DISSERTATION

ON

ROOT CAUSE ANALYSIS OF MAJOR IDENTIFIED ISSUES LEADING TO SERVICE RESTORATION INCIDENTS

SUBMITTED BY

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PG/13/033

UNDER THE GUIDANCE OF

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INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT & RESEARCH

Internship Training

at

Deloitte Consulting India Pvt. Ltd

Root Cause Analysis of Major Identified Issues leading to

Service Restoration Incidents

by

Komal Vats

PG/13/033

Under the guidance of

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Post Graduate Diploma in Hospital and Health Management

2013-15

IIHMR DELHI

International Institute of Health Management Research

New Delhi

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May 15, 2015

To Whom It May Concern

This is to certify that Ms. **Komal Vats** was on a fixed term Internship from **February 09, 2015** to **May 15, 2015**. She has successfully completed her Internship in **Application Management Services**.

We wish you the very best in your future endeavors.

Yours truly,

For Deloitte Consulting India Pvt. Ltd.

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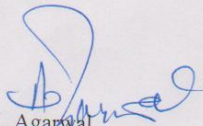This document is digitally signed and does not require company seal.

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

The Internship is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

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The following dissertation titled **"Root Cause Analysis of Major identified Issues leading to Service Restoration Incidents"** at **"Deloitte Consulting India Pvt. Ltd"** 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 **Post Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by 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.

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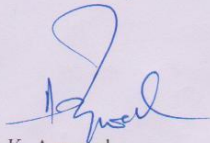
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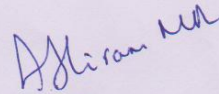DIVYA AGGARWAL

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Certificate from Dissertation Advisory Committee

This is to certify that **Komal Vats** a graduate student of the **Post- Graduate Diploma in Health and Hospital Management** has worked under our guidance and supervision. She is submitting this dissertation titled "**Root Cause Analysis of Major Identified Issues leading to Service Restoration Incidents**" at "**Deloitte Consulting India Pvt. Ltd**" in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital 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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**INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH,
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CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **Root Cause Analysis of Major Identified Issues leading to Service Restoration Incidents** submitted by **Komal Vats (PG/13/033)** under the supervision of **Dr. Ashok K Agarwal** for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from **9th February, 2015 to 15th May, 2015** 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.

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FEEDBACK FORM

Name of the Student: Komal Vats

Dissertation Organisation: Deloitte Consulting India Pvt Ltd.

Area of Dissertation: Root cause analysis of Major identified issues leading to service restoration.

Attendance: 100%.

Objectives achieved: Komal has performed above and beyond set expectations.

Deliverables: Shadowed Orders team of incident and change Management.

Strengths:
① Hard working.
② Commited.
③ Flexible.

Suggestions for Improvement: ① Interact more with in the team.

Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

Date: 5/15/2015
Place: Bangalore

Dissertation Writing

ABSTRACT

To minimize the occurrence of medication-related errors, implementing health information technologies in conjunction with other process improvements such as, Computerized physician order entry (CPOE) is a health information technology (health IT) system that is commonly used by hospitals and other health care providers to prevent medication and procedure related errors and increase efficiency in medication administration. Computerized physician order entry (CPOE) is a system that allows direct entry of medication orders and instructions for the treatment of patients by a medical practitioner. The orders are communicated through a computer network to medical staff or other various departments responsible for fulfilling an order, including pharmacy, radiology or laboratory. CPOE decreases delay in order completion, reduces errors related to handwriting or transcriptions, allows order entry at point-of-care or offsite, provides error checking for duplicate or incorrect doses or tests, and simplifies inventory and positing of charges.

An Order set is a group of orders that are commonly placed together based on a diagnosis or treatment plan. Order Sets can contain both procedure and medication orders. Having them come in a pre-packaged "set" increases providers' efficiency in placing orders while still giving them the opportunity to customize the orders for their patient. Order sets are preconfigured groups of orders that are commonly ordered together for a specific problem or diagnosis. They are designed for inpatient settings.

There is a proper well defined process for the intake of service restoration incident. The analyst collects all required information from the user and gives resolution. The incident is closed after proper documentation.

9

This retrospective study was conducted analyzing an EMR Application related data taken for three months. After analyzing 168 Service restoration incidents, it was found there were many issues which were leading to these incidents. They were user training issue (65.47%), device issue (10.71%), EMR Functionality issue (8.92%), Issue unidentified (5.95%), Interface (4.76%) and Mapping issue (4.16%). Also, it was found that 60% of critical incidents and 61.6% of high incidents occurred because of User training issue.

Pareto analysis technique was used to find the major issues which are causing around 80% of incidents. They were found to be User training issue and Device issue. Further in-depth analysis was done to find the root cause of these issues. User training incidents were related to workflows which users lack knowledge of like placing a procedure order, Release future order, Cancellation of an order, Reconciliation of Order, Logging into a department and there were many others. Device issues were found to be related to system and printing.

ACKNOWLEDGEMENT

It is not possible to prepare a project report without the assistance and encouragement of other people. This one is certainly no exception.

On the very onset of this report, I would like to extend my sincere and heartfelt obligation towards all the personages who have helped me in this endeavor. Without their active guidance, help, cooperation & encouragement, I would not have made headway in the project.

My deepest sense of gratitude towards **Mr. Sumit Singhal,** Manager, Deloitte Consulting India Pvt. Ltd and **Mr. Abhiram Ravindrababu,** Senior Consultant, Deloitte Consulting India Pvt. Ltd and all my **Team members** at Deloitte Consulting India Pvt. Ltd for their immense support and guidance. Thanks and appreciation to all the people at Deloitte for their support.

I am extremely thankful and pay my gratitude to my guide and mentor **Dr. Ashok K Agarwal** for his valuable guidance and support.

I am highly fortunate to express my deep sense of gratitude and indebtedness to **Dr**. **Lakhwinder P Singh ,** Director, IIHMR DELHI for his invaluable inspiration.

At last but not the least all my friends, colleagues and family who have directly or indirectly helped me complete this project report.

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LIST OF ABBREVIATIONS

1.	CPOE	Computerized Physician Order Entry
2.	IT	Information Technology
3.	EMR	Electronic Medical Record
4.	ADE	Adverse Drug Event
5.	CDS	Clinical Decision Support
6.	CDSS	Clinical Decision Support System
7.	ICD	International Classification of Diseases
8.	TATs	Turnaround Times
9.	NA	Not Applicable

ORGANIZATION PROFILE

Deloitte provides industry-leading audit, consulting, tax, and advisory services to many of the world's most admired brands, including 70% of the Fortune 500. Deloitte functions across more than 20 industry sectors with one purpose: to deliver measurable, lasting results. Deloitte helps reinforce public trust in our capital markets, inspire clients to make their most challenging business decisions with confidence, and help lead the way toward a stronger economy and a healthy society. Deloitte has more than 210,000 professionals at member firms delivering services in more than 150 countries and territories. Revenues for fiscal year 2014 were US$34.2 billion.

