IOSR Journal of Nursing and Health Science (IOSR-JNHS)
e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 11, Issue 4 Ser. II (Jul. – Aug. 2022), PP 01-07
www.iosrjournals.org

Hazard Identification and Risk Analysis (HIRA) In Critical Care Units of Christian Medical College (CMC), Vellore.

Mrs.Sheeba.J[1*], Mrs.Jeyalindha Christopher[2], Dr.Lallu Joseph[3]
[1*]*Tutor MSc Nursing,Christian Medical College, Vellore, Tamil Nadu, India*
[2]*Pofessor, Medical Surgical Nursing, Associate Nursing Superintendent, Christian Medical College, Vellore, Tamil Nadu, India*
[3]*Quality manager and Associate General Superintendent,Christian Medical College, Vellore, Tamil Nadu, India*
**Corresponding Author Mrs.Sheeba.J*

Abstract:
Background of the study*: For any hospital to be successful, it has become essential to identify the hazards and to assess its associated risks that are acceptable. The presence of vulnerable environmental factors places the hospitals particularly critical care units at a greater risk for disaster. An important step in emergency preparedness is to identify all hazards that may affect the hospital and assess their associated risks to determine which hazards are most likely to result in disaster. This approach both satisfies accreditation requirements and also allows for a systematic, targeted approach to emergency preparedness. HIRA provides a systematic and objective approach in recognizing hazards, associated risks and its potential impact to the system*
Aim*: Thestudy aims to identify the hazards and perform risk analysis in critical care settings.*
Method: *A descriptive research design was undertaken to meet the study objectives.HIRA was assessed in 5 critical care units using Hazard Vulnerability Analysis (HVA) tooldeveloped by Kaiser Permanente*
Results*: The findings of the study reveals that 13% of the hazards are human related, 12.2% of the hazards are due to technological events, 5.5% of the hazards results due to natural events, only 1.8% of hazards results due to hazardous material and the overall hazards seen in critical care settings is 8.12% which signifies that there are good facilities available with no consequences. There is statistically significant correlation between probability and severity of hazards with P value of 0.016 level of significance.*
Conclusions
Identification of hazard and the risk assessment in critical care units enhances patient safety and hospital safety through emergency responseplan. HIRA offers the most good to greater number of peopleenabling health care facilities to identify and reduce the potential hazards.
Key words*: Hazard ,Risk Analysis, critical Care units.*

Date of Submission: 09-07-2022 Date of Acceptance: 25-07-2022

I. Introduction

Hospitals with large scale population and infrastructure confront extraordinary challenges in creating a safe environment to the patients. It becomes mandatory for the hospitals to provide a safe and secure environment of healing as well as optimal level of preparedness .The Christian Medical College is a tertiary hospital which serves as a level one trauma Centre. There are more than 15 critical care units which are involved in lifesaving for vulnerable population. Most of the patients in critical care settings are dependent which poses incremental risk to hazards that can result in physical or psychological harm.How safe are they in preventing and mitigating disaster effect?In order to have an effective hospital safety programme, which will prevent functional collapse of critical care facilities we use HIRA. It is a term that encircles all activities involved in identifying hazards and evaluating risk at facilities and to make certain that risks to employees, the public, or the environment are consistently controlled .It's a process which involves Hazard identification, Risk assessment, Risk analysis, monitor and review.

