curve. Two indicators were calculated: the distribution per 10,000 population and the distribution per 1000 km² area.

Results: Urban and rural areas were significantly different only in the distribution of physicians per population. However, in terms of the distribution per area, there were statistical differences in physicians, nurses, and hospital beds. We also found that distributions per population unit were equal, with Gini coefficients for physicians, nurses, and hospital beds of 0.18, 0.07, and 0.06, respectively. Distributions per area unit were highly unequal, with Gini coefficients for physicians, nurses, and hospital beds of 0.74, 0.67, and 0.69, respectively.

Conclusions: Although the distributions of health care resources per population were adequate for the population size, a striking difference was found in terms of the distributions per geographical area. Because of the nomadic lifestyle of rural and remote populations in Mongolia, geographical imbalances need to be taken into consideration when formulating policy, rather than simply increasing the number of health care resources.

Keywords: Geographic distribution, Equality, Physicians, Health resources, Mongolia

Background

Human resources are the major building blocks of health systems [1, 2], and all health care is eventually delivered by and to people [3]. Thus, a clear picture of the allocation of physical and human resources (especially by area), the proportionate distribution of such resources, and timely revision enable the achievement of better health outcomes and health care accessibility for all [4].

Overview of health resources in Mongolia

Mongolia is a land-locked country with a population of three million, 54.3% of whom reside in rural areas. On average, fewer than two people occupy each square kilometer [5]. The Human Development Index value for Mongolia was 0.73 in 2015 [5].

The Mongolian health administration is split into two main divisions: one for the capital city of Ulaanbaatar and one for the 21 provinces (aimags). Ulaanbaatar consists of nine districts, which are further divided into 152 sub-districts (khoroo). Likewise, each province consists of 3–28 sub-provinces (soums). The 329 sub-provinces are further divided into 1613 communes (baghs) [5].

These administrative divisions are represented by a two-tier referral system: primary care and specialized care, which includes secondary and tertiary care (Fig. 1). Health care services are delivered by 3100 health organizations—both public and private sectors—and all specialized centers are located in Ulaanbaatar [6].

A few studies in Mongolia have focused on inequality in health. However, little attention has been paid to
inequalities in health resources by geographical area [7, 8]. For this reason, the present study aimed to compare the distributions of health care resources in urban, suburban, and rural areas.

**Methods**

**Setting**

The data analyzed in this study were obtained from the 2014 Mongolian Health Indicators, as compiled by the Ministry of Health of Mongolia [6]. Geographical and population data were taken from the National Statistical Information Service of Mongolia [5]. All of the data used in this study were publicly available online when the study was conducted. We selected three health care resource variables for the study: numbers of physicians, nurses, and hospital beds.

We used population density to differentiate urban, suburban, and rural areas—a definition suggested by Matsumoto et al. [9]—because no standard demarcation for urban vs. rural status exists. Provinces with a population density higher than 200 people/km² were defined as urban, those with a population density higher than 10 people/km² were defined as suburban, and those with a lower population density were defined as rural. Ulaanbaatar was defined as urban, Darkhan-Uul and Orkhon were defined as suburban, and other locations were defined as rural.

**Analysis**

First, the Mann–Whitney U test was employed to compare distributions between urban and rural areas. Then, distribution equality was determined using the Gini coefficient, one of the most common measures of distribution [4, 9–12], which was derived from the Lorenz curve. The Gini coefficient measures the area between the Lorenz curve and a hypothetical line of absolute equality, which is expressed as a percentage of the maximum area under the line. The Gini coefficient ranges from 0 to 1, with 0 representing perfect equality and 1 indicating perfect inequality [13]. In our study, the x-axis illustrates the cumulative share of the population and area of all of the provinces, and the y-axis illustrates the cumulative share of health care resources. Two indicators were calculated: the distribution of health resources per 10 000 population and the distribution of health resources per 1000 km² area. Lorenz curves for each health care resource were created from the cumulative number of health care resources per population and area shares. The Gini coefficient was calculated using the following formula for each health care resource [13] (Fig. 2):

\[
R = \frac{\sum_{i=1}^{n-1} (x_{i-1} + x_i - 1) f_i x_i}{(n-1)A_n} - 1
\]

We performed a cluster analysis to determine cut–off values, and differences among the provinces were depicted on a map using these cut–off values to show contrasts in distribution density.