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LEARNING

During my internship in Deloitte Consulting India Pvt. Ltd, I learned about various things given below:

- US health care system and how providers and payors work together in health care industry

- Underwent trainings for various processes followed in the organization

- Underwent EMR specific trainings

- Brief knowledge about HIPAA

- Brief knowledge about impact of ICD-10 on operations

- Underwent other trainings related to healthcare industry

INTRODUCTION OF THE STUDY

The safe use of medications is an important area of concern within health care. In an average week in the United States, four out of every five adults will use prescription medications, over-the-counter drugs, or dietary supplements of some sort; nearly a third of adults will take five or more medications. These medications usually provide some benefits to the person taking them, or at least do not cause harm. Yet medications occasionally cause injury. Process-related medication errors and adverse drug events (ADEs) are still too common, often preventable, costly, and they can result in serious injury or death.

To reduce the occurrence of medication-related errors, computerized provider order entry (CPOE) which is a health information technology (health IT) system was developed. CPOE is commonly used by hospitals and other health care providers to prevent medication-related errors and increase efficiency in medication administration.

CPOE is an application that enables providers to enter medical orders into a computer system that is located within an inpatient or ambulatory setting. CPOE replaces more traditional methods of placing medication orders, including written (paper prescriptions), verbal (in person or via telephone), and fax. Most CPOE systems allow providers to electronically specify medication orders as well as laboratory, admission, radiology, referral, and procedure orders.

On its own, CPOE has an impact on safety by ensuring that orders are legible. Yet the value of this EMR functionality is increased by adding clinical decision support (CDS) systems. CDSS is a technology that provides clinicians with real-time feedback about a

wide-range of diagnostic and treatment-related information as they are entering electronic orders. By running electronic rules in the background, decision support can check for a variety of potential errors. Examples include drug interactions, patient allergies to prescribed medications, medication contraindications, and renal- and weight-based dosing.[1]

If the physician is ordering a series of tests and medications for a common diagnosis, the computer can offer the use of a pre-programmed, institutionally reviewed and approved sets of orders to facilitate the process and help the physician follow accepted protocols for that diagnosis.[2]

In most (but not all) CPOE implementations, orders entered into the system are communicated electronically to the departments and personnel responsible for their execution, and frequently, the departments send back notification of the status of the order and/or the results of order execution (eg., Laboratory results, X-ray results). CPOE can thus improve process turnaround times – for example, reduce the time from ordering to arrival of the medication. It can improve documentation received by ancillary departments, such as pharmacy and radiology, thereby reducing the chance of misinterpretation of an order and improving documentation needed for payment.

FEATURES OF CPOE SYSTEMS

- Ordering

  Physician orders are standardized across the organization, yet may be individualized for each doctor or specialty by using order sets. Orders are communicated to all departments and involved caregivers, improving response time and avoiding scheduling problems and conflict with existing orders.

- Patient-centered decision support

  The ordering process includes a display of the patient's medical history and current results and evidence-based clinical guidelines to support treatment decisions. Often uses medical logic module to facilitate fully integrated Clinical Decision Support Systems (CDSS).

- Patient safety features

  The CPOE system allows real-time patient identification, drug dose recommendations; adverse drug reaction reviews, and checks on allergies and test or treatment conflicts. Physicians and nurses can review orders immediately for confirmation.

- Regulatory compliance and security

  Access is secure, and a permanent record is created, with electronic signature.

- Portability

  The system accepts and manages orders for all departments at the point-of-care, from any location in the health system (physician's office, hospital or

home) through a variety of devices, including wireless PCs and tablet computers.

- Management

    The system delivers statistical reports online so that managers can analyze patient census and make changes in staffing, replace inventory and audit utilization and productivity throughout the organization. Data is collected for training, planning, and root cause analysis for patient safety events.

- Billing

    Documentation is improved by linking diagnoses (ICD-9-CM or ICD-10-CM codes) to orders at the time of order entry to support appropriate charges.

ADVANTAGES OF CPOE:

- Reducing the potential for human error.

- Reducing time to care delivery.

- Improving order accuracy.

- Decreasing time for order confirmation and turnaround.

- Improving clinical decision support at the point of care.

- Making crucial information more readily available.

- Improving communication among physicians, nurses, pharmacists, other clinicians, and patients.

INTEROPERABILITY

Effective CPOE implementation requires integration with existing hospital information systems such as registration, pharmacy, laboratory and electronic medical record systems. Problems can occur if there is no integration between the modules or between different vendors.

TECHNICAL SUPPORT

Ready and immediate access to technical support is critical to the success of CPOE. Organizations can expect the users to have many concerns and questions about CPOE during and after the implementation. Because of the nature of inpatient care, questions regarding CPOE may occur at any time of the day or night. Therefore organizations need to have 24*7 technical support [3]

Figure 1 - CPOE Inpatient Workflow

```
┌──────────┐      ┌──────────────┐      ┌──────────────┐
│ Patient  │ ───► │ Oral         │ ───► │ Order faxed  │
│ admitted │      │ chemotherapy │      │ to Pharmacy  │
└──────────┘      │ prescribed   │      └──────────────┘
                  └──────────────┘              │
                                                ▼
┌──────────────────┐          ◇ Pharmacy order ◇
│ Prescriber       │   No     ◇ review : Is order ◇
│ contacted for    │ ◄─────── ◇ appropriate ?    ◇
│ clarification/   │          ◇                  ◇
│ revision         │
└──────────────────┘                   │ Yes
                                        ▼
                            ┌──────────────────┐
                            │ Order entered    │
                            │ into pharmacy    │
                            │ system           │
                            └──────────────────┘
                                        │
                                        ▼
┌──────────────────┐          ◇ Order review by ◇
│ Prescriber/      │   No     ◇ nurse : is order ◇
│ pharmacist       │ ◄─────── ◇ appropriate ?   ◇
│ contacted for    │          ◇                 ◇
│ order            │
│ clarification    │                   │ Yes
└──────────────────┘                   ▼
┌──────────────────┐          ┌──────────────────┐
│ Patient          │ ◄─────── │ Medication       │
│ monitored for    │          │ administration   │
│ adverse effects  │          │ and              │
└──────────────────┘          │ documentation    │
                              └──────────────────┘
```

ORDER SETS

An order set is a group of related orders which a physician can place with a few keystrokes or mouse clicks. An order set allows users to issue prepackaged groups of orders that apply to a specified diagnosis or a particular period of time. One of the main impetuses for order sets comes from the need to improve user acceptance of computer-based physician order entry, by decreasing the time physicians require to enter orders. Using order sets reduces both time spent entering orders and terminal usage.

Benefits

There are many reported benefits of order sets. Order sets represent a potential solution to the time constraints of busy physicians and may even improve quality and safety. Obstacles to overcome would include physician acceptance, costs of creation and maintenance, and user interface issues.

Order set reduces medical errors, especially omission errors. It eases access to linked guidelines, integrate evidence based guidelines into daily physician's point of care-practice. They also facilitate ordering of routine parts of patient care enabling the physicians to focus on unique need of each patient.