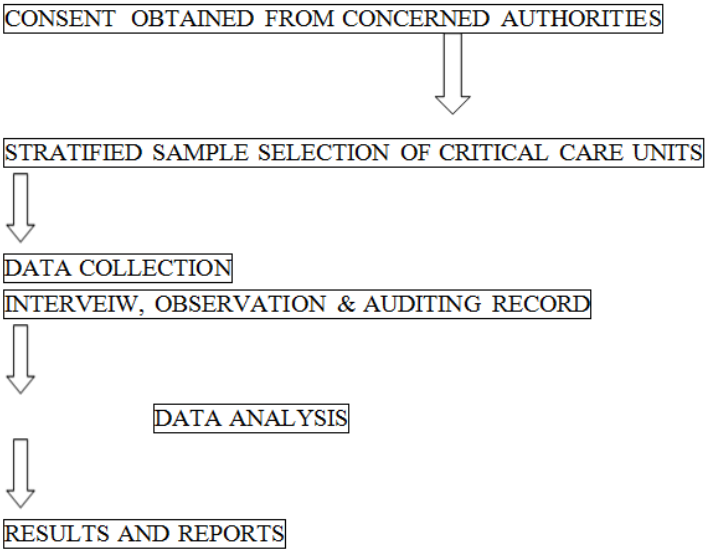
II. Objectives Of The Study

1. To identify the hazards in selected Critical Care Units.
2. To perform risk analysis of the hazards in selected Critical Care Units
3. To determine the correlation between probability and severity of the hazards.

III. Methodology

Approach and design: Quantitative non experimental approach and descriptive design was used.
Setting: The study was conducted in 5critical care units which includes both medical and surgical units of Christian Medical College,Vellore
Sample: A total of 5 critical care units were selected using stratified sampling technique Adescriptive research design was undertaken to identify the hazards and perform risk analysis in critical care units.

Detailed algorithm of the study:



IV. Description Of The Instrument:

SECTION A

- Name of The ICU:
- No of beds:
- Medical / Surgical:
- Emergency floor plan
- Emergency exit

SECTION B

A widely used tool to perform HIRA is Medical centre Hazard Vulnerability Analysis (HVA) tool which was developed by Kaiser Permanente in 2001was used in the study.

The following risk were assessed:

1. Naturally occurring events
2. Technologic events
3. Human related events
4. Events involving Hazardous material

Risk = Probability X Severity.

This allows quantitative assessment of probability, impact and risk for different hazards

Table 1: The probability is rated as below

Rating	Description	Events of the hazard
3	High	1 to 3 years
2	Moderate	3 to 10 years
1	Low	>10 years
0	Not Applicable	Less than 1% chance

Severity is calculated from the difference between **Magnitude** (human impact, property impact, and business impact.) and **Mitigation**(preparedness, internal response, and external response)The cumulative index of assessment will reveal the overall percentage score of each Hazard.

Table 2: The rating score of impact:

Rating	Description	Impact
3	Facility without extensive assistance from provincial or federal resources	**Catastrophic**
2	facility can provide normal level of service with assistance from outside or can provide minimal level of service with normal resource	**Critical**
1	Facility can provide normal level of Service with assistance within region or can provide reduce level of service with normal resources	**Serious**
0	Normal level of functioning or increased level of service within	**Marginal**

Table 3: The cumulative index of each hazard is represented as percentage and is interpreted as below:

Percentage	Description
100 – 75%	Severe consequences with little capability
74 – 50%	Medium consequences with some capability
49 – 25%	Minor consequences with good capability
24 – 0%	No consequences with very good capability

V. Results:

Descriptivestatistics was used for analyzing the data. The categories of each event and response obtained from hazard specific scale is represented in frequency and percentage. The correlation between the probability and severity of hazard were analyzed using Pearson's correlation co-efficient.

The "p" value of 0.05 is considered statistically significant and less than 0.01 as highly significant for the study.

The findings of the study were represented as table and figures under the following sections

SECTION A

Table 4: Distribution of demographic variables

Name of the ICU	Medical/Surgical	No of beds (Total 51 Beds)	Emergency floor plan &Emergency exit
Medical Intensive care unit	Medical	13	Present
Surgical Intensive care unit	Surgical	13	Present
Coronary Care unit	Medical	6	Present
Neuro Intensive care unit	Medical	6	Present
Cardio-Thoracic Intensive care unit	Surgical	13	Present

TABLE 4 depicts different Medical and Surgical intensive care units with total of 51 beds. Almost there is equal proportions of Medical intensive care unit (25) and Surgical intensive care units(26).To mark the safety, all the ICU S had emergency floor plan displayed and signage's were present for emergency exit .