**Results**

The urban area in the study had the highest numbers of physicians (42.4) and hospital beds (77.6), but one rural province, namely Gobi-Altai, had the highest number of nurses (44.3) per 10 000 population, on average.
Suburban areas had slightly higher numbers of these resources than did the rural provinces, with the exception of hospital beds. Rural areas had the lowest numbers of resources, on average.

In terms of the distribution of physicians and nurses per 1000 km² area, the urban study area had 1228 and 1185, suburban areas had 193 and 260, and rural areas had 2.7 and 4, respectively. Further, the number of hospital beds was 2248 in the urban area, 453 in suburban areas, and 7.4 in rural areas, on average.

Results from the U test showed that, in terms of the distribution per population, there was a statistically significant difference only for physicians (P = 0.04); the distributions of nurses and hospital beds were not statistically different in urban and rural areas. In contrast, in terms of the distribution per area, there were statistically significant differences for all three health resources (P = 0.007) by location type.

Table 1 presents a comparison of health care resources in urban, suburban, and rural areas. The data are sorted from highest to lowest by the number of physicians per area.

The Lorenz curves of the cumulative share of health care resources per population and area shares are shown in Fig. 3.

The Lorenz curves depicting health care resources per share of the population were close to the equality line for all three variables (Fig. 3a). This indicates that the three resources were equally distributed among the entire population. The distribution of physicians per share of the population had a Gini coefficient of 0.18, indicating equality. In contrast, the distribution of physicians per share of the area had a Gini coefficient of 0.74, indicating high inequality (Table 2).

Unlike the curves for distribution by population share, the Lorenz curves showing health care resources per share of the area were far from the ideal line for all three variables; health care resources were found to be unequally distributed across geographical areas (Fig. 3b). The Gini coefficients for the distribution of nurses and hospital beds by share of the population were 0.07 and 0.06, respectively. In contrast, the Gini coefficients for the distribution of nurses and hospital beds by share of the area were 0.67 and 0.69, respectively.

Comparing Fig. 4a and b shows that the distribution of physicians per 10 000 population (minimum = 16.6, maximum = 42.4) was found to be better balanced than was the distribution of physicians per 1000 km² area (minimum = 0.9, maximum = 1228), which had a very large range, as is depicted using multiple colors on the map.

Similarly, comparing Fig. 4c and d shows that the distribution of nurses per 10 000 population (minimum = 27, maximum = 44) was more balanced than was the distribution of nurses per 1000 km² area (minimum = 1, maximum = 1185), which was highly imbalanced, as is shown using multiple colors on the map.

Further, Fig. 4e illustrates that the distribution of hospital beds per 10 000 population (minimum = 54.8, maximum = 77.6) was nearly balanced, with only slight differences across the provinces. In contrast, the distribution per 1000 km² area (minimum = 2.5, maximum = 2284) was highly imbalanced, as can be seen in Fig. 4f.

There was a statistically significant difference in the distribution of physicians in urban and rural areas, with urban areas having the highest number of physicians (Table 1, Fig. 5). The suburban areas also had higher numbers of physicians than did the rural provinces. Gobisumber was the rural area with the lowest number of physicians. However, the number of health resources per population unit was high in Gobisumber because of the province’s small population.

Discussion

Distribution of health care resources in Mongolia

Our results show that human resources exceeded the target numbers set in the Human Resource Policy of the Health Sector in Mongolia [14]. Additionally, the distributions of the three examined resources per 10 000 population were found to be equal throughout the country, based on the calculated Gini coefficients.

