Paediatric respiratory isolation: A challenge for a secondary care hospital! A service innovation project

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Abstract

Objective: The aim of this project was to broaden the secondary care hospital's scope of services and provide safe, effective and quality care for the patient presenting with measles.

Methods: Six Sigma DMAIC [define measure, analyze, improve, and control (DMAIC)] methodology was used in this quality improvement project. The quality project was started in October 2015 using a Gantt chart quality tool.

Results: The paediatric team with the support of administration of the hospital has established isolation rooms and devised a policy for the care and management of patient with airborne infection to avoid cross transmission. During six months period after establishment of isolation room there were sixty two suspected or confirmed measles cases who were admitted in our hospital, out of them only 4(6.4%) of patients were referred because of their sick condition and need of ventilator support. Further, the percentage of patient's satisfaction level also improved from 60 to 80%.

Conclusion: After this clinical service innovation, there was significant reduction in referrals of measles patients to another hospital and consequently there was an increase in the patient's satisfaction.

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Introduction

Problem

Measles (rubeola) is a communicable viral illness which significantly contributes to under- five child mortality across the globe.[1] Measles spreads rapidly amongst children who have not had the disease and amongst those who have not been immunized against measles.[2] Measles is transmitted through airborne transmission, aerosolized droplet nuclei has been documented in closed areas (e.g., examination room) for up to 2 hours after a person with measles occupied the area.[3] The Centers for Disease Control (CDC) clinical case definition of measles is an illness with a generalized maculopapular rash for 2- 3 days; fever, with temperature 38.3°C and at least one of the following: cough, coryza, or conjunctivitis.[4] Measles can cause severe complications, including pneumonia, severe diarrhea, blindness, encephalitis, and ear infection. Infectious period is three days before and 4-6 days after appearance of rash.[5] Early and effective case management is critical in reducing measles mortality and morbidity. Severe complications from measles can be avoided through supportive care that ensures good nutrition and adequate fluid intake. Case management depends on the severity of disease; all children with severe complicated measles should be admitted in hospital in an isolation room to prevent nosocomial spread of infection.

Aga khan hospital for women (AKHW), Garden campus is a secondary care hospital for maternal and child health affiliated with Aga Khan University Hospital, Karachi, Pakistan (AKUH), caters to a class of patients that belong to the lower and middle class social strata. It is a forty bedded hospital with six bedded urgent care service room (UCS), seven bedded Pediatric general ward and nine private rooms for both pediatric and obstetric population, unfortunately there are not any negative pressure room facility that caters patients requiring airborne transmission based precautions. During the 2015 measles outbreak in Karachi, AKHW had received a high influx of patients with suspected and confirmed measles cases, but due to unavailability of isolation room all patients with measles were referred to other hospitals, which constitute 100% of measles referral rate. Moreover as a result of referral cases of measles, AKHW had received lots of negative feedback from the community, such as "being integrated with AKUH, why Aga khan hospital

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garden campus does not have this critical facility?" Thus, these negative feedbacks and referral eventually result in loss of significant number of patients. Based on analysis of community feedback and urgent need of isolation for complicated measles cases, our team decided to initiate new clinical service in response to public expectations on an economically viable and sustainable basis to cater these patients, give them easy accessibility of care and reduce referral rate because of measles.

