



Cross-sectional Study on Utilization of Radiology and Imaging Equipment in the District Hospitals of Bangladesh

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ABSTRACT

A quality diagnosis mostly depends on the availability and proper utilization of radiology and imaging equipments in the modern medical technology. Every year, huge amount of revenue is spent to purchase costly and sophisticated radiology and imaging equipments for the district hospitals of Bangladesh. But radiology and imaging equipments are underutilized in most of the developing Asian and African countries, including Bangladesh. This descriptive cross-sectional study was conducted to find the functional status, workload, utilization, and factors affecting the utilization of radiology and imaging equipments in the district hospitals of Bangladesh. Interviewer-administered questionnaire was used to take interview of relevant human resources. Work time study method was applied where multiple checklists were used to measure consumed time for each procedure and daily actual work time of radiology and imaging equipments. In this study, 46.9% radiology and imaging equipments were found functional, 40.6% radiology and imaging equipments nonfunctional, and 12.5% radiology and imaging equipments functional but not in use. This study revealed that 53% of total radiology and imaging equipments of district hospitals were nonfunctional, and functional but not in use, where 8 equipments became nonfunctional before 10 years due to unavailability of spare parts and inadequate maintenance fund. Work time in radiography identified 83.51% and in ultrasonography (USG) 71.08% among the respondents of radiology and imaging department in the district hospitals. Utilization rate of general radiography equipments was found to be 67.01%, portable radiography equipments 16.5%, and USG equipments 71.08%. Average utilization rate of radiology and imaging equipments was found to be 51.53% in the district hospitals of Bangladesh. Utilization rate of radiology and imaging equipments more than 50% is considered as standard utilization. Current status of utilization rate needs to accelerate to get maximum turnover of the equipments among the district hospitals of Bangladesh. Important factors affecting the utilization of radiology and imaging equipments were observed – shortage of manpower, inadequate physical infrastructure, and less incorporation of advanced technology with existing facility.

Keywords: District hospital, Functional status, Radiology and imaging equipments, Utilization, Workload.

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INTRODUCTION

Radiology and imaging play a vital role in modern medical science, so that medical imaging is considered as the heart of medical practice. It is almost impossible to appropriately diagnose and medicate most health conditions without the use of radiology and imaging equipment. It is one of the most rapid changing technologies in modern medical science. According to studies in India, United States, European Union, Norway, and Ethiopia, spare parts of old equipment become unavailable after a certain period due to rapid technological development and changing modalities. It becomes mostly impossible to maintain the continuous utilization of the existing defective or malfunctioning radiology and imaging equipment.¹⁻⁵

According to Bangladesh Medical Equipment Survey Report 2008 and World Health Organization report on Human Resources for Health, Bangladesh has a severe shortage of allied health professionals mostly in Upazila Health Complex and district hospitals. Many of the hospitals have not adequate manpower to operate the equipments, and a remarkable number of equipments lose their half-life before installation due to inadequate physical infrastructure. Electromedical equipments are not maintained properly due to unavailable biomedical engineer, unavailable maintenance services and spare parts. Follow-through productivity of radiology and imaging equipments becomes poor and finally the utilization of radiology and imaging equipments becomes unsatisfactory within its lifetime. Every year, a lot of revenue is being wasted to operate the lower productive equipment in the district hospitals of Bangladesh.⁵⁻⁷

According to Health Facility Survey Report 2014, every year 40 to 50% of total budget of health sector is spent to purchase the medical equipments.^{5,6} Radiology and imaging equipment is also costly and sophisticated, so that every year a large amount of revenue is spent to

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purchase the equipments. But the productivity of these costly equipments depends upon proper utilization. Lower utilization denotes higher cost of health care facilities and higher utilization improves the productivity of the equipment, so that health care cost becomes lower and affordable. Improper and inadequate utilization of medical equipment is increasing among many countries of the world. Most of the poor utilizing countries are also situated in South-east Asia and Africa along with Bangladesh. Thus, the objectives of the study were to identify functional status, workload, utilization, as well as factors affecting the utilization of radiology and imaging equipments in the district hospitals of Bangladesh.

