

## Original Article

# An analysis of structure, organization and delivery of ICU care in Bangladesh

Mohammad Omar Faruq<sup>1\*</sup>, ARM Nooruzzaman<sup>2</sup>, Rownak Jahan Tamanna<sup>3</sup>, AK Qumrul Huda<sup>4</sup>, Amina Sultana<sup>5</sup>, Uzzwal Kumar Mallick<sup>6</sup>, Mohammad Asaduzzaman<sup>7</sup>, Md Motiul Islam<sup>8</sup>, Tarikul Hamid<sup>9</sup>, Mohammad Rabiul Halim<sup>10</sup>, Mohammed Arafat Hossain Rubayet<sup>11</sup>, Rawshan Arra Khanam<sup>12</sup>, Samira Humaira Habib<sup>13</sup>, Ashiq Haider Choudhury<sup>14</sup>, Md Tahsin Salam<sup>15</sup>, Mohammad Rashed Mahmud<sup>16</sup>, Ridwan Naim Faruq<sup>17</sup>

**Abstract:**

**Background :** This study is a sub analysis of data submitted on behalf of Bangladesh to an international study (2013-2014) involving Asian ICUs and merits comparison with prior study done in Bangladesh in 2007 which had similar objective.

**Objective :** To assess structure, organization and delivery of ICU care in ICUs of Bangladesh with attention to hospital organizational characteristics, ICU organizational characteristics, staffing etc.

**Method :** Prospective cohort study involving ICUs of 51 hospitals of Bangladesh done in 2013-2014. The hospitals in our study were divided into three groups : clinics/hospitals less than 50 beds (n =18), clinics/hospitals more than 50 beds(n=24) and Govt. hospitals/academic hospitals/ medical colleges hospitals (n=9).

**Results :** Most respondent hospitals were from Dhaka (77.4%). Only 17.6% hospitals were university affiliated. The average number of hospital beds were 225. The average number of ICU beds were 14. 19.6 % hospitals had infection control committees. Basic life support training was required for doctors and nurses in 31.4 % and 27.5 % hospitals respectively. Small clinics/ hospitals (less than 50 bed capacity [n=18]) had significantly less government funding ( $p < 0.0001$ ), were less attached to university hospital ( $p < 0.0001$ ), had fewer referral centers ( $p < 0.001$ ), had less total hospital beds ( $p < 0.004$ ) and were less in case of ICU beds : hospital beds percentage ( $p < 0.003$ ). 28 ICUs had no single room. Govt. hospitals/academic hospitals/Medical colleges had relatively more ICU beds .(12.33% -  $p < 0.004$ ). 60.8% ICUs were operated as open units. Open units were more likely present in hospitals/clinics more than 50 beds. Multivariable analysis showed that the presence of 1:1 nursing staff was much lower in private hospitals. Funding sources and types of hospitals were independently associated with lower percentage of ICU beds ( $p < 0.002$ ) and ( $p < 0.0001$ ) respectfully. University affiliations was more likely associated with closed ICU ( $p < 0.002$ ). Presence of MD CCM qualified intensivists are more in government funded hospitals ( $p < 0.003$ ) than those of private hospitals

**Conclusions :** Our study demonstrates considerable variation in the organization and staffing among Bangladeshi ICUs. Compared to 2007 study it shows increased trend in number of closed units( 39% vs 15%) and percentage of ICU beds relative to number of hospital beds (6.5% vs 4.8%) .

**Key words :** Bangladesh; ICU; Intensive care; Critical care.

**Introduction:**

Critical care or Intensive care has emerged as a distinct specialty in the world over the last 5-6 decades. The importance of mechanical ventilation was mostly realized in the polio epidemic in Copenhagen in 1952. During this time mortality was reduced from 90% to 40% following its introduction<sup>1</sup>. Since then concept of intensive care units gradually spread across the world.

According to the first study<sup>2</sup> done in 2007 involving 40 ICUs of Dhaka, the capital of Bangladesh, intensive care services in Bangladesh were significantly underdeveloped since its inception in 1978.

Critical care infrastructure of Asian ICUs involving 335 ICUs of 20 Asian countries including Bangladesh was studied from April 2013 to January 2014. In this study<sup>3</sup> 51 ICUs of Bangladesh participated.

