Dissertation

at

Asia Med Centre (Aakash Healthcare Multi Speciality Hospital), Uzbekistan

on

Evaluation Of H.I.S based on DeLone & Mclean model for IS success and assessment of EHR based on The Safety Assurance Factor of EHR Resilience (SAFER)

by

<u>Mr. RAJDEEP DEY</u>

Enroll No**. <u>PG/021/079</u>**

Under the guidance of

Dr. PIJUSH KANTI KHAN

PGDM (Hospital & Health Management)

2021-23

International Institute of Health Management Research
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IIHMR DELHI

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The certificate is awarded to

Name: <u>RAJDEEP DEY</u>

in recognition of having successfully completed his/her
internship in the department of

Title: <u>OPERATIONS</u>

and has successfully completed his Project on

**Evaluation Of H.I.S based on DeLone & Mclean model for IS success and assessment of EHR based on
The Safety Assurance Factor of EHR Resilience (SAFER)**

Date: MAY, 2023

Organisation: Asia Med Centre (Aakash Healthcare Multi Speciality Hospital), Uzbekistan

He comes across as a committed, sincere & diligent person who hasa
strong drive & zeal for learning.

We wish him all the best for future endeavors.
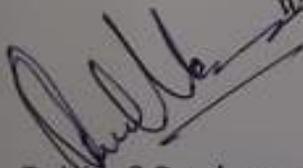
Training & Development

Zonal Head-Human Resources

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that__RAJDEEP DEY__ student of PGDM (Hospital & Health Management) from International Institute of Health Management Research, New Delhi has undergone internship training at Asia Med Centre (Aakash Healthcare Multi Specialty Hospital), Uzbekistan from Feburary,2023 to May,2023.

The Candidate has successfully carried out the study designated to him during internship training and his/her approach to the study has been sincere, scientific and analytical.

The Internship is in fulfilment of the course requirements.

I wish him all success in all his future endeavours.

Dr. Sumesh Kumar
Associate Dean, Academic and Student Affairs
IIHMR, New Delhi

Mentor

IIHMR, New Delhi

Certificate of Approval

The following dissertation titled "**Evaluation Of H.I.S based on DeLone & Mclean model for IS success and assessment of EHR based on The Safety Assurance Factor of EHR Resilience (SAFER).**" at "**Asia Med Centre (Aakash Healthcare Multispecialty Hospital, Uzbekistan)**" is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **PGDM (Hospital & Health Management)** for which it has been submitted. It is understood thatby this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

Name

Dr. Himanshu Tolani

Dr. Sumant Swain

Dr. Jacob

Signature

Certificate from Dissertation Advisory Committee

This is to certify that **Mr. Rajdeep Dey**, a graduate student of the **PGDM (Hospital & Health Management)** has worked under our guidance and supervision. He is submitting this dissertation titled **"Evaluation Of H.I.S based on DeLone & Mclean model for IS success and assessment of EHR based on The Safety Assurance Factor of EHR Resilience (SAFER)."** at **"Asia Med Centre (Aakash Healthcare Multi Speciality Hospital), Uzbekistan"** in partialfulfilment of the requirements for the award of the **PGDM (Hospital & Health Management).**

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

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Designation,

Organization

Organization Mentor Name Aditya
Designation, Deputy Manager

Organization

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled "**Evaluation Of H.I.S based on DeLone & Mclean model for IS success and assessment of EHR based on The Safety Assurance Factor of EHR Resilience (SAFER)."**

and

submitted by **Mr. RAJDEEP DEY**, Enrollment No.: **PG/021/079**

under the supervision of **Dr. PIJUSH KANTI KHAN** for award of

PGDM (Hospital & Health Management) of the Institute

carried out the period from **FEBURARY, 2023** to **MAY, 2023**, embodies my original work and has not

formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other

Institute or other similar institution of higher learning.

Rajdeep Dey

Signature

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FEEDBACK FORM

Name of the Student: Rajdeep Dey

Name of the Organisation in which Dissertation Has Been Completed: Asia Mod Center (AHISLL)

Area of Dissertation: Operation (HIS)

Attendance: 100%

**Objectives achieved:** HIS Audit, Quality & Operations

Deliverables: Achieved on Time.

Strengths: Hard working, Good Analytical skills Quick learner.

Suggestions for Improvement: Set clear Goals.

Suggestions for Institute (course curriculum, industry interaction, placement, alumni): As per his Quick learning skills, He should learn financial management as well.

Signature of the Officer-In-Charge/ Organisation Mentor

Date:

Place: Tashkent, Uzbekistan

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INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH (IIHMR)

Plot No. 3, Sector 18A, Phase- II, Dwarka, New Delhi- 110075

Ph. +91-11-30418900, www.iihmrdelhi.edu.in

CERTIFICATE ON PLAGIARISM CHECK

Name of Student (in block letter)	Mr. Rajdeep Dey		
Enrolment/Roll No.	PG/21/079	Batch Year	2021-2023
Course Specialization (Choose one)	Hospital Management		
Name of Guide/Supervisor	Dr. Pijush Kanti Khan		
Title of the Dissertation/Summer Assignment	Evaluation Of H.I.S based on DeLone & Mclean model for IS success and assessment of EHR based on The Safety Assurance Factor of EHR Resilience (SAFER)		
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Similar contents acceptable (%)	Up to 15 Percent as per policy		
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Guide/Supervisor

Name: Dr.Pijush Kanti Khan

Signature:

Report checked by

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Library Seal

Student

Name: Rajdeep Dey

Signature:

Dean (Academics and Student Affairs)

Signature:
Date:
(Seal)

ACKNOWLEDGEMENT

I would like to express my deepest gratitude and appreciation to all individuals and entities who have contributed to the successful completion of this project. Their invaluable support, guidance, and collaboration have played a pivotal role in the achievement of my goals.

First and foremost, I extend my heartfelt thanks to Dr. Pijush Kanti Khan, My mentor, for unwavering guidance and expert insights throughout the project's duration. His mentorship and encouragement have been instrumental in shaping the dissertation's direction and ensuring its overall success.

