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Workplace Fire Safety: Knowledge and Preparedness in a Public Tertiary Healthcare Facility in Abia State, South East Nigeria

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Keywords

Knowledge; Fire Safety; Healthcare Facility; Preparedness; Nigeria.

ABSTRACT

Background: Fire outbreak in a healthcare facility presents enormous challenge and a need for rapid response. The purpose of this study was to examine fire safety (FS) knowledge of workers and preparedness measures in Federal Medical Centre Umuahia, Nigeria.

Methods: This cross-sectional study involved 27 buildings and 310 employees from different units and departments, recruited by convenient non-probability sampling technique. A walk-through observational checklist and self-administered questionnaire were used to collect data which was analysed with SPSS software, version 20. Association between knowledge of FS and respondents' working experience and FS training was measured using x^2- test. P ≤0.05 was assumed to be statistically significant

Results: The highest proportion of participants were administrative staff 93 (30%), followed by medical doctors 80 (25.8%) and nurses 63 (20.3%). Only 28 (9.0%) had received training on FS, 109 (35.2%) knew how to operate a fire extinguisher, while 139 (41.9%) had knowledge of the location of fire extinguisher in their workplaces. Twenty-six (8.4%) knew the emergency number(s) to call if fire occurs. Only 107 (34.5%) of them had good knowledge of fire safety. Training on FS was significantly associated with knowledge of fire safety (p=0.026). All the buildings lacked necessary measures for FS.

Conclusion: FS knowledge and level of preparedness were unsatisfactory in the hospital, which may constitute serious threat to the safety of workers and patients. The hospital management should implement regular FS training programmes for the workers to improve their knowledge, as well as put in place other FS measures.

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INTRODUCTION

Fire safety constitutes all measures which are employed to prevent, detect and control fire in order to safeguard human life and property.[1] Prevention and mitigation of negative outcomes from fire outbreaks can be achieved through provision of equipment, infrastructure, policies and adequate knowledge on fire safety.[2]

Fire is an important resource to human existence. It is used for clearing land for agriculture, cooking, generating heat and electricity, incineration of waste, and sterilization of instruments. However, when fire becomes an inferno it causes damage to lives and property.

Three components: heat, fuel and oxygen are required to interact together to ignite fire.[2] Heat can be produced by open flames, overloaded or faulty electrical circuits, chemical reactions, and overheated equipment. Fuel on the other hand includes flammable and combustible materials like paper, beddings, furniture and flammable liquids.[3]

Hospitals are not immune to fire incidents because of the existence of flammable materials and liquids, medical gases, chemical agents and equipment that are used to provide health care to people. Similarly, wastes generated by hospitals have potential risk to cause fire outbreak if poorly handled.

Fire outbreaks in health care facilities have been reported in recent years, locally and internationally. These fire incidents have caused alarming damages to lives and property, and in most cases endangered human health.[4] For example, in 2013 about thirty-six people including medical staff were killed in a fire accident at a psychiatric hospital on the outskirts of Moscow and ten lost their lives in an orthopaedic hospital, Fukuoka, Japan.[2] Ninety-three persons including patients in wards and intensive care unit lost their lives during a fire outbreak in AMRI Hospital in Kolkata, India in 2011.[5] In Ghana, the operating theatre of Bongo district hospital was consumed by fire in 2013 and almost everything in the building was destroyed.[6] Fire outbreaks in hospitals have also been reported in Nigeria. In 2016, the accident and emergency ward of the University College Hospital, Ibadan was gutted by fire, destroying the multimillion naira building and equipment.[7] In the same year, fire outbreak occurred at the engineering section of Orthopaedic Hospital, Igbobi, Lagos and destroyed appliances and equipment valued at millions of naira.[8] In 2018, over fifty corpses were burnt beyond recognition due to fire outbreak that occurred in Enugwu Ukwu general

hospital's mortuary, in Anambra State.[9]

