

STREAMLINING SEPSIS CARE IN THE EMERGENCY DEPARTMENT OF A TERTIARY CARE CENTRE IN NORTHERN INDIA-A QUALITY IMPROVEMENT PROJECT

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Abstract

Introduction: Strict adherence to the sepsis bundle especially the early identification, collection of adequate cultures and administration of appropriate antibiotic plays a key role in patient outcome in the Emergency Department(ED). **Aim:** The study was a Quality Improvement (QI) project and the primary objectives were to identify the door to antibiotic time (DTAT) for patients with suspected sepsis and streamlining it to one hour bundle as per surviving sepsis campaign guidelines and to increase the blood culture collection rate by atleast 25-30% in one year. The secondary objective was to identify the factors affecting the blood culture collection in emergency. **Methods:** This study was a prospective observational QI project which was conducted in the ED of a tertiary care centre in Northern India, with an average daily intake of 70-80 patients. It was conducted from September 2021 to August 2022. All adult patients presented to the emergency with suspected sepsis were included, except patients of trauma and cardiac arrest. Data was collected in the pre-intervention phase and subsequently Plan-Do-Study-Act cycles were conducted to improve the deficient parameters. Further they were implemented and assessed in the intervention and post-intervention phases. **Results:** Though it was observed that the antibiotic was administered as per the bundle and there was no significant delay, the culture collection rates were very low. It was almost nil in the pre-intervention phase which improved tremendously to 94% in the post-intervention phase. Introduction of newer protocols, on-site training and awareness and frequent reassessments proved to be a major factor in the improvement of the rates. **Conclusion:** This QI study helped us in identifying a major lacuna in sepsis care in ED. Phase-wise assessments, on-site trainings and frequent reassessments helped us in achieving a target well above the set one.

INTRODUCTION

Sepsis is a life-threatening organ dysfunction caused by dysregulated host response to infection². It was estimated in 2017 that around 11 million deaths due to sepsis was reported³. Surviving sepsis campaign guidelines(SSC) recommend the implementation of 1 hour bundle to reduce mortality .It includes measuring lactate on arrival, obtaining blood cultures before antibiotics, administering broad spectrum antibiotics, administering 30ml/kg crystalloid for hypotension or if lactate >4mmol/L, initiating vasopressors if hypotensive after fluid resuscitation². Sepsis, being a common presentation, antibiotic prescription remains the most frequent decision in emergency department. Lack of a proper antibiotic formulary leads to irrational and injudicious prescription which further adds on to the global burden of emerging antimicrobial resistance. Emergency department being the first point of contact, proper

decision regarding the same and streamlining of sepsis care is most essential. The WHO, Infectious Diseases Society of America (IDSA) and Center for Disease Control (CDC) have declared antibiotic resistance as a 'global public health concern'⁴. India has the highest burden of drug resistant gram positive and gram-negative organisms worldwide⁵.

The emergency department (ED) of our hospital has a daily intake of 60 to 70 patients of which majority presents with fever. Sepsis care is often limited due to shortage of manpower, financial burden and lack of awareness. Hence to improve patient care, a Quality Improvement (QI) initiative is planned in ED, focusing on the one-hour sepsis bundle and antibiotic policy. Early identification of sepsis, prompt management as well as proper rational use of antibiotic is equally important. Administering broad spectrum antibiotic has been associated with emergence of multi drug resistance organisms.

REVIEW OF LITERATURE

Sepsis is defined as life threatening organ dysfunction characterized by dysregulated host response to infection. The third international consensus definition of sepsis emphasizes on host response to infection and the need for urgent recognition. Even a modest degree of organ dysfunction associated with sepsis is associated with an increased in-hospital mortality of 10%. Hence early recognition and prompt initiation of treatment is important. Septic shock is defined as a subset of sepsis in which profound circulatory, cellular, and metabolic abnormalities are associated with a greater risk of mortality. In septic shock, patients will have refractory hypotension requiring vasopressors to maintain mean arterial pressure (MAP) more than 65mm of Hg or lactate more than 2 mmol/Litre. Mortality increases to almost 40% with septic shock.

