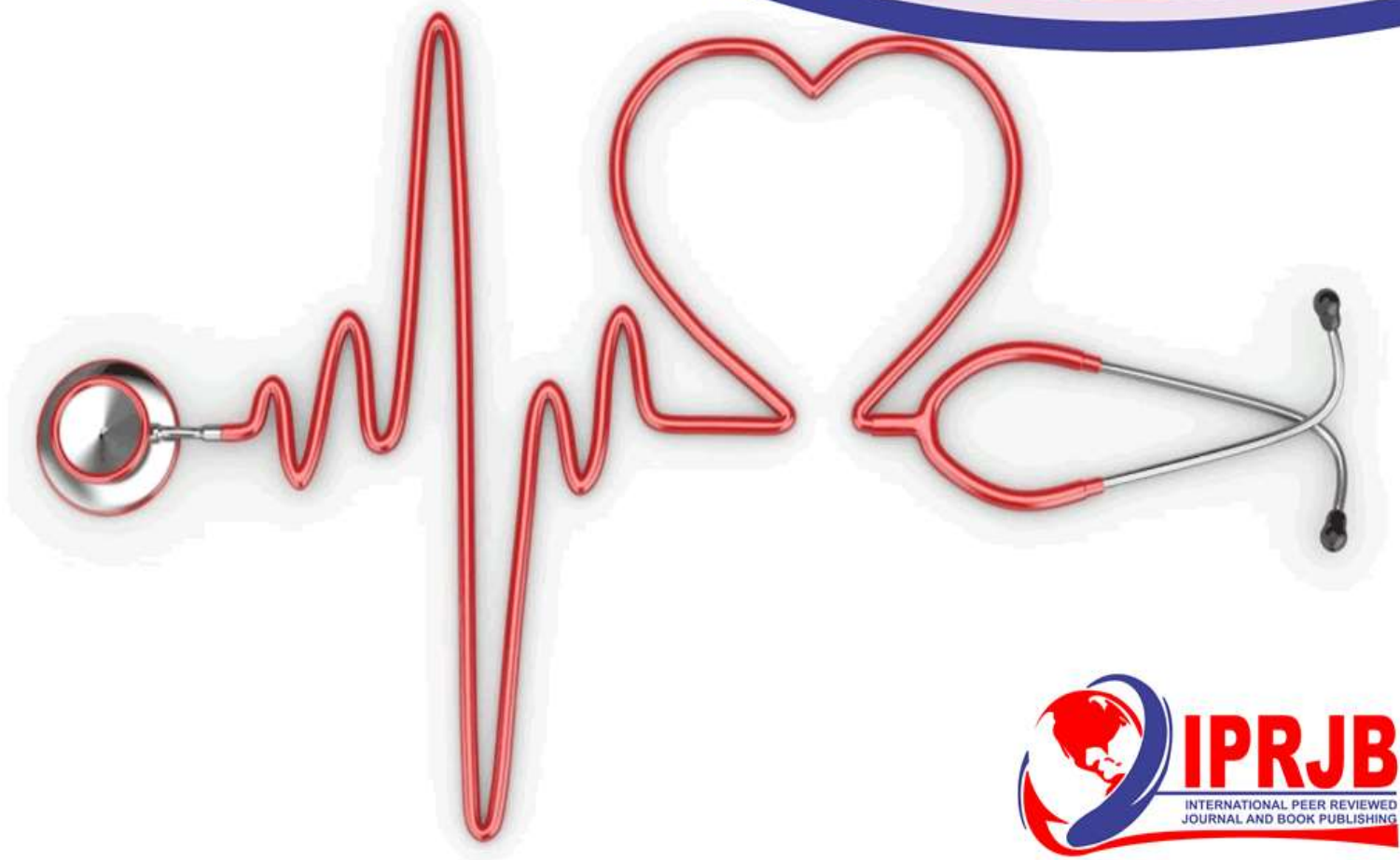


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Fire Emergency Preparedness among Healthcare Workers in Selected Hospitals in Botswana

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Abstract

Purpose: Insufficient safety protocols during the planning and operation of hospitals can lead to hazardous incidents. With multiple incidents occurring annually that frequently go undetected and result in fatalities and service disruptions, fire emergencies remain a significant risk in healthcare settings. This study assessed the level of fire emergency preparedness among healthcare workers in selected hospitals in Botswana.

Methodology: An analytical cross-sectional design was employed. Quantitative data were collected using semi-structured questionnaires and observation checklists, while qualitative data were collected through key informant interviews. The study sampled 359 healthcare workers and included seven Safety, Health, and Environment (SHE) officers from seven hospitals. Quantitative data were analyzed using SPSS version 26, with descriptive statistics, chi-square tests, and binary logistic regression; qualitative data were analyzed thematically.

Findings: Educational background and years of experience were significantly associated with fire preparedness. Healthcare workers with bachelor's degrees had 34.5% preparedness, while those with more than 15 years of experience had the highest preparedness at 52.9%. Only 18.5% had participated in fire drills and 34.3% had received fire safety training in the previous years. Only 40.5% knew how to properly use fire extinguishers, although 79.5% knew their location. Participation in fire safety training was the most significant indicator of individual preparedness ($\chi^2 = 121.104$, $p < 0.001$). Overall, 87.7% were unfamiliar with specific emergency roles, and only 27% demonstrated adequate fire emergency preparedness. Hospital preparedness varied from 47.2% to 100%.

Unique Contribution to Theory, Practice and Policy: The Emergency Management Preparedness Cycle guided the study, highlighting planning, training, equipping, drills, evaluation, and continuous improvement. The findings support competency-based fire safety training, clear emergency roles, regular drills, functional safety equipment, and stronger institutional communication. The Ministry of Health and relevant authorities should strengthen fire safety regulations, develop national hospital fire preparedness guidelines, provide adequate resources, and establish regular training, drills, and monitoring systems.

