Healthcare Services Quality Improvement Process "Basic Six Sigma Breakthrough"

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Abstract:

Healthcare, necessitates organized revitalization efforts to continue competitive, cost proficient, and up-to-date. This paper outlines a methodology and presents an example to illustrate how principles of Six Sigma can be combined to provide an effective charter for producing regular improvement efforts in healthcare. Through the implementation of the procedural steps of Six-sigma methodology, it has been possible to enhance the healthcare service quality of the organization. Controlling healthcare cost increases, improving quality, and providing better healthcare are some of the profits of this approach.[1]

Index Terms: Healthcare, Quality; Six Sigma: DMAIC, performance matrix, control process, cause-effect diagram, remedy matrix.

Introduction:

In Libya, unfortunately, the health care system is overwhelmed with a variety of problems. Even with the increased provision to health care, access to the system continues to be problematic and is evident from a variety of indicators: Serious staff are absent, essential supplies are generally unobtainable, facilities are inadequate, and the quality of staffing is poor. Problems of supervision and responsibility intensify the problems, while unethical practices seem to be on the increase as reports indicate. The cost of medical care is increasing at an alarming and unsustainable rate worldwide. Certainly, a significant percentage of these cost increases can be attributed to technological advances. This factor is inevitable because the technological and demographic developments of modern society are largely beyond control. However, another major source of healthcare cost increases can be characterized as excessive operational uselessness. Healthcare professionals have more control over this factor. Inefficiency can be measured and changes implemented to improve quality. These efforts provide more affordable and better healthcare for a large percentage of the population. Some operational inadequacies are associated with the direct medical service delivery, others are associated with the administrative, logistical, and operational side of the healthcare system. Both areas can benefit from systematic process modernization activities.

Recent activities include minimizing patients length of stay[2], improving efficiency[3], controlling infections[4], and reducing waiting time[5].

One of the primary concerns in healthcare sectors as the issue of *nosocomial infections control*. There have been many healthcare organizations implementing quality assurance systems and are reformist. Six Sigma has recently been applied in the healthcare sector; and used as tool to undertake existing healthcare challenges through some projects.

The study focuses on increasing infections control through Six sigma DMAIC, an effective management of available capacity and statistics.[6],[7]

Our own experience with Six Sigma at the *Zahra Hospital* in applied year before the term itself was used.. The hospital management had already introduced a basic quality assurance system, and also deployed a number of teams to work on specific quality improvement projects. At the time, management believed that these pre–Six Sigma projects worked well and were completed with good results.

Hospital management over time identified the following problems:
• Projects were not necessarily of strategic relevance.
• Projects did not always have a significant business case.
• A systematic project-tracing system was missing.
• There was no uniform method for project management and control.
• Too many projects were not completed.
At the end, the hospital management was introduced to Six Sigma and found that this methodology provided solutions to many of these problems.[8] In addition to outlining Six Sigma's management framework and lessons learned relevant to healthcare[9], this article also describes selected example of the project. A sampling will provide an impression of the range of problems tackled[10]: • shortening the length of stay in chronic disease patients
• allowing parents to room in with their neonates
• reducing the number of patients requiring intravenous antibiotics
• shortening the preparation time of intravenous medication.

Indeed, some healthcare professionals think QI methods should address only defects, significant gains made by applications to all processes and all operational inefficiency[11].

Synthesis of Six Sigma:

Six Sigma offers a structured, analytic, and logically sound approach and context to problem solving, as well as a strong organizational framework for its deployment[12].

Six Sigma consists of the following elements:

• **organizational competency development:** A committed staff of Six Sigma project leaders are trained in a curriculum of Six Sigma with additional quality components.

• **organizational securing of solutions:** To secure the solutions implementation and guard against reverting, tasks; responsibilities are clearly defined, procedures are standardized, and process controls are imposed as part of a project improvement.

• **linking strategy with project selection:** Strategic objectives are translated into performance indicators and tactical goals. These are then used as a basis for project selection and help secure a position of projects with the overall organization strategy. • **a structured approach:** The task force deployment strategy.

• **project-based deployment:** Six Sigma projects apply to more general, chronic and complex problems and involve solid, data-based analytic methods and statistics. Typical Six Sigma projects involve increasing quality, decreasing defects, reducing variation, and increasing yield.

The problem-solving algorithm of DMAIC is always used, and projects are monitored after each phase is completed.

Methods and Material :

Zahra Hospital in the west region of Libya is a 300-bed, medium-sized general hospital employing a staff of 966, in addition to being a general healthcare provider. In 2008, the Hospital had 12,669 admissions, performed 11,064 outpatient treatments, and received 198,591 visits to its outpatient units, of which 78,832 were first contacts.

Six Sigma was employed at the Hospital in Nov. 2008 with the first wave of training.

