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RESEARCH ARTICLE

ASSESSMENT OF READINESS TO HANDLE FIRE CHALLENGES IN A TERTIARY CARE TEACHING INSTITUTE.

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Abstract

Rationale: Fire incidents in hospitals in the recent past have brought to fore the necessity of continuous efforts for fire prevention in all Healthcare organizations (HCOs). The recent devastating fire accidents in country highlighted lacunae in hospitals and were harsh learning experiences both for administrators as well as fire safety regulators. In today's world of advanced technology, "nothing is safe" and the challenge of handling disasters caused by job related accidents always exists. Therefore, preparedness of HCOs, for probable accidents and providing safety for patients, staff and materials is vital.

Objectives. The study aimed to carry out fire audit i.e. examination of premises as well as conducted relevant document review to ascertain how the premises are being managed regarding fire safety. The study also undertook assessment of level of fire awareness amongst occupiers, identified gaps and made recommendations. Recommendations were made to make the organization compliant with the fire safety standards as per National Building Code 2016.

Methodology: An observational study by carrying out audit of infrastructure, equipment, policies for preparedness in preventing/fighting fire as well as awareness amongst various categories of personnel was assessed. Structured questionnaire was given to stake-holders to gather factual information from all areas, which was later analyzed through Focused Group Discussions. The audit included five critical components of Fire maintenance, Staff training, Fire prevention, Fire alarm and Fire evacuation plan (last 2 included under Fire action plan).

Results: The overall fire safety compliance was found to be 60.42%. Fire prevention and Fire maintenance compliance percentages were 83.8% and 67.92% respectively. The critical non-compliant factors identified were staff training and Fire action plan. Level of fire-awareness of the study population was associated with educational level and job tenure.

Conclusion: Fire safety in healthcare is a sensitive topic as the very existence of healthcare facilities controlled by government agencies suggests that nation, through government, has taken responsibility to

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care for people who are ill in some way. If patients or staff members are harmed by fire accidents, then it is a direct reflection on quality of management of total healthcare system. The study provides insight into identifying the critical factors in order to help minimize potential adverse effects whilst at the same time provides recommendations for integration of organizational requirements with NBC 2016 guidelines.

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Introduction:-

Nowadays, more attention is being paid to different aspects of occupational safety.[1] In health system, safety is defined as a set of security measures used to protect the physical assets, staff and clients and also reduce the possibility of damage; of course, safety cannot eliminate all the risks.[2] The first reason for paying attention to safety in hospitals is the moral responsibility.[3] In fact, all the organizations, especially those which provide emergency services, are committed to create a safe environment for both the staff and the clients.[4] The second reason for paying attention to safety is the legal responsibility. Observing safety considerations in different areas of institute can lead to reduction of risks and potential complaints.[1]

Manpower is a fundamental and important resource for every organization and paying heed to this resource is critical for any organizational success. [5] Staff in any organization are exposed to occupational hazards and are susceptible to several job-related diseases.[6] Observing safety principles is one of the important tasks of administrators.

Fire is a life-threatening event for any organization, which can inflict both financial damage as well as human resource injuries. However, it is seen that fire safety is not in the day to day priority of most individuals and organizations. Habits, such as working casually or in an unsafe manner are usually the result of lack of knowledge. Thus, job training with an emphasis on safety aspects is very effective in driving employee behavior, preventing safety related accidents, and also eliciting appropriate response in such situations. Hence the first step in fire prevention in any organization is training and sensitization related to various safety aspects, including fire prevention. Owing to the importance of fire and its impact on the functioning and image of healthcare organizations, it was decided to assess the fire safety status of a tertiary care teaching institute and make recommendations, if any.

Materials and Methods: -

Structured questionnaire was given to stake-holders to assess areas for collecting factual information which was later scrutinized through Focused Group Discussions. Since the fire-safety audit is meant to measure fire risk impact on levels of fire safety in individual buildings, it became essential to carry out risk profiling of existing buildings. The assessment included five critical components like Fire maintenance, staff training, Fire prevention, Fire alarm and Fire evacuation plans. (last two included under Fire action plan).