Keywords: Healthcare Workers, Hospital Fire Safety, Fire Emergency Preparedness, Emergency Response, Botswana

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INTRODUCTION

Hospitals are vulnerable to fire risks due to their high occupancy, constant operations, large mechanical and electrical systems and the presence of patients with restricted mobility. These factors make fire safety a concern in health care systems worldwide (Centers for Disease Control and Prevention [CDC], 2024; Occupational Safety and Health Administration [OSHA], 2025). Hospital fires still occur in developed countries despite strict fire safety regulations. According to the United States Fire Administration [USFA] (2020) and Spellman (2023), there are approximately 5,700 fires in healthcare facilities each year that result in injuries, fatalities, and serious service disruptions. The National Health Service of the United Kingdom reported 1,372 hospital fires in the period between years 2022 and 2023, showing an increasing trend associated with ongoing safety issues and deteriorating infrastructure (Hoey, 2024). These incidents indicate that even in well-resourced settings, hospital fire risks are still a concern.

In operational terms, this complexity directly challenges healthcare workers' response capacity because staff must recognize hazards, activate alarms, rapidly communicate, use appropriate firefighting equipment, and support evacuation while making sure to maintain patient safety. The risk is intensified by patients who need assistance to evacuate, including immobile, critically ill, peri-operative, oxygen dependent patients. Staff role clarity and practical evacuation competence are central to safe horizontal or vertical movement during a fire emergency.

Hospital fires are more frequent and have serious consequences in developing countries. In India, government hospital has recorded over half of hospital fires. These trends show how low-and middle-income countries are more vulnerable. Hospitals fires in Sub-Saharan Africa continue to expose gaps in response and preparedness. Over 700 patients had to be evacuated as a result of the 2021 fire at the Charlotte Maxeke Johannesburg Academic Hospital in South Africa, which damaged the hospital's infrastructure (Magome, 2021). Research from countries like Namibia and Tanzania indicates that healthcare workers lack proper fire safety training and preparedness (Johannes and Koray, 2024; Simon et al., 2022).

Despite recorded fire incidents in Botswana, there is limited data on hospital fire preparedness. Even in cases where training programs were put in place, research has shown notable gaps in healthcare workers awareness of fire safety and emergency preparedness (Meki, 2018). Understanding healthcare workers' level of preparedness is key for enhancing patient safety and ensuring the continuation of healthcare services, given the crucial role they play during fire emergencies. Therefore, this study assessed healthcare workers preparedness for fire emergencies in selected Botswana hospitals.

Statement of the Problem

Hospital fires continue to be a major global safety concern, putting patients, healthcare workers, and the continuation of essential health services at serious risk (Wu et al., 2025). Studies show that the hospital fire incidents have increased from the pre-COVID-19 era, reporting a two to threefold rise compared to pre-pandemic periods, and at least 280 people died in hospital fire in China, expanding the scope of this issue globally (Wu et al., 2025 and Liu et al., 2023). Hospital staff's lack of awareness of fire safety procedures increases these risks because unskilled workers are more likely to sustain injuries or fatalities during fire emergencies (Mankar, 2019). International safety organizations therefore emphasize that hospitals must put patient and staff safety first by offering regular training and updating emergency response

procedures (OSHA, 2007). These global pressures are especially consequential in resource-constrained health systems, where ageing infrastructure, electrical faults, limited emergency resources, and inconsistent staff training may compound fire risk. This provides a direct transition from the international evidence to the infrastructural vulnerabilities reported in Sub-Saharan Africa and specifically Botswana.

Electrical failures that remain the primary cause of hospital fires globally are frequently associated with electrical overloads and short circuits (Sharma et al., 2020). Three of every four hospital fire incidents in Botswana that were reported were attributed to electrical causes (Ministry of Health-Botswana, 2023/2024). One notable incident occurred in January 2024 when a fire forced the operating room at Nyangabwe Referral Hospital to be totally shuttered for renovation. The transfer of emergency surgery patients to Mahalapye District Hospital, which is roughly 237 kilometers far, put a great deal of burden on the receiving facility. The unexpected increase in patient volume disrupted scheduled surgical procedures, required reprioritization of clinical cases, and affected adversely the continuity of care for both hospitals.

These incidents highlight how crucial it is for healthcare workers to be prepared for fire emergencies. Healthcare workers with sufficient knowledge and awareness are better prepared to identify potential hazards, respond to incidents effectively, and contribute to the improvement of existing fire safety practices. Studies indicate that hospitals with established fire safety training and preparedness measures have less fire incidents (Salim et al., 2021). Despite this, there are still gaps in healthcare workers preparedness for fire emergencies, particularly in resource constrained settings. In order to safeguard lives, maintaining uninterrupted healthcare delivery, and strengthen hospital systems ability to withstand fire-related incidents, these gaps must be addressed. However, an operational gap remains; despite documented electrical anomalies and structural fire incidents in Botswana hospitals, it is still unclear whether healthcare workers possess the competencies, role awareness, drill experience, communication readiness and practical confidence required to execute safe horizontal or vertical evacuation when a fire occurs. In order to close that gap, this study assessed hospital initiatives and healthcare workers preparedness.

LITERATURE REVIEW

Sociodemographic Factors and Fire Safety Preparedness

For this study, the sociodemographic literature is interpreted primarily in relation to healthcare workers. Evidence concerning vulnerable patient groups is retained only as operational context, while the analytical emphasis is on whether healthcare worker age, gender, educational level, professional cadres, and length of service influence training retention, response confidence, and fire emergency preparedness.