The training was provided in two separate periods of 3 days, 2 months apart worked 2 days a week on their projects. As part of the project-management system, Teams were required to present their results twice, and were carefully monitored and allowed to proceed to the next phase of the DMAIC sequence only after presenting a report providing evidence that the preceding phase had been completed..

The data- focused attitude was regarded as helpful in establishing support of the teams during the implementation of the results. The data-based analysis and decision making seemed to minimize resistance to change. The experience from the previous waves of training indicated that

many healthcare problems involved various forms of wasted time. First, the hospital applied the organizational infrastructure typical of Six Sigma. Second, utilization of quality improvement was project by project. Third, the Six Sigma approach was based on developing organizational competency. Fourth, project selection had a strategic focus. In the present case at the hospital, a strict focus on infections reductions while maintaining or possibly improving quality. Six Sigma is arranged by carrying out improvement projects based on an evaluation strategic relevance, and on a translation of the strategy into operational goals.[13]

Six Sigma's approach is similar to that of good medical practice used; relevant information is assembled followed by careful diagnosis. After a thorough diagnosis is completed, a treatment is proposed and implemented. Finally, checks are applied to see if the treatment was effective. To operationalize this problem-solving strategy, The paper is organized as follows*:* Six Sigma uses five phases—*define, measure, analyze, improve,* and *control* (DMAIC). In the *define* phase, a charter is drafted that includes a cost-benefit analysis. If the cost-benefit analysis meets the established basics, the charter will be accepted, and the project will continue through the DMAIC process. In the subsequent *measure* phase, baseline data are assembled, and the diagnosis is started in deep. The problem is translated into quantifiable terms using critical -to-quality characteristics. The *analysis* phase continues the diagnosis and involves an identification of possible causal relationships between inputs and the outputs. After the diagnosis is completed, the team proceeds to the *improve* phase and suggests a solution to the problem. Finally, in the *control* phase, control systems are developed to ensure that improvements are maintained and the new improved process can be dispensed. Each of the five DMAIC phases involves detailed plans that help to guide project leaders through the

finishing of the quality improvement project. To secure a successful inauguration of Six Sigma, a deployment plan for strategically relevant projects ensures an orientation of project goals with the long-term objectives.[14]

Six Sigma Project Case Study:

Nosocomial Infection Rate Reduction In Neonatal Intensive Care Unit At Zahra Hospital

Six sigma application to decrease nosocomial infections and improve services system.

The management of the hospital felt that it would be crucial to control and reduce its infections with the current expansion plan to meet its strategic objectives. It was decided to implement the Six Sigma methodology in intensive care unit at hospital in the city of Zahra in western region of Tripoli "National Healthcare Provider".

Is it Quality improvement ?

1) Trying to reach a new level of performance.
2) Trying to discover the infection root causes in neonatal ICU and eliminate them.
3) Not developing a new process.
4) Can measure problem and prospects by same measure (Neonatal Infection Rate).

Symptoms of the problems:

- Serious complications; Increased death rate.
- Increased length of stay (LOS), workload, and cost of treatment
- Increased non availability of places in NICU for other neonates
- Decreased staff & family satisfaction .

Phase 1 : DEFINE

The first of Six Sigma methodology started with deciding and defining the infection rate to be improved

The Define phase concentrates on forming the team, defining the project's goals, mapping the process, identifying infections, and identifying impact characteristics. In this study, Factor analysis, Performance Matrix and Risk Priority, are utilized to identify potential criteria responsible nosocomial infections.

A survey of questionnaire demonstrated[15].

Step I A : Identify a project

High infection rate in 30 incubators in NICU at a general Zahra hospital.

Evaluation and selection :

It is rational a good six sigma project as it is : A chronic continuing problem during the last 2 years.

Significant results : the results of decreasing neonatal infection rate and its complications worth the effort which will be done.

Size is manageable : within six months period, positive impact as it will decrease complications, retain customers, reduce cost, and enhance customers and employees satisfaction.

The project: is urgent as it has quality problem in core service

No potential risk : not involve new or unproven technology.

It is predictable low resistance : as it improves morale of the employees.

Step 1 B : Establish the project : Mission statement

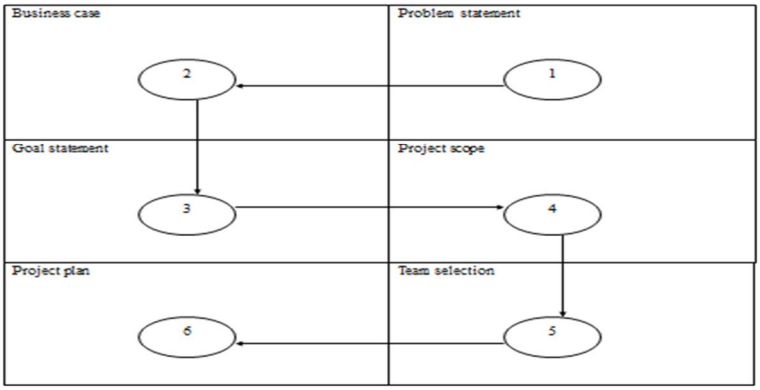
Problem definition :

Neonatal Infection rate in 30 incubators in NICU at a general hospital of about 25 % which is more than expectation .