1. Reduction of transcription errors.
2. Promotion of adherence to consistent standards of care
3. Focus attention upon unique features of a patient.
4. Quicker order entry
5. Reduction in delays due to inconsistent or incomplete orders

A strong advantage for using order sets is that they minimize time required for clinicians to order routine and guideline-driven tests and medications. Default values for orders can dramatically reduce the time needed to order a test or medication. For example, they can automatically complete certain data fields, such as dosage, length of treatment, and testing interval. Clinicians viewed default values as "recommended values" and were offended by the CPOE systems "suggestions" for how they should practice medicine. Some systems provided with many free text fields providing opportunities for error, and can result in confusion among the lab technicians and pharmacists who receive completed orders.[4]

WELL-DESIGNED ORDER SETS HAVE THE POTENTIAL TO:[5]

- Integrate and co-ordinate care by communicating best practices through multiple disciplines, levels of care, and services.

- Modify practice through evidence-based care.

- Reduce variations and unintentional oversight through standardized formatting and clear presentation of orders.

- Enhance workflow with pertinent instructions that are easily understood and organized.

- Reduce the potential for medication errors through integrated safety and reminders.

- Reduce unnecessary calls to physicians for clarifications and questions about orders.

However if standard order sets are not carefully designed, reviewed, and maintained to reflect best practices and ensure communication, they may actually contribute to errors.

OBJECTIVES

GENERAL: To carry out root cause analysis of major identified issues leading to various service restoration incidents raised by end users

SPECIFIC:

- To understand the workflow of incident resolution

- To identify various issues leading to service restoration incidents

- To carry out root cause analysis of major issues identified using Pareto analysis technique

- To recommend solutions for these issues

REVIEW OF LITERATURE

Effect of a Computerized Provider Order Entry (CPOE) System on Medication Orders at a Community Hospital and University Hospital[6]

With a pre-post study design, the effects of a CPOE system on the medication ordering process at both a community and university hospital were assessed. The two environments differed significantly in that the community hospital's patients had orders entered by staff physicians or physician assistants. At the university hospital, the majority of orders were entered by house staff (residents and fellows) or medical students. In both settings, adopting CPOE was a significant undertaking, requiring extensive resources, process, and cultural changes.

The time from provider ordering to pharmacist verification decreased by two hours with CPOE at the community hospital ($p<0.0001$) and by one hour at the university hospital ($p<0.0001$). The rate of medication clarifications requiring signature was 2.80 percent pre-CPOE and 0.40 percent with CPOE ($p<0.0001$) at the community hospital. The university hospital was 2.76 percent pre-CPOE and 0.46 percent with CPOE ($p<0.0001$). CPOE improved medication order processing at both community and university hospitals. These findings add to the limited literature on CPOE in community hospitals.

This study demonstrated that CPOE improves efficiency in the medication order processing at both the community hospital and a university hospital, specifically the time from medication ordering to pharmacist verification. Medication clarifications requiring signature were reduced 6–7 fold with CPOE compared with handwritten orders at both hospitals.

Another study was conducted which included a meta-analysis of nine papers that compared the medical error rates in hospitals before and after their adoption of CPOE. At the rate of CPOE adoption and implementation in 2008, the study said, medication errors were reduced by 12.5% nationally, meaning there were 17.4 million fewer errors than there would have been without CPOE. If all hospitals adopted CPOE and if the implementation level remained around 60%, the researchers added, up to 51 million medication errors a year could be averted.[7]

Efficiency Gains with Computerized Provider Order Entry[8]

This project was carried out to measure efficiency gains in turnaround times with the implementation of a computerized provider order entry (CPOE) system.

Pre- and post-CPOE turnaround times (TATs) were measured for orders placed for laboratory, radiology, and pharmacy. The pre-CPOE group was nonrandomized and included a convenience sample of 240 patients with a sample of 1,420 total orders (laboratory N = 340; radiology N = 490; and pharmacy N = 590). The post-CPOE group was randomized and included 241 patients with a sample of 2,390 total orders (laboratory N = 750; radiology N = 680; and pharmacy N = 960).

TATs were statistically significantly lower ($P < 0.0001$) in all three departments: laboratory TATs decreased 54.5 percent, from 142 to 65 minutes; radiology TATs decreased 61.5 percent, from 31.0 to 11.9 hours; pharmacy TATs decreased 83.4 percent, from 44.0 to 7.3 minutes.

Implementation of CPOE resulted in dramatic improvements in TATs, which, in turn, can lead to more timely treatment of patients and enhanced communication of results to providers. It also supports the effort to improve quality of patient care and patient safety.

Another study was conducted by Van Doormaal et al in 2009 to evaluate the expectations and experiences of physicians' and nurses' regarding computerized physician order entry system (CPOE) and provide suggestions for future optimization of the system and the implementation process. 18 physicians and 42 nurses were interviewed from four internal medicine wards of two Dutch hospitals. Semi- structured questionnaire was used as the tool for evaluation and the statements were measured on a 5-point Likert scale. Chi-squared tests were used to compare the experiences and expectations of the respondents and for assessing the differences between them. The study reported that both physicians and nurses were positive about CPOE both before and after implementation. The nurses were not clear about the overview of patients' medication use. It was concluded that CPOE could be improved especially the technical aspects and decision support on drug-drug interactions to fit into the clinical practice.[9]

A literature review to gain an insight into the impact of Computerized Provider Order Entry systems on inpatient clinical workflow was carried out in 2009 by Zahra Niazkhani et al. various databases like PubMed and Cochrane were searched for journal articles, conference proceedings and summaries. 51 publications were selected which included 31 journal articles, 16 proceedings papers and 4 proceedings abstracts. The research designs used were mixed method, quantitative and qualitative studies. The beneficial effects reported were:[10]

- Remote access to enter orders or view their status

- Multiple people enabled to view the same patient's orders simultaneously

- Access to knowledge sources, order sets, geographical display of data, and easier charting of medications

- Removal of many intermediary and time-consuming tasks for physicians, nurses and ancillary departments

- Decreased order turnaround times

- Decreased verbal orders

METHODOLOGY

This retrospective study was done analyzing an EMR Application related data taken for three months (December 2014 to February 2015). The data was analyzed using Microsoft Excel. Tables and graphs were generated and inferences were drawn using appropriate software.