MATERIALS AND METHODS

A cross-sectional descriptive study was conducted in three district hospitals of Bangladesh from September 1 to December 30, 2016. The purposively selected three district hospitals were District General Hospital, Gajipur, District General Hospital, Shirajgonj, and 250-bedded District Shadar Hospital, Kishorgonj. In this study, the respondents were authorized radiology and imaging equipments and relevant human resources working in the radiology department of district hospitals. Work time study method was used to measure actual work time, workload, and actual utilization of radiology and imaging equipments. Interviewer-administered questionnaire was used to take interview with nine human respondents. Different checklists were used to collect data of functional status, installation date, starting date of radiology and imaging equipments, and radiological procedures carried out from June to October 2016 from the record book of district hospitals. Utilization of 9 radiology and imaging equipments in three categories and 232 radiology and imaging procedures was observed during the study period. The quantitative data and identified factors were analyzed by using Statistical Package for the Social Sciences (SPSS) and MS Excel.

RESULTS

The study was carried out to identify the status of utilization of radiology and imaging equipments in the selected district hospitals of Bangladesh. Data were collected from the District General Hospital, Gajipur (study area 1), District General Hospital, Shirajgonj (study area 2), and 250-bedded District Shadar Hospital, Kishorgonj (study area 3). After completing data analysis, the following results were found from the study.

Table 1 shows that 32 radiological equipments were available in the three district hospitals. Among them were 7 general radiography (GR), 6 portable radiography (PR), 1 digital radiography (DR), 3 dental radiography (Dt.R), 12 ultrasonography (USG), 2 Auto-processor (AP), and 1 computed radiography (CR). These radiology and imaging equipments are authorized by the Directorate General of Health Services for district hospitals in Bangladesh but only three categories of equipments were available in the three study area. Table 1 also indicates that 15 (46.9%) radiology and imaging equipments were functional, 13 (40.6%) equipments were nonfunctional, and 4 (12.5%) equipments were functional but not in use.

Table 2 shows 13 nonfunctioning radiology and imaging equipments in the three district hospitals, where 3 (23.08%) equipments were found nonfunctioning for a long time due to unavailable service engineer of the respective vendor, 6 (46.15%) equipments were found nonfunctioning due to unavailable spare parts, 3 (23.08%) equipments were found nonfunctioning due to unavailable fund for repairing the equipment, 1 (7.69%) equipment was found nonfunctioning which was donated 5 years ago and from the very beginning the equipment remained nonfunctioning.

Table 3 indicates that average of 32 (32.39) GR procedures were done in the district hospitals for which required time was 261.34 minutes, average 7 PR procedures were done for which required working time was 64.35 minutes. The study found average consumed time of 326.9 minutes for average number of 39 radiology and imaging procedures. So that actual work time of human

Table 1: Current status of radiology and imaging equipments in the three district hospitals of Bangladesh

List of equipment	No. of FE (%)	No. of NFE (%)	No. of FNU (%)	Total no. equipments (%)
GR	5 (15.63%)	2 (6.25%)	0 (0%)	07 (1.88%)
FR	0 (0%)	0 (0%)	0 (0%)	00 (0%)
PR	3 (9.38%)	1 (3.13%)	2 (6.25%)	06 (18.76%)
DR	1 (3.13%)	0 (0%)	0 (0%)	01 (3.13%)
Dt.R	1 (3.13%)	0 (0%)	2 (6.25%)	03 (0.38%)
USG	4 (12.5%)	8 (25%)	0 (0%)	12 (37.5%)
AP	0 (0%)	2 (6.25%)	0 (0%)	02 (6.25%)
CR	1 (3.13%)	0 (0%)	0 (0%)	01 (3.13%)
Total	15 (46.9%)	13 (40.6%)	4 (12.5%)	32 (100%)

FE: Functional equipments; NFE: Nonfunctional equipments; FNU: Functional but not in use equipments; FR: Fluoroscopy machine; AP: Auto-processor

Table 2: Distribution of the reasons of nonfunctioning radiology and imaging equipments