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In conclusion, I recognize and appreciate the support of all individuals and organizations that have played a part in this research's success. Your contributions have been truly significant and have made a lasting impact on our work. Thank you for being an integral part of this journey.

Sincerely,

RAJDEEP DEY

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LIST OF ABBREVATIONS:

EHR - Electronic Health Record

HIS - Hospital Information System

CDS - Clinical Decision Support

IT - Information Technology

IS - Information Systems

SAFER - The Safety Assurance Factor for EHR Resilience

HIMS - Hospital Information Management Systems

USA - United States of America

UK - United Kingdom

NCR - National Capital Region

ICU - Intensive Care Unit

T&E - Trauma & Emergency Centre

ED- Emergency Department

MS - Microsoft (referring to MS Excel)

PHI – Patient Health Identity.

Aakash Healthcare Super Speciality Hospital

Aakash Healthcare Super Speciality Hospital, situated in the National Capital Region (NCR) of Delhi, in Dwarka, is an advanced tertiary care facility boasting 230 beds, including 15 Dialysis beds and 80 Critical Care beds. Equipped with cutting-edge technology and state-of-the-art infrastructure, the hospital is staffed by skilled clinicians and compassionate healthcare professionals.

The hospital has earned a reputation for its excellence in Orthopaedic and Joint replacement surgeries, offering a comprehensive range of high-quality services. Aakash Healthcare takes pride in its specialized 'Centers of Excellence,' encompassing Cardiology and Cardiac Surgery, Orthopaedics & Joint Replacement, Mother & Child, General & Minimal Access Surgery, Ophthalmology & Refractive Error Surgery, Neurology & Neuro Surgery, and Renal Sciences.

Additionally, the hospital provides round-the-clock services, including a 24x7 'Trauma & Emergency Center,' a fully-equipped blood bank, and state-of-the-art Neonatal and Paediatric ICU. The institution is under the management of a team of highly qualified and trained experts, ensuring comprehensive patient care at all times. To meet complex medical needs and enhance patient convenience, Aakash Healthcare has implemented advanced technologies and smart digital systems, including robust Hospital Information Systems.

At the helm of the hospital's leadership is Mr. J C Chaudhry, the Chairman, and Dr. Aashish Chaudhry, the Managing Director, renowned in the region as an Orthopedic Surgeon.

Aakash Healthcare has recently unveiled its expansion plans, marking its entry into foreign territory by establishing a multi-speciality hospital in Tashkent, Uzbekistan. This milestone makes Aakash Healthcare the first Indian hospital to manage a fully operational hospital in a foreign land, with an initial investment of $3.5 million.

While other Indian healthcare players in Uzbekistan focus on outpatient services and limited surgeries or have affiliations with local hospitals, Aakash Healthcare has taken a different approach. Through its affiliate company, the hospital has acquired an existing local hospital in Tashkent, intending to operate it as an Indian hospital, upholding the highest clinical expertise, world-class infrastructure, and ethical standards, while emphasizing compassionate care.

Aakash Healthcare acknowledges the rising influx of Uzbek patients seeking medical treatment in India, particularly in New Delhi, with approximately 8,000 patients visiting annually, contributing to a market size of around $30 million. Aakash Healthcare's affiliate company, Anvika Healthcare, has set up a foreign entity named Aakash Healthcare LLC, which has acquired the Tashkent hospital as a foreign investment. Over the next three years, the company plans to invest $10 million and create 200 direct jobs in Uzbekistan.

The hospital's focus in Uzbekistan will be on addressing major health issues, particularly related to liver problems, as nearly 15% of the population suffers from Hepatitis B. Uzbek patients often seek complex medical procedures like liver transplants, cancer surgeries, neurological, and orthopedic treatments in India. Hence, Aakash Healthcare LLC's primary areas of expertise will include Mother & Child, Orthopaedic, and Liver specialties, among others.

Aakash Healthcare aims to establish a robust healthcare ecosystem for Uzbekistan and neighbouring countries, where quality healthcare currently remains underdeveloped. After meticulous planning over three years, Aakash Healthcare LLC successfully acquired its first overseas hospital, the Asia Med Centre in Tashkent, renaming it as Aakash Healthcare Multispeciality Hospital. Operations at the new facility are set to commence formally from November 23, 2022. The hospital currently has 50 beds and offers several specialty departments, including orthopaedics, paediatrics, endocrinology, neurology, internal medicine, physiotherapy, cardiology, gynaecology, urology, general surgery, neurosurgery, ENT, USG, X-ray, Laboratory, and Dentistry. Aakash Healthcare Multispeciality Hospital in Tashkent is committed to adhering to global best practices and providing world-class facilities, aligning with the highest healthcare standards.

Abstract

Introduction: Uzbekistan's healthcare industry has undergone substantial transformation since gaining independence, driven by the need to accommodate a rapidly growing population and improve the quality of healthcare services. The government has made concerted efforts to enhance the country's health infrastructure, with a focus on quality treatment, expanded facilities, and partnerships with global private healthcare providers. Aakash Healthcare, a Delhi-based organization, has ventured into Uzbekistan by establishing a state-of-the-art multi-specialty hospital in the heart of Tashkent. This move represents a significant milestone in international healthcare, as Aakash Healthcare brings Indian standards of clinical expertise, world-class infrastructure, ethical practices, and a compassionate approach to patient care. In recent years, the healthcare landscape in Uzbekistan has witnessed the development of modern medical facilities, particularly in Tashkent. This growth has led to an increased adoption of Health Information Systems (HIS) and a rise in Private Health Insurance (PHI) usage. Implementing HIS offers numerous advantages, such as accessing staff performance data, analysing patient care, and evaluating the efficiency and stability of healthcare organizations. When operating in a new environment and serving overseas patients, the implementation of an effective hospital information system becomes crucial. It ensures smooth workflow management, fosters interdepartmental collaboration, and safeguards patient data privacy, all of which are essential for delivering quality healthcare services.

