

MEDICAL EQUIPMENTS AND ITS USES IN VARIOUS HOSPITALS AND CLINICS IN DHAKA BANGLADESH

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Abstract

Biomedical imaging equipments like X-ray, CT (Computed Tomography), MRI (Magnetic Resonance imaging), Endoscopy, ECG (Electrocardiogram), EEG (Electroencephalography) and many other imaging instruments are being used in our country every day for medical diagnosis purposes. In this research various public and private hospitals/clinics in Dhaka city were investigated and it was found that every hospital has X-ray and ultrasound machine and some hospital do not have CT or MRI machine. So the percentage of X-ray and Ultrasound machine is 100% and another CT or MRI machine is 90% available on our researched hospital in Dhaka city. The patients in Dhaka city and also those who comes for treatment from outside Dhaka have accessibility to the medical equipments in Dhaka. But in private hospitals/clinics the medical equipment services are expensive. The public hospitals provide cheaper service and so more cost effective medical services needs to be implemented for patients.

Keywords: Medical Imaging, Instruments, Hospitals, Clinics, Applications, Cost, Dhaka

1. INTRODUCTION

Biomedical imaging is one of the most important subjects in all over the world. Its demand is increasing day by day not only to the world, but also in Bangladesh. Medical imaging was primarily seen as the use of non-invasive techniques to create internal images of the human body for clinical or medical purposes. There is a continuous drive not only to improve the diagnostic yield of medical imaging techniques for clinical use, but also the management of the huge amount of digital information available to medical imaging departments. Today there is an increasing interest to harness medical imaging processes to improve research in the biophysical domain. The rapid changes in digital technology have also created opportunities for the development of high-tech equipment employed in medical imaging practice. Many different techniques have been developed to get a look inside the patient. They are all based on a signal travelling right through a patient: different kinds of electromagnetic radiation (such as X-rays or gamma-rays) or sound waves. These signals interact with the tissues of the patient. By detecting the signal coming out of the body an image of the inside of the patient can be made. In this way the patient seems to become transparent.

In last few decades, the rapid progress in Medical imaging techniques has completely revolutionized medical diagnostic system. The modern imaging system is not only limited to image production, but also focused on image processing, image transmission, image recording and automated diagnosis. In order to give best treatment doctor needs to examine patient's body from inside. Medical imaging system reveals internal organs hidden by skin and creates visual representation of internal body for diagnosis purpose.

Earlier the interpretation of medical images was done by physicians manually i.e. doctor had only 5 senses to examine problem but nowadays computer aided diagnosis system acts as an intermediate between doctor and patient, the machine examine patients body and doctor examines the report generated by machine which gives fast, accurate, reliable and consistent results.

Medical imaging has advanced in remarkable ways since the discovery of x-rays. Using x-ray, one can image the human body in intricate detail using computed tomography, magnetic resonance imaging, positron emission tomography, ultrasound, and various other instruments. Such technology allows for improved screening, diagnosis, and monitoring of disease. (Scatliff, 2014) There are various medical imaging techniques and applications (Hodder, 2012) Kunio in a review article has discussed about Diagnostic imaging over the last 50 years: research and development in medical imaging science and technology. (Kunio, 2006). The use of imaging has skyrocketed in the past decade, but no one patient population or medical condition is responsible. (Smith-Bindman, 2008)

Today, medical images are obtained by different acquisition modalities, including X-ray Computed Tomography (CT), Magnetic Resonance Imaging (MRI), single photon emission tomography (SPECT), positron emission tomography (PET), ultrasounds etc. Forming images of the human body using ionizing radiation has been a part of the diagnostic process in medicine for many years. More recently, other probing radiations, notably ultrasound, have provided successful diagnostic images. Tomography is now in widespread use in the clinic with ionizing radiations (X-ray, isotopes) and with nuclear magnetic resonance imaging.

In the past few years, other probing radiations have been considered for tomography, including ultrasound (Mueller, 1979) (Duchene, 1985), very low-frequency electromagnetic fields in electrical impedance tomography (Barber, 1983), and microwaves (Bolomey, 1982), (Ermert, 1986).

Nowadays biomedical imaging is one of the most developing research sectors all over the world. Famous researchers in many countries work in this field. Germany, USA, Canada, Sweden and many other countries work on medical imaging. In Bangladesh, recently some research and education processing of biomedical engineering has been started. Some university has opened undergraduate program on biomedical engineering. Recently some professors of BUET and DMC discovered Elastography which has been accepted by world's scientists. Elastography helps to detect breast cancer. (Nakata, 2014)

The current population of Bangladesh is 162,956,972 as of Monday, July 11, 2016, based on the latest United Nations estimates. Bangladesh population is equivalent to about 2.19% of the total world population. In terms of population, Bangladesh ranks number 8 in the list (BD, 2016). Dhaka, the capital of Bangladesh has a population of 1, 25, 17, 361 people having 68, 13, 463 males and 57, 03, 908 females. 70.50% of Dhaka city population are educated. Per capita income is 550 USD. (Dhaka, 2016)

2. METHODS

Questionnaire forms of hospital/clinic features and medical equipment usage info were prepared and used for investigation. Permission was taken for access to the hospital/clinics imaging divisions. Questions were asked and by observation of the instruments, the formed were completed.

3. RESULTS

Findings at different EMF sources: Public hospitals features. Table 1 shows the public hospitals in Dhaka and its features and divisions. Shaheed Suhrawardy Medical College & Hospital is a government hospital where patient can undergo treatment with very low cost. Dhaka Medical College & Hospital is one of the busiest hospitals in Dhaka city. Some Patient uses floor for getting treatment, critical patient is also treated here. Bangabandhu Sheikh Mujib Medical University is the first medical university in Bangladesh where doctor takes their master's degree from here and it has four blocks (A, B, C, D) building with a large area. Two new buildings are also established for outgoing patient treatment. BIRDEM Cardiac Hospital is mainly diabetes basis hospital but all types of patient are treated here. The patient pressure is so much in this hospital.

Private hospitals features

Table 2A shows the private hospitals/clinics in Dhaka and its features and divisions. IBN-SINA Medical College & Hospital Ibn Sina is the mother of treatment. Basically this hospital name has come from this and it has more branches in Dhaka city, main branch is situated in Dhanmondi, Dhaka. Square Hospital Limited is the number one private hospital in Bangladesh and its service is really much better than another hospital. The internal environment is very neat and clean of this hospital and the staff behave is really good. Gastro Liver Hospital & Research Center is a well-designed modern hospital which was established recently. In Labaid Hospital & Diagnostic Center the environment is nice and the staffs are well dressed. On the roof of the hospital building have a nice garden and also have a canteen. At the Popular Medical college Hospital & Consultation Centre the hospital building is nice looking and also have the patient pressure as it is main branch. At Ad-din Womens Medical & Hospital the environment of the hospital is very neat and clean. The cost is not so high, the hospital have a foundation named Ad-din foundation. This is basically pregnant women and child care basis hospital. Dr. Sirazul Islam Medical College & Hospital is a new medical college and hospital so patient pressure is not so much but imaging equipments are new.