The institute spread over 107 acres has multiple stand-alone buildings. In order to evaluate the fire safety status, the institute was divided into 14 sub-sectors based on their locations. (Table I) The questionnaire containing fifty-one questions was evaluated under five components as discussed above to make this study easier for analysis. All the sub-sectors were audited in the similar manner to maintain consistency in collecting data. All items of the checklist were observed by the researchers. The items were assessed to be either present/provided (yes) or not present/provided (no). The item was, then, scored 1 if it were present/provided (yes) and 0 if it were not present/provided (no). The total safety score was calculated by adding all score of items in the checklist.[7]

The questionnaire also included questions in order to evaluate the level of fire awareness. Based on the inputs, only high-risk buildings i.e. densely populated, occupied 24 x 7 or with high density of biomedical and electrical equipment were physically inspected. Aspects seen were factors like number and location of fire points, hazmat storage, signages and information display.

A questionnaire survey was chosen in this research because it enabled gathering of more quantitative information. Before the respondents were asked to complete the survey, the stakeholders were briefed on the purpose of research. In Section I the questions solicited about fire equipment maintenance i.e. adequacy, accessibility, siting of the

equipment and their log books. Section II collected information on the fire prevention checklist and predisposing or potential factors. Section III obtained information on training, display of fire orders and record of mock drills while Section IV dealt with adequacy, location and operability of fire detection devices. Section V obtained information relating to modes of evacuation and signposting of layout.

Emphasis was given on identifying subsectors having equipment generating heat and materials which are combustible under right circumstances at relatively lower temperatures as the fuel for fire does not have to be recognized fuel in the sense of petrol or gas. The factors like compressed air, oxygen cylinders enhancing the naturally present oxygen in order to aid combustion were also identified.

The respondents in the research were given questionnaires with time provided for self-administration at convenient locations. In brief, the data was collected through a self-conducted fire safety audit and the use of a self-administered questionnaire.

Result: -

An audit was carried out of all the 14 subsectors as per the NBC 2016 Norms. The subsectors were either a block having many departments or a group of many standalone buildings. Few buildings were occupied 24 x 7 which included the hostels and accommodation for staff. The response on fire safety status of buildings which were compliant were marked Y and those non-compliant were marked N. There were few subsectors which along with a Y or N had a comment to add in the remark's column provided in the questionnaire. Those remarks were also incorporated in the results. The score of each Y and N was then converted into percentage. The results thus obtained are presented in Table II.

The overall fire safety compliance was found to be 60.42 percent. It was found that subsectors A, C and F are 83, 76.9 and 76.2% compliant respectively (Figure I) as these sub-sectors had inflammatory and hazardous materials which followed the fire safety standards better than other sub-sectors. Few subsectors B, H and MB were < 45% compliant. (Table III) The reason for this could be attributed to less perception of fire threats by stake holders. The compliance of Fire maintenance and Fire prevention were 83.8% and 67.9% respectively whereas Fire action plan (including evacuation and alarm system) and staff training compliance were 46.04% and 43.94% respectively. (Figure II) The factor wise subsector compliance is described in Figure III.

Sr No	Sub Sector	Areas covered	Remarks
1	A	Dental Surgery, Electrical Substation, Animal House, Living accommodation	
2	B	Library, Psychiatry, Forensic Medicine, Obstetrics & Gynae, Paediatrics, ENT, Orthopaedics depts, DNA Lab, Establishment office	
3	C	Laboratory Science block, Dermatology dept, Lecture Halls and Auditorium	
4	D	Transport section, Patients Inspection room, Mandir, Warden room	
5	E	Living accommodation of staff	
6	F	LPG Stores, Gas plant, Pump house, Mechanical Laundry, Ration and Fuel stores, Dhobi ghat, Medical Stores, Masjid	
7	G	Hostel (multiple stand-alone buildings), Dining mess	
8	H	Single living old and new accommodation,	
9	J	Nursing College, Nursing dining mess	
10	K	Pharmacology, Physiology dept, Principal office, Accounts & Admission section	
11	MB	Administrative block, paramedical and training wing, guest rooms	
12	Misc and School	Various schools and Family welfare centre (Miscellaneous buildings)	
13	OR	All staff of institute including single and married accommodation	
14	Radio	Radio diagnostic department including MRI and Patient waiting area	