Methodology: The study took place in a 60-bedded hospital located in Tashkent, Uzbekistan. It was a cross-sectional study that included all stakeholders involved in the interaction with the Hospital Information System (HIS) as the study sample. Data collection was performed using structured questionnaires, evaluating the HIS based on the DeLone & McLean IS success model and utilizing the SAFER Guide Checklist for assessing the Electronic Health Record (EHR). The collected data was analysed using MS Excel and Cronbach's Alpha Analysis to determine reliability.

Result: Based on the interview conducted with 34 stakeholders who had direct interaction with H.I.S (Health Information System), it was observed that the internal reliability of H.I.S was not meeting the expected standards. The stakeholders suggested various improvements to ensure full compliance with safety measures and enhance the overall usability of H.I.S. The assessment was conducted using the DeLone & Mclean Success Model, where scores ranging from 0.65 to 0.85 were obtained out of a maximum score of 3. Additionally, the cumulative functional percentage for the Electronic Health Records (E.H.R) component was found to be 32%

Conclusion: In conclusion, evaluating information system implementation in healthcare is crucial for delivering high-quality services. This study emphasizes the importance of non-technological factors, urging hospital management and IT developers to understand and address them during Health Information System (HIS) implementation. Management support and engagement are critical for sustainable HIS, ensuring user-friendly systems and tangible benefits. This research provides valuable insights for hospital management, IT developers, and researchers, shedding light on implementation challenges and guiding effective strategies.

INTRODUCTION:

Since gaining independence, Uzbekistan's healthcare industry has undergone a significant transformation to address the urgent needs of its rapidly growing population and improve the quality of healthcare services. With a commitment to developing a robust healthcare system, the Uzbekistani government has taken concerted efforts to enhance the nation's health infrastructure. These efforts encompass various aspects, including upgrading treatment standards, expanding healthcare facilities, and fostering collaborations with esteemed global private healthcare providers [1].

A pivotal development in Uzbekistan's healthcare landscape is the entry of Aakash Healthcare, a highly regarded organization headquartered in Delhi, India. By establishing a state-of-the-art multi-specialty hospital in Tashkent, the capital city of Uzbekistan, Aakash Healthcare has marked a remarkable milestone in the realm of international healthcare. This strategic move introduces Indian benchmarks of clinical expertise, world-class infrastructure, ethical practices, and a compassionate patient care approach, aiming to elevate the quality of healthcare services available in Uzbekistan.

In recent years, Uzbekistan, particularly in its bustling capital city, Tashkent, has witnessed substantial growth in healthcare infrastructure. This progress has given rise to modern medical facilities that align with international standards. Alongside this development, there has been an increased adoption of Health Information Systems (HIS) and a rising utilization of Private Health Insurance (PHI) across the country [13].

The implementation of an effective HIS offers numerous advantages for healthcare providers, revolutionizing their approach to data management and decision-making [6]. By granting access to valuable data on staff performance and patient care, the HIS empowers healthcare professionals to make informed decisions and optimize healthcare delivery [3]. This data-driven approach holds the potential to enhance treatment outcomes and the overall stability and efficiency of healthcare organizations [12].

Furthermore, the implementation of a robust hospital information system becomes even more crucial when healthcare providers cater to overseas patients in a new environment. A well-designed HIS ensures seamless workflow management and facilitates smooth interdepartmental collaboration, contributing to improved patient care and organizational efficiency [12] Additionally, safeguarding patient data privacy and security is paramount, and an effective HIS plays a vital role in maintaining the confidentiality of sensitive healthcare information [4].

Leveraging a comprehensive HIS, healthcare providers can significantly enhance their operational efficiency and effectiveness. The system's seamless integration of various departments streamlines administrative processes and fosters better communication among healthcare professionals. Through timely and accurate information exchange, the HIS facilitates coordinated care and contributes to better patient outcomes, improved patient experiences, and the delivery of high-quality healthcare services to both domestic and international patients.

Aakash Healthcare's entry into Uzbekistan marks a momentous milestone in international healthcare, enriching the nation's healthcare system with Indian standards of expertise and compassionate care. By adopting modern healthcare facilities, implementing HIS, and embracing private health insurance, Uzbekistan's healthcare sector is poised for further growth and improvement. These developments promise to enhance the accessibility and quality of healthcare services, positively impacting the well-being of Uzbekistan's population and beyond.

Beyond Uzbekistan's borders, the implementation of health information systems and electronic health records (EHRs) has gained substantial attention in countries such as the USA [6], UK [17], Austria [18] and Norway [19]. Notably, Denmark has been at the forefront of EHR development and implementation since the mid-1990s, focusing on cross-professional, structured records to enhance clinical work, planning, and research [20][21].

Despite the increasing adoption of EHRs, uncertainties and risks remain associated with their introduction, and further research on their value and efficacy is required. To address this challenge, a study endeavours to develop a questionnaire survey instrument based on the DeLone & McLean Information System Success Model to measure the success of EHRs. The instrument takes into account various variables, including system quality, information quality, service quality, training, self-efficacy, intention to use, use, user satisfaction, and net benefits [5]. The study aims to assess the success of EHR implementation in aged care organizations and validate the reliability of the survey instrument.

This research paper aims to shed light on the transformation of Uzbekistan's healthcare industry and providing valuable insights for improving healthcare services and fostering international collaborations in the healthcare sector. The findings will contribute to the enhancement of healthcare delivery and access, ultimately benefiting the well-being of population and setting a precedent for similar endeavours in other regions.

RATIONALE:

Importance of the Study: The study is essential because there has been no previous assessment of the HIS & EHR at Aakash Healthcare Multi Specialty Hospital, Tashkent. Understanding the performance and effectiveness of their current HIS is crucial for identifying strengths and weaknesses in the system.

Identifying Major Key Factors: The primary objective of the study is to identify the key factors that contribute to the successful functioning of the Hospital Information System. These factors could include technology infrastructure, user training, system usability, data security, and overall alignment with the hospital's workflows.

Analysis of New Variables: As part of the study, new variables may be created and analyzed. These variables will help in investigating the smooth functioning of the HIS. For instance, researchers might explore how certain factors, such as patient satisfaction, staff productivity, or data accuracy, relate to the efficiency of the HIS.