Table 2B shows the private hospitals/clinics in Dhaka and its features and divisions. Administration of this hospital is very good. Day by day this hospital is improving their infrastructure. They are giving their best service. DigiLab is the only hospital where separate treatment units are for female and male patients. NARGIS Clinic seems to be very good. There are various kinds of equipments and the housing location is very nice. The maintenance of Popular Hospital Sector-10, Dhaka is very good. The hospital authority takes responsibility with the cleanliness. The administration of Khidmah Hospital is very good. It is improving day by day. Also, it gives discounts to the poor patients. Apollo Hospital is the only 'JCI Accredited' multidisciplinary super specially tertiary care hospital in Bangladesh which its operation on 2005 with a mission to provide high quality standard health care with latest medical, surgical and diagnostic facilities that meets the needs and exceeds the expectations of peoples of Bangladesh. Apollo Hospital is now financially robust with a healthy balance. The cash flow of the hospital is also improving. They invest in equipment and for recruiting and retaining skilled health care workers to give the proper treatment. Labaid Hospital Gulshan2 its hospitality system is very good. They have many kinds of equipments and their housing location is very good.

Table 1: Hospital/clinic features, units/divisions and diagnostic Imaging Equipments available in various public Hospital & clinics at Dhaka city in Bangladesh

No.	Hospital/Clinic name	Features (No. of beds, No. of patients treated, No. of doctors)	Units/division	Imaging equipments
1	Shaheed Suhrawardy Medical College & Hospital SSMCH) (College Gate, Sher-e-Bangla Nagar, Dhaka)	Beds : 850 Patient treated per day : 1500-2000 (in summer season), 1200-1600(in winter season) Doctors : 167	Units/Division : 22 These are – Medicine, Orthopedic, Oncology, Breast feeding, Dermatology, Emergency, Child division, Surgery, Physical medicine, Gynecology, Hematology, Neurology, Cardiology, Dental, Urology, Mental Health division, Biomedical & Biotechnology division, ENT division, Eye division, Respiratory medicine division,, Burn Plastic& Reconstructive surgery division.	X-Ray, Ultrasonography, Endoscopy, CT(Computed Tomography) Scan & MRI(Magnetic Resonance Imaging)
2	Dhaka Medical College & Hospital DMCH) (Dhaka University Area)	Beds : 1200 Patient treated per day : 4000-5000(In summer), 3500-4000(In winter) Doctors : Above 600	Units/Division : 27 Internal Medicine, Cardiology, Nephrology, Gastroenterology, Endocrinology, Hematology, Neurology, Dermatology, Mental, Physical Medicine, Child Division, General surgery, Urology, Oncology, Dental, Pedicardiac surgery, Orthopedic, ENT, Head & Neck, Eye Division, Cancer & Radiotherapy, Burn & Plastic Surgery, Gynee & Obs, Anesthesiology, Emergency, Blood Transfusion, Clinical Pathology & Radiology Imaging.	X-Ray, Ultrasonography, Endoscopy, CT, MRI, Mammography, ECG(Electrocardiogram)
3	Bangabandhu Sheikh Mujib Medical University BSMMU) (Shahbag, Dhaka)	Beds : 1600 Patient treated per day : 4000-5000(in summer season), 4000-4600(in winter season) Doctors : Above 700	Units/Division : 27 Medicine,Gastro Aentralogy, Androcrinology, Neuro Medicine, Child neurology , Oncology, Cardiac surgery & Mental division, Physical Medicine, Clinical pathology, Orthopaedix, Breast feeding, Dermatology, Emergency, Child division, Anesthesia, Surgery, Gynecology, Hematology, Neurology, Nephrology, Cardiology, Dental, Urology, Mental Health division, Biomedical & Biotechnology division, ENT division, Eye division, Respiratory medicine division,, Burn Plastic& Reconstructive surgery division.	X-Ray, Ultrasonography, Endoscopy, CT, MRI, Mammography
4	Birdem Cardiac Hospital (Shahbag, Dhaka)	Beds : 992 Patient treated per day: 3000-3500 Doctors : 500	Units/Division : 27 Medicine, Gastro Aentralogy, Androcrinology, Neuro Medicine, Child neurology , oncology, Cardiac surgery & Mental division, Physical Medicine, Clinical pathology, Orthopedic, Breast feeding, Dermatology, Imargency, Child division, Anesthesia, Surgery, Gynecology, Hepatology, Neurology, Nephrology, Cardiology, Dental, Urology, Mental Health division, Biomedical & Biotechnology division, ENT division, Eye division, Respiratory medicine division, Burn Plastic& Reconstructive surgery division.	X-Ray, Ultrasonography, Endoscopy, CT, MRI, Mammography

Table 2A: Hospital/clinic features, units/divisions and diagnostic Imaging Equipments available in various private Hospital & clinics at Dhaka city in Bangladesh

No.	Hospital/Clinic name	Features (No. of beds, No. of patients treated, No. of doctors)	Units/division	Imaging equipments
5	IBN-SINA Medical College & Hospital (Kallyanpur, Mirpur, Dhaka)	Beds : 250 Patient treated per day : 600-700 Doctors : 45	Units/Division : 13 These are– Medicine, Gastroenterology, Surgery division, Gyne & obs, ENT division, Orthopedic, Eye division, Child & child neurology division, Dermatology, Monorog, Cardiology, Urology	X-Ray, Ultrasonography, Endoscopy
6	Square Hospital Limited (Green road, Dhanmondi, Dhaka)	Beds : 450 Patient treated per day : 800-1000 Doctors : 86	Units/Division : 19 Internal Medicine, Cardiology(Interventional), Cardiac & Vascular surgery, Gastroenterology, General surgery, Urology, Oncology, Pediatrics, Dermatology, ENT, Head & Neck surgery, Orthopedic, Neuromedicine, Obs & Gynee, Pathology & Lab medicine, Radiology, Ophthalmology, Nephrology, Physical medicine, Anesthesiology	X-Ray, Ultrasonography, Endoscopy, CT, MRI
7	Gastro Liver Hospital & Research center (Green road, Dhanmondi, Dhaka)	Beds : 500 (Five hundred) Patient treated per day : 500-600 Doctors : 95	Units/Division : 22 Medicine, Orthopedic, Oncology, Breast feeding, Dermatology, Emergency, Child division, Surgery, Physical medicine, Gynecology, Hepatology, Neurology, Cardiology, Dental, Urology, Mental Health division, Biomedical & Biotechnology division, ENT division, Eye division, Respiratory medicine division,, Burn Plastic & Reconstructive surgery division.	X-Ray, Ultrasonography, Endoscopy, CT, MRI
8	Labaid Hospital & Diagnostic Center (Dhanmondi, Dhaka)	Beds : 400 Patient treated per day : 800-1000 Doctors : Full time-48, Part time-103, Friday-10	Units/Division : 20 Interventional Cardiology, General & Laproscopic, Nephrology, Neurology, Urology & Andrology, Gynecology, Oncology, Internal Medicine, Trauma & Orthopedic, ENT Division, Dermatology, Dental Division, Gastroenterology, Pediatric & Neonatology, Physical Medicine, Burn & Plastic, Endocrinology, Child division, Urology, Hematology Division.	Imaging Equipments: X-Ray, Ultrasonography, Endoscopy, CT, MRI
9	Popular Medical college Hospital & Consultation Centre (Dhanmondi, Dhaka)	Beds : 350 Patient treated per day : 700-800 Doctors : 114	Units/Division : 19 Cardiology, Medicine, Rheumatology Medicine, Physical Medicine & Rehabilitation, Oncology, Neurology, Gastroenterology, Nephrology, Endocrine Medicine, General Surgery, Plastic Surgery, Liver, Biliary & Pancreatic Surgery Division, Urology, Orthopaedic Surgery, Gynaecology, Child Division, Dermatology, ENT, Head & Neck, Eye division, Physiotherapy Division	X-Ray, Ultrasonography, Endoscopy, CT
10	Ad-din Womens Medical & Hospital (Boro Moghbazar, Dhaka)	Beds : 200 Patient treated per day : 500-600 Doctors : 62	Units/Division : 15 Medicine, Surgery, Gynee & obs, Child division, Orthopedic & Trauma, Urology, Child Surgery, ENT Division, Eye Division, Dental, Dermatology, Anesthesiology, Radiology, Pathology & Microbiology Division.	X-Ray, Ultrasonography, ECG, EEG, CT
11	Dr. Sirazul Islam Medical College & Hospital (Malibagh, Dhaka)	Beds : 250 Patient treated per day : 100-150 Doctors : 65	Units/Division : 18 Medicine, Cardiology, Gynecology, Nephrology, Neuromedicine, Physical medicine, Eye division, Child division, Dental, General Surgery, Urology, Cancer, Orthopaedic, Radiology & Imaging, Dermatology, Emergency, Neurology, ENT division.	X-Ray, Ultrasonography, Endoscopy, CT, MRI