Table I: - Various Sub-sectors

Table II:-(Fire Safety Measures) Subsector Compliance: Factor wise

Inspected subsectors	Inspected plan	Compliant level (%)	Non-compliant level (%)	Total (%)
Subsector A	Fire maintenance plan	67.19	32.81	100
	Fire prevention plan	95.00	05.00	100
	Staff training plan	100.00	00.00	100
	Fire action plan	70.00	30.00	100
Subsector B	Fire maintenance plan	36.36	63.64	100
	Fire prevention plan	86.36	13.64	100
	Staff training plan	16.36	83.64	100
	Fire action plan	36.36	63.64	100
Subsector C	Fire maintenance plan	79.86	20.14	100
	Fire prevention plan	90.00	10.00	100
	Staff training plan	75.56	24.44	100
	Fire action plan	62.28	37.78	100
Subsector D	Fire maintenance plan	55.73	44.27	100
	Fire prevention plan	88.33	11.67	100
	Staff training plan	40.00	60.00	100
	Fire action plan	50.42	49.58	100
Subsector E	Fire maintenance plan	75.00	25.00	100
	Fire prevention plan	70.00	30.00	100
	Staff training plan	80.00	20.00	100
	Fire action plan	65.00	35.00	100
Subsector F	Fire maintenance plan	78.68	21.32	100
	Fire prevention plan	92.36	07.64	100
	Staff training plan	68.24	31.76	100
	Fire action plan	65.88	34.12	100
Subsector G	Fire maintenance plan	85.42	14.58	100
	Fire prevention plan	90.00	10.00	100
	Staff training plan	83.24	16.66	100
	Fire action plan	12.97	87.03	100
Subsector H	Fire maintenance plan	84.37	15.63	100
	Fire prevention plan	80.00	20.00	100
	Staff training plan	00.00	100.00	100
	Fire action plan	16.66	83.34	100
Subsector J	Fire maintenance plan	84.38	15.62	100
	Fire prevention plan	90.00	10.00	100
	Staff training plan	00.00	100.00	100
	Fire action plan	40.00	60.00	100
Subsector K	Fire maintenance plan	61.72	38.28	100
	Fire prevention plan	75.00	25.00	100
	Staff training plan	55.00	45.00	100
	Fire action plan	40.00	60.00	100
Subsector MB	Fire maintenance plan	52.35	47.65	100
	Fire prevention plan	76.25	23.75	100
	Staff training plan	05.00	95.00	100
	Fire action plan	42.50	57.50	100
Subsector Misc & Sch	Fire maintenance plan	50.00	50.00	100
	Fire prevention plan	90.00	10.00	100
	Staff training plan	05.00	95.00	100
	Fire action plan	42.50	57.50	100
Subsector OR	Fire maintenance plan	87.75	12.50	100
	Fire prevention plan	80.00	20.00	100
	Staff training plan	40.00	60.00	100
	Fire action plan	60.00	40.00	100

Subsector Radio	Fire maintenance plan	52.08	47.92	100
	Fire prevention plan	70.00	30.00	100
	Staff training plan	46.66	53.34	100
	Fire action plan	40.00	60.00	100
Note: The entire college was covered under these various subsectors				