Emergency preparedness is a critical component of safety in healthcare settings, where rapid and coordinated, action is required to minimize loss of life, property damage, and service disruptions. Research from developed countries shows that sociodemographic characteristics are significantly associated with variations in fire safety outcomes. In the United States, older adults (60+ years) face the highest mortality risk in fire emergencies, primarily due to mobility limitations, delayed reactions, and comorbidities (Runefors et al., 2021). In Sweden, fire incidents have been found to occur more frequently among sociodemographically dominant groups, particularly those with higher levels of education and income. In both high-income and low-income settings, these variations affect the level of preparedness among healthcare professionals and other groups.

Research in Taiwan indicates that older adults with lower mobility levels are more poorly prepared for evacuation, and in the event of a fire, older adults often make up the bulk of the casualties, as they take longer to respond to and may suffer more smoke inhalation from the event (Huang, 2022). These results show an interaction between age and social status and fire safety capacity. Elderly age, living alone, and low-income groups are more likely to experience the worse outcomes including evacuation delays and fire extinguishing challenges (Nilsson et al., 2020). These findings underscore the correlation between the ability to take part in fire safety, age, and social status. Studies conducted in Europe also reveal ambiguous results: while some suggest that men are better at feeling prepared to take action against fire and have higher fire risk perceptions, others indicate that women are more focused on fire risk and less confident in their response (Cvetković et al., 2021; Cuesta et al., 2022).

There are generally inconsistent but interesting patterns in the relationship between sociodemographic characteristics and knowledge and preparedness about fire in developing countries. A Nigerian study revealed no significant association among age, gender, and educational level to fire emergency preparedness (Ngwoke and Wahab, 2021) implying that sociodemographic factors are not significant enough to overwhelm the system factors which include inadequate training and unsafe infrastructure. However, research conducted in middle-income countries shows that sociodemographic characteristics such as educational level, marital status, gender, and work experience are significantly associated with fire emergency preparedness (Cvetković and Marković, 2021). Moreover, research shows that the poor health of the elderly (frailty and comorbidities) is a sociodemographic vulnerability that contributes to fire-related injuries and deaths (Akgün et al., 2022; Francis et al., 2024). The results of this study demonstrate that fire preparedness is a complex issue in developing countries, where structural constraints such as poor safety culture in the hospital and lack of fire equipment pose a challenge.

Research in Sub-Saharan Africa is still limited, but what is known suggests that sociodemographic factors are important in determining how prepared healthcare workers are for fire emergencies. The studies undertaken in Namibia show that there were significant gender differences; in the study male healthcare workers had significantly more adequate knowledge about fire safety than female healthcare workers (Johannes & Koray, 2024). Similar to Asian and European preparedness studies, education level and professional experience were also found to be important factors of preparedness. But there are a number of system problems which include resources shortages, inadequate hospital infrastructure and inconsistent training.

Evidence from Botswana show similar concerns, where studies among healthcare workers in Gaborone show persistent knowledge gaps in fire safety despite the existence of safety policies and some training (Meki, 2018). The patterns suggests that sociodemographic characteristics like education level, cadre, and years of service may influence preparedness, but these relationships have not been thoroughly studied in the Botswana healthcare context. Strengthening national fire safety plans requires adequate understanding of how demographic factors influence preparedness, given the increased complexity and budget restrictions faced by hospitals.

Accordingly, the Botswana evidence requires closer examination at healthcare worker level to determine whether preparedness varies systematically across professional and demographic groups, or whether institutional factors such as training, drills, communication systems and resource availability exert the stronger influence.

Hospital initiatives on Fire Safety and Healthcare Workers (HCWs)

Institutional Policy Frameworks and Organizational Arrangements

In order to improve response capabilities and lower the risk of fire in healthcare facilities, fire emergency management involves a continuous cycle of planning, organizing, training, equipping, exercising, evaluating and refining strategies (Kuligowski, 2021). In developed countries, persistent emphasis on preparedness has not eliminated the dangers posed by hospital fires; in the United States, inadequate preparedness in nursing homes contributed to increased fire incidence, with studies showing that staff and management were frequently ignorant of critical hazards (Festa, 2022). Even well-equipped systems heavily rely on staff competence. The risks associated with hospital fires have not been removed in developed countries despite emphasis on preparedness. This has been seen in situations where inappropriate staff behavior made fire outcomes worse, like as in India, when workers fleeing during a fire was blamed for over 89 patient deaths (Irwanto et al., 2021).

Training and Frequency/Structure of Fire Drills

Hospitals in developed countries include emergency management procedures, trained fire safety officers, and fire protection systems, such as alarms, early detection devices, and extinguishing equipment; however, research continues to show that training remains the primary determinant of effective response. Salim et al. (2021) emphasize the need for continuous training, particularly in high-risk areas like intensive care units and theatres; similarly, over 280 hospital fire deaths have been reported in China despite significant investment in fire safety (Liu et al., 2023). Preparedness is still uneven throughout Europe, for instance Poland does not have thorough staff capability assessments, which leads to a lack of understanding of the skills needed for the situation (Goniewicz, 2020). These results indicate that staff training, drills, and institutional preparedness are universally emphasized as essential hospital fire safety activities.

In Asia, healthcare workers are often not trained in responding to a fire, using fire extinguishers, and evacuating. Patients are especially vulnerable in such settings because of their high reliance on healthcare workers, and staff preparedness is important for life-saving evacuation, notes Sachdeva et al. (2022). The results indicate that during fire emergencies, staff competence plays a critical role in patient safety in China and India (Liu et al., 2023). Many hospitals in these areas are aware of the need for well-established and regular training initiatives, yet the lack of administrative and financial resources makes it difficult for many to make them a consistent reality (Mondal and Sinha, 2025).