Table 2B. Hospital/clinic features, units/divisions and diagnostic Imaging Equipments available in various private Hospital & clinics at Dhaka city in Bangladesh (contd. from Table 2A)

No.	Hospital/Clinic name	Features (No. of beds, No. of patients treated, No. of doctors)	Units/division	Imaging equipments
12	Islami Bank Central Hospital(Kakrail, Dhaka)	Beds : 160 (total)ICU beds: 26Doctors : 50 up	Units/Division: Two buildings having 19 floors.	X-Ray, CT, ICU ventilator,Ultrasonography, Haemodialysis, Syringe pump
13	National Heart Foundation Hospital, Mirpur, Dhaka	Beds : 300ICU beds: 16Doctors : 75-80Consultant doctors: 30-35Nurses: 450	-	X-Ray, Ultrasono, Endoscopy, CT, MRI, ECG, echo
14	DigiLab Medical Services Ltd., Mirpur, Dhaka	Beds : 500 roomsPatient treated > 1 lac Doctors : 31	Units/Division: 5 units in country. Free: diabetic care center, consultation services for the poor, ambulance service for CT patient, Special discount for corporate patient, Female separate unit for all tests	X-Ray, Ultrasonography, Endoscopy, CT, MRI
15	Islamia General Hospital, North Jatrabari, Dhaka	Beds : 30Patient treated per day : 20Doctors : 30	-	-
16	Monowara General Hospital, Biswaroad	Beds : 100Patient treated per day : 80Doctors : 50	-	-
17	Al-Karim General Hospital, North Jatrabari, Dhaka	Beds : 100Patient treated per day : 120 Doctors : 45-50	-	-
18	Nargis Clinic, Sherpur	Bed: 100, No ICU bedNo. of doctor: 30, Outdoor bed: 40	-	X-ray, MRI, Ultrasono, endoscopy, ECG
19	Popular Hospital, Sector-10,Dhaka	Bed: 135, ICU bed: 20Outdoor beds: 40, Docs: 30+	-	X-ray, Ultrasonography, endoscopy, ECG
20	Ayesha Memorial, Mokakhali	Beds: 220, ICU beds: 15, NICU: 18, Normal: 87Doctors: 40	-	X-ray, MRI, Ultrasonography, endoscopy, ECG, CT
21	Khidmah Hospital Pvt. Ltd.	Beds: 75 (total)VIP bed: 10, Other bed: 65Doctor: 40+	Internal medicine, respiratory, day care, surgical unit, etc.	X-ray, Syringe pump, Ultrasonography, endoscopy, CT etc.
22	Badda General Hospital, Uttar Badda, Gulshan1,Dhaka	Beds: 50, Special bed: 15Consultant doctors: 28Specialist: 20Regular on duty: 5	-	50 equipments
23	Pancare Hospital Ltd. Dhanmondi R/A, Dhaka	Floor: 10NICU: 10, Beds: 20NICU beds: 10	3 doctors for each shift along with NICU. Each shift consists of 8 hours	-
24	Aryan General Hospital & Diagnostic center, Khilkhet	No beds Doctors: 35	-	X-ray, Haemodialysis Ultrasonography, etc.
25	Dogma Diagnostic center, Uttar Badda	No bedsDoctors: ~ 45	-	X-ray, Haemodialysis Ultrasonography, etc.
26	United Hospital, Gulshan2, Dhaka	Beds: 400 total ICU beds: 20, Other beds: 380 Doctors: 100-120 (MBBS)	-	-

		Consultants: 60		
27	Apollo Hospital, Bashundhara R/A, Dhaka	Beds: 450 Doctors: 54 up Patients treated/day: 1200-1500 ICU: (1) MICU: 18 beds (2) SICU: 9 beds (3) HDU: 12 beds (4) CTHDU: 5 beds (5) KTU: 2 beds (6) NICU: 12 beds (7) CCU: 11 beds (8) ICCU: 8 beds (9) CTICU: 7 beds (10) NICU: 16 beds.	Units: 1) Internal medicine, respiratory medicine, endocrinology and diabetology, gastroenterology and hepatology, endoscopy/ colonoscopy, bronchoscopy, dermatology, medical oncology, psychiatry, general & laparoscopy, ENT, plastic reconstructive & cosmetic surgery, ophthalmology, day care facility, surgical ICU.	-
28	Labaid Hospital, Gulshan2, Dhaka	Bed: 65 total. ICU bed:10, Outdoor beds: 15 Doctor: 35	-	MRI, ECG, X-ray, endoscopy, ultrasonogram
29	IBN SINA Diagnostic and Consultation Center, Uttar Badda, Dhaka	No beds this center Doctors: 70	No units	X-ray, CT scan, dental etc.

Public hospitals available equipments and uses

Table 3 shows the public hospitals in Dhaka and its medical equipments and applications. In Shaheed Suhrawardy Medical College & Hospital, to collect this information we faced a beautiful experience about medical imaging instruments and the condition of the hospital in our Dhaka city. Dhaka Medical College and Hospital: Beside the all imaging equipment room have an alert notice about radiation problem and entry is restricted. In Bangabandhu Sheikh Mujib Medical University, all imaging equipment rooms have an alertment notice/info about radiation problem and entry is restricted for everyone. In Birdem Cardiac Hospital imaging equipments are new and the operators give us information intelligently.