- Study area – Deloitte Consulting India Pvt. Ltd, Bengaluru

- Sample size – 168 service restoration incidents

- Duration of the study – 15th March, 2015 to 30th April, 2015

- Technique – Pareto analysis technique was used to identify major issues. Root cause analysis was done for the identified major issues.
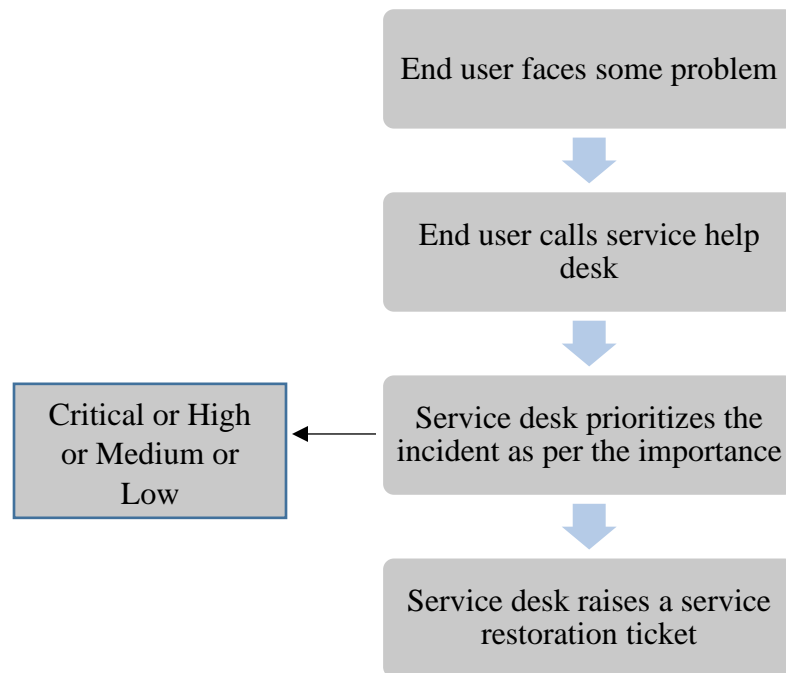
Ethical Considerations:

- Security of Deloitte Data

- Privacy and Confidentiality shall be maintained

RESULTS AND DISCUSSION

Whenever any service restoration incident comes, there is a process to intake that issue.

Figure 2 – Incident Intake Process

```
                    ┌─────────────────────────┐
                    │  End user faces some     │
                    │        problem           │
                    └─────────────────────────┘
                                ↓
                    ┌─────────────────────────┐
                    │ End user calls service   │
                    │      help desk           │
                    └─────────────────────────┘
                                ↓
 ┌──────────────┐   ┌─────────────────────────┐
 │ Critical or  │ ← │ Service desk prioritizes │
 │ High or      │   │ the incident as per the  │
 │ Medium or    │   │       importance         │
 │ Low          │   └─────────────────────────┘
 └──────────────┘                ↓
                    ┌─────────────────────────┐
                    │ Service desk raises a    │
                    │ service restoration      │
                    │        ticket            │
                    └─────────────────────────┘
```
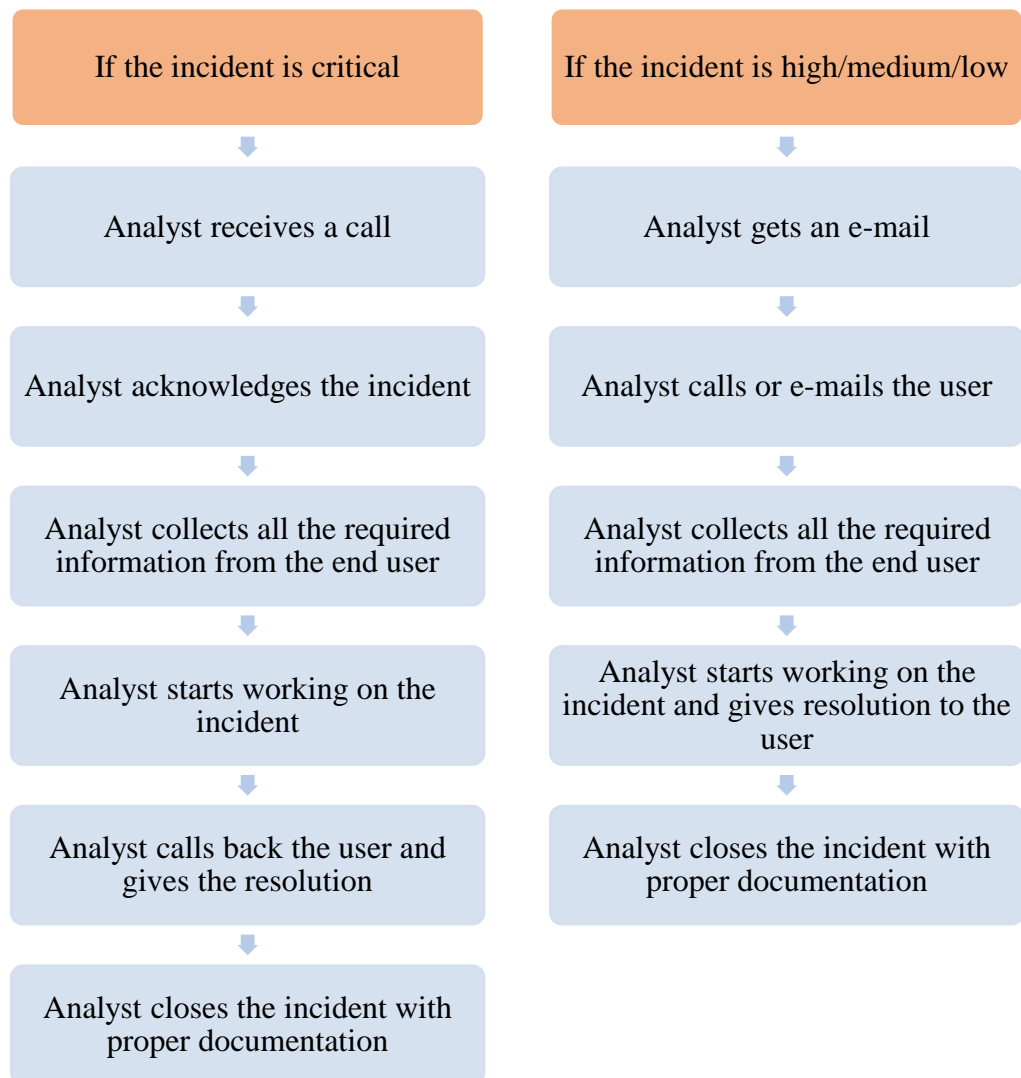
Whenever some issue is faced by an end user, he calls the help desk regarding that issue. Help desk tries to understand the issue and as per the user, prioritizes the issue as either critical or high or medium or low. Then a service restoration ticket is raised and the incident is received by an analyst.

Critical and High incidents are those which are directly affecting patient care, thus, have to be resolved as soon as possible.

Once the incident has been received by an analyst, the analyst starts resolving the issue.

