Original Research Article

Impact of targeted bundles to reduce the nebulization time gap from prescription to administration among red triaged patients in emergency department: An quality improvement initiative

Running title :

Reducing the nebulization time gap from prescription to administration in Emergency department.

Abstract:

Background: Severe exacerbation of asthma are potentially life-threatening and therefore require prompt care and frequent management. Important elements of early treatment includes recognition of early signs and symptoms of breathing difficulty and timely prescription and administration of therapeutic agents. A subsequent delay in receiving nebulization during an acute exacerbation of asthma can leads to cardiac arrest and even death.

Aim: To reduce the gap in administration of nebulization from its prescription time among red triaged patients by 50% from its baseline.

Setting and design: This interventional study was conducted among red triaged patients in emergency department of tertiary care hospital, India .

Material and Methods: Baseline information was collected during first 4 weeks to find gap in administration of nebulization from its prescription time. Fish bone analysis and process map were laid down to analyse the situation. The intervention using targeted bundles was done via 3 PDSA (PDSA1: indenting the nebulizers, PDSA 2: training of doctors and nurses, PDSA 3; introducing equipment checklist) to reduce the gap . A run chart using time series analysis model was used to compare the pre and post intervention nebulization gap.

Results: Total 74 patients (30 in pre- intervention, 44 in post intervention) admitted in red triaged area were observed for nebulization gap from prescription to administration. Median

time for nebulization gap before intervention was 46.5 minutes which reduced to 15 minutes in post intervention phase.

Conclusion: This bundles of targeted interventions was successful to reduce the nebulization gap.

Key words: nebulization gap, prescription time, administration time

Introduction:

Hospital treatment of acute asthma consists of evaluation, assessment of the need for bronchodilator or steroid therapy and other adjunctive treatments.[1] The European Respiratory Society (ERS) recommends the use of nebulizer to administer a drug to the airways in the form of an aerosolized mist of fine droplets for the management of asthma, chronic obstructive pulmonary disease (COPD) and other chest diseases. [2] As majotity of cases of asthma are treated and discharged from the ED, expediting treatment is important to quality of care. Timely delivery of stat medications in asthma cases is important for high-quality care. A stat medication order should be administered as soon as it is ordered. Many reasons could explain the delay in the administration of urgent medications like time taken to prepare the medication, insufficient staffing, poor communication and lack of prioritization of stat medications. [3] Emergency department (ED) crowding represents an international crisis that may affect the quality and access of health care. Overcrowded EDs cause problems for both hospital patients and staff, such as increased wait times, length of stay (LOS), medical errors, and gap in receiving treatment. The delay in receiving inhalation therapy is unlikely to reverse bronchospasm and asthma may becomes life-threatening thereby patient may need intubation and ventilation, which are associated with high morbidity and mortality. A gap of nebulization over 1 h create further build up of oedema and mucus plugs.[4] Higher levels of crowding are independently associated with delay to order stat treatment for asthma patients. The study had suggested to initiate and implement the protocols for asthma management to reduce the treatment delays. [5]

Rationale for the study: Our institute is a tertiary care referral centre and the Emergency Deparetment (ED) caters to about 450 patients per day. Average 10 -12 patients receive nebulization per day in red triage area (4 red triage area in ED) with 5 common ultrasonic nebulizers for entire emergency ward (red, yellow and green triage area). In baseline data collection of nebulization time, the resercher found the gap of 46.5 minutes from its

prescription time (T1) to administration time (T2). Therefore, this quality initiative was planned under the mentorship of esteemd faculties of emergency department to reduce nebulization time gap from prescription to administrtion and improve the quality of emergency care. Number of studies in Indian scenario have reported the factors responsible for delay in nebulization treatement but there is a paucity of data which relates th**e time gap information from prescription to administrtion o**f nebulization for the treatment of acute respiratory conditions like asthma.