Human factors such as carelessness, negligence and lack of fire safety awareness are some of the leading causes of these fire outbreaks. The occurrence of these fire incidences and the resulting damages seem to show how unprepared many hospitals in Nigeria are in preventing and suppressing fire outbreaks. Reports indicate that many of the hospitals in Nigeria do not have fire preparedness plan nor fire simulation activities. Indeed, fire safety awareness and preparedness do not seem to be part of their organizational plan. For instance, a study among selected health institutions in Niger State showed that fire safety preparedness in the facilities was low.[4] Similarly, Ikpae et al[10] reported low awareness and training of fire safety parameters among healthcare providers in a specialist hospital in Port Harcourt. An effective fire prevention and suppression strategy is an essential feature of fire safety plan. It is important that every employer ensures that employees are trained and engaged in periodic drills on fire emergencies as these would likely make emergency response more effective.[11] If staff are properly trained, they can prevent fire hazards and respond appropriately to fire outbreaks.

Clearly, fire emergency in a health care facility presents enormous challenge and a need for special attention, and specialised response. Patients have special challenges that make them vulnerable in a fire outbreak. Within the hospital are children and elderly, those who are in post-operative or intensive care, those who are chronically ill and under the influence of various drugs. Furthermore, different departments and units in the hospital make use of expensive and complex equipment and devices for diagnosis and treatment. This emphasizes the importance of adequate fire safety measures in hospitals in order to secure lives of patients, staff and visitors, as well as properties; and to guarantee a safe environment for healthcare service delivery.

There is paucity of research on fire safety in health care facilities in South East Nigeria, and there is no

known documented study on fire safety knowledge and preparedness in a public health care facility in Abia State. The aim of the study was to assess the baseline fire safety knowledge of staff and level of preparedness in Federal Medical Centre, Umuahia so that improvements can be made where shortcomings are identified.

METHODOLOGY

This was a cross-sectional descriptive study conducted in Federal Medical Centre Umuahia (FMCU) between August and September, 2019. The hospital is a 405-bed facility that provides specialized and comprehensive healthcare services (using modern equipment), training and research. It has a current staff strength of about 1489, including team of doctors, nurses, pharmacists, laboratory scientists, radiographers, administrators and other auxiliary health workers. The facility has low-rise (bungalows, one and two-storey) buildings spread within its territory.

The entire staff who had worked in the hospital for at least six months and consented to participate in the study, as well as all non-residential buildings in the hospital premises were included in the study. Casual, temporal and intern staff, as well as buildings under construction or renovation were excluded from the study.

The sample size was calculated using the Cochran formula ($n=Z^2pq/d^2$) for prevalence studies.[12] The level of confidence (Z) and the desired degree of accuracy (d) for this study were 95% and 0.05 respectively. From a previous study[9], the proportion (p) of healthcare workers aware of emergency number to call in case of fire incident was 30%. Substituting, the calculated sample size was 322. When adjusted for a population of 1489 (less than 10,000) and non-response rate of 10%, the final sample size for the study was 298.

Convenient non-probability sampling technique was used to recruit members of staff in different work stations (clinics, wards, units and departments) of the hospital. All eligible workers met in their duty posts and who consented to participate in the study were recruited and interviewed. This was done for ten consecutive working

days until 310 participants were recruited for the study. In addition, 27 out of 29 eligible buildings were studied.

The study used both primary quantitative and qualitative methods. The quantitative data was collected by means of a self-administered questionnaire to assess fire safety knowledge of participants, while a personal observational checklist assessed the hospital buildings and safety measures put in place to prevent or respond to fire outbreak. These were developed based on information obtained from literature [4,10,11] and personal conversations with FS experts. The researchers and five research assistants (RAs) administered the questionnaires and went round the facility buildings to observe all items of the checklist. The filled questionnaires and checklists were collected daily and stored by the principal investigator for quality control. The duration of data collection was fifteen working days.