The success of evacuation has been well documented to rely on staff involvement, teamwork, and preparedness education for disaster (Shirolkar et al., 2021). When it comes to evacuations, the number of staff on duty will have a significant influence on outcomes, with less staff on duty, the greater the delay and risk. Regular drills, strong coordination preparedness are essential components of hospital safety initiatives in African healthcare contexts (Raman & Sruti, 2024). Finances, aged facilities, equipment, and irregular fire drill schedules are some common issues affecting many healthcare systems around the world. Studies carried out in Nigeria show that there is a clear need for organized and required fire safety training, frequent fire evacuation exercises and effective communication of fire procedures to increase staff awareness and emergency response (Onyekwere et al., 2024). In spite of these requirements, many facilities in Sub-Saharan Africa report a lack of knowledge of the different types of fire

and how to extinguish them; they conduct very few or no routine fire simulations and maintenance of extinguishers is inadequate.

Access to and Maintenance of Firefighting Equipment and Emergency Resources

The Ministry of Health (MOH) highlight that the fire risk in clinical settings is constant and all healthcare workers should be provided with fire safety training (Ministry of Health, Botswana, 2024). Earlier research identified a lack of knowledge and practice, particularly regarding the appropriate use of fire extinguishers and actions required during fire emergency (Ministry of Health, Botswana, 2024; Mondal & Sinha, 2025). Healthcare providers are often not trained in fire safety matters such as the use of fire extinguishers, fire classification and evacuation procedures. This has raised some concern as the performance of staff is a critical determinant in protecting immobile or critically ill patients in hospitals in Botswana (Ministry of Health, Botswana, 2021). The results reveal that, although a great deal is being done in hospitals to prepare them for a fire, the current efforts are questioned as far as the elements of structuring the training, conducting regular drills and including hospitalization personnel are concerned. Knowing what training is available, accessible and quality, the number of fire drills conducted, the communication systems in place and the fire-fighting equipment in use is important because these are all key determinants of what hospitals in Botswana have done to prepare their health workers for fire safety.

Recent evidence suggests that, in many hospitals, structured fire safety training, regular fire drills, and employee involvement remain inadequate, indicating that the fire preparedness programmes currently in place may not be sufficiently effective. Given this development, it is very important to establish the specific programs that have been established in Botswana's hospitals to train health care workers for fire safety. Thus, it means everyone knows how much, how good, and how often they receive training; how well they are prepared to communicate; how well they have the firefighting equipment; how well they are trained with the proper knowledge and skills to respond to a fire emergency.

Overall, the literature shows that hospital fire preparedness is shaped by three connected institutional domains: clear policy and role structures, regular and practically oriented training/drills, and accessible, functional firefighting and evacuation resources. These domains, together with healthcare worker sociodemographic factors, inform the conceptual framework below.

Table 1: Summary of Variables Emerging from the Literature

Literature theme	Variables/indicators	Relevance to fire preparedness	Conceptual framework placement
Healthcare worker sociodemographic factors	Age, gender, education, professional cadre, length of service	May influence knowledge retention, exposure to training, confidence, and accumulated response experience	Independent variable
Institutional policy framework	Fire safety policies, OSH/fire-safety roles, reporting chains, emergency response plans, communication	Provides accountability, role clarity, coordination, and standardized response	Hospital initiatives
Training and fire drills	Training exposure and recency, drill participation, practical rehearsal	Builds knowledge, teamwork, procedural competence, and evacuation readiness	Hospital initiatives
Firefighting and evacuation resources	Extinguishers, evacuation routes, alarms, assembly points, equipment availability and maintenance	Supports rapid initial response and safe evacuation when resources are functional and familiar to staff	Hospital initiatives
Fire emergency preparedness	Knowledge, awareness, procedural familiarity, practical response readiness	Represents the healthcare worker outcome assessed in the study	Dependent variable

Conceptual Framework

Independent variables

Dependent Variable

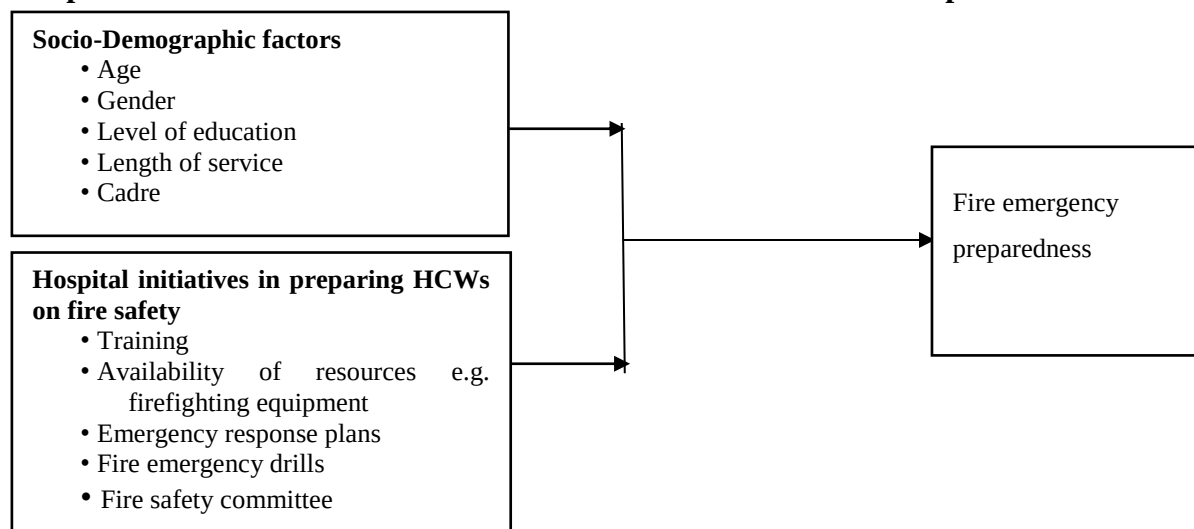


Figure 1: Conceptual Framework

Research Gaps

There is limited information currently available on hospital fire preparedness in Botswana, particularly on how healthcare workers sociodemographic characteristics influence

preparedness, and how hospital level initiatives like budget, organizational culture, communication systems, training, and drills affect preparedness. Previous research on the availability, frequency and quality of fire safety programs in Botswana hospitals is insufficient. This research thus addresses these gaps by looking at both institutional and individual factors associated with fire emergency preparedness among healthcare workers in selected hospitals.