SECTION B :DISTRIBUTION OF HAZARDS IN CRITICAL CARE UNITS

TABLE 5

HAZARDS	Risk	Coronary catre care unit %	Medical intensive care unit %	Surgical intensive care unit %	Neuro intensive care unit %	Cardio thoracic intensive care unit %
HAZMAT	Probability	0.11	0.26	0.22	0.07	0.11
	Severity	0.07	0.15	0.16	0.07	0.06
	Relative Risk	0.01	0.04	0.04	0.01	0.01
Human Related Hazards	Probability	O.17	0.06	0.63	0.40	0.20
	Severity	0.10	0.34	0.42	0.33	0.11
	Relative Risk	0.02	0.21	0.27	0.15	0.02
Technological Hazards	Probability	0.30	0.42	0.51	0.42	0.37
	Severity	0.17	0.36	0.39	0.35	0.17
	Relative Risk	0.05	0.15	0.20	0.15	0.06
	Probability	0.25	0.25	0.25	0.25	0.25

Natural Hazards	Severity	0.26	0.26	0.24	0.25	0.25
	Relative Risk	0.06	0.07	0.06	0.06	0.06
Total facility	Probability	0.23	0.38	0.41	0.31	0.26
	Severity	0.16	0.29	0.31	0.27	0.16
	Relative Risk	0.14	0.11	0.13	0.06	0.14

Table 5 reveals thatin coronary care unit the hazard of total facility is only 0.04% of which the probability of the hazard is 0.23% with the severity of 0.16% which reveals good facility with no consequences.
In Medical Intensive care unit shows that the hazard of total facility is only 0.38% of which the probability of the hazard is 0.29% with the severity of 0.11% which reveals good facility with no consequences
InNeuro Intensive Care unit shows that the hazard of total facility is only 0.31% of which the probability of the hazard is 0.27% with the severity of 0.08% which reveals good facility with no consequences
In Surgical Intensive Care shows that the hazard of total facility Unit is only 0.41% of which the probability of the hazard is 0.31% with the severity of 0.13% which reveals good facility with no consequences
In Surgical Intensive Care shows that the hazard of total facility is only 0.26% of which the probability of the hazard is 0.16% with the severity of 0.04% which reveals good facility with no consequences

VII: **Correlation between Probability and Severity of hazards**

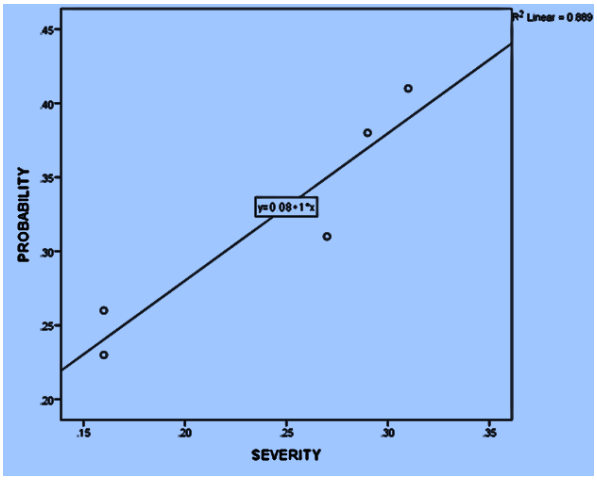


Figure 1 reveals that there is statistically significant correlation between probability and severity of hazards with P value of 0.016 level of significance.