The objectives of this Asian study<sup>3</sup> were to describe structure,

organization and delivery of critical care in Asian ICUs with attention to architectural design to facilitate infection control, staffing with intensivists, closed unit model and nurse to patient ratio etc. using the world bank classification of low, middle and high income groups based on 2011 gross national income<sup>4</sup>.

Bangladesh is a low income country as per world bank income classification. In 2014 its per capita income was 1470 US \$ when the Asian study was done. In 2018 the per capita income exceeded 1600 US\$ according to latest world bank statistics<sup>5</sup>. So people can afford to pay relatively more for critical care which is expensive considering low income status of Bangladesh<sup>6</sup>.

Since the study of 2007<sup>2</sup> no credible study was done with the aim to audit intensive care services in Bangladesh. As such we have made a domestic sub analysis of Asian study<sup>3</sup> to assess structure, organization and delivery of ICU care in Bangladesh.

It has been suggested that higher quality critical care incorporating best practices in structure, organization and care delivery could reduce the high mortality in ICU patients in general<sup>7</sup>. Related factors such as architectural design to facilitate infection control<sup>8</sup>, staffing with intensivists<sup>9</sup>, the closed unit model<sup>10-11</sup> and nurse to patient ratio<sup>9</sup> have also been associated with improved patient outcomes.

## Methods.

This was a prospective cohort study that took place during the period of April 2013 to January 2014 and 51 ICUs of Bangladesh participated in the study. While selecting the study ICUs we used a snowball method to identify the units who would be interested to participate. Physicians representing each ICU was called an investigator. Participation by the site investigators was voluntary and unfunded. Investigators obtained approval by institutional review boards as appropriate.

1. Professor of Critical Care Medicine, Chief Consultant, General ICU and Emergency. United Hospital Ltd , Dhaka 1212, Bangladesh.
2. Consultant , ICU , Bangladesh Specialized Hospital, Dhaka , Dhaka 1207, Bangladesh .
3. Consultant cardiologist and intensivist, Uttara Crescent Hospital, Dhaka 1230, Bangladesh.
4. Professor, ICU, Dept. of Anesthesia, BSM Medical University, Dhaka, 1000, Bangladesh.
5. Junior Consultant, General ICU, United Hospital Ltd, Dhaka 1212, Bangladesh.
6. Registrar and in Charge, ICU, National Institute of Neuro science hospital, Dhaka1207, Bangladesh
7. Consultant, ICU, Green life Hospital, Dhaka1205, Bangladesh
8. Associate Consultant and head of ICU, Asgar Ali hospital, Dhaka 1204, Bangladesh.
9. Associate Consultant, ICU, Asgar Ali Hospital, Dhaka 1205 , Bangladesh.
10. Consultant, ICU, Dhaka Medical Hospital, Dhaka 1000, Bangladesh..
11. Consultant ICU, Dhanmondi clinic, Dhaka1205, Bangladesh.
12. Consultant Pulmonologist, Ingenious Health care Ltd, Dhaka 1207, Bangladesh.
13. Principal research officer and Associate Professor, Health Economics Unit, Diabetic Association of Bangladesh, Dhaka 1000, Bangladesh.
14. Research Assistant, United Hospital Ltd, Dhaka1212, Bangladesh
15. Associate Consultant ICU and HDU, Ibn Sina Hospital, Dhaka 1209, Bangladesh.
16. Consultant, ICU, Oasis Hospital, Sylhet 3100, Bangladesh.
17. Lecturer, Ibrahim Medical College, Dhaka 1000, Bangladesh.

### \*Corresponding Author:

Professor Mohammad Omar Faruq  
MD. FCPS. FACP. FACEP. FCCM.  
Chief Consultant, General ICU and Emergency  
United Hospital Ltd. Dhaka 1212, Bangladesh.  
Cell : 01674 999897  
E mail: faruqmo@yahoo.com

The survey included the following domains : hospital organizational characteristics, ICU organizational characteristics (number of beds, single vs shared rooms, negative pressure rooms if any, open vs closed ICU, staffing (medical, nurse and others), procedures and therapies available in the ICU and written protocols and policies.

