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Importance and Application of Quality Tools in Healthcare Facilities

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ABSTRACT: Wherever we go and whatever we buy we always look for quality. Every organization, company, industry, and institution is trying and struggling to give quality services and products, and to overcome the struggle, management experts have given many tools to improve quality for better outcomes. They are PDCA, 5 S, Histogram, flow chart, run chart, control chart, Brainstorming, Why-Why analysis, Pareto chart, Check sheet, Gantt chart, Scatter chart, Fishbone chart, Mistake proofing, and Six Sigma. This review aims to explain the importance and application of these Quality tools in healthcare facilities.

KEYWORDS: Hospital Quality Management, PDCA, 5 S, Quality Tools.

BACKGROUND

Simply tools are instruments used to identify and solve the problem in the machines for smooth functioning or any equipment used to do a particular work to correct malfunctions by tightening the loose or unstable objects. E.g., Screwdriver, Wrench, Clamp, Tester, hammers, etc.

In Healthcare, Quality Tools are used for measuring quality to improve efficiency and reduce waste and error. (1) Quality Tools can help the organization with problem-solving and process improvements, (2) involves in the organization's improvement and decision-making process. It can be used in all the phases of a company or organization's process from the beginning of production of services to implementation or supply. (3) The quality tool helps check and explain the processes' problems in any organization and involves prioritizing the quality and safety-related problems in Healthcare industries. (4) It improves the condition of the healthcare organization and its process and reduces the organization's defects. (5) This study aims to know the uses and importance of Quality tools and their application in healthcare facilities. The tools are,

- Plan, Do Check, Act (PDCA)
- 5 S
- Gannt chart
- Brainstorming
- Flow chart
- Histogram
- Check sheet
- Run Chart
- Control chart
- Scatter chart
- Why- Why analysis
- RCA- Fishbone chart
- Pareto chart
- Mistake proofing
- Six Sigma

1. PDCA

Plan-Do-Check-Act (PDCA) otherwise called PDSA (Plan, Do, Study, Act), the "Deming Wheel" or "Deming Cycle" or sometimes 'The Shewhart Cycle". It was developed by Dr. William Edwards Deming in 1950. It Helps in various activities such as starting a new project, creating a new access, service, or product, implementing a new solution or any change, etc. The PDCA/PDSA is a four-stage quality-improving approach applied for continually improving the services, and processes and reducing the errors. It also involves analyzing possible solutions systematically, checking the results, and implementing new designs or approaches. (6)

Plan

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This phase is for the identification and understanding of the problem. Here we will define the problem, and create and screen the implementation plan or solution to achieve the target or goal.

Do

Once we have planned a solution, test the solution on a smaller scale or a smaller geographic area with a small group as a short pilot. It doesn't mean full implementation, it is a testing and trying approach.

Check

It is a process of assessing and analyzing the pilot test's results and checking whether the newer solution or idea worked or not, if it didn't work we have to return to Phase 1 (i.e. Plan), and if it works well, will move to the final phase (i.e. Act). When the results give an acceptable and happy outcome then will move to the action stage otherwise we should test new and different ideas with the plan and do phase.

Act

It is an implementation phase, here we will implement the idea or solution fully but it's not an end and final phase, the PDCA is always a continuous process, and it should run as a loop.

Example: - *Plan*: In a Community Hospital, there is a plan to improve hand washing practices in a hospital due to low hand hygiene awareness, less training, and poor hospital infection control management system. ***Do***: the training was given to all the staff and the inspection was formed to monitor the hand washing practice. ***Check***: the six-step hand washing and fast disinfectant hand washing evaluation was taken and the hand washing practice of staff, and indicators were monitored regularly by the Director and head nurse. ***Act:*** the improved practice has been followed up and monitored regularly and the results were linked to the personal assessment and performance of the staff. [7]

2. 5 S

5S is a lean method of workplace management. It is a Japanese-based tool used for organizing and managing the workplace for workplace improvement, and it's a continuous process, not a one-time activity, then it's one of the most popular tools used in Healthcare to achieve lean healthcare by reducing waste and improving quality. it is a Japanese word abbreviated as *Seiri*-sort, *Seiton*-set in order, *Seiso*-shine, *Seiketsu*-standardize, and *Shitsuke*- sustain. [8]