Private hospitals/clinics available equipments and uses

Table 4 show the private hospitals/clinics in Dhaka and its medical equipments and applications. In every diagnostic exam IBN-SINA Medical College & Hospital provides 25% discount and the patient gets this opportunity from all branches. In Square Hospital Limited the treatment cost is so high. Mainly rich people take the treatment from this hospital. The entire machine are new and the operators behave is quite good and they operate machine nicely. Gastro Liver Hospital & Research Center is a well-designed imaging room and the examinee patient wait outside of the imaging room because of radiation problem. In Labaid Hospital & Diagnostic Center the staffs and operators are helpful and sometimes the doctors operate the machine like CT, MRI and Endoscopy. At the Popular Medical college Hospital & Consultation Centre the Imaging equipments

were looking new but diagnosis cost is not comfortable for all patient specially the poor patient. At the Ad-din Womens Medical & Hospital, though this is women hospital so it became hard to collect the information but instrument is really good and the staff behavior is also good. Meanwhile in this hospital we see the different looks where the majority staffs are women. At Dr. Sirazul Islam Medical College & Hospital, the imaging equipments are new but patient pressure is not so much because it is new hospital. The operator's behaviors are also remarkable. Badda General Hospital has more equipments but most of them are old. Apollo hospital has a wide range of equipment services but access wasnot available for information. Pancare Hospital Ltd. Is a small but efficient hospital and all equipments are in good condition.

In most cases, X-rays imaging instrument was used for detecting block of lungs, fracture of bones, fracture of hurt blockage. The Ultrasound machine was mainly used for pregnant women to show the condition unborn baby. Also used for kidney patient. CT scan was used for detecting the brain damage. The MRI was used for scanning the whole body to detect neurological and brain problem. Mammography instrument was used for detecting breast cancer and Endoscopy machine was used for finding ulcer and gastric problems.

Table 3: Equipments available and its uses in various public hospitals in Dhaka

No.	Hospital/clinic name	Equipment Name	Equipment info. (Machine, Machine model, made country, Date of installation)	Application/Uses for diagnostic purposes	Observations
1	Shaheed Suhrawardy Medical College & Hospital	X-ray	Machine: ToshibaModel:DMT-80Made country: KoreaInstall date:5-09-05	Uses for bio and non bio medical diagnostic purpose	It looks old and the operators faces some problem at that time
		Ultrasonography	Machine: ToshibaModel:DC-70Made country: JapanInstall date:2-09-12	Mainly used for pregnant women to know the baby's position	The operators did not allow entry
		CT Scan	Machine: ToshibaMade country :Japan Install date:25-6-11	It is used for brain and many other problem	Restricted room, entry is forbidden for radiation
		MRI	Have but did not install	Brain and neurological purpose	The room was totally closed
		Endoscopy	Machine: AohuraModel:AQ-100Made country :KoreaInstall date:7-02-12	Use for finding the problem of ulcer, gastric etc.	Just saw the machine
2	Dhaka Medical College & Hospital	X-ray	Machine: MobayashiModel: CP-35 Made country: Korea Install date: 02.05.2001	It is not visible, have no smell and one can't sense it out even it exposed with high intensity	It looked old and back dated but worked well
		Ultrasonography	Machine: PhilipsModel: J-0046Made country: KoreaInstall date: 28.03.2004	Uses for pregnant women and many other diseases	Operators were helpful and operated carefully
		CT Scan	Machine: Scenia Made country: JapanInstall date: 18.04.1999	All structures of all densities are visualized	Enter the room and see the machine for short time due to radiation problem
		MRI	Machine: HitachiMade country: JapanInstall date: 07.09.2009	Brain and neurological purpose	Just saw the machine
		Mammography	Machine: SiemenMade country: KoreaInstall date: 07.09.2009	Uses for finding breast cancer problem	Only saw the machine
		ECG	Machine: SiemenModel:ECG-300GMade country: KoreaInstall date: 5.12.2013	Uses for finding heart problem and heart beat rhythm	It looked new
		Endoscopy	Machine: Siemen Model: CR-35Made country: Korea Install date:22.7.2009	Uses for finding Ulcer diseases	It does not look old
3	Bangabandhu Sheikh Mujib Medical University	X-ray	Machine: ToshibaModel: TR-0056Made country: KoreaInstall date: 02.05.2013	Transmitted ray passes through the patient and detected by x-ray film	It looked good and worked well
		Ultrasonography	Machine: ToshibaModel: DC-93Made country: JapanInstall date: 28.03.2004	Uses for pregnancy	Operators are very carefully operating the machine
		CT Scan	Machine: Hitachi Made country: JapanInstall date: 22.05.2008	Image quality and resolution is very high	Discussed with the operator about the machine
		MRI	Machine: HitachiMade	Uses for whole body	The machine was

			country: Japan Install date: 01.09.2010	purpose	very large compared to CT
		Mammography	Machine: Siemens Made country: Korea Install date: 07.09.2009	Uses for finding breast cancer problem	Saw the machine
		Endoscopy	Machine: Siemens Model: AQ-2800 Made country: Korea Install date: 25.03.2011	Uses for finding Ulcer & gastric problem	It's not look so old
4	Birdem Cardiac Hospital	X-ray	Machine: Siemens Model: TR-300A Made country: Korea Install date: 08.09.2012	Uses to know the anatomy position	Have caution in the door but the room was open
		Ultrasonography	Machine: Mindray Model: DP-2200 Made country: China Install date: 13.04.2013	It is transmitted as longitudinal wave	New machine
		CT Scan	Machine: Hitachi Made country: Japan Install date: 19.11.2011	Brain and other detector	Machine is not so old.
		MRI	Machine: Hitachi Made country: Japan Install date: 02.04.2014	Uses for body scan	The machine looks new
		Mammography	Machine: Ecoray Model: MX-3000 Made country: Korea Install date: 18.12.2014	Uses for finding breast cancer	Machine set up to the proper place
		Endoscopy	Machine: Scenia Model: SP-200 Made country: Korea Install date: 10.11.2009	Uses for finding Ulcer problem	It looked good

Table 4A. Equipments available and its uses in various private hospitals/clinics in Dhaka city Bangladesh

No.	Hospital/clinic name	Equipment Name	Equipment info. (Machine, Machine model, made country, Date of installation)	Application/Uses for diagnostic purposes	Observations
5	IBN-SINA Medical College & Hospital	X-ray	Machine: CR Wandong Model: R-99ICT Made country: China Install date: 9.3.2009	Uses to know the bones position	It is quite new
		Ultrasonography	Machine: Teknova Model: TA-5500 Made country: Korea Install date: 23.04.2009	The velocity of sound depends on the nature of medium	The doctor showed us the machine and its work function nicely
		Endoscopy	Machine: Siemens Model: SP-3000 Made country: Korea Install date: 03.05.06	Uses for gastrological problem	Machine looked old so patient faces some problem during diagnosis
6	Square Hospital Limited	X-ray	Machine: Scenia Model: YZ-500B Made country: Japan Install date: 28.05.2012	Uses for bio medical diagnostic purpose	It looks new and the operators are very sincere about the test
		Ultrasonography	Machine: Scenia Model: TA-5500 Made country: Korea Install date: 09.06.2014	Mainly Use for pregnant women to know the baby position	The operators did not allow entry
		CT Scan	Machine: Toshiba Made country: Japan Install date: 03.07.2011	Uses for brain scan and neurological problem	Restricted room entry is forbidden for radiation
			Machine: Toshiba Made	Uses for whole body scan	Saw the machine