Overall, this study will provide valuable insights to Aakash Healthcare Super Specialty Hospital in Uzbekistan. It will help them understand the strengths and weaknesses of their current HIS and identify areas for improvement. By focusing on the key success factors and analyzing new variables, the hospital can make data-driven decisions to enhance the efficiency and effectiveness of their HIS, ultimately leading to better patient care and overall operational performance.

AIM:

The aim of the research of the research is to assess the performance of the electronic health Record and identify the key factor for the successful working of the Hospital information system providing the recommended practice for the safety and safe use of the Electronic Health Record.

Primary Objective:

To identify the key factors that would contribute for successful working of hospital information management systems based on DeLone and McLean Model.

Secondary Objective:

- To review the EHR of the hospital based on the performance on nine guides as per The Safety Assurance Factor for EHR Resilience (SAFETY) Guides.

- To identify the recommended practices to optimize the safety and safe use of EHR.

Methodology:

➢ **Study Setting:**
This Study was conducted in 60 bedded multi-speciality hospital in Tashkent region (Uzbekistan).

➢ **Study Design:**
A cross-sectional study was conducted to evaluate the hospital information system and for the assessment of the electronic health record for the 60 bedded Multi speciality hospital.

➢ **Study Duration:**
A period of 2 months was being consider for the e following research.

➢ **Sample Size:**
Study Sample of 34 members were taken into consideration which includes 8 consultant, 16 Nurses and 10 Supportive staffs. (All the members were directly related to the usage of H.I.S).

- ➢ **Sampling Technique:**

A Connivence non-random sampling technique was being used for the interview of the all the stalk holder. All the consultants, nurses and other supportive staff who were present at the time & were involved with the H.I.S usage were interviewed.

- ➢ **Inclusion Criteria:** All the participants who gave their consent were included for the study.

- ➢ **Exclusion Criteria:** All the participants who did not gave their consent were excluded from the study.

- ➢ **Data Collection tool:**

To evaluate the Hospital Information System (H.I.S), a data collection tool in the form of structured questionnaires was developed. These questionnaires were utilized to conduct interviews with consultants, nurses, and supportive staff involved in the hospital management system evaluation. The design of the questionnaires was based on the DeLone & Mclean IS Success Model, which served as a framework for assessing various aspects. The variables of interest in the evaluation included System Quality, Information Quality, Service Quality, User Satisfaction, Intention to Use, and Net Benefit.

Additionally, to assess the safety and secure utilization of electronic health records (E.H.R), the S.A.F.E.R (Safety Assurance Factors for E.H.R Resilience) Guide Checklist was employed. This checklist was derived from three operational guides: Foundational, Clinical Process, and Infrastructure. These operational guides address three domains: Safe Health IT, Using Health IT Safely, and Monitoring of Health IT. Within these domains, several factors are considered, such as High Priority Practices Organizational Responsibilities, Contingency Planning, System Configuration, System Interfaces, Patient Identification, Computerized Provider Order Entry with Decision Support, Test Results Reporting and Follow-up, and Clinician Communication. These factors play a crucial role in ensuring the safety and effectiveness of the E.H.R system.

- ➢ **Data Analysis:**

The data collected from the data collection tool were then put into the Excel to digitalise the data. MS Excel was used for data analysis. Descriptive statistics was used to quantitatively summarise the collected data in form of percentages. Further graphs and pie charts were made to analyse the collected data. Further Cronbach's Alpha Analysis was used to check the internal consistency and reliability of the H.I.S.

- ➢ **Ethical Consideration:**

The purpose and process of the study was explained to the participants and then duly signed consent forms were taken prior to the data collection from participants who gave their consent for the study. The privacy and confidentiality of the data given by the interviewee was strictly maintained.

Results:

The S.A.F.E.R guide is primarily designed to assist healthcare organizations in optimizing the safety and safe use of electronic health records (EHRs). It encompasses three main pillars: Foundational Guides, Clinical Process Guides, and Infrastructure Guides. These guides address nine key areas of concern, which include High Priority Practices, Organizational Responsibilities, Contingency Planning, System Configuration, System Interfaces, Patient Identification, Computerized Provider Order Entry with Decision Support, Test Results Reporting and Follow-up, and Clinician Communication.
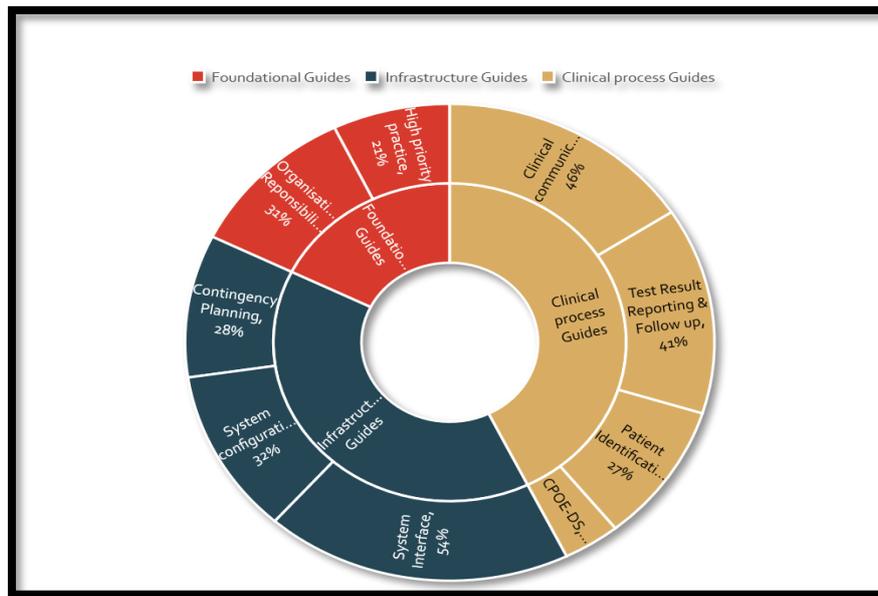
Figure 1: Percentage contribution by 3 guides.