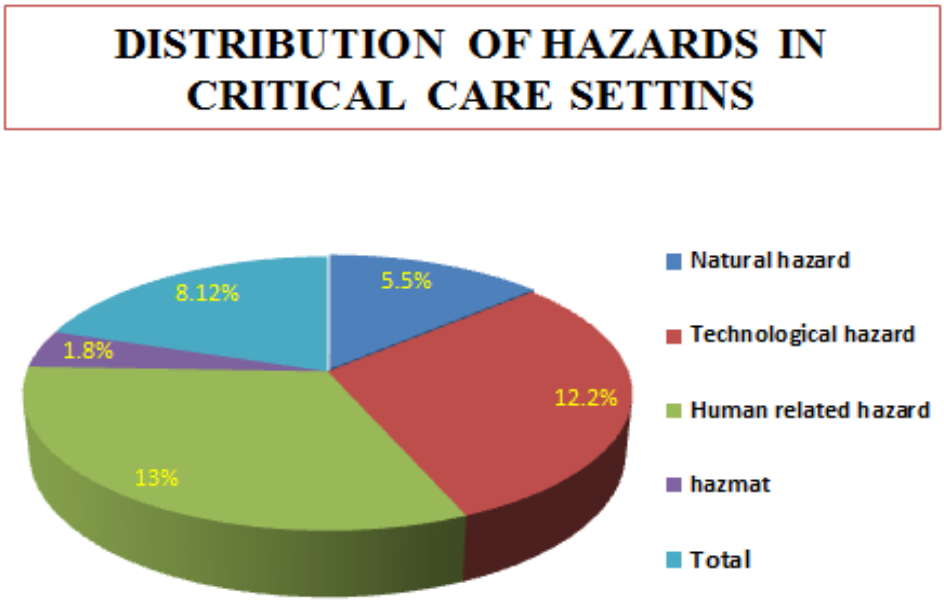


Figure 2 shows that 13% of the hazards are human related, 12.2% of the hazards are due to technological events,8.2% of the hazards result due to natural events, only 1.8% of hazards results due to hazardous material and the overall hazards seen in critical care settings is 5.5%

Table 6: **Descriptive statistics of all hazards**

		Natural Hazard	Technological Hazard	Human related Hazard	Hazardous Material	Risk	Probability
Mean(Average)		6.80	12.20	13.00	1.80	0.0820	0.3180
Median		7.00	15.00	13.00	1.00	0.0900	0.3100
Std. Deviation		0.447	6.458	11.203	2.049	0.04087	0.07662
Minimum		6	5	2	0	0.04	0.23
Maximum		7	20	27	4	0.13	0.41
Percentiles	25	6.50	5.50	2.00	0.00	0.0400	0.2450
	50	7.00	15.00	13.00	1.00	0.0900	0.3100
	75	7.00	17.50	24.00	4.00	0.1200	0.3950

Table 6 reveals that the average risk of all hazards is 0.0820 which demonstrates safe critical care settings.

VI. Discussion

There is a growing threat of hazards in critical care units and preparing for such an event is a challenge considering the diverse nature of its type. Hazards like natural, technological, and man-made hazards are ultimately becoming more frequent in critical care settings, which is why conducting a standardized hazard vulnerability analysis is essential in order to establish a robust emergency and disaster management program.The Sendai Framework 2015 to 2030 for disaster risk reduction has been recently adopted by 187 countries including India, emphasizes the need to strengthen functional disaster risk prevention and reduction measures in critical care facilities, including hospital emergency departments. (Sendai, 2015).The present study was intended to identify the hazards and its risk in various critical care units of Christian Medical College and subsequently endorse to develop an emergency response plan and provide recommendations to reduce the risk which will enhance patient safety and hospital safety. In addition it will facilitate smooth functioning of the system in times of disaster. Understanding the importance of risk the hospital administrators can develop a team for ongoing assessment and formulate control measures, eliminate or minimize the risk for disaster.

Hazard Vulnerability Analysis tool aids to assess all hazards, their risk of actual occurrence, as well as the impact on life, property, and business.HIRA will be able to offer the best to greater number of people enabling health care facilities to identify and reduce the potential hazards. The three highlighted risk questions are - What can go wrong? (Hazard), How bad it could be? (Consequences) How often it might happen? (Likelihood).HIRA is a systematic process which involves Hazard identification, Risk assessment, Risk analysis, Monitor and Review.