Figure 3 – Incident Resolution Process

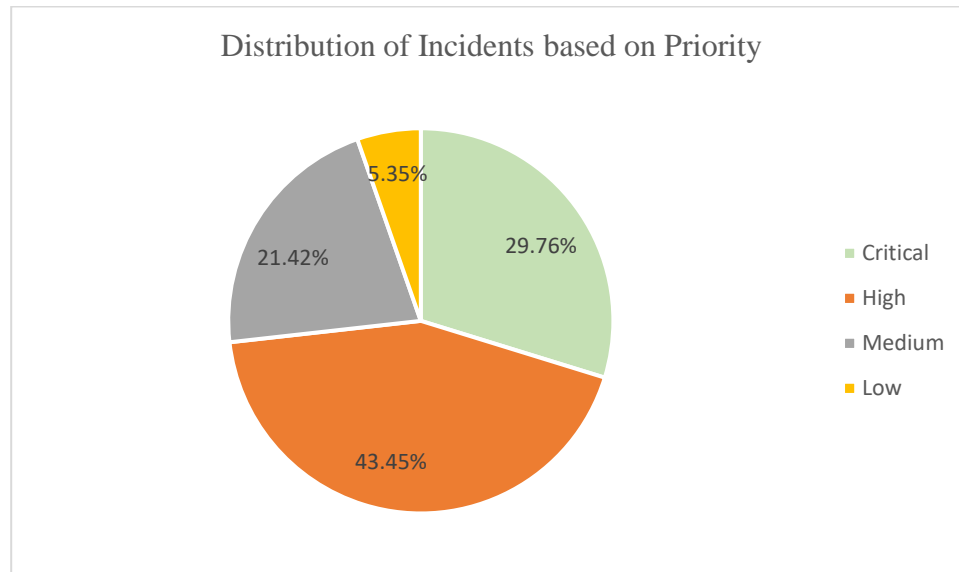| If the incident is critical	If the incident is high/medium/low
Analyst receives a call	Analyst gets an e-mail
Analyst acknowledges the incident	Analyst calls or e-mails the user
Analyst collects all the required information from the end user	Analyst collects all the required information from the end user
Analyst starts working on the incident	Analyst starts working on the incident and gives resolution to the user
Analyst calls back the user and gives the resolution	Analyst closes the incident with proper documentation
Analyst closes the incident with proper documentation	

If the incident is critical, the analyst immediately responds to it as it is affecting patient care directly. The analyst gets a phone call for a critical incident. As it is critical, the analyst starts working on it after collecting all the required information from the user. Then

the analyst calls back the user and gives the appropriate resolution. After confirmation from the user, the analyst closes the incident with all the required documentation.

If the incident is high or medium or low, the analyst gets an e-mail in which all the details regarding the incident are mentioned. Still if the analyst finds some information missing, the analyst emails the user and asks for the information. After collecting all the information, the analyst starts working on it and gives the user a resolution. After confirmation from the user, the analyst closes the incident with all the required documentation.

There is also a specified time limit within which the analyst is required to respond to the incident and resolve it.
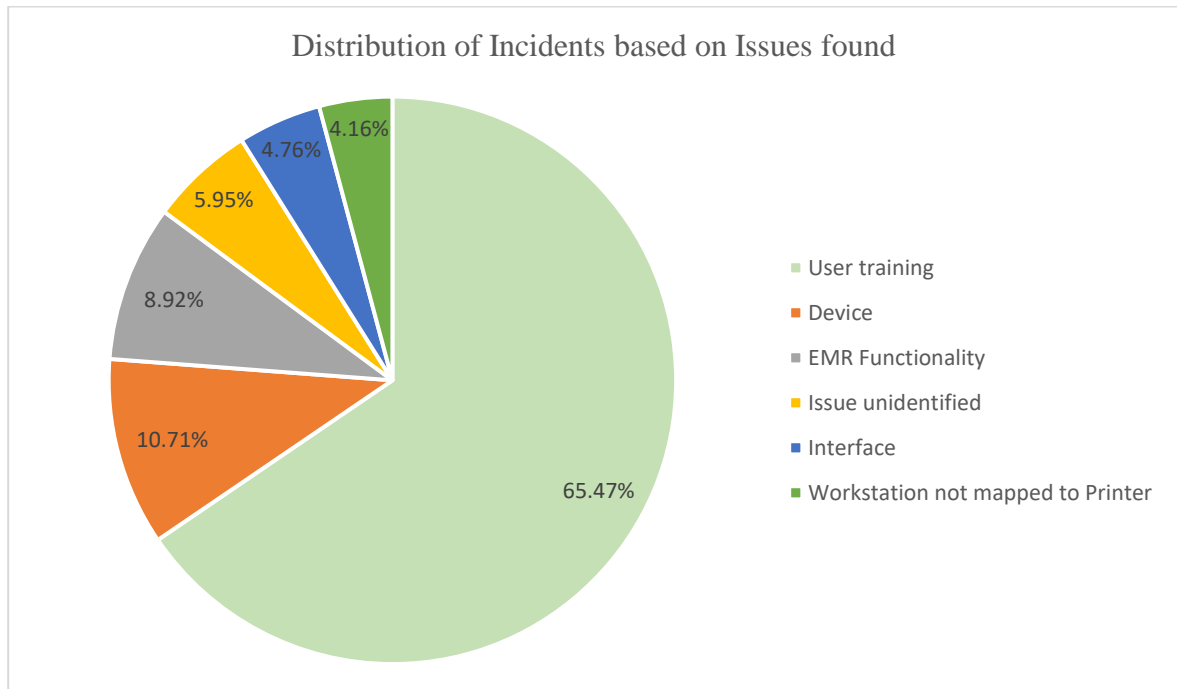
Figure 4 – Distribution of Incidents based on Priority

Distribution of Incidents based on Priority

Priority	Number of incidents
Critical	50
High	73
Medium	36
Low	9
Total	**168**

Inference – Out of 168 Service restoration incidents, High priority incidents were maximum (43.45 %). Critical priority incidents were 29.76 %. Medium priority incidents were 21.42 %. Low priority incidents were minimum (5.35%).

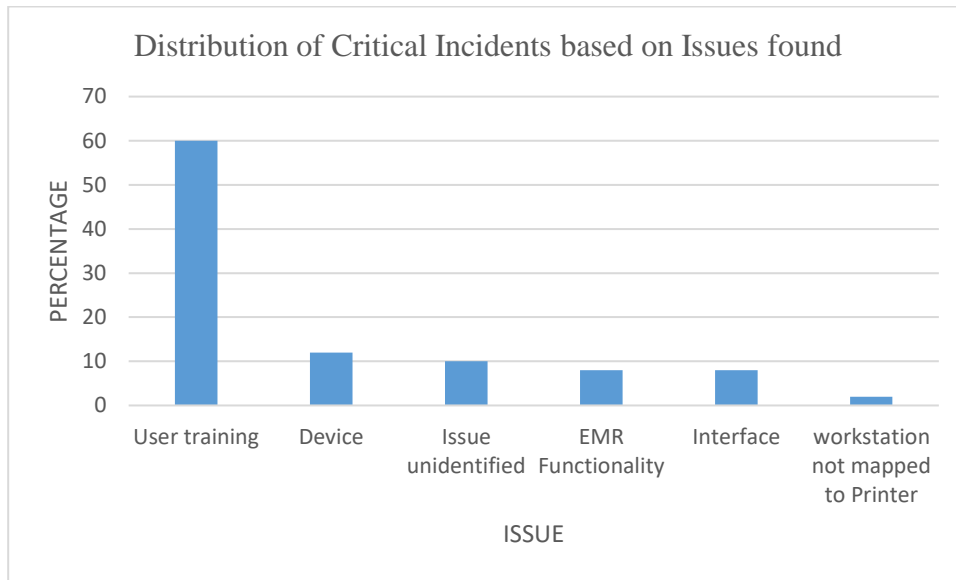**Figure 5 – Distribution of Incidents based on Issues found**

