A STUDY ON HAZARD IDENTIFICATION AND RISK ANALYSIS IN LABORATORY DEPARTMENT

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the

Degree of Master of Business Administration

(MBA)

in

Hospital and Health Management

By

Nupur

Under the Supervision and Guidance of

Dr. Nutan P Jain

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DECLARATION BY THE STUDENT

I hereby declare that this dissertation titled A STUDY ON HAZARD IDENTIFICATION AND RISK ANALYSIS IN LABORATORY DEPARTMENT is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Nupur

CERTIFICATE

This is to certify that dissertation titled A STUDY ON HAZARD IDENTIFICATION AND RISK ANALYSIS IN LABORATORY DEPARTMENT is a record of the research work undertaken by Nupur in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide
IIHMR University, Jaipur

Date

School Dean
IIHMR University, Jaipur

Date

ACKNOWLEDGEMENT

No serious and lasting achievements of success, one can ever achieve without the help of friendly guidance and co-operation of people involved in it.

The success of my project is never limited to the individuals undertaking the project. It is a co-operative effort of the people around and individual. For all effort, behind this successful project, I am highly intended to the following personalities without which this project would never be completed. I find no words to express my gratitude towards those who were constantly involved with me, through my work.

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TABLE OF CONTENT

ACRONYMS/ ABBREVIATION

Hazard	A Hazard is a potential source of harm or adverse health effect on a person or persons
HAZMAT	Hazardous material
Likelihood of occurrence	Likelihood on a risk matrix represents the likelihood of the most likely consequence occurring in the event of a hazard occurrence
MSD	Musculoskeletal Disorders
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
Risk	likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard
RPN	Risk Priority Number
RR	Risk Ratio
Severity	Severity on the risk matrix represents the severity of the most likely consequence of a particular hazard occurrence.
SOP	Standard Operating Procedure
WHO	World Health Organisation

ABSTRACT

A hazard is defined as a situation that poses a level of threat to life, health, property, or environment.

These hazards are also very dangerous for human and animal life . Most hazards are dormant or potential, with only a theoretical risk of harm; however, once a hazard becomes "active", it can create an emergency . A hazardous situation that has come to pass is called an incident. Hazard and possibility interact together to create risk .

A Risk defined by ISO 31000 as the effect of uncertainty on objectives, whether positive or negative).

A probability or threat of damage, injury, loss, liability or any other negative occurrence that is caused by either internal or external vulnerabilities .

Laboratory Department is one of the most important departments in a hospital that requires high level of care. Occurrence of hazards in laboratory department can bring a major risk to the laboratory personnel, and patients. Therefore, a list for prevention of hazards in laboratory department must be taken into account to prevent occurrence of any hazards.

This study is conducted in Asian Institute of Medical Sciences, Faridabad on "Hazards identification and risk analysis in laboratory Department" under the guidance of Dr. Shashi Tiwari, Manager- Quality & Operations. During the whole duration, a list of hazards has been prepared. It is found that there can be many hazards in all the process carried in the laboratory department from sample collection, sample transport to the dispatch of the reports. There are various risks associated with these hazards and also the control measures which have been taken by the hospital and staff of laboratory department to prevent these hazards are also included in this list.
At last, some recommendations are given which can further improve the quality of laboratory services.

INTRODUCTION

Risk management is the identification, assessment, and prioritization of risks (defined in ISO 31000 as the effect of uncertainty on objectives, whether positive or negative) followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities

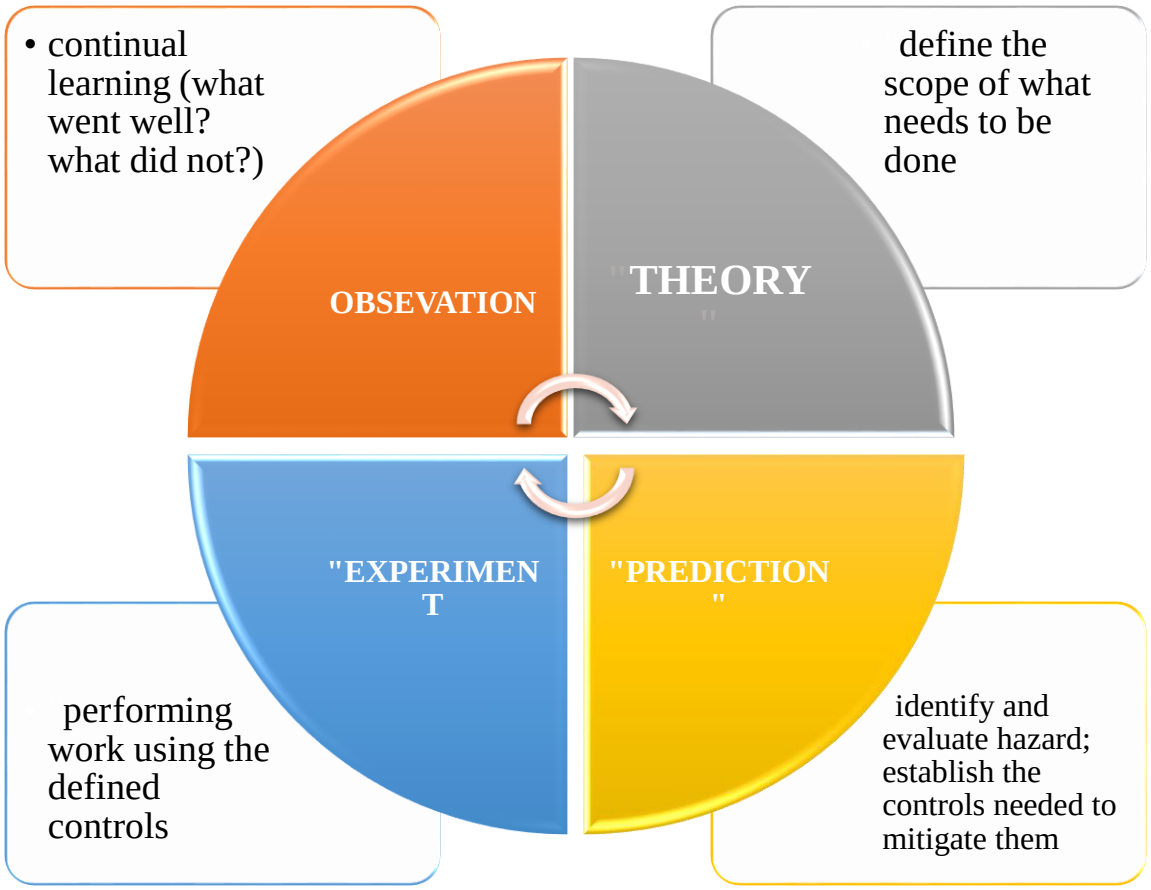
A hazard is defined as a "Condition, event, or circumstance that could lead to or contribute to an unplanned or undesirable event." It can be any event or because that has led to such an incident that is not desired. However, the occurrence of any hazard is rare and often undesired incidents/accidents are caused due to multiple hazards.

Generally speaking, risk management is the process to protect the assets and minimize financial loss to the organization . Managing risk is a proactive function. It is taking action to reduce the frequency and severity of unexpected incidents, reduce the impact of legal claims, and promote high reliability performance, system design, and the uniqueness of each patient exposes the organization to the potential for liability .