Clinical Criteria to Identify Patients in Sepsis

A 1991 consensus conference defined sepsis based on the then-prevailing concept that sepsis resulted due to Systemic Inflammatory Response Syndrome (SIRS) of the host to infection⁶. The SIRS criteria (Box-1), was used as the screening tool for sepsis. Two parameters out of the four, if present, was considered as sepsis. In a study by Levy et al in 2003, limitations with these definitions were found, so the list of diagnostic criteria was expanded but no alternatives were given due to the lack of supporting evidence⁷. Since sepsis involves early activation of both pro-inflammatory and anti-inflammatory responses,¹⁶ criteria based on SIRS proved to be less valid since it focused solely on inflammation⁸. The Third international sepsis consensus definition task force put forward a new screening tool to facilitate simple recognition of sepsis especially in the emergency department, the qSOFA(quick Sequential Organ Failure Assessment)(Box-2) since the original SOFA score requires various laboratory investigations and is cumbersome².

| |
|---|
| Box-1 SIRS (Systemic Inflammatory Response Syndrome) criteria |
| Two or more of: 1. Temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ 2. Heart rate $>90/\text{min}$ 3. Respiratory rate $>20/\text{min}$ 4. White blood cell count $>12,000/\text{mm}^3$ or $<4000/\text{mm}^3$ or $>10\%$ immature bands Bone et al ⁶ |

| |
|---|
| Box-2 qSOFA criteria ² |
| Any two of: 1. Respiratory rate $\geq 22/\text{min}$ 2. Altered mental status 3. Systolic blood pressure $<100\text{mm}$ of Hg |

The administration of broad-spectrum antibiotic within one hour of arrival after obtaining blood cultures is the key element of sepsis bundle. But lack of awareness regarding antibiotics lead to irrational prescription contributing to antibiotic resistance. Previous QI initiatives in sepsis patients showed significant improvement in practice after implementation⁹

| Box-3 The 1- hour sepsis bundle ¹ | |
|--|--|
| Bundle element | Grade of recommendation and level of evidence |
| 1. Measure lactate. Re-measure if initial lactate > 2 mmol/L. | Weak recommendation. Low quality of evidence. |
| 2. Obtain blood cultures prior to administration of antibiotics. | Best practice statement. |
| 3. Administer broad-spectrum antibiotics. | Strong recommendation. Moderate quality of evidence. |
| 4. Rapidly administer 30 ml/kg crystalloid for hypotension or lactate ≥ 4 mmol/L. | Strong recommendation. Low quality of evidence. |
| 5. Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ≥ 65 mm Hg. | Strong recommendation. Moderate quality of evidence. |

AIMS AND OBJECTIVES

Primary Objective

1. Identify the door to antibiotic time (DTAT) for patients with suspected sepsis and streamlining it to one hour bundle as per surviving sepsis campaign guidelines.
2. To increase the blood culture collection rate by atleast 25-30%.

Secondary Objective

1. To identify the factors affecting the blood culture collection in emergency.

STUDY DESIGN AND METHODOLOGY

Study design: Prospective observational study

Study setting: The study was conducted in the emergency department of a tertiary care centre in Northern India, (SMS&R, Sharda hospital), with an average daily intake of 60-70 patients.

Inclusion criteria: 1. All adult patients more than 18 years of age presenting to the emergency with fever of more than one day duration.

Exclusion criteria: 1. Age less than 18years

2. Trauma patients

3. Patients presenting in cardiac arrest state

Period of study: September 01 2021 to August 31 2022

All adult patients more than 18 years with suspected sepsis was enrolled for the study. The study was divided into three phases, Pre-intervention, intervention and post-intervention phase.

Pre-intervention phase was from September 01 2021 to December 31 2021. During this phase, data will be collected as per the data collection proforma, including DTAT, blood culture collection, antibiotic administered and 24 hour in hospital mortality. Details are mentioned below.

