

Summer Training Report

By

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ACKNOWLEDGEMENT

For a management student, the power of knowledge is an attainable unless an element of observation is not added. It is a great pleasure for me to undertake this project entitled- **“Assesment of knowledge and practices among healthcare workers regarding prevention of Surgical site infection”**

I would like to express my special thanks to my mentor **“Dr.Sandesh Sharma Sir”** faculty member of IIHMR University Jaipur for his guidance, support and encouragement in my report. This project would not have completed without his enormous help and worthy experience. Whenever I was in need, he was there behind me.

I would also like to extend my gratitude to the Dean **“Dr. Sodani Sir”** for providing me all the facility that was required.

Lastly I would like to express my gratitude to my family and friends for being a constant source of inspiration for me. I would also like to acknowledge all author and organization who published papers and articles in relation to my topic those I reviewed

Dr.PrachiTyagi

MBA HM 24

DECLARATION

I do hereby declare that I am a student of 1st year, MBA in hospital and Healthcare Management, IIHMR University, Jaipur, Rajasthan session 2019-2021.I would like to state that I have done a project assignment under the guidance of my mentor **Dr. Sandesh Sharma**, for partial fulfillment for the degree of MBA in Hospital and Health Management. This work is my own and has not been submitted to any of the other institute or University for the purpose of award of any degree or diplomaⁱ.

Dr. Prachi Tyagi

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LIST OF ABBREVIATIONS

- HAI : Healthcare associated infection
- HCW : Healthcare workers
- SSI: Surgical site infection
- CDC: Center of disease control and prevention
- WHO: World health organization
- PCHS: Probiotics cleaning hand hygiene

Assesment of knowledge,practice and barriers in prevention of Surgical Site infection among healthcare workers in private hospital of Sehore district

ABSTRACT

Healthcare associated infection (HAI) also known as a nosocomial infection, is an infection acquired in hospital by a patient who was admitted for a reason other than infection.

HAI greatly increase morbidity and mortality of patients and healthcare cost.HAI is of many types, Surgical site infection is commonest infection seen in a hospital. Surgical site infection is an infection that occur after surgery in the part of body where surgery took place. To prevent SSI's doctors, Nurses and other healthcare workers must follow infection control guidelines.

Knowledge and practices of healthcare workers about surgical site infection are not well studied. An institutional based cross-sectional study was conducted in two private hospital of Sehore district. The random sampling technique was used to collect data from healthcare workers in hospital using a online self-administered questionnaire. This study contains findings about Knowledge and practice regarding elimination/ prevention of SSI. The main objective of study was to access degree of knowledge and extent of practices being performed by healthcare workers towards SSI's and also to locate the barriers which hinders healthcare workers in performing practice to prevent SSI. The study was done using a online questionnaire survey among 57 healthcare workers who were working in private hospitals of Sehore district of Madhya Pradesh. The study showed that more than half of the HCV who participated in survey had inadequate knowledge regarding elimination and to limit SSI's. Moreover more than half were practicing inappropriately. The most important associated factor found is lack of training among healthcare before commencement of their jobs . Training of healthcare workers with SSI's guidelines is recommended. Healthcare training and programs should be carried out by the hospitals.

INTRODUCTION

Healthcare associated infection are one of the leading cause of death that involve a huge number of patients every year worldwideⁱⁱ. According to World health organization and the centers for disease Control and prevention(CDC), SSI can be considered one of the preventable HCAⁱⁱⁱ. HAI are considered to be the greatest risk patients. Nearly upto 2 millions patients experienced a healthcare associated infection every year in US, leading to approx 88,000 deaths around 4.5 billion dollar in extra cost per year. Moreover, the incidence of HAI appears to have increased over the last three decades, despite the fact that most of the HAI are preventable. ^{iv}

One of the foremost common variety of Healthcare associated infection is Surgical site infection that is taken into account 20-25% of all healthcare associated infection. It is estimated that 2-5% of all the patients who endure a surgical procedure will suffer from SSI. Patients who develops surgical site infection are two times more probable to die as other postoperative patients ^v30 days after a surgical procedure while in patients with implants it could be upto one year ^{vi}. and it is resulting increased morbidity, extended hospital stay and increases financial expenditure.

SSI may be prevented by several infection management strategies as well as surgical hand preparation, increased organic process support, preoperative bathing, surgical site skin preparation, hair removal, mechanical gut preparation, and by the use of oral antibiotics . correct hand hygiene. The correct use of basic precautions throughout invasive procedures are straightforward and of low prices however need employees education and good practices. Incompetent knowledge and practices among healthcare workers may lead to a increase in prevalence of infection specially among open wound / site of the surgeries.

The world health organization in its pointers has set variety of recommendations towards interference of surgical site infection. By the implementation of those pointers(guidelines) healthcare workers could forestall their patients from Surgical site infections and promote health of their patients. Recommendation of those guidelines embrace pre-operative showering, hand hygiene, fittingly and timely administration of antibiotics, pre and post operative glycemic management, wound management, organic process assessment and surgical site preparation etc

Healthcare employees have a chance to scale back prevalence of SSI's, they could assist the patient in their recovery and scale back the compliances related to infection by utilizing their knowledge and by doing sensible practices.

Healthcare employees play a very important role in preventing SSI's, the roles of aid employees ought to be studied. Thus the study objective is to assess the degree of knowledge and practices among healthcare employees towards interference of SSI's and to evaluate the barriers which hinder them in doing ideal practices.

Problem statement

Infection control is significant worry for any healthcare unit. Surgical site infections are generally basic in our nation. Healthcare workers assume significant job in forestalling infection. In many studies, it has been discovered that because of insufficient information among healthcare workers prompts increment in the SSI. Healthcare workers don't play out their practices appropriately. This inappropriate practice can cause transmission of contamination extraordinarily surgical site infection. In this manner the Healthcare workers are the primary objective of our examinations. They are the person who can restrain the spread of the contamination. Moreover it is very necessary to find out the boundaries that are barriers which are thwarting specialists to perform standard practices on prompting increment of Surgical site infection.

Purpose of Study

The purpose of this study is to assess the knowledge and practices being performed by healthcare workers in a district hospital to limit/eliminate surgical site infection. Also to search for the barriers which inhibit them to perform good practice to limit the infection. Moreover the research would be helpful for further research in healthcare professionals.