Total	Reasons of NF radiology and imaging equipments				
	NFE	UME	USP	UMF	LAP
13 (100%)	3 (23.08%)	6 (46.15%)	3 (23.07%)	1 (7.69%)	0 (0%)

NFE: Nonfunctional equipments; UME: Unavailable maintenance engineer; USP: Unavailable spare parts; UMF: Unavailable maintenance fund; LAP: Lengthy administrative process

Table 3: Distribution of GR, PR, average radiology, and imaging procedure done/day and average consumed time in the three study areas

Type of procedure	Study area 1		Study area 2		Study area 3		Average radiology procedure done/day	Average consumed time (minutes)/day
	No. of procedure	Consumed time	No. of procedure	Consumed time	No. of procedure	Consumed time		
GR	45	298.34	23	203.03	30	283.05	32 (32.39)	261.34
PR	6	45.30	7	62.03	9	86.10	7 (7.19)	64.35
Total	51	344.04	30	265.06	39	369.15	39	326.9

Table 4: Distribution of USG done/day and average consumed time/day in the three study areas

Types of procedures	Study area 1		Study area 2		Study area 3		Average procedure done/day	Average consumed time/day
	No. of procedure	Consumed time	No. of procedure	Consumed time	No. of procedure	Consumed time		
USG	36	324.03	25	180.35	51	327.40	37.33 (38)	277.26 minute

resource and radiography equipments identified 83.51% (326.9 minutes) and idle time 16.49% (63.51 minutes). The daily working time was considered 6½ hours (8:00 am to 2:30 pm).

Table 4 shows that average 37 (37.33) USG procedures were done in the district hospitals for which required working time was 277.26 minutes. The actual work time in USG identified 71.08% (277.26 minutes) and idle time 28.92% (112.34 minutes). The daily working time was considered 6½ hours (8:00 am to 2:30 pm) in the district hospitals of Bangladesh.

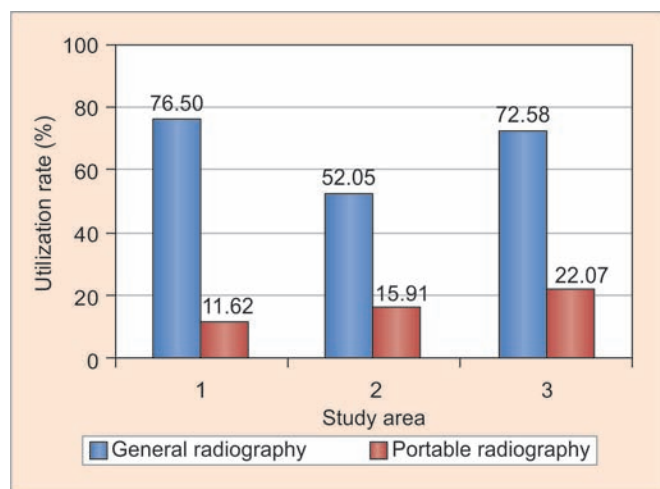
Graph 1 illustrates daily utilization rate of GR and PR equipments in the three district hospitals of Bangladesh. In study area 1, utilization rate of GR was found to be 76.50% and PR 11.62%. In study area 2, utilization of GR

was found to be 52.05% and PR 15.91%. In study area 3, utilization rate of GR was found to be 72.58% and PR 22.07%.

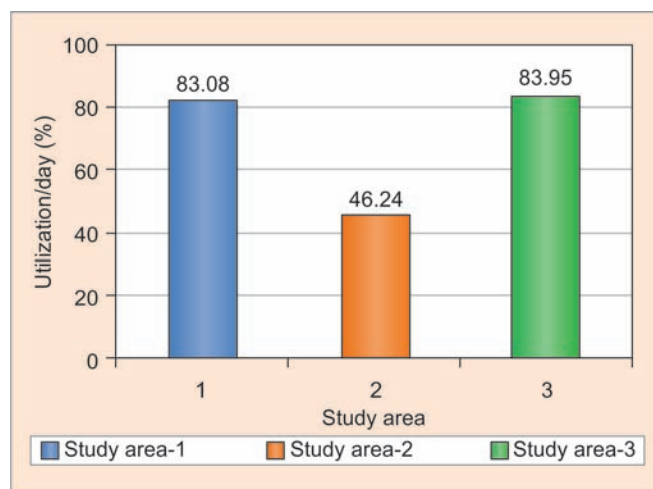
Graph 2 shows daily utilization rate of USG equipments in the three district hospitals of Bangladesh. The utilization rate was found in study area 1 – 83.08%, study area 2 – 46.24%, and study area 3 – 83.95%.