> ### FOUNDATIONAL GUIDE:

The Foundational Guide comprises two key components: High Priority Practices and Organizational Responsibilities. (Fig:1)

The High Priority Practices SAFER Guide focuses on identifying "high risk" and "high priority" safety practices to optimize the safety and safe use of EHRs. It accounts for 21% of the overall foundational guide.

On the other hand, the Organizational Responsibilities SAFER Guide identifies individual and organizational responsibilities aimed at optimizing EHR safety. It recognizes that a safe EHR implementation heavily relies on the people involved and emphasizes human behaviour and relationships. This guide, which accounts for 31% of the foundational guide, specifically addresses the individuals responsible for patient safety in EHR-enabled healthcare organizations. The functional contribution of the foundational guide was found to be 26%.

➢ INFRASTRUCTURE GUIDE:

The Infrastructure Guide consists of three components: Contingency Planning, System Configuration, and System Interfaces. (Fig:1)

The Contingency Planning SAFER Guide focuses on recommended safety practices associated with planned or unplanned EHR unavailability. Temporary unavailability of EHRs can pose significant safety risks if not adequately prepared for. This guide represents 29% (Fig:2) of the overall planning process.

The System Configuration- SAFER Guide addresses recommended safety practices related to the setup of EHR hardware and software. It includes the creation and maintenance of the physical environment and required infrastructure, contributing 32% (Fig:2) to the guide's functionality.

The System Interfaces- SAFER Guide concentrates on optimizing safety and safe use of system-to-system interfaces between EHR-related software applications. It specifically addresses integration between different applications, accounting for 54% (Fig:2) of the System Interface assessment. The functional contribution of the Infrastructure Guide was found to be 38%.

➢ CLINICAL PROCESS GUIDE:

The Clinical Process Guide comprises four components: Clinician Communication, Test Results Reporting and Follow-Up, Patient Identification & CPOE. (Fig:1)

The Clinician Communication SAFER Guide is designed to identify and recommend safety practices that enhance communication between clinicians and optimize the safety and effective use of electronic health records (EHRs). Communication processes among clinicians within the context of EHR-enabled healthcare are intricate and prone to vulnerabilities and breakdowns. Through a comprehensive assessment, it was observed that the compliance rate for the recommended safety practices outlined in the Clinician Communication SAFER Guide reached 46% (Fig:2).

The Test Results Reporting and Follow-Up SAFER Guide aims to identify and recommend safety practices that optimize the safety and efficient utilization of processes and EHR technology for electronic communication and management of diagnostic test results. The processes involved in test result reporting and follow-up are delicate and require meticulous planning, thorough implementation, and ongoing maintenance to ensure the accurate and timely delivery of information to the intended recipients. The compliance rate achieved for the safety practices outlined in the Test Results Reporting and Follow-Up SAFER Guide was found to be 41% (Fig:2).

The Patient Identification SAFER Guide focuses on identifying and recommending safety practices associated with the reliable identification of patients within the EHR system. Accurate patient identification is crucial to ensure that the information captured and entered into the EHR is correctly linked to the appropriate individual. The processes involved in patient identification are complex and necessitate careful planning and attention to detail in order to mitigate the occurrence of errors. In the assessment conducted, a compliance rate of 27% (Fig:2) was observed for the recommended safety practices outlined in the Patient Identification SAFER Guide.

The Computerized Provider Order Entry with Decision Support (CPOE) SAFER Guide aims to identify and recommend safety practices associated with computerized provider order entry and the integration of clinical decision support systems. The use of CPOE with decision support entails a complex and delicate process that requires meticulous planning, precise implementation, and continuous maintenance to ensure proper functionality and maximize safety. However, the assessment revealed a relatively low compliance rate of 10% (Fig:2) for the recommended safety practices outlined in the CPOE SAFER Guide.

Overall, the analysis of compliance rates demonstrates the varying effectiveness of different components within the clinical process guide. It was found that the clinical process guide contributed 31% towards the overall compliance, highlighting its significance in optimizing safety practices and promoting the secure utilization of EHRs within healthcare environments.
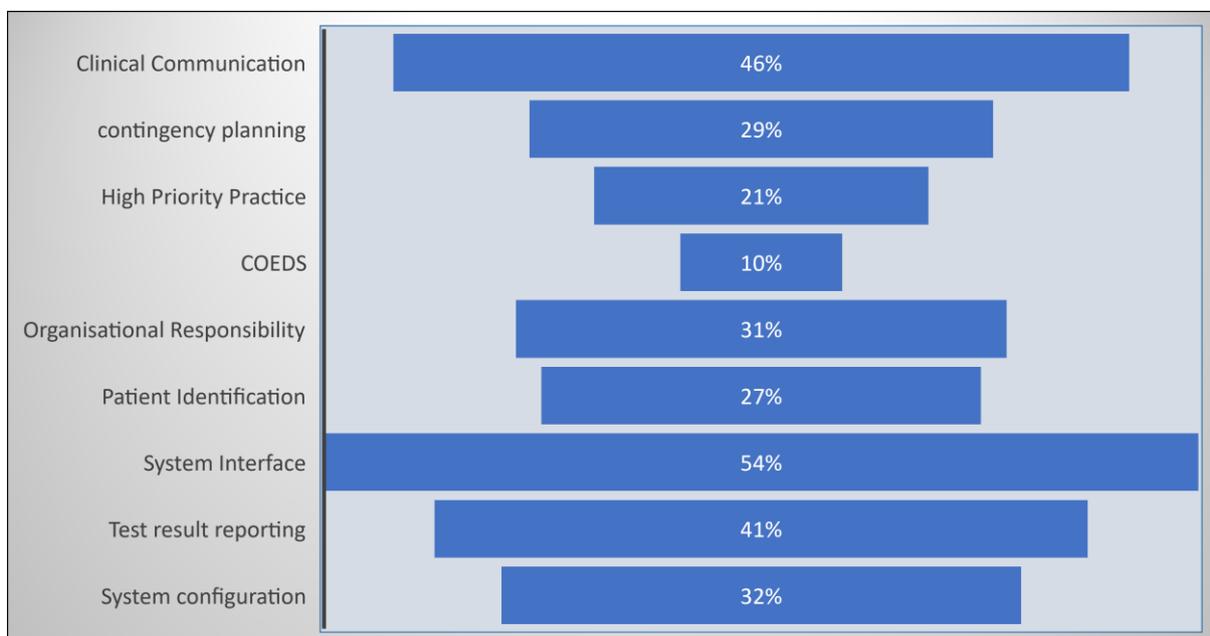
Figure 2: Compliance Percentage by the operational pillars of S.A.F.E.R guides

The optimal performance of an electronic health record (EHR) system is essential across three domains: Safe Health IT, Using Health IT Safely, and Monitoring Safely. These domains collectively ensure the effectiveness and safety of the EHR system.