Objective:

Reduce infection rate in this hospital from 25 % to less than 10 % within a period of six months .

Project charter :



Business case →→ **Problem statement**

- High infection rate give serious Complications , increase death rate , increase cost , Increase LOS, decrease customer satisfaction.

- High infection rate about 25% at NICU
- The process is currently operating at 2.4 sigma.

↓

Goal statement → **Project scope**

- Reduce infection rate to less than 10 % .
- Increase sigma level up to 3.3

- The process starts by admission and ends by discharge .

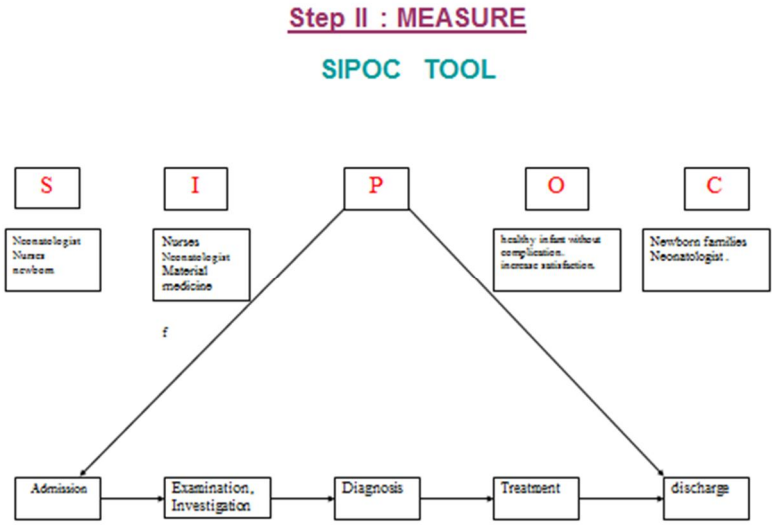
↓

Project plan	←	Team selection
Define : 1/11/2008 – 15/11/2008		Sponsor : head of NICU
Measure : 16/11/2008 – 15/12/2008		Team member: Neonatologist
Analyze : 16/12/2008- 31/12/2008		Team member: nurse
Improve : 1/1/2009 -31/3/2009		Team member: maintenance
Control : 1/4/2009 – 30/4/2009		Infection control committee member.

Phase-II: MEASURE:

Measure is the second phase of DMAIC model, this step is necessary to measure the existing state of process. In this study; detailed flow diagram is used to measure the infection state. Another tool "Pareto chart" is also integrated for measuring the current status of the service level and hospital environment.

Monitoring and Measuring Day to Day Performance using 'data sheet'



Analyze symptoms

It has to :

- Develop operational definition .
- Measure the symptoms .
- Define boundaries then
- Concentrate on vital few.

Operational Definition of neonatal infection :

Neonatal infection rate of newborn who acquired infection after staying longer than 24 hours in the NICU.

Infection rate =

Number of infants with one or more infection (during specific time period) **x 100**

Number of infants at risk (during same period and time)

Measure the symptom:

Data sheet for infection in NICU

Infection case in NICU

Time period :

Interviewer :

For every infected case ask the following questions:

Age: Gender: Weight: gestational age:

Days in hospital

Days in NICU

Procedures done :

Therapeutic interventions

Antimicrobial use

Indication of Antimicrobial (prophylactic - therapeutic)

