Point-of-Care Testing in the Overcrowded Emergency Department-Comparison of the Values of Four Essential -STAT- Blood Parameters with Core Laboratory Values

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Abstract: *This prospective preliminary study conducted in the ED of a tertiary care hospital aimed at the comparison of the turnaround times (TAT) and accuracy of the values of four STAT blood parameters-WBC and Platelets counts, haemoglobin and CRP levels obtained by Point of care Testing with Core Laboratory values. Each of the parameter studied has its own importance and impact on the diagnosis, treatment and decision for disposal and the turnaround time of the overcrowded ED flow enabling accommodation and assuring of appropriate timely care for the awaiting ED patients. The TAT of POC Testing is very fast-around five minutes for all the four parameters per sample-compared to around ninety minutes for the same by core laboratory testing. The values obtained by POCT for all the four parameters are with comparable accuracy with that of core laboratory reports. Multi centric study covering larger sample sizes and lot more parameters may throw further light on the quality, accuracy, reliability and application of POCT in many domains of patient care.*

1. "Definitions/Key Terms of categories of tests

STAT Tests: Test results that are urgently needed for the diagnosis or treatment of the patient. The delay can be life threatening. Laboratory Assistants - are responsible for collecting and delivering STAT samples to the laboratory as quickly as possible. STATs are given priority over all other sample collections. CLS (Clinical Laboratory Scientists) - are responsible for analysing STATs as quickly as possible. STATs are given priority over all other tests.

ASAP (As Soon As Possible): Test results that are needed as soon possible for the diagnosis and/or treatment of the patients.

Routine: Tests that are collected and batched for efficiency and cost effectiveness. These results are not needed on an immediate basis for diagnosis or treatment.

2. Introduction

The mounting overcrowding scenarios of EDs all over the world necessitates the need for quick triaging, diagnosis and stabilization of critically ill or injured patients, and prompt and appropriate decision making for early disposition of the ED flow, with limited resources, to attend to/accommodate the long awaiting unattended deserving patients at the earliest to optimise their care and outcome. Any undue delay in attending to the patients would not only jeopardise the patients' outcomes endangering their lives but also can lead to legal implications of negligence, omission and abandonment on the part of the care givers. Ethical and legal bindings warrant the ED physicians to explore and adhere to appropriate means to reduce the ED patients' turnaround time without compromising the quality of patient care. In the recent times, the outbreaks of bystanders' vandalism on the hospital properties and the manhandling of the health care team around the nation have become day to day unpleasant affairs. Solution for all these things lies not only on the knowledge, wisdom and clinical acumen of the ED physicians but also on the quickest availability and access for all essential appropriate STAT investigations and their reports. This only can pave way for the shortening of the turnaround time of ED patients with their appropriate disposal to accommodate the long queues of awaiting ED patients.

TAT (Turnaround Time) – The interval of time between when a sample is received by the laboratory and the results are reported.

TAT for the tests in the clinical Laboratory: STAT – One hour or less from when the sample was received in the laboratory. ASAP/Now – Two hours or less from when the sample was received in the laboratory. Routine – Four hours from when the sample was received or as scheduled for the next run."[1]

Turnaround time remains an active issue that is potential for more improvements in modern healthcare [2].

ER physicians' productivity and satisfaction are also affected by the timely reporting of results of critically important laboratory tests, where these tests can guide physicians to better manage their patients [3].

ER patients' length of stay is highly influenced by the efficiency of 1 Consultant, Medical & Clinical Informatics.[4]

How to shorten the turnaround time:
Despite improvements in analytical testing systems due to automation and machinery innovations, little or no measurable improvements have been demonstrated for the pre-analytical phase of the lab turnaround time [5].

Some studies divided the total testing turnaround cycle into a series of nine steps, where the main two components of the pre-analytical phase of the lab turnaround time is the collection time and the transportation time of the sample [6,7]. Many efforts have been done to address samples' transportation methods, such as the utilization of pneumatic tubes, as well as using system alerts to help nurses' timely draw, the turnaround extended due to noncompliance of nurses to draw samples immediately when requested, in addition to the slow transportation of samples from the ER to the central hospital Lab[7].

Turnaround time remains an active issue that is potential for more improvements in modern healthcare [8].Timeliness is considered an essential quality indicator for laboratory tests where many studies show that it can shorten patients' length of stay in ER [9].