The questionnaire had two sections: Section 1 - the personal and general questions such as age, sex, education, designation and duration of employment, fire safety training and use of fire extinguisher. Section 2 - the knowledge section which had 14 items, each designed to assess the participant's knowledge on fire safety. The knowledge items included: do you know fire emergency number(s) to call in case of fire outbreak, the first thing to do if fire occurs at your workplace is to raise alarm, do you know how to use a fire extinguisher, do you know the location of fire extinguishers in your workplace/unit, there are at least four types of fire extinguishers used for different classes of fire, and signage is a type of fire safety measure. This section had three answer options: 'Yes', 'No' and 'Not sure'. 'Yes' denoted correct answer, while 'No' and 'Not sure' denoted incorrect answers. Each correct answer was scored 1point, and each incorrect answer scored 0 point. Knowledge score of 0- 6 was ranked “Poor”, while 7-14 was rated “Good”. This knowledge cut off scores were modifications of other studies with similar research focus.[4,13]

The checklist had eight basic items to assess safety measures put in the hospital buildings to prevent and

respond to any fire incident. In this study the measures used to assess FS preparedness in the hospital included fire exit route/door, exit route clearly marked with "EXIT" sign or "running man" symbol, provision of directional signs, availability of fire alarm system, provision of firefighting equipment, fire precaution notices/posters clearly displayed, availability of emergency number to call in case of fire outbreak, workplace kept clear of rubbish and combustible materials. Each item had 'Yes' (if provided) and 'No' (if not provided) options. 'Yes' was given a score of 1, while 'No' was given a score of 0. Eight is the highest score and highest level of preparedness, while zero indicates no preparedness. Total score of less than 8 (<100%) was rated unsatisfactory level of fire safety preparedness, while score of 8 (100%) indicated satisfactory level of preparedness. These ratings were decided on after the authors sought the views of some FS experts in the State, and after a review of a similar study in the country.[4]

Analysis of data obtained was carried out using SPSS version 20. Descriptive statistics was used to describe the socio-demographic characteristics of respondents, and presented in tables and charts. Associations between overall knowledge of FS and work experience and FS training were measured using Chi square test. P-value of ≤0.05 was assumed to be statistically significant.

Ethical clearance (FMC/QEH/G.596 /Vol.10/404) was obtained from the Ethics Committee of Federal Medical Centre, Umuahia. Participation in this study was voluntary and informed consent was obtained from each participant before enrolment into the study. Respect and dignity of participants were observed throughout the study period. The purpose of the study was clearly explained to them before recruitment. Furthermore, confidentiality of personal information was ensured as number codes rather than names were used on the data collection instruments. Also there was no known risk associated with the study and participants were free to discontinue from the study without facing any consequences. The questionnaire was short and required less than ten minutes to fill.

Table 1: Socio-demographic characteristics of Respondents

Parameter	Frequency (n=310)	Percent
Age (years)		
<20	3	1.0
20-29	110	35.5
30-39	143	46.1
40+	54	17.4
Mean age (31.07±8.62)		
Sex		
Male	118	38.1
Female	192	61.9
Educational level		
Primary	3	1.0
Secondary	10	3.2
Post-secondary	297	95.8
Job designation		
Doctor	80	25.8
Nurse	63	20.3
Pharmacist	12	3.9
Lab Scientist	7	2.3
Administrative staff	93	30.0
Other auxiliary staff	55	17.7
Work experience (years)		
0-4	91	29.3
5-9	83	26.8
10+	136	43.9

RESULTS

This section shows the findings of the study after analysis of the questionnaires and observational checklist. A total of 310 participants were interviewed, and 27 out of 29 eligible buildings were observed.