5S Practice

Sort (*seiri*): Sorting of the items based on the need at that place,

Set in Order (*seiton*): Arrange the items for easily accessible,

Shine (*seiso*): Keep and maintain the items neat and clean,

Standardise (*seiketsu*): To maintain these practices in everywhere the facility at a high standard,

Sustain (*shitsuke*): Train the staff and other workers to maintain this practice regularly and continuously in a habitual manner. [8]

Example: - In Thapa R et al biomedical engineer dept. was followed by this 5 S method for workplace management and Quality improvement. In this example ***Sort*** the biomedical engineering department was not sorted and equipment was kept untidy and in haphazard condition without labelling. The unwanted equipment and non-working equipment were cleared and shifted to the condemnation room. ***Set in Order:*** The equipment, spare parts, and vital documents were arranged in organized and proper order. The regularly used spare parts and tools were kept in easily accessible and convenient places within proximity of trooper labeling. It will reduce the unwanted wastage of time and travel. Shine: all the areas in the departments were cleaned and washed with an appropriate solution, the repaired and broken false ceiling was repaired, and the cleaning chart time table prepared and formulated. ***Standardise:*** the checklist was prepared for audit and rules and regulations were formulated and followed accordingly. ***Sustain:*** the 5 S checklist was used and an audit has been carried out in the department, a good improvement had seen and found in the biomedical engineering department. [8]

3. Gannt chart

The Gantt chart is a planning tool used to track the tasks, here each activity is plotted in a linear chart. It depicts the timelines of the particular project or work. It is an important tool in improving patient safety and Improvement. It also reduces preventable errors in the healthcare domain. [9]

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Figure 1 shows the Gantt chart for conducting an outreach camp, various activities are planned for a certain period, and the planning of conducting the camp has been planned and executed. Similarly, in healthcare patient treatment can also plan a time and will be tracked for smooth execution

Gantt chart for conducting outreach camp					
Sl.no	Activities	1st week	2nd Week	3rd Week	4th Week
1	Obtaining Permission from the Panchayat				
2	Arranging the Vehicle				
3	Advertising the Public				
4	IEC preparation & Print				
5	Conducting Camp				

Figure 1: Activities and tasks to be done for conducting outreach camp

4. Brainstorming

Brainstorming is an effective problem-solving technique used to get a greater number of creative ideas to solve problems in all industries. It generates new ideas and provides more options to solve problems. It always groups activities of creative technique.

It has the stages of selecting the group, specifying the objectives of the brainstorming session, defining the roles, explaining the rules, discussing, recording ideas, and encouraging the ideas. [10]

Brainstorming involves participants in new ideas generation, emerging concept prioritizing, and result in interpretation. This also engages the people in generating new and suitable ideas appropriate to problem-solving. [11]

As an example, In Michael Herrera-Galán's study brainstorming sessions were conducted in various hospitals and identified and grouped the main causes for the underperformance of hospital equipment. [12]

5. Flow Chart

Flow charts are the process improvement tool used to analyze the series of events in a workflow diagram. Here we can identify the non-value-added activities and also will check the flow of work, and remove unwanted activities. [3]