When assessing the cumulative function of these three domains, it was determined to be 32%. This measurement reflects the overall effectiveness of the EHR system in adhering to recommended safety practices within these domains. Monitoring Safely exhibited the lowest contribution, accounting for only 12% of the cumulative function. This suggests that there is room for improvement in effectively monitoring the EHR system to ensure its safety and performance.
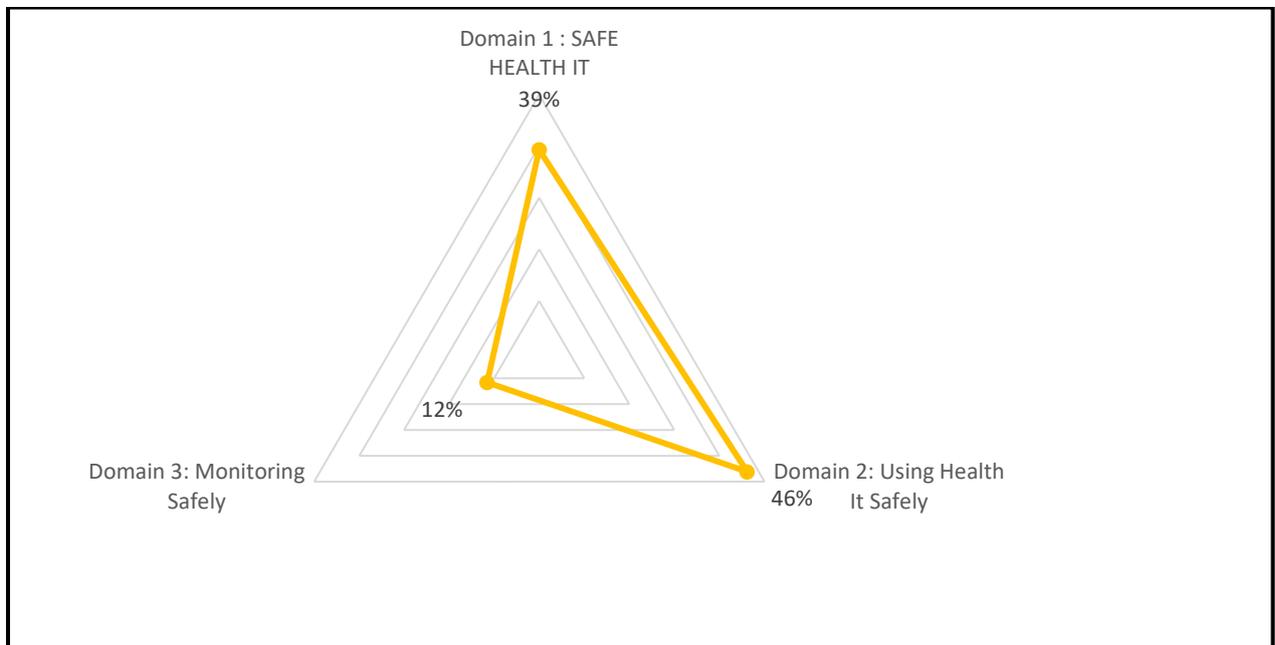
Figure 3: E.H.R performance status.

On the other hand, Safe Health IT demonstrated a higher contribution of 39% to the cumulative function. This indicates that the EHR system has implemented safety measures such as secure infrastructure, data protection, and reliable system configurations to a relatively satisfactory extent.

The domain of Using Health IT Safely showed the highest contribution of 46% to the cumulative function. This indicates that the EHR system has performed well in ensuring safe and appropriate utilization by healthcare professionals. This domain encompasses various aspects, including clinical communication, test result reporting, follow-up processes, patient identification, and computerized provider order entry with decision support.

It is crucial for an EHR system to have optimal operating ability across all three domains—Safe Health IT, Using Health IT Safely, and Monitoring Safely. While the EHR system has shown a stronger performance in Using Health IT Safely, areas such as Monitoring Safely may require further attention to enhance safety and effectiveness. Continued efforts to improve and optimize all three domains are necessary to ensure the best possible operating ability of the EHR system and promote patient safety in healthcare settings. (Fig:3)
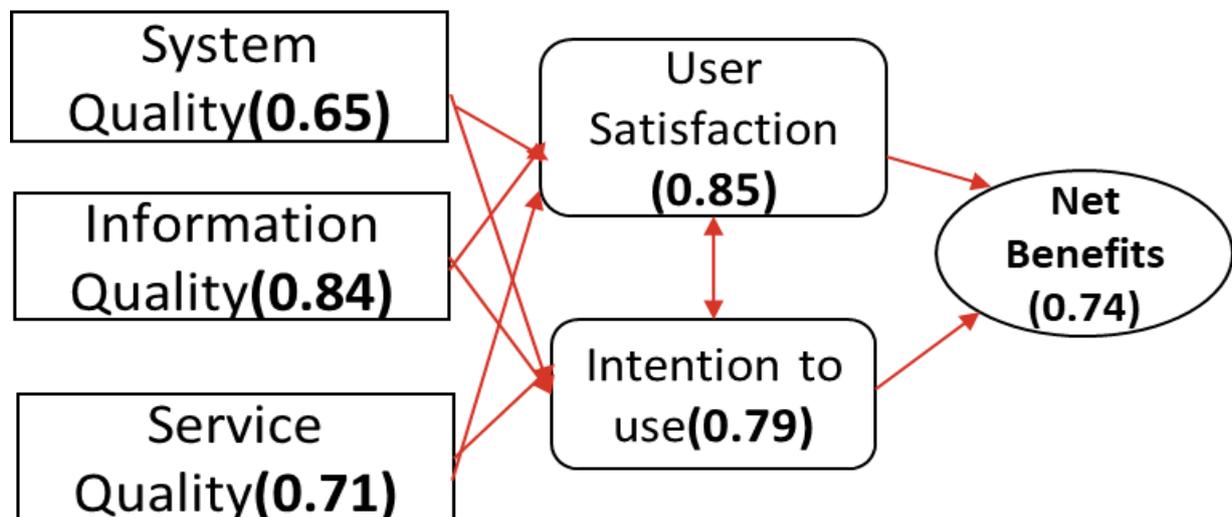
Figure 4: DeLone & McLean IS success model for Hospital information System