Background

Measles is the leading cause of vaccine-preventable childhood deaths, with the greatest mortality in regions with limited primary health care services.[6] Even though clinically safe, economical and effective vaccine has been available for the last four decades (costs less than 1 US$),[7,8] measles is responsible for more than 100000 deaths each year.[9] Pakistan is a middle income developing country that has an estimated national population of 162 million with 31.36% are children (0 to 14 years).[10] Pakistan comes under the category of the poor control measles country because of its continued regular large outbreaks.[11] In Pakistan every 1,000 children who suffered from measles, 1or 2 of them die.[12] In Pakistan; Measles vaccine is administered to target population under the umbrella of Expanded Program of Immunization (EPI).[8] Although initiatives have been taken to improve the frequency of measles immunization through supplementary immunization campaigns reflected by the WHO figures (measles immunization coverage in Pakistan 59% in 2002 and 83% in 2013).[13] Despite the improvement in the statistics of vaccine coverage, Pakistan suffered by measles epidemics that have claimed the lives of many young children.[14] In 2013 epidemic, 40,000 cases and 700 deaths were documented by WHO.[14] In 2017 epidemic, 3190 confirmed cases of measles with annual measles incidence were 33.09 per 1'000'000 total population have been reported.[15] Every year 2.1 million Pakistani children suffered from measles with 19000 - 20000 developed Measles related complications.[8] Every day in Karachi, Pakistan 58 children died because of measles associated case fatality.[8] Malnutrition, floating populations, low vaccine efficacy due to cold chain related issues, poor coverage, limited intensive care health facilities to manage complicated measles cases are the fundamental causes of high rates of measles related morbidity and mortality in Pakistan.[8] Strengthening of routine immunization system in terms of high vaccine coverage (> 80 - 90%), cold chain maintenance with good surveillance, two-dose vaccine strategy[8] along with proper management of measles cases (Isolation, intensive care) are the crucial steps towards reducing measles related morbidity and mortality.

Keeping in view the aggressiveness and contagiousness of measles in Pakistan with related complications and long term sequelae for instance, subacute sclerosing panencephalitis (SSPE), we have undertaken present quality project that is based on provision of quality and safe care to these patients.

Measurements

Widespread community outbreaks of measles, result in high influx of patient with measles in hospitals where over-crowding and breach in infection control practices leads to nosocomial spread. As our hospital did not have isolation area or separate triage for these patients, there was a potential risk to expose other patients and visitors, so these patients were referred to another hospital for proper management and minimize risk of spread within the hospital. Before starting on this project we collected data of referral patients due to measles during the outbreak of measles in the year 2015, to gain a "snapshot" of the problem. From these baseline figures we identified that during 2015, we have received around sixty patients with the suspicious or confirmed cases of measles and all these patients were referred to another hospital due to unavailability of isolation room facilities, which resulted in 100% referral rate of measles cases. Furthermore, owing to referral, hospital also received parent's negative feedback.

Measles is airborne infection and patients with measles require isolation. AKHW is a secondary care hospital with limited resources. Stakes holders of the hospital had the perception that isolation facility required lots of resources and budget. However, literature supports that it can be doable by innovative strategy within limited resources in order to provide accessible quality care for population requiring transmission based precautions.[16]

The aim of our project was to initiate new clinical service in response to public expectations on an economically viable and sustainable basis, we planned to establish isolation room to cater these patients and provide them with easy accessibility for proper care and reduce referral cases due to measles.

Design and Strategy

A multidisciplinary team comprising a team leader who was paediatric consultant and other members included administrator, head nurse, infection control team and quality officer were involved in this project. Prior to the commencement of the project, baseline measurement was carried out between November and December 2015, during which referral cases of measles were collected.

Based on the results of the baseline measurement and in accordance with stakeholders a Six Sigma methodology was applied. The choice of Six Sigma methodology was based on the significant patients feedback and limited resources.[17]

Method

Six Sigma [define measure, analyze, improve, and control (DMAIC)] improvement project was implemented on intervention room. Moreover, several quality tools were executed to rectify the problem for instance, Gantt chart and Pareto analysis.[18] For successful and timely completion of this project a Gantt chart was developed to make sure everything progresses as it should. Figure-1 showed a Gantt chart which illustrates the start and finish dates of the terminal elements of a project. The Pareto analysis, quality tool was used for the selection of a limited number of tasks that produce a significant overall effect. Pareto analysis highlighted that to provide safe care to measles patient, the first priority was to establish a negative isolation room. During the outbreak of measles, there was a high influx of patients with measles in the hospital, which motivated us about the need to develop a new clinical area of service in the hospital, so the quality project improvement team chose to focus efforts in this area to cater measles patients to provide them with proper and adequate management.

◆ Define phase

The problem and goal were defined. The primary goal was to provide an area of care for a patient with an airborne infectious disease like measles as per WHO based guidelines[19] without further transmission within the hospital setting (other patients, employees, visitors etc.) in order to reduce referral rate of patients due to measles. Another goal was to improve patient satisfaction by providing safe and quality care of measles patient and minimize referral of measles cases.