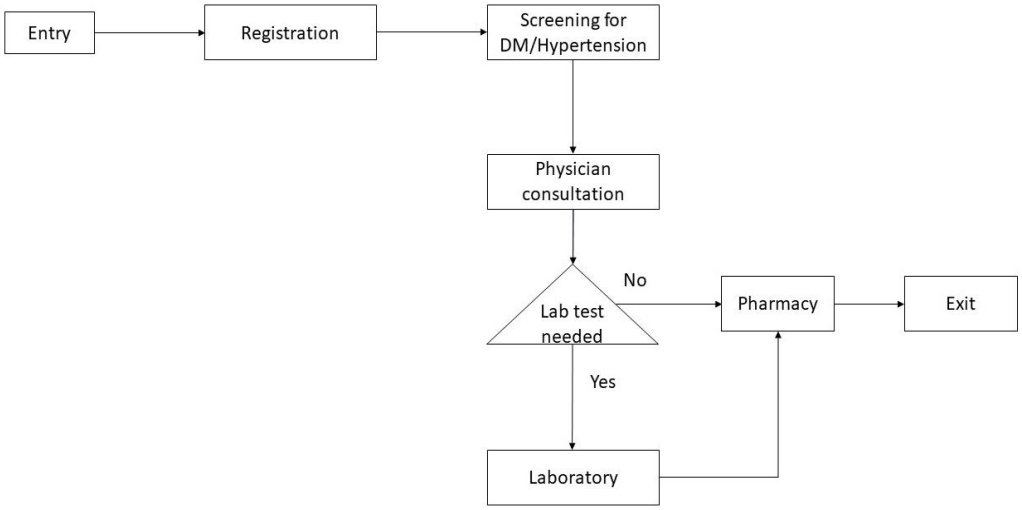

Figure 2: The flow of patients in an NCD camp

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Figure 2 shows a flow chart of the patient flow in the NCD camp as the patient enters the camp area, registration has done then Screening for Diabetes and hypertension happens after screening patient goes to consultation with a physician based on that patient will go to the laboratory and pharmacy then exit from the camp.

6. Histogram:

Histogram is one of the data visualization tools, it is the earliest type used to visualize the distribution shape of a single quantitative variable. it is very helpful in visualizing exploratory data for skew, spotting outliers, and bimodality. [13] Histogram is not a bar chart. It is a type of bar chart, that displays the counts of categorical variables but a histogram displays quantitative data. it has the goal of visualizing the shape of data for a single quantitative variable. It consists of adjacent equal-width vertical columns with no space between the columns. [14] It can help to understand where problems are, where to focus, and when to use to improve quality. [15]

Histogram is also used for the evaluation of the current situation. The improvement of the outcome can be decided by the shape and statistical information of the histogram. [16]

For example, figure 3 Histogram shows the number of OPD cases in 2022. Till the cases in March moth, the cases were less than 15 but from April onwards the attendance of cases rises gradually from 25 to 36.

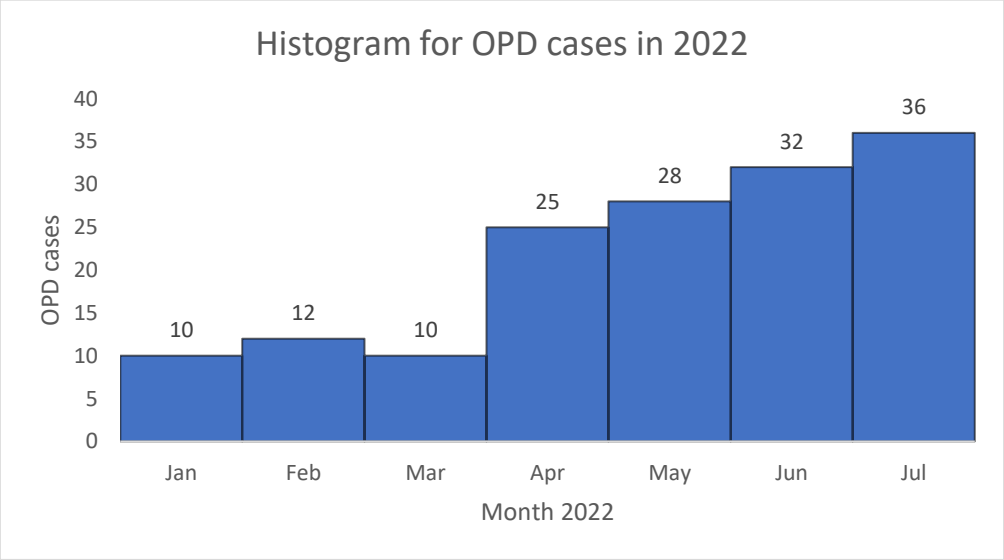

Figure 3: Histogram of the OPD cases during the year 2022

7. Check sheet

A check sheet otherwise called a Defect concentration diagram. It is a simple tool to evaluate the data by collecting, organizing, and analyzing the data. This can be used when the data can be collected and observed repeatedly from the same person or same location when to collect the frequency of events, defects, and problems. [17]

The check sheet is used for collecting real-time data and it has been divided into different levels or regions that each have variety and different significance. By using this check sheet, the user can decide what problem arises and how long it persists. [16]

Example – figure 4 shows the check sheet of vaccination coverage in a week at the health center. It depicts what the vaccination and its total values are represented.