If hazards arenot identified early it can lead to major consequences like disasterwhich can strike the critical care units in the hospitaland subsequently leaves a substantial burden on the affected vulnerable population, often resulting in human, material, economic, or environmental losses or impacts. According to global platform 2011, hospitals also represent enormous investments for any country. Destruction of such facilities results in significant

economic burden. In addition the decline in function of the hospitals and emergency services during disaster can enormously affect public morale and a community's social and health capital. Rising from these disasters require significant amount of human and financial resources which can be a huge challenge if the affected population is already struggling economically It's important to remember that a disaster is typically the product of a hazard and vulnerability combined.Nurses working in critical care settings have plethora challenges in contributing and enhancing disaster risk reduction as professional health personnel. HIRA will be able to offer the best to greater number of people enabling health care facilities to identify and reduce the potential hazards in critical care.

The current study is indulged in retrospective and prospective assessments of possible hazardous events in critical care units which are fundamental. Efforts were taken to establish reliable resources and obtained accurate information. The hazards like Technological, Natural, Human related hazards, and Hazardous material in various medical and surgical critical care settings of a tertiary level hospital was examined.As the patients are highly vulnerable to hazards in critical care units its very important to identify the hazards and perform risk analysis to perform safe hospital programme . According to Ahmadreza et al, 2014 Hazards that occur in areas with low vulnerability will not turn into a disaster. Similarly the present study has revealed that hazards like natural (5.5%),Technological (12.2%). Human related (13%) , hazards related to hazardous material (1.8%)indicates very low vulnerability .The overall hazards shown through the study is 8.12%,which signifies that there are good facilities available with no consequences.Also the mean average probabailityof the hazards is 0.3180 and the risk related to the hazard is identified as 0.0820. This may be attributed to the well - defined system in the hospital which is formulated by the administration. . In concern with the safety of the patient, staff and the hospital the quality management cell and the safety cell of the institution has formulated standard operating procedures ,emergency response plan , provided exclusive emergency exit floor plan for all ICU with adequate signages,equipped all the areas with appropriate fire extinguishers and planned for training , equipping and empowering all the staff to encounter disaster through various education modules which was made easily available through intranet.

Each critical care unit poses department quality manager and department safety advisor who are empowered to play vital role in each unit . The major role of activity is performing ongoing assessment of hazards, conducting periodic audits on the quality , safety checks, conducting disaster mock drills, fire mock drills , earth quake evacuation mock drills of critical care patients from different ICUS .

Simple anonymous computer based sentinel event reporting systems are formulated which has subsequently improved reporting rates from the staff about the potential hazards if noted .Equipment related Critical incidents are reported, thereby corrective and preventive actions are taken to practice safe hospital programe and ensure hazard free environment.

In coronary care unit the probability (0.30%) of technological hazard was found to be higher when compared with other hazards, with the severity of 0.17% and relative risk of 0.05% .Similar to the findings in Neuro intensive care unit findings also revealed that the probability of the technological hazard is 0.42%,with the severity of 0.35% and the relative risk of 0.15%.Not only in medical even in cardio thoracic intensive care unit the probability of technological hazard has shown that 0.37%, with the severity of 0.17 and the relative risk is 0.06%. similar to this findings the Ingeborg D Welters et al 2011 has identified that the equipmemt errors 30% (technological) were rated to be higher in major sources of critical incidents in ctitical care . Contradicting this findingsin CCU, NICU and Cardio Thoracic ICU, the Medical intensive care unit has identified that the probability of human related hazard is 0.60% was found to be higher than other hazards,with the severity of 0.34 % and the relative risk is 0.21%.similar to the medical ICU even in Surgical intensive care unit the probability of human related hazard is 0.63% ,with the severity of 0.42% and the relative risk of 0.27%.The present study has brought to light that the technological hazard and the human related hazards are much more common in the critical care settings.This may be attributed to the fact that all critical care settings are equipped with various advanced equipments and monitors for providing quality care to the patients. The

number of emergency surgeries, turn over of patients , bed occupancy status, economic status of the patient ,invasive procedures ,handling various Medico-legal cases are quite challenging.