Figure I: -Subsector wise compliance

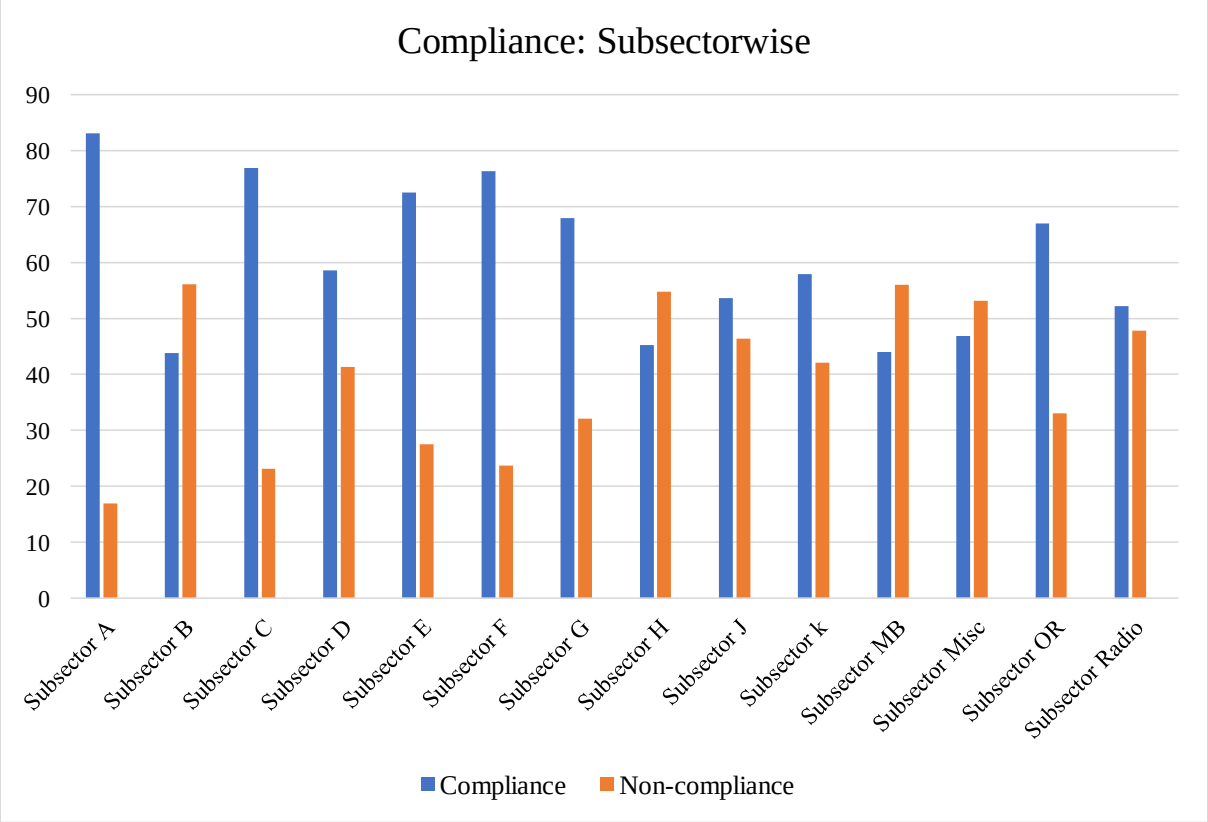

Table III: -Compliance rate of various subsectors: A summary

Inspected subsectors	Compliant level (%)	Non-compliant level (%)	Total (%)
Subsector A	83.05	16.95	100
Subsector B	43.86	56.14	100
Subsector C	76.92	23.08	100
Subsector D	58.62	41.38	100
Subsector E	72.50	27.50	100
Subsector F	76.29	23.71	100
Subsector G	67.91	32.09	100
Subsector H	45.25	54.75	100
Subsector J	53.60	46.40	100
Subsector K	57.93	42.07	100
Subsector MB	44.02	55.98	100
Subsector Misc & School	46.87	53.13	100
Subsector OR	66.94	33.06	100
Subsector Radio	52.18	47.82	100
Note: The entire college was covered under these various subsectors			