Hazard Identification and Risk Assessment Framework

INTRODUCTION TO HAZARD IDENTIFICATION AND EVALUATION

The means of determining hazards, assessing the risks offered by those hazards, and managing the risks of hazards of the experiment to be done are all processes that organisations with strong safety cultures find methods to incorporate into the experimental design process . The simplest components of the scientific method are depicted within the circle, and the simplest components of a process for identifying, evaluating, and controlling hazards are displayed in the matching boxes, to demonstrate this interaction.



KEY ELEMENTS OF HAZARD IDENTIFICATION AND EVALUATION

- **Defining the Scope of Work**

An important but often overlooked preparatory step in identifying & assessing hazards is identifying the task or group of tasks to be evaluated . Without this, the effectiveness of each subsequent process step can be compromised. Any behaviour that poses a significant risk, hand-over between laboratory staff, critical skills, or any specific training required for a researcher performing a task can be overlooked . Conversely, by analysing a 0well-defined scope of work, an individual or team can choose the best method for assessing the risk of laboratory work, defining who needs to be involved in the analysis . Create a framework to facilitate identification. Of future changes.

Organizations often find it useful to establish scoping guidelines appropriate to the type of research activity being conducted. For example, an organization might say that all tasks performed within the four walls of a given laboratory would be collectively analysed as the "range" however, higher risk activities have been identified, such as working with pyrophoric materials or linking laser systems, which require additional analysis to a limited extent. Another organization may decide that each individual should complete an analysis of the tasks they will perform, which means that the individual's daily activities become "the ". However, another organization may decide that individual tasks, such as research protocols or steps required to successfully operate an instrument , should be analysed as "scope" Individual. Each of these strategies can be effective in allowing an organization to ensure that all laboratory studies are fully reviewed.

- **Hazard Identification**

Recognizing the existence of hazards is essential to performing a complete analysis. Simply put, a hazard is a possibility of harm . The term is often associated with an agent, condition, or activity (a natural phenomenon, a chemical substance, a mixture of substances, a process involving substances, a source of energy, or a situation or event) that, if left unchecked, could result in injury, illness, loss of property, or damage to the environment . A hazard is an intrinsic property of an agent, condition or activity. It is often easier to identify the agents or conditions that cause a hazard, but more difficult to identify the hazards associated with an activity. Techniques are presented later in this guide to facilitate identification and assessment of hazards. One quality that makes each of these techniques unique is the method used in each to enable the user to identify hazards.

- **Hazard Evaluation**

The product of a hazard evaluation should be the qualitative—and sometimes quantitative—understanding of a hazard. The results of an assessment or evaluation of the risk of the hazards of a given experiment should guide the selection of risk management techniques and tools—elimination or substitution of materials; primary safety devices or engineering controls, such

as chemical fume hoods; personal protective equipment (PPE); and specific procedures and processes .

To sufficiently understand the purpose of hazard evaluation and risk mitigation, one must understand the relationship between hazard and risk . Risk is the probability that a hazard will result in an adverse consequence . The terms hazard and risk are not synonymous. Since hazards are intrinsic properties of a substance or condition, they can only be eliminated by eliminating the agent, condition or activity that causes the hazard . Danger can't really reduce; however, once identified, appropriate control measures can be implemented and the risk associated with the hazard can be minimized or minimized . For example, benzene is a human carcinogen; therefore, exposure to benzene in the laboratory poses a health hazard . If working with laboratory-scale benzene in a properly functioning chemical fume hood, with practices and PPE that minimize the possibility of exposure or inhalation, the possibility of exposure is low or eliminated. thus, minimizing the risk . Some of the methods presented in this guide encourage the use of risk scoring .

PRINCIPLES OF RISK MANAGEMENT

For risk management to be effective, an organization should at all levels comply with the following principles :

- ✓ Risk management creates and protects value.
- ✓ Risk management is an integral part of all organizational processes.
- ✓ Risk management is part of decision making.
- ✓ Risk management explicitly addresses uncertainty .
- ✓ Risk management is systematic, structured and timely .
- ✓ Risk management is based on the best available information .
- ✓ Risk management is tailored .
- ✓ Risk management takes human and cultural factors into account .
- ✓ Risk management is transparent and inclusive .
- ✓ Risk management is dynamic, iterative and responsive to change .
- ✓ Risk management facilitates continual improvement of the organization .

ESSENTIALS OF RISK MANAGEMENT

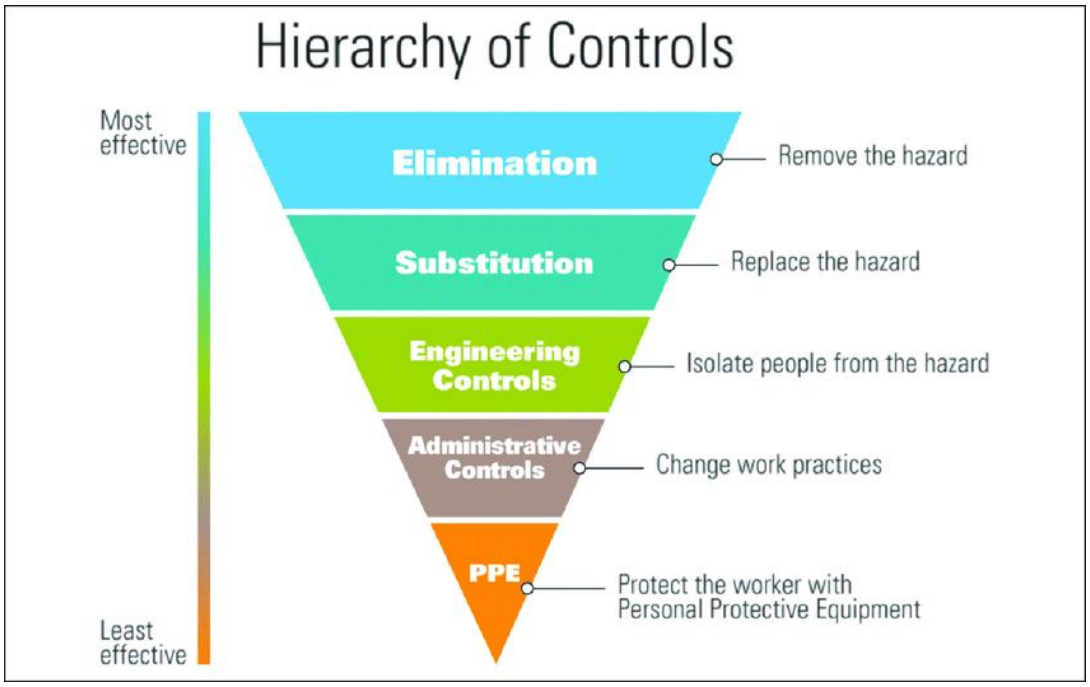
- ➢ Identification of situations in the hospital that could produce an incident that would result in financial loss –directly or indirectly .
- ➢ Evaluation of incident reports regularly to be able to identify those situations in the hospital those are likely to yield an incident.
- ➢ Elimination of needlessly dangerous procedures that are performed on the premises that can result in product liability suits

- Reduction of risks so that the hospital can feel comfortable in instituting an internally funded and operated insurance mechanism .
- Transfer of liability by having "hold harmless" agreement with vendors/ parties of business .
- Insurance coverage through the best option among the commercial, captive, and self-insurance by itself or in a combination to meet the needs of the hospital in the most reliable and cost-effective manner.