It was identified that we had a misperception about clinical service scopes and we did not have the credential to cater patients with measles, although this was not mentioned in pediatric admission policy, whether to entertain the patients measles, second we did not have space for the placement of patients with measles and there were no guidelines how to protect health care providers and visitors from exposure to measles.

Measure phase

Process measure

Every week meeting was conducted in which all members participated, and during meeting following steps were discussed.

◆ Evaluation of the system that already exists.

◆ Scopes of clinical service to admit these patients were clarified.

◆ Review the process to provide proper placement for these patients by establishing an airborne infection isolation rooms (AIIR).

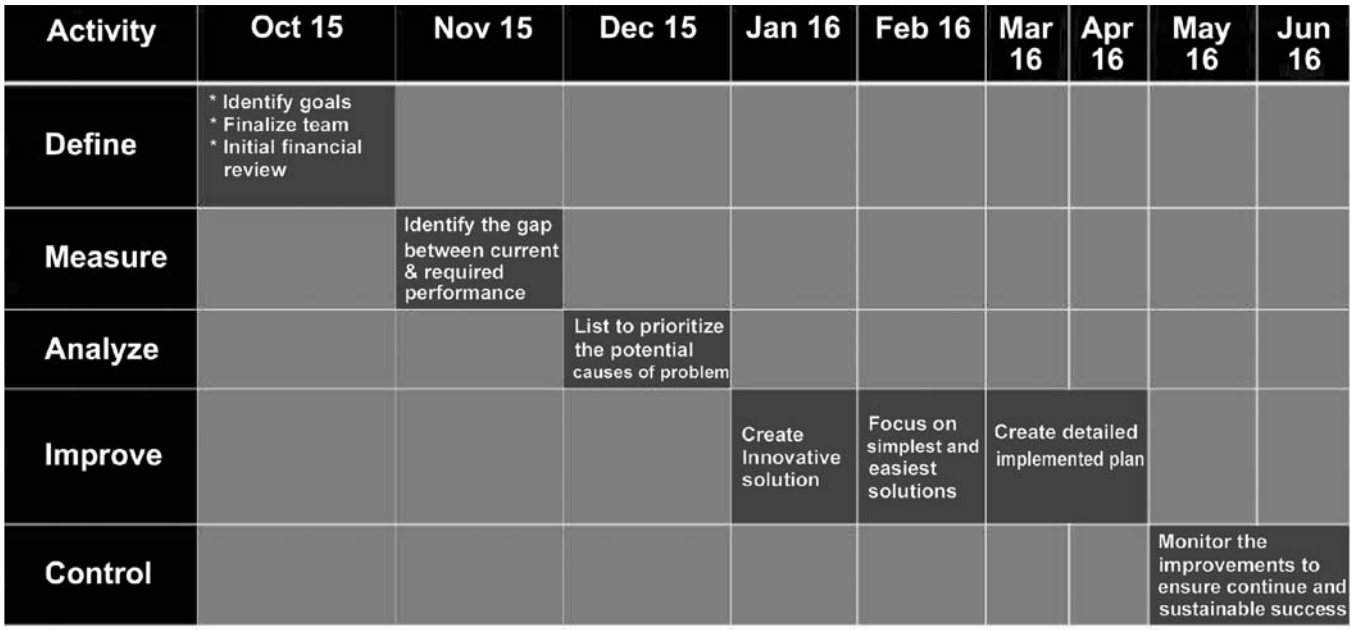

Figure-1: Gantt chart. quality tool for project on Measles started in 2015.

◆ Various strategies, how to design an isolation room with limited resources

Outcome measure

To evaluate the impact of establishment of isolation room, we obtained data from the hospital database of referral patients due to measles during the outbreak of measles in the year preceding the implementation of this project and compared it with the referral cases during the first six months after implementation of the project.

Balance measure

Using patient satisfaction survey, we surveyed patients about their perception of this new clinical innovation, how much this facility helps to reduce referral of measles patients and their satisfaction regarding our services. This survey was conducted six months after initiation of isolation facility.

Analyze phase

Project team members followed up with further analysis (the "analyze" phase) to understand other factors that contributed to accomplishment of goals of the project. During the analyze phase team developed a list of variables and clarified how changes in variables could help to succeed the objective of the project. The project team compiled data and created a Pareto chart to analyze the reasons for why our hospital was not admitting patients with measles. The Pareto analysis helped to determine which reason occurred most frequently. Figure-2 showed vital fews of Pareto analysis.