However, the geographical distributions of the three resources per 1000 km² area were markedly different across the country. Geographical difficulties, extreme weather conditions (with temperatures as low as −40 °C and as high as 35 °C), and limited transportation have created obstacles for the population in distant places in...
| Category | Province          | Number of population | Area (km) | Demographic density/1 km | Total number of physicians | Number of physicians /10 000 pop | Number of physicians /1 000 km | Total number of nurses | Number of nurses /10 000 pop | Number of nurses /1 000 km | Total number of hospital beds | Number of hospital beds /10 000 pop | Number of hospital beds /1 000 km |
|----------|-------------------|----------------------|-----------|---------------------------|-----------------------------|----------------------------------|-------------------------------|------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|
| Urban    | Ulaanbaatar       | 1 362 974            | 4 704     | 306.5                     | 5 779                       | 42.4                             | 5 575                         | 40.9                   | 1 185.1                       | 77.6                         | 10 577                        | 77.6                         | 2 248.4                      |
| Suburban | Orkon             | 94 421               | 840       | 127.2                     | 260                         | 27.5                             | 309.1                         | 342                    | 36.2                          | 406.9                        | 592                           | 62.7                         | 704.8                        |
|          | Darkhan-Uul       | 99 947               | 3 280     | 309                        | 253                         | 25.3                             | 77.1                          | 375                    | 37.5                          | 1143                         | 660                           | 66                            | 201.1                        |
|          | Mean in suburban  | 97 184               | 2 060     | 7905                      | 257                         | 26.4                             | 193.1                         | 359                    | 36.9                          | 2606                         | 626                           | 64.4                          | 4529                         |
| Rural    | Gobiumber         | 16 058               | 5 540     | 31                         | 60                          | 37.6                             | 10.9                          | 68                     | 42.1                          | 122                          | 89                            | 55.7                          | 16.1                         |
|          | Selenge           | 106 212              | 41 200    | 26                         | 192                         | 18.1                             | 4.7                           | 286                    | 26.9                          | 69                           | 630                           | 59.3                          | 15.3                         |
|          | Uvurkhangai       | 112 992              | 62 900    | 18                         | 229                         | 20.3                             | 3.6                           | 329                    | 29.1                          | 52                           | 720                           | 63.7                          | 11.4                         |
|          | Bayan-Ulgii       | 95 151               | 45 700    | 22                         | 158                         | 16.6                             | 3.5                           | 287                    | 30.2                          | 63                           | 671                           | 70.5                          | 14.7                         |
|          | Arkhangai         | 93 086               | 55 300    | 17                         | 167                         | 17.9                             | 3                             | 281                    | 30.2                          | 5.1                          | 532                           | 57.2                          | 9.6                          |
|          | Tuv               | 90 107               | 74 000    | 12                         | 188                         | 20.9                             | 2.5                           | 302                    | 33.5                          | 4.1                          | 533                           | 59.2                          | 7.2                          |
|          | Khovd             | 81 479               | 76 900    | 1.1                        | 181                         | 22.2                             | 2.4                           | 280                    | 34.4                          | 3.6                          | 574                           | 70.5                          | 7.5                          |
|          | Bulgan            | 60 494               | 48 700    | 12                         | 111                         | 18.4                             | 2.3                           | 217                    | 35.8                          | 4.4                          | 349                           | 57.7                          | 7.2                          |
|          | Khuvsgul          | 126 043              | 100 600   | 13                         | 223                         | 18.4                             | 2.2                           | 359                    | 28.5                          | 3.6                          | 691                           | 54.8                          | 6.9                          |
|          |Uvs                | 75 792               | 69 600    | 12                         | 145                         | 18.4                             | 2.1                           | 274                    | 36.2                          | 3.9                          | 521                           | 68.8                          | 7.5                          |
|          | Khentii           | 71 212               | 80 300    | 9                         | 155                         | 18.4                             | 1.9                           | 242                    | 34                            | 3                            | 416                           | 58.4                          | 5.2                          |
|          | Zavkhan           | 69 732               | 82 500    | 9                         | 159                         | 18.4                             | 1.9                           | 270                    | 38.7                          | 3.3                          | 592                           | 84.9                          | 7.2                          |
|          | Dornogobi         | 63 808               | 109 500   | 6                         | 198                         | 18.4                             | 1.8                           | 200                    | 31.3                          | 1.8                          | 401                           | 62.8                          | 3.7                          |
|          | Dundgobi          | 44 351               | 74 700    | 0.6                        | 121                         | 18.4                             | 1.6                           | 164                    | 37                            | 2.2                          | 247                           | 55.6                          | 3.3                          |
|          | Sukhbaatar        | 57 423               | 82 300    | 0.7                        | 126                         | 18.4                             | 1.5                           | 211                    | 36.7                          | 2.6                          | 379                           | 66                            | 4.6                          |
|          | Bayankhongor      | 83 044               | 116 000   | 0.7                        | 169                         | 18.4                             | 1.5                           | 306                    | 36.8                          | 2.6                          | 480                           | 57.8                          | 4.1                          |
|          | Dornod            | 75 194               | 123 600   | 0.6                        | 174                         | 18.4                             | 1.4                           | 274                    | 36.5                          | 2.2                          | 438                           | 58.3                          | 3.5                          |
|          | Gobi-Alta         | 56 735               | 141 400   | 0.4                        | 166                         | 18.4                             | 1.2                           | 251                    | 44.3                          | 1.8                          | 386                           | 68.1                          | 2.7                          |
|          | Umnugobi          | 59 694               | 165 400   | 0.4                        | 150                         | 18.4                             | 0.9                           | 160                    | 26.8                          | 1                            | 412                           | 69.1                          | 2.5                          |
| Mean in rural |                  | 75 716               | 81 902    | 12                        | 162                         | 18.4                             | 2.7                           | 251                    | 34.2                          | 4                            | 477                           | 69.9                          | 7.4                          |