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Vaccination Coverd in this week						
Reason	Day					
	Mon	Tue	Wed	Thurs	Fri	Totall
ARV	𝍸	I	II	I		9
Hep B	I	I			𝍸	7
MR			𝍸	I	II	8
Total	6	2	7	2	7	24

Figure 4: Vaccination coverage in a week

8. Run Chart

A Run chart is used to study the trends or patterns of data over time. It will help to monitor the data for its trends, shifts, or cycles over time. It focuses attention on vital changes and abnormal variation and it also tracks the information for trend prediction [18]. It helps to understand the impact of tests and interventions over some time. It preserves the data in time order. It also helps us to detect the improvement or failure as earlier. However, this chart is not suitable to determine if the stable process. [19]

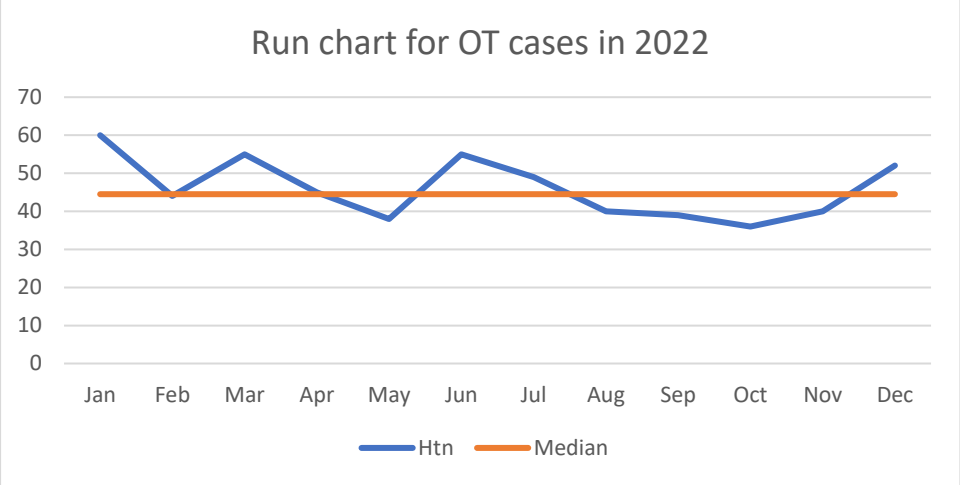

Figure 5: The run chart Shows the flow of OT cases in the year 2022, Here during the rainy season OT cases have decreased.

9. Control chart

The control chart is a primary tool in Statistical Process Control (SPC) and is commonly used for monitoring and improving ongoing processes. There are three lines in the control chart i.e., the Centre line, upper control limit, and lower control limit. In healthcare, we can use this for formal ranges values. [20] E.g. ILR tempt (2-8 ^{O}C)

The control chart is a statistical process control methodology designed to evaluate the process improvement or change in the manufacturing industry and is being implemented gradually in the healthcare sector

This will enable healthcare organizations to prevent unnecessary investment or spending in any changes that sound good but do not have any positive impact on real progress or improvement

Control charts are a valuable SPC tool established by physicist Walter Shewhart to identify if the variability in the manufacturing process is consistent and within the control state. [8] Recently, there is a growing interest in the healthcare sector to implement the control chart to monitor and improve the healthcare process performance.