The specific gaps can therefore be stated as follows:

Empirical gap: The level of fire emergency preparedness among Botswana's healthcare workers and the relative influence of sociodemographic factors, training, drills, policy awareness, communication systems, and resource availability are not well documented.

Contextual gap: Most published evidence comes from settings outside Botswana or from limited local contexts; preparedness across hospitals operating at different levels of care and under different resource conditions remains inadequately documented.

Methodological gap: Existing local evidence has largely described knowledge or isolated safety practices, with limited use of an analytical approach that simultaneously examines individual healthcare worker factors and hospital level initiatives in relation to a defined preparedness outcome.

In order to fill these gaps, the present study assesses healthcare workers fire emergency preparedness in selected Botswana hospitals by combining the institutional and individual factors.

METHODOLOGY

An analytical cross-sectional research design was used in the study. The study was conducted in a few public and private hospitals at the quaternary, tertiary, district, and primary levels of healthcare delivery in order to ensure heterogeneity in operational settings and organizational structures influencing preparedness. Seven SHE officers served as key informants to offer contextual perspectives on hospital fire safety policies and procedures, and a sample of 359 participants was selected from the study population of 1775 healthcare workers. Hospitals were first grouped based on the level of service they provided as part of a multistage sampling procedure. Following that, a random sample of seven hospitals was drawn from a national pool of 37 hospitals. Key informants were chosen through purposive sampling, whereas healthcare workers were chosen through systematic random sampling based on staff size and cadres. The data was obtained using a mixed method approach. Quantitative data was collected using an observation checklist and a semi-structured questionnaire. Indicators of individual preparedness, such as familiarity with fire safety equipment and understanding of fire emergency protocols, were recorded. Quantitative data was analyzed using SPSS version 26. Descriptive statistics were used to characterize preparedness levels and system factors, chi-square tests were used to evaluate associations between variables and binary logistic regression was used to determine predictors of fire emergency preparedness. To supplement and improve the quantitative data, a thematic analysis of the qualitative data was conducted. Strict adherence to ethical principles was maintained, including getting informed consent, protecting confidentiality and anonymity, and obtaining ethical approval from the relevant institutional review boards.

RESULTS

Sociodemographic Characteristics of Healthcare Workers and Fire Safety

The findings related to level of fire emergency preparedness and the factors associated with their preparedness are presented in this section. A total of 341 respondents completed the self-administered questionnaires, representing a high response rate of 94.98%, providing a robust basis for assessing healthcare workers preparedness and associated characteristics.

Table 2: Sociodemographic Characteristics of Healthcare Workers (n = 341)

Variable	Categories	n (%)
Gender	Male	148 (43.3)
	Female	193 (56.6)
Age (years)	16–24	14 (4.1)
	25–35	156 (45.8)
	36–45	110 (32.3)
	45–60	61 (17.9)
	61 and above	10 (2.9)
Level of Education	Diploma	196 (57.5)
	Degree and above	145 (42.5)
Professional Role	Nurse	230 (67.4)
	Dental Practitioners	19 (5.6)
	Doctor	38 (11.1)
	Clinical Laboratory Staff	30 (8.8)
	Pharmaceutical Staff	24 (7.0)
Years of Service	0–5	198 (58.1)
	6–10	101 (29.6)
	11–15	25 (7.3)
	16 and above	17 (5.0)

The respondents were predominantly female 193 (56.6%) and mostly aged between 25 and 45 years 266 (78.1%). Over half, 196 (57.5%) held diploma-level qualifications, while 145 (42.5%) had a degree or higher. Nurses constituted the majority of respondents, followed by doctors 38 (11.1%). Most healthcare workers had limited work experience, with 198 (58.1%) having served for five years or less and only 42 (12.3%) having more than ten years of service.

Sociodemographic factors associated with fire emergency preparedness

Using Chi-Square analysis, the level of fire preparedness was analysed across the respondents' ages, gender, level of education and length of service (Table 3).

Table 3: Sociodemographic Factors Linked to Fire Preparedness

Variable	Categories	Fire preparedness		χ^2	p-value
		Prepared n (%)	Not Prepared n (%)		
Gender	Male	61 (50.41)	87 (39.55)	3.7534	0.053
	Female	60 (49.59)	133 (60.45)		
Age	18–35 years	42 (24.71)	128 (75.29)	19.2719	0.001
	36–60 years	79 (46.20)	92 (53.80)		
Level of Education	Diploma	60 (30.61)	136 (69.39)	5.1899	0.0754
	Bachelor's and above	61 (42.07)	84 (57.93)		
Length of Service	0–5 years	63 (52.07)	135 (61.36)	10.339	0.016
	6–10 years	42 (34.71)	59 (26.82)		
	11–15 years	8 (6.61)	18 (8.18)		
	16 years and above	8 (6.61)	8 (3.64)		

Fire emergency preparedness varied across sociodemographic characteristics. Gender was not significantly associated with preparedness, although a higher proportion of males were prepared compared to females ($\chi^2 = 3.753$, $p = 0.053$). Age showed a significant association with preparedness, with older healthcare workers (36–60 years) being more prepared than younger ones (18–35 years) ($\chi^2 = 19.272$, $p = 0.001$). Level of education was not significantly associated with preparedness, though preparedness was higher among those with a bachelor's degree or above. Length of service was significantly related to preparedness, with higher levels observed among healthcare workers with longer work experience ($\chi^2 = 10.339$, $p = 0.016$).