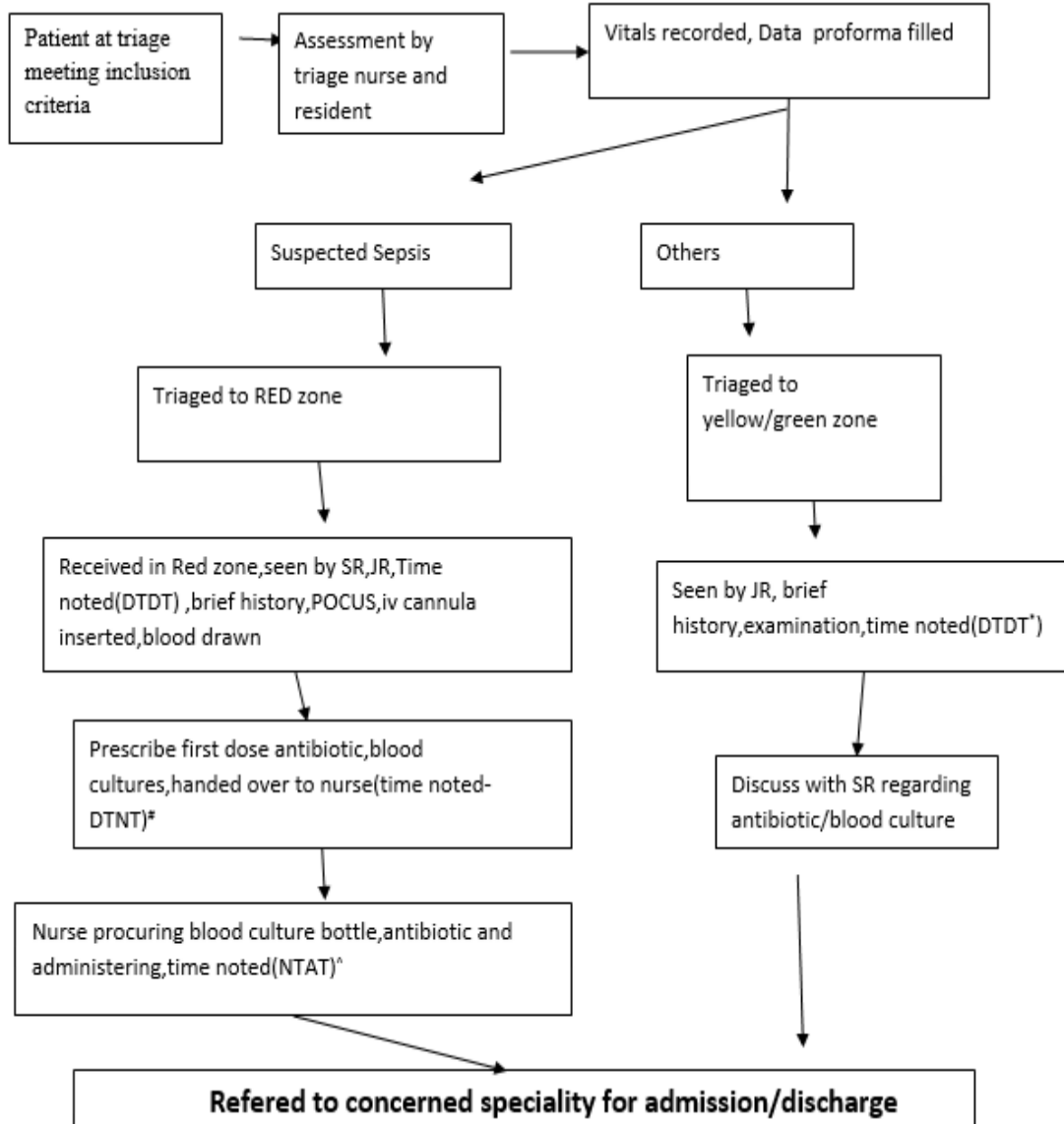
Intervention phase was from January 01 2022 to April 30 2022. There will be 4 Plan-Do-Study-Act (PDSA) cycles.

Post-intervention phase was from May 01 2022 to August 31 2022. . Data will be collected as in pre-intervention phase.

50 patients were included in each phase. We used the four step Point of Care Quality Improvement (POCQI) ¹⁰adapted by WHO South East Asian Regional office containing a facilitator manual and a learning manual⁴. A QI team was formed comprising of two faculty, one senior resident, two junior residents, one nursing supervisor. Baseline data was collected during the pre-intervention phase, possible reasons for the decrease/lack of blood culture collection, DTAT, irrational antibiotic use analyzed, a series of PDSA cycles conducted to test the changes made in intervention phase.