Cronbach's Alpha parameter

>0.9= Excellent

>0.8=Good

>0.7=Acceptable

>0.6 = Questionable

>0.5= Poor

<0.5=Unacceptable

Cronbach's Alpha analysis (α):

$$\alpha = K/K\text{-}1\{1\text{-}\sum s * \frac{s\,y}{s} * s * x\}$$

K= No. of Items

$\sum(s * s)\,y$ = Sum of Items variance

$(s * s)x$ = Variance of total score

α= 0.515

Interpretation: $0.5 < \alpha < 0.59$

The Extended Framework for the DeLone and McLean model consists of five segments: System Quality, Information Quality, Service Quality, User Satisfaction, Intention to Use, and Net Benefit (Fig:4). Based on an average total score of 3, the lowest score was observed for System Quality with value of 0.65, while User Satisfaction had the highest score with 0.85 out of 3. These scores indicate the level of performance and effectiveness within each segment. In the analysis of Cronbach's Alpha for the IS Success model in the context of the Hospital Information System, a value of 0.515 was obtained. This value indicates poor internal consistency and validity for the Hospital Information System. It suggests that there is room for improvement in terms of the reliability and accuracy of the measurement instrument used to assess the system's success.

The findings emphasize the need for quality improvement in various segments of the Extended Framework. By enhancing System Quality, Information Quality, Service Quality, User Satisfaction, and Intention to Use, the net impact on the organization can be increased, along with improvements in the efficiency of the Hospital Information System and responsiveness to consumer needs.

Efforts should be directed towards addressing the identified weaknesses, such as enhancing system functionality, improving the quality and accuracy of information, providing superior service experiences, ensuring user satisfaction, and promoting the intention to use the system effectively. These improvements will ultimately lead to increased organizational impact and efficiency in the Hospital Information System, as well as better responsiveness to consumer needs.

DISCUSSION:

In order to make EHRs safe and for better, safer use, it is important to maintain compliance in all three domains: monitoring safely, using health IT, and safe health IT. This ensures that proper monitoring practices, health IT utilization, and safe health IT protocols are followed throughout the nine areas of concern outlined in the S.A.F.E.R guides.

> **Timely delivery and recording of urgent clinical information:**

To ensure effective and efficient Health Information Systems (HIS) and safe use of EHRs, it is crucial to ensure timely delivery and recording of urgent clinical information. Policies and training should support the appropriate use of messaging systems, enabling clinicians to track message status, access up-to-date patient and clinician contact information, and facilitate accurate routing, forwarding, and inclusion of necessary information. Highlighting time-sensitive data, identifying responsible clinicians, and implementing mechanisms to monitor response timeliness are also important.

> **Accurate entry of allergen and reaction information:**

Accurate entry and updating of allergen and reaction information in the EHR before order entry is essential. It is important to use evidence-based order sets and standardized terms to support efficient and consistent ordering practices. The EHR system should enable timely cancellation and acknowledgment of orders, display Clinical Decision Support (CDS) alerts within relevant clinical contexts, and ensure user training, involvement in CDS implementation, and adherence to best practices. Proper use of Computerized Provider Order Entry (CPOE) for medication, test, and procedure orders is encouraged, with checks for allergies, duplicates, drug conditions, and patient age.

> **Redundancy and backup systems**:

Organizations should implement hardware redundancy by duplicating critical applications to ensure continuous EHR functionality during hardware failures. Backup systems capable of running EHR functions should be available during extended power outages. Regular backups of patient data and software application configurations should also be performed to minimize data loss and enable quick recovery.

➢ **Downtime procedures and staff training:**

Establishing comprehensive policies and procedures specific to EHR downtimes and recovery processes is crucial. Staff members should be trained on these procedures and periodically tested to ensure familiarity and competence. Accurate patient identification protocols should be in place to mitigate errors during downtime. A communication strategy independent of the computing infrastructure should enable effective communication and coordination during downtime and recovery periods. In the event of EHR downtime, organizations should have contingency measures in place, such as utilizing temporary paper forms to replace key EHR functions.

➢ **Security and ransomware prevention**:

To protect EHR systems from cybersecurity threats, staff members should be trained in ransomware prevention strategies. Regular monitoring and testing of system security should be conducted to detect and mitigate vulnerabilities. Proactive measures should be taken to prevent security breaches and protect the integrity and confidentiality of EHR systems.

➢ **Proactive monitoring and root-cause analysis:**

Implementing a comprehensive testing and monitoring strategy helps identify functional system downtimes proactively. Unexpected extended downtimes exceeding 24 hours should be subject to root-cause analysis to identify underlying causes and prevent future occurrences.

➢ **Data integrity and redundancy:**

To ensure data integrity, regular backups of patient data and software application configurations should be performed. Hardware systems should be redundant to minimize the risk of system failures and data loss. Regular reviews of EHR downtime and reactivation policies and procedures help ensure that they remain up to date and effective.

➢ **Standardized and coded data elements:**

Standardizing the entry and storage of critical patient information using coded data elements improves accuracy and facilitates information exchange. Clear interpretations of test results enhance the effective understanding of patient data.