| U test result | ★★ | ★★★ | ★★★ | ★★★ |
|---------------|-----|------|------|------|

Total: 2 995 949, 1 564 964, 9 364, 11 053, 20 890

Mann–Whitney U test: urban + suburban vs. rural; ★ P < 0.05, ★★ P < 0.01
terms of accessing health services [12]. In addition, certain cultural and social factors [15, 16], especially the nomadic lifestyle, might account for the gap between rural and urban areas. An inherently nomadic lifestyle is a unique feature in rural areas, where herders are not rooted in a permanent setting across the seasons; rather, these people must move to a new place to provide food for their livestock and to maintain their livelihood. In this context, imbalanced distributions of health care resources per geographical area may be a barrier contributing to the disproportionate accessibility of health care services, especially in rural areas.

**International comparisons**

The unideal allocation of health service providers at national level is a global, long-established, and grave problem. Regardless of how developed or rich countries are, higher proportions of health personnel are found in urban areas with better facilities [9, 17–19]. According to the World Health Organization’s (WHO) World Health Report [20], an estimate of 22.8 physicians, nurses, and midwives per 10 000 people is the minimum standard for achieving essential health interventions in those countries most in need. In a recent publication by the WHO [21], this minimum threshold for the health workforce requirements has been updated to 44.5 for achieving universal health coverage and reaching the Sustainable Development Goals 2016–2030. Mongolia was found to be close to the ideal point in terms of both numbers and adequate distribution for the three studied resources per population unit, with an average of 69.4 physicians and nurses per 10 000 people. Comparing our findings with those in a developed country, the Gini coefficient for physicians per population unit was 0.33 in Japan [11] and 0.18 in Mongolia.

We did not find any past work investigating the distribution of health care resources per area unit using the Gini coefficient. In the present study, we emphasized two types of distributions: per population unit and per area unit. Our results showed great differences between these two types of distributions. Further investigation is needed to determine the accessibility of health care resources and other contributing factors. This work could employ geographical information systems or other tools able to analyze both distribution and accessibility [22, 23]. Considering the nomadic lifestyle found among rural and remote populations in Mongolia may be critical for analyzing the distribution of health care resources.

**Recommendations**

We recommend several provisions that interact with each other to achieve equality in the distribution of health care resources in Mongolia.