We defined ICUs as units capable of providing invasive mechanical ventilation and organ support, such as using vasoactive medications and renal replacement therapy, and recognized to be ICUs by their hospitals. We defined a post graduate qualified intensivist as a physician who had passed a MD examination in critical care medicine (CCM) or MD/FCPS examination in another clinical specialty like Anesthesia, Cardiology or Internal medicine and a general intensivist as a physician who had completed training program in intensive care or who treated ICU patients and was recognized by his hospital as an intensivist but without post graduate qualification in CCM or other above mentioned specialties. ICU was labeled as closed if intensivists were responsible for admission, management and discharge decisions for critically ill patients.

The information from data sheet from the “Asian ICUs Structure- Process- Outcome (AISPO)” study questionnaire (3) was used for our survey. In Bangladesh, the survey was distributed in paper form. Completed surveys were returned by mail or hand delivered and then entered into the database for submission into the Asian study initially. Copies of the submitted data sheets were retained for subsequent sub analysis in our study.

### Statistical Analysis

Through a pre-set self-administered questionnaire designed by AISPO, data was collected from hospital ICUs all over the country, especially the divisional districts and main cities. Data was collected according to the responses received from the participants. Data from 51 hospitals (with ICU) from all over the country was collected. The hospitals were divided into small clinic/ hospital (less than 50 bed capacity [n=18]), small clinic/ hospital (more than 50 bed capacity [n=24]) and government hospital/ academic hospital and medical college hospital [n=9]. Comparisons were made among these three types of hospitals. The variables like source of hospital funding, academic affiliations, referred status, number of beds, types of characteristics of the hospital, types of ICU patients admitted, number of ICU beds, operational model, visiting hours, specialty of physicians, nurse to patient ratio, predictors of percentage of ICU : hospital bed, predictors of percentage single rooms, predictors of closed ICU, predictors of the presence of Post graduate qualified intensivists, predictors of the availability of 1:1 nursing staff have been estimated and analyzed. Statistical Package for Social Scientists (SPSS) 20 was used to analyze the data. Percentage distribution were shown. Chi-square and multinomial logistic regression were used to analyze the data. P value < 0.05 was taken as significant value. OR (odds ratio) and SEM (standard error of mean) were calculated where necessary.

## RESULTS

Data from 51 ICUs from all over the country was collected and tabulated. The highest responses were from Dhaka (77.4%) followed by Sylhet (9.4%), Chattogram (5.7%), Mymensing (3.8%) and Savar (1.9%).

### Hospital Organizational Characteristics (Table 1)

Most hospitals (86.3%) were private funded, 11.8% were government funded. Only 17.6% were affiliated with university attached hospitals and 58.8% were referral centers. The average number of hospital beds was 225.45 (SEM, 50.815). The number of all ICU beds including adult, pediatric and neonatal in the study hospitals was 14 (SEM, 2) and the mean percentage of ICU beds: hospital beds was 1:16. Respondents reported that 10 hospitals (19.6%) had infection control departments or committees, 4 (7.8%) had chronic ventilation units and 9 (5.9%) had cardiac arrest team. Basic life support training was required in 16 (31.4%) of hospitals for physicians and in 14 (27.5%) for nurses. Hospital characteristics varied considerably according to the hospital bed capacity and hospital category. Small clinic/ hospital (less than 50 bed capacity [n=18]) have significantly less government funding ( $p < 0.0001$ ), less attached to university hospital ( $p < 0.0001$ ), had less referral centers ( $p < 0.001$ ), less hospital beds ( $p < 0.004$ ) and more in case of ICU beds : hospital beds percentage ( $p < 0.003$ ).

### ICU Organizational Characteristics (Table 2)

The majority of these units admitted a wide patient mix: medical (98%), surgical (96%), trauma (88.2%), respiratory (90.2%), neurologic (90.2%), and cardiac (52.9%) patients. Burn patients were admitted in 52.9% of these units and cardiac surgery patients in 11.8%.