Distribution of Incidents based on Issues found

- User training
- Device
- EMR Functionality
- Issue unidentified
- Interface
- Workstation not mapped to Printer

Issue found	Number of incidents
User training	110
Device	18
EMR Functionality	15
Issue unidentified	10
Interface	8
Workstation not mapped to Printer	7
Total	**168**

Inferences – After analyzing the data of Service restoration incidents taken for three months, it was found that these incidents are occurring because of some main issues. Those issues were user training, device, EMR functionality, interface, workstation not mapped to printer and some unidentified issues. These were the issues which led to service restoration incidents.

It can be clearly seen that 65.47% of incidents occurred because of user training issue. User training issue contributed a lot towards these incidents. Device issue led to 10.71% of incidents. EMR Functionality issue led to 8.92% of incidents. Some issues remained unidentified because of lack of proper documentation. They led to 5.95% of incidents. Interface issue was found to cause 4.76 % of incidents. Lastly, mapping issue caused 4.16% of incidents.

Thus these were some issues which were found while analyzing the data obtained. Further in-depth analysis was done on some major issues found using Pareto analysis technique so that more efforts could be put on major issues. This would help solving majority of incidents and prevent their recurrence in future.

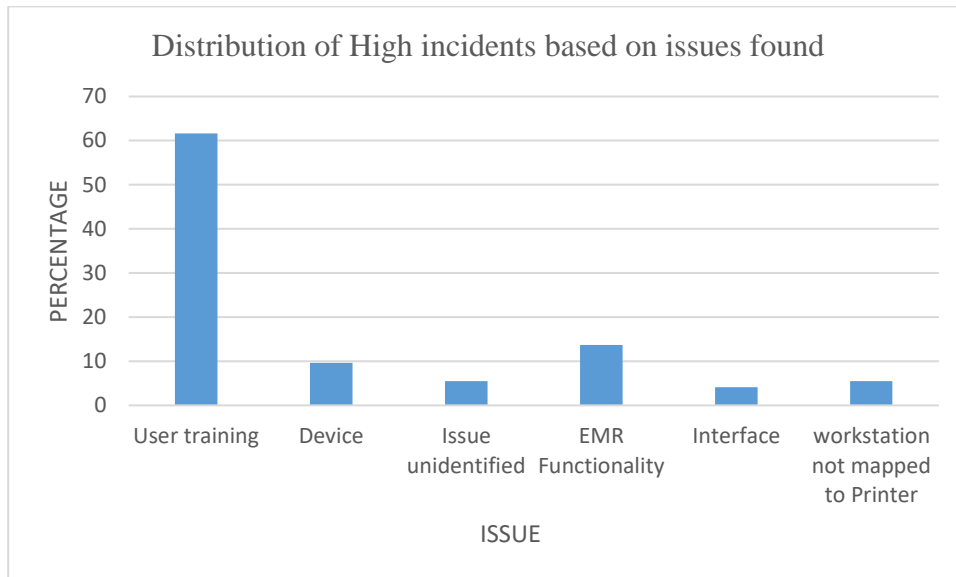**Figure 6 – Distribution of Critical incidents based on Issues found**

Distribution of Critical Incidents based on Issues found

Issue found	Number of critical incidents
User training	30
Device	6
Issue unidentified	5
EMR Functionality	4
Interface	4
Workstation not mapped to Printer	1
Total	**50**

Inference – Above Graph shows the percentage distribution of critical incidents on the basis of issues found. It can be clearly seen that total number of critical incidents were 50. Critical incidents make 29.76% of total incidents.

As it can be seen that 60% of critical incidents occurred because of user training issue. User training issue led to more than 50% of critical incidents. Hence it needs more attention. Device issue led to 12% of critical incidents. 8% of critical incidents occurred because of EMR functionality issue. 10% of critical incidents were unidentified. Though they were resolved but unidentified during the study because of lack of proper documentation. Interface issue contributed towards 8% of critical incidents. Incidents caused by mapping issue were minimal.

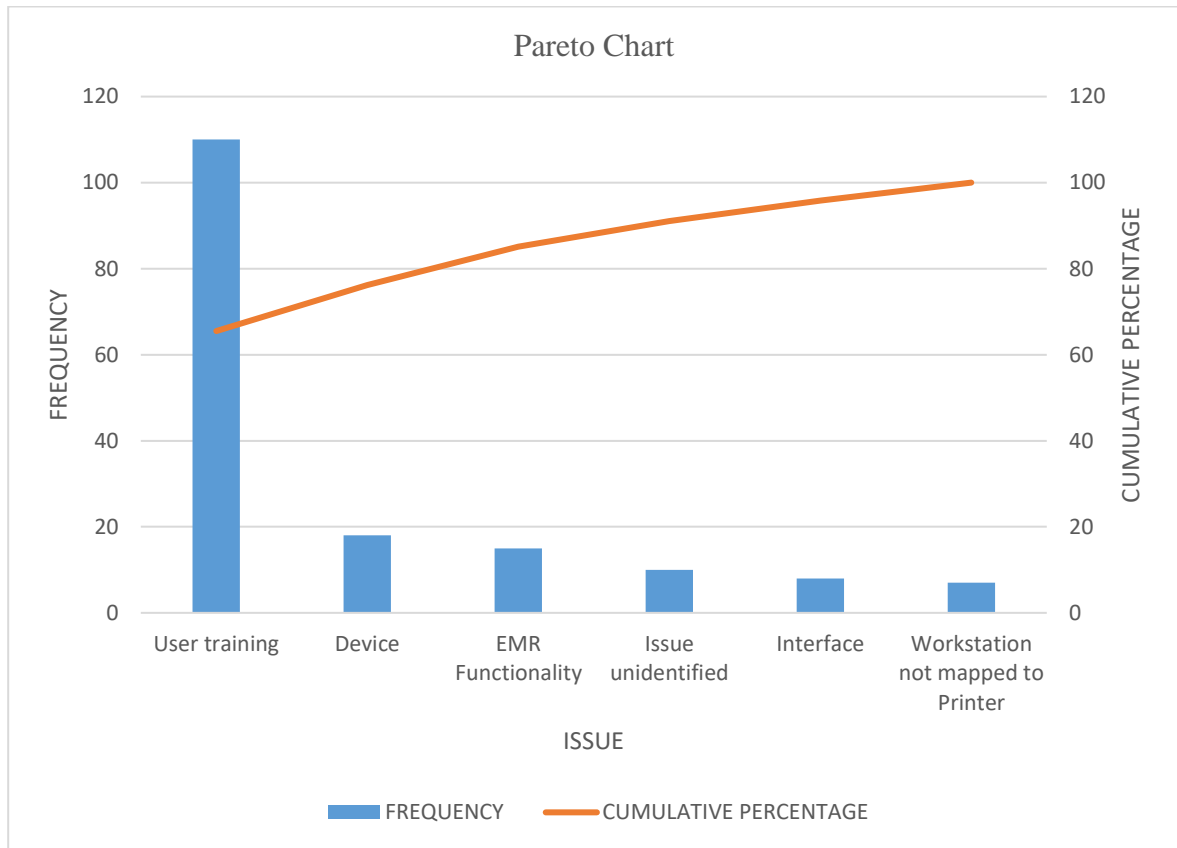**Figure 7 – Distribution of High incidents based on Issues found**