**The mobile clinic**

Mongolia can import accumulated practices from developed countries to increase the accessibility of health care services for its remote population; the mobile clinic would be the best method of health care provision in
Mongolia. *Saiseimaru* is a mobile health ship that was equipped with professional teams to diagnose and cure conditions among people living on islands in Japan [24]. Adapted versions of *Saiseimaru*, such as a mobile bus or car, are needed in the Mongolian context, especially for herders living in remote sub-provinces and communes. The “Mobile Clinic” project [25] was initiated and implemented to fight adverse circumstances in six rural
provinces of Mongolia. With this project, the Minister of Health approved a procedure that advanced the legal environment for delivering universal access to better quality health care services among the remote population. Based on these achievements, Mongolia must now move forward to the next step by implementing a nationwide, long-term program for delivering basic health care services throughout the year.

Rotational deployment procedures and higher incentives

Because all health care services are ultimately delivered by people, effective human resources management will play a vital role in the success of the health sector [3]. Regional disparities in the allocation of health resources might be a significant obstacle, preventing the rural population from accessing basic health care. Currently, “there is no efficient system for correcting the imbalance in the distribution of physicians in urban and rural areas” [11]. Mongolia has confronted this issue by devising rotational deployment procedures and a “calling service,” which allows physicians to be called from provincial hospitals or regional diagnostic and treatment centers to remote areas [26, 27]. However, the implementation and outcome of these procedures remain unclear. Stable rotational deployment procedures, where physicians—especially specialists—are dispatched from urban areas to treat the remote population within a certain time, are crucial. To achieve an equal distribution of existing human resources, collaboration with the Mongolian Health Workers’ Union, which acts for the protection of the rights, legal capacity, and social protection in labor relations of its members, is needed in the country.

Moreover, by definition, “rural and remote areas often convey a sense of isolation, both from a professional and personal point of view” [28]. On the professional level, career development, advancement opportunities, and the exchange of ideas with peers through networking have been considered of equal importance [9, 28, 29]. In Thailand, rural physicians have established their own society to support each other [29], and this society has been welcomed in public and medical arenas. Additionally, public recognition awards have been created, and some physicians have been recognized as the person of the year in Thailand at the national level. Thus, encouragement beyond salary, such as public recognition [30], flexible working hours [17], intensive training [28], additional cash bonuses [10, 29, 30] based on experience or length of commitment [17], and an adequate health infrastructure, are required [21, 26] in rural and remote areas. The Mongolian health sector currently has a few incentives: training, special awards, and cash bonuses [31–33]. However, additional incentives are needed for health workers in remote areas. Thus, the government of Mongolia should develop these kinds of encouraging incentives to reduce the geographical disparity and attract more medical personnel to rural areas.

Conclusions

Although the distributions of health care resources per population were adequate for the population size, a striking difference was found in terms of the distributions per area. Because of the nomadic lifestyle among rural and remote populations in Mongolia, geographical imbalances need to be taken into consideration when formulating policy, rather than simply increasing the number of health care resources.

Studies such as ours can be used as a basis for health systems planning to correct the unequal distribution of health care resources. Additional studies should be done continuously and should incorporate other types of health care resources, including technological resources and financing, to identify the overall circumstances of health resources in the country.
Abbreviation
WHO: World Health Organization

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Availability of data and materials
The data used in this study are available at the following locations:
1. The Ministry of Health of Mongolia repository: http://www.chd.mohs.mn/images/pdf/sma/2015/eruul_mendiin_uzuulelt_2014_angli_1.pdf
2. The Mongolian Statistical Information Service repository: http://www.1212.mn/en/contents/stats/contents_stat_fld_tree_html.jsp

Authors’ contributions
All authors participated in the study design. OE collected the data, carried out the analysis, and drafted the manuscript. SAP analyzed the data. CY, HK supervised the overall study process. All of the authors read and approved the final manuscript.

Ethics approval and consent to participate
Not applicable

Consent for publication
Not applicable

Competing interests
The authors declare that they have no competing interests.