The average number of beds in the index ICUs was 8.2 (SEM, 4.746) with a mean of 8.2% (SEM, 0.665). A total of 28 ICUs (24.13%) had no single rooms. The percentage of single rooms out of all ICU rooms varied with an average of 9.89% (SEM, 1.680) in small clinic/ hospital (less than 50 bed capacity [n=18]), 14.67% (SEM, 4.342) in small clinic/ hospital (more than 50 bed capacity [n=24]) and 24.22% (SEM, 6.416) in government hospital/ academic hospital and medical college hospital [n=9]. There is no negative pressure room available in any ICU of our study hospital. There is a significant difference between the types of hospitals in regard to the number of ICU beds, it is 6.94% (SEM, 0.574) in small clinic/ hospital (less than 50 bed capacity [n=18]), 7.58% (SEM, 0.903) in small clinic/ hospital (more than 50 bed capacity [n=24]) and 12.33% (SEM, 2.309) in government hospital/ academic hospital and medical college hospital [n=9] ( $p < 0.004$ ). The number of sinks and alcohol hand gel dispensers for hand hygiene also varied considerably according to the types of hospitals. The lowest number of hand washing sinks was in small clinic/ hospital (less than 50 bed capacity [n=18]). ICUs in government hospital/ academic hospital and medical college hospital [n=9] had the highest number of hand washing sinks (mean 2.67; SEM, 0.527) and alcohol hand gel dispensers (mean 3.56; SEM, 1.701). Among the responding ICUs, 39.2% operated as closed units.

Multivariate analysis showed that the closed-unit model was more likely to be present in small clinic/ hospital (less than 50 bed capacity [n=18]). Multivariate analysis showed that the open unit model was more likely to be present in small clinic/ hospital (more than 50 bed capacity [n=24]) (mean 17; SEM, 33.3%). There is no significant difference among the types of hospitals in case of operational model of closed ICU and visiting hours.

### Staffing Pattern (Table 3)

The responding ICUs reported having an average of 0.84 (SEM, 0.403) post graduate qualified intensivists as defined above and 2.49 (SEM, 0.411) intensivists without postgraduate qualification as defined above. Having a post graduate qualified intensivist was much less common in private hospitals (OR, 0.612, CI, 1.615 – 0.232;  $p < 0.003$ ) (Table 4).

Most ICUs (80%) had a nurse – to – patient ratio as 1:1 or 1:2. It was 1:1 in 27%, 1:2 in 53% and 1:3 or more in 20%. Multivariate analysis showed that the presence of 1:1 nursing staff was much lower in private hospitals (OR, 0.145; CI, 5.317 – 0.004,  $p < 0.293$ ). (Table 4)

The following staff categories were also present: physiotherapists in 30 ICUs (58.8%), clinical pharmacists in 8 (15.7%), respiratory therapists in 12 (23.5%), social workers in 5 (9.8%), infection control practitioners in 10 (19.6%) and dieticians in 21 (42.2%).

Multiple regression analysis revealed that funding sources and types of hospitals are independently associated with lower percentage of ICU beds ( $p < 0.002$ ) and ( $p < 0.0001$ ) respectfully. University affiliations is more likely associated with closed ICU nature ( $p < 0.002$ ). Presence of MD CCM qualified intensivists are more in government funded hospitals ( $p < 0.003$ ) than those of private hospitals. There is no significant difference between funding, university affiliation, referral status and types of hospitals in regards to predictors of availability of 1:1 nursing staff and predictors of percentage of single rooms (Table 4)

## DISCUSSION

Our study demonstrates considerable variation in the organization and staffing among Bangladeshi ICUs. The variability was observed in the structure of the unit, the operation model, staffing levels as well as different care processes. The variations were related to several factors including hospital size and hospital category. An important finding is the deficiency in the availability of single room and non-availability of negative – pressure room, which has significant implication for infection control.

The survey highlights that Bangladesh's hospitals in general have a mean percentage of ICU beds (6.22%) that is higher compared to that of Japan (3%), China (3%) and lower than Saudi Arabia (10%) according to AISPO study<sup>3</sup>.

Our study was comparable to reported percentages from US ICUs. In a 2004 study from United States, adult ICU beds accounted for 9.0% of acute care hospital beds<sup>12</sup>.

Interestingly, the percentage was lower in Canada (3.4%)<sup>12</sup> and Europe (the average was 2.8% in 2011 and ranged between 1.3% in the Czech Republic and 5.1% in Germany)<sup>13</sup>.