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The control charts have been commonly used in the manufacturing industry over several decades since 1924. The chart illustrates how the production or process differs over time. Thus, we could recognize whether a process is in or out of control and whether the source of variation is caused by common causes or by special causes. (21)

Example Figure 6 shows the control chart of temperature shows in Ice-lined refrigerators **(ILR)**

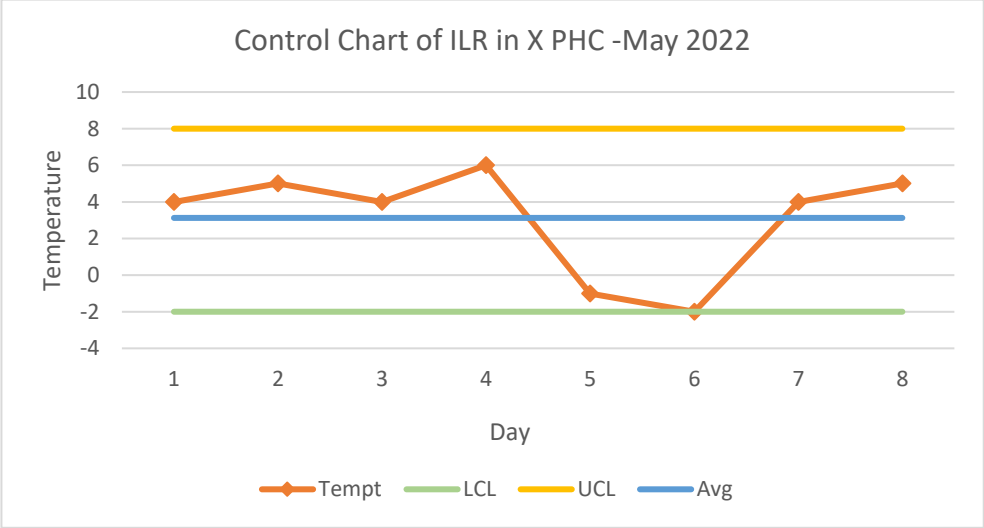

Figure 6: control chart for ILR Temperature maintenance in May 2022

10. Scatter Chart/ Diagram

This is one of the most powerful tools and best methods to identify the relationship between the two different quantitative variables and it also helps to understand what type of relationship between the two variables if the relationship is present (i.e. Weak or strong and positive or negative). The correlation between the variables reveals the cause of the problem. And it also shows the degree and relationship between dependent and independent variables. (22)

As an example, figure 7 shows the scatter diagram for fever cases and months, it clearly shows there was a relationship between the rainy season and fever, this scatter plot shows from the 8th month (i.e. August) the number of fever cases rises, and reaches the maximum in that year.

In Takahisa kawano et al the relationship between the length of stay in the Emergency department and mean patient age per day was seen among total patients by using this scatter chart. (23)

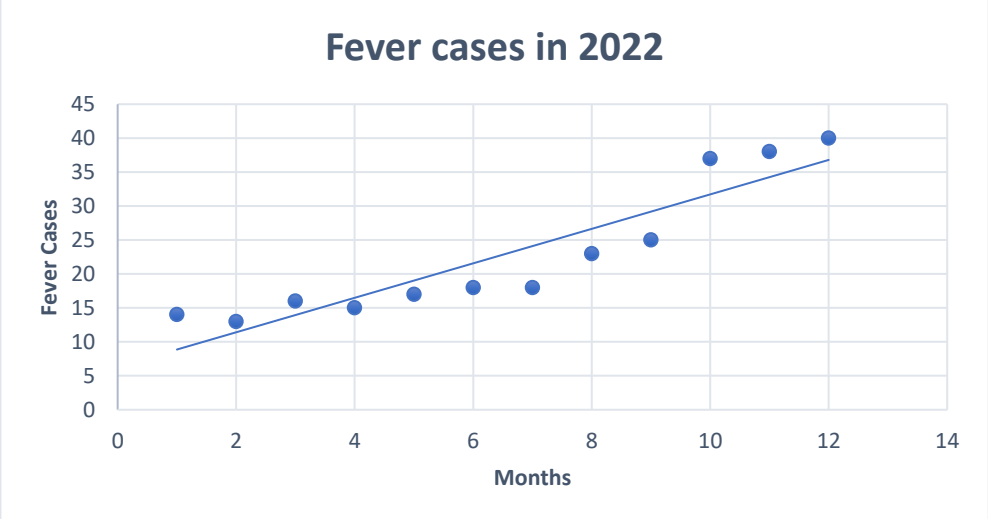

Figure 7: Scatter plot for Fever cases in the year 2022

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11. Why- why analysis

It is very one of the ways to find the root cause of a problem, and It is simply to ask "Why?". When a problem presents itself, ask "Why did this happen?" Then, ask "Why?" again and again until you find the root cause. This simple tool can be helping in to rule out what is going on, and It can help you and is useful for tackling chronic problems that show up over and over again in a complex system. (24)

Here is an example of how to ask "Why?"