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References
1. Dal Poz MR, Gupta N, Quain E, ALB S. Handbook on monitoring and evaluation of human resources for health: with special applications for low- and middle-income countries; 2009. p. 178.
2. Global health workforce alliance. Synthesis paper of the thematic working groups—Health Work Force 2030—towards a global strategy on human resources for health, 2015. p.1–40
3. Kabene SM, Orchard C, Howard JM, Soriano MA, Leduc R. The importance of human resources management in health care: a global context. Hum Resour Health. 2006;4:20.
4. Ameyoun A, Meskpour-Amili M, Dezfuli-Nejad ML, Khoddami-Vilhate HR, Tofighi S. The assessment of inequality on geographical distribution of non-cardiac intensive care beds in Iran. Iran J Public Health. 2011;40(2):25–33.
5. Mongolian Statistical Information Service. Country profile [Internet]. 2016. Available from: http://www.1212.mn/en/contents/stats/contents_stat_fld_tree_html.jsp.
6. The Ministry of Health, Mongolia; Health Indicators 2014 [Монгол улсын Эрүүл мяндийн эхлэл, Эрүүл мяндийн үгийгүүцгэлэх 2014] [Internet]. 2014. Available from: http://www.chd.mohs.mn/images/pdf/sma/2015/eruul_mendiin_uzuulelt_2014_angli_1.pdf.
7. Dorjdagva J, Barbatar E, Dorjiuren B, Kauhanen J. Income-related inequalities in health care utilization in Mongolia, 2007-2008-2012. Int J Equity Health [Internet]. 2015;14:57. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26204928
8. Asian Development Bank. Program performance evaluation report in Mongolia [Internet]. Available from: https://www.adb.org/sites/default/files/evaluation-document/35099/files/28451-mon-pper.pdf
9. Matsumoto M, Inoue K, Kashima S, Takeuchi K. Does the insufficient supply of physicians worsen their urban-rural distribution? A Hiroshima-Nagasaki comparison. Rural Remote Health. 2012;12:2085.
10. Theodorakis PN, Mantzavinis GQ, Rumballallu L, Lions C, Trell E. Measuring health inequalities in Albania: a focus on the distribution of general practitioners. Hum Resour Health. 2006;4:5.
11. Toyabe S. Trend in geographic distribution of physicians in Japan. Int J Equity Health [Internet]. 2009;9:5. Available from: http://equityhealthj.biomedcentral.com/articles/10.1186/1475-9276-9-5
12. Sakai R, Wang W, Yamaguchi N, Tamura H, Goto R, Kawachi J. The impact of Japan’s 2004 postgraduate training program on intra-prefectural distribution of pediatricians in Japan. PLoS One [Internet]. 2013;8:e77045. Available from: http://dx.doi.org/10.1371/journal.pone.0077045
13. Gini C. On the measurement of concentration and variability of characters (translation by Giovanni Maria). Int J Stat. 2005;LXIII:3–88.
14. The Ministry of Health Mongolia. Minister of Health Decree No 443 The Year 2009 Health Sector Human Resource Development Policy (Эрүүл мяндийн эхлэл 2009 оны 443 тоот түүхий) [Internet]. Available from: http://ethics.mohs.mn/files/huul-erkh-ziin-altuud/03%20En%20Mendii%20aidiim%20aituualhii/04%20huulhavral%20X.pdf. Accessed 22 Aug 2017.
15. Tsilaijav TS, Ser-Od E, Baasa B. Mongolia health system review [Internet]. 2013. Available from: http://www.wpro.who.int/asia_pacific_observatory/series/Mongolia_Health_Systems_Review2013.pdf.
16. Chuluunbaatar CH. Issues of regional development and health care services in Mongolia (Монгол улсын бүсгүйл болон үйлчилгээний хялб харууны өндөр хүндтын тушаал, үйлчилгээний хялб харууны ард түлээх) [Internet]. Mong Med Sci. 2004(2):128 Available from: http://www.mongolmed.mn/article/1014.
17. Dussault G, Franceschini MC. Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce. Hum Resour Health [Internet]. 2006;4:12. Available from: http://wwwhuman-resources-health.com/content/4/1/12.
18. Sasah H, Otsubo T, Imanaka Y. Widening disparity in the geographic distribution of pediatricians in Japan. Hum Resour Health [Internet]. 2013;11:59. Available from: http://www.human-resources-health.com/content/11/1/59.
19. Takata H, Nagata H, Negawa H, Tanaka H. The current shortage and future surplus of doctors: a projection of the future growth of the Japanese medical workforce. Hum Resour Health [Internet]. 2011;9:14. Available from: http://wwwhuman-resources-health.com/content/9/1/14.
20. Campbell J, Dussault G, Buchan J, Pozo-Martin F, Guerra Arias M, Leone C, et al. A universal truth: no health without a workforce [Internet]. 2013. Available from: http://www.who.int/workforcealliance/knowledge/resources/GHWA-a_universal_truth_report.pdf
21. World Health Organization (WHO). Health workforce requirements for universal health coverage and the sustainable development goals [Internet]. 2016. Available from: http://www.who.int/hrh/resources/health-observer17/en/
22. McAlfferty SL, GS and health care. Annu Rev Public Health [Internet]. 2003; 24:25–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12668754
23. Kruger E, Teninart M, George R. Application of geographic information systems to the analysis of private dental practices distribution in Western Australia. Rural Remote Health. 2011;11(3):1736.
24. Mobile ship [Internet]. Available from: http://www.okayamamaisaikei.or.jp/saiseimaru_cal/. Accessed 22 Aug 2017.
25. Czech mobile ambulances help herdiers in Mongolian steppes [Internet]. Available from: https://www.clovekvsintis.cz/en/articles/czech-mobile-ambulances-help-herdiers-in-mongolian-steppes. Accessed 22 Aug 2017.
26. The Minister of Health Mongolia: Minister of Health Decree No 81 The Year 2004 Regulation of remote ambulance service (Эрүүл мяндийн эхлэл 2004 оны 81 тоот түүхий) in Mongolia [Internet]. Available from: http://www.legalinfo.mn/annex/details/4066?awid=4624. Accessed 22 Aug 2017.
27. The Minister of Health Mongolia: Minister of Health Decree No 162 The Year 2012 the Rotational procedure of Medical Profession (Эрүүл мяндийн эхлэл 2012 оны 162 дугаар төлөө түүхий Эрүүл мяндийн барьцаалбар) in Mongolia [Internet]. 2012; 162. Available from: http://www.mohs.mn/web/upload/files/8f8b0daddd5c3e0c7c7537ae839f9b3.pdf. Accessed 20 May 2016.
28. World Health Organization (WHO): Increasing access to health workers in remote and rural areas through improved retention. Sci York [Internet]. 2010;23:3–69.
29. Wibulpolprasert S, Pengpaibon P. Integrated strategies to tackle the inequitable distribution of doctors in Thailand: four decades of experience. Hum Resour Health [Internet]. 2003:1–12. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=317381&tool=pmcentrez&rendertype=abstract