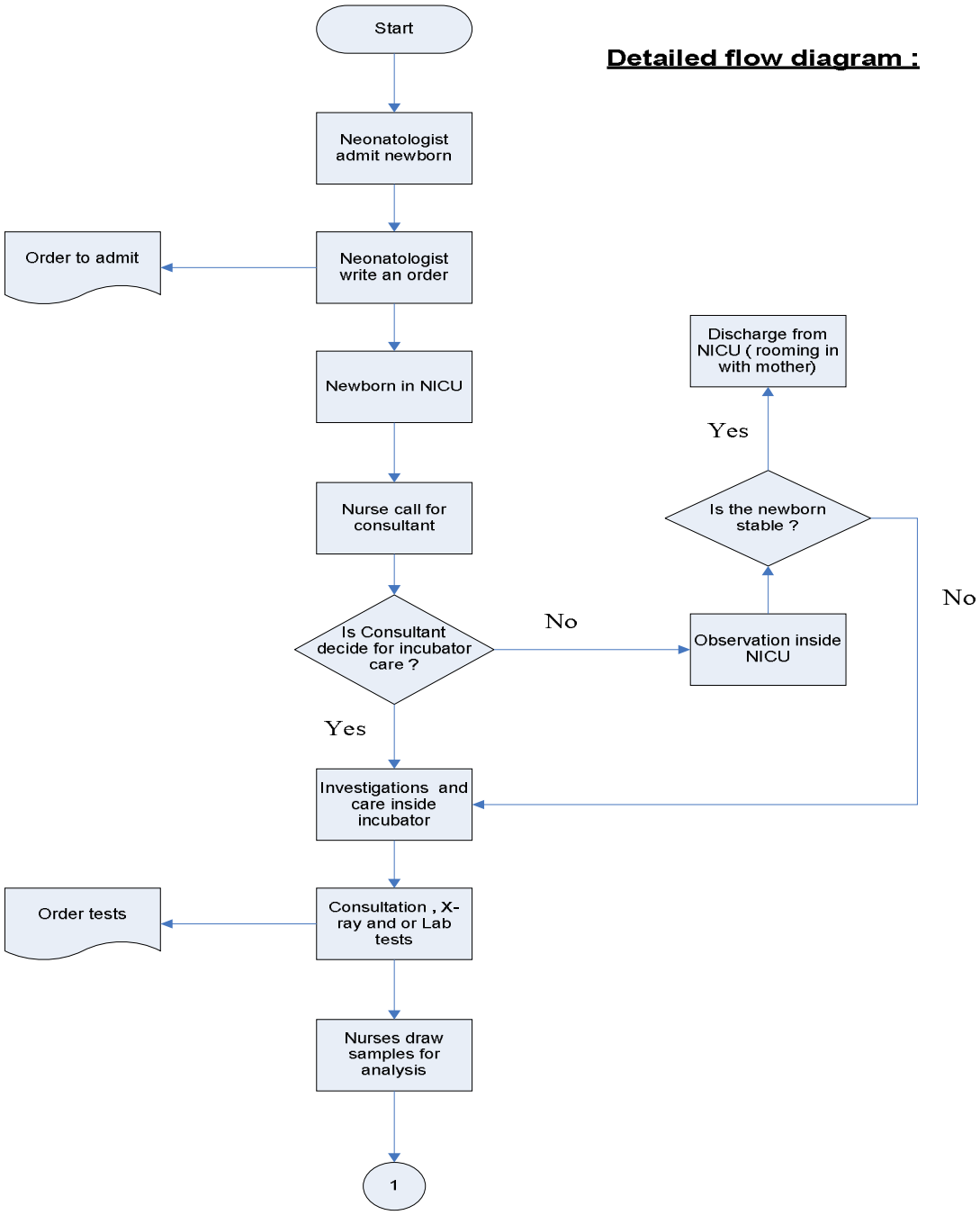
Infection type:

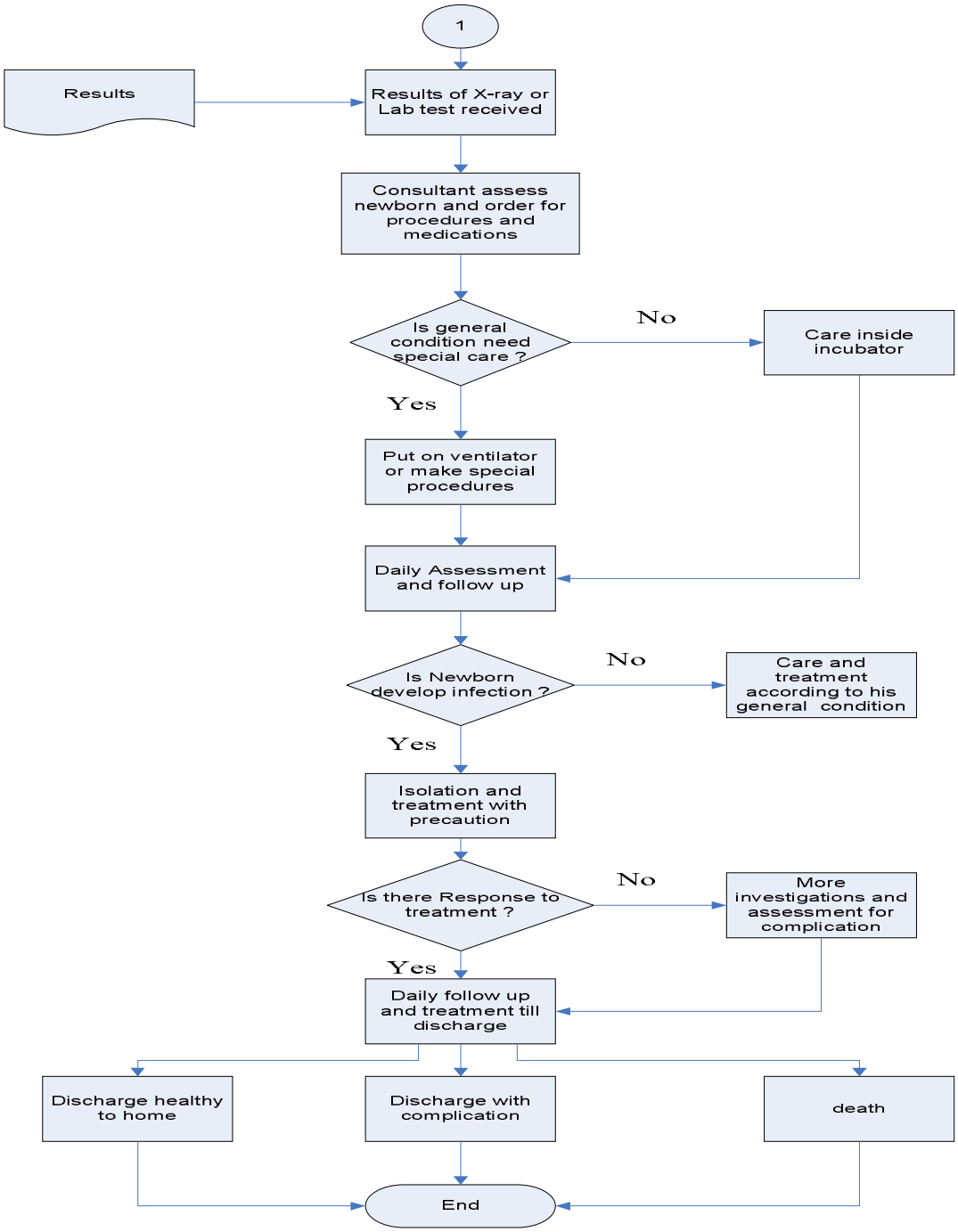
Septicemia
Pneumonia
upper resp. tract
Urinary tract infection
Skin infection
Fungal infection
Others

Infections according to types

Type of infection	Number	% of total infection cases
Blood stream infection	23	28.75
Pneumonia	17	21.25
Urinary tract infection	13	16.25
Upper respiratory tract	9	11.25
Skin infection	7	8.75
Conjunctivitis	6	7.5
Others	5	6.25

Detailed flow diagram :

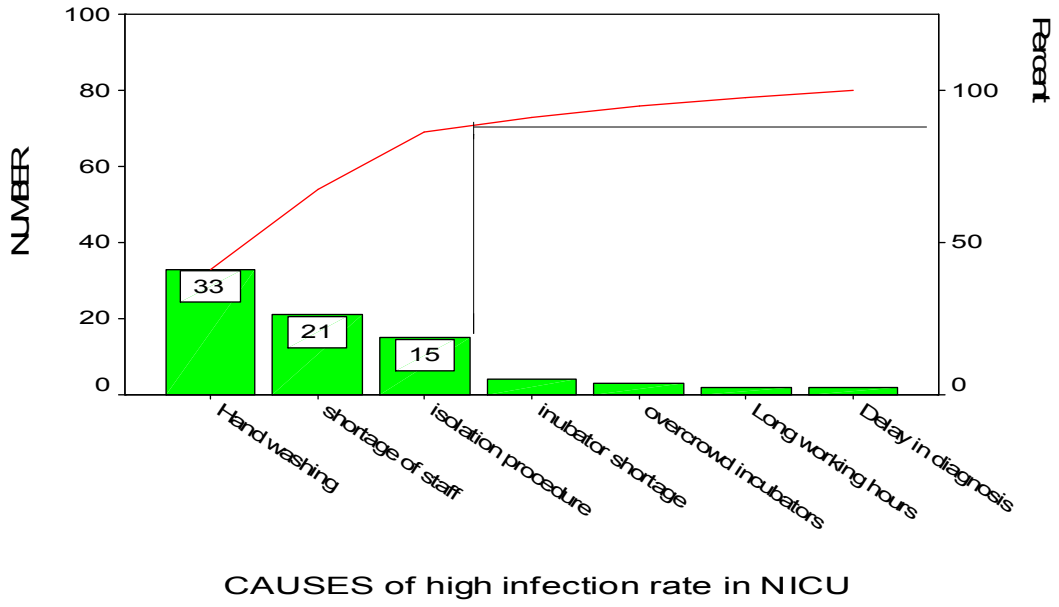



1
Results
Results of X-ray or Lab test received
Consultant assess newborn and order for procedures and medications
Is general condition need special care ?
No
Care inside incubator
Yes
Put on ventilator or make special procedures
Daily Assessment and follow up
Is Newborn develop infection ?
No
Care and treatment according to his general condition
Yes
Isolation and treatment with precaution
Is there Response to treatment ?
No
More investigations and assessment for complication
Yes
Daily follow up and treatment till discharge
Discharge healthy to home
Discharge with complication
death
End

