International Journal of Healthcare and Medical Sciences
ISSN(e): 2414-2999, ISSN(p): 2415-5233
Vol. 3, No. 11, pp: 98-102, 2017
URL: http://arpgweb.com/?ic=journal&journal=13&info=aims

Effective Dose of Computed Tomography (CT) Head in Some Selected Hospitals in Federal Capital Territory, Abuja, Nigeria

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Abstract: Investigations have been done concerning computed tomography (CT) dose output of some selected hospitals in the Federal capital Territory, Abuja, Nigeria by calculating the Effective doses of CT head in some selected hospitals and compare its average with the Mean Reference Dose of CT Head. Data was collected at five hospitals in the Federal Capital Territory, Abuja, Nigeria. The Effective Dose of each of the patients undergoing CT Head examination was calculated using the coefficient factor and the DLP values. Patients' CT dose data from the ages of 18 to 60years from each of the 5 centres for each study types from January, 2013 to December, 2014 were extracted. A total of 181 patients' CT dose data was extracted. The effective dose range for CT Head examination in Abuja, Federal Capital Territory is 1.8 to 6.8mSv.

Keywords: Head; Computed tomography; Hospitals; Abuja, Nigeria; CT Scanner; CTDI; DLP.

1. Introduction

There is a high probability of developing cancer from exposure to X-ray from computed tomography. The effective dose of radiation from brain computed tomography procedure is about 1-2mSv [1]. From background radiation, it will take 4-8 months to achieve 1 to 2 mSv effective dose of radiation on an individual. It may not be used for pregnant women for reason of foetus that is in the formation stage which involves cell divisions. When these cell divisions are interrupted by x-radiation, this action leads to mutations and subsequently congenital anomalies in the new born child. When used for nursing mothers, they must wait for 24 hours before resuming breast feeding. This is as a result of contrast medium used for most human body computed tomography examinations pass through the Blood Brain Barrier. Children should have body computed tomography scans only for diagnoses and should not be repeated. And the benefits should outweigh the damage/risks. When computed tomography scans are repeated the radiation dose to the part of the body is increased. This will therefore increase the probability of radiation effect to the part of the body irradiated [2].

Castellano, *et al.* [3] confirmed the effect of computed tomography by stating that computed tomography is a source of man-made radiation. They estimated that in developed countries, computed tomography have currently contributed to 40 – 75% collective dose from medical radiation. Similarly, in 1996, the International Commission on Radiological Protection (ICRP) in their report on radiological protection and safety in medicine recommended that particular attention should be given to optimization of radiation doses from this modality, that is, computed tomography machine.

Smith-Bindman, *et al.* [4]; worked on Radiation dose Associated with common computed Tomography Examination and the Associated lifetime attributable Risk of cancer. They conducted a retrospective cross-sectional study describing radiation dose associated with 11 most common types of diagnostic CT studies performed on 1119 consecutive adults' patients at 4 San Francisco Bay Area institutions in California between January 1 and May 30, 2008.Their results showed radiation doses variation which was significantly between the different types of CT studies. The overall median effective dose ranges from 2mSv for a routine head CT to 31mSv for a multiphase abdomen and pelvis CT scan.

2. Methodology

Data were collected from five hospitals in the Federal Capital Territory, Abuja. Abuja Clinics, Maitama, using 64 slice GE CT scanner; Life Bridge Diagnostic Centre, Garki, using 64 slice Toshiba CT scanner; Asokoro General

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Hospital, Abuja using 64 slice GE CT scanner; State House Hospital, Aso Rock, Abuja using 16 slice GE CT scanner and Zankli Hospital Utako, using 8 slice Hitachi CT scanner machine.

These facilities were selected because of their relative large size, diverse area locations that allows for geographic diversity and availability of dose area product, which is found in modern multi-slice CT scanner

The most important factor was their CT scanner functionality at the point of data collection.

For each patient body parts like Head, the technical parameters and dose report data (DLP), Scan area, Scan length, Slice thickness, kVp, mAS, Pitch, DLP, $CTDI_{vol,}$ quantity of contrast used, Effective Dose and Scan type were extracted from the CT examinations recorded.

The Effective Dose of each of the patients undergoing the particular examination was calculated using the coefficient factor and the DLP values.

Patients' CT dose data from the ages of 18 to 60years from each of the 5 centres for each study types from January, 2013 to December, 2014 were extracted. A total of 346 patients' CT dose data were extracted

3. Results

The results are shown using bar charts and tables.