One hundred and forty-three (46.1%) of the respondents were between the age of 30 and 39 years, with a mean age of. 31.07±8.62 years. Among the participants, 118 (38.1%) were males and 192 (61.9%) females. Most 297 (95.8%) had post-secondary education. The administrative staff constituted the highest proportion of the participants 93 (30.0%), followed by medical doctors 80 (25.8%) and nurses 63 (20.3%). More than one-third of the respondents 136 (43.9%) had worked in the hospital for at least ten years. (Table 1)

Table 2: Respondents' knowledge on Fire Safety

Knowledge variable	Yes n (%)	No n (%)	Not Sure n (%)
Do you know fire emergency number(s) to call in case of fire outbreak?	26 (8.4)	276 (89.0)	8 (2.6)
The first thing to do if fire occurs at your workplace is to raise alarm (Yes)*	216 (69.7)	70 (22.6)	24 (7.7)
The very first thing you do when you hear a fire alarm is to escape (Yes)*	196 (63.3)	108 (34.8)	6 (1.9)
Do you know how to use a fire extinguisher?	109 (35.2)	165 (53.2)	36 (11.6)
Do you know the location of fire extinguisher in your work station?	130 (41.9)	154 (49.7)	26 (8.4)
There are at least four major types of fire extinguishers used for different classes of fire (Yes)*	48 (15.5)	210 (67.7)	52 (16.8)
Foam containing fire extinguisher is NOT meant for electric fire (Yes)*	80 (25.8)	202 (65.2)	28 (9.0)
Dry chemical powder fire extinguisher can be used for A, B, C classes of fire (Yes)*	100 (32.3)	190 (61.3)	20 (6.4)
Signage is type of fire safety measure (Yes)*	98 (31.6)	168 (54.2)	44 (14.2)
The best way to exit a building when there is heavy smoke is to crawl on your hands and knees (Yes)*	132 (42.6)	114 (36.8)	64 (20.6)
The main cause of death in a fire outbreak is smoke and suffocation (Yes)*	220 (71.0)	70 (22.6)	20 (6.4)
In event of fire in a high rise building, the staircase is the best route of escape (Yes)*	144 (46.5)	126 (40.6)	40 (12.9)
A,B,C,D,K are the five classes of fire (Yes)*	80 (25.8)	194 (62.6)	36 (11.6)
Simple direction for using a fire extinguisher is Pull, Aim, Squeeze, Sweep (P.A.S.S) (Yes)*	99 (31.9)	179 (57.8)	32 (10.3)

*n=310 (*Correct answer)*

Those who had received training on fire safety, and on how to operate a fire extinguisher were 28 (9.0%) and 21 (6.8%) respectively. Response with respect to participants' knowledge on FS is shown in Table

2. Only 26 (8.4%) knew emergency number(s) to call in case of fire outbreak. Majority 216 (69.7%) and 196 (63.3%) had correct knowledge of the first thing to do when fire occurs and when they hear the sound of fire alarm respectively. Only 109 (35.2%) knew how to use a fire extinguisher. Less than half, 130 (41.9%) had correct knowledge of the location of fire extinguisher in their workplace/unit.