Association between Sociodemographic Factors And Fire Emergency Preparedness at Bivariate Analysis Level using 2x2 Cross-tabulation

Table 4 presents the crude odds ratios (cOR) and corresponding p-values examining the association between selected sociodemographic characteristics and fire emergency preparedness. These crude estimates show the degree and direction of the relationship between each variable and preparedness.

Table 4: Crude Odds Ratios (cOR) for Sociodemographic Factors Associated with Fire Emergency Preparedness

Variable	Categories	Prepared n (%)	Not Prepared n (%)	cOR	95% CI	p-value
Gender	Male	61 (50.41)	87 (39.55)	1.43	0.99 :2.15	0.054
	Female	60 (49.59)	133 (60.45)			
Age	18–31 years	42 (34.7)	129 (58.6)	0.37	0.23: 0.59	0.001
	32–60 years	79 (65.3)	91 (41.4)			
Level of Education	Diploma	42 (21.5)	153 (78.5)	0.52	0.33: 0.82	0.005
	Bachelor's and above	50 (34.5)	95 (65.5)			
Length of Service	0–10 years	106 (21.7)	195 (78.3)	0.91	0.48 :1.73	0.788
	11+ years	15 (30.7)	25 (69.3)			

Crude odds ratio analysis showed that gender was not significantly associated with fire preparedness, although males had higher odds of being prepared than females (cOR = 1.43, 95% CI: 0.99–2.15, $p = 0.054$). Age was significantly associated with preparedness, healthcare workers aged 18–31 years having significantly lower odds of preparedness compared to those

aged 32–60 years (cOR = 0.37, 95% CI: 0.23–0.59, $p < 0.001$). Level of education was also significantly associated with preparedness, as diploma holders were less likely to be prepared compared to those with a bachelor's degree or higher (cOR = 0.52, 95% CI: 0.33–0.82, $p = 0.005$). Length of service did not show a significant association with fire preparedness (cOR = 0.91, 95% CI: 0.48–1.73, $p = 0.788$).

Association between Sociodemographic Factors and Fire Emergency Preparedness at Multivariate Analysis Level

Using binary logistic regression model, the dataset was analysed to determine the association between sociodemographic characteristics and fire emergency preparedness while controlling for other variables (Table 5).

Table 5: Sociodemographic Factors Associated with Fire Emergency Preparedness

Variable	Categories	Fire preparedness		aOR	CL (95%)	P-Value
		Prepared n (%)	Not Prepared n (%)			
Age	18–31 years	42(34.71)	129(58.64)	1.69	(1.26: 2.26)	0.001
	32–60 years	79(65.23)	91(41.36)			
Level of Education	Diploma	42 (21.5)	153 (78.5)	1.69	(1.07: 2.68)	0.026
	Bachelor's and above	50 (34.5)	95 (65.5)			

Age remained a significant indicator, with healthcare workers aged 18–31 years having higher adjusted odds of preparedness compared to those aged 32–60 years (aOR = 1.69, 95% CI: 1.26–2.26, $p = 0.001$). Level of education was also significantly associated with preparedness, as diploma holders were more likely to be prepared than those with a bachelor's degree or higher (aOR = 1.69, 95% CI: 1.07–2.68, $p = 0.026$).

Hospital Initiatives towards Preparing Healthcare Workers on Fire Safety

This section shows the association between exposure to fire safety initiatives including training, timing of training, participation in fire drills, and knowledge of key response step sand the level of fire emergency preparedness among healthcare workers.

Table 6: Fire Prevention Measures and the Respondents' Levels of Preparedness

Variable	Categories	Prepared n (%)	Not Prepared n (%)	95% CI	p-value
Ever received fire safety training	Yes	72(61.5)	45(38.5)	108.143	0.001
	No	20(9.1)	204(91.1)		
	0-2 Years ago	9(56.3)	7(43.8)		
When trained on fire safety (timing)	3-5 Years ago	34(60.7)	22(39.3)	106.504	0.001
	6-10+ Years ago	28(60.9)	18(39.1)		
	Not Trained	20(9.0)	203(91.0)		
Participation in fire drills in past year	Yes	52(82.5)	11(17.5)	121.104	0.001
	No	40(14.4)	238(85.6)		
Knowledge of key steps when discovering fire	Yes	78(57.8)	57(42.2)	107.824	0.001
	No	10(6.1)	155(93.9)		
	Uncertain	6(14.6)	35(85.4)		

Hospital fire preparedness was strongly associated with exposure to fire safety initiatives. Healthcare workers who had never received or were uncertain about fire safety training were

largely unprepared (91.1%), while those who had received training showed substantially higher preparedness (61.5%), with the association being highly significant ($\chi^2 = 108.1$, $p = 0.001$). Similar patterns were observed for training timing, as trained staff were markedly more prepared than untrained counterparts ($\chi^2 = 106.5$, $p = 0.001$). Participation in fire drills during the past year was also significantly associated with preparedness, with 82.5% of participants who had engaged in drills being prepared compared to only 14.4% among those who had not ($\chi^2 = 121.1$, $p = 0.001$). Additionally, knowledge of key steps to take when discovering a fire was significantly associated with preparedness, as more than half of those with such knowledge were prepared, while the vast majority without this knowledge were unprepared ($\chi^2 = 107.8$, $p = 0.001$).