The Effective doses calculated from the Dose Length Product (DLP) values of the Computed Tomography Scanners of the selected hospital are shown using bar charts. The one shown below in Figure 1 is that of Abuja Clinics.

Figure-1. Bar Chart of Effective Dose of CT Head in Abuja Clinics

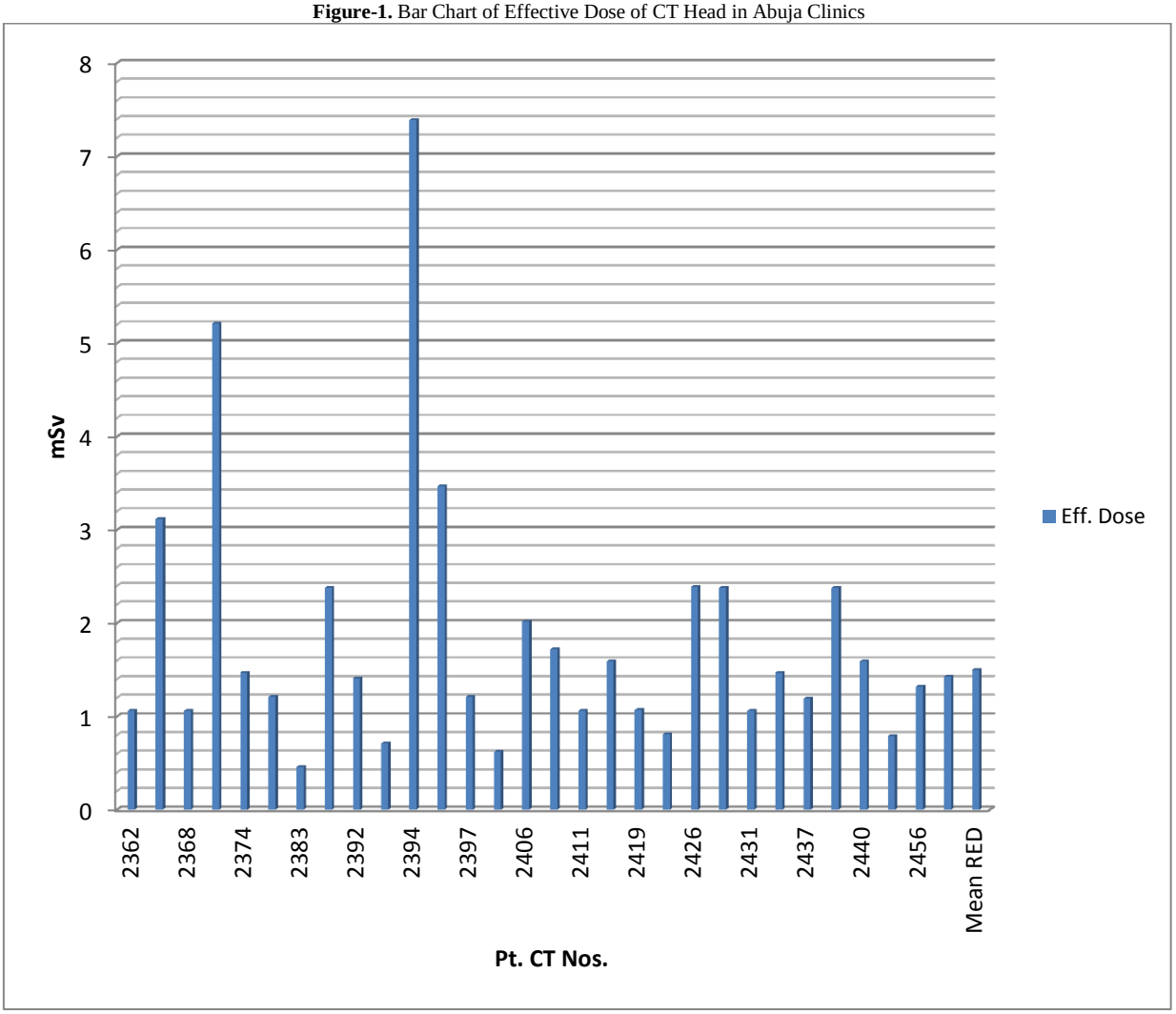

Fig. 1 shows a result from Abuja Clinics. The calculated effective doses ranged from 0.5 to 7.4mSv as against 1-2mSv Reference Effective Dose range. The highest values came from examinations with contrast medium, high mAS and kVp. That is CT examination numbers of 2371 =5.2mSv and 2394 = 7.4mSv. The Mean value from this examination is 1.8mSv, which is slightly more than the Mean Reference Effective Dose (mean RED) of 1.5mSv.