Research objectives:

- To study the degree of knowledge among healthcare workers regarding elimination/ limitation of Surgical site infection in patients
- To study the extent of practice being performed by healthcare workers in hospital
- To assess the barriers to SSI's prevention

Research Question:

- What is the knowledge of healthcare workers regarding elimination/ limitation of Surgical site infection in a hospital
- What is the extent of practice among healthcare regarding elimination /limitation of surgical site infection?
- What are the barriers in preventing SSI's?

LITERATURE REVIEW

- Many studies discussed healthcare professional's knowledge and practices on eliminate/limit Surgical site infection. Different methodologies are used in different studies, some studies focus only on knowledge of Healthcare workers regarding spread of infection while some studies focus on type of practices being performed by them. Unfortunately there is no study which focuses on barriers which healthcare workers face on practicing standard practices.
- A cross sectional examination was done in fauji emergency clinic in 2014 to see the Gapes in practices and information among 300 healthcare workers. Most participants were Nurse. It was discovered that Knowledge was sufficient however practices being performed were wrong.
- An investigation was directed in National instructing clinic to asses the practices being performed inside the emergency clinic room. Assesment of sterilization process, clinical guide and so on all were done. It was discovered that a large portion of healthcare workers were performing insufficient practices and they need fitting information with respect to contamination control
- An enlightening connection study done to asses the Nurses's data and evaluate the sterilisation Techniques being performed by them. Complete 21 Nurses were included for the investigations from four unique hospitals. It was discovered that under 50% of medical caretakers didn't know about appropriate Sterilization Technique. Most of them had no reasonable information in regards to anticipation of contamination. (Dhakal, Angadi, and Lopchan, 2016)
- The study was conducted in Ethiopia among nurses to check the knowledge and practices regarding prevention of Surgical site infection. The main objective was to asses knowledge, practice and associated factors . The study was done using a questionnaire, there were 423 paticipants who were practicing in a hospital during a study period. It was found that more than half of the participants had no proper knowledge regarding prevention of SSI's and they were doing wrong practice. (Eshetu Haileselassie Engeda, and Workie Zemene Worku, 15 Dec 2015)
- Another study was conducted in KFSH and BCH hospital of Buraidah city with the aim to evaluate the Knowledge and practice of healthcare professional towards preventing SSI's. Total 218 professionals were included in the study. It was found that only 25% in KFSH and 18% in BCH were knowledgeable while rest participants had inappropriate knowledge. While practice level was seen good. (Elaf Alabdulrazaq, Hanadi AL Mutairi, Mnahal AlHaon, Sultan Alsaigh, 2017)
- A descriptive cross sectional Study was conducted in Faisalabad among 111 Nurses. Study was conducted to assess nurses knowledge and practice regarding Surgical site infection. All participants were female nurse and convenient sampling method was used. The study revealed that nurses had poor knowledge regarding infection

and most of them were doing low level practice. (Sadia Sadaf, MS Shafqat Inavat, M. Afzal, Muhammad Hussain)

- A descriptive study was done with the aim to examine the level of knowledge and level of practice among nurses and to examine the association between practice and knowledge regarding prevention of surgical site infection. Participants were Bangladeshi Nurses working in Surgical wards. Questionnaire were used for analysis. The finding revealed that nurses had low level of knowledge and high level of practice. Negative association was seen between knowledge and practice. (Humaun Kabir Sickder , Asst. Prof. Dr. Wipa Sae-Sia , Asst. Prof. Dr.Wongchan Petpichetchian)
- Haleema Sadia , Robina kousar, Muhammad Azhar, Ali Waqas, Prof. Dr. Syed Amir Gilani performed a descriptive correlation study in two public hospitals in Pakistan. The aim was to asses knowledge and practices among Nurses regarding SSI's. A questionnaire was prepared and convenient sampling was done. Total 131 nurses participated in a survey. For analyzing the data descriptive statistics and Pearson Product Moment Correlation test was used. It was found that nurses had poor knowledge but they were performing good level of practice.

MATERIAL AND METHODS

A Descriptive study was conducted to access knowledge and practices and to evaluate the barriers that hinder in performing standard practices. Data was collected from surgical wards of two private hospitals "Nidaan Hospital" and "Jaiswal Hospital" of Sehore district(MP). Convenient sampling techniques was used in this study and sample size was 57.

Healthcare workers of age 20-55 were included in the study, with at least 6 months of practice experience. They all voluntarily participated , informed consent were taken. Healthcare workers with less than 6 months of work experience and with age more than 55 years were excluded from the study.

Study period

The study was conducted between May 3 to July 2, 2020 in the selected hospitals of Sehore district of Madhya Pradesh

Research tool:

The tool used for the data collection was online closed ended Questionnaire. The questionnaire was pretested. Before filling forms the aim of study was clearly explained to all the healthcare workers. Collection of data was done after obtaining content of participants.

The questionnaire consisted of 3 parts

- Part 1:
Consisted of questions related to demographic data of participants like age, sex, education, marital status, years of experience
- Part2:
Consisted of questions related to practices which healthcare workers do perform regarding prevention of SSI. There were total 13 questions in this part.
- Part3:
Consisted of questions regarding knowledge among healthcare workers. There were 12 questions in this part .

Data Analysis

Data is analysed by using computer software.

Ethical Consideration

All the participants were informed about the objectives of study. Permission for data collection was taken from the participants as well as from hospital authority. Data was collected from those who voluntarily participated. Participants were informed that their information will be kept confidential. Before collecting data from participants informed consent were taken from them

RESULTS AND DISCUSSION

A total 57 healthcare workers were included in study.

Demographic Profile

Table1: The distribution of participants according to Demographic profile (n=59)

		Frequency	Percentage
Gender	Male	n=27	45.8%
	Female	n=32	54.2%
Age	18-28yrs	n=22	37.3%
	29-39 yrs	n=23	39%
	39-49yrs	n=13	22%

	50 and above	n=1	1.7%
Marital Status	Married	n=32	54.2%
	Unmarried	n=22	37.3%
	Divorced	n=5	8.5%
Education	First degree	n=13	22%
	Second degree	n=17	28.8%
	Diploma in Nursing	n=24	40.7%
	Some other course	n=5	8.5%
Years of Practice	<2 yrs	n=11	19%
	2-4yrs	n=9	15.5%
	5-9yrs	n=21	36.2%
	10-14yrs	n=13	22.4%
	15-19yrs	n=3	5.2%
	20yrs and above	n=1	1.7%

The result indicates that 54.2% of total subjects were female while 45.8% were males, and maximum of the participants were of age of 29-39years. Regarding to level of education, the study depict that most of the subject have done diploma in Nursing that is about 40.7% have done diploma in nursing, while 28.8% have done second degree, 22% have done 1st degree. Concerning the years of experience, most of them had a experience of 5-9 years. About 22.4% had a experience of 10-14 years, 15.5 % had a 2-4 years of experience while 19% had a experience of less than 2 years.