Resource and Equipment Availability

Table 7: Fire Prevention Measures and Respondents' Preparedness Levels

Variable	Categories	Prepared n (%)	Not Prepared n (%)	cOR	95% CI	p-value
Knowledge of hospital fire extinguisher locations	Yes	87 (33.6)	180 (66.4)	4.24	1.6:11.0	0.001
	No/Uncertain	5 (1.4)	69 (98.6)			
Knowledge of types and correct use of fire extinguishers	Yes	82 (59.4)	56 (40.6)	31.40	14.7:67.2	0.001
	No/Uncertain	9 (4.5)	193 (95.5)			
Familiarity with evacuation routes	Yes	90 (42.3)	123 (57.7)	36.93	15.4:88.4	0.001
	No/Uncertain	6 (1.6)	122 (98.4)			
Knowledge of assembly points	Yes	86 (34.8)	161 (65.2)	6.72	2.9 :15.2	0.001
	No/Uncertain	7 (7.4)	88 (92.6)			
Familiarity with fire alarm activation	Yes	67 (76.1)	21 (23.9)	29.10	15.3:55.3	0.001
	No/Uncertain	25 (10.2)	228 (89.8)			
Availability of resources for fire safety implementation	Yes	50 (49.5)	51 (50.5)	4.98	2.9 :8.4	0.001
	No/Uncertain	39 (16.3)	198 (83.7)			

Fire emergency preparedness was strongly and consistently associated with healthcare workers' knowledge of fire safety procedures and resource availability. Preparedness was markedly lower among those who were unaware or uncertain about fire extinguisher locations, correct extinguisher use, evacuation routes, assembly points, and fire alarm activation. In contrast, substantially higher levels of preparedness were observed among respondents who reported adequate knowledge and familiarity with these measures, particularly fire alarm activation and correct extinguisher use. Perceived availability of fire safety resources was also significantly associated with preparedness. All associations were statistically significant ($p = 0.001$) (Table 7).

Policies and Procedures

Institutional policies and adherence to procedures played a critical role in fire preparedness. Staff in facilities with dedicated Occupational Safety and Health (OSH) officers demonstrated higher levels of preparedness (48.6%) compared to those in facilities without an OSH officer

(12.7%) or uncertain status (11.5%) ($\chi^2 = 56.241$, $p = 0.002$). Fire preparedness was strongly associated with knowledge of reporting chains, namely reporting to OSH officers or fire marshals (38.5%, $\chi^2=9.165$, $p=0.010$). Preparedness was significantly improved by documented fire safety policy (37.5% vs 2.0%) and being familiar with the chain of command (91.2% of prepared respondents) ($\chi^2=12.456-77.958$, $p\leq 0.001$). These results underscore the importance of formalized institutional structures, clear communication of roles, and defined accountability mechanisms in promoting hospital fire preparedness.

Table 8: Policies and Procedures Adherence

Variable	Categories	Fire preparedness		χ^2	p-value
		Prepared n (%)	Not Prepared n (%)		
Presence of OSH Officer	Yes	68(48.6)	72(51.4)	56.241	0.002
	No	10(12.7)	69(87.3)		
	Uncertain	14(11.5)	108(88.5)		
Reporting chain knowledge	My manager	17(15.5)	93(84.5)	8.165	0.010
	OSH Officer	12(25.5)	35(74.5)		
	Fire Marshall	62(38.5)	99(61.5)		
Fire safety policy availability	Uncertain	6(31.6)	13(68.4)	12.456	0.001
	Yes	12(37.5)	20(62.5)		
	No/Uncertain	17(7.87)	199(92.13)		
Chain of command familiarity	Yes	62(91.2)	6(8.8)	77.958	0.001
	No	25(10.5)	214(89.5)		
	Uncertain	5(14.7)	29(85.3)		

Fire Safety Awareness

Healthcare workers' awareness of common fire causes and procedural knowledge of emergency steps significantly influenced preparedness. Staff aware of common fire causes were more prepared (39.0%) compared to those unaware (13.5%) or uncertain (12.9%) ($\chi^2 = 18.689$, $p = 0.009$). Knowledge of correct response steps had an even stronger association, with 57.8% of knowledgeable staff prepared versus 6.1% of those lacking this knowledge ($\chi^2 = 7.824$, $p = 0.033$). These findings indicate that procedural and practical knowledge, rather than general awareness, is the strongest predictor of effective fire response among healthcare workers.

Table 9: Association Between Fire Awareness and Emergency Preparedness Among Healthcare Workers

Variable	Categories	Fire preparedness		CL (95%)	cOR	p-value
		Prepared n (%)	Not Prepared n (%)			
Awareness of common fire causes	Yes	84(69.4)	97(44.1)	(1.76:4.75)	2.88	0.001
	No/Uncertain	37(30.6)	123(55.9)			
Key steps knowledge in Fire emergencies	Yes	85(70.3)	50(22.7)	(4.72:13.69)	8.03	0.001
	No/Uncertain	36(28.7)	170(77.3)			

Multivariate Analysis

Table 10: Output of the Multivariate Logistic Regression

Variable	aOR	95%CL	p-values
Are there organizational culture barriers that exist in your unit/ department that might keep you from actively practicing fire safety?	0.4113	(0.185:0.916)	0.030
Is there enough budget for implementation of fire safety measures in hospitals?	0.3998	(0.179:0.893)	0.025
Are there enough resources for implementation of fire safety measures in your unit in case of a fire outbreak?	0.6547	(0.383:1.089)	0.101
Are there any difficulties in making sure that you are aware of your obligations in the event of a fire?	1.1837	(0.576:2.434)	0.647
Are there challenges to fitting fire safety into your hectic schedules?	0.645	(0.374:1.111)	0.114