		MRI	country: Japan Install date:16.02.2013	of the patient	outside of the room
		Endoscopy	Machine: Teknova Model:AS-3000+ Made country: Korea Install date:02.05.09	Used for finding the problem of ulcer, gastric etc.	Saw the work function
7	Gastro Liver Hospital & Research center	X-ray	Machine: Philips Model:199-IBT Made, country: Korea Install date:29.05.14	Photographic film can be made image visible	It looked old and the operators faced some problem at that time
		Ultrasonography	Machine: Teknova Model:DP-20 Made country: Japan Install date:4.05.14	The velocity of sound depends on the nature of medium	The operators did not allow entry
		CT Scan	Machine: Philips Made country: Japan Install date:6.05.14	All structures of all densities are visualized	Restricted room entry is forbidden for radiation
		MRI	Machine: Hitachi Made country: Japan Install date:12.05.14	Uses for Brain and neurological and whole body purpose	The room was totally closed
		Endoscopy	Machine: Aohura Model:VMS-3500+ Made country: Korea Install date:04.05.14	Uses for ulcer problem	Just saw the machine
8	Labaid Hospital & Diagnostic center	X-ray	Machine: Ecoray Model:F99-ICT Made country: Korea Install date:11.05.08	Using filter can harden poly energetic X-ray	It looks old and the operators faces some problem at that time
		Ultrasonography	Machine: Chison Model:ECM-7000 Made country: France Install date:03.05.09	It has frequency more than 20 kHz	The operators did not allow entry
		CT Scan	Machine: Hitachi Made country: Japan Install date:08.09.10	Uses for neurological problem	Restricted room entry is forbidden for radiation
		MRI	Machine: Toshiba Made country: Japan Install date:11.11.10	Uses for body scan	The room was totally quiet
		Endoscopy	Machine: Siemens Model:SMQ-4000 Made country: Korea Install date:04.07.09	Uses for finding the ulcer and gastric problem	Machine was set properly
9	Popular Medical college Hospital & Consultation Centre	X-ray	Machine: Truip Model: DR-400 Made country: China Install date:26.07.12	To Know the bones problem	The machine was okay
		Ultrasonography	Machine: Chison Model:Ivis-60 Made country: China Install date:01.05.12	Uses to know the baby position	Got the proper information from the operator
		CT Scan	Machine: Philips Made country:Japan Install date:11.08.13	Crystal detector and image reconstruction occur in a digital computer	Restricted room and have the caution outside of the door
		Endoscopy	Machine: Teknova Model:AS-200 Made country: China Install date:04.02.13	Ulcer gastric and any other purpose	Nice machine
10	Ad-din Womens Medical & Hospital	X-ray	Machine: Ecoray Model: HF525+ Made country: Korea Install	It can be deflected by electric and magnetic field	The operators are sensitive

			date:04.07.2010		
		Ultrasonography	Machine: Mindray Made country: China Install date:04.07.2010	The intensity of ultrasound varies longitudinally along the length of the beam	The operators did not allow entry (Though it is women hospital)
		CT Scan	Machine: Toshiba Model:DD-335 Made country: Japan Install date: 19.12.13	Mainly uses for brain scan	Restricted room but doctor allowed entry and provided the info nicely
		Mammography	Machine: Nova Model:NV-3000 Made country: Korea Install date:09.05.2012	Finding the breast cancer	Only women are allowed
11	Dr. Sirazul Islam Medical College & Hospital	X-ray	Machine: CR Wonder Model:TR-300A Made country: China Install date:09.11.2014	Transmitted ray passes through the patient and detected the X-ray film	It looked new
		Ultrasonography	Machine: Siemens Model:TH-280 Made country: Korea Install date:22.11.2014	Basically uses in the time of pregnancy	Saw the machine nicely
		CT Scan	Machine: Philips Made country: Korea Install date: 27.12.14	It is used for brain neurological and many other scan	The machine looked new
		Endoscopy	Made country: Korea Install date: 22.11.2014	Uses for finding the ulcer problem	The operator gave us info

Table 4B. Equipments available and its uses in various private hospitals/clinics in Dhaka city Bangladesh

No.	Hospital/clinic name	Equipment Name	Equipment info. (Machine, Machine model, made country, Date of installation)	Application/Uses for diagnostic purposes	Observations
12	Islami Bank Central Hospital(Kakrail, Dhaka)	X-ray 500 mA	Machine: Hitachi Model:RadNext50 Made country: Japan Install date:9.2.2015	Diagnose fractured bones or joint dislocation	It is very latest version
		Ultrasonography	Machine: Siemen Model:AcusonX700 Made country: Korea Install date:4.01.2014	Internal body structures such as tendons, muscles, joints, vessels, internal organs	New device. Last year this was installed.
		Syringe pump	Machine: Atom Model: S-1235 Made country: Japan Int date: 27.8.2015	Used to gradually administer small amount of fluid to a patient/ use in chemical, biomedical research	-
		Haemodialysis	Machine: Model: 4008S Made country: Germany Int date: 19.6.2011	Used for purifying blood and remove waste:involves an artificial kidney	Haemodialysis usage increasing
		ICU ventilator	Machine: Impination 5i Made country: USA Int date: 18.9.2013	-	-
13	National Heart Foundation	LaBiTec	Made country: Germany GmbH, D-22926	Blood coagulation and	Good condition

	Hospital, Mirpur, Dhaka			platelet function	
		Mythic 22	Germany 220T, AL	Blood: WBC, RBC, PLT, HGB, MCV, RDW, HCT, PDW etc. measuring	In good condition
		East Lyte Plus	Made country: USARcf3f046	Blood: Finding the Na/k/Cl	In good condition
		ADVIA Centaur XP	Made country: USACentour XP	Powerful and mid-sized Immunoassay system	In good condition
		Celltac α	Made country: JapanMEK- 6400	Used for feline and canine blood samples	In good condition
		X-ray 500mA	Machine: HitachiModel: Fad Next 50Made country: JapanInt date: 25.2.2015	Used to diagnose fractured boe and joint dislocation	In good condition
		Ultrasonogram	Machine: SiemensModel: Acuson X 700Made country: KoreaInt date: 10.1.2015	Used to see internal body structures e.g. muscles, joints, vessels, liver, kidney, uterus, pancreas, heart, lungs, prostate, blood vessels etc.	In good condition
14	DigiLab Medical Services Ltd., Mirpur, Dhaka	USG with 4D Doppler	Model: Toshiba ApLio 500Made: Japan Inst. Date: 05.07.2012	Suitable for use in x-ray fluoroscopic and radiographic diagnosis, used in gastrointestinal radiographic diagnosis	Allows the detection,contrast and grading of inflammation in rheumatology.
		Digital X-ray with computed radiography	DRGEM X-ray machine 500mAModel: XD52Made country: KoreaInst. Date: 17.01.2012	1)Contrast-enhanced ultrasound, 2)Contrast quantification 3)Realtime elastography 4) Shear wave elastography 5) Propagation mapping	preferable for radiography such as general body, beam filtration and chest
		Echo Color Doppler, EEG, EET, Video Endoscope, Mammography, OPG, Dental X-ray, Multislice CT	-	-	-
15	Islamia General Hospital, North Jatrabari, Dhaka	UCG machine	Model: Nemlo SG SSA-580AMade country: JapanMachine: Toshiba Color	For imaging inside the body	Digital