It is found that more than half of the participants that is 60.3% had not received any type of training regarding infection control, only 39.7% had received training.

The study reveals that there is no proper infection control guidelines in the workplace and hospitals are not enrolled in any surveillance system.

PRACTICES

Table 2 indicates that only 56.1 % of participants use antiseptic Solution or sanitizer rest about 43.9% uses Soap for washing their hands. The Study reveals that 83.9% perform Glucose test before and after surgery while 16.1% do not perform Glucose test. It was found that 91.1% participants do separate infected dressing from non-infected while 8.9% do not do it. When ask about Pre-operative shaving right before Surgeries which is very essential step, the study reveals that only 4% of total participants perform it, about 63% perform it occasionally while 33% participants do not perform it. The study reveals that only 36.8% participants always uses hand gloves when dealing with patients, while 61.4% sometimes uses gloves while about 8% of participants very rarely use gloves when dealing with patients.

In figure 2 we can see, When asked about type of gloves being used by them, it was found about 73.2% subjects use Latex gloves, about 23.2% use vinyl gloves while just 3.6% use nitrile gloves. Nitrile gloves are the best gloves with best quality providing high quality of infection but are being used by only 3.6% participants.

The study reveals that only 36.8% participants wash their hands after removing their gloves, 57.9% participants wash their hands occasionally while we can see about 6% of participants do not wash at all.

It is found that only 29.8% subject sterilized the surface of dressing trolley with antiseptic solution, 66.7% occasionally sterilized rest participants do not sterilized at all.

The study reveal that only 41.8% workers use sterilized dressing material for cleaning surgical wound dressing while 58.2% workers do not use sterilized dressing

when asked about practice of washing hands before and after changing wound dressing and touching surgical site, it was found that only 83.3% participants practice this while 16.7% participants do not wash their hands after changing wound dressing and touching surgical site.

About 72.2% participants use providine-iodine and saline for surgical wound dressing while 27.3% don't use it.

It was found that only 66.1% uses face mask during cleaning surgical site infection while remaining 33.9% do not use face mask during handling surgical wound infection.

Table2:Frequency and percentage of answers given by participants on each item of Practice section (n=59)

S No.	Multiple choice Question	YES	NO	SOMETIMES
1.	Do you use antiseptic solution/sanitizer to wash hands	n=32 56.1%	n=25 43.9%	-
2.	Do you perform glucose test before and after surgery	n=47 83.9%	n=9 16.1%	-
3.	Do you separate infected dressing from non-infected dressing	n=51 91.1%	n=5 8.9%	-
4.	Do you perform pre-operative shaving right before surgeries	n=19 33.3%	n=2 3.5%	n=36 63.2%
5.	Do you wash your hands after removing gloves	n=21 36.8%	n=3 5.3%	n=33 57.9%
6.	Do you disinfect the surface of dressing trolley with antiseptic solution	n=17 29.8%	n=2 3.5%	n=38 66.7%
7.	Do you use sterilized dressing material for cleaning surgical wound dressing	n=32 58.2%	n=23 41.8%	-
8.	Do you wash your hands before and after changing wound dressing and touching surgical site	n=45 83.3%	n=9 16.7%	-
9.	Do you use providine-iodine and saline for surgical wound dressing	n=40 72.7%	n=15 27.3%	-
10.	Do you use face mask during cleaning surgical;	n=37	n=19	

	site infection	66.1%	33.9%	
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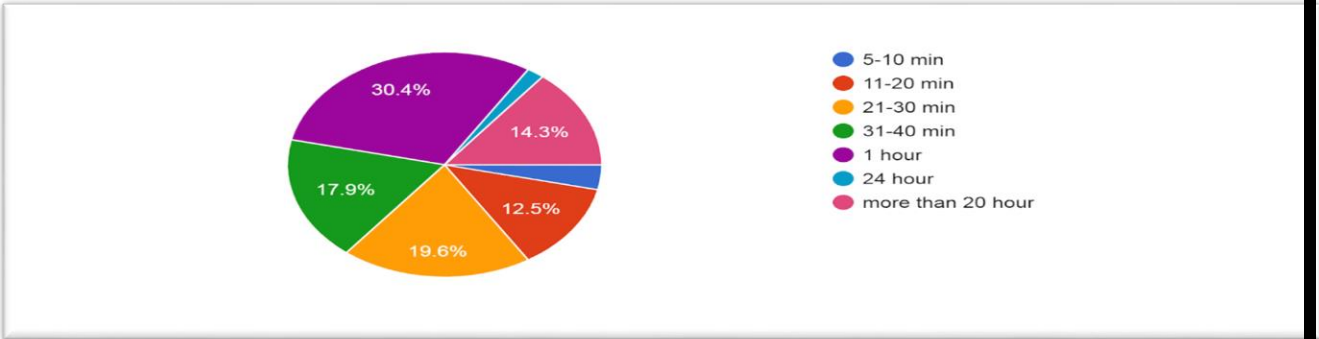


Figure 1:How often healthcare workers put medical instrument in Chlorine Solution