The Figure 2 shows the calculated effective doses for CT Head examinations from the Lifebridge Diagnostic Centre.

Figure-2. Effective Dose values for CT Head in Lifebridge

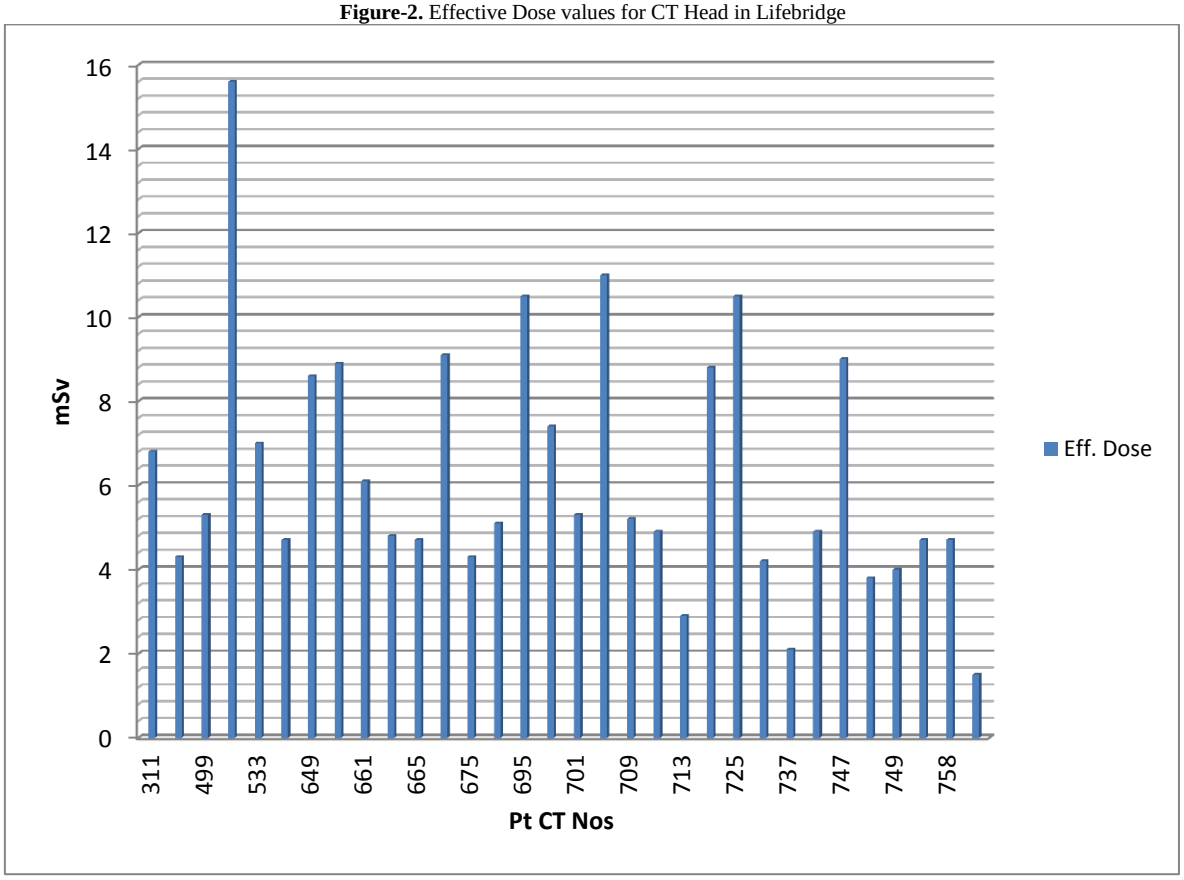

Fig. 2 is a result from Lifebridge. The calculated effective doses ranged from 2.1 to 15.6mSv as against 1-2mSv Reference Effective Dose range. The highest values came from examinations with contrast medium, high mAS and kVp. That is CT examination numbers of 531 =15.6mSv. The Mean value from this examination is 6.4mSv, which is much more than the Mean Reference Effective Dose (mean RED) of 1.5mSv.