HIERARCHY OF RISK CONTROL

The "Hierarchy of Controls" is used at all the times when implementing controls to eliminate hazard or reduce the risk of a hazard causing loss/ damage/ injuries .

TYPES OF THE CONTROLS



1. ELIMINATION

   Elimination of hazard us the most effective means of hazard control. It involves the physical removal of the hazard ,

   - for example ,

- If employees are required to work high above the ground, the hazard can be eliminated by moving the piece they are working on to "ground level" to eliminate the need to work at heights
- Repair damaged equipment promptly
- Move noisy machine from a quiet area .

2. SUBSITUTION

The second most effective way to control hazards is substitution replace the hazard with a lesser hazard

For example :

- A telephone hand set can be replaced with a head set where there is constant use of telephone
- Substituting a smaller package or container to reduce the risk of manual handling injuries such as a back strain substituting a hazardous chemical with less dangerous one

3. ENGINEERING CONTROLS

The third most effective means of controlling hazards is engineering controls. Engineering controls do not eliminate the hazards, but rather keep people isolated from the hazard

4. ADMINISTRATIVE CONTROLS:

Establishing policies, procedures and work practices designed to reduce worker's exposure to risk. It can also include provision of specific training and supervision. For example:

- Job scheduling to limit exposure
- Posting hazard signs
- Restricting access
- Training

5. Personal protective equipment (PPE)

Covering and protecting a worker's body from hazards. It can be used as a short-term control measure until a higher order control has been provided, or to supplement it. The employer would also have to provide training for workers required to use it, and the employees would have a responsibility to use it properly .

- Some examples of PPE are :
- Use of ear plugs/muffs in noisy areas
- Use eye protection when working with chemicals
- Use gloves to protect against infections

INTRODUCTION OF THE HOSPITAL

ASIAN INTITUTE OF MEDICAL SCIENCES

OVERVIEW

A 425 bed super speciality tertiary care hospital brings some of the best doctors in India and is absolutely futuristic in its services and technology. The hospital is outfitted with cutting-edge equipment and has received NABH and NABL accreditations. According to the "A C Nielson Survey," THE WEEK magazine ranked “ASIAN INSTITUTE OF MEDICAL SCIENCES” as the seventh-best hospital in Delhi-National Capital Region. Dr. Narendra Kumar Pandey, a Palmistry Awardee and “FRCS (Edinburgh)” and “FRCS (Glasgow)” FACS, FICS, is the architect of the hospital.

Through its thirteen centres of excellence, the “Asian Institute of Medical Sciences” offers comprehensive tertiary care facilities for many different specialties.

VISION

"To be the most trusted healthcare partner FOR PEOPLE through our unsurpassed quality & care and by striving to provide ACCESSIBLE, AFFORDABLE and BEST AVAILABLE healthcare services in India."

MISSION

"To provide comprehensive patient care by working as a team and offering highest standards of medical service in an ethical manner for delivering extraordinary customer satisfaction."

OUR MOTTO

"Will to Serve. Skill to Cure"

CORE VALUES

- Focus on Patient and Patient Care
- To provide extraordinary customer satisfaction
- Treating all people with respect and dignity
- Acting always with utmost integrity
- Creating value for the society we live in
- Service with Empathy and Compassion
- Teamwork – Partnering for success

QUALITY POLICY

"To create a safe patient centric healthcare delivery system which is accessible, affordable and best available"

SPECIALITIES

Asian Institute of Medical Sciences provides comprehensive multi-specialty tertiary care facilities through its thirteen centres of excellence.

- **Asian Cancer Centre**

  The Cancer Treatment Centre at Asian Hospital is renowned for its brilliance in patient care and services Well-experienced oncologists are known for their perfection in their field of expertise. The oncologists from different disciplines of surgical, radiation and medical oncology consolidate their experiences to provide the precise and best treatment for cancer patients. Hence, we succeed to offer synchronized services along with cutting edge infrastructure and facilities. We are devoted to offering the best treatment and patient's satisfaction . The Asian Cancer Centre offers end to end services from prevention to early detection, comprehensive treatment, and palliative care; all under one roof for both adults and pediatrics .

- **Asian Heart Centre**

  Asian Heart Centre is proud to be one of the most premium hospitals for heart treatment in Faridabad . It is also one of the best heart treatment centers in India. The vision of this department is to provide the highest quality of integrated cardiac care to the population of this region at acceptance cost with a focus on research and education. In a short period of time, the center has been recognized as the premier cardiac center of this region through its proficient services and dedication in patient care for cardiovascular diseases and cardiac surgeries

- **Asian Centre for Advanced Surgery**

  The Asian Centre for Advanced Surgery provides a wide range of surgical services starting from conventional surgeries to minimally invasive laparoscopic surgeries and rare and critical surgeries This department is managed by well experienced and highly skilled surgeons, expertise in multiple disciplines of surgery. We have state-of-the-art equipment and latest technology to support the proficiency of our surgeons . This department of surgery at Asian Hospital offers a full range of laparoscopic surgery procedures . It also provides consultation and surgery on medical conditions involving breast, lungs, endocrine system, gastrointestinal tract, colon, rectum, liver, pancreas, varicose veins and accident and trauma services

- **Asian Centre for Urology & Kidney Transplant**

  Asian Institute of Medical Sciences has a vision of being a center of excellence in renal (Kidney) care It has state-of-the-art medical (Nephrology) and surgical (Urological) departments working together with a backup of excellent ICU, emergency, cardiology, operative, imaging and diagnostic team so that a world class renal diseases treatment facility can be provided to the patients with a difference

Asian Centre for Renal Diseases and Dialysis provides dialysis support to critically ill patients with the aid advanced infrastructure and technology . Both the modalities, convective and diffusive are available along with a tailor-made therapy for the needy patients. The spectrum of therapy options available are :

- SLED (Sustained Low Efficiency Dialysis)
- PIRT (Prolonged Intermittent Renal Replacement Therapy)
- CRRT (Continuous Renal Replacement Therapy)
- Various hemoperfusion techniques such as charcoal hemoperfusion
- Hemodiafiltration facility is available to provide better clearance of middle molecules

Kidney is an important organ to maintain correct composition of human body. Disease of kidney has protean manifestation and includes various disorders such as :

- AKI (Acute Kidney Injury)
- RPRF (Rapidly Progressive Renal Failure)
- CKD (chronic kidney disease)
- Fluid and Electrolyte Imbalance
- Acid Base Disorder
- Renal Hypertension
- Bone Mineral Disorder of CKD

- **Centre for Neurology and Neurosurgery**

  Asian Centre for Neurology and Neurosurgery is an integrated department to provide exhaustive medical solutions to all types of neurological disorders . This unit has a perfect blend of best medical and surgical expertise of eminent neurologists and neurosurgeons, constant research and development and latest technology . Our expert care is aided by the state-of-the-art infrastructure from life-saving intervention for acute brain trauma to skillful management of chronic illnesses through medicine or surgery . This department is one of the most successful units in Delhi NCR as it has diagnosed and treated thousands of neurological disorders of national and international patients along with some very rare and complex cases .

The department has two divisions- Neurology and Neurosurgery which work in sync to provide best diagnostic and treatment facilities for brain and nervous system disorders .