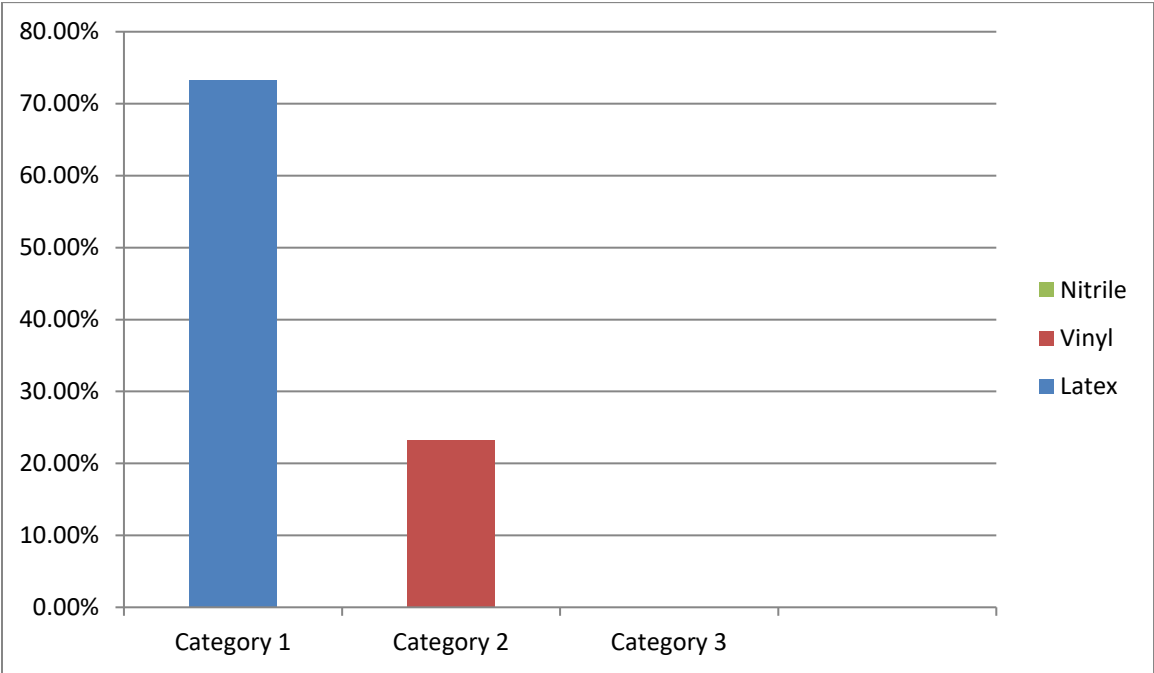


figure2:Types of gloves used by Healthcare workers

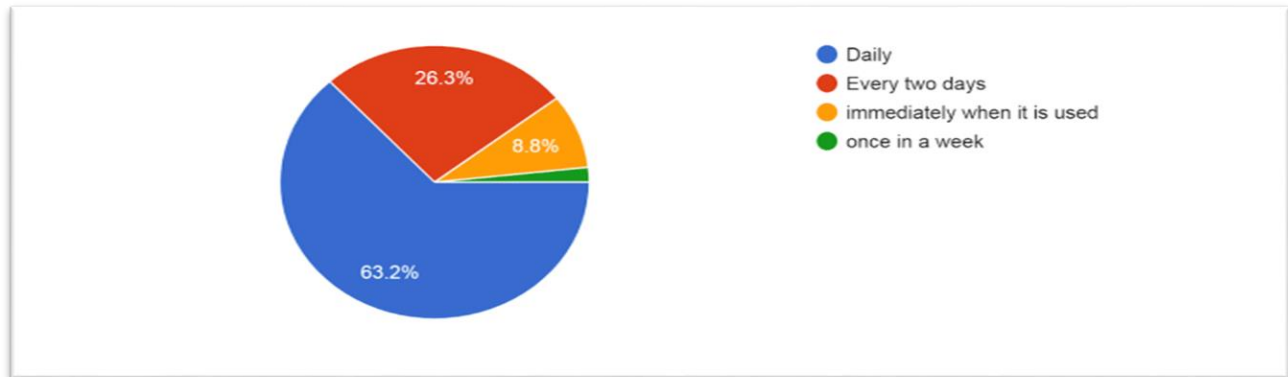


Figure 3: Time period of changing Chlorine Solution which is used for sterilization purpose

KNOWLEDGE

For checking knowledge various questions were asked related to prevention of SSI

In table 3 we can see, about 81.5% of participants were unaware about the best method of pre-operative shaving, only 18.5% participants were aware about it.

The study reveals that less than 50% healthcare workers thinks that pre-operative showers with antiseptic solution are cost effective in preventing SSI.

About 31.5% subjects were aware about standard isolation precautions of healthcare setting rest 68.5% were not aware about it.

In figure 5 we can see that only 27.3% people had sufficient knowledge, 70.9% had a partial knowledge but remaining 1.7% had no knowledge about hand hygiene.

When asked about the minimum time required for hand washing which is ideally 20 sec, only 43.6% participants gave the right answer remaining participants were not knowing the proper timing.(figure 6)

When participants were asked about contaminated patients care equipments could leads to spread of infection or not, only 42.6% said yes , 53.7% were not sure about it and 5% participants said no.

When it was asked about Preoperative showers with antiseptics are cost effective in limit surgical site infection or not, than it was found that only 30.9% believes that it is cost effective ,rest participants were not sure about it.

The study reveals that only 56.9% participants believe that removal of accessories like nail paints , jewelry etc could reduce SSI remaining 43.1% that removal of accessories has no significant role in reducing SSI.

It was found that only 30.9% participants believe that puncture in Surgical gloves could lead to SSI, About 67.3% participants were not sure about it and around 3% believe that puncture in gloves couldn't lead to SSI.

When it was asked whether administration of prophylactic antibiotics could prevent SSI or not than, only 25.5% participants gave the right answer.while most of the participants think that prophylactic antibiotics has no significant role in preventing SSI.

When it was asked about right time of giving pre-operative prophylactic antibiotics which is 1 hour before the surgery, only 20.4% gave the right answer , about 40.7% participants said it is 5 hrs before the surgery while about 38.9% said one day before the surgery.

The study reveals that only 20.8% participants are aware about the best method of pre-operative shaving rest 79.2% were not aware about it.

When asked about best method of gloving in special cases, than it was found that 80% of participants were not aware about it

figure 7 below indicates the barriers that hinder them in practicing preventive measure to limit SSI than . we can clearly see in figure below

It was found that about 76.7% said that it is due to limited resources in their work place, 69.1% said that it is due to lack of hospital safety climate/culture, About 60% participants said it is due to lack of training regarding prevention of SSI.About 54.5% believe it is due to lack of scientific information regarding prevention of infection.