The most important reason was unavailability of airborne isolation room, to design the isolation room there were some essential ventilation prerequisites required like dilution ventilation to reduce contagion inside the room, filtration to remove contagion outside the ventilated facility and pressure management (negative pressure as above to minimize leakage of infected air to other cleaner areas). By analyzing and learning more about these factors the team was able to develop process changes and then test the effectiveness of the improvements.

Improve phase

Improving phase was performed by eliminating factors identified during analyze phase. Designing an isolation room in poor resource setting was very challenging, especially where the heating, ventilation and air conditioning (HVAC) system was not installed. In these circumstances following strategies may be employed while monitoring for efficiency.

Natural ventilation has been proven as an effective method of removing airborne contagion.[20] Natural ventilation can be incorporated into hospital buildings without HVAC to achieve dilution of airborne infectious agents either at the design stage or changes can be made later as per requirement. Furthermore, in naturally ventilated room filtration of air is not required, because infectious agent is directly discharged into outer air;

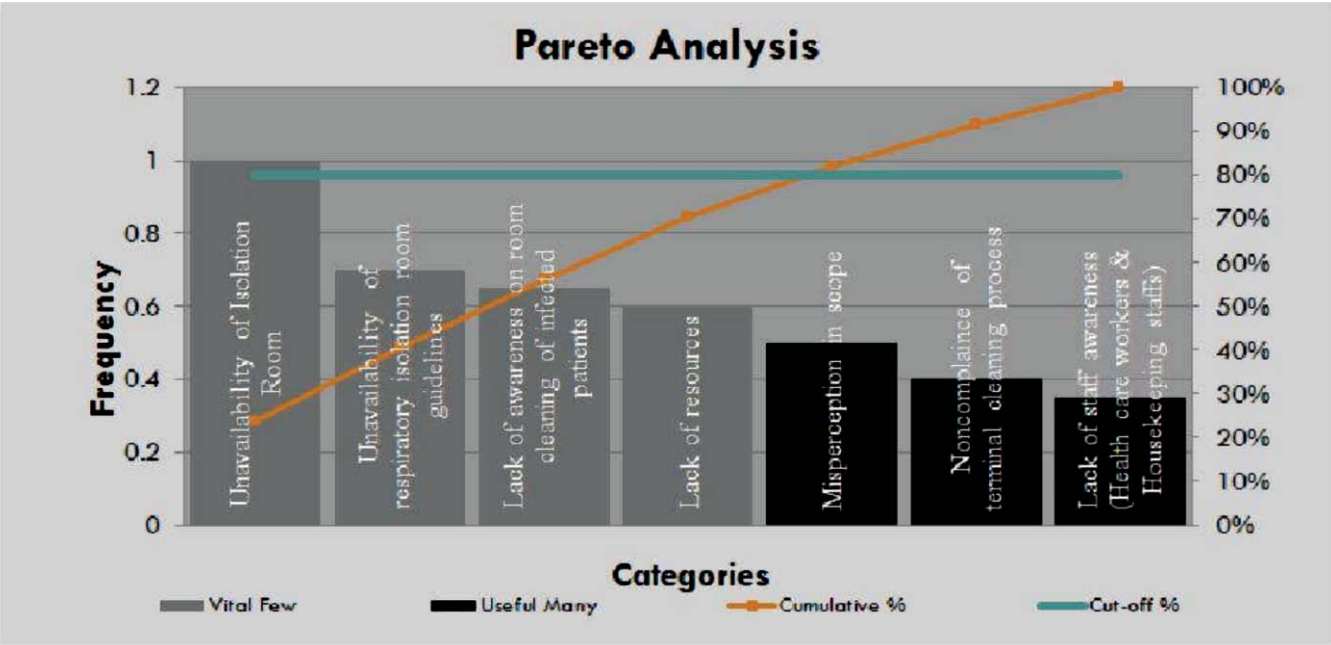

Figure-2: Pareto analysis.

