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Original Research Article

Study on awareness of e-waste management among medical students

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ABSTRACT

Background: Economic growth seen in the past 25 years with changes in Information Technology and the concurrent rapid electronic product obsolescence has generated massive amounts of electronic waste (or e-waste), creating a general waste management issue, due to the presence of many hazardous chemicals in electronic products, with a potential to severely compromise human health and environment. The purpose of this study is to describe awareness regarding the existence, hazards and management of e-waste among medical students and to measure effect of health educational intervention.
Methods: An interventional cross-sectional study was carried out from May to June, 2016 among II MBBS students, Kurnool Medical College, Kurnool, Andhra Pradesh. A predesigned questionnaire was administered as pretest followed by health educational intervention session to 100 study subjects selected by simple random sampling and a post test two weeks later. Data was entered in MS Excel 2007 and analyzed. Chisquare test was applied and p value < 0.05 considered significant.
Results: Out of 100 study subjects, 4 did not participate in the post test. So, a total of 96 questionnaires were considered for analysis. 56.25% of the students were males and 43.75% were females. Their main source of information regarding e-waste management was internet (30.2%) followed by family & friends (16.6%). There was a statistically significant gain in knowledge regarding e-waste management among the study subjects after the educational intervention at $p<0.05$.
Conclusions: Health education to create awareness regarding the hazards and management of e-waste is the need of the hour to reduce, reuse and recycle e-waste.

Keywords: Electronics, E-waste, Medical students

INTRODUCTION

Electronic waste or e-waste is one of the fastest growing types of waste. Used electronics which are destined for reuse, resale, salvage, recycling or disposal are also considered e-waste. E-waste may be described as waste electrical and electronic equipment (WEEE), in whole or in part from their manufacturing and repair process, which are intended for disposal.[1] Informal processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution. Many old electronic goods gather dust in storage waiting to be reused, recycled or thrown away. The US Environmental Protection Agency (EPA) estimates that as much as three quarters of the computers sold in the US are stockpiled in garages and closets. When thrown away, they end up in landfills or incinerators or, more recently, are exported to Asia.[2]

Over the past two decades, the global market of electrical and electronic equipment (EEE) continues to grow exponentially with consistent advent of new designs, "smart" functions and technology, while the life span of those products becomes shorter. Rapid changes in technology, falling prices, and planned obsolescence have resulted in a fast-growing surplus of electronic waste

around the globe. A global review of e-waste management indicates that generally waste production is on the rise mainly in the realm of Information Technology (IT) and communications equipment.[3]

India's dramatic economic growth has largely promoted the domestic market for a variety of electronics, most notably mobile phones, personal computers, televisions, refrigerators, and washing machines. However, most consumers do not know about proper disposal of the older versions of the product once they go for the latest updated versions. It is estimated that 75% of old electronic items are stored due to uncertainty of how to manage their disposal. Thus, unused electronics lie unattended in homes, offices, and warehouses until they are eventually mixed up with regular waste and dumped in landfills. Several studies indicate that the annual rate of e-waste production will reach 0.7 million metric tons by 2015 and 2.0 million metric tons by 2025. [4]

Electrical waste contains hazardous but also valuable and scarce materials. Up to 60 elements can be found in complex electronics. [5] E-waste contains toxic substances like Lead, Mercury, Cadmium and Polycyclic Aromatic Hydrocarbons (PAH) that have an adverse impact on human health and the environment if not handled properly. [6]

India has also become a hotspot for e-waste dumping by developed countries, where environmental and health regulations increase the cost of recycling and processing. The US is the only developed country that has not signed the UN Basel Convention, which prohibits the export of hazardous waste to developing countries. [7]Dishonest organizations from developed countries will use donations of obsolete electronics as a loophole in the Basel Convention to export both functioning and nonfunctioning equipment to countries like India.[3]

Effective management of e-waste is not just a legal necessity but also a major social responsibility. There is a lack of awareness among the general population, lack of government regulatory policy and negligence from producers.[8]Many are unaware of the potential negative impact of the rapidly increasing e-waste. [9]Through a great deal of advocacy and pressure from civil society, the Indian government enacted the E-Waste (Management and Handling) Rules in 2011 and began enforcement in May 2012. This was the first bill that directly addressed the issue of e -waste ("Implementation of E-Waste Rules, 2011"), and essentially required producers, collection centers, dismantlers, and recyclers to comply with WEEE policies. A major component of the 2011 legislation is the Extended Producer's Responsibility (EPR), which placed the responsibility of environmentally sound management of end-of-life products on the manufacturer of the electronic consumer goods.[1]

