Improving waiting time in vaccination room using Lean Six Sigma methodology
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Background information

ELsenayea primary healthcare centre is one of the largest primary healthcare centers in Khamis region in KSA. It provides preventive, curative and health promotion services to more than 29000 population, due its large catchment area it serves more than 300 customer per day so the waiting time is very important to calculate and to improve.
1-Define phase

▲▲▲  A) Identify the project

To select the most appropriate project we review the data on potential project against specific criteria & after evaluation of these projects we decided to work on the problem of prolonged waiting time in vaccination room because it meet the criteria of selecting a project as follow:

- **Chronicity** of the problem as it is a persistent problem
- **Significant** because it has a favorable outcome
- It is of **manageable size** as it can be completed in less than six months
- Improve the **level of competition**
- It has **potential impact** on
  - Retaining customer
  - Attracting new customer
  - Reducing the cost of poor quality
  - Enhancing employee & customer satisfaction.

▲▲▲  B) Prepare problem statement & goals

► The problem
Waiting time before entering vaccination room is too long (average 25.4 minute) between 21st of March to 21st of
April 2012 which lead to external customer dissatisfaction and internal customer pressure.

► **The goal** is to reduce average waiting time in the vaccination room to meet customer expectations which is 10 minutes.

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**PROJECT TEAM CHARTER**

1- **Problem statement**

Waiting time before entering the vaccination room is too long (average 25.4 minute) between 21\textsuperscript{st} of March to 21\textsuperscript{st} of April 2012 which lead to external customer dissatisfaction and internal customer pressure.

2- **Business case**

About 30 children are vaccinated daily. The delay in vaccination negatively affects the customers satisfaction, organizational reputation in the catchment area of the PHCC, disciplinary actions from higher authorities in response to customer complaints and puts more pressure on internal customers.

3- **Goal statement**
to reduce average waiting time in the vaccination room to meet customer expectations which is 10 minutes.

4-Project scope

The process starts by the parent ordering his child’s family health record & end by the child entering the vaccination room.

5- Select team

Sponsor  (PHCC director)
Green belt [Quality professional Dr Mohamed Adel Elfaiomy]
Green belt [Quality professional dr Ayatullah Amr Shabana]
Team member [medical supervisor]
"   "   [general practitioner]
"   "   [head of nurse]
"   "   [vaccination nurse]
"   "   [medical record clerk]
“   “   [well baby clinic nurse]

6-Project plan

Define phase  10/3/2012 to 10/4/2012
Measure phase  11/4/2012 to 30/4/2012
Analyze phase  01/5/2012 to 9/5/2012
Improve phase  10/5/2012 to 23/6/2012
Voice of customers:

- **4 focus groups** were done with 57 parents from the 60 surveyed cases to estimate the upper specification limit for the process, and the mean of customer's requirements was 10 minutes.

- **An AD HOC team** was formed from all the process owners to estimate the minimal time for the process using the above mentioned flow chart, and it was 5 minutes, which we the team considered as the lower specification limit.

**CTQs**

<table>
<thead>
<tr>
<th>Customer needs</th>
<th>Drivers</th>
<th>CTQs</th>
<th>Internal metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least waiting time</td>
<td>Least cycle time in vital signs room</td>
<td>Standard procedures for pre vaccination process</td>
<td>Time for pre vaccination process</td>
</tr>
<tr>
<td></td>
<td>Least cycle time in examination room</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Least cycle time in vaccination process</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SIPOC ANALYSIS AND MAP

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Inputs</th>
<th>Process</th>
<th>Outputs</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health record clerk.</td>
<td>Human resources.</td>
<td><strong>Process description:</strong> The procedure since the child reaches the primary healthcare center until he’s called by the nurse for vaccination.</td>
<td>standardized process for receiving child for vaccination</td>
<td>Parents and child.</td>
</tr>
<tr>
<td>Vaccination room nurse.</td>
<td>Equipments</td>
<td>Process map: High level process map</td>
<td></td>
<td>Health record clerk.</td>
</tr>
<tr>
<td>Pediatrician</td>
<td>Materials.</td>
<td>The parent orders the child family health record</td>
<td></td>
<td>Vaccination nurse.</td>
</tr>
<tr>
<td>Porters.</td>
<td>family health records.</td>
<td>The parents &amp; child go to the waiting area</td>
<td></td>
<td>Pediatrician.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The porter takes the file to the well baby room</td>
<td></td>
<td>porters.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The well baby nurse calls the child name</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The well baby nurse takes the vital signs of the child</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The parents &amp; child go to the waiting area</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The pediatrician examines the child for fitness for vaccination</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The parents &amp; the child go to the waiting area</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The vaccination nurse calls the child for vaccination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2-Measure phase

The measure step identifies the symptom of the problem & establishes base line measurement of current and recent performance. It also maps the process that is producing the problem in order to understand how the current process actually operates.