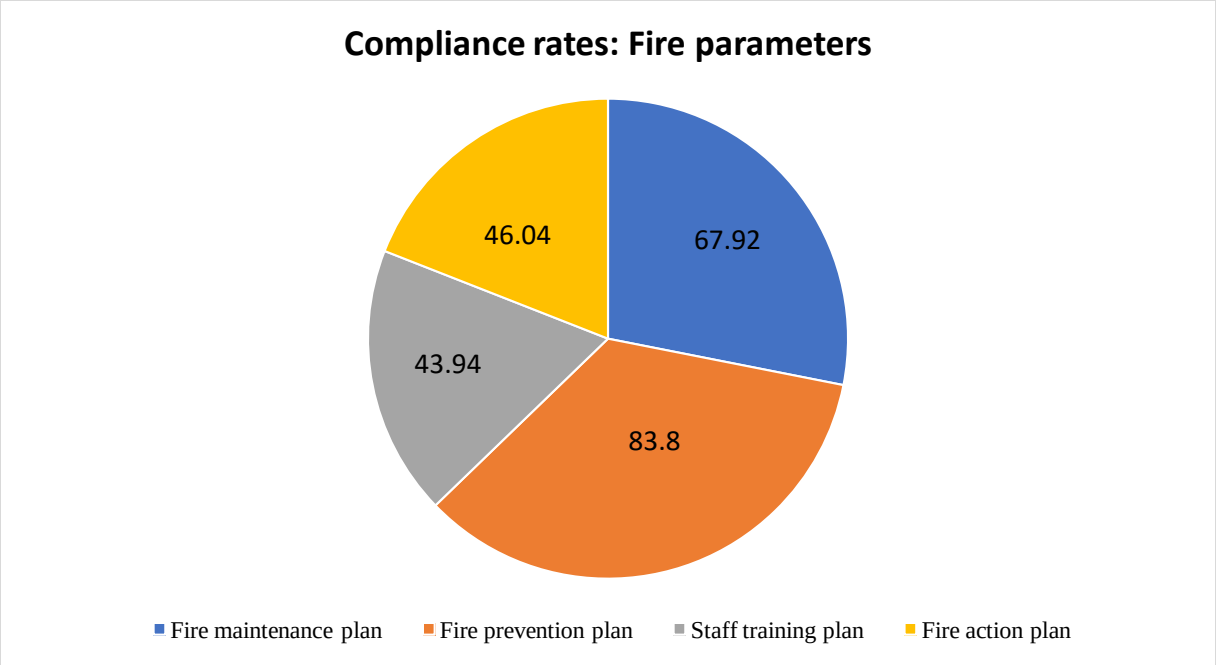

Figure II: -

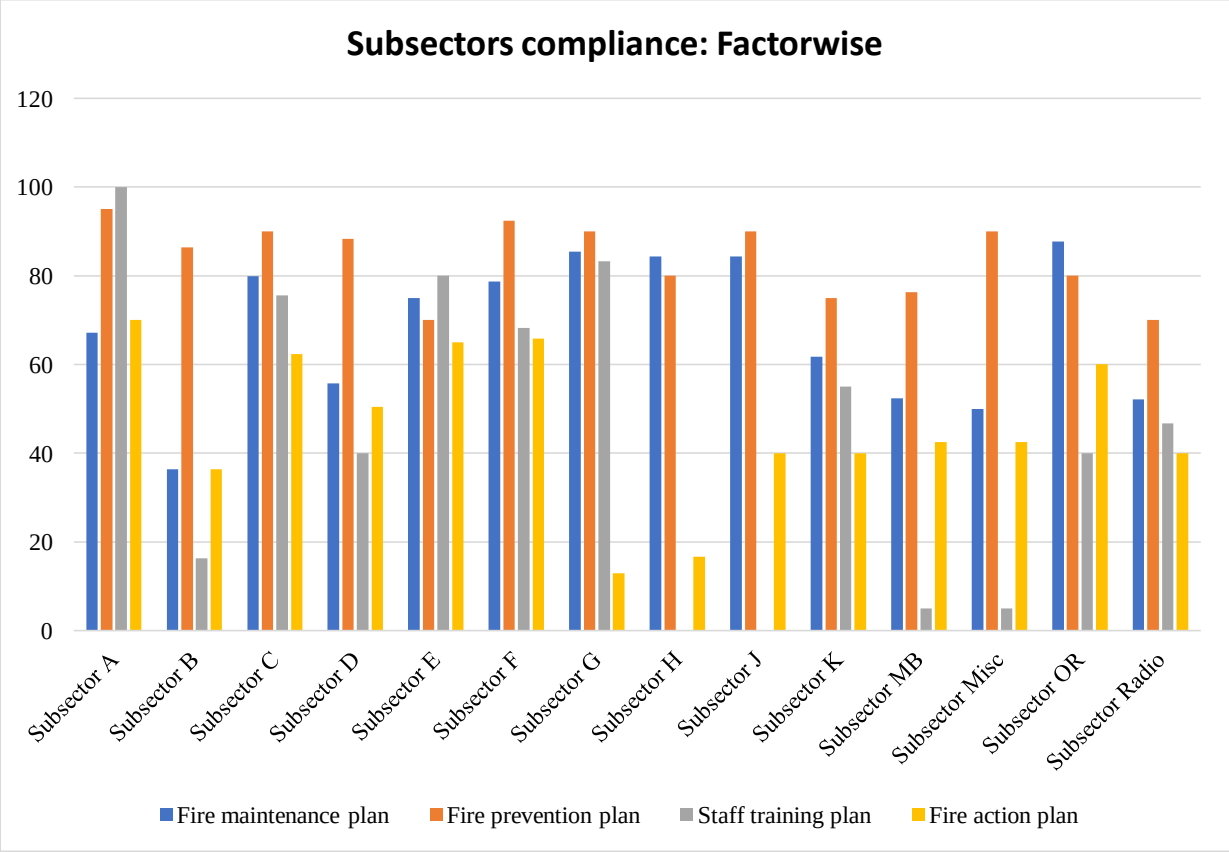

Figure III: -

Findings

The overall fire safety compliance of the organization was found to be 60.42 percent as per the questionnaire criteria. The non-compliant factors identified were: -

1. Fire maintenance plan revealed deficiencies in firefighting equipment like noncompliance in ranking order as follows: -

1. Unavailability of safety pin
2. Pressure gauge at recharging levels
3. The firefighting equipment not fitted
4. No wall brackets, thereby critically reducing accessibility and visibility
5. Fire hose reels & Fire hydrants not present

2. **Fire prevention plan**

1. "No smoking" signs not present
2. The electrical discipline was not maintained in various subsectors

3. **Staff Training Plan**

1. Staff training not carried out regularly
2. Staff awareness was not up-to-date
3. Mock drills were not conducted regularly
4. Records were not maintained properly

4. **Fire Alarm systems**

No building had any fire detection devices or central alarm system to alert the occupants in case of fire accident.