Awareness regarding e-waste management among general public is essential. Use of electronic devices has increased among medical students due to the convenience and speed of accessing medical literature and keeping abreast with the latest modalities of prevention and cure. Being responsible global citizens, medical students can play a major role in proper e-waste management. While buying electronic products, opting for energy efficient ones, designed for easy upgrading or disassembly and made of fewer toxic constituents would go a long way in reducing e-waste generation. Research on awareness regarding effective ways of e-waste handling among medical professionals after WEEE policy implementation in India is limited. Therefore, the current study aims to assess the awareness of medical students regarding e-waste hazards and management before and after health educational intervention session.

METHODS

An interventional cross-sectional study was carried out from May to June, 2016 among II MBBS students, Kurnool Medical College, Kurnool, Andhra Pradesh. Institutional ethical committee clearance was obtained. The batch of II MBBS students of strength of 200 assembled in the lecture gallery and 100 students were selected by simple random sampling after explaining the scope of the study. Informed consent was obtained and predesigned pretested questionnaire was administered as pretest.

Description of the study tool:

- Part i - personal identification details
- Part ii - source of information on e-waste, usage of electronic gadgets
- Part iii - awareness on e-waste hazards, management, recycling hotspots and legislations

This was followed by a health educational intervention session lasting for one hour. A power-point presentation was used to impart knowledge on e-waste management. Two weeks later, a post test was held using the same questionnaire among the same study subjects. After checking for completeness of data, the responses were entered and subjected to descriptive and inferential statistical analysis in MS Excel 2007. Chisquare test was applied to test association between variables. McNemar Chi square test was applied to determine the effectiveness of the health education intervention on awareness among the study subjects. p value $\leq$ 0.05 was considered statistically significant. Of the 100 study subjects, 4 did not participate in the post test. So a total of 96 questionnaires were considered for analysis.

RESULTS

The study sample (n= 96) consisted of 42 (43.75%) female & 54 (56.25%) male students (Table 1). Their average age was 20.5 years. The main source of information regarding e-waste management was internet (30.2%) followed by friends and family (16.6%) (Table

2). Majority of the respondents indicated a desire for new technology as their primary motivation to purchase new electronic products (Table 3). 31.25% of the respondents had purchased mobiles once and 35.41% twice during the last ten years. 62.5% of the study subjects responded that of the mobiles purchased during the last ten years, one was functional and currently being used.

Table 1: Distribution of study subjects.

Gender	Frequency	Percentage (%)
Male	54	56.25
Female	42	43.75
Total	96	100

Table 2: Source of information regarding e-waste.

Source	Percentage
Friends and family	16.6
Internet	30.2
Television	10.4
Newspaper	13.5

83.34% of males and 97.62% of females considered unused electronics as a waste and 38.88% of boys and 30.95% of girls know about formal e-waste collection services which include the process of dismantling and recycling of e-waste. 81.48% of the boys and 88.1% of girls were aware of the hazards of e-waste and 11.11% of boys and 7.14% of girls have knowledge on e-waste government policy. Only 5.55% of boys and 4.76% of girls were aware of e-waste recycling hotspots. A statistically significant difference in awareness that unused electronics is considered a waste was found, at $p<0.05$, though there was no statistically significant difference in awareness about other aspects regarding e-waste management, among males and female students, in the pretest, as shown above (Table 4).

Table 3: Reason to purchase new gadgets by the study subjects.

Reason	Number (%)
Physical damage	9 (9.38)
Loss of function	19 (19.79)
Need for greater functionality	16 (16.67)
Desire for newer technology	44 (45.83)
Others	8 (8.33)
Total	96 (100)

Table 4: Gender difference in awareness regarding e-waste among study subjects in the pretest.