- Asian Centre for Renal Diseases

- **Asian Centre for Bone & Joints**

  diverse expertise and are committed to provide effective solutions to a broad range of orthopedic problems such as sports medicine, trauma, slip disc surgery, adult reconstruction, joint replacement, pediatrics, orthopedic oncology, spine, shoulder and elbow, foot and ankle and hand . The department is dedicated to provide expert treatment for all aspects of musculoskeletal injuries including inpatient and outpatient surgical care, rehabilitation and prosthetics .

- Asian Centre for Advanced Imaging
- Asian Centre for Gastroenterology
- Asian Centre for Mother and Child
- Asian Centre for Bariatric & Metabolic Surgery
- Asian Centre for Aesthetic Surgery & Medicine
- Asian IVF Centre

REVIEW OF LITERATURE

According to chapter 1 of national board for hospitals and health care providers (NABH) standard AAC 6 says about laboratory services. some of its objectives focus on documented procedures guide ordering of tests, collection, identification, handling, safe transportation, processing and disposal of specimens . Critical results are to be intimated immediately to the personnel concerned. Results are reported in a standardized manner and outsourced laboratory tests .

According to quality assurance manual, department of laboratory services AIMS states the process involved in laboratory services starting from sample collection, sample transport to the report dispatch and the hazards during these process and various controls like safety equipment, use of laminar flow/ biosafety cabinets, autopipettes etc.

As per the laboratory safety manual of AIMS, there are many occupational health risks in hospitals & laboratories and how can hazards be identified and risk analysis made and about the implementation of MSDS. Also, it highlights about the handling and processing of specimens, PPE, handwashing and handling & disposal of hazardous lab materials.

Guidelines developed by the hazard identification and evaluation task force of the American chemical society's committee on chemical safety enlist elements of hazard identification and hazard evaluation . The hazard identification can be done by agent, condition and activity. A hazard cannot be truly reduced; however, once identified, appropriate controls can be implemented and the associated risk from the hazard can be reduced or mitigated . For example, benzene is a human carcinogen; therefore, exposure to benzene in laboratory work poses a health risk . If one works with laboratory scale amounts of benzene in a properly functioning chemical fume hood, with practices and PPE that minimize the potential for contact or inhalation, the likelihood of exposure is low or eliminated, thereby minimizing the risk

Article in Journal Oral and Maxillofacial Pathology March 2013 highlighted on quality and safety aspects of histopathology lab. The Safety measures while handling hazardous materials, storage: - Containers of chemicals should be labelled with certain basic information: chemical name, manufacturer's name and address, storing and handling instructions, date of receipt and opening, date purchased, expiration date, hazard warnings and safety precautions .

- Stored chemicals should be examined periodically for replacement, deterioration and container integrity. Whenever possible, buy dangerous reagents in plastic- or plastic-coated containers .

In a recent book published by the **center for chemical process safety by David J. Leggett** discussed the relationship between the hazards and consequences of an upset event, likelihood of its happening and the resulting risk to personnel, property and the environment . This study assists organisations with goals of improving safety and managing the risk of operations . However, reported data on incidence in academic chemistry laboratories indicated that the accidental rate is 10-50 times higher than that in industrial laboratories.

- Some well-established risk procedures have been adapted to the task of hazard identification and risk assessment in the chemical research laboratory .

The world health organization Geneva 2004 introduced the laboratory biosafety manual and concluded that the backbone of the practice of biosafety is risk assessment. While there are many tools available to assist in the assessment of risk for a given procedure or experiment, the most important component is professional judgement . The laboratory director or principal investigator is responsible for ensuring that adequate and timely risk assessments are performed, and for working closely with the institution's safety committee and biosafety personnel to ensure that appropriate equipment and facilities are available to support the work being considered . Once performed, risk assessments should be reviewed routinely and revised when necessary, taking into consideration the acquisition of new data having a bearing on the degree of risk and other relevant new information from the scientific literature

Clifford M. Chapman MS, HTL(ASCP), QIHC on his book safety in the histology laboratory mentioned about Personal Protective Equipment. Some practices and equipment that can offer protection in the histology laboratory are the following that should be used for all laboratory work with chemicals

1. Accidents and spills

a. Eye contact: promptly flush eyes with water for a prolonged period (at least 15 minutes) and seek medical attention .

b. Ingestion: Check the specific MSDS and call the Poison Center at 1-800-222-1222 .

c. Skin contact: promptly flush the affected area with water and remove any contaminated clothing .

d. Spills:

- If symptoms persist after washing, seek medical attention

(1) "NOTIFY" co-workers so that they may exit the area,

(2) CONTAIN the spill with absorbent from any of the spill control stations located in the laboratory ,

(3) NOTIFY the Chemical Hygiene Officer or Technician in charge so they may arrange for clean-up.

The Chemical Hygiene Officer may clean up the spill using equipment designated for h is use only. If he is not available, the Technician in charge will call Clean Harbours at (617) 849-1800 and request spill clean-up.

Avoid unnecessary exposure to chemicals.

a. Do not smell or taste chemicals. Vent toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices

b. Use only those chemicals for which the quality of the available ventilation system is appropriate .

c. There is no eating, drinking, smoking, or application of cosmetics in areas where laboratory chemicals are present .

d. No food is allowed in laboratory refrigerators .

e. Handle and store laboratory glassware with care. Do not use damaged/cracked glassware; discard immediately .

f. Wash hands well each time you leave the laboratory .

g. Avoid practical jokes or other behaviour, which might confuse, startle or distract another worker .

h. Do not use mouth suction for pipetting .

I. Confine long hair and loose clothing .

j. Wear shoes with flat rubber soles in the laboratory; do not wear sandals or perforated shoes .

k. Keep the work area clean and uncluttered, with chemicals and equipment properly labelled and stored; clean up the area upon completion of an operation

l. Make sure that eye protection is worn by all persons, including visitors, wherever chemicals are used/stored .

m. Wear appropriate gloves when the potential for contact with toxic materials exists .

n. Use other protective equipment (i.e., isolation gowns, safety glasses as appropriate).

"A case study was conducted by Maazza Yousuf Abdallah Mohamed http://eprints.usm.my/10354/1/RISK_ASSESSMENT_OF_HAZARDOUS_CHEMICALS.pdf) (on risk assessment on hazardous chemicals. The sixteen hazardous chemicals were handled by the students, along with other less hazardous chemicals, during their laboratory works . The assessment was conducted for a period of more than 6 months, and it was based on observation while the students were performing their normal experimental works i.e., whether they followed the safety parameters and considered the appropriate precautions for handling the chemicals . The primary parameters used to evaluate the risk were: exposure, hazard and risk ratings . The method applied was adopted from Occupational Safety and Health Administration OSHA (Malaysia) . The modified method showed more credibility and reasonability when compared to conventional OSHA model . The vapour pressure (VP), lethal dose (LD50) and solubility (S) were considered the most effective physicochemical properties for estimating the degree of chemical release and the degree of chemical absorbed . "Although the trend obtained from these physical parameters and the risk

rating were almost similar, but the results attained from vapour pressure and LD50 were found to be more rational for estimating the risk rating. The risk rating of the chemicals was found to decrease in the order: sodium cyanide (NaCN) > benzene (Bz) > gold potassium cyanide (Kau (CN)2) > benzyl chloride (BC) > 1,1-(Methylenedi-4,1-phenylene) bismaleimide (BMI).