The overall model was statistically significant, LR χ^2 (5) =19.09, P0.0018, suggesting that the combined factors contributed to explaining differences in fire preparedness among healthcare workers. Organizational culture barriers, aOR=0.411, p=0.030, and budget availability, aOR=0.400, p=0.025, were significantly associated with fire preparedness, indicating that institutional culture and financial support influenced the likelihood of being prepared. This implies that while sociodemographic characteristics may shape individual preparedness levels, hospital initiatives, especially supportive organizational culture and adequate budgeting, remain central to strengthening fire safety preparedness in hospitals.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Discussion

This study reveals that the fire emergency preparedness of healthcare workers in Botswana is at a very low level and the main reason is the absence of systematic, continuous and effective fire safety education. This present study shows that only 27% of healthcare workers were categorized as prepared for emergencies, while 34.4% received fire safety training, 18.5% had participated in fire drills. Fire emergency preparedness remains a serious issue even in the developed countries despite the existence of strict fire safety regulations, better infrastructure and more advanced emergency management systems. Several incidents have occurred in healthcare facilities, including hospitals, in the United States that involve fire, even with the presence of rules (United States Fire Administration [USFA], (2020); Spellman, (2023)). A similar study in the UK has shown that hospital fires remain an issue, due to operational pressures and the lack of standards (Hoey, 2024). Sociodemographic factors like age, gender, income, and education have been associated with differences in fire safety risk perception and preparedness in Sweden and other European countries (Nilsson et al., 2020; Runefors et al., 2021; Cvetković et al., 2021; Cuesta et al., 2022). Evidence from Poland, Goniewicz et al. (2021) also shows that insufficient staff competency assessment could negatively impact emergency response even in hospital settings with higher resources. The findings suggest that

in developed countries, staff training, clear and written emergency roles, practice, and culture of safety within the institution are still important to a successful fire preparedness.

Results of this study indicate that, apart from staff knowledge, other hospital activities like budget allocation, availability of equipment, regular drills and administration commitment can also influence fire safety preparedness. In developing countries, fire preparedness in hospitals is often affected by financial limitations, suboptimal enforcement of fire codes and standards, hospital overcrowding, and the lack of adequate fire training, which is a major challenge in poorer countries (Juyal et al., 2023; Malviya et al., 2022; Rather et al., 2024). The results of the research work carried out in China and India show that patient safety is greatly influenced by staff knowledge, preparedness for evacuation and knowledge of equipment usage in the event of a hospital fire (Liu et al., 2023). Fire safety problems in Bangladesh health care institutions (HCI) have been associated with inadequate preparedness and lack of proper safety requirements (Hosen et al., 2021). In addition to the above, Iran, Seyghalani Talab et al. (2024) emphasizes the importance of institutional coordination, readiness, resources and leadership support in hospital emergencies.

The results of this study are in line with this broader pattern in Botswana. Preparedness was impacted by sociodemographic variables like age, education level, and length of employment, indicating that individual characteristics influence how healthcare workers perceive and handle fire emergencies (Meki, 2018). The multivariate results, however, indicate that hospital initiatives were equally crucial. Fire preparedness was statistically associated with organizational culture barriers and budget availability. This suggests that institutional culture, financial support, role clarity, training and involvement in fire drills all influence hospital fire preparedness in Botswana.

Overall, the results indicate that hospitals in Botswana deal with issues that are comparable to those noted in other developing and Sub-Saharan African countries. However, the issue is still present in developed countries. The discussion demonstrates that hospital initiatives like sufficient budgeting, regular training, fire drills, clear communication systems, equipment availability, and a supportive safety culture are crucial for enhancing fire emergency preparedness, even though sociodemographic factors may affect individual preparedness. As a result, enhancing fire safety in Botswana necessitates a thorough strategy that takes institutional structures and individual capacity into account.

Conclusion

The results indicate that 27% of the healthcare workers were considered well prepared for fire emergencies, a figure which is still very low. There is significant difference in preparedness between hospitals and sociodemographic groups. Fire safety training had a significant positive effect on preparedness outcomes, while age and education were important sociodemographic factors affecting preparedness. There were large variations in the level of preparedness between hospitals, from 47.2% to 100%. Comprehensive, evidence-based intervention is needed because gaps were seen in the training coverage of healthcare workers, awareness about emergency procedures and effectiveness of institutional communication system. Although the institutional infrastructure was in general compliant with safety requirements, preparedness at the individual level was low, due to poor training, unclear role definitions and poor communication. In particular, the preparedness for frontline workers was lowest amongst junior and diploma level workers, who are the biggest proportion of frontline workers. This is

a major weakness which requires urgent, competency-based and tailored training methods to enhance the preparedness for fire emergencies in hospitals.

Recommendations

The recommendations of this study are that the regulations and regulatory bodies, such as Ministry of Health, Botswana improve the implementation of fire safety rules in healthcare buildings by creating clear fire safety sector-specific guidelines and competency-based training programs that focus on practical application and collaborative emergency response. Ministry of Health should lead the development of a national framework for fire emergencies with periodic training and drills, resources allocation and monitoring and evaluation of the implementation at all levels of care. Fire preparedness should be a priority for hospitals and other health facilities, so that regular and inclusive training is provided; the internal communication system is strengthened; roles of staff members are clearly defined in case of fire; and fire safety equipment is available and working, especially for frontline, junior staff and diploma-level doctors who are important during a disaster, using differentiated training approaches. Healthcare workers are encouraged to actively participate in fire safety training and fire drills, become familiar with healthcare emergency procedures and equipment, and have personal responsibility to follow fire safety procedures and report hazards to increase overall preparedness and patient safety.

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