Patient load was decreased

why

No adequate staff in OPD

why

The OPD staff took leave

why

The staff had an illness

why

The staff didn't take the vaccine

why

Inadequate vaccine ordered due to following of older order level

Solution: Update the order level and keep adequate storage of the vaccine

12. RCA- Fishbone chart

The fishbone diagram is also called the **"**Cause-and-effect diagram" or "Ishikawa chart". It is designed to find the root cause of the problem. without finding the root of the problem, it's not possible to eliminate the problem permanently. This chart helps in finding the possible causes of the problem of quality and it also helps in focusing on the improvement of quality in any sector and healthcare domain too. It can be applied at any stage of the quality improvement in the Hospital. This diagram replicates the skeleton of a fish.

To construct this the central line(spine of the Fish's body) depicts the problem. The diagonal lines from central lines (fish bones) are the causes, and different groupings of causes indicate the causes of the problem, this group can be organized and categorized into 6Ms (machine, method, materials, measurement, man, and Mother Nature) or 5Ps (patients/clients, providers, policies, processes and procedures, and place/equipment) or 4S (surroundings, suppliers, systems, and skills). After the groupings have been specified, the Hospital Quality team will decide on the most important cause of the problem and will try to rectify it one by one until the problem will be solved. [25] Figure 8 shows the fishbone chart for high newborn death

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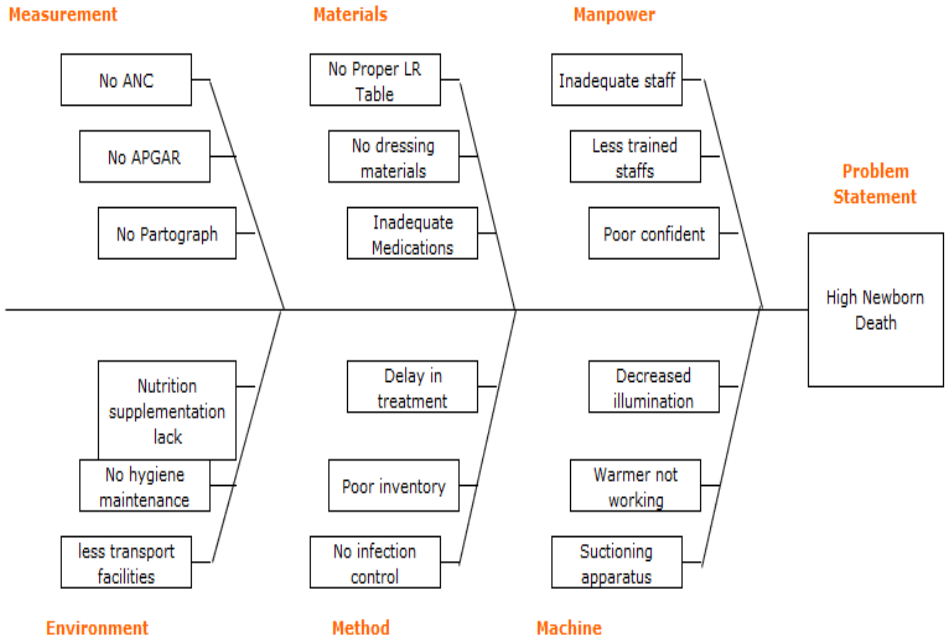

Figure 8: Fishbone diagram for high Newborn deaths in a Hospital

13. Pareto chart

Pareto charts come from the Pareto principle in the 19th century by Italian Economist Vilfredo Pareto, this principle is also known as the 80/20 rule. Which means 80 percent of effects arise from 20 percent of defects or causes. It is one of the important quality tools recognized by the American Society for Quality (ASQ), and this became one of the basic seven quality tools for quality improvement. This chart contains both graphs of bars and a line.