High level flow chart of the current process
# Data collection plan:

<table>
<thead>
<tr>
<th>variable</th>
<th>operational defenition</th>
<th>data source</th>
<th>data collection method</th>
<th>who will collect data</th>
<th>when data will be collected</th>
</tr>
</thead>
</table>
| waiting time in file room       | it starts since the parent ask for his child's medical record till the file reaches the well baby room | waiting time data collection sheet                                           | the medical record clerk register the time when the parent ask for the file and record it in the collection sheet  
the vaccination nurse record the time when the child enters the room and before he takes the vaccination  
the nurse supervisor collect the data from data collection sheet                                         | nurse supervisor      | between 21 march and 28 march                              |
| waiting time in well baby room  | it starts since the file reach the room till the child name is called in well baby room | waiting time data collection sheet                                           | the medical record clerk register the time when the parent ask for the file and record it in the collection sheet  
the vaccination nurse record the time when the child enters the room and before he takes the vaccination  
the nurse supervisor collect the data from data collection sheet                                         | nurse supervisor      | between 21 march and 28 march                              |
| waiting time in pediatric clinic | it starts since the file reach the room till the child name is called in pediatric clinic | waiting time data collection sheet                                           | the medical record clerk register the time when the parent ask for the file and record it in the collection sheet  
the vaccination nurse record the time when the child enters the room and before he takes the vaccination  
the nurse supervisor collect the data from data collection sheet                                         | nurse supervisor      | between 21 march and 28 march                              |
<table>
<thead>
<tr>
<th>waiting time in vaccination room</th>
<th>it starts since the file reach the room till the child name is called in vaccination room</th>
<th>waiting time data collection sheet</th>
<th>the medical record clerk register the time when the parent ask for the file and record it in the collection sheet the vaccination nurse record the time when the child enters the room and before he takes the vaccination the nurse supervisor collect the data from data collection sheet</th>
<th>nurse supervisor</th>
<th>between 21 march and 28 march</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of staff working in each room</td>
<td>staff actually working in every room involved in the process</td>
<td>staff checksheet</td>
<td>number of staff actually working in each room is collected by the nurse supervisor</td>
<td>nurse supervisor</td>
<td>between 21 march and 28 march</td>
</tr>
</tbody>
</table>
Step 3 Analyze phase

*Analyze phase seeks to discover root causes of the major contributors to the problem. Theories are generated by mean of brainstorming; the list of theories is organized by mean of cause-effect diagram so the team can discern the specific theories of root causes. Finally, theories of root causes are tested and causes are identified.

Test theory:
After gathering data about phases of waiting time the team used Scatter diagram to find the cause of prolonged waiting time through correlation

So we have four theories to test using scatter diagram:-
1. The delay because of waiting at file room
2. The delay because of waiting at well baby room
3. The delay because of waiting at pediatrician room
4. The delay because of waiting at vaccination room
Correlations: file waiting time; total waiting time by minutes

Pearson correlation of file waiting time and total waiting time by minutes = 0.712
Correlations: well baby waiting time; total waiting time by minutes

Pearson correlation of well baby waiting time and total waiting time by minutes = 0.891

[Scatterplot of total waiting time by minutes vs well baby waiting time]
Correlations: pediatrician waiting time; total waiting time by minutes

Pearson correlation of pediatrician waiting time and total waiting time by minutes = 0.668
Correlations: vaccination room waiting time; total waiting time by minutes

Pearson correlation of vaccination room waiting time and total waiting time by minutes = 0.725

And from the above graphs we found positive correlation between increased total waiting time and waiting time in well baby room

**At the end of analysis phase:**

We found that the highest correlation was at the phase of waiting at well baby room
Step 4 Improvement phase

1- choose remedy.

the team sit together after analyze phase and by brainstorming the team agreed upon a remedy which is:

** redesigning the process of pre vaccination to be in one room only to avoid waiting time between steps**

2- Design remedy.

After the team reviewed the goals and determined the required resources from people-money-time-material, the team decided the following remedy:-

"Using lean technique to make the whole process done in one room."

So we will calculate and sum the area of the three rooms and transfer the whole process to the vaccination room after arranging it using lean technique, so that the parent and child will only wait one time before getting the service.

The team defines a tree diagram to identify the role of each member in the new project.
The tree diagram

New strategy for pre vaccination process

- Calculate the area of the 3 rooms
  - task
  - who: Nurse supervisor
  - when: end date 10 may

- Choose room for the whole process
  - task
  - who: medical director
  - when: end date 17 may

- Deploy equipment and desks in the new room
  - task
  - who: supporting services
  - when: end date 24 may

- Arrange room using 55
  - task
  - who: vaccination room nurse, well baby nurse, quality professional
  - when: end date 30 may
3- Prove effectiveness:

Before an improvement is finally adopted, it must be proven effective under operating condition. A pilot test is designed to start working in the new room for 1 week from 9th of May 2012 to 16th of May 2012 and calculating waiting time in this period.