however, open windows designed to achieve dilution must face a cordoned-off area with no traffic to minimize contamination. Unidirectional airflow (i.e., Air moves from the patient room to the outside) is also needed to dilute the infectious particles in the environment. This may be achieved by combining the natural ventilation mode with exhaust fans (the hybrid model) with the aim of facilitating air flow direction from patient room to the outside. Negative pressure may also be achieved through this model.[1] The team has discussed this approach with the infection control team. Aga Khan University Hospital infection control (IC) policy also recommended this approach, if Airborne Infaction Isolation Room (AIIR) rooms are not available, the patient may be placed in a room with the open window with air-conditioner switched off and use of an exhaust fan in the window. (Make sure that the exhaust window should not face visitor/play area).

So we implemented this protocol in two of our private rooms to cater measles patients with air borne precautions. This was our first step, the next step was to make hospital staff aware of this facility and to improve their knowledge and practices in order to prevent nosocomial measles outbreak, which was done by designing and displaying of airborne isolation precaution flyers on different areas of hospital, training of health care worker (HCW), housekeeping and food serving staff through different sessions. A separate isolation trolley was designed in which N95mask, gloves, gown and purell were available. To reduce measles spread in hospital following measures were taken, the appropriate triage area was designated for assessment of suspected and confirmed measles cases, HCW was trained to keep a high index of suspicion in outbreak situations, expedited isolation process for patient with suspected measles and process for efficient transfer to an isolation room to decrease risk of spread in hospital.

After the establishment of isolation facilities our hospital referral rate due to measles infection decreased dramatically and as a result patient's satisfaction level increased. From the year 2016 we are admitting and providing care to measles patient and till now no nosocomial measles infection has been reported.

Control Phase

For the sustainability of the project and to minimize nosocomial measles infection, following factors were focused.

Early diagnosis of measles, this topic is incorporated in the staff education module, which is taught regularly during their teaching classes, infection control team has developed policy on care and management of paediatric patients with airborne infection and terminal cleaning protocols. Staff awareness sessions on specific guidelines and protocols are conducted on a monthly basis, audit tool is designed to assess practices of HCWs monthly or randomly as the spot check to ensure their best practices, Measles alert stickers are designed to be displayed on Medical Record file of measles patients. Mass Vaccination Process against Measles is initiated to know the measles vaccination status of all staff including housekeeping, food service. After assessing measles vaccination status, those staff who did not receive measles vaccination or did not experience measles during their life, then one dose of measles vaccine will be given to all these staff to prevent them from measles infection.

Non-immunized visitors and infants are at high risk to acquire measles infection, so visitors follow airborne precautions and get immunized against measles. Vaccination messages in the form of clinic flyers are provided to change public attitude in favor of vaccinations. Visitors and attendants of measles patients are advised to use personal protective equipment (PPE). N-95 masks are provided to visitors. Number of visitors per patient is also restricted to prevent spread of measles.

Data of all the patients with measles is collected on a daily basis and government is notified on a monthly basis. We cater patients from lower and middle class community. For this community affordability is also an issue. Keeping this issue in mind patient welfare and Behbud facility is offered to non-affording patients.

Results

Before the start of the project all patients with suspected or confirmed cases were referred to other hospitals for management. Pre and post establishment of isolation room data was collected. After creating isolation room from existing room we were able to isolate all children with diagnosis of measles, during six months period after establishment of isolation room there were sixty two suspected or confirmed measles cases who were admitted in our hospital, out of them only 4 (6.4%) of patients were referred because of their sick condition and need of ventilator support. Figure-3 shows percentage of in-patient cases of measles during January 2016 to June 2016. In addition to reduction in referral cases of measles, the percentage of patient's satisfaction level also improved from 60 to 80%. Improvements were sustained and targets were achieved. Strong and optimal interdepartmental communication was also observed. From the year 2016 we are admitting and providing care to measles patient and till now no cross infection with

