INTRODUCTION

Equality in health care access is a fundamental human right [1]. But equal distribution in health service has become a major challenge among different countries [2]. Also geographic distribution of health care delivery is an important component for health care access [3]. At present, fairness distribution of health services and increase in equality has become a major concern, especially among developing countries [4]. For distribution of health care resources, researchers and policy makers are focusing on beds, doctors and equipment as indicators of general health [5]. Bangladesh is a developing and densely populated South-Asian country. In 2013, population was 156.8 million and it is expected to increase to 218 million by 2030 [6]. With the increase of population, hospital demand will be increased side by side. There will demand for more beds for increasing patients. In 2011, total public hospital was 583 which increase by 607 in 2016. Total hospital bed was 41655 in 2011 and 49414 in 2016 [7, 8]. Although the number of public hospital and beds increased in those years, there is still lack of supply for covering the population needs in some regions. Compare to other developing countries it is clear that Bangladesh doesn’t have adequate supply to serve this large population. For example, Bangladesh has 0.4 beds/1000 inhabitants where Ghana has 0.9 beds/1000 inhabitants. Also, with the same economic level, Kenya has 35 percent more hospitals than Bangladesh [9]. Bangladesh has well-structured facilities to serve primary health care facilities but with inadequate supply of logistics, those potentials were not realized [10]. In terms of total allocation to health care system, there is a serious problem prevailing. According to World Health Organization (WHO, 2010) only 3% of total Gross Domestic Product (GDP) is used for health care services. Government expenditure on health is about 34% of the total health expenditure, other 66% being out-of-pocket [10]. Hence, the objective of this study is to describe inequalities of public hospital beds in the country level geographic distribution in 2011 and 2016.

METHODS

Data Sources

Bangladesh administrative unit is divided into 8 divisions and 64 districts. Districts also divided into local govern-
Gini coefficient is calculated based on the proportion of two areas. The area under diagonal line and the area between diagonal line and Lorenz curve [19]. Thus, the Gini coefficient is the division of the area between diagonal line and Lorenz curve by the total area under Lorenz curve [19]. In this study, value less than 0.2 is termed as complete equality, value range from 0.2-0.3 is moderate equality, value range from 0.3-0.4 is inequality, value range from 0.4-0.6 is higher inequality and value greater than 0.6 is perfect inequality observed in the distribution [20].

**The Location Quotient**

The location quotient is measured by the geographic concentration in a region. It was first introduced by Florence (1939). The location quotient is a calculation to compare a region with national average [21]. It can quantify the concentration of a particular phenomenon, characteristics, occupation or a group in a region as compare to the national level [22]. It can be calculated by using equation (3)

\[
LQ = \frac{X_i}{Y_i} \times \frac{X}{Y} \quad \text{--------------- 3}
\]

Where \( X_i \) = value of variable X in a region i, \( Y_i \) = value of variable Y in a region i, X = national value of variable X, Y = nation value of variable Y. Value less than 1 indicates low concentration of a variable in a region, value greater than 1 indicate high concentration of a variable in a region and value equal to 1 indicate the same concentration as national average [23]. In this study, value greater than or equal to 1.20 is very intense, value less than 1.20 and greater than or equal to 1.05 is intense, value less than 1.05 and greater than or equal to 0.95 is average, value less than 0.95 and greater than or equal to 0.8 is moderate and value less than 0.8 and greater than or equal to 0 is very moderate [21].

**Table 1: Descriptive statistics of Data, Bangladesh, 2011 and 2016**

<table>
<thead>
<tr>
<th>Description</th>
<th>Year 2011</th>
<th>Year 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Population</td>
<td>23591</td>
<td>27795</td>
</tr>
<tr>
<td>Max Population</td>
<td>8831900</td>
<td>8833022</td>
</tr>
<tr>
<td>Mean Population</td>
<td>290149</td>
<td>307763</td>
</tr>
<tr>
<td>Total Bed</td>
<td>38930</td>
<td>46883</td>
</tr>
<tr>
<td>Min Bed</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Max Bed</td>
<td>5824</td>
<td>9014</td>
</tr>
<tr>
<td>Mean Bed</td>
<td>81.79</td>
<td>97.46</td>
</tr>
<tr>
<td>SD Bed</td>
<td>291.94</td>
<td>436.64</td>
</tr>
<tr>
<td>Min Bed per 1000 Population</td>
<td>0.0004</td>
<td>0.0002</td>
</tr>
<tr>
<td>Max Bed per 1000 Population</td>
<td>0.0036</td>
<td>0.0046</td>
</tr>
<tr>
<td>Mean Bed per 1000 Population</td>
<td>0.00026</td>
<td>0.0028</td>
</tr>
</tbody>
</table>

**RESULTS**

*Sample description*

Table 1 represents the descriptive statistics of variable for 2011 and 2016. Total public hospital beds increased by about 20% in five years but there is still inequalities in the highest and lowest hospital beds per 1000 population. In 2011, the highest hospital bed density was 9 times greater than the lowest and this discrepancy increased by 23 times in 2016; this evidence reflects huge health resource inequalities in Bangladesh.
Geographic Distribution

Figure 2 is the representation of two different measures for hospital beds. First one (a). is the bed availability/1000 inhabitants for 2011 and 2016, at upazila level. In all over the whole region, hospital beds density is at a minimum level. Values for beds density less than 0.0002 highly observed in whole region. Spatial distance to service provider is also a determinant of beds demand [24]. So, the second one (b). is the bed density/1000 inhabitants/km². In this measure country is facing more inequalities. South-western and central regions recorded the minimum level of beds density. Where in five years, with the population increase bed density decrease in some regions.