Table 5 shows that average utilization rate of GR equipments – 67.01%, PR equipments – 16.50%, and USG equipments – 71.08%. Finally, our study found the average radiology and imaging equipments utilization rate of 51.53% in the district hospitals of Bangladesh.

Graph 3 shows current status of utilization rate of radiology and imaging equipments as 52% (51.53) and nonutilization rate of 48% (48.47) in the district hospitals of Bangladesh.



Graph 1: Distribution of daily utilization rate of GR and PR equipments in the three district hospitals



Graph 2: Distribution of daily utilization rate of USG equipments in the three district hospitals

Table 5: Actual utilization rate of radiology and imaging equipments

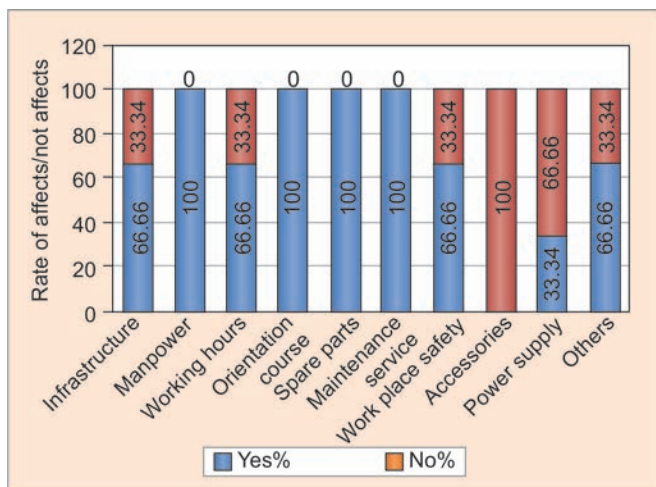
Types of equipment	Study area 1 (%)	Study area 2 (%)	Study area 3 (%)	Average REUR (%)
GR	76.50	52.05	72.58	67.01
PR	11.62	15.91	22.07	16.50
USG	83.08	46.24	83.95	71.08
Av. REUR	57.07	38.07	59.53	51.53

REUR: Radiology and imaging equipments utilization rate

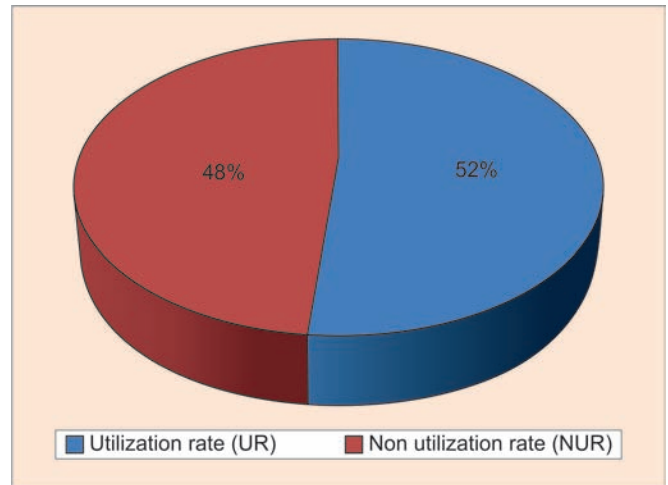
Graph 4 shows the analysis of the perception-based factors affecting the utilization. Perceptions of 100% respondents were shortage of manpower, lack of orientation course, unavailable spare parts, and delayed maintenance services that affect the utilization of radiology and imaging equipments; perceptions of 66.66% respondents were inadequate physical infrastructure, inadequate working hours/day, insufficient radiation safety program, and others (quality of accessories, unavailable servicing fund, and lengthy administrative process) that affect the utilization; perceptions of 33.34% respondents were that inadequate power supply affecting the utilization; and perceptions of 100% respondents were that accessories did not affect the utilization of radiology and imaging equipments in the district hospitals due to 100% availability (Table 6).