30. Tangcharoensathien V, Limwattananon S, Suphanchaimat R, Patcharanarumol W, Sawaengdee K, Putthasri W. Health workforce contributions to health system development: a platform for universal health coverage. Bull World Health Organ [Internet]. 2013;91:874–80. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3853960&tool=pmcentrez&rendertype=abstract

31. The government of Mongolia. The government of Mongolia Decree No. 89 The Year 2002 about Development Program for Sub-provincial level hospitals (Элчин Газар 2002 оны 89 дугаар нутагдлын хэлэлцүүлэг) in Mongolian [Internet]. Available from: http://www.legalinfo.mn/annex/details/1579?lawid=3689. Accessed 22 Aug 2017.

32. The government of Mongolia: Constitutional Law. The Year 2005 Law of Health (Монгол Улсын Засгийн Газар Эрүүл мэнгийн тухай хууль 2005 оны) in Mongolian [Internet]. Mongolia; Available from http://www.legalinfo.mn/law/details/49. Accessed 22 Aug 2017.

33. The government of Mongolia. The government of Mongolia Decree No. 150 The Year 2012 The system of additional incentives and cash bonuses for Medical professions (Монгол Улсын Засгийн Газар 2012 оны 150 дугаар хууль) [Internet]. Available from: http://www.legalinfo.mn/law/details/5699. Accessed 22 Aug 2017.