➢ **Clinical decision support (CDS) features:**

Interactive CDS features, such as interruptive warnings, passive suggestions, and info buttons, assist clinicians in making informed decisions based on evidence-based practices. Ensuring the availability and proper functioning of these features contributes to patient safety and improved clinical outcomes.

These considerations are crucial for promoting the safe and effective use of EHRs, enhancing patient care, and reducing the risk of errors or vulnerabilities in healthcare systems.

On other hand, at the highest level, decision makers such as boards of directors or owners of physician practices should be committed to promoting a culture of safety that prioritizes the safety and safe use of Health Information Systems (HIS). Their support and involvement are crucial in fostering a safe and effective environment for HIS utilization.

Organizations should implement an organizational policy that facilitates the reporting of HIS-related hazards and errors. This policy ensures that reports are promptly investigated and addressed, promoting a culture of transparency and continuous improvement. The human-computer interface of the HIS system should be designed to be easy to use, ensuring that required information is visible, readable, and understandable. A user-friendly interface enhances usability and reduces the risk of errors caused by confusion or lack of clarity.

In the event of unexpected extended system downtimes exceeding 24 hours, a review should be conducted using root-cause analysis or similar approaches.

This analysis helps identify underlying causes and implement measures to prevent future occurrences, minimizing disruptions and ensuring system reliability. HIS training and support should be provided by qualified trainers and appropriately tailored to the specific needs of different types of users. This ensures that users are proficient in utilizing the system effectively and safely, promoting efficient workflows and minimizing the risk of errors.

By implementing these considerations, organizations can foster a culture of safety and ensure the safe and effective use of Hospital Information Systems, ultimately enhancing patient care and reducing the potential for adverse events.

Conclusion:

The conclusion emphasizes the significance of the S.A.F.E.R guide as a comprehensive framework to optimize the safety and secure use of electronic health records (EHRs) in healthcare organizations. The guide is structured around three essential pillars: Foundational Guides, Clinical Process Guides, and Infrastructure Guides, each addressing critical areas related to EHR safety and utilization.

The Foundational Guide highlights the importance of high priority practices and organizational responsibilities in ensuring EHR safety. By focusing on these key aspects, healthcare organizations can prioritize safety measures and foster a culture of responsibility, ultimately contributing to a safer and more efficient EHR system.

The Infrastructure Guide is another crucial component that emphasizes contingency planning, system configuration, and system interfaces. These elements play a pivotal role in establishing a secure and reliable EHR environment. Adequate planning for system unavailability, robust interfaces between applications, and efficient hardware and software setups are essential for seamless EHR operations.

The Clinical Process Guide dives into specific clinical processes, such as clinician communication, test results reporting and follow-up, patient identification, and computerized provider order entry with decision support. By optimizing these processes, healthcare professionals can enhance patient care, improve clinical outcomes, and reduce potential errors.

The conclusion also underscores the significance of compliance in three key domains: monitoring safely, using health IT safely, and safe health IT practices. Addressing considerations like timely information delivery, accurate allergen and reaction information entry, redundancy and backup systems, downtime procedures and staff training, security and ransomware prevention, proactive monitoring, data integrity, standardized data elements, and clinical decision support features is essential for maximizing EHR safety and efficacy.

Leadership commitment and a culture of safety are highlighted as critical factors in promoting transparency and continuous improvement in EHR safety practices. Having policies for reporting and investigating hazards and errors ensures prompt action and facilitates ongoing improvement efforts.

Furthermore, the conclusion emphasizes the importance of an intuitive and user-friendly human-computer interface. Effective training and support contribute to user proficiency, smooth workflows, and minimal errors, leading to an overall safer and more effective EHR system.

By incorporating these considerations into healthcare strategies, organizations can establish a safer and more efficient EHR system, benefiting both healthcare providers and patients. Continuous efforts to improve compliance will set a standard for excellence in EHR safety, driving advancements in healthcare delivery and patient safety.

In summary, the S.A.F.E.R guide provides a comprehensive roadmap for healthcare organizations to enhance EHR safety and utilization. By implementing its recommendations and principles, healthcare providers can lay the foundation for a safer and more effective future in healthcare, ultimately improving patient care and well-being.

Recommendation:

To ensure optimal performance and effectiveness of their Hospital Information System (HIS) and Electronic Health Record (EHR) implementation, several key steps should be taken.

Firstly, a strong focus should be placed on enhancing the quality and reliability of the system. Thorough testing and addressing any identified weaknesses will ensure that the HIS meets industry standards and functions seamlessly.

Secondly, improvements should be made to ensure the accuracy and consistency of information within the HIS. This can be achieved through the use of standardized data elements and effective data entry practices.

Furthermore, prioritizing comprehensive user training and support will enhance the overall service quality. By providing tailored training programs and establishing an organizational policy that encourages reporting of hazards and errors, a culture of continuous improvement and transparency will be fostered.

User satisfaction is crucial, and attention should be given to improving the user interface of the HIS. By making it more intuitive, user-friendly, and responsive to user feedback, overall satisfaction and usability will be greatly enhanced. Ensuring the safety and secure utilization of the EHR requires implementing recommended practices outlined in the S.A.F.E.R guides. This includes measures such as contingency planning, system configuration, and effective clinician communication. Compliance with these practices will greatly enhance patient safety and data security.

Data security should be a top priority, with the implementation of robust measures to protect against cybersecurity threats. Regular monitoring, testing, and updates to system security will ensure the EHR remains safeguarded. To create a culture of safety, involvement of decision-makers and stakeholders is essential. Encouraging transparency, reporting of hazards, and continuous improvement will promote a safe and accountable environment for HIS utilization.

Lastly, ongoing evaluation and feedback mechanisms should be established to continuously assess the performance and effectiveness of the HIS. This will enable prompt identification of areas for improvement and the implementation of necessary changes to optimize functionality and user experience. By implementing these recommendations, high-performing HIS and EHR system can be achieved also ensuring the delivery of exceptional healthcare services while prioritizing patient safety and satisfaction.

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ANNEXURE : S.A.F.E.T.Y Guide Checklist (checklist structure)

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