Table3: frequency and percentage of answers given by participants on each item of Knowledge section(n=57)

No.	Question	Yes	No	May be
1.	Do you know best method of pre-operative shaving	n=37 66.1%	n=19 33.9%	-
2.	Are you aware about standard isolation precautions of healthcare setting	n=17 31.5%	n=37 68.5%	-
3.	Does contaminated patients care equipments could lead	n=23 42.6%	n=2 3.7%	n=29 53.7%

	to spread of infection			
4.	Does pre-operative showers with antiseptic are cost effective in limit surgical site infection.	n=17 30.9%	n=3 5.5%	n=35 63.6%
5.	Does removal of accessories like nail paints, jewelry etc could reduce chances of SSI	n=29 56.9%	n=22 43.1%	-
6.	Does puncture in Surgical gloves could lead to SSI	n=17 30.9%	n=1 1.8%	n=37 67.3%
7.	Does administration of prophylactic antibiotics could prevent SSI	n=14 25.5%	n=1 1.8%	n=40 72.7%
8.	Does prolong pre-operative hospitalization associated with occurrence of SSI	n=20 36.4%	n=3 5.5%	n=32 58.2%
9.	Do you know the best method for pre-operative shaving	n=11 20.8%	n=42 79.2%	-
10.	Are you aware about method of gloving in special cases	n=11 20%	n=44 80%	-