Variable	Response	Males (%)	Females (%)	Chi Square value, p value
Unused electronics is a Waste	Yes	45 (83.34)	41 (97.62)	$X^2=5.1668$, $p=0.023$
	No	9 (16.66)	1 (2.38)	
Collection services for e-waste	Yes	21 (38.88)	13 (30.95)	$X^2=0.6506$, $p=0.429$
	No	33 (61.12)	29 (69.05)	
E-waste causes health & environmental hazards.	Yes	44 (81.48)	37 (88.1)	$X^2=0.7839$, $p=0.3759$
	No	10 (18.52)	5 (11.9)	
Government policy regarding e-waste	Yes	6 (11.11)	3 (7.14)	$X^2=0.4379$, $p=0.508$
	No	48 (88.88)	39 (92.85)	
Aware of recycling hotspots	Yes	3 (5.55)	2 (4.76)	$X^2=0.0301$, $p=0.862$
	No	51 (94.44)	40 (95.23)	

Table 5: Awareness regarding e-waste among study subjects in the pretest and post-test.

Variable	Response	Pretest Number (%)	Posttest Number (%)	Chi Square value, p value
Unused electronics is a Waste	Yes	86 (89.58)	89(92.71)	$X^2=1.28$, $p>0.05$
	No	10(10.42)	7 (7.29.)	
Collection services for e-waste	Yes	34(35.42)	83(86.45)	$X^2=34.79$, $p<0.05$
	No	62(64.58)	13(13.55)	
E-waste causes health & environmental hazards.	Yes	81(84.37)	93(96.87)	$X^2=9$, $p<0.05$
	No	15(15.63)	3(3.13)	
Government policy regarding e-waste	Yes	9(9.3)	41(42.71)	$X^2=25.6$, $p<0.05$
	No	87(90.62)	55(57.29)	
Aware of recycling hotspots	Yes	5(5.2)	41(42.71)	$X^2=32.4$, $p<0.05$

A statistically significant difference between pre test and post test awareness was found at $p<0.05$.

The researchers attempted to determine the effectiveness of the health educational intervention on awareness regarding e-waste and its management among the study subjects, by comparing the pretest and post-test

responses, by applying the McNemar's Chi square test, with null hypothesis of marginal homogeneity stating that there was no effect of the intervention. The null hypothesis was rejected as there was a statistically significant difference between pre test and post test awareness regarding e-waste management among the study subjects after the educational intervention, at $p<0.05$ (Table 5).

DISCUSSION

This study brings out the lack of adequate knowledge about e-waste and its proper management among the study subjects and the need to address this issue. In the present study, 55.55% of males and 54.76% of females considered unused electronics as a waste. 90.74% of boys and 80.95% of girls knew about formal e-waste collection services while in Anuj Shah's study, 37% of public knew about formal services. 83.33% of the boys and 85.71% of girls were aware of the hazards of e-waste and 11.11% of boys and 7.14% of girls had knowledge on e-waste government policy. 35% of public have awareness on e-waste hazards and only 11% have knowledge on legislation regarding e-waste in Anuj Shah's study in Gujarat on awareness on e-waste among public.[10]

A statistically significant difference in awareness that unused electronics is considered a waste was found, at $p<0.05$, though there was no statistically significant difference in awareness about other aspects regarding e-waste management, among males and female students, in the pretest. Since pretest awareness about "unused electronics considered a waste" was high, no statistical significance in comparison with the post test response was found, while a statistically significant gain in knowledge about other aspects was found in the post test. In a study by Sindhu Bala, there was no significant difference in the awareness regarding existence of e-waste in college going students of professional and non-professional streams while a statistically significant difference in the awareness regarding dangers of e-waste among them was found, with those from the professional stream having a greater awareness.[11]

Given the Public Health scenario of growing e-waste in developing countries like India, it is important that all health care providers have proper knowledge of handling e-waste in order to put it into practice, to protect self, the community and more importantly the environment from the hazards of mismanagement of e-waste. The findings of this study have implications for medical education, service, public health administration and research.

CONCLUSION

Knowledge retention has its limit and for knowledge to be transformed into practice, periodic reinforcement is essential. It equips health care providers with essential knowledge, attitude and skills for proper e-waste handling to protect the community. The key to success in terms of e-waste management is to develop eco-friendly devices, properly collect e-waste, recover and recycle material by safe methods, dispose of e-waste by suitable techniques, forbid transfer of used electronic devices to developing countries, and raise awareness of the impact of e-waste. Consumer awareness through public awareness campaigns is a means to have a new responsible kind of consumerism. Future efforts to minimize e-waste will include aggressive legislation and increased public awareness through health education on hazards and handling in appropriate ways, with the help of the available or newer technology for a safe environment.

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