According to **BK Rout et al 2017 Risk Analysis** is the process of evaluation of the risks arising from the hazard ,taking into account the adequacy of any existing controls and deciding whether the risks is acceptable .The relative risk analysis done in critical care settings has shown that medical ICU is 0.038%,Neuro ICU is 0.31%,coronary care unit is 0.04%, surgical ICU is 0.41% and cardiothoracic ICU is 0.26% respectively. This data identified in this study reveals that the preventive measures, mitigation and preparedness of critical care units to manage each hazards are fervently carried out .

The present study has identified that there is statistically significant positive correlation between probability and severity with p value of 0.016. As the probability increases the severity also increases but the study has brought to a light that though the probability is high the relative risk is very less due to hospital preparedness.

VII. Conclusion

Hospitals are required to conduct HIRA annually. It serves as a key step in need assessment and plan emergency response to hazards and subsequently can help the organization to prioritize planning, mitigation, response, and recovery activities accordingly.

As nurses are at the forefront of disaster and serve a critical role in hazard management conducting HIRA systematically in critical care settings will enable to prioritize, plan and prepare recommendations to minimize or control disaster.

Recommendations:

- Similar studies can be done in larger scales in the hospital.
- Multidisciplinary emergency response team can be initiated in the hospital.
- Performing HIRA periodically to have an effective hospital safety programme

CONFLICTS OF INTEREST: The authors have declared no conflicts of interest

Bibliography:

[1]. Hospital safety index: guide for evaluators. Geneva, Switzerland: World Health Organization; 2008. http://www.paho.org/english/dd/ped/SafeHosEvaluatorGuideEng.pdf

[2]. Sauer, LM, McCarthy, ML, Knebel, A, Brewster, P. Major influences on hospital emergency management and disaster preparedness. Disaster Med Public Health Prep. 2009

[3]. "Sendai 2015: a new global agreement on disaster risk reduction | Overseas Development Institute".ODI.Retrieved 2016-01-13.

[4]. Assessment of disaster preparedness among emergency departments in Italian hospitals: a cautious warning for disaster risk reduction and management capacity Matteo Paganini,Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine2016

[5]. Nursing Home and Assisted Living Hazard and Vulnerability Analysis Tool
Type: Planning and Response,Author: American Health Care Association, from Kaiser Permanente,Year of Publishing: 2014

[6]. Common Hazards Found in Hospital Environments, By Layla Davis onFebruary 25, 2015

[7]. Emergency Response Plan: Hazard Identification and Risk Assessment (HIRA) Haltom health care. 2014.

[8]. Hazard © 2001 American Society for Healthcare Engineering of the American Hospital Association One North Franklin, Chicago, Illinois 60606 -9-

[9]. Hazards Analysis. www.pascocounty.com/odp/ hazard.htm

[10]. Hospital Accreditation Standards. Joint Commission on Accreditation of Healthcare Organizations, Oakbrook Terrace, IL, 2001.

[11]. Major sources of critical incidents in intensive careIngeborg D Welters,Critical Care volume 15, Article number: R232 (2011)

[12]. American Society for Healthcare Engineering of the American Hospital Association www.ashe.org

[13]. Kaiser Permanente's interactive HVA tool available at: www.emsa.ca.gov/dms2/kp_hva.xls

[14]. Emergency Management Program GuidebookPublished by VHA Center for Engineering & Occupational Safety andHealth, St. Louis, MO vaww.ceosh.med.va.gov

[15]. Kaiser Permanente. Medical center hazard and vulnerability analysis. 2001 Kaiser Foundation Health Plan, Inc

Mrs.Sheeba.J, et. al. "Hazard Identification and Risk Analysis (HIRA) In Critical Care Units of Christian Medical College (CMC), Vellore." *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, 11(4), 2022, pp. 01-07.