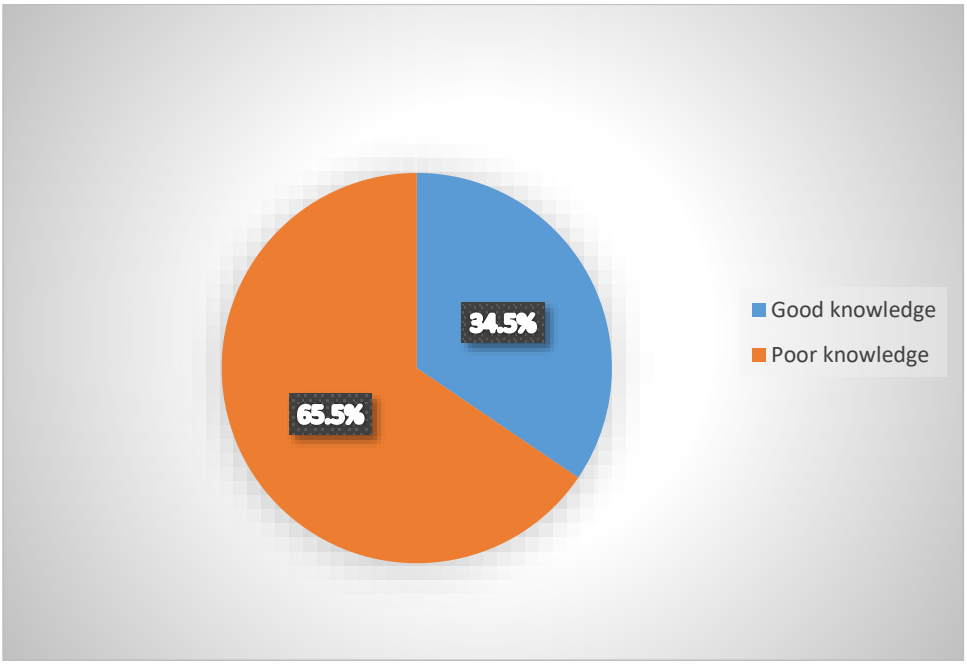

Figure 1: Respondents' knowledge score on fire safety

Table 3: Association between Fire safety knowledge and respondents' characteristics

Variable	Fire safety knowledge		x^2	p-value
	Poor (n=203)	Good (n=107)		
Training on FS				
Yes	13 (46.4%)	15 (53.6%)	4.945	0.026
No	190 (67.4%)	92 (32.6%)		
Work experience (Years)				
0-4	56 (61.5%)	35 (38.5%)	1.519	0.468
5-9	53 (63.9%)	30 (36.1%)		
10+	94 (69.1%)	42 (30.9%)		

Table 4: Proportion of buildings with FS measures

FS Measures	Frequency (n=27)	Percent
Fire exit route available	27	100.0
Workplace clear of rubbish and combustibles	21	77.8
Firefighting equipment e.g. fire extinguisher provided	11	40.7
Exit route clearly marked with "EXIT" sign	1	3.7
Directional sign to exit route provided	0	0.0
Fire precaution notices/posters clearly displayed	0	0.0
Fire alarm system available	0	0.0
Availability of emergency number to call in case of fire incident	0	0.0

Figure 1 shows the fire safety knowledge score of the respondents. One hundred and seven (34.5%) had 7 and above scores on the knowledge rating scale, representing the proportion with good knowledge on fire safety measures.

Training on fire safety was significantly associated with knowledge on fire safety. Fifteen (53.6%) of those who had received FS training had good knowledge of fire safety compared with 92 (32.6%) who had not been trained, $x^2=4.945$, df=1, p=0.026. On the other hand, there was no significant association between years of work experience and knowledge of fire safety. Participants with 0-4 years work experience 35 (38.5%) had good knowledge of FS compared with 42 (30.9%) who had worked for 10 years and above, $x^2=1.519$, df=2, p=0.468. (Table 3).

All the buildings were provided with exit routes, but only one building (3.70%) had exit route clearly marked with "EXIT" sign, and none had directional sign to exit route. Eleven (40.74%) buildings were provided with firefighting equipment (fire extinguisher), and 21 (77.78%) were clear of rubbish and combustibles. However, none of the buildings had fire alarm system, clearly displayed fire precaution notices/posters, or emergency number to call in case of fire incident (Table 4).

DISCUSSION

This study examined the baseline FS knowledge of staff and preparedness in Federal Medical Centre Umuahia, Nigeria. Our study shows that only 9.0% and 6.8% respectively had received training on fire safety and on the use of fire extinguishers. This demonstrates that the hospital does

not include fire safety training as part of its safety plan. In fact, we observed that the hospital does not have fire management plan/policy. Rohini et al[11] noted that if employees are trained and engaged in regular fire drills, they would likely be more effective to respond to fire emergencies. Similar finding was reported among staff of a specialist hospital in Port Harcourt, only 12.1% of them had ever received training on fire safety prepared-ness.[10] On the other hand, a study done in India among workers in a teaching hospital shows that 54% and 49% respectively had received training in their workplace on fire safety and on the use of fire extinguisher.[11]