Table 6: Perception based factors

Factors	Yes (%)	No (%)	Total (%)
Infrastructure	66.66	33.34	100
Manpower	100	0	100
Working hours	66.66	33.34	100
Orientation course	100	0	100
Spare parts	100	0	100
Maintenance service	100	0	100
Work place safety	66.66	33.34	100
Accessories	0	100	100
Power supply	33.34	66.66	100
Others	66.66	33.34	100



Graph 4: Analysis of perception-based factors affecting the utilization of radiology and imaging equipments



Graph 3: Current status of utilization of radiology and imaging equipments in the district hospitals of Bangladesh

Table 7 shows the distribution of human resources, number of functional radiography, and USG equipments and available physical infrastructure for these equipments. It was observed that, in study area 1, five radiography equipments were installed in one room and manpower was found in one, in study area 2, four radiography equipments were installed in two rooms, but available manpower was also in one, in study area 3, six radiography equipments were installed in a single room and manpower is again one. Two radiography equipments are only utilized and rest of them remain unutilized due to unavailable required room and manpower for each functional equipment.

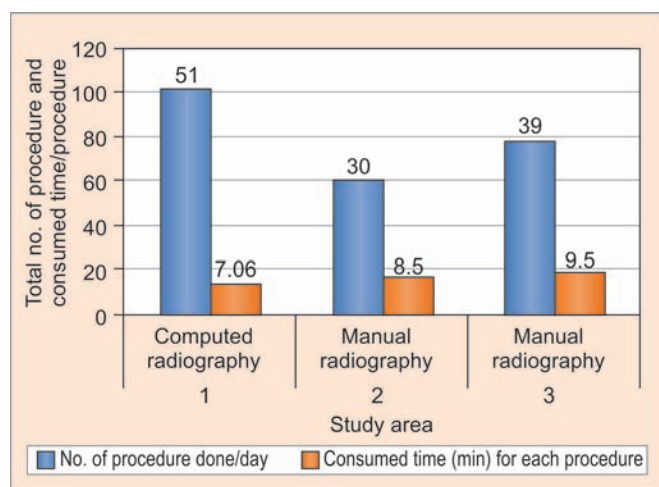
Graph 5 shows that in study area 1 where computed film processing (CR) system was used and 51 radiology and imaging procedures were carried out/day, total consumed time observed was 344.04 minutes (6 hours and 14 minutes) and time consumed for each procedure was 7.06 minutes; in study area 2 where manual film processing was used and 30 radiological procedures were carried out/day, total consumed time observed was 265.06 minutes (4 hours and 41 minutes) and average consumed time for each procedure observed was 8.5 minutes; in study area 3 where manual film processing is used and 39 radiology and imaging procedures carried out/day, total consumed time observed was 369.10 minutes (6 hours and 15 minutes) and average consumed time for each procedure observed was 9.5 minutes.

Graph 6 shows the number of radiology and imaging procedures carried out during last 5 months. The trend of changing the number of radiology and imaging procedure shows that in General Hospital, Gajipur, the utilization rate of radiology and imaging equipments becomes upward consistently in comparison with other two study areas of General Hospital, Shirajgonj and 250-bedded Shadar Hospital, Kishorgonj. While the number