"Qureshi (1987) had done a Hazard and Operability Study (HAZOP) in which potential hazards and identified by looking at the design in a dynamic manner":

- To identify the nature and scale of the dangerous substances ;
- To give an account of the arrangements for safe operation of the installation, for control of serious deviations that could lead to a major accident and for emergency procedures at the site";
- To identify the type, relative likelihood and consequences of major accidents that might occur; and
- To demonstrate that the manufacturer (operator) has identified the major hazard potential of his activities and has provided appropriate controls .

"Texas technical university conducted a case study on laboratory explosion". Through a review of evidentiary records, interviews, and post-incident observations, they concluded that each layer of safety management within the institution had deficiencies that contributed to the **January 2010 Texas Tech incident** . Additionally, they identified several gaps beyond the university itself where safety management and practices of the researchers could have been influenced to aid in prevention, including the grant funding agency, the existing laboratory safety regulations, and good practice guidance. Specifically, the CSB found : The physical hazards of the energetic materials research work were not effectively assessed and controlled ; Comprehensive hazard evaluation guidance for research laboratories does not exist; Previous Texas Tech laboratory incidents with preventative lessons were not always documented, tracked, and formally communicated at the university .

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

In everyday language, research refers to the pursuit of knowledge . It might also be defined as a scientific search for relevant knowledge on a certain subject . In reality, searching is a form of scientific inquiry. In layman's words, research is defined as "a thorough examination or inquiry, particularly via the discovery of new facts in a field of expertise."

RESEARCH QUESTION

How “Hazard identification and risk assessment” (HIRA) influences the safety of the employees in the laboratory department in context of Asian Hospital.

OBJECTIVES OF THE STUDY

The broad objective is to study “Hazard identification and risk analysis” (HIRA) in laboratory department of Asian Institute of medical sciences, Faridabad. The specific objective of the study are:

- To examine the process carried in the biochemistry, histopathology, microbiology and hematology departments.
- To evaluate the hazards and risk associated with the processes or methods, materials and equipment used to perform work.
- To analyze the probability and severity of the identified risks and give appropriate scoring and rating
- To identify the control measures sufficient to eliminate or reduce risk to an acceptable level

RATIONAL OF THE STUDY

Risk Management, is the process of identifying hazards, determining the risk based on likelihood and severity of work injuries, ill health and property damage, prioritising the

implementation of preventive measures to mitigate these risks and communicating the risk assessment to workers

Ideally, physical, chemical, biological, ergonomic and psychosocial hazards are identified when conducting Risk Management with the intent to reduce human error and influence positive safety behaviour .

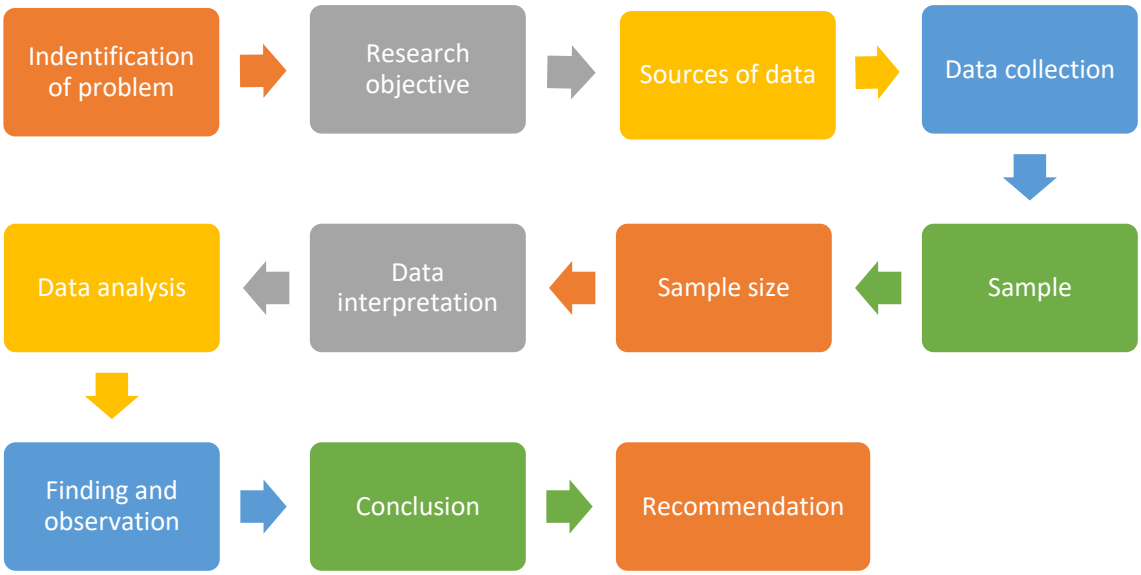
During this project, we tried to work closely with management and to keep abreast of newly introduced work processes and changes in work arrangements as these may introduce new hazards and require a review of existing risk assessments . When conducting OSH risk assessments, we should proactively and systematically identify all relevant hazards . By doing hazard identification well, we will be one step nearer to our goal of achieving zero harm .

It was envisaged therefore that Findings generated from this study would enable Asian hospital to assess its Hazards more critically and have correct perceptions of the actual situation of safety in the hospital.

i. The findings of the study can motivate staffs and safety managers to focus attention on issues critical to safety of their work force.
ii. The findings of the study will be highly beneficial to laboratory department in hospital as the study suggests many ways to develop its hazard control methods.

LOGICAL FLOW OF IS AS FOLLOW

The following steps is being followed in this project



SAMPLING TECHNIQUE USED

The technique of **Convenience sampling** has been used in the observation of the data Convenience sampling is adopted because in this data can be collected from a conveniently available pool of respondents It is the most commonly used sampling technique as it's incredibly prompt, uncomplicated, and economical and also members are readily approachable to be a part of the sample .

SELECTION OF SAMPLE SIZE

In order to take a reasonable sample size and not to disturb the functioning of the laboratory department, a sample size of reasonable strength of the hospital has been taken in order to arrive at the present practises in the hospital .

- A daily visit of the department for 1.5 month and taking a sample size of 4 per day i.e., total 120 samples and then tracking the whole process finding the hazard and associated risk and combining the results and come to the conclusions.

DATA COLLECTION

To decide the suitable information for research mainly two kinds of data was collected namely primary and secondary data as clarified below :

PRIMARY DATA

Primary data are those that are obtained from scratch and for the first time, and hence are unique. However, there are a variety of approaches for gathering primary data, none of which have been used in this study . The following are the ones that have been used:

- Checklist
- Informal interviews (for clarity about the process flow of laboratory hazards and their associated risk with their control measures)
- Observations

SECONDARY DATA

Secondary data is gathered from prior studies and publications for completing the project. The secondary data was gathered using the following methods:

- Text books
- Articles
- Hospital's safety manuals, laboratory SOP, quality assurance manuals)
- Journals
- Websites (google scholar, PubMed)

CONSTRUCTION OF CHECKLIST

Traditional checklists use" "Yes," "No," and "N A" "scales for the checklist questionnaire . This can potentially over simplify the scale and severity of the hazard present . To address this issue, checklists now include degrees of the "Severity of Consequences" and the "Probability of Occurrence"(described in APPENDIX 1) to identify a more accurate representation of the risk associated with an entire laboratory's operations, a laboratory-specific operation .