Concentrate on vital few:

Pareto table for contributors to high infection rate in NICU

Categories	Frequency	Percent	Cumulative %
Hand washing	33	41.25	41.25
Shortage of staff	21	26.25	67.5
Deficient isolation procedures	15	18.75	86.25
Shortage in incubators	4	5	91.25
Overcrowdings of incubators	3	3.75	95
Long working hours	2	2.5	97.5
Delay in diagnosis	2	2.5	100



CAUSES of high infection rate in NICU

Monitoring:

The second phase of Six Sigma involved mapping out the processes and then monitoring and measuring the performance indicators in a predefined and planned manner. Each of the above key performance indicators were tracked by the Six Sigma project team used Individual control charts on a daily basis.[16]

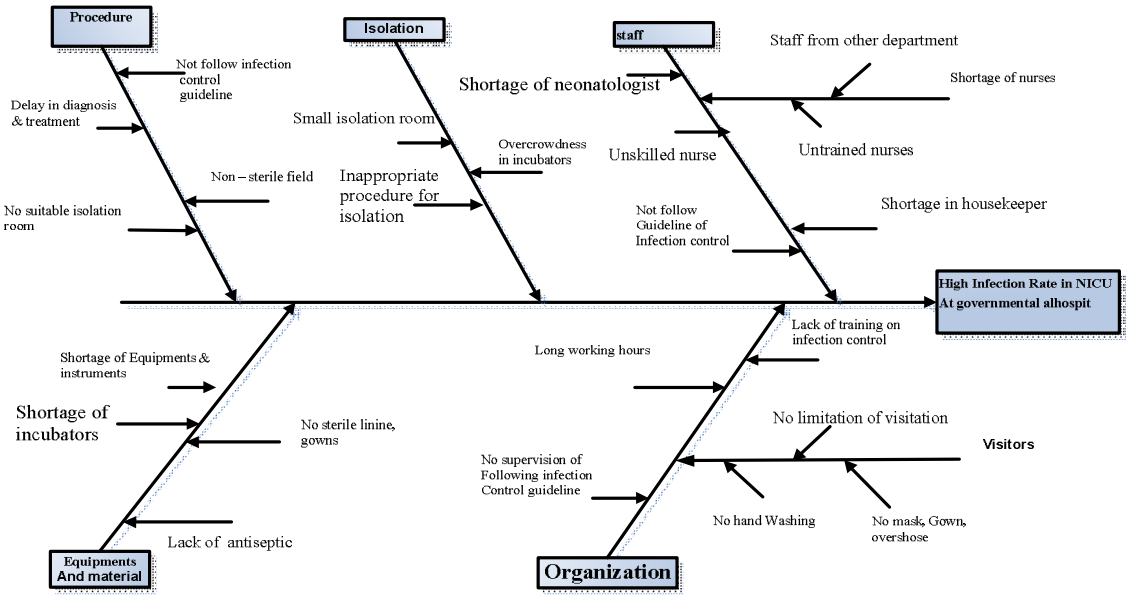
The **Pareto chart** above shows that about 86.25 of the infections came from unassuming factors. In other words, almost 86.25 per cent of the risk factors can be reduced by focusing improvement efforts only.

Phase-III: ANALISE

The purpose of this phase of Six Sigma methodology is to analyse the root causes of process deficiencies in an effort to completely eliminate them or at least reduce the effect of the root causes on process parameters. Several techniques and tools are available to analyze a process.[17]

Cause-Effect analysis was done by Cause-Effect diagram based on the observations at the hospital and discussions with groups of experienced individuals from the hospital. In conducting the analysis, five main categories of causes are created.

Formulate theories: Cause and Effect diagram



Test theories :

- To test theories the team must decide which theory to test , plan to data collection, collect data and analyze the results.
- The team decided to test all the theories as a group in time series.

In the initial phases of the project, the team focused on understanding and investigating the reasons for day -day-variations observed in the performance as shown by the control charts. A close watch was kept on the Moving Range chart to observe the variation in performance between two consecutive days of operation.[18]

The Six Sigma team also investigated and brainstormed various factors and root cause(s) resulting in higher infection rate identified by the Six Sigma team.

Root causes of high infection rate in NICU :

- Non following the infection control guidelines.
- Shortage of staff .

- Deficient isolation procedures .

Phase-IV: IMPROVE

Once the root causes were identified, then team moved on to the next phase of Six Sigma i.e. improvement phase. The purpose of this phase is to plan and implement various measures to eliminate various root causes of problems identified in the analyse phase[19].

