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RADIATION EXPOSURE FROM DIFFERENT TELEVISION SCREEN TYPES SOLD IN MINNA, NIGERIA

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ABSTRACT
In this study, x-ray dose rate levels from 14 different models/brands of television (TV) Screens commonly sold in Minna town were measured. The TVs were divided into two groups (flat and curved screen) with the aim of comparing dose rates from the two screen models of equal Screen sizes. The dose rate for each of the different TVs was measured with the aid of a low level radiation monitor (Digilert Nuclear Radiation Monitor; S.E. International, Inc, USA) placed at 5cm and 10cm from the screen. The total radiation count from the screens was measured for 3600s and converted to dose rate (mR/hr). The radiation dose rates from TVs with flat screen ranged from 0.094mR/hr to 0.289mR/hr, while for the Curved Screen it ranged from 0.023mR/hr to 0.109mR/hr at 5cm and from 0.0016mR/hr to 0.026mR/hr for curved screen and 0.003 mR/hr to 0.075 mR/hr for flat screen at 10cm. Generally, for same model and screen size, the dose rates from TVs with flat screen were higher than that with curved screen. Although this work confirms the presence of low level radiation from TV screen, the dose rate obtained for all the 14 TVs considered were below the 0.5mR/hr recommended by the Food and Drug Administration of the U.S.

KEYWORDS: *Television screen, X-rays, Dose rate, Radiation detector*

INTRODUCTION
Ever since its invention, the television (TV) has been a medium of communicating and educating the people (society) about past or present events. Over the years it has moved from being just an educational electronic gadget but also to an entertaining one. The easy access with low price of subscription to many viable TV stations through Digital Satellite Antenna (DSTV, SAT, SPACE etc) has immensely contributed to the increase in television viewers in most developing countries like Nigeria in the last few years. In addition, the introduction of children programs and games on TVs in many parts of the world is another contributing factor to the increase in the number of television viewers which includes children. Consequently television can be found in many homes even in a developing country like Nigeria. Over the years the number of televisions found at Banks, restaurants, market stores, schools, industries and cinema has increased tremendously. This increase, can be attributed to the need and crave for information, entertainment and its ever relatively decreasing cost. The cost and size of television has reduced drastically due to the improvement in I.C. (Integrated Circuit) technology over the years. The design of television has been made into different sizes and brands for consumers to have the liberty to choose whichever suit their taste, thanks to modern day technology.

The display technology of a conventional television has been the phosphor coated Cathode Ray Tube (CRT). The modern day TV CRT comes in two shapes: the flat and the curve (bulge) screen style. The fundamental principle behind CRT displays is cathodoluminescence which occurs due to bombardment of the phosphor coated screen by controlled streams of high-energy electrons [1]. The sudden deceleration of fast moving electrons in this manner subsequently causes x-rays to be produced [2]. When an electron beam moving with energy that is dependent on the accelerating potential difference of the CRT, strikes the phosphor-coated screen, some of the energy is dissipated as heat and some

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transferred to the electrons of the phosphor atoms making them to move to higher quantum energy levels. While returning to their ground level state, they give up their excited energy inform of photons at frequencies predicted by quantum theory. Furthermore, when an incident beam of electrons is suddenly decelerated on impart with a target material like monitor screen, some of its kinetic energy is converted to electromagnetic energy which is propagated as photons (x-rays). The energy spectrum of these X-rays is determined by the accelerating voltage of the fast moving electrons [3]. With the increasing voltage, the amount of radiation (x-rays) increases, the wavelength at which these peaks are observed are characteristic of the target (characteristic radiation). X-rays in the continuous part of the spectrum are emitted from the target when the bombarding electrons from the cathode are slowed down upon hitting the target [4].

Unfortunately, it has been reported that ionizing radiation (x-rays) from TVs or cathode ray tubes could be hazardous to human health and the environment [5]. When a biological cell is exposed to ionizing radiation depending on the energy of the radiation; the radio sensitivity of the tissue and time of exposure, it could be damaged or killed. The destruction or death is due to the ionization, excitation dissociation of atoms or Deoxyribonucleic Acid (DNA) molecules in the cell [6]. The commonest types of such ionizing radiation induced illnesses are: Leukemia, cataract, miscarriage, fatigue, headache and chronic pain [6]. Children are more susceptible to harmful effect of radiation than the adults at the same dose level [7]. This is so, because of their cell proliferation and long life span expectancy, which also increases the probability of late (delayed) effect of radiation. Consequently there is need to quantify the radiation from TV screen. Such measurement will reveal if radiation from TV screens is within safe level, and remedial actions to be taken to reduce it to acceptable (safe) level suggested. This will protect the TV viewers from any possible radiation hazard without preventing them from the entertainment and comfort of their favourite TV programs.

This study attempts to evaluate the amount of radiation (x-rays) from different brand of TV screens commonly sold in Minna town, measure the dose rates from the various TV screens with the view to comparing them with the 0.5mR/hr recommended limit by the Food and Drug Administration in the U.S [8] and to compare the x-ray dose rate from TV with Flat Screen and those with Curved Screen of the same size. The objective of this study is to ascertain if any TV screen type and brand gives dose rate higher than this limit, and also to suggest dose reduction techniques for TV viewers.