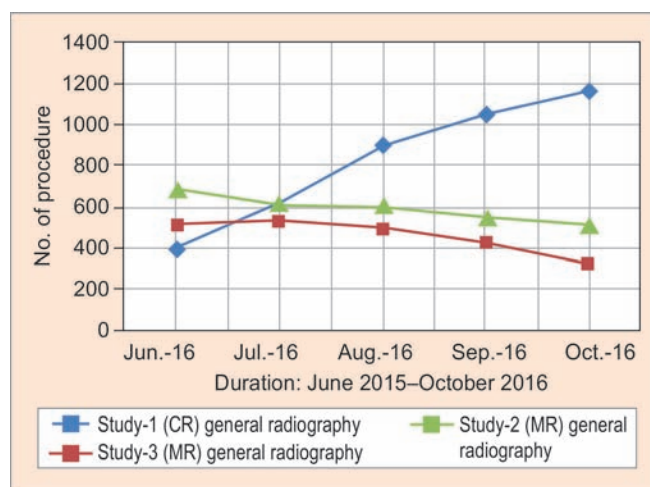
Table 7: Distribution of human resources, functional equipments, and available physical infrastructure in the three district hospitals

Types of work	No. of MP			No. of FE			No. of ARE		
	Study area 1	Study area 2	Study area 3	Study area 1	Study area 2	Study area 3	Study area 1	Study area 2	Study area 3
Radiography	1	1	1	5	4	6	1	2	1
USG	2	2	2	2	1	1	1	2	1

MP: Manpower, FE: Functional equipment, ARE: Available room for equipment



Graph 5: Comparison between efficiency of manual image and computed image processing method



Graph 6: Comparison among the efficiency of radiology and imaging equipments and methods of film processing

of radiology and imaging procedures increased from 398 to 1,170 in General Hospital, Gajipur during June to October 2016, the number of radiology and imaging procedures decreased in the other two hospitals – from 509 to 319 in General Hospital, Shirajgonj and from 686 to 509 in 250-bedded District Shadar Hospital, Kishorgonj.

Table 8 shows 66.66% respondents were middle aged, 33.33% respondents were young, 88.89% respondents were married, 100% respondents were adequately qualified, 88.89% respondents were male, 100% respondents were highly experienced, and 66.66% respondents were satisfied with their income. Table 8 also shows that sound professional education is the important sociodemographic status, which is directly related with the utilization of equipment. Though 100% respondents were professionally educated, they have no opportunity of orientation course on newer modalities or changing technologies.

DISCUSSION

The study was carried out to identify the functional status, workload, utilization, and factors affecting the utilization of radiology and imaging equipments in the district hospitals of Bangladesh. Total 9 equipments and 232 radiological procedures were observed and 9 human respondents were interviewed during the study period. Collected data were analyzed by employing SPSS version 16 and Microsoft Excel.

According to Bangladesh Medical Equipments Survey Report 2008, 53% equipments were functional and in use, 12% functional but not in use, and 35% were fully nonfunctional.⁷ The current study found 46.9% radiology and imaging equipments functional, 40.6% equipments nonfunctional, and 12.5% equipments functional but not in use in the district hospitals of Bangladesh. Overall 53.1% radiology and imaging equipments were not utilized. The study also found that 8 (25%) out of 32 equipments became nonfunctional before 10 years. According to American and Canadian standard, minimum lifetime of radiology and imaging equipment is considered 10 years. Life span of greater than 10 years is considered as maximum utilized and lower than 10 years is considered as underutilized.⁸⁻¹⁰ More than 46% nonfunctional equipments denote the poor maintenance of radiology and imaging equipments. The reasons of nonfunctioning equipments were found to be unavailable spare parts, inadequate fund for spare parts, and unavailable servicing manpower.

The previous study of United States Agency for International Development (USAID) and National Institute of Population Research and Training (NIPORT) found that only 14.5% equipments are maintained by National Electro Medical Equipments Workshop of Bangladesh. and 29% equipments are maintained by vendor as per after-sales service warranty up to 1 year of installation, but after completion of the warranty

Table 8: Frequency distribution of sociodemographic background of human respondents