This is consistent with earlier single country studies showing that ICU beds accounted for 1.8% of total hospital beds in China<sup>14</sup>, 2% in Japan<sup>15</sup>, and 5-10% in India<sup>16</sup>. It is important to point out that the higher ICU hospital beds does not necessarily reflect higher ICU provision to the general population, but simply higher ICU provision relative to hospital bed provision - both maybe inadequate<sup>3</sup>.

The low percentage of single rooms in the surveyed hospitals reflects an old design of ICUs in many hospitals as an open shared space, which is thought to facilitate care and reduce staffing needs in Bangladesh. However, such structure has also implications for patient privacy and for infection control. This finding, along with variability in the presence of hand hygiene facilities and infection control departments, or committees, highlights potential deficiencies in infection control. This is particularly true for small clinic/hospital (less than 50 bed capacity [n=18]), where resource limitations may impede funding of basic infection control procedures.

We also believe that all ICUs should have adequate hand hygiene infrastructure and infection control and prevention programs in accordance with international guidelines<sup>17</sup>.

Our survey showed that approx. nine of the surveyed ICUs had no post graduate qualified intensivist. There are substantial regional variations in the presence of intensivist coverage across the world. Studies showed that 53% of ICUs in the United States had no intensivist coverage<sup>18</sup> whereas 71.7% of European ICUs were staffed 24 hours by intensivists<sup>19</sup>.

Additionally, the closed ICU model was reported in 39.2% of the surveyed ICUs in our study. Interestingly, this is relatively higher than what has been reported in a US survey (26%)<sup>18</sup> and less than in a European study (59.1%)<sup>20</sup>, and is consistent with earlier single - country studies from Asia.

A study from China reported that 52% of ICUs were closed, 36% semi - closed, and the others were open ICUs<sup>14</sup>. These numbers may also reflect biased sampling, since the contact persons for the survey were mainly intensivists; therefore, ICUs without intensivists were likely to be reached.

Although we observed substantial variation in the presence, number, and qualifications of intensivists, the mean ratio of post graduate qualified intensivists - to - ICU beds was 1:9 which increased proportionally from small clinic/hospital (less than 50 bed capacity [n=18]) to government hospital/academic hospital and medical college [n=9]. In Asian study<sup>3</sup> this ratio was 1:6 across Asian ICUs under that study.

A previous study from China showed that the nurse-to-patient ratio ranged from 1:1.4 to 1:2.0<sup>13</sup>. In our study the nurse to patient ratio of 1:2 or less was observed in less in 73% of Bangladesh's ICUs. A nurse to patient ratio of 1:2 or less was observed in 67% of Asian ICU<sup>3</sup>. Higher ICU nurse - to - patient ratio has been associated with improved outcomes<sup>21</sup>. In a large US study, the median nurse - to - patient was 1:1.7

and higher ratio was associated with improved survival<sup>22</sup>. Additionally, our study demonstrated that hospital bed capacity (hospital size) and hospital category were important determinants of staffing in Bangladesh's ICUs. Given the fact that government hospital/ academic hospital and medical college hospital were less represented in our study compared with small clinic/hospital (less than 50 bed capacity) and small clinic/hospital (more than 50 bed capacity), it is likely that Bangladesh's ICUs as part of Asian ICUs have actually a considerable shortage of intensivists and ICU nurses<sup>23</sup>.

Use of written policies and clinical protocols was insignificant among our study hospitals.

Lastly it becomes imperative to compare outcome of our study (2013-14) with the only study of similar kind done in Bangladesh in 2007<sup>2</sup>.

Compared to 2007 study our study is much more structured and both studies predominantly involved ICUs of capital city of Dhaka.

In 2007 study, 15% ICUs were closed units as opposed to 39% ICUs in our study. The significant increase of closed ICUs in our study was attributed to introduction of Post graduate MD course in critical care medicine in Bangladesh in 2007 resulting in post graduate qualified Intensivists managing ICUs in subsequent years. This increase in closed ICUs also reflected positive attitude of hospital administrations.

1:1 nurse patient ratio was found in 34% ICUs as opposed to 27% ICUs in our study. This comparison could not be justified as 2007 study did not address type of hospitals as done in our study.