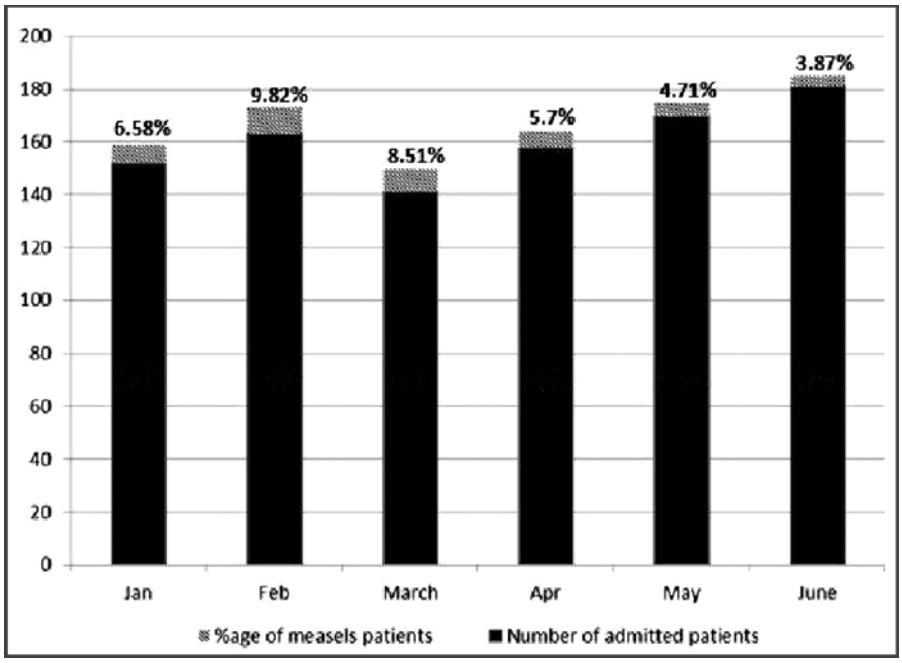

Figure-3: Percentage of patient admitted in hospital with measles during January to June 2016.

measles has been observed in admitted children with other diagnosis.

Limitations and lesson

Our organization has been well involved in continuous improvement initiatives for higher customer satisfaction and lower operational costs. Initially in seeking to start this new clinical service, challenges were encountered in gaining support from hospital administration, particularly due to financial and space constraint, unavailability of isolation room which results in patient's dissatisfaction, and also there was unclear admission policy regarding scope of service. Some team members had particular concerns about the cross transmission of measles infection and whether or not it could potentially be harmful to the other patients. These concerns were addressed by detailed discussions in meetings. Furthermore our hospital did not have enough resources to establish negative isolation room, this agenda was discussed with AKUH infection control team and with their recommendation isolation rooms with bare minimum requirement were designed. AKHW is secondary hospital catering paediatric and obstetric patients and as measles is airborne infection, there is risk of transmission especially pregnant women are at high risk, to minimize this risk we have taken preventive measures as discussed in control phase. Staffs are emphasized for strictly follow airborne precautions by practicing this, we can minimize risk of nosocomial measles infection.

Vaccination is far most important part of prevention of measles infection and as we cannot vaccinate the child during acute illness, therefore at the time of discharge all admitted children who were diagnosed other than measles and found to be partially vaccinated or completely unvaccinated were referred to vaccination centre for catch up immunization which needs to be done later once patient's condition is stable.

Last but not least visitor control is always impossible, for this we have restricted the number of visitors per patient and at specific time with strict recommendation to follow air borne transmission precautions.

Mission of our hospital is to provide safe and quality care to patients. Isolation room was a crucial need for secondary care hospitals but we didn't have it so by process reengineering we accomplished this target and designed isolation rooms for airborne precautions. By doing this project the number of referral patients with measles has decreased, which in turn has increased community trust and patient's satisfaction. Isolation facility at our hospital is cost effective, and is more accessible to community.

Despite these limitations, Six Sigma was experienced as an appropriate, well-designed and effective quality improvement strategy. Improvements were easily selected with the identified causes as starting point. Support of hospital administration in order to create isolation rooms by dedicating two rooms and direct involvement of nursing personnel for instance, strictly follow air born precaution to minimize risk of nosocomial measles infection were key to the success of this project.

Conclusions

DMAIC study helps to reduce referral of measles cases and only those cases were referred who were very sick and required ventilator. This project has successfully convince hospital administration to dedicate two rooms for respiratory isolation for measles patients and has managed to effectively counsel the parents of admitted children other than measles for catch up immunization.

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