	Frequency	Percent
Age		
36–45 years	3	33.34
46–55 years	6	66.66
Total	9	100
Sex	Frequency	Percent
Male	8	88.89
Female	1	11.11
Total	9	100
Marital status	Frequency	Percent
Married	8	88.89
Unmarried	1	11.11
Total	9	100
Education	Frequency	Percent
Diploma	3	33.34
Postgraduate	6	66.66
Total	9	100
Experience	Frequency	Percent
11–20 years	3	33.34
21–30 years	6	66.66
Total	9	100
Income satisfaction	Frequency	Percent
Yes	6	66.66
No	3	33.34
Total	9	100
Enough Prof. education	Frequency	Percent
Yes	9	100
No	0	0
Total	9	100
Orien. Prog. opportunity	Frequency	Percent
Yes	0	0
No	9	100
Total	9	100

period, maintenance services become unavailable due to unavailability of fund as per contract agreement.⁶ According to Bangladesh Medical Equipments Survey Report – April 2008, 5 to 7% of total capital investment should be reserved for future maintenance services. But this guideline has not been established for some most costly equipments like computed tomography (CT) and magnetic resonance imaging (MRI). The maintenance services are not assured and follow-through life span of radiology and imaging equipments becomes little.⁷

The study measured the actual work time of GR equipment is 67.01%, PR equipment 16.5%, and USG equipments 71.08%. General radiography equipments were idle for 32.99% time and USG equipments were idle for 28.92% time out of daily stipulated work time due to interruption of electricity, calibration, personal times of human resources, and unavailability of patients, but PR equipments become idle for 83.5% time of daily stipulated work time due to unavailability of patients and technologists. According to *Principles of Hospital Administration and*

Planning by Sakharkar,¹¹ two technologists can carry out maximum 54 radiology and imaging procedures by using one equipment in one room, while daily working time is considered 8 hours; thus one technologist is able to carry out maximum 40 radiology and imaging procedures. This study found one technologist carried out average 39 radiology and imaging procedures during 6.5 stipulated working hours/day by using multiple equipments. It was observed that one technologist was working with GR and PR equipments, so that actual daily work time of technologists was 83.51%, which is quite higher in the district hospitals of Bangladesh.

According to the Bangladesh medical equipments survey report – 2008, the utilization rate was 50.3%.⁷ According to global standards, the utilization rate of radiology and imaging equipments more than 50% is considered as justified utilization.^{1,4,10,12} The current study found that utilization rate of radiology and imaging equipments is 51.53% in the district hospitals of Bangladesh, which is significant in comparison with previous study in many developing countries of Asia and Africa along with Bangladesh. But this utilization rate looks still behind in comparison with many developing and developed countries, such as India and the United States. The current ratio of utilization rate of radiology and imaging equipments among Bangladesh, United States, and India is 52%:53%:60%.

According to reported guidelines of Canadian Society of Radiology and Imaging, the average standard of general radiology and imaging procedure/equipment should be at least 15,000/year, where PR is 4,500/year and USG is 3,000/year, and equipment should be used at least 8 hours/day.¹⁰ In Bangladesh, average GR procedure is 7,500/year and number of PR is 1,020/year, which is underutilized in comparison with international level, and USG is 9,380/year, which is significant in comparison with international standards. Due to short working and accessibility time, service become unavailable for the patients after ending of 6½ hours daily stipulated working time, so that equipments remains idle for 17½ hours/day. The utilization of radiology and imaging equipments is just above the minimum standard level. To accelerate the turnover of radiology and imaging equipments, the utilization should be maximized.

According to Nuclear Safety and Radiation Control rules of Bangladesh Atomic Energy Commission and International Atomic Energy Agency, multiple equipments will not be used in a single room at a time under the consideration of radiation safety of patient and technologist.¹³⁻¹⁵ The study found that physical infrastructure was not available in the three district hospitals where multiple equipments were installed in a room, so that while one

equipment was used, other equipments were idle. The utilization of radiology and imaging equipments was reduced due to inadequate physical infrastructure. This study compared the number of human resources, functional radiography, and USG equipments and available infrastructure for these equipments. In study area 1, five radiography equipments were installed in one room, in study area 2, four radiography equipments were installed in two rooms, in study area 3, six radiography equipments were installed in a single room. Two radiography equipments were only utilized and rest of them remained unutilized due to shortage of room. According to analysis of perception-based factors affecting the utilization, inadequate infrastructure was most significant.