Distribution of High incidents based on issues found

Issue found	Number of high incidents
User training	45
Device	7
Issue unidentified	4
EMR Functionality	10
Interface	3
Workstation not mapped to Printer	4
Total	**73**

Inference - Above Graph shows the percentage distribution of high incidents on the basis of issues found. It can be clearly seen that total number of high incidents were 73. High incidents make 43.45% of total incidents.

As it can be seen that 61.6% of high incidents occurred because of user training

issue. User training issue led to more than 50% of high incidents. Hence it needs more attention. Device issue led to 9.6% of high incidents. 13.7% of high incidents occurred because of EMR functionality issue. 5.5% of high incidents were unidentified. Though they were resolved but unidentified during the study because of lack of proper documentation. Interface issue contributed towards 4.1% of high incidents. Percentage of high incidents caused by mapping issue was 5.5%.

Figure 8 – Pareto Chart

Issue found	Number of incidents	Cumulative number	Cumulative percentage
User training	110	110	65.5
Device	18	128	76.2
EMR Functionality	15	143	85.1
Issue unidentified	10	153	91.1
Interface	8	161	95.8
Workstation not mapped to Printer	7	168	100

Inference – Pareto analysis technique had been used to identify major issues which are causing around 80% of service restoration incidents so that they could be more focused and resolved first.
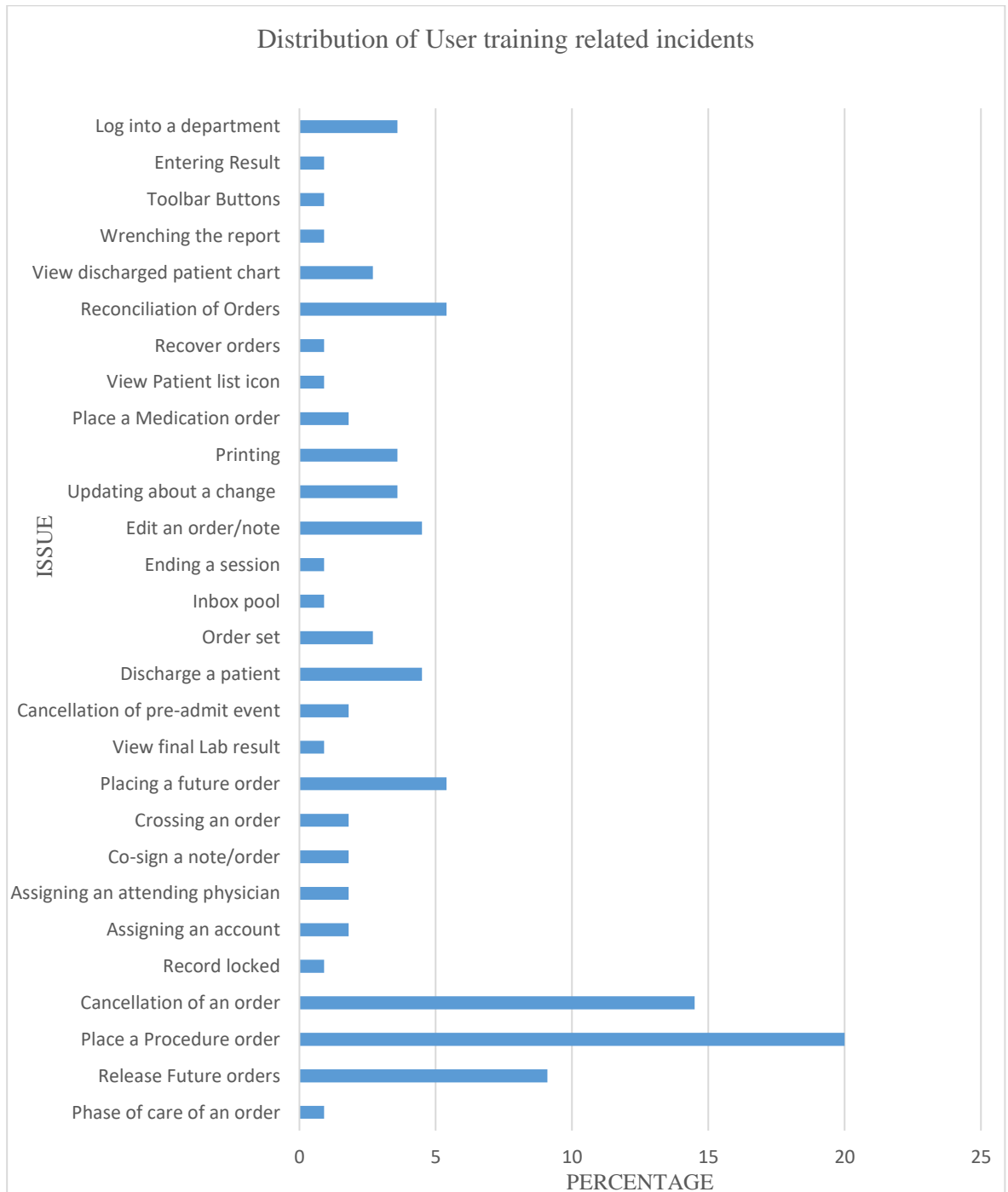
After carrying out Pareto analysis technique, it was found that user training issue and device issue were two major issues which were leading around 80% of service restoration incidents. So, around 80% of total service restoration incidents were caused led by 33% of issues found. So it was clear that these two issues required more attention. They were given first priority.

Pareto analysis technique makes it clear for an individual as where more efforts are required. It prevents an individual from putting efforts on low priority issues.

As it was found that user training and device were two major issues which are leading to majority of incidents. So further in-depth analysis was carried out for the major issues to identify the root cause of these issues.

There could be many areas where user training issue might be found. Focus was to figure out those areas. Same was done for device issues. Solutions were recommended regarding the same.