In 2007 study 424 ICU beds (adult) were counted among 8824 hospital beds and it accounts for 4.8 ICU beds per 100 hospital beds. In our current study 748 ICU beds (adult, fewer pediatric & neonatal) were counted among 11475 hospital beds and it amounts to 6.51 ICU beds per 100 hospital beds. It appears that there is about 70% increase in number of ICU beds including insignificant number of pediatric and neonatal beds. But it does not reflect significant increase in absolute number in ICU beds required to meet the needs of critical care in our country.

According to a news report from an influential daily of Bangladesh<sup>24</sup>, as of Jan 2019 there are about 220 ICU beds in govt. medical colleges, district hospitals and institutes. Same report claims that there are about 1000 ICU beds in about 70 private hospitals and institutions across our country. Unofficial estimates suggest number of required ICU beds in our country to be about ten thousand among one hundred and thirty seven thousand hospital beds in our country<sup>25</sup>.

Compared to 2007 study our study is much more structured. Our study reflected considerable variation in the organization and staffing among ICUs in Bangladesh. This variation was related to the hospital funding source, hospital size and the type of hospital.

The limitations of our study are the following. Our study involved about half of all ICU containing hospitals of

Bangladesh (including Govt funded and private) that have ICUs. So this is not a true reflection of all ICUs of Bangladesh. Secondly we surveyed staffing quantitatively but we did not assess the quality of training and competencies. We also did not assess patient outcomes, cost or resource utilization.

Critical care medicine is expensive, with annual costs approaching 82 billion USD in United States<sup>26</sup>. An important question is how much should be invested in critical care of low income country like Bangladesh. Reducing ICU cost without compromising quality in Bangladesh is possible<sup>6</sup>. It has been also suggested that a short period of critical care is cost - effective for the treatment of the life - threatening

conditions and a public health argument can be made for intensive care in low - income settings<sup>27</sup>.

#### ACKNOWLEDGMENTS.

We acknowledge with thanks primary Asian study authors for permitting us to sub analyze the data of Bangladesh participating hospitals, submitted on self-administered questionnaire designed by Asian study authors<sup>3</sup>. We are also thankful for the encouragement from Asian Critical Care Clinical Trial Group (ACCCTG) which endorsed the original study and which is represented by our corresponding author from Bangladesh. This study was self funded and there was no conflict of interest.

**Table 1: Hospital Organizational Characteristics According to The hospital Bed capacity and Hospital Category**

Variables	Total (n=51)	Small clinic /hospital (Less than 50 Bed capacity) (n=18)	Small clinic /hospital (More than 50 Bed capacity) (n=24)	Government Hospital/ Academic Hospital and Medical College Hospital (n=9)	p Value
<b>Source of Hospital Funding, n(%)</b>					
Government	6(11.8%)	0	0	6(11.8%)	<b>.0001</b>
Private	44 (86.3%)	18(35.3%)	24(47.1%)	2(3.9%)	<b>.0001</b>
<b>Academic Affiliation, n(%)</b>					
University attached Hospital	9(17.6%)	0	1(2.0%)	8(15.7%)	<b>.0001</b>
Non University Hospital	42(82.34%)	18(35.3%)	23(45.1%)	1(2.0%)	<b>.0001</b>
<b>Referral Status , n(%)</b>					
Referral Hospital	30(58.8%)	5(9.8%)	16(31.4%)	9(17.6%)	<b>.001</b>
Nonreferral Hospital	21(41.2%)	13(25.5%)	8(15.7%)	0	.009
<b>No of Bed (mean, SEM)</b>					
No of Hospital beds	225(50)	33(2)	123(20)	882(146)	.004
No of ICU Beds in Hospital	14(2)	9(1)	14(4)	24(6)	.014
ICU: Hospital Bed Percentage	1:16	1:3	1:8	1:36	.003
<b>Other types of Characteristics of the hospital, n(%)</b>					
Infection controlled Department or Committee	10(19.6%)	2(3.9%)	5(9.8%)	3(5.9%)	.382
Chronic Ventilation Unit	4(7.8%)	1(2.0%)	2(3.9%)	1(2.0%)	.873
Cardiac Arrest Team	9(5.9%)	3(9.8%)	5(2.0%)	1(17.6%)	.801
Basic Life Support Training required for Physicians	16(31.4%)	5(9.8%)	9(17.6%)	2(3.9%)	.645
Basic Life Support Training required for Nurses	14(27.5)	2(3.9%)	8(15.7%)	4(7.8%)	.126