			DuplexIns date: 2013		
		X-ray	Model: WD 9311/10(Baiging Wingdong) 500mA Digital X-rayMade country: ChinaInst date: 2010	For imaging of bone	Digital
		C/R computerized X-ray	Model: DRYPIX-2000Country: JapanMachine: Fujifilm (capsula)Inst date: 2013	For imaging inside the body	Digital
		ECG	Model: ECG-1200GMade country: ChinaMachine: CONTECInst date: 2012	Pulse measurement	Digital
16	Monowara General Hospital, Biswaroad	ECG	Model: ECG-C120Country: JapanMachine: FUKUDA ME KURDISUNYInst date: 2012	Pulse measurement	Digital
		X-ray	Model: WD 9311/10(Baiging Wingdong) 500mA Digital X-rayMade country: ChinaInst date: 2011	For imaging of bone	Digital
		C/R computerized X-ray	Model: DRYPRO-873Made country: JapanMachine: Fujifilm Inst date: 2013	For imaging inside the body	Digital
17	Al-Karim General Hospital, North Jatrabari, Dhaka	X-ray	Machine: SiemensModel: HF 500mA Digital X-ray-525 PlusMade country: GermanyInst date: 2012	For imaging of bone	Digital
		C/R computerized X-ray	Machine: AFGA-CURVYModel: CR-30XMade country: JapanInst date: 2013	For imaging inside the body	Digital
		CT scan	Machine: HITACHI (EL00W-KB-229580)Model: E-1747Country: JapanInst date: 2014	Pulse measurement	Digital
		ECG	Machine: FUKUDA ME KURDISUNYModel: ECG-C120Country: JapanInst date: 2014	For imaging whole body scan	Digital
18	Nargis Clinic, Sherpur	ARCHI TECT	Model: I-100 Made: USA Inst date: 2014	Biochemistry test	Condition good
		BECKMAN COULTER	Model: AU-640Made: USAInst date: 2013	Biochemistry test	Condition good
		YSMEX	Model: CA-5000Made: JapanInst date: 2014	Coagulation test Analysis	Condition good
		CENTRIFUGE	Model: ROT AFIX-32A	Test tube centrifuge	good
		YSMEX	Model: XE-1000Made: JapanInst date: 2013	Haematology detection test	Condition good
		BACTEC	Model: 9120Made: JapanInst date: 2013	Microbiology for culture test	Condition good
		YSMEX	Model: XE2100Made: JapanInst date: 2011	Haematology test	Condition good
19	Popular Hospital Sector-10, dhaka	X-ray 500mA	Machine: OrichModel: V5670Made: USA Inst. Date: 7.06.2014	Human diagnosis purpose	Latest model from brand Orich
		Ultrasonogram	MACHINE: SiemensModel: Acuson 1700Made: KoreaInst. Date: 12.11.2014	It is used for observing human internal body parts	Advance machine

		MRI	Machine: PhilipsModel: 3.OTMade: NetherlandsInst. Date: 07.09.2013	For diagnosis purpose	Most costly equipment in the hospital
		ICU ventilator	Machne: ImpinationModel: 5iInst. Date: 18.09.2013	This is to blow air with mixture of gases into the lungs	This is clean and protected.
20	Ayesha Memorial, Mokakhali	X-ray machine 500mA	Brand: JPI HealthcarModel: DRE-180Made: JapanInst date: 2013e	Bone measurement	Good condition
		Full digital 12 channel ECG	Model: EC-12TMade: RussiaInst date: 2014	Heart rate analyzer, systolic and diastolic measure	Good condition
		MRI	MRI 1.5 Tesla (superconductor)Made: JapanInst date: 2013	Brain, neck, head, glands, kidney, liver, leg, foot etc.	Good condition
		Analyzer	Machine: CormyModel: Multi+Made: PolandInst date: 2012	Blood analyzer, blood refine	Good condition
		OT table	Machine: LEWINMade: JapanInst date: 2014	Hydraulic and Electric OT table	Good condition
21	Khidmah Hospital, Biswaorad, Dhaka	X-ray machine 500mA	Machine: SiemensModel: Radnou+55Made: GermanyInst. Date: 3.3.2016	Used to diagnose joint dislocation and fractures bones	Latest machine
		Ultra sonogram	Machine: Siemens 4D colorModel: Acuson X-500Inst. Date: 04.05.2012	It is used to see internal body structures such as tendon, muscles, joints, vessels, internal organs	New device
		Syringe pump	Machine: AtomModel: 1235Made: JapanInst. Date: 27.10.2015	Used for administering small amount of fluid into patient, used for chemical and biomedical research	New device
22	Badda General Hospital, Uttar Badda, Gulshan1,Dhaka	Incubator	Model: jouan 36	Sterilization, microbiological test	New
		Autoclave	Made: China	Sterilization for glass tube, test tube and others	New
		Sysmax	Model: KX21Made: JapanInst. Date: 2012	Hematological purpose; detect for CBC, ADL, blood platelets, dengue fever	New
		Micro-ER	Model: ER-500Made: China Inst. Date: 2012	Hematological purpose used for hormonal assay, detect hormone problem	New
		Evolution machine	Model: 300 EvolutionMade: Japan	All biological test, S, bilirubin,	Old

				RB, SFBs	
		Centrifugal machine	Model: SB-100Made: Japan	SPPR	Old
		Hot air oven	Made: Japan	Protect all equipment in diagnosis	Old
		Ultrasono	Model: Logiq-2200Made: China	Mostly used for liver, stomach, kidney problem	Old
		ECG	Model: Cardiofax ECI Made: Japan	Used for chest problem	Old
		VLTROS	Model: ECIMade: England	Unknown	Old
		CT scanner	Siemens CT	Mostly used for brain scanning	Old
		X-ray	Model: CR-30-X Arfa Made: Japan	Used for chest and other parts of body checking	Old
		Nebulizing machine	Made: China	breathing treatment	Old
		Evolis	Model: Twin plus	Unknown	Old
		Dimension	Model: Rx2 max	Unknown	Old
		VESMATIC CUBE	Model: UnknownMade: Germany	Unknown	Old
23	Pancare Hospital Ltd. Dhanmondi R/A, Dhaka	Magnamed (NICU)	Model: GT-2000Made: Japan, Inst. Date: 2014	Used as a ventilator in NICU as infant warmer	Good condition
		Incubator (infant)	Model: CE0197-B3000Made: GermanyInst. Date: 2009	Incubator as life support for infant	Good condition
		Ventilator (PICU)	Model: Takaoka-6060Made: Brazil, Int. date2008	Ventilator	Good condition
		Pulse Oximetal	Model: NT2A, Made: USA Inst. Date: 2009	Measure the pulse rate of the infant patient	Good condition
24	Aryan General Hospital and Diagnostic center, Khilkhet	X-ray Machine	Model: Lumimos.RSMade: Germany, Inst. Date: 2005	Takes images of specific bones	Digital
		Dental machine	Model: CramexaMade: GermanyInst. Date: 2006	Check teeth by the machine	Digital
		Sysmex	Model: XT2000CMade: Finland, Inst. Date: 2010	Pathology purpose	Digital
		VESMATIC cube	Model: 80Made: GermanyInst. Date: 2010	Use for Ametological purpose	Digital
		ECG	Model: Toshiba- ISTYLEMade: Japan, Inst. Date: 2005	Used for dental purpose	Digital
		CRAtex	Model: ExcelMade: JapanInst. Date: 2006	To pulse check	Digital
25	Dogma Diagnostic center, Uttor Badda	X-ray	Model: MAINSMade: JapanInst. Date: 2008	Used for checking the body, teeth purpose	Digital
		Dental	Model: Panpas-EMade: JapanInst. Date: 2009	To absorb teeth purpose	Digital
		FCR	Model: CAPSULAMade: JapanInst. Date: 2008	X-ray purpose	Digital
		X-ray controller	Model: FUJIFILMMade:	To absorb X-ray	Digital