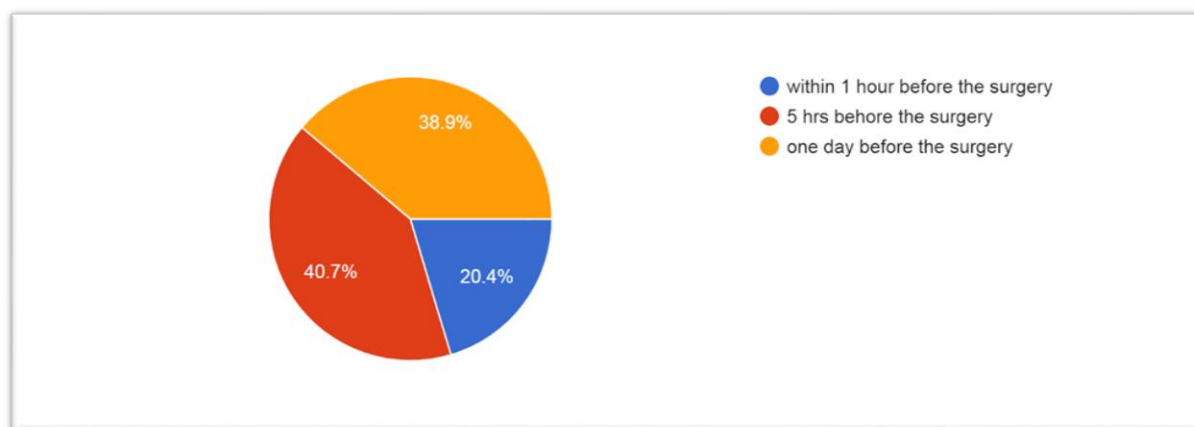


Figure4: Right time of giving pre-operative prophylactic antibiotics

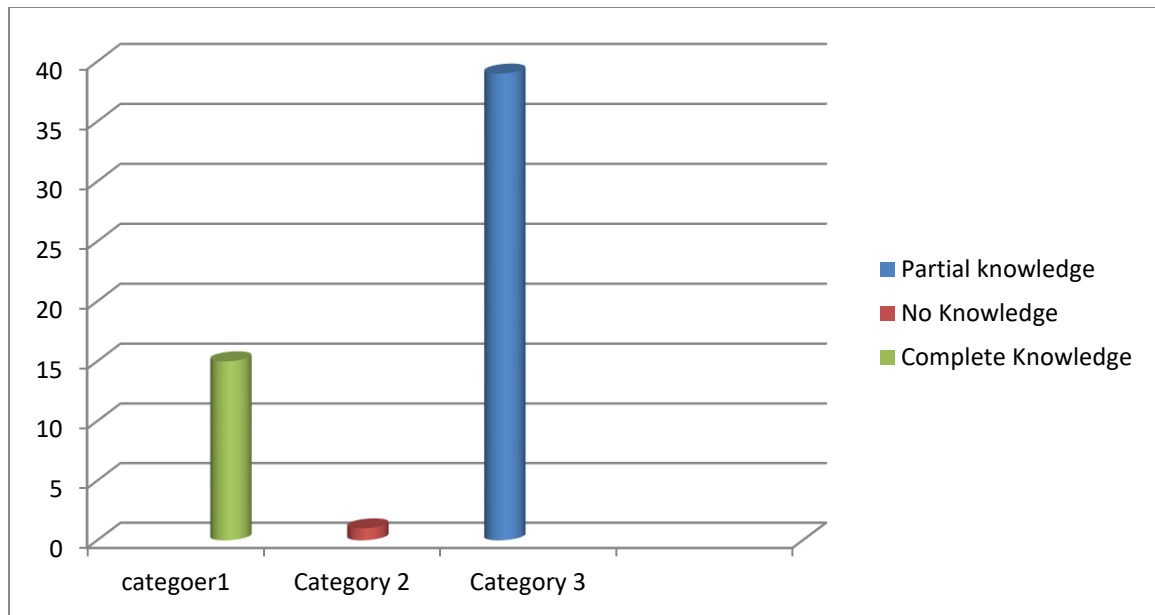


Figure5: knowledge regarding hand hygiene

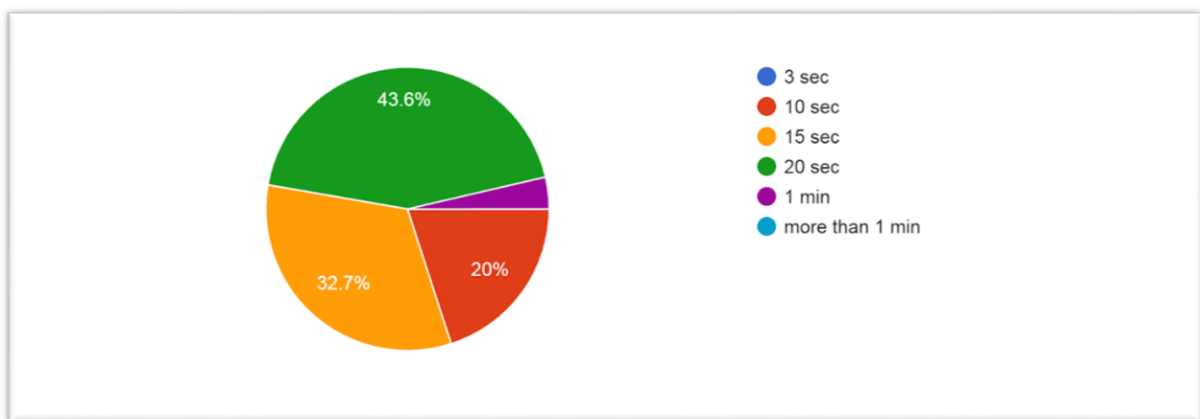


Figure 6: For how long do healthcare workers wash their hands

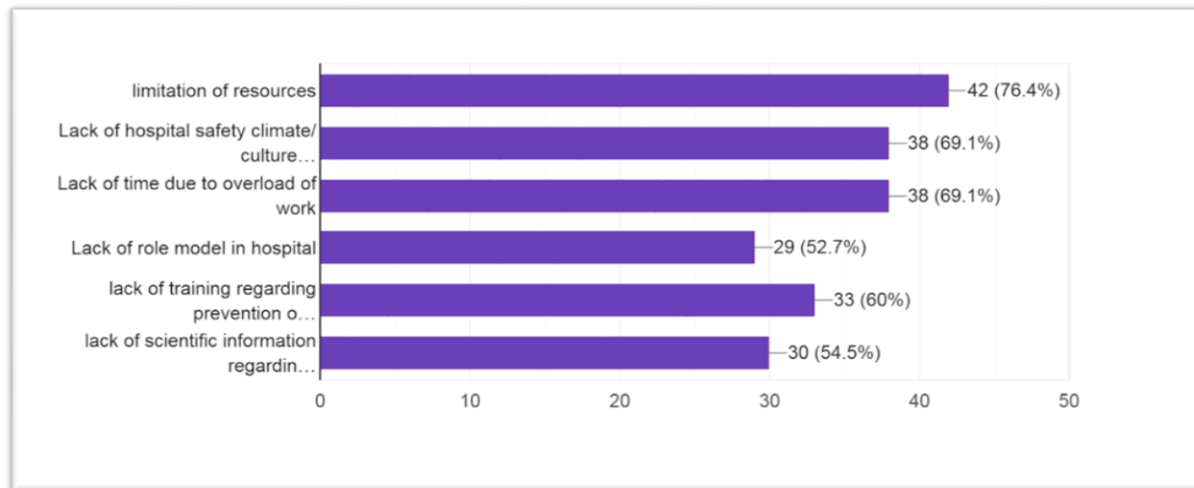


Figure 7: Barriers that hinder healthcare workers in performing standard practices

CONCLUSION , LIMITATION AND RECOMMENDATION

A descriptive study was conducted in two private hospitals of Sehore District. Based on the findings it is found that the knowledge and practice among healthcare workers related to prevention of surgical site infection is not appropriate. Most of the healthcare workers have no complete knowledge and they are doing wrong practices in their work place.

The study reveals that there are various barriers like lack of resources, lack of training, lack of safety climate, lack of role model and lack of any scientific knowledge which hurdle workers to perform ideal practices.

There should be availability of proper resources in the hospital. The hospital should organize Training programs regarding prevention of SSI.

The climate and culture of hospital plays a crucial role in preventing infection. So there should be safe climate and culture within the workplace.

So it is recommend to improve patient care and safety from struggling of SSI, Healthcare training and programs should be carried out by the hospitals.

Hospital administration must offer standard Guidelines and appropriate resources for prevention of SSI for healthcare workers in sanatorium.

Limitation of Study

One of the drawback of this study is convenient sampling technique was used. Results are totally dependent on respondents subjective self-assessment.

Respondents behavior should have been analyzed via checklist rather than to rely on the respondents subjective self assessment completely. The respondents might had not reflected their true practices.

But due to current situation of a country it was not possible to do so.

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 15. Haleema Sadia, Robina kousar, Muhammad Azhar, Ali Waqas, Prof. Dr. Syed Amir Gilani, “Assessment of Nurse’s knowledge and Practices Regarding Prevention of Surgical Site Infection”

PART 2: REPORT OF ONLINE COURSE

Operations Management: Analysis and Improvement Methods

University of Illinois by Udatta Palekar

COURSE DESCRIPTION

Welcome to the world of operations management. This course is demonstrated by Udatta Palekar professor in the Department of Business Administration in the Gies College of Business at the University of Illinois and he is the Executive Director of the Supply Chain Management program. Operations are the repetitive processes used to create and deliver products and services. This course introduces to tools, techniques and technologies used in operation management. It introduces us to a process view of operations and study the different metrics used to measure their performance. Calculation of process capacity under different process configuration and the effect of variability on process capacity will be discussed. It helps in learning the role of inventories play in operations and some common methods for calculating economic order quantities and re-order times. We will learn about supply chains and the important factors to consider in sourcing decisions. The bullwhip effect in supply chain will be introduced and ways to mitigate it through information sharing will be discussed. Finally we look at continuous improvement techniques such as lean management and the six sigma methodology. This course intended as a two-part series on operation management.

COURSE GOALS AND OBJECTIVES

- Analyze operations and processes, select appropriate process type and calculate performance metrics for processes.
- Recognize the role of inventories in operation and their connection to other process metrics and calculate performance metrics for inventory system.
- Design an inventory management policy by calculating optimal quantities, safety stock and re-order point.
- Demonstrate an understanding of the issues associated with managing supply chain and explain the bullwhip effect in supply chain and how it can be mitigated.
- Apply transaction cost economics, strategic risk and economic criteria to make outsourcing decisions.
- Demonstrate an understanding of how Lean management and six sigma methodologies used to continually improve operations.
- Reorganize operation through continuous improvement method to reduce waste.

COURSE METHODOLOGY

- Lecture videos
- Readings
- Quizzes
- Peer assignment

COURSE CONTENTS

WEEKS	CONTENTS
Week 1-Module 1 Reading: 60mins Lecture: 70mins Quiz: 30mins	Process Analysis 1. Process View of Operations (part 1) 2. Process View of Operations (part 2) 3. Process Flow Analysis 4. Capacity and Utilization 5. Little's Law
Week 2-Module 2 Reading: 120mins Lecture: 70mins Quiz: 30mins	Inventory Management 1. Inventory Basics 2. Economic Order Quantity (part 1) 3. Economic Order Quantity (part 2) 4. Re-Order Point (part 1) 5. Re-Order Point (part 2) 6. Re-Order Point (part3)
Week 3-Module 3 Reading: 90mins Lecture: 100mins Quiz: 30mins	Supply Chain 1. What is a Supply Chain? (part 1) 2. What is a Supply Chain? (part 2) 3. Sourcing Decisions (part 1) 4. Sourcing Decisions (part 2) 5. Bullwhip Effect

Week 4-Module 4	Continuous Improvement
Reading: 90mins	1. History of Continuous Improvement?
Lecture: 135mins	2. Lean Management (part 1)
Quiz: 30mins	3. Lean Management (part 2)
Peer assignment: 120mins	4. Six-Sigma Methodology (part 1)
	5. Six-Sigma Methodology (part 2)
	6. Six-Sigma Methodology (part 3)
	7. Six-Sigma Methodology (part 4)

KEY LEARNINGS

Module1

▪ Process View of Operations

Operations are composed of a collection of activities that are purposeful planned and coordinated.