![I Chart of well baby waiting time](image)

This control chart showing waiting time before well baby room (the red X) before applying the remedy.
This is the control chart showing waiting times before applying the remedy showing:

1. 53 out of 60 observations are above the upper specification limit which is 10 minutes according to VOC, with percentage = 88.3%.
2. The mean is 25.42
This is the control chart showing waiting times after applying the remedy showing:

1. All observations are within the specification limits.
2. The mean is 7.55

**5- Implementation**

After the one week pilot and calculating waiting time and according to the improvement proven by the control chart we decided to implement this remedy using the attached tree diagram
New strategy for pre vaccination process

- **Task:** Calculate the area of the 3 rooms
  - **Who:** Nurse supervisor
  - **When:** End date 10 May

- **Task:** Choose room for the whole process
  - **Who:** Medical director
  - **When:** End date 17 May

- **Task:** Deploy equipment and desks in the new room
  - **Who:** Supporting services
  - **When:** End date 24 May

- **Task:** Arrange room using 5S
  - **Who:** Vaccination room nurse, Well baby nurse, Quality professional
  - **When:** End date 30 May

- **Task:** Make new flow chart
  - **Who:** Team members
  - **When:** End date 2 June

- **Task:** Train personnel on new process
  - **Who:** Medical director
  - **When:** End date 9 June

- **Task:** Start pilot
  - **Who:** Medical director
  - **When:** From 9 June to 16 June

- **Task:** Calculate waiting time
  - **Who:** Nurse supervisor
  - **When:** From 9 to 16 June

- **Task:** Implement
  - **Who:** Team members
  - **When:** From 23 June 2012
Step 5 Control

Implementation 3 activities for control:
1- Design effective quality controls.
2- Foolproof the improvement.
3- Audit the controls.

A) Design control

To ensure that the breakthrough is maintained, the quality improvement team needs to develop effective quality control by feedback loop.

- Measure actual performance
- Compare to specifications
- Customer specifications (upper and lower control limits)
- Regulate process

Flowchart:

- Ok
- Not ok
To build a feedback loop, the team will need to

1- Measure the end results or the outcome of the improved process must be measured to be between upper and lower specification limits (5 min and 10 min) by random samples taken every week using the following data collection plan.

<table>
<thead>
<tr>
<th>variable</th>
<th>operational definition</th>
<th>sample size</th>
<th>data source</th>
<th>data collection method</th>
<th>who will collect data</th>
<th>when data will be collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>waiting time before vaccination</td>
<td>it starts since the parent ask for his child's medical record till the child name is called in vaccination room</td>
<td>5% of cases in the week</td>
<td>waiting time data collection sheet</td>
<td>the medical record clerk register the time when the parent ask for the file and record it in the collection sheet</td>
<td>nurse supervisor</td>
<td>Starting from 23 June 2012</td>
</tr>
<tr>
<td>Waiting time in vaccination room</td>
<td>It starts from entry of child till he is out</td>
<td>5% of cases in the week</td>
<td>Vaccination room register</td>
<td>the vaccination nurse record the time when the child enters the room and before he takes the vaccination the nurse supervisor collect the data from data collection sheet</td>
<td>Room nurse</td>
<td>Starting from 23 June 2012</td>
</tr>
</tbody>
</table>

The act of comparing actual performance to specifications will be the role of quality professional:-

- plotting the actual performance on control chart
- monitor the chart for trends and pattern and special causes
• decide with the team what is the corrective action that will be taken to control the process according to control plan:

<table>
<thead>
<tr>
<th>Control variable</th>
<th>How measured</th>
<th>Where measured</th>
<th>Upper and lower control limits</th>
<th>Who analyze</th>
<th>Who acts</th>
<th>What done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting time for pre vaccination process</td>
<td>since the parent ask for his child's medical record till the child name is called in vaccination room</td>
<td>Files room Vaccination room</td>
<td>Between 5 min and 10 min</td>
<td>Quality professional</td>
<td>Team leader</td>
<td>5 why technique to know the reason for variation Team meeting to suggest error proof solution</td>
</tr>
<tr>
<td>Waiting time in vaccination room</td>
<td>Since the child enters the room till he leaves</td>
<td>Vaccination room</td>
<td>Less than 10 min.</td>
<td>Quality professional</td>
<td>Team leader</td>
<td>5 why technique to know the reason for variation Team meeting to suggest error proof solution</td>
</tr>
</tbody>
</table>

**B) Audit the control**

- Routine reporting of result is maintained
- Clear documentation of control is done