		machine	JapanInst. Date: 2008	machine control	
		Pathology printer	Model: DRY PI X 2000Made: GermanyInst. Date: 2008	Used for printing	Digital
		CRALEX	Model: ExcelMade: JapanInst. Date: 2008	Dental purpose	Digital
		ECG	Model: Toshiba-ISTYLIMade: JapanInst. Date: 2007	To check pulse	Digital
		NIHONKOHDED	Model: Cardeofax SMade: JapanInst. Date: 2007	Attached on ECG monitor	Digital
26	United Hospital, Gulshan2, Dhaka	ARCHITECT	Model: ARCHITECT I 1000SRMade: USAInst. Date: 05.01.2015	Biochemistry test analyzer. e.g, URTA, SGPT, SGOT, etc.	-
		SYSMEX	Model: CA500Made: JapanInst. Date: 15.03.2015	Coagulation test analyzer. e.g. PT, etc.	-
		SYSMEX	Model: XE1000Made: JapanInst. Date: 03.04.2015	Haematology test e.g. CBC	-
		ARCHITECT	Model: CI8200Made: USA Inst. Date: 01.04.2015	Biochemistry test analyzer e.g. SGPT, SGOT etc.	-
		Centrifuge machine	Model: ROTAFIX 32AMade: ChinaInst. Date: 02.02.2014	Used for test tube centrifuge	-
		SYSMEX	Model: XE 2100Made: JapanInst. Date:10.12.2011	Haematology test e.g. CBC, ESR, CE	-
		BACTEC	Model: 9120Made: JapanInst. Date:01.01.2014	Microbiology for blood culture test	-
		D-10	Model: D-10Made: JapanInst. Date: 01.02.2015	Biochemistry test specially for HBAIC	-
		X-ray machine 500mA	Brand: JPI HealthCareModel: DRE 140Made: KoreaInst. Date: 2014	Bone measurement	Good condition
		ECG	Model: EC12TMade: RussiaInst. Date: 2013	Heart rate analyzer, Systolic and Diastolic measure	Full digital good
		Ultrasonography	Machine: AlpinonModel: E cube-15Made: USAInst. Date: 2012	Golbladder, thyroid, kidney, heart	Good
		OT table	Machine: LEWINMade: USAInst. Date: 2010	Electric, hydrolytic OT table	Very good condition
27	Apollo Hospital, Dhaka	Has a lot of good equipments	-	-	In good condition
28	Labaid Hospital, Gulshan2, Dhaka	Ultrasonogram	Brand: SiemensModel: Acuson X700Made: KoreaInst. Date: 5.07.2014	Used to observe human body parts	Advanced machine
		MRI	Brand: PhilipsModel: 3.0tMade: USAInst. Date: 07.06.2015	It is used to blow air on a mixture of gases into the lungs	Costly equipment
		X-ray 500mA	Machine: OrichModel: V 5670Made: USAInst. Date: 2013	Human diagnosis purpose	Latest Orich model

		CT scan	Model: I-1000SRMade: USA, Inst. Date: 2014	Human full body test purpose	Large machine
		SYSMEX	Model: X5-1000Made: Japan	Hematology detection test	
29	IBN-SINA diagnostic and Consultation center, Uttar Badda	X-ray machine	Model: LUMINOS.RSMade: GermanyInst. Date: 11.2.2010	Used to check body and bone	New and digital
		CT scan	Model: SOMAT6M SpirtMade: GermanyInst. Date: 21.1.2013	Used in brain and check whole body	New and digital
		DENTAL machine	Model: CRANEX-AMade: FinlandInst. Date: 2.10.2012	Used in teeth test purposes	Digital
		SYSMEX	Model: XT2000CMade: Japan, Inst. Date: 2013	It is used in amatological diagnostic purposes	Digital
		VESMATIC CUBE	Model: 80Made: GermanyInst. Date: 2.10.2010	-	-
		BD BACTEC	Model: FX 40, Made: USA, Inst. Date: 20.01.2013	It is used in blood culture sensitive test	New and digital
		SIFT	Model: MN 090Made: TurkeyInst. Date: 20.01.2013	-	Digital
		Dimension	Model: RXL MAXMade: GermanyInst. Date: 20.01.2013	Biochemistry test for diagnostic purposes	Digital
		VICTROS	Model: ECIMade: UKInst. Date: 10.12.2009	Used in imological test	Digital
		IMMULITE	Model: Immulite 2000Made: GermanyInst. Date: 27.07.2010	Used in imological test	Digital
		DADEBEHRING	Model: BN PROSPECemade: GermanyInst. Date: 28.12.2013	Used in serological test	Digital
	EVOLIS	Model: Twin plusMade: SwitzerlandInst. Date: 15.5.2012	Used in Alaiga various panel	New and digital	

Table 5 shows the major equipments availability on 11 major hospitals and clinics in Dhaka. It is found that x-ray, ultrasound and CT are present in all 11 major hospitals in Dhaka. While endoscopy is present in all but one hospital. Also, PET is not available in any of the hospitals. Mammography is present in 6 hospitals, while MRI is present in 7 hospitals amongst which one of them is not installed yet. EEG is available in 3 hospitals amongst which 2 are public, and ECG is available in 7 hospitals amongst the 11 major hospitals/clinics in Dhaka. All the major hospitals have X-ray and ultrasound machine and some hospital do not have CT or MRI machine. The percentage of X-ray and Ultrasound machine is 100% and another CT or MRI machine is 90% available on our researched hospital in Dhaka city.

Table 6 shows the costs of usage of various equipments in public and private hospitals in Dhaka. Mostly the poor patients go to the public hospitals for treatment and usage of the various medical equipments as it is much cheaper there. There is a huge line and rush in these public hospitals. Patients have accessibility to these equipments as the doctors prescribe various tests for diagnosis and treatment purposes. Hospital, clinic and diagnostic centers show off

their equipment services in banner and leaflets. The number of equipments in Dhaka city are not enough for the diagnosis and treatment of the patients who come also from other parts of the country to the capital for better treatment. Most of the well-known doctors try to stay in capital and there are more treatment equipments and facilities in Dhaka than in other parts of Bangladesh. Medical equipments costs also can be reduced for better access for diagnosis and treatment purposes.

In this research, some public (government) and private (non-government) hospitals/clinics of Bangladesh were visited. Some data about medical imaging instrument were taken. There are some common instruments like x-ray, ultrasound machine, endoscopy, computed tomography machine. But MRI, linac accelerator, mammography machine are not available everywhere. It was also found that most of the instruments are made by Japan, Korea, China and others countries. Bangladesh only imports that machine. So it can be said that Bangladesh is not so updated with medical imaging. In this research we saw the condition of public and private hospitals/clinics in Dhaka in terms of medical imaging instruments condition.

Table 5: Table 5. Summary of frequently used instruments available in various major 11 public and private medical hospitals/clinics in Dhaka city. “P” stands for instrument present in the hospital/clinic, while “A” means not available.