PROCESS OF DATA COLLECTION

Checklist was structured according to the process flow of the laboratory then the thorough observation of the whole process flow to identify Hazard and risk associated and giving scoring (Evaluation matrix- Apendix 2)

- **Data Analysis:** A Risk assessment matrix using a mixed method analysis of descriptive & self-inspectional and interviews are used
    - The risk probability number (RPN) will be calculated by multiplying likelihood of occurrence and severity. According to the RPN score the hazard are further classified as low, moderate and high risk.

TOOLS USED

The main tool used for the collection and analysis of data in this project are :

- Tables
- Fishbone diagram

LIMITATION OF THE STUDY

- The study is limited to a single department of the ASIAN HOSPITAL Faridabad,
- This is carried out for a small period of time. Moreover, the data has been extracted from secondary source hence the limitation of such source do apply to the survey also. The sample size for survey is also very small.
- The response of employees in giving information was lukewarm .

The response given by the employees have to be believed and have to be taken for granted as truly reflecting their perception

IMPLICATION OF THE STUDY

Hazard identification and risk analysis in hospitals is one of the most important works that would help to increase patient safety and therefore increasing patient satisfaction. It will also help in identify, analyze and prioritize all hazards in laboratory department. This case study takes into account for the vulnerabilities of a specific hazard, consequences if a hazard is realized and means to prevent those hazards.

The staffs of the laboratory department are getting trained for proper technique of patient care and usage of the equipment's to avoid hazards in the department. Equipment's are timely calibrated to avoid failure during procedure. This study illustrated what are the types of hazards that can happen in the department and how to prevent them.

DATA ANALYSIS

DATA ANALYSIS

This basically consists of Hazards that can hamper the safety of the human, material associated with proper functioning of the laboratory their associated risk. The likelihood of occurrence and severity of the hazard (Evaluation matrix- appendix). Based on the matrix RPN score are calculated. By calculating the RPN score we can categorize hazards in low, medium and high and accordingly actions are taken to reduce or eliminate those hazards and promote safe work environment. Here Hazards are mainly divided into Physical, chemical, biological, ergonomics.

HIRA : Laboratory								
S.No	Activities of Laboratory	Hazards	Risk	Likelihood of Occurrence	Severity	Risk Score	Risk Rating	Recommendations/Controls
1	**Doctor's order**	illegible handwritting of doctors	Misinterpretation of test	2	2	4	L	1) Training to doctors on improving hand writing and to write in capital letters. 2) Top management evaluation / audits should be done.
2	**Handling of Electrical**	Improper maintenance of equipment/Faulty equipment	Risk of Fire of Fire /explosion	1	2	2	L	In house Bio Medical Engineering team is in place to take care of routine equipment breakdown 2. training of staff regarding management of handling faulty equipments 3. periodic facility management round
		Electrical shock due to contact with high power / Voltage equipments	Electroculation/ Burn	2	2	4	M	Work specific gloves,training of staff
		faulty equipment	Risk of Fire / Short circuit	1	2	2	L	In house Bio Medical Engineering team is in place to take care of routine equipment breakdown 2. training of staff regarding management of handling faulty equipments 3. periodic facility management round 4.
		Over plugging in extension cords	Short ciruit due to overloading	3	3	9	M	cords should be plugged in within the range to avoid overloading
		Entangled wire/cords in the path ways	slip and trip which can cause sprain , strain and cuts	3	2	6	M	electrical pendants used to keep cords out of the way
3	**Handling of Chemicals**	skin absorption of chemicals	allergic reactions or other skin problems if absorbed by the skin	2	2	4	L	appropriate personal protective equipment, lab coat are worn
		inhalation of toxic fumes due to Improper storage	certain chemicals can cause irritatation in the eyes, nose, throat and lungs	2	2	4	L	appropriate personal protective equipment and proper ventilation

4	**Physical**	Poor lightening	Sprains , Strains and Bruises	1	1	1	L	porper signages for wet areas , Proper lightining
		Sharp tools	Cut / Bruise	2	2	4	L	gloves and training of staff about usuage/ handling of the sharps
		Heat released form equipments	hastily or improper handling can cause serious burns	3	2	6	M	gloves, trining of staff as per manufacturer's mannual to avoid such cases
		movement of machinery	Breakage	3	1	3	L	training to staff regarding maintenance handling of equipments as per manugfacturer's mannual
		blocked passages/ emergency exits	slip and trip can occurs and also moving heavy materials along passage can be difficult 2. blocked emergency exits	4	3	12	H	no controls
		spills and breaks	cuts and scrapes	3	2	6	M	spillage management training
5	**Biological**	body fluids	infection	1	2	2	L	appropriate use of personal propective equipment
6	**Ergonomics**	Repitition of work, awkward posture, lifting or handling loads	Poor ergonomics can cause musculoskeletal disorders (MSDs). These include numbness, tingling, and sharp pain	2	2	4	L	1. Adjust the height of working surfaces to reduce long reaches and awkward postures 2. using mechanical lifting equipment for lifting heavy loads
7	**Occupational**	Improper handling of hazardous materials	Spillage	2	2	4	L	training of staff about spill management

Processes								
BIOCHEMISTRY								
8	**Centrifugation**	speed not monitored	breakage & aerosolization can occur	3	1	3	L	Speed monitoring,balance monitoring, daily log.If breakage occurs: 1:10 dilution of bleach or a non-corrosive disinfectant into canister to decontaminate, after it gets soaked for 20 min. Use forceps & dispose in sharp container.
		caps or parafils not used	Centrifugation creates a vacuum &volitizes liquids 1)Contaminated items become aerosols 2) flammable liquids may explode	3	1	3	L	Use caps or parafilm
		maintenance not proprely done	Inaccurate lab results can occur	3	1	3	L	Calibration schedule & preventive maintenance schedule is in place with bio-medical engineering department
		not knowing hand hygiene	Risk of contamination	3	1	3	L	1) Use hand hygiene technique 2) Hand hygiene posters above the sinks. 3) Lab coat & gloves to be worn in every procedure.
		ingestion	Ingestion of reagents can whole mouth pipetting and can cause serious health hazard	4	1	4	L	1)Autopipetsare used 2)Training of MSDS (Material safety data sheet) to staffs working in labs 3)MSDS in place

MICROBIOLOGY								
9	**Preparing culture media**	not prepring media in laminar flow	Contamination of the media by microorganisms that are in the environment	3	2	6	M	Sop should be followed for Preparing the media in laminar air flow bench To Maintain Sterility
		Burns from molten agar (sterilizing& melting solidified agar media in the autoclave)can occur while pouring in the agar plate	Burns	3	1	3	L	1)Training to lab technicians on pouring in the plates safely 2)Cloths or tissues can be used to hold hot flask 3) wearing PPE
10	**Specimen processing**	streilization not done properly	Inoculation loop can contaminate the samples and therefore false reading of the samples can occur	3	1	3	L	Sterilize the inoculation loop by heating it red hot by the use of Bunsen burner before and after each sample
11	**Handling of microscope**	long examination time	Excessive Strain In The Eyes While Looking In Microscope	1	3	3	L	Taking breaks in between while examining the slides.
		Cuts from slides	Cuts from sharp edges on glass slides or broken slides	2	2	4	L	1)Training to lab technicians on handling slides carefully. 2) wearing PPE
		Working with stains/ gram	Can cause eye/skin irritation and if inhaled can cause respiratory tract infection & in chronic cases kidney and liver damage.	3	2	6	M	1)Training to lab personnel on handling strain with care 2)Wearing gloves and eye protectors throughout procedure 3)MSDS if any incidence occur
HISTOPATHOLOGY								
12	**Grossing process**	Working with blades / sharps	Injury (cuts) From Blades Used In Grossing	2	3	6	M	1)Training to lab personnel to be vigilant while grossing the samples 2) use PPE 3) keep it in a safe position after use. 4) Incident reporting if injury occurs.
		Working with infected tissues and body fluids	infection	2	2	4	L	Gloves & PPE to be used, Hoods That Prevents Fumes To get inhaled
13	**Handling Solvents**	Exposure with solvents	Constant Exposure To Solvent Leads To Reynolds Phenomenon (color change of the skin especially fingers to white or blue color,numbness and tingling sensation,throbbing pain &in severe condition ulceration can occur)	3	2	6	M	wearing gloves (PPE) when working with solvents
14	**Disposal**	BMW not segregated	Organs and tissues disposal can cause biohazards	3	1	3	L	BMW rule 2016 needed to be followed for disposal of bio-hazardous waste