Process View: Processes are structured activities that transform inputs to outputs (and are usually repetitive). The process view shows how an organization uses resources to coordinate activities.

Process Flow Units: The basic unit of flow at which we wish to study a process

Process Representation: Processes can be represented as a connected network of activities.

Product Focused Operations: Resources and activities required for a "product family" or customer type are grouped together.

Process Focused Operations: Similar skills or technologies are grouped together in specialized departments.

Layout Characterization: Linear - flow units move sequentially from one activity to the next in a fixed sequence. Eg- getting your food at Chipotle and car assembly.

Jumbled or Job-Shop - Flow units may have different sequence of activities. eg- patient flow in a clinic.

Batching: Processes can also be characterized based on how flow units move between activities through the process. There are- Continuous Flow, Single Unit and FlowBatch Flow. Reasons for Batching: Economy of Scale and shared Resource with changeover.

Process Type Selection

Project - One off (very low volume), very expensive, unique, very flexible

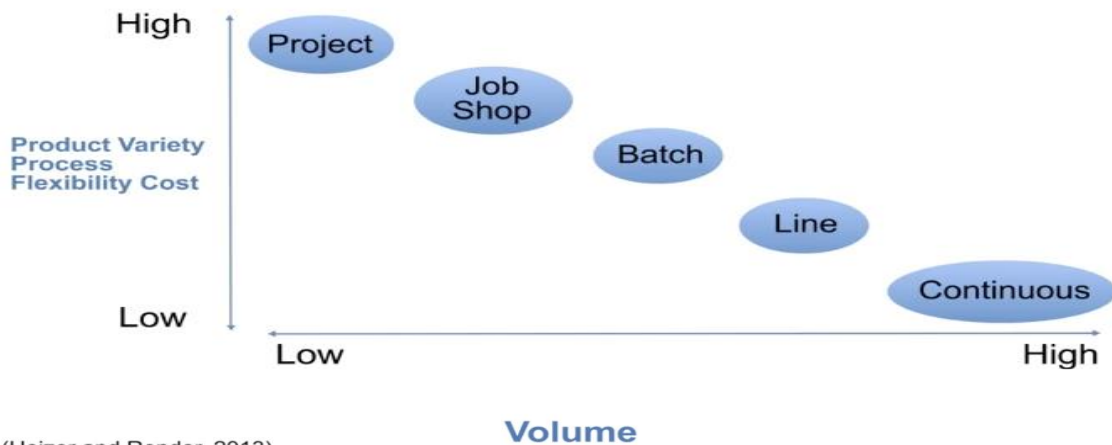
Job Shop - Multiple Products, low volume, and moderate flexibility

Batch - Many products, moderate volume, low flexibility

Line - few products, high volume, very low flexibility

Continuous - Very few products, very high volume, very low flexibility

Product-Process Matrix



■ Process Flow Analysis

Process Flow Metrics:

- Cycle time- Time between two consecutive units departing the process.
- Flow Rate = $1/(\text{Cycle Time})$
- Flow time or throughput time- From the time it enters to the time it departs the processor time taken to travel whole process..
- The longest path from start to finish is called flow time.

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- Flow rate, cycle time and flow time can be defined for any contiguous sub-process we want to study down to an individual activity.
 - For an individual activity the cycle time is simply the processing time for that activity if one flow unit is worked on at a time.
 - Cycle time of an activity = Processing time/number of stations.

Bottleneck Activity: The activity with the smallest flow rate is called the bottleneck activity. The bottleneck is the activity with the longest cycle time.

▪ Capacity and Utilization

Activity Capacity: The activity is capable of producing the flow rate.

Setup Times and Activity Capacity: Effective Flow Time = Processing Time + waiting times

Process Capacity The capacity of a process is equal to the capacity of its bottleneck activity

Capacity Utilization = Actual Production Rate/Available Capacity

Implied Utilization = Demand Rate/Available Capacity

Little's Law: Little's law says that $I = R \times T$ (I = Inventory, R = Flow rate, T = Flow time)

Module2

• Inventory Basics

Inventories are good or material that are in any stage of readiness that are being held for future sale

Types of Inventories:

- Based on stage of completion- raw material goes through process to provide finished goods.
- Based on reason for keeping- Cycle inventory due to batching, anticipation inventory for seasonality, safety stock to buffer against uncertainty, pipeline inventory that is on-order or in-transit and strategic inventory to position for better negotiation.

Inventory Metrics: Macro level metrics

- Inventory Turnover Ratio = Cost of Goods Sold ÷ Average Inventory in \$
- Periods of Inventory = Average Inventory in \$ ÷ Cost of Goods Sold in a period

▪ Economic Order Quantity

Inventory Related Costs: Setup/ordering cost denoted by "S".

Holding Cost = Item Cost × Interest Rate + Storage Cost/Item/Year

Frequency of ordering- If you order more often, you pay more transaction cost but with lower holding costs. If you order less often, you pay lower transaction cost but with higher holding costs.

Annual Cost

Annual cost of ordering = number of orders × ordering cost/order

Annual cost of inventory = Average inventory × holding cost

Total cost = Cost of ordering + cost of inventory

Economic Order Quantity: To minimize the Total Annual Cost we use the Economic Order Quantity.

$$Q^* = \sqrt{\frac{2DS}{H}}$$

With annual total costs = $\sqrt{2DSH}$

Annual ordering costs = $\sqrt{\frac{DSH}{2}}$

Annual inventory costs = $\sqrt{\frac{DSH}{2}}$

Economic Manufacturing Quantity: Suppose we have a known rate of production (R) then the optimal manufacturing quantity is

$$EMQ = \sqrt{\frac{2SDR}{H(R-D)}}$$

▪ Re-Order Point

Order when the amount of inventory on-hand is $D \times L$.