After analyzing the drawbacks, the QI team conducted PDSA cycles to implement the changes. Data collected in Microsoft Excel and analyzed using SPSSv.22. The quantitative data will be depicted in tables and charts.

EMERGENCY DEPARTMENT SEPSIS FLOWCHART



*DTDT-Door To doctor Time, #-DTNT-Doctor to Nurse Time, ^-Nurse To Antibiotic Time

RESULTS

The first PDSA cycle was held on January 3rd. During the pre-intervention phase, it was observed that there was no practice of obtaining blood cultures prior to antibiotic administration. The first PDSA cycle was meant to find out the reasons for the same. It was noticed that the awareness among junior residents and nursing staff was less. Patients of suspected sepsis was fast-tracked triage to red zone hence there was no delay in DTDT or prescription of antibiotics. The main lacunae were lack of awareness regarding the sepsis

guidelines. Hence it was decided to conduct training on triage and sepsis flowchart every Monday morning to all the nursing staff and residents in emergency department. It was found that the training sessions proved beneficial and awareness regarding blood cultures was improved.

One of the major types of feedback noted from the training sessions was non-availability of blood culture bottles most of the times in emergency department. Hence the second PDSA cycle was planned for the same. On further analysis, it was found that the blood culture bottles were issued by the microbiology department only after billing done hence the non-availability. A meeting was called upon with the head of the department of microbiology, laboratory in-charge and the QI team ED on February 2nd. A plan was formulated that as soon as a patient of suspected sepsis comes to the red zone, blood culture bottles will be dispatched from the laboratory without billing once resident calls and confirm the same. This was put into practice from February. Subsequently it was observed that lot of blood culture bottles were wasted since patients went to other hospital due to financial constraints.

The third PDSA cycle started from March 2nd. On-site training and awareness were the key concern. Daily morning 9 am to 9:30am was scheduled for the same. The QI team has observed the following points: blood culture collection technique was not appropriate when done by junior nursing staff, the blood culture bottles were over utilized and later discarded, antibiotics were given only after the relatives purchased from pharmacy and provided. Hence the training of junior staff was strengthened by the senior resident on morning shifts. Video based lectures were provided. It was made mandatory that senior resident would undersign the order of antibiotic and blood culture for every patient and nursing staff would sign it with time after completion. This helped in streamlining the care a lot. Injudicious prescription of antibiotics and over-utilization of blood culture bottles were controlled.

The final PDSA cycle was initiated on March 4th. The team observed that due to the financial constraints, many patients refused for blood cultures and ICU admission. This matter was taken up with the administration team and it was decided that the rate of blood culture investigation would be subsidized with 50% discount and 24-hour admission charges of all patients enrolled in the study would be waived off. This tremendously improved the results. Training and supervision by QI team further strengthened the results.

The intervention phase began from May. QI team met frequently and analyzed the improvement. On-site training, supervision and education kept on regular basis. The blood culture collection rates improved to 94% which was more than our intended target.

Characteristics of study population

| Data | Pre-intervention | Intervention | Post-intervention | Mean |
|-------------------------|------------------|--------------|-------------------|-------|
| Age (years)% | 44 | 46 | 43 | 44.2 |
| M: F | 30:20 | 29:21 | 27:23 | 86:64 |
| Triage category-Red | 90% | 94% | 84% | 80.6% |
| DTDT (min) | 4.7 | 5.7 | 3.9 | 4.8 |
| Blood culture taken (%) | 0 | 50% | 94% | 48% |
| DTAT (min) | 45.6 | 40.7 | 28.4 | 38.2 |

Comorbidities of the study population total (percentage)