HEMATOLOGY								
15	**Slide preparation**	Get Contacted With Blood While Preparing Slides	infection	3	1	3	L	1)Gloves Should Be Worn 2)Slides Should Be Kept For Drying Aside Rather Waving And Drying
MISCELLANEOUS								
16	**Others**	Transport of Specimens	Breakage and Aerosolization	2	2	4	L	
		Storage of Specimens		2	2	4	L	storage room is ventilated and have exhaust fans
		Disposal of Specimens		2	2	4	L	Proper BMW segregation, autoclaving

FINDINGS

In this study findings of activities that leads to Hazards and their associated risk are divided into 2 sections :

1st section consists of:

- **DOCTOR'S ORDER :**
  Risk: The risk associated with illegible handwriting of doctors is misinterpretation of the test mentioned in the prescription

CONTROL:

✓ Training to doctors on improving hand writing and to write in capital letters.
✓ Top management evaluation / audits should be done.

- **ELECTRICAL HAZARD**
  RISK: Improper maintenance of equipment, faulty equipment, over plugging or entangled wires/cords in the pathways leads to risk of fire/explosion, electrocution/ burns, short circuit and slip, trip which can lead to strain slip and trip.

CONTROL:

✓ In house Bio Medical Engineering team is in place to take care of routine equipment breakdown.
✓ training of staff regarding management of handling faulty equipment.
✓ periodic facility management round
✓ cords should be plugged in within the range to avoid overloading
✓ electrical pendants used to keep cords out of the way

- **BIOLOGOCAL HAZARD**
  RISK: Coming in contact with tissue and body fluids can leads to infection

CONTROL:

✓ appropriate use of personal protective equipment

- **CHEMICAL HAZARD**
  RISK: skin absorption and inhalation of chemicals can leads to allergic reactions or other skin problems and also certain chemicals if inhaled can cause irritation in nose throat and can also lead to respiratory diseases

CONTROL:

✓ appropriate personal protective equipment, lab coat and proper ventilation for releasing the fumes of chemicals

- **PHYSICAL HAZARD**
  RISK: Poor lightening , sharp tools, heat released from equipment, moving heavy machinery blocked passages/emergency exits , spills and breaks can lead to sprains, strains , cuts , scarps and hastily or improper handling of heat releasing equipment can cause serious burns.

CONTROL:

✓ proper signages for wet areas for Proper lightening it should be made sure that maintenance department of the hospital must do a periodic check and immediately replace broken lights
✓ training to staff regarding maintenance handling of equipment as per manufacturer's manual
✓ spillage management training (HAZMAT) and also mock drills
✓ gloves and training of staff about usage/ handling of the sharps

- **ERGONOMICS HAZARD**
  RISK: Repittion of work, awkward posture, and lifting of heavy loads can lead to MSD that include numbness, tingling, and sharp pain.

CONTROL:

✓ Adjust the height of working surfaces to reduce long reaches and awkward postures
✓ using mechanical lifting equipment for lifting heavy loads

- **OCCUPATIONAL HAZARD**
  RISK: Improper handling of hazardous material can to spillage.

CONTROL:

✓ training of staff about spill management (HAZMAT training) and also conducting
✓ mock drills for checking attentiveness

SECTION 2:

- **BIOCHEMISTRY**

CENTRIFUGATION:

RISK: While centrifugation not monitoring speed, not using caps for parafills, not properly maintaining the machine and ingestion can leads to serious risk breakage and aerosolization, if caps or Para fills are not used centrifugation creates a vacuum and violates liquids and contaminated items become aerosols as well as flammable liquids may explodes , inaccurate lab results and also ingestion of reagents and whole mouth pipetting can cause serious health hazard.

CONTROL:

✓ Speed monitoring, balance monitoring, daily log. If breakage occurs: 1:10 dilution of bleach or a non-corrosive disinfectant into canister to decontaminate, after it gets soaked for 20 min. Use forceps & dispose in sharp container.
✓ Use caps or parafilm
✓ Calibration schedule & preventive maintenance schedule is in place with bio-medical engineering department.
✓ Autopipettes are used
✓ Training of MSDS (Material safety data sheet) to staffs working in labs

- **MICROBIOLOGY**

1. CULTURE MEDIA

RISK: not preparing culture media in laminar flow can lead to contamination of the media by microorganisms that are present in the environment and also use of molten agar (molten agar is used to detect pathogens) while autoclaving or can occur while pouring in the agar plate can leads to severe burns.

CONTROL:

- ✓ Sop should be followed for Preparing the media in laminar air flow bench To Maintain Sterility
- ✓ Training to lab technicians on pouring in the plates safely
- ✓ Cloths or tissues can be used to hold hot flask
- ✓ wearing PPE

2. SPECIMEN PROCESSING

RISK: sterilization not done properly and that can lead to inoculation loop, can contaminate the samples therefore false reading of the sample can occur.

CONTROL:

- ✓ Sterilize the inoculation loop by heating it red hot by the use of Bunsen burner before and after each sample

3. HANDLING OF MICROSCOPE

RISK: long examination time i.e. sitting for long time in front of microscope can lead to excessive strain in the eyes and MSD , cuts can occurs due to sharp slides or broken slides that are used in microscope and working with stains/ gram (safarnin) can cause skin irritation and if inhaled can cause respiratory tract infection & in chronic cases of kidney and liver damage.

CONTROL:

- ✓ Taking breaks in between while examining the slides.
- ✓ Training to lab technicians on handling slides carefully.
- ✓ Training to lab personnel on handling strain with care
- ✓ Wearing gloves and eye protectors (PPE) throughout procedure

- **HISTOPATHOLOGY AND HEMATOLOGY**

1. **GROSSING PROCESS**

RISK: Working with blades/ sharps during grossing process can lead to Injury (cuts). And also working with infected tissues or body fluids can lead to infection**.**

CONTROL

- ✓ Training to lab personnel to be vigilant while grossing the
- ✓ samples
- ✓ use of PPE
- ✓ keep Blades and sharps in a safe position after use.
- ✓ Incident reporting if injury occurs.

2. **HANDLING OF SOLVENTS**

RISK: Constant Exposure To Solvent Leads To Reynolds Phenomenon (color change of the skin especially fingers to white or blue color, numbness and tingling sensation, throbbing pain &in severe condition ulceration can occur)

CONTROL:

- ✓ wearing gloves (PPE) when working with solvents

- **MISCELLANEOUS**

RISK: risk associated with transport, storage disposal and segregation of waste includes breakage and aerosolization, NSI , air borne disease due to improper disposal and storage of waste collected from the laboratory.