Name of hospital	X-ray	Ultra sound	CT	MRI	EEG	ECG	Endoscopy	Mamography	PET
S.S.M.C	P	P	P	P (not installed)	P	P	P	A	A
DMCH	P	P	P	P	P	P	P	P	A
Bangabandhu MC	P	P	P	P	A	P	P	P	A
Birdem	P	P	P	P	A	P	P	P	A
Ibn Sina	P	P	P	A	A	A	P	A	A
Square	P	P	P	P	A	P	P	A	A
Gastro Liver Hospital	P	P	P	P	A	A	P	A	A
Labaid	P	P	P	P	P	P	P	P	A
Popular	P	P	P	A	A	P	P	A	A
Ad-din	P	P	P	A	A	A	A	P	A
Dr Sirajul Islam	P	P	P	A	A	A	P	A	A

Table 6. Summary of frequently used instruments cost for patients in public and private hospitals/clinics/diagnostic centers in Dhaka city and in outside village (rural area).

Instrument Name	Cost in Public Hospital(Dhaka City) in Taka	Cost in Private Hospital(Dhaka City) in taka	Cost in Village Hospital in Taka
X-ray	100-400	400-1800	400-1200
Ultrasonography	100-500	400-1500	420-1000
ECG	100	400-800	500-600
CT Scan	2000-2500	4000-5500	Rare in village but some costlier from city
MRI	2000-3000	5000-7000	Didn't see in village

4. DISCUSSION

Medical imaging was first started in 17th century. X-ray machine was first published in 1895 and now in 2016 it is updated continuously. There are many instruments and technologies which are not used in our country. Some technology which are not yet used in Bangladesh like CAVEman (image), Corneal topography, Simultaneous Algebraic Reconstruction Technique Preclinical imaging, Algebraic Reconstruction Technique, Altropane, Ambivu 3D Workstation, Amorphous Selenium Flat Panel Detectors Amplitude of low frequency fluctuations Analysis of Functional NeuroImages, Anthropometry, Nanotomography, National Coalition for Quality Diagnostic Imaging Services, Neutron stimulated emission computed tomography, Non-contact thermography. Machlett Laboratories Magnetic field imaging, Magnetic resonance elastography, Magnetogastrography, *Medcyclopaedia* Medical animation, Medical image computing, Medical Image Sharing, Medical ultrasound Medipix MICAD, MicroDicom, MicroDose, Molecular imaging, Multiscale motion map and many others. They all are modern biomedical instruments and technology.

In this research, we discussed about biomedical imaging and recent condition of biomedical imaging instruments and their usage in Bangladesh. Medical imaging is very important sector all over the world. In Bangladesh this

sector is not so popular. Many kinds of medical instruments were found like x-ray, ultrasound machine, CT, MRI, ECG, EEG, mammography etc. But they all are not available. In public (government) hospitals, there is lack of medical imaging instruments. Private (non-government) hospital keep more medical instruments. But is very high cost in non-government hospital.

Radiation Effect from medical equipments and Protection Background radiation refers to the ionizing radiation from high energy particles or rays that we are unavoidably exposed to in our daily lives, which gives each of us a small but continuous dose of ionizing radiation. All persons are weakly radioactive due to the presence of radioactive elements in our bodies (e.g. ⁴⁰K and ¹⁴C), and this contributes to our background radiation exposure. An X-ray beam is absorbed differently by different parts of the body, and these differences make shadows that are used to create an image or picture. A dense structure, such as bone, absorbs a high percentage of an X-ray beam (appears light grey on the image); whereas low-density structures, such as soft tissues (e.g. muscle and skin), absorb a small percentage (appears dark grey). Metal objects will usually show up as white and air will usually appear black. Man-made X-rays are electrically generated and are only present when the X-ray machine is switched on. Once the X-ray machine is switched off, there is no radiation coming from the X-ray machine. Computed tomography (CT) is a specialized X-ray

examination using powerful computers to make the pictures. Having an X-ray or CT examination does not make a patient radioactive. The radiation exposure from having an X-ray, fluoroscopy, mammography or Computed Tomography (CT) examination only occurs while the machine is on and activated by the operator. Any operator of X-ray machines has to be trained in the use of these machines and holds a government license. Magnetic resonance imaging (MRI) uses strong magnetic fields and radio waves to make images. It does not use ionizing radiation. Ultrasound uses high frequency sound waves that the human ear cannot detect to make images. It does not use ionizing radiation. Although ultrasound imaging is generally considered safe when used prudently by appropriately trained health care providers, ultrasound energy has the potential to produce biological effects on the body. Ultrasound waves can heat the tissues slightly. In some cases, it can also produce small pockets of gas in body fluids or tissues (cavitation).

There are some technical research findings related to radiation exposure and it can be summarized as: (1) If the Radiation is greater than 5000 mSv the patient will die between 2 hours (2) If the Radiation is (3000-4000) mSv the patient will die between 3 hours (3) If the Radiation is (500-2000) mSv the patient will die between 1-3 days (4) It increases the cancer probability (5) It causes skin diseases, skin cancer and eye problem (6) It also creates the genetic problem, blood cancer and also the abortion in pregnant women (7) Cosmic ray which is primary, natural radiation (Uranium), Internal radiation source, Somatic effect (High range alpha particle) (8) Ionization particle cause cancer, lungs cancer, eye problem (9) A few parts of the world have background radiation 10 or more times greater than that generally found in Australia, but there are no studies that have shown an increased risk of cancer in populations living in areas with a higher background radiation level. (Hossian, 2009)

4.1 Radiation Protection

For occupational worker, the following precautions should be taken: (1) Minimum possible time of exposure and maximum possible distance should be maintained. (2) Only patient should be exposed to the primary beam. (3) Occupational workers should stay in the control panel which should be behind the X-ray tube and should have a protective wall or screen at least 7 feet high and provided with lead glass. (4) The exposure due to leakage radiation should not exceed 100mr/hr at 1 meter from the focus. (5) Primary beam size should be small. (6) Reporting room should be away and behind the x-ray room. (7) Proper shielding of walls, floors and ceiling should be maintained. (8) Person should wear gloves with shisha (9) Suitable voltage limitation. (Hossian, 2009)

For patient, the following precautions should be taken: (1) Patient waiting for examination must be seated outside and away from the room. (2) The machine should be set up in proper side of the room. (3) Less time to get the picture. (4) Avoid unnecessary reexamination exposed patient. (5) X-ray

of pregnant woman should be avoided as possible, especially during the time of organogenesis. (Hossian, 2009)

It has been found that most of the patients are not aware of the radiation and its effects and also how to take precautions. In addition, in some of the places, the operators were not also taking necessary precautions for taking data.

5. CONCLUSION

In this research, work was carried out to find the recent medical imaging condition of Bangladesh. Some data of imaging instruments were taken in Dhaka. It was found that some new techniques and instruments are not yet available in Bangladesh. Also, some hospitals and clinics have good number of new equipments available while some do not have adequate ones. The costs of some of the well-used equipments were taken. In future, we plan to take this data of all over the Bangladesh. There is another part of medical imaging like therapy. This work can be also extended to see the overview of medical therapeutic equipment conditions in Dhaka city as well as the other parts of Bangladesh. This is the overall view of biomedical imaging on the prospect of Bangladesh.

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