About 64.8% of the respondents did not have the knowledge of how to operate a fire extinguisher. Fire extinguisher is one of the basic and commonly available tools used in firefighting. This finding may be attributed to absence of FS training and drills programmes in the facility. This implies that the workers lack capacity to respond to fire outbreaks. In contrast, a study on selected health institutions in Niger state[4] shows that 73.3% of staff of the hospitals surveyed had the knowledge of the use of available fire extinguishers. The availability of copies of fire disaster management plan and schedule on fire safety training/drills for the employees in some of the health institutions studied may have accounted for this difference.

Less than half (41.9%) of the respondents were aware of the location of fire extinguisher in their workplaces. This finding may not be unrelated to the few number of fire extinguishers provided in the hospital. Only 40.7% of the buildings in the hospital were provided with fire extinguishers. In our study, 91.6% of staff did not know the emergency number to call in case of fire outbreak in the workplace. Similarly, a study in Kenya[14] reported that 72% of the staff in medical training college did not know the emergency telephone numbers to report fire outbreak. Absence or delayed transmission of information in an event of fire accident could worsen the impact of the inferno.

Fire safety knowledge was found to be poor among the staff. This suggests a great need for organized

training on fire safety in the hospital. Our study demonstrated significant association between FS training and knowledge. A higher proportion of those who had been trained had good knowledge compared to those who were not trained. Lee et al showed that an on-line fire safety training improved health care workers' knowledge of fire prevention and evacuation.[15] On the other hand, there was no significant association between work experience and FS knowledge. This is in agreement with the findings of Ikpae et al.[10] Something common about the two study centres is that training and retraining of FS for workers were not given priority.

Analysis of the buildings revealed that almost all lacked the necessary measures for fire safety. For instance, only 3.7% and 40.7% had "EXIT" sign clearly marked on the exit route and fire extinguisher provided, respectively. Some of the multi-storeyed buildings just had fire extinguisher provided in one floor. It is recommended that firefighting equipment should be located within 10 metres from the user's desk or station for easy accessibility, otherwise it becomes unreliable in the time of emergency.[16] Furthermore, other measures like emergency number to call in case of fire outbreak, directional signs to exit routes, fire precaution notices/ posters and fire alarm system were lacking in all the buildings surveyed. Thus with significant numbers of staff, patients and visitors in all the buildings, any event of fire accident may result to huge damage to lives and properties. Other studies conducted in different cities have reported similar results.[4,13,17] This implies that a common problem exists in all the mentioned workplaces, and is not receiving adequate attention.

The study is not without limitations. The results obtained may not be truly representative of the population due to the convenience sampling method used and the social desirability bias associated with self-reported interviews. The researchers however ensured that the sample interviewed was diverse. The questionnaires were also anonymous and the respondents were implored to be as truthful as possible.

Conclusion: Generally, the hospital's level of fire preparedness

was unsatisfactory. None of the buildings complied with FS measures as per the scoring criteria, and FS knowledge is poor. The implication of these findings is that the workers, patients and relatives/visitors are exposed to fire risks which would adversely affect their physical, social and psychological wellbeing and health, and healthcare delivery. Hence there is urgent need for a paradigm shift. The hospital should among other measures develop and implement FS policy/plan that would include adequate provision of firefighting equipment, signage and regular training programmes for the staff to improve their knowledge.

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Authors' contributions: AUU was responsible for manuscript conceptualization, research proposal writing, supervision of data collection, data analysis and interpretation. PUN participated in data collection and analysis. KCM was involved in study design process and manuscript writing. UUU participated in study design, data analysis and result interpretation. OCO assisted in data collection and analysis. CNE participated in manuscript writing. All the authors read and approved the final manuscript.

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