The team successfully achieved the following tasks in this phase of the project:

a) Brainstorm various countermeasures to eliminate the root causes.

b) Develop an implementation as well as contingency plan to implement the countermeasures.

c) Plan and measure the improvement resulting from the implementation of the countermeasures.

This phase took almost three months i.e. Jun. -Mars'.09

Three main remedies have been proposed by the team members :

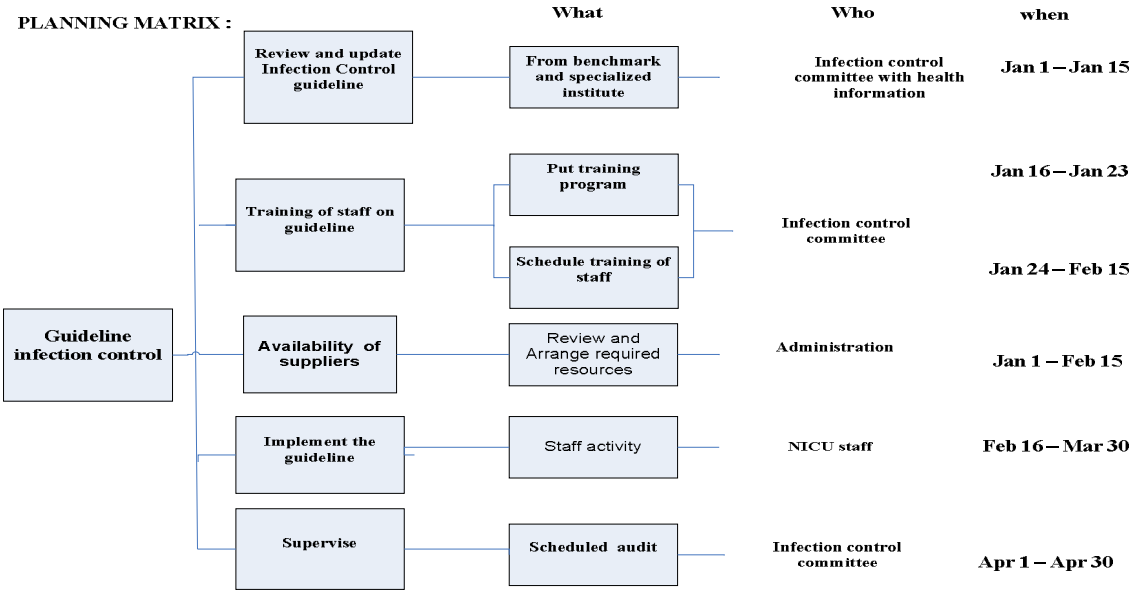
- Staff training on infection control guideline .
- Re-arrangement of working hours to overcome staff shortage.
- NICU redesign .

Remedy Selection Matrix

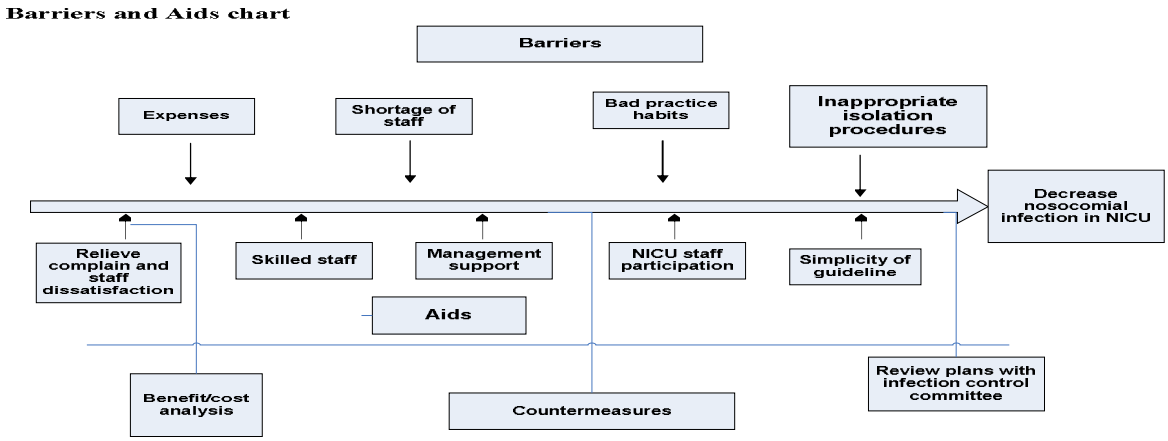
Criterion	Remedy 1	Remedy 2	Remedy 3
Remedy name	Staff Training on infection control guideline	Re-arrangement working hours	NICU redesign
Total cost	2	3	1
Impact on the problem	3	2	2

Criterion	Remedy 1	Remedy 2	Remedy 3
Benefit/cost relationship	3	2	1
Cultural impact/ resistance to change	3	1	3
Implementation time	2	3	1
Uncertainty about effectiveness	3	1	1
Health and safety	3	2	2
Environment	---------	----------	----------
Summery (rate 1 , 2 for next and so on.	19	14	11

Design remedy :



Design for culture :



Benefits Achieved:

As a result of the implementation [20], the team recorded significant improvement in almost all of the infections.