Inventory Position = on-hand inventory + inventory on-order

Demand Uncertainty: To avoid stock-out add extra inventory—Safety stock

ROP = Average demand during leadtime + Safety stock

Order if: Inventory position $\leq$ Re-Order Point

Period of Uncertainty:

- Continuous review: POU = Leadtime
- Periodic review: POU = Review interval (r) + Leadtime

Safety Stock Calculation:

- Decide your tolerance to stockouts

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- Probability of Stockout = α
 - Service Level = $(1 - \text{Probability of Stockout}) = (1 - \alpha)$
 - Find the z-value
 - a. using Standard Normal Tables or
 - b. using Microsoft Excel `NORM.INV(1 —  $\alpha$  , 0, 1)`
 - $\text{ROP} = \text{mean} + z \times \text{standard deviation}$

Uncertainty in Leadtime:

- Mean leadtime = L
- Std. dev of leadtime = SDL
- Mean during POU = $L \times D$

$$\text{Std. dev during POU} = \sqrt{L * (SD_D)^2 + D^2 * (SD_L)^2}$$

Order Up To Policy = $\text{ROP} + \text{EOQ}$

Order Quantity = Order up to level - inventory position

➤ **Module3**

▪ **Supply Chain**

Supply chain is a name given to a complex network of interrelate companies that work in a coordinate manner to transfer raw material and resources into product and services.

Layers of the Supply Chain: Logistics; Information; Financial; Governance.

▪ **Sourcing Decisions**

Why do Supply Chains Exist?- Lack of expertise/competence, lower costs and resource constraints.

Outsourcing Risks:Dependence on suppliers; loss of flexibility; loss of core activities; intellectual property loss&supplier financial risk.

Transaction Cost Economics An economic theory that seeks to explain how a firm should be organized based on the attributes of the transactions it undertakes.



Transaction Characteristics: Frequency of Transaction; Asset Specificity; Uncertainty.

Transaction Costs: Apart from the cost of items or services, transactions involve other costs: Identifying suppliers; informational cost of finding prices, quality, durability; transportation costs; legal costs & insurance costs.

▪ **Bullwhip Effect**

It is effect where small perturbation at one end results in large changes upstream in the supply chain.

Contributing Factors: Demand variability, panic ordering, strategic ordering, batch quantities, quantity discounts, trade promotions, leadtimes, shortages, quality recalls, engineering changes, new product introductions and delivery problems.

Combating Bullwhip:

- Information Sharing: Point-of-Sales information; improved forecasting and analytics; vendor managed inventory & supplier and customer communications.
- Manufacturing Decisions: Batch size reduction; just-in-time ; inventory pooling; delayed differentiation or postponement & leadtime reduction.
- Marketing Decisions: Pricing discipline; rolling sales incentives & trade promotions or quantity discounts.

➤ **Module 4**

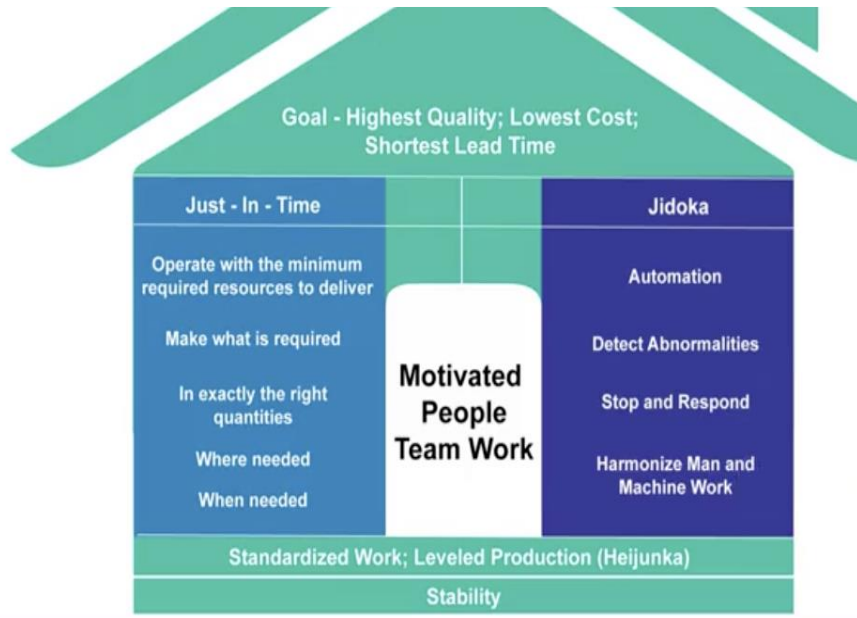
▪ **Continuous Improvement**

System of Profound Knowledge

P-D-C-A Cycle: Plan, Do, Check and Act

- **Lean Management**

Toyota Production System



Elimination of waste in processes through continuous improvement.

Value: Customer's perspective- quality, delivery, cost

Types of Activities

- Value adding activity
- Essential non- value adding
- Non- value adding

7Types of Waste: W-I-P-C-O-M-M

Waiting;Inventory;Processing;Correction;Overproduction;Motion and Material movement.

Principles of Lean:

- Customer-focused value
- Identify all steps in the value stream, eliminate wasted steps
- Make productsflow smoothly
- Let customer pull product
- Create perfection or ideal state with no waste

Lean Tools: 5s

- Sorting or Organizing
- Set in order (Simplify Access)
- Shine (Cleaning or Sweeping)

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- Standardize neatness
 - Sustain (Self-Discipline)

5 Whys- A simple root cause analysis technique.

Kaizen:

- Small group improvement activity.
- Use the line workers creativity to reduce waste.

Work Cells:

- Create natural groupings of tasks/products and equipment/personnel needed to do them.
- Single piece flow in the cell.

Standardized Work:

- Every process step is rigorously documented.
- Sequence of task steps are specified with cycle times, inventory required, tools, and equipment needed.
- Everyone knows their exact roles and responsibilities.

Six-Sigma Methodology

- Defects per opportunity (DPO)
- Defects per million opportunities(DPMO)

Six-Sigma Infrastructure

- Executive Leadership- Highest level possible in the Organization– Often C-level executives&provide strategic focus to the program.
- Champions and sponsors-Identify individual projects; align to mission and vision&remove roadblocks.
- Master black belts-Trains the Black Belts and Green Belts; helps as a technology/methodology consultant to Black Belts&has a program-level focus rather than project focus.
- Black belts-Expert in six-sigma methodology; DMAIC expertise; statistical training&respected for their expertise
- Green belts-Project managers/leaders&Domain expertise.

Yellow, white etc. Belts-Have some training in six-sigma methodology; project team members&project champions or sponsor