CONTROL:

- ✓ storage room is ventilated and have exhaust fans
- ✓ Proper BMW segregation, autoclaving (BMW rule 2016 needed to be followed for disposal of bio-hazardous waste for that proper training should be provided)

INTERPRETATION AND DISCUSSION

RISK ASSESSMENT TOOL

Consequences/ severity	Likelihood/ probability	Risk
1. NEGLIGIBLE: First Aid needed at scene, minor suppotive medical treatment, minor system imparment, No man-day lost	Unlikely: Can assume will not occur	1-5:Low risk: Acceptable , no further action needed
2. MARGINAL: Hospital treatment needed, "minor injury, lost workday accident, compensible injury or illness, minor property damage", man day lost (Patient/ attendant/ staff)	2. "Seldom: unlikely, but could occur at some time"	6-10: MODERATE RISK: Adequate, look to improve at next review
3. CRITICAL: Major injury, temporary or total diasbility in excessof 3months, major system damage, significant property damage, critical to personal (patient/attendant/staff) health	3. Possible/Occasional: occurs sporodically	11-15:HIGH RISK:Tolerable , look to reduce
4. "CATASTROPHIC: Death or permanent disability, system loss, major property damage"	4.Likely: Occurs several times	16-20:EXTREMELY HIGH RISK: Unacceptable, stop activity and make immediate improvements
	5.Very Likely/ Frequent: occurs often, continuously experienced	

		PROBABILITY				
		FREQUENT (5)	LIKELY (4)	OCCASIONAL (3)	SELDOM (2)	UNLIKELY (1)
"SEVERITY"	"CATASTROPHIC"(4)	E (20)	E (16)	H (12)	M (8)	L (4)
	CRITICAL (3)	H (15)	H (12)	M (9)	M (6)	L (3)
	MARGINAL (4)	H (10)	M (8)	M (6)	L (4)	L (2)
	NEGLIGIBLE (5)	M (5)	L (4)	L (3)	L (2)	L (1)

Probability

FREQUENT - Occurs often, continuously experienced

LIKELY - Occurs several times

OCCASIONALLY - Occurs sporadically

SELDOM - Unlikely, but could occur at some time

UNLIKELY - Can assume will not occur

Severity

- CATASTROPHIC - Death or permanent total disability, system loss, major property damage
- CRITICAL - Permanent or total disability, temporary total disability more than 3 months, major system damage

- MARGINAL - Minor injury, lost workday accident, compensable injury or illness minor property damage .
- NEGLIGIBLE - First aid minor supportive medical treatment, minor system impairment

By multiplying the severity × probability we get the result of risk score and with the help of risk assessment matrix we perform the risk rating.

1-5:	LOW RISK :	Acceptable, no further action needed
6-10:	MODERATE RISK :	Adequate, look to improve at next review
11-15:	HIGH RISK :	Tolerable, look to reduce risk
16-20:	EXTREMELY HIGH RISK :	Unacceptable, stop activity

INTERPRETATION

As per the observations it can be seen that there are hazards that workers in pathology laboratories face including specific risk from chemicals, mechanical, electrical etc . According to the risk ranking the

High and extreme risks are:

- While grossing in the histopathology lab
- Handling of the formalin and various other harmful chemicals.
- Improper handling of hazardous materials from lab
- Electrical short circuit.
- Improper handling of inflammable materials.
- Blocked evacuation pathways.

Moderate risks

- Electrical shock due to contact with high power / Voltage equipment
- Over plugging in extension cords
- Entangled wire/cords in the pathways
- Heat released form equipment
- not prepring media in laminar flow
- Spills while transportation
- Risks while preparing samples in the microbiology lab
- Preparing the culture media
- Gram staining

- Blood culture preparation
- Risk from bacterial plates
- Risk of equipment breakdown

Low risk :

- Untrained billing executives
- Illegible handwriting of doctors in prescription form
- skin absorption of chemicals
- Poor lightening
- Repetition of work, awkward posture, lifting or handling loads
- "Burns from molten agar
- (sterilizing& melting solidified agar media in the autoclave) can occur while
- pouring in the agar plate
- Storage and disposal of samples
- Infection from microscope
- Breakages and leakages

NOTE: The control measures that are used in these departments decrease the likelihood / probability of the risk to occur and therefore the risks that come under high and extreme risks are less.

"The danger can be aggravated by ignorance of the hazards, lack of knowledge on safety measures and inadequate safety measures adopted by laboratories . " Safety consciousness and safe laboratory practices are therefore of primary importance for the protection of laboratory workers against injury and infection and the prevention of damage to property."

RECOMMENDATION

OTHERS:

- Computerized physician order entry (CPOE) can be implemented for improving the risk of illegible handwriting and wrong interpretation of doctors' orders.
- Audits can be done by the top management to reduce the risk of hazards
- Rubber hand protectors can be used while preparing culture media to protect themselves from burns from molten agar.
- SOP's should be revised periodically
- Hazards assessment task force should be formed
- All laboratory personnel must at a minimum completed safety training on an annual basis . Additionally, laboratory personnel who handle or use the High Hazard Substance must demonstrate specific competency and familiarity regarding the safe handling protocols
- Proper training record should be maintained, with proper checklist (checklist - Appendix)

CONCLUSION

Hazard identification and risk analysis in hospitals is one of the most important works that would help to increase patient safety and therefore increasing patient satisfaction. It will also help in identify, analyse and prioritize all hazards in laboratory department. This case study considers for the vulnerabilities of a specific hazard, consequences if a hazard is realized and means to prevent those hazards.

The staffs of the laboratory department are getting trained for proper technique of patient care and usage of the equipment's to avoid hazards in the department. Equipment are timely calibrated to avoid failure during procedure. This study illustrated what are the types of hazards that can happen in the department and how to prevent them.

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APPENDIX/ ANNEXURE

APPENDIX: 1

Checklist

HIRA : Laboratory								
S.No	Activities of Laboratory	Workplace Hazards	Risk	Likelihood of Occurrence	Severity	Risk Score	Risk Rating	Recommendation/ control

APPENDIX: 2

Risk assessment matrix

Consequences/ severity	Likelihood/ probability	Risk
1. NEGLIGIBLE: First Aid needed at scene, minor suppotive medical treatment, minor system imparment, No man-day lost	Unlikely: Can assume will not occur	1-5:Low risk: Acceptable , no further action needed
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	5.Very Likely/ Frequent: occurs often, continuously experienced	

		PROBABILITY				
		FREQUENT (5)	LIKELY (4)	OCCASIONAL (3)	SELDOM (2)	UNLIKELY (1)
SEVERITY	CATASTROPHIC (4)	E (20)	E (16)	H (12)	M (8)	L (4)
	CRITICAL (3)	H (15)	H (12)	M (9)	M (6)	L (3)
	MARGINAL (4)	H (10)	M (8)	M (6)	L (4)	L (2)
	NEGLIGIBLE (5)	M (5)	L (4)	L (3)	L (2)	L (1)

APPENDIX: 3

Training Records

"By my signature, I verify that I have read and understand this SOP that was taught in lecture and have discussed any questions I have had with the indicated trainer. I agree to fully adhere to its requirements."

S.no	Date	Topic	Signature/ emp. ID	Marks obtained	Trainer