5. **Fire Evacuation Plan**

1. None of the standalone buildings or floors had escape plans/exit signs
2. The fire exit plan/layout was not displayed thereby leaving the occupants/visitors to guess the exit in case of any emergency
3. The exit routes were obstructed by items and furniture
4. Buildings did not have earmarked assembly area

Limitations

The findings of study are subject to few limitations. Firstly, the parameters covered may not be exhaustive and other factors may be required to be included in other organizations, depending on local circumstances. Secondly, respondents answered questions based on their perceptions, experiences and understanding. Thirdly, considering the wide spread of the organization over 107 acres, only high-risk areas were physically inspected in detail.

Discussion: -

Fire is a complex phenomenon, which characteristically occurs when there is an optimum mix of heat, fuel and oxidizing agent where fuel is the combustible agent and oxygen generally the oxidizing agent. So, the first step in fire prevention is segregating these three elements of fire triangle. The second broad step to ensure fire safety is designing buildings with fire safety parameters. Establishing fire detecting systems and fixing firefighting appurtenances in the building is the next step. But fire prevention does not stop at establishing these systems and there is a need to continuous assessment, monitoring, and improving them. Further, although the broad principles of fire prevention and response maybe same, many aspects and responses need to be customized in each building and organization depending upon the variables.

Number of variables are responsible in the fire phenomenon of the buildings, which are to be identified, assessed as fire hazard. Type of building, the activities going inside of the building, maintenance of the building, fire risk management, security management, preparedness, awareness of fire, keeping away the fire sources from the combustible materials, proper elimination of combustible materials. If we adopt these parameters in the buildings, we can avoid the fire accidents and assure the absolute safety of the buildings in future. [8]

Teaching institutions with residential buildings, have to comply with the fire safety guidelines of National Building Code (NBC) 2016. Preventive architectural design, fire drills, training of the hospital staff is mandatory in hospitals in western world. [9]

The study enhances understanding of dimension that fire safety management procedures must be properly implemented. The majority of the non-compliant areas involved training of the staff and fire alarm systems. Emphasis must be given on staff training and fire action plan activities. Sensitization of staff is necessary by reiterating the tragedies that a fire can bring to human life and damage to the property. The knowledge about fire safety will enable them to understand the characteristics of fire, components of fire, and the correct response in case of fire incident. Adequate training can reduce the damaging consequences of fire. Fire training needs to be conducted continuously in order to review, revise and reconfigure the knowledge. A large part of knowledge, if not used or reiterated can easily be forgotten or ignored.

The ability to elicit fire response may not only control the spread of fire, thereby giving those precious few moments, but also reduces fire damage to a lower level than would have been the case if the fire had spread unchecked. It is therefore very important that all personnel are familiar with the available fire-fighting equipment and their correct use. When fire safety information is conveyed frequently or repetitively then it becomes a habit amongst the occupants.

As part of recommendations, proper fire detection systems, fire exit plans, fire hydrants, first aid hose reel and automatic sprinkler systems in all multistoried buildings were suggested to management. The requirement of regular and periodic training and audits was also emphasized.

Conclusion: -

In the wake of growing fire incidents, it is always a good idea to review your fire prevention plans and make sure that staff are taking all necessary precautions to keep fires at bay. Required maintenance of electrical systems and equipment should be done regularly. In addition, staff members should receive regular reminders about the evacuation protocols to be followed in case of fire. [10] Fire safety inspections with qualitative assessment by using national norms will make the management of any organization to appreciate the need for fire safety measures and treat recommendations with respect. Practically, however, society can neither forestall all loss of life nor spend limitlessly to avert loss of life due to fire. The ideal goal of life /fire safety design is to prevent all fire deaths, injuries and losses under all imaginable circumstances. History has proven that nearly every fire extinguisher failure can be traced back to human negligence.

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