**Table 2:** Status of ICU structure according to the types of hospital

<b>Variables</b>	<b>Total (n=51)</b>	<b>Small clinic /hospital (Less than 50 Bed capacity) (n=18)</b>	<b>Small clinic /hospital (More than 50 Bed capacity) (n=24)</b>	<b>Government Hospital/ Academic Hospital and Medical College) Hospital (n=9)</b>	<b>p Value</b>
<b>Types of ICU Patients Admitted, n(%)</b>					
Medical	50(98.0%)	18(35.3%)	24(47.1%)	8(15.7%)	.321
Surgical	49(96.1%)	18(35.3%)	23(45.1%)	8(15.7%)	.373
Trauma	45(88.2%)	16(31.4%)	21(41.2%)	8(15.7%)	.988
Respiratory	46(90.2%)	18(35.3%)	20(39.2%)	8(15.7%)	.197
Neurologic	46(90.2%)	17(33.3%)	22(43.1%)	7(13.7%)	.369
Burn	27(52.9%)	12(23.5%)	11(21.6%)	4(7.8%)	.348
Cardiac	30(58.8%)	14(27.5%)	12(23.5%)	4(7.8%)	.122
Cardiac Surgery	6(11.8%)	0(0.0%)	3(5.9%)	3(5.9%)	<b>.004</b>
<b>No of ICU Beds</b>					
No of bed in ICU (mean, SEM)	8.20(4.746)	6.94(.574)	7.58(.903)	12.33(2.309)	<b>.004</b>
Single Room (mean, SEM)	2.27(6.067)	1.06(.392)	3.71(1.746)	.89(.484)	.091
Percentage of ICU Bed (mean, SEM)	8.20(.665)	9.89(1.680)	14.67(4.342)	24.22(6.416)	<b>.005</b>
ICU without Single Room, n(%)	28(24.13)	10(8.62)	12(10.34)	6(5.17)	.211
No of Sinks per ICU (mean, SEM)	2.33(3.468)	1.78(.417)	2.63 (.970)	2.67(.527)	.558
No of Alcohol Hand Gel Dispenser per ICU (mean, SEM)	3.12(4.260)	3.11(.740)	2.96(.979)	3.56(1.701)	.909
<b>Operational Model</b>					
Closed ICU	20(39.2%)	9(17.6%)	7(13.7%)	4(7.8%)	.367
Open ICU	31(60.8%)	9(17.6%)	17(33.3%)	5(9.8%)	
<b>Visiting Hours, n (%)</b>					
Open visiting hours policy	31(60.8%)	9(17.6%)	17(33.3%)	5(9.8%)	.368
Restricted visiting hours	20(39.2%)	9(17.6%)	7(13.7%)	4(7.8%)	
If restricted, no of visiting hours (mean, SEM)	2.20(.168)	2.22(.308)	2.42(.225)	1.56(.377)	.480