The study found that shortage of manpower is an important factor that may affect the utilization. The study found that one post of medical technologist was available in each 100-bedded district hospitals of Bangladesh, so that more than one equipment was not used at a time.^{5,16} While a medical technologist used GR equipment and then portable equipment, dental equipment remained unused; again when he/she used portable equipment, the GR equipment became idle, even 4 (12.50%) equipments were found functional but not in use in the three hospitals due to shortage of manpower. This study revealed that in study area 1, functional radiography equipments were found to be five, where manpower was found to be one, in study area 2, functional radiography equipments were found to be four, but available manpower was one, in study area 3, functional radiography equipments were found to be 6 where manpower was one. Only two radiography equipments were utilized and rest of them remained unutilized due to shortage of manpower. According to analysis of perception-based factors affecting the utilization, shortage of manpower was most significant.

Most of the previous studies in India, the United States, and Norway considered rapid technological development as a factor affecting the utilization.^{1,4,12} But the previous studies did not mention how digitization or computerization influences the utilization rate. It was a great effort of the current study to identify how computerized image processing system influences the utilization rate. This study found that while a GR procedure consumes 7.06 minutes by using CR, 8.5 minutes (study area 2) and 9.5 minutes (study area 3) is consumed for each procedure by using manual processing system including 25 to 30 minutes drying time. It was observed that, 30 to 45 minutes was required for each manual imaging, while 7–8 minutes was only required for computed method. It was observed that in study area 1 (General Hospital, Gajipur), 51 procedures were carried out by consuming

344.04 minutes with CR, but only 39 procedures were carried out by consuming 369.10 minutes with manual radiography in study area 3 (250 bedded Shadar Hospital, Kishorgonj). The study observed that digitization and computerization influence the utilization of radiology and imaging equipments in the district hospitals of Bangladesh.

The study observed that most of the sociodemographic background of respondents was not correlated with utilization of radiology and imaging equipments in the district hospitals of Bangladesh. The respondents were experienced, professionally qualified, and satisfied with their income. The sociodemographic background, such as age, sex, marital status, income, and experience of all respondents were significant, which may positively influence the utilization rate. This study observed that all respondents are professionally educated but they have no adequate opportunity for orientation program or newer technologies. Different studies in India, United States, Norway, and Ethiopia found that less skilled operating manpower is the key factor affecting the utilization rate of newer modalities.^{1,3,4,12} Bangladesh Health Facility Survey Report 2014 revealed that human resources development program was available for only 13% of workforce who are working with high technology, such as CT and MRI. The study of USAID and NIPORT noted that although 7% of total cost of the equipments is mandatory for human resources development, it was not maintained,⁶ so that most of the sophisticated equipments are being operated without adequate knowledge and skills.

CONCLUSION

A study was conducted in the radiology department of three district hospitals based on daily 6½ hours stipulated working time to identify the functional status, workload, utilization, and factors affecting the utilization of radiology and imaging equipments. According to the study results, a significant number (53%) of radiology and imaging equipments in the district hospitals were nonfunctional and functional but not in use. It was found that more than 50% capital investments remained unused in the district hospitals, which reduced the turnover of radiology and imaging equipments. Average daily work time of GR equipments was found to be 67.01%, PR equipments 16.5% and USG equipments 78.08%. Actual work time of radiologists was 71.08% and technologist 83.51%. Average utilization rate of radiology and imaging equipments in the district hospitals was identified as 51.53%, which was more than the standard (50%) and was significant in comparison with many developing countries of Southeast Asia and Africa. The current utilization rate needs to accelerate to increase the turnover of radiology

and imaging equipments in the district hospitals of Bangladesh. Adequate human resources, physical infrastructure, as well as incorporating advanced technology with existing facility may be considered for more utilization of radiology and imaging equipments. Three district hospitals were not enough to generalize 61 district hospitals. A wide range of studies may be considered for more extensive result. Perception-based factors of respondents may also be considered for further evaluation to find out how they influence the utilization rate.

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