Figure 9 – Distribution of User training related incidents

Distribution of User training related incidents

Issue	Number of user training related incidents
Phase of care of an order	1
Release future orders	10
Place a Procedure order	22
Cancellation of an order	16
Record locked	1
Assigning an account	2
Assigning an attending physician	2
Co-sign a note/order	2
Crossing an order	2
Placing a future order	6
View final Lab result	1
Cancellation of pre-admit event	2
Discharge a patient	5
Order set	3
Inbox pool	1
Ending a session	1
Edit an order/note	5
Updates about a change	4
Printing	4
Place a Medication order	2
View Patient list icon	1
Recover orders	1

Reconciliation of Orders	6
View discharged patient chart	3
Wrenching the report	1
Toolbar Buttons	1
Entering Result	1
Log into a department	4
Total	**110**

Inference – After carrying out Pareto analysis, it was found that user training issue was one of the major issue causing majority of incidents for end users. Further in-depth analysis was done to find the root cause of the issue.

As it is clear from the above graph that many user training related incidents were because of placing a procedure order. 20% user training related incidents were because of this workflow. Users were found to be not aware of exact workflow as how to place a procedure order. They were found to skip some steps while placing an order. Cancellation of an order also led to many incidents. Users were not aware of how to cancel an order and when to cancel an order. It contributed towards 14% of user training related incidents. Another workflow which led to around 9% of user training related incidents was Release future orders. Users were not aware of the process of releasing future orders. They lack the knowledge as to when to release future orders and how to release them. Some of them are also not aware of how to place a future order. Reconciliation of orders is another workflow where users lack training. It led to 5.4% of user training related incidents. Discharging a patient and edit an order/note are other workflows each of which led to 4.5% of user training related incidents. Sometimes users were logged into wrong department. So they
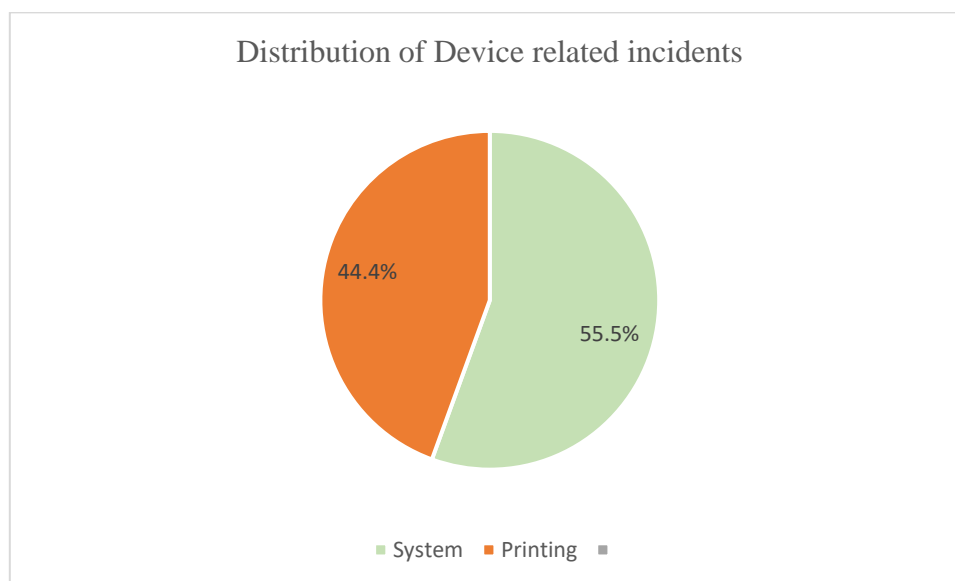
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were not able to do what they were supposed to. 3.6% of user training related incidents were related to logging into wrong department.

There were some other incidents because of assigning an account to the patient, co-sign an order/note, crossing an order, order set, updates about any change, printing, placing a medication order, wrenching the report etc. which led to many user training related incidents. Users were not aware of the exact workflows due to which they were facing problems. It was found that sometimes, users were stuck at one step and were not able to proceed further. Sometimes, they were moving around wrong navigator and thus, were not able to search for right order set. Users were lacking training as to when notes/orders can be edited and how.

Sometimes, users are not aware of some change made in the EMR Application. So they face issue regarding the same. If some EMR functionality has been updated or changed, they don't understand the change and raise an incident. 3.6% of user training related incidents were related to this.

So it can be said that user training regarding EMR Application plays a very important role in smooth functioning of the process. Complete knowledge about all important workflows can help reduce the occurrence of these user training related incidents.

Figure 10 - Distribution of Device related incidents

Distribution of Device related incidents

44.4%

55.5%

■ System   ■ Printing   ■

Issue	Number of device related incidents
System	10
Printing	8
Total	**18**

Inference – After carrying out Pareto analysis. It was found that in addition to user training issue, device issue was another major issue which caused many incidents. Further in-depth analysis was done to find the root cause of this issue.

As it is clear from the above graph, device issue was related to system and printing. System led to 55.5% of device related incidents whereas printing led to 44.4% of device related incidents.

Incidents caused due to system could be because of many reasons like heavy system load or the network was down. Sometimes, load is so high that system starts behaving weird. Also Sometimes, System doesn't respond because of network problem. As a result, end users face some problems.

Incidents caused due to printing could be because of many reasons like ink problem or unavailability of pages or the printer was switched off. As a result, end user faces some difficulty in doing his/her work.

So it can be said that device issue regarding EMR Application plays a very important role in smooth functioning of the process. Proper functioning of all the devices can help reduce the delay in services.

RECOMMENDATIONS

- Training can be imparted again to end users regarding various workflows

- It was seen that user training issue was due to lack of knowledge about various workflows. To avoid this, a proper document of workflow can be prepared and forwarded to all end users

- The word document should contain every detail about that particular workflow like when and how to follow that workflow and under which conditions

- A checklist can be prepared containing all the required steps regarding placing a procedure order. If an end user feels some difficulty while placing a procedure order, he/she can refer that checklist and can analyze what wrong he did and what he/she is actually supposed to do

- Whenever any analyst makes some changes to the EMR functionality, then those changes should be communicated to the end users through tip sheets in timely manner. This keeps end users updated about the changes

- For device issue related to system, all EMR functionality of EMR application should be reviewed. If everything is correct with the application, then system settings should be reviewed. Interface settings can also be reviewed. If everything is correct, users can be asked to wait for five minutes and then start the system again

- For device issue related to printing, some basic settings should be first checked by end users before raising an incident like whether the printer is switched on or ink is available or availability of pages

CONCLUSION

In many studies, it was proved that CPOE was an effective method to reduce and solve the incidents for end users which facilitated to reduce the medical errors and to increase the work efficiency. The entire study was based on 168 service restoration incidents related to an EMR Application. The issues which contributed towards these incidents were:

- User training issue
- Device issue
- EMR Functionality issue
- Issue unidentified
- Interface issue
- Workstation not mapped to printer issue

Further in-depth analysis was done on user training issue and device issue to find the root cause of these issues. Solutions were recommended for the same to prevent their recurrence.

Thus from this study, it can be concluded that user training issue and device issue caused majority of incidents. Users didn't have required knowledge regarding exact workflows which made them face problems during patient care. Sometimes, incidents related to device occurred which further caused problems for end users. More Appropriate and feasible solutions could be recommended for the same.

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