MATERIALS AND METHODS

In order to ascertain the types and sizes of Colour TV that are commonly used (or sold) in Minna town, a preliminary survey was carried out. The survey was conducted by visiting homes and major TV sales outlet randomly selected across the town to take statistics of the various TVs available for sales or being used. At the end of the survey, the fourteen TVs considered in this work accounted for more than 90% of the ones used in and around Minna town. These TVs were then collected, verified to be in good operating condition before taking radiation exposure measurement emanating from their screens. A Geiger Mueller tube based radiation monitor (dosimeter) (Digilert Nuclear Radiation Monitor; S.E. International, Inc, USA) was used to measure radiation exposure from the television screens. The dosimeter is exclusively designed to serve as a low level radiation detector (survey meter), capable of measuring gamma dose rates in the range 0 – 20mR/hr. These features make this dosimeter an ideal choice for the measurement of low level X-radiation from TV screen. It was calibrated with a Cesium – 137 gamma source. The dosimeter was positioned at 5cm [8] and 10cm from the centre of the screen and total radiation count for 3600 seconds was obtained for each of the model and sizes of the TV. The procedure was repeated twelve times so as to obtain a very good average.

The background radiation was obtained with each of the systems switched off and each background radiation was deducted from total radiation obtained in order to obtain the actual value for each case.

RESULT AND DISCUSSION

The result obtained after converting the average total count to dose rate in mR/hr is shown in table 1 for all the TVs included in this study.

For all the TVs considered in this work, the dose rates from Flat Screen CRT are generally higher than those obtained for the curved screen. For the Flat Screen Model, the minimum dose rate obtained (0.09mR/hr) was from Samsung 15" and LG 21" (0.09mR/hr), while the maximum dose rate (0.29mR/hr) was obtained for Sony 25". For the curve, the minimum dose rate obtained (0.02mR/hr) was from Samsung 15", while the maximum dose rate (0.11mR/hr) was obtained for LG 14".

Among TVs of the same screen size, only two sizes are represented; 15" and 21". For 15" screen, only Sharp and Samsung brand were considered. Sharp TV gave higher dose rate compared to Samsung for both Flat and Curve Screen. The dose rate from Sharp curve screen is about 3 times that of Samsung both of 15", while for Flat screen it's about 1.4 of that of Samsung. Also for 21", Sharp and LG product were included in this work. Again, sharp gave higher dose rate compared to LG for both flat and curved screen. The dose rate of Sharp 15" curve screen is approximately double that of LG, while for the Flat screen the dose rates are comparable.

The variation in the radiation dose rate from screen models from different manufacturers even at same screen size could be due to the different target materials used in accelerating the electron beam by the different manufacturers to achieve a brighter image on the screen. If all TV model of same screen shape operate at the same voltage, and use same phosphor material on the target screen, they would likely have equal dose rates. Also as the distance of the detector from the screens is doubled, the dose rate reduced drastically (table1). This is in agreement with the findings of previous study on computer screen which produces image based on same principle as the TV screen [5].

Table 1: *Radiation Dose Rate (mdr) ± Standard Deviation (sd) at 5cm and 10cm from different TV screen types*

Tv Manufacturer	Screen Type	Sizes (inch)	mdr ± s.d (mR/hr) at 5 cm	Mdr ± s.d (mR/hr) at 10 cm
LG	CURVED	14''	0.11 ± 0.05	0.026± 0.002
LG	FLAT	14''	0.17 ± 0.07	0.045±0.003
SHARP	CURVED	21''	0.06 ± 0.02	0.016±0.003
SHARP	FLAT	21''	0.11 ± 0.08	0.027±0.001
SAMSUNG	CURVED	32''	0.05 ± 0.01	0.014±0.002
SAMSUNG	FLAT	32''	0.09 ± 0.03	0.025±0.004
SONY	CURVED	25''	0.09 ± 0.03	0.023±0.003
SONY	FLAT	25''	0.29 ± 0.03	0.075±0.004
SHARP	CURVED	15''	0.06 ± 0.02	0.017±0.002
SHARP	FLAT	15''	0.13 ± 0.03	0.035±0.001
LG	CURVED	21''	0.03 ± 0.01	0.007±0.002
LG	FLAT	21''	0.09 ± 0.02	0.022±0.003
SAMSUNG	CURVED	15''	0.02 ± 0.01	0.005±0.002
SAMSUNG	FLAT	15''	0.09 ± 0.03	0.003±0.003

The higher dose rate observed generally for all flat screens when compared to curve ones of equal size could be attributed to the difference in thickness / width of the screen used in the different models of the TVs. the screen of the curved screen TV is thicker than the screen of all flat screen TVs thus more x-rays are absorbed for the same operating voltage when compared to the thinner flat screen.

CONCLUSION AND RECOMMENDATION

In this work, fourteen (14) TVs were investigated for x-rays at 5cm and 10cm away from the TV screens. The dose rates of x-rays from the screens of the investigated TVs ranges from 0.02mR/hr to 0.29mR/hr at 5cm and 0.0016mR/hr to 0.075 mR/hr at 10cm. Among all the TVs measured, Sony 25" flat screen has the highest dose rate and Samsung 15" curve screen has the lowest dose. Generally the dose rates obtained for the TVs in this study were low when compared to the 0.5mR/hr limit at 5cm recommended by the Food and Drug Administration in the U.S. [8]. It can be concluded that flat screen present more radiation when compared with the curved screen.

Although dose rate obtained in this work is very low it is still necessary that adequate care be taken to reduce exposure to as low as reasonably achievable. Since children are more susceptible to the harmful effects of ionising radiation than adults, further care should be taken to reduce their exposure. Exposure to low level of radiation from TVs could be achieved using the three cardinal principles of radiation protection i.e. distance, time and shielding. Maximum possible distance should be maintained between viewer and TV, time spent in front of TV screen should be reduced especially for kids and manufacturer should be encouraged to use thicker secondary glass for TV screen.

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