The Gini Coefficient

Figure 3 reports the hospital beds density/1000 inhabitants and Gini coefficient/1000 inhabitants for each district. The result is showed at divisional level (the country is divided into 8 divisions).

In Gini coefficient value and hospital beds density, Chittagong and Dhaka division facing disadvantage in 2011 and 2016. There are also disparities within divisions. Some districts of Chittagong and Dhaka division also facing inequality with high beds densities. Most of the districts are clustered center where bed density is minimum and high in equality.

Figure 4 represents inequalities frequency at the divisional level. In 2011, Rajshahi had the highest frequency in complete equality, but in 2016, some regions enter into high inequality and moderate equality region. It is also noticeable for Khulna division. Here some regions shifted from moderate equality to high inequality region. In those five years, equality decreased for Dhaka, Khulna, Chittagong and Rajshahi division. On the other hand, equality increased in Barisal and Rangpur. More or less stable condition remained in Sylhet and Mymensing.

Supply of Bed

Figure 5, is the representation of hospital bed location quotient which is the indication of supply of bed in upazila compare to national level. In 2011, about 5% upazila had no hospital but the figure is increased by 1% in 2016. In the whole country, very moderate supply with beds is the highest. And in five years this percentage increased from 58 to 65. Moreover, moderate, average, intense and very intense supply decrease by 1.4, 2.2, 0.8 and respectively by 2.2 percent.

Discussion

Equity and social justice for promoting health sector indices depends on equal and proper distribution of the resources [25]. In this paper we consider public hospital bed as a health resource indicator to determine supply and inequalities at country level. For this, we mapped a distribution of beds/1000 inhabitants to find out deprived regions. We used Gini coefficient to explain equalities for this resource distribution. And location quotient was used to see supply nature at regional level.

Our paper has four major findings. First, from 2011 to 2016, in those five years, the number of hospital beds increased by 20% but the geographical distribution analysis highlights some regions faced inequalities. Variation between the minimum and maximum values of the number of beds/1000 inhabitants in 2011 was 9 times high and this value increased by 23 times in 2016. Existence of these disparities can conclude that this resource (bed of hospital) is not equally distributed at upazila level.

Second, we mapped hospital beds density/1000 inhabitants and also hospital beds density/1000 inhabitants /km² to explain geographical variation of different upazila. Here, hospital beds/1000 inhabitants density of 0.0002 showed the highest percentage for both extreme of the period: 2011 and 2016. This value is below than average as compare to other developing countries. When area was also taken into account to explain spatial distance to health resource access, the distribution become more acute. There was no pattern found in geographical distribution but inequalities were randomly recorded all over the country. Behind the randomness, there is a particular reason which brings forward Bangladesh health system hierarchy. In every district sadar upazila, there are two types of health facilities-primary and secondary, which are upazila health complex and district sadar hospital. And also some district sadar upazila have tertiary and specialized hospital like medical colleges. Other upazila of a particular district have only primary health facilities. As a result, hospital bed density is low in other upazila than sadar upazila of a district.

Third, we calculated Gini coefficient value for each district and explained it at divisional level. From 2011 to 2016, in these five years, equality decrease for Dhaka, Khulna, Rajshahi and Chittagong. Equality increase in Rangpur and Barisal. Stable condition found for Sylhet and Mymensing. Most of the district are in moderate equality zone but hospital beds density is low. In those five years, three districts of Chittagong recorded high inequality with low hospital beds density. Dhaka is on the first place in top and Chittagong is the second one district for internal migration rate [26]. But with the increasing population, the hospital beds is not increasing. As a result, equalities in hospital beds density decreased in those regions.

Fourth, we used location quotient to zone, supply with bed for each upazila compare to national. The values were classified into five categories; a very moderate supply was frequently found in the whole country. Also, the percentage increased in these five years. On the top of that, intensive supply for some upazila is also decreased in these years. The annual allocation to the hospital/bed is negligible in Bangladesh. A medical college hospital receives an annual allocation of about Tk. 25000/bed while sadar hospital get Tk. 18000/bed and upazila health complex receive Tk. 10500/bed [27]. As a conclusion, with the increase in population, hospital bed is not increasing at sufficient level.
Figure 2: Hospital bed density at upazila level, 2011 and 2016

Figure 4: Division level Gini coefficient value frequencies, a. 2011 and b. 2016
Figure 3: Relationship between Gini coefficient and bed density per 1000 people at division level, a. 2011 and b. 2016

Figure 5: Hospital bed Location Quotient, a. 2011 & b. 2016
CONCLUSION

Bangladesh has a well-structured health system with good infrastructure for delivering primary health facilities but due to inadequate supply with resources the full potential of this structure has never been realized. Insufficient supply and unequal distribution of bed resource create inequalities in many regions. Also, some regions has no primary health care facilities. Population is increasing by both natural growth and migration to cities which creates pressure to facility resource allocation policy. Furthermore, some regions are facilitated with adequate resources where population is low and some regions are facilitated with inadequate supply of resources where population is high. Bangladesh government should distribute facility resources equally all over the country and primary health care facility need to be strengthen for increasing population.

References
16. WAN GH. *Changes in Regional Inequality in Rural China: decomposing the Gini index by income sources*. Australian Journal of Agricultural Economics. 2002;45(3):361-381