3. Point of Care Testing

Point-of-care testing (POCT), or bedside testing is defined as medical diagnostic testing at or near the point of care—that is, at the time and place of patient car[10]. This contrasts with the historical pattern in which testing was wholly or mostly confined to the medical laboratory, which entailed sending off specimens away from the point of care and then waiting hours or days to learn the results, during which time care must continue without the desired information[11].

The coupling of POCT devices and electronic medical records enable test results to be shared instantly with care providers. The use of mobile devices in the health care setting also enable the health care provider to quickly access patient test results sent from a POCT device.[12]

Nurses training only cannot sustain the improvement in the turnaround time even if initially succeeded in reducing the pre-analytical phase [13]

The performance goals of POCT are
- Provide accurate and timely analyses
- Provide reports that are useful to the clinician treating the patient
- Make epidemiological information available to public health authorities
- Make the best possible use of people, equipment, and reagents in the interests of efficiency
- Manage use[14]

A reduction in morbidity and mortality has been associated with such rapid turnaround times.[15]

Potential operational benefits of POC Testing include more rapid decision making and triage, reduced operating times, high-dependency, postoperative care time, emergency room time, number of outpatient clinic visits, number of hospital beds required, ensuring optimal use of professional time and antimicrobial medication[15].

Because of the all the embedded advantages of POC Testing in the patient care, this prospective preliminary study was conducted to evaluate the turnaround time and accuracy of values of the reports of four essential STAT blood parameters – WBC and Platelet counts, haemoglobin and CRP estimated simultaneously by POC Testing and core laboratory.

4. Materials and Methods

This is a prospective randomised study conducted at the Emergency Department of AIMS, a multi-disciplinary tertiary care hospital in Kochi, Kerala, India.

HORIBA Emi CRP three part haematology analyser, having capacity of doing complete blood count with C – Reactive Protein (CRP)from same EDTA samples was used for parameter evaluations. CRP in the analyser is estimated by immunoturbidometry.

Inclusion criteria:
The study included a total of 67 consecutive patients of both the genders, all aged 18 years and above, who presented to the ED with signs and symptoms of infection.

Exclusion criteria
1) Patients aged less than 18 years of age.
2) Patients who do not have clinical signs and symptoms of infection on arrival to ED.

Informed consents for this study were obtained from all the study patients . Apart from all other aspects of appropriate clinical care for these patients, the blood samples were taken from them by vene section for the estimation of CRP and CBC on arrival to ED.

One portion of the blood sample was sent for analyses to POC testing available at ED itself and another portion to Core laboratory without any undue delay.

Reports of the results of four STAT blood parameters-WBC and Platelet counts, haemoglobin and CRP obtained by both the methods were taken for comparison and statistical analysis

Turn-around time for the reports by each method was calculated excluding the time taken for blood sample collection and transport to testing points.

5. Results

The sample size included 67 patients.
Males   -   37 patients - 55.7%
Females -   30 patients –44.3%

Investigation results for four STAT blood parameters:

1)WBC Total count values- Cells/microliter
a) POCT   - Min.3400 & Max.26900
b) Core Lab.- Min. 3500 & Max.36980

2) Platelet count values- Cells/microliter
a) POCT   -- Min.79000 & Max.474000
b)Core Lab   -- Min.79100 & Max.487000

3)Haemoglobin values-gm/dL
a) POCT   -- Min.7.2 & Max.15.2
b) Core Lab.   – Min.7.6 & Max.15.3

4) CRP Values – milligrams/L
a) POCT   -- Min. 01 & Max.210.4
b) Core Lab.   – Min. 0   & Max.290

In this study, only insignificant differences were found in the values of the blood parameters estimated by POC Testing and core laboratory: the p values are as follows:

WBC count   -   0.076
Platelets count   - 0.931
Haemoglobin   - 0.174
CRP   - 0.712

Turn-Around Times:
The average turnaround time for CBC and CRP including all the four STAT blood parameters was around five minutes by POCT and around ninety minutes by core laboratory testing .

6. Discussion

Turnaround Time
Laboratory turnaround time is considered one of the most important indicators of work efficiency in hospitals; physicians always need timely results to take effective clinical decisions especially in the emergency department where these results can guide physicians whether to admit patients to the hospital, discharge them home or do further investigations.[16]

By POC Testing, the average turn-around time for CBC plus CRP was around five minutes per sample where as it was around ninety minutes by the core laboratory estimation.

The statistical analysis is described below:
Table 1 depicts the mean, standard deviation, N and standard error mean with p – values for the results of all the four parameters assessed by POCT and Core Laboratory methods.