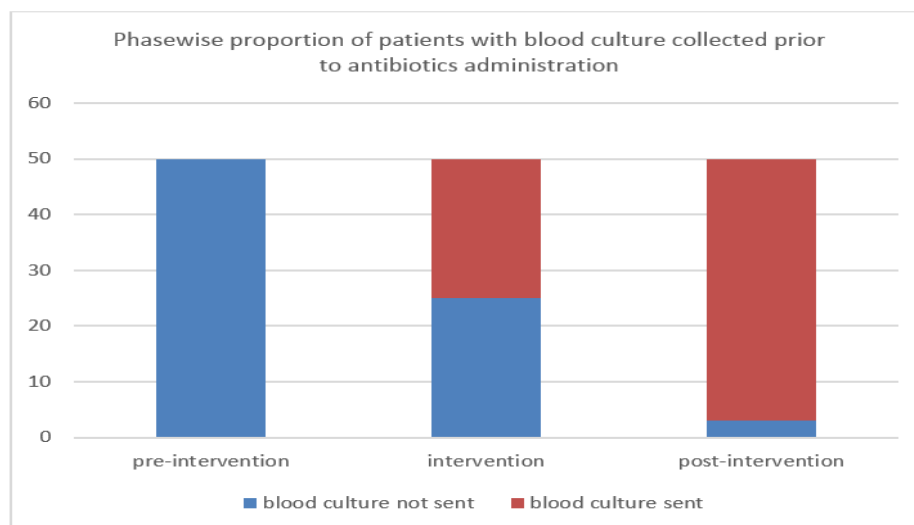
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|--------------|-----------|
| DM | 64(42.7%) |
| Hypertension | 32(21.3) |
| CKD | 14(9.3) |
| CAD | 11(7.3) |
| CLD | 10(6.7) |
| TB | 27(18) |
| Malignancy | 1(0.7) |

Initial vitals on arrival

| Vitals | Abnormal(n=150) | Total mean |
|------------------|-----------------|------------|
| HR>100 | 115 | 109 |
| MAP<65 | 17 | 73 |
| S.I>1 | 87 | 1.1 |
| SPO2<94 | 73 | 91 |
| RBS>140 | 71 | 166 |
| GCS<8 | 8 | 14 |
| RR>22 | 83 | 25 |
| Lac >2 | 140 | 3.7 |
| Temperature >101 | 79 | 100.4(F) |

Initial resuscitation

| | Total patients | Average requirement |
|---------------|----------------|---------------------|
| Oxygen | 89 | 8(Liters/min) |
| Intubation | 29 | 19.3(%) |
| NIV | 12 | 8(%) |
| IVFluid bolus | 90 | 808(millilitres) |
| POCUS | 102 | 68(%) |
| Vasopressors | 56 | 37.3(%) |



This QI project was intended to identify the lacunae in sepsis care in emergency department. It was also observed that the antibiotics were prescribed injudiciously. Through the PDSA cycles the awareness regarding the same was strengthened, frequent training and monitoring was done. An antibiotic formulary was made by the microbiology department which was approved and implemented.

The mean age of the study population was 44 years of which 57% were males. 81% were triaged as Red category on arrival. The average door to doctor time was 4.8 min with the best time observed in post-intervention phase (3.9min). The blood culture collection rate was nil before the study. It was observed that out of 50 samples collected during the pre-intervention phase, no blood cultures were obtained in ED. During the intervention phase this increased to 50% and to 94% in the post-intervention phase. This was more than our intended target.

Another objective of our study was to implement point of care ultrasonography in resuscitation of sepsis. POCUS is a wonderful tool in identifying the source of infection in the ED. The training on using bedside ultrasound was given to all residents as a part of our study and was reinforced. During the pre-intervention phase, POCUS was done on 54% of the study population. The PDSA cycles during the intervention phase further strengthened it and percentage improved to 82% in the intervention phase. The post-intervention phase witnessed 100% implementation of POCUS in the initial resuscitation of sepsis.

The Door to Antibiotic Time (DTAT) was found to be within one hour as per the guidelines before the intervention phase hence our one of the objectives were already in place. We maintained the same and strict policy was implemented to ensure there is no delay in antibiotic delivery. The maximum time observed was 90min for a patient of suspected pneumonia. The delay was due to human error from the nursing side. To avoid any miscommunication, it was instructed that all antibiotics will be given after countersigned by the team leader of the shift and will be started in his/her presence. On random observations, this was found to be in practice successfully.