**Table 3: Staffing Pattern according to the types of hospital**

Variables	Total (n=51)	Small clinic /hospital (Less than 50 Bed capacity) (n=18)	Small clinic /hospital (More than 50 Bed capacity) (n=24)	Government Hospital/ Academic Hospital and Medical College Hospital (n=9)	p Value
<b>Physicians</b>					
No of post graduate qualified intensivists (mean, SEM)	.84(.403)	.44(.185)	.96(.751)	1.33(1.106)	.029
No of Intensivists without p.g. qualification(mean, SEM)	2.49(.411)	1.56(.315)	2.75(.764)	3.67(.816)	<b>.0001</b>
Accredited intensive care MD training program, n(%)	1.92(.038)	2.00(.000)	2.00(.000)	1.56(.176)	.042
<b>Nurse to Patient ratio, n(%)</b>					
One nurses: One Bed	14(27.45)	2(11.1)	10(41.7)	2(22.2)	.043
One nurse: two beds	27(52.94)	11(61.1)	13(54.2)	3(33.3)	
One nurse: three beds	7(13.72)	4(22.2)	1(4.2)	2(22.2)	
One Nurse: four or more Beds	3(5.88)	1(5.6)	0(0)	2(22.2)	
Percentage of nurse manager, n(%)	37(72.5)	12(66.7)	21(87.5)	4(44.4)	.037
No of registered nurses (mean, SEM)	13.67(2.405)	8.39(1.147)	16.58(4.756)	16.44(3.891)	.011
No of nonregistered nurses (mean, SEM)	5.88(1.012)	5.78(1.395)	6.08(1.277)	5.56(3.937)	.281
<b>Other staff, n(%)</b>					
Physiotherapists	30(58.8%)	8(15.7%)	15(29.4%)	7(13.7%)	.223
Clinical pharmacists	8(15.7%)	2(3.9%)	5(9.8%)	1(2.0%)	.635
Respiratory therapists	12(23.5%)	4(7.8%)	6(11.8%)	2(3.9%)	.973
Social Workers	5(9.8%)	2(3.9%)	2(3.9%)	1(2.0%)	.946
Infection control practitioners	10(19.6%)	3(5.9%)	5(9.8%)	2(3.9%)	.923
Dieticians	21(41.2%)	5(9.8%)	13(25.5%)	3(5.9%)	.198

**Table 4: Predictor of percentage of ICU: Hospital beds, percentage of Single Rooms, Closed ICU Model, Availability of a Post Graduate qualified Intenivist and Availability of 1:1 Nursing Staff**

Variables	Parameter Estimate/OR	CI	P value
<b>Predictors of percentage of ICU: Hospital bed</b>			
Private vs government funding	.015	2.715 - -2.364	<b>.002</b>
Nonuniversity vs university affiliation	-.239	3.072 - -23.635	.128
Nonreferral vs referral hospital status	.088	11.600 - -5.734	.499
Small clinic/hospital (Less than 50 Bed capacity (n=18) vs Small clinic/hospital (More than 50 Bed capacity (n=24) vs Government Hospital/ Academic Hospital and Medical college Hospital (n=9)	-.762	-9.924 - -25.499	<b>.0001</b>
<b>Predictors of percentage of single rooms</b>			
Private vs government funding	1.554	8.715 - .277	.616
Nonuniversity vs university affiliation	1.216	12.742 - .116	.870
Nonreferral vs referral hospital status	1.447	5.492 - .381	.587
Small clinic/hospital (Less than 50 Bed capacity (n=18) vs Small clinic/hospital (More than 50 Bed capacity (n=24) vs Government Hospital/ Academic Hospital and Medical college Hospital (n=9)	1.504	5.021 - .451	.507
<b>Predictors of closed ICU</b>			
	<b>Odds Ratio</b>		
Private vs government funding	.577	10.172 - .275	1.672
Nonuniversity vs university affiliation	.330	3.471 - .025	<b>.002</b>
Nonreferral vs referral hospital status	.621	2.823 - .176	.705
Small clinic/hospital (Less than 50 Bed capacity (n=18) vs Small clinic/hospital (More than 50 Bed capacity (n=24) vs Government Hospital/ Academic Hospital and Medical college Hospital (n=9)	.212	1.587 - .125	.446
<b>Predictors of the presence of post graduate qualified intensivists</b>			
Private vs government funding	.612	1.615 - .232	<b>.003</b>
Nonuniversity vs university affiliation	1.571	25.989 - .095	.752
Nonreferral vs referral hospital status	.942	4.709 - .189	.942
Small clinic/hospital (Less than 50 Bed capacity (n=18) vs Small clinic/hospital (More than 50 Bed capacity (n=24) vs Government Hospital/ Academic Hospital and Medical college Hospital (n=9)	1.705	7.386 - .393	.476
<b>Predictors of the availability of 1:1 nursing staff</b>			
Private vs government funding	.145	5.317 - .004	.293
Nonuniversity vs university affiliation	1.302	28.506 - .060	.867
Nonreferral vs referral hospital status	1.632	7.540 - .353	.531
Small clinic/hospital (Less than 50 Bed capacity (n=18) vs Small clinic/hospital (More than 50 Bed capacity (n=24) vs Government Hospital/ Academic Hospital and Medical college Hospital (n=9)	.524	2.128 - .129	.366



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