It can be seen from the above table that Six Sigma methodology implementation in a short span of six months has led to following improvement at the hospital:

a) Risk factors have reduced as much as possible per day.

b) Visitor No. per patient has decreased.

It must be noted that the above improvements i.e. reduction in utility consumption were achieved without any compromise on patient care services and patient satisfaction.

Phase-V: CONTROL

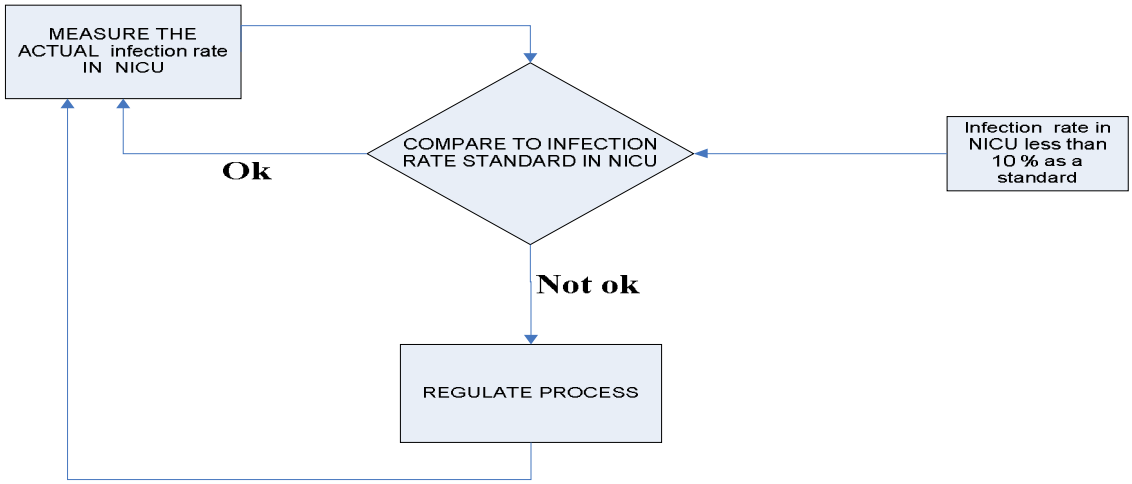
The hospital management realises that the benefits achieved so far must be sustained by maintaining strict vigilance on the underlying systems and processes. Therefore the team has successfully implemented several process control checks to aseptic procedures and maintenance tasks. These

checks includes detailed procedures, audits, training of operators, training of end users on control charts on a daily basis [21].

Implementing the three activities

- Design effective quality control
- Foolproof improvement
- Audit the control

FEEDBACK LOOP



Control spreadsheet

Control variable	How measured	Where measured	Standard	Who analyzes	Who acts	What done
Infection rate in NICU	Number of new cases of infection in NICU	In NICU for newborns catch infections after 24 hours from admission	10 % maximum	Infection control physician	Head of NICU	- Check activity according to infection control guideline. - Arrange staff work time - Check availability of equipments and materials - Appropriate isolation procedures

The controls:

The team make audit by answering two questions :

- First : the results being achieved.
- Second: what quality controls should be followed .The team arranged for routine reporting of results and clear documentation of controls.

Report results :

- The team plan to make routine reports every month about:
- The rate of incidence of infection.
- The availability of material and resources.
- The routine check of the staff for following the infection control procedure in NICU.
- The aim of the report is to monitor progress and respond if gains are not held.

Document controls :

- The team will develop a quality control manual that document the procedures to control infection in NICU in term of goals, measurements and feedback loop responsibilities. This is to effectively audit all the critical elements of the control process

Conclusion :

- This study shows that incremental changes in workflow processes in a residency clinic can have a significant impact on practice efficiency and adherence to scheduled visits for preventive health care and disease management.
- Quality is dynamic and not static and hence Six Sigma pursuit is a journey and not an end result in itself .[21]

With patient-focused processes, we:

- Enhance the quality of patient care
- Amplify the voice of patients and families
- Develop a culture that promotes continuous improvement
- Cultivate strong leadership
- Improve business operations

Six Sigma achieves these benefits by: [22]

- Empowering employees to bring about change
- Fostering two-way communication between leadership and front-line staff
- Supporting the hospital's strategic growth initiatives
- Streamlining services, creating cost savings and increasing capacity through improved utilization of resources (i.e., beds, equipment and staff)

- Eliminating activities that don't add value to the patient experience, allowing us to focus on delivering the best care

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