Materials and methods

The study was conducted in red triage area of emergency department in leading tertiary care hospital, India. A multidisciplinary QI team consisting of mentor cum consultant from Department of Emergency Medicine, two senior nursing officers with administrative roles, senior residents, senior Nursing Officer, store in charge and nurse educators was formed to meet the target of decreasing the nebulization time gap. The QI team members were trained using the WHO South- East Asia Regional Office (WHO SEARO) Point of Care QI methodology.[6] The ethical aproval for quality improvement study was granted by Institute ethics committee, AIIMS, Delhi. The QI team members met at least once every 2 weeks and also formed a WhatsApp group to communicate more frequentlyregrding further planning, intervention and evaluation for interventions. The nursing officers who were duty incharge of red triage area collected baseline data for nebulization time gap from prescrition to administration in 4 weeks (16th August to 14th September 2019) with average 6-8 patients per week (N=30 for baseline information) in red triage areas in morning and evening shifts (figure 1). The median time gap from prescription to administration (T1 to T2) was found to be 46.5 minutes (IQR=63 min). The aim of the QI project was framed with a title, "to reduce the median time gap in administration of nebulization from its prescription time among red triaged patients by 50% from its baseline i.e. 22 minutes within next 4 months from October 2019 to Jan 2020 in emergency department."

The team used process flow diagrams and fishbone analysis [6] to identify the bottlenecks of gap in nebulization from its prescription to administration in red triage area. Based on the causes identified in the analysis the team came up with change ideas. The change ideas were tested using the iterative plan–do–study–act cycles (PDSAs). [6] Change ideas were first tried for a short time and on a small scale to learn if they were feasible.

UNDERSTANDING AND ANALYSING PROCESSES OF CARE

The QI team drew a process flowchart (**figure 1**) to study the flow of the nebulization process in red triage area in emergency department. The triage system uses a simple red, yellow and green classification system. **In nebulization process**, once the emergency physician decides the nebulization for patient admitted in red triaged area, he/ she writes the prescription in patient treatment chart (time of prescription is usually missed on patients'charts) and concerned nursing officer is notified for nebulization. If machine is available in red triage area, the nursing officer administer the drug through nebulization. And if, the ultrasonic nebulizer is not available in red triage area then either ward attendant or patient's relative is instructed to search for nebulizer which is the **common reason for gap in treatment**. Because of limited number of nebulizers, common for red, yellow and green triage area, patient has to wait till the machine gets available for use. Moreover post procedure documentation is done by nursing officer but time of administration is usually missed which creates a difficulty of observe the time gaps from prescription to administration.
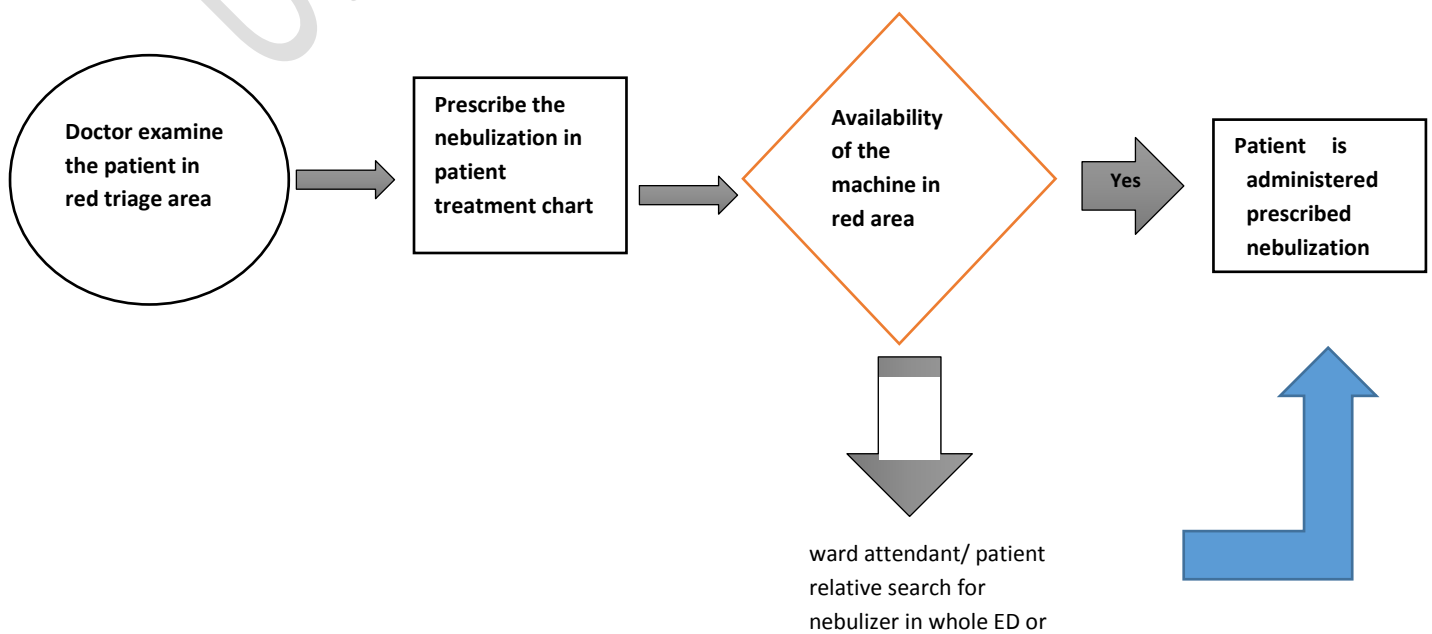
Figure 1:

Doctor examine the patient in red triage area → Prescribe the nebulization in patient treatment chart → Availability of the machine in red area → **Yes** → Patient is administered prescribed nebulization

ward attendant/ patient relative search for nebulizer in whole ED or

Figure 1: Simplified process flow chart of nebulization process in ED

☑ Diamond shape signifies decision making point

☑ Circular shape signifies the staring point of the process

☑ Rectangular shape signifies the steps taken to complete the process

The process flowchart made it clear that to reduce nebulization time gap from prescription to administration there should be an efficient time documentation both by doctors and nurses and availability of separate nebulizers dedicated for red triage units.

The QI team also performed a cause and effect (fishbone) analysis[6] to analyse different problems leading to delays. Fish bone analysis method was used to identify the major bottlenecks which were categorised under four headings— people, place, process and policy (**table 1**). The analysis helped the QI team come up with several change ideas which were tested using PDSA cycles. The major bolttlenecks were mainly; limited number of nebulizer (only 5 for whole ED) , common nebulizers for yellow and red triage area , communication gap between the resident and nursing staff, lack of prioritization of administering nebulization, nurses shortage in red triage areas.

Table 1: Fish bone analysis to identify the gap in nebulization from prescription to administration

People	Place	Process	Policy
No due importance to nebulization than other procedures	No proper designated place to keep nebulization machine with its dedicated trolley	Nebulization is given secondary importance if to be given with other drugs	No equipment manager to take responsibility of handling the nebulizers
No special hospital staff assignment for handling and supervising nebulizer machine	Space constraints to carry nebulizer and its trolley to bed side of patient	Need attendants/ relatives to arrange/ search the machine	No standardized policy for different nebulization machine in red and yellow triage areas.
Communication gap b/w doctors and nurses	Overcrowded red triage area	Equipment failure	
Inadequate nurse patient ratio in red triage area			

MEASUREMENT

The data for nebulization time gap from prescrioption to administration was collected by nursing officers of QI team who had supervision duty in red triage area in emergency department. The staff involved in data collection could collect nebulization time in red triage area only in morning and evening shifts as per convenience of their shift timings. The main challange in data collection was improper **time** documentation for nebulization prescrition

and administration in the begining of the project. To collect the data, T1 was quoted as prescription time of nebulization and T2 as administration time of nebulization. Time was noted down by investigators from patient treatment records which was readily available at patient bedside. In order to standardize and obtain accurate data, stop clocks were made compulsory for noting the time gap.

STRATEGIES

After several discussions, the QI team came up with several change ideas to reduce

the nebulization time gap from prescription to administration using PDSA cycles to test these

change ideas.