Figure-3. Effective Dose values for CT Head in State House Medical Centre

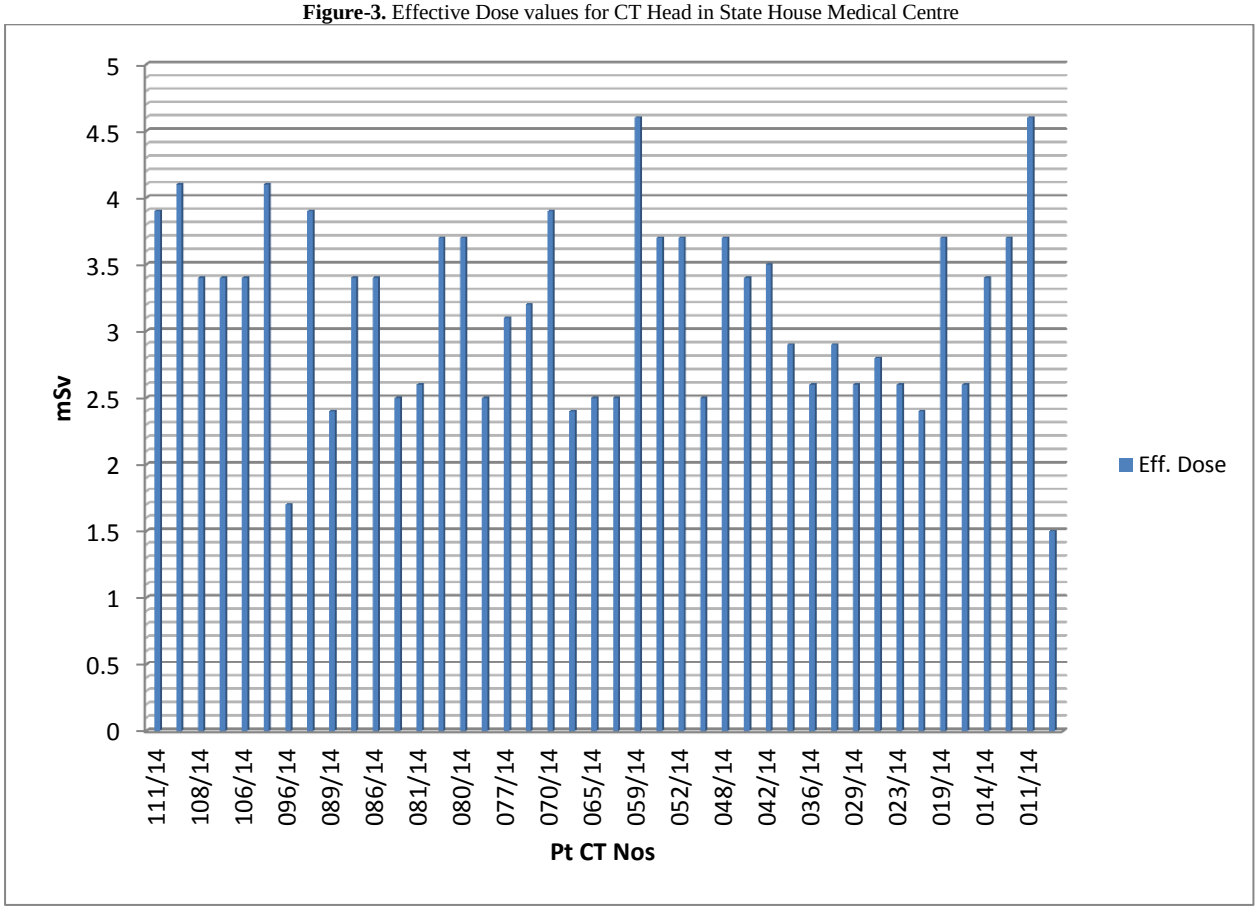

Fig. 3 shows a result from State House Medical Centre. The calculated effective doses ranged from 1.7 to 4.6mSv as against 1-2mSv Reference Effective Dose range. The highest values came from examinations with contrast medium, high mAS and kVp. That is CT examination numbers of 059/14 =4.6mSv and 011/14 = 4.6mSv. The Mean value from this examination is 3.2mSv, which is double the Mean Reference Effective Dose (mean RED) of 1.5mSv.