The average DTAT in pre-intervention phase was 45.6minutes, intervention phase was 40.7minutes and post-intervention phase it even improved to 28.4min. Hence, we ensured that there was no delay in antibiotic administration in sepsis.

On observing the demographics of the study population, we found that the major comorbid condition was diabetes mellitus (DM), affecting 42.7% of the study population. The mean RBS on arrival was 166mg/dl. 21.3% of the population were hypertensive. 9.3% had chronic kidney diseases. 7.3% were having coronary artery diseases. Tuberculosis was another major comorbidity affecting almost 18% of the study population. 6.7% were having liver diseases.

The average heart rate on arrival was 109/minute with 115 patients in tachycardia (HR>100bpm) on presentation in ED. Tachycardia still remains an important component of SIRS and sepsis. 17 patients had a MAP of less than 65mm of Hg, with average on arrival of 73mm Hg. It was observed that tachycardia being more predictive than lower MAP in early detection of sepsis. 87 patients had a higher shock index with average being 1.1. The mean oxygen saturation on arrival was 91%.

Mental status is also an important criterion in sepsis. It was observed that the mean GCS on arrival was 14, 8 patients had very low GCS<8. The mean respiratory rate on arrival was found to be 25/min. Lactate is an important surrogate marker for hypoperfusion and sepsis. It was found that 140 patients enrolled in study had lactate more than 2.0 on arrival in ED. The average lactate was 3.7. Higher lactate and base deficit are poor markers of sepsis. The mean temperature on arrival was found to be 100.4F. 89 patients enrolled in this study needed oxygen on arrival with the mean requirement of 8litres/minute. 29 patients had to be intubated and 12 patients required NIV assistance. 56 patients (37.3%) required vasopressors for fluid refractory shock.

CONCLUSION

Streamlining sepsis care is very important in all critical areas like emergency department and intensive care units since sepsis is a life-threatening condition which needs prompt and appropriate treatment. Our QI project helped us in identifying the deficiencies and correcting them. Obtaining cultures before antibiotics is a very important aspect of the SSC bundle and we targeted on this and improved the rate tremendously. On-site training and spreading awareness helped in maintaining the results.

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DATA COLLECTION PROFORMA

1. Name _____ Age _____ Gender _____
 Date of arrival _____ Time of arrival (triage) - _____ Time seen by doctor- _____

2. Symptoms associated with fever:

3. Comorbidities:

| | | | | | | |
|----|-----|-----|-----|-----|------------|-------------|
| DM | HTn | CAD | CKD | CLD | Malignancy | Hypothyroid |
|----|-----|-----|-----|-----|------------|-------------|

4. Vitals on arrival

| | | |
|-----------------|-----------------------------|------------------|
| Spo2 (%) | RR (per min) | Chest signs |
| HR (per minute) | BP (mm Hg) MAP (mm Hg) | S.I |
| RBS(mg/dl) | GCS/AVPU | Temperature-(°F) |

5. within one hour bundle:

| | | | |
|--|----------------------|---------------------|--------------------------------|
| Shifted to area | Red | Yellow | Green |
| Oxygenation(L/min/NIV/intubated) | | | |
| Initial lactate(mmol/L) | | | |
| IVFluids given | | | |
| Blood cultures taken prior to antibiotics, if not specify reason | Yes/ No | If No,Reason- | |
| First dose antibiotic given within 1 hr of arrival(specify dose and time) | Antibiotic with dose | Time of prescribing | Time of administering by nurse |
| Vasopressors initiated | | | |
| Use of (Point Of Care UltraSound)POCUS | | | Suspected Sepsis- Yes/No |
| Repeat lactate if initial >2mmol/l | | | |
| Relevant labs | Ph | Po2 | Pco2 |
| | Hco3 | Anion Gap | Base Deficit |
| | | | Total count- Platelet- |

6. Suspected source of sepsis (please tick)

| | | |
|-----------|--------------------------------|-------------------------------|
| Pneumonia | Skin and soft tissue infection | Genitourinary tract infection |
| GI sepsis | CNS infection | Others(please specify) |

7. Mortality at 24 hours: Yes/ No