PDSA 1 – Indenting the 4 ultrasonic nebulizer and 4 trolleys and setting accountability

In the first change idea, the 4 ultrasonic nebulizer and 4 portable trolleys for these nebulizers were indented especially for red triage units with permission of head of the department of Emergency department. Each trolley and machine was numbered sequentially acc to number of red triage unit. The nursing officer was made accountable for the availaibility of nebulizer at all time in her unit. Data was collected on 6 patients in red triage area in 1st week of October but there problem in tracking nebulization time from prescription to administration due to inadequate time documentation (Time was not mentioned either by doctor for prescription of nebulization or administration time by nurses) which was taken up in next PDSA cycle.

PDSA 2-   Orientation session and sensatization of Doctors and Nursing Officers regarding nebulization time

An orientation session was organised on 10th October 2019 to sensatize the doctors and nurses to document nebulization time both for prescription and administration for all the patients in ED. This session was to understand the problem from different perspectives, motivate the team, get the frontline workers involved and share our vision to reduce nebulization time gap from prescription to administration. The meeting was led by a faculty member in the presence of other senior faculty members who addressed the issues in the department one by one and their possible solutions. With common consensus from the Emergency department staff, a written notice was issued by Head of the department, Emergency department to strictly write the time of nebulization on every patient chart at all

times. The nursing officers were given formal theory class and demonstration about nebulization, working of machine, its importance and nursing responsibilities. Posters were displayed in all red areas to document the time of nebulization on patient's chart by doctors (for prescription) and nurses (for administration). Data was collected from 15 October to end of November 2019 (6 weeks with avg 6 patients/ week) to track nebulization time gap from prescription to administration. Nebulization time documentation for all patients was well documented by doctors for prescription and administartion in this change idea.

PDSA 3 – Introducing equipment checklist and ensuring availability of nebulizers in red area at all times.

With inputs from QI team members, process was futher streamlined by introducing equipment checklist inculding nebulizers in all red triage areas. The nursing officer posted in that red area was accountable for presence of nebulizer and other resuscitative equipments in her assigned unit. This change idea further reduced time gap as nursing officers did not have to search for the nebulizer in other area. Following introduction of checklist, the data was collected in next two weeks in December 2019 with 6 to 8 patients per week.

Statistical method:

The run charts were used to analyse the data. The median was selected as measure of central tendency as median is less susceptible to outlier data. A shift is≥6 consecutive data points on the same side on the median. [7]

RESULTS:

The baseline data showed the nebulization time (N=30 observations) gap from prescrition to administration (T1 to T2) was 46.5 minutes (IQR=63 min) (**Figure 2**).
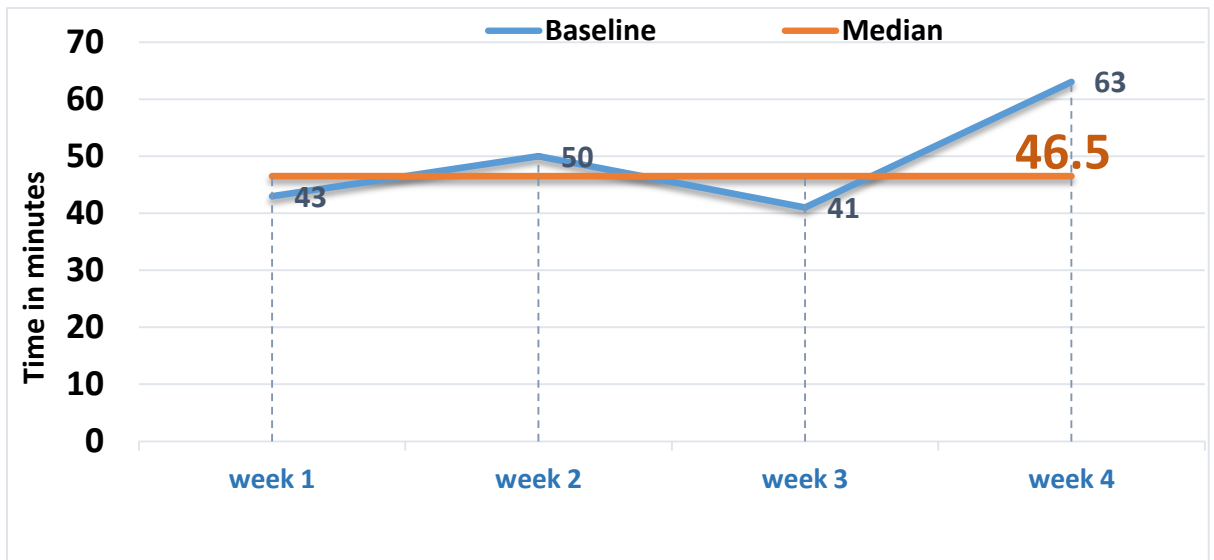
Figure 2: Run chart of baseline average nebulization time gap from prescription to administration (August to september 2019) in red triage unit in ED