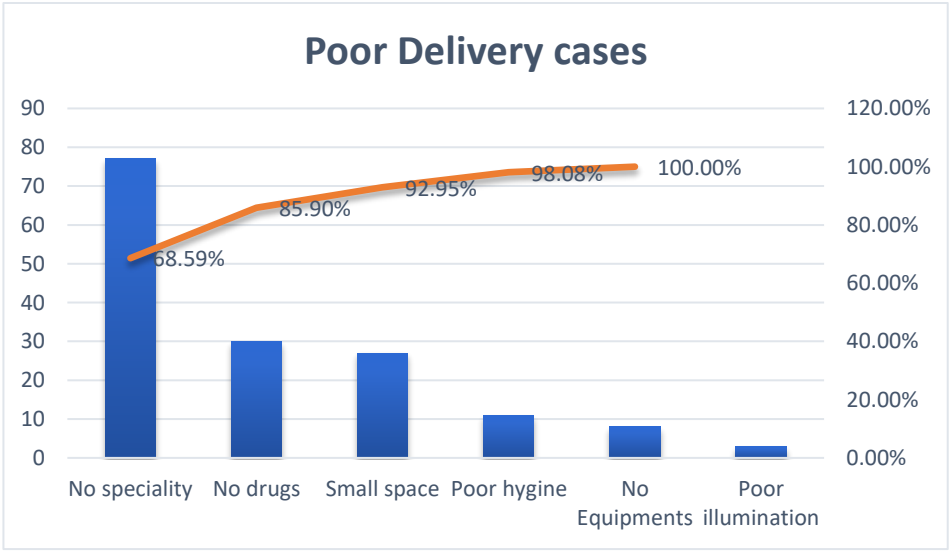

Figure 9: Pareto chart on the poor delivery cases

A Pareto chart has a bar graph on the left side with frequency (y-axis), on the right-side percentage (z-axis), and on the x-axis, the factors contributing are arranged in descending order. The line that shows the cumulative percentage of

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the factors. when the cumulative line reaches 80%, this means that all of the covered factors represent 20% of the causes. If you rectify or solve these causes, then you will attain the desired outcome. [26]

14. Mistake proofing

Mistake proofing a Japanese term (Poka-yoke), is an approach to reducing inadvertent errors and this helps to avoid mistakes and defects earlier by preventing, and correcting human errors as they occur. It is the one effective way to avoid medical errors, the primary aim is to eliminate the mistakes in the process as early as possible. It ensures the proper conditions exist to prevent errors before happen. [27]

Table 1 Examples of what constitutes mistake proofing using the definition in this paper Mistake proofing

Sl. No	Examples of Mistake Proofing
1	Setting an alarm in the Infusion pump that regulates the flow of intravenous fluids
2	Coding of the gases outlet based on color
3	Using barcoded stickers for patient identification in files and requisition forms
4	Following Unambiguous handwriting in notes and prescription
5	Using identification tags on patients, especially pediatric child

15. Six Sigma

Six Sigma (SS) follows the DMAIC principle (Define, Measure, Analyse, Improve, and Control) for quality improvement and Reducing problems in various departments in the healthcare facilities. DMAIC is an integral part of SS. It is systematic, fact-based, and provides a rigorous framework for results-oriented project management. This offers a sound approach in a structured, analytic, and logical way to problem-solving Additionally, 6S has been used to solve numerous problems like decreasing length of stay, reducing medication errors, and improving the admission and discharge process in healthcare sectors. [28]

DMAIC has five phases, which are interconnected, they are,

***Define* is** the identification of the work project, it has the components of Identifying the project, problem, and objectives.

Measure the parameters and their key performances and is the process of understanding the process for need improvement

Analyze by checking the causes and key determinants;

Improve by change and optimize the process and its performances; and

Control by sustaining the output.

CONCLUSION

In conclusion, these are the Quality tools used for Quality improvement in any organization of various sectors. these tools can help the institution to meet its quality needs and objectives, these tools are useful and could be used in many phases of quality improvement projects, serving many functions. Applying these tools can reduce the costs, efforts, and time in a healthcare setting for improvising quality. And finally, These Quality tools are not only helpful for organizations and industries but can also be applied in our life experience too and will improve our Quality of life.

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