Figure-4. Effective Dose for CT Head in Asokoro General Hospital

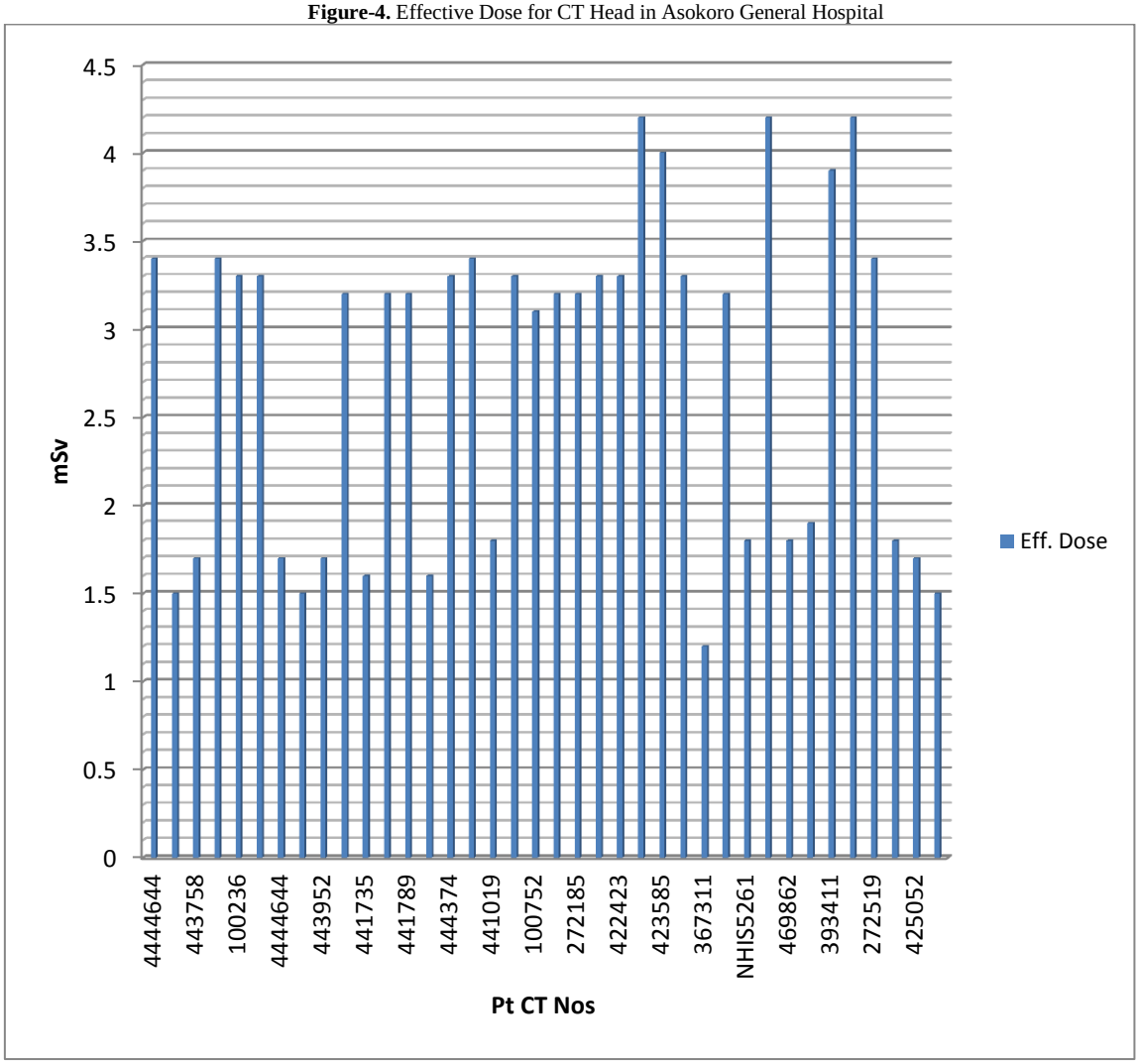

Fig. 4 shows a result from Asokoro General Hospital. The calculated effective doses ranged from 1.2 to 4.2mSv as against 1-2mSv Reference Effective Dose range. The highest values came from examinations with contrast medium, high mAS and kVp. That is CT examination numbers of 414222 =4.2mSv, EC94976 =4.2mSv and 41523 = 4.2mSv. The Mean value from this examination is 2.8mSv, which is more than the Mean Reference Effective Dose (mean RED) of 1.5mSv.

For Zankli Hospital, the 42 cases had a mean value of 5.1mSv.

4. Data Analysis

The mean effective dose from the study is 3.8mSv, with Abuja Clinics recording the lowest at 1.8mSv and Lifebridge Diagnostic Centre recording the highest at 6.8mSv.

Apart from Abuja Clinics, the rest of the centres will have to put in place measures to reduce radiation doses in CT Head [5].

5. Conclusion

The mean effective doses of the different examinations are higher than the Mean Reference Effective Doses recommended by international regulatory authorities [6, 7].

There is an urgent need for the Centres to start implementing the CT dose reduction measures [5], to bring the CT effective doses of the different examinations to the acceptable levels.

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