☑ Number of observations per week 6-8

With implementation of change ideas, there was a significant reduction in the nebulization gap from prescription to administration (N=44 observations in PDSA1, 2 and 3). After PDSA1,(indents of new nebulizers for red triage area) median time for nebulization (T1 to T2) reduced from baseline of 47 minutes to 25 minutes (IQR=33 min). In PDSA 2 (Orientation session for doctors and nurses) the median time of nebulization from prescription to administration further reduced; median=15 minutes (IQR=20). In PDSA 3, with introduction of equipment checklist, Nebulization time gap (T1 to T2) remained almost same i.e.15 minutes (IQR=20min). With subsequent shift of more than 6 data points after introducing PDSA 1, nebulization time gap from prescription to administration was significantly reduced as shown in following run chart. (**figure 3)**
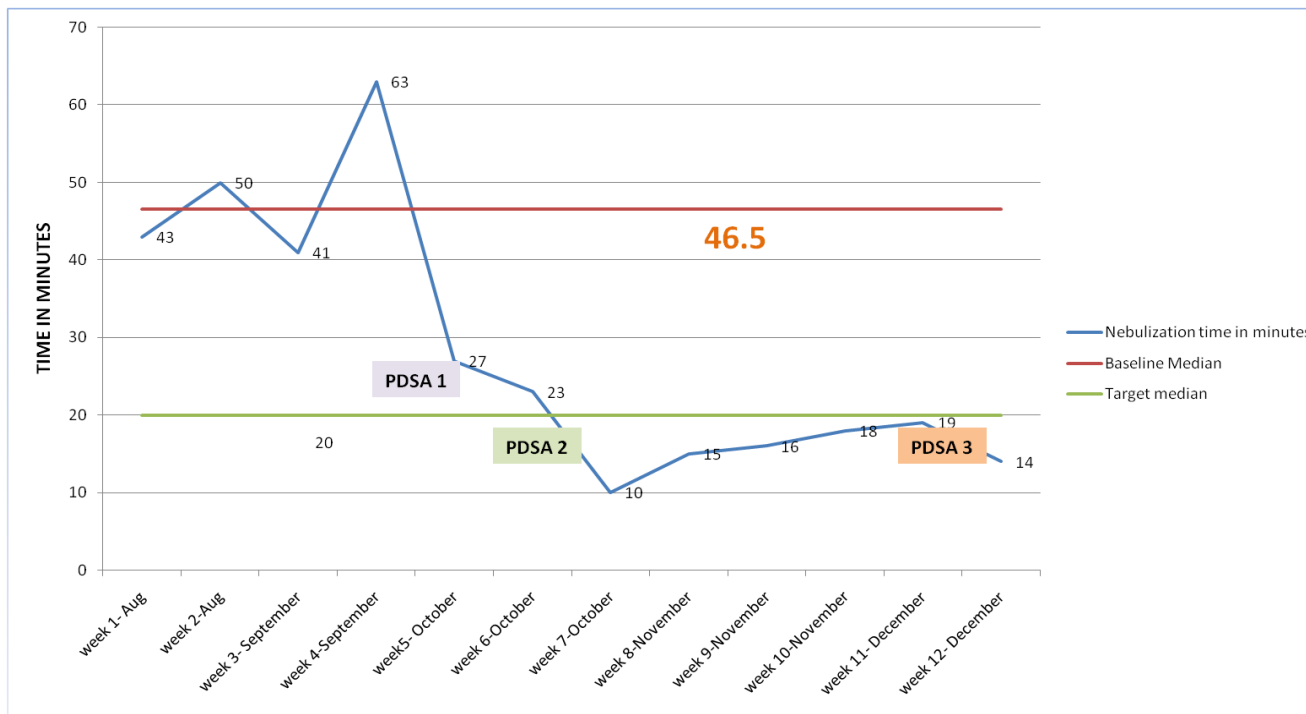
Figure 3: Run chart of average nebulization time gap from prescription to administration in red triage unit with PDSA cycles

*Each data point is the average of 6 to 8 observations collected per week

We collected data for 6 weeks after the PDSA 3 to look for sustainability. The median nebulization time (T1 to T2) was 18 minutes (IQR=21min) which was quite near to set target time.

Discussion:

Nebulization time gap from prescription to administration was reduced to 15 minutes after testing change ides via 3 PDSA and sustained at 18 min with the QI inititive. Though we faced many challenges during the collection of data and implementation of change ideas. The data was collected by a QI team nursing officers on supervision duty. Due to inadequate documentation of time for nebulization, it was found very difficult to track the time from T1 to T2 in the begining of the project. Moreover due to the shift duties the investigators could not collect data in all shifts. Sometimes the supervisory nursing officer responsible for data collection, was posted in red triage area to provide direct patient care. Therefore the data could not be collected for all red triage area patients needs nebulization. A similar study has reported multiple factors like shortage of staff, overcrowed ED and delayed time to order of treatment for asthma patients were responsible for nebulization delay.[5] There was initial resistance among doctors and nurses to document time of nebulization (prescription time by

doctors T1) and (administration time T2 by nurses) so multiple informal sensitization sessions were also conducted to promote time documentation.

QI team members conducted multiple on site-awareness sessions for doctors and nurses in the morning and late evening shifts to reduce nebulization time gap from prescription to adminstration. Another study on training the nurses and implementing nurse-initiated asthma management protocol expedited the relief of symptoms of acute asthma and proved to be beneficial in improving acute asthma care in crowded ED. [8] Introduction of checklist helped further to reduce the nebulization time gap as nurses were accountable for nebulizer presence in their red area at all times. Another quality improvement study in UK introduced checklist realted to all essential equipments in triage area and other elements of care to improve patient safety. The implementation of checklist had significantly improved clinical quality, patient safety and reduced treatment delays.[9]

Testing small cjange ideas by using PDSA cycles, the time gap reduced significatanly from 46.5 min to 15 minutes and sustained at 18 min till next 6weeks observations

Limitations and strength:

The main limitations of this project was inadequate documentation of nebulization prescription time which made time tracking quite difficult for data collection staff. Data collection was done by supervisors/ duty in charge. Measurement timing, frequency and sample size were by convenience of investigators. Due to shortage of staff in red triage area, most of the times data was missed. The data collection was limited to red triage area only.

The strength of the study was constant support and involvement of all QI team members and their inputs. This project led to improvement in documentation for nebulization prescription and administration in ED. Patient safety was promoted by implementing equipment checklist, setting accountability for essential equipment's like portable ventilator, cardiac monitor and nebulizer in each shift.

Implications:

The change ideas in present QI project to reduce nebulization time gap from prescription to administration can used as quality indicator for emergency care. Similar study can be taken up by future reserchers particularly in large public hospitals with heavy patient loads. The new change ideas can be tested as per available resources and team support.

The **lessons learnt** from the project was that team effort is crucial to bring success. Focussing small change ideas in process of care can bring big changes and sustained results. Despite challenges, with the constant motivation and guidance of the mentor and the efforts of QI team members, it was possible to achieve and sustain the aim of reducing nebulization time from prescription to administration gap .

Conclusion: Nebulization time gap reduced from prescription to administration near to target value ie. 15 minutes .

List of abbreviations:

QI: Quality improvement

PDSA: Plan Do Study Act

ED: Emergency department

T1: Prescription time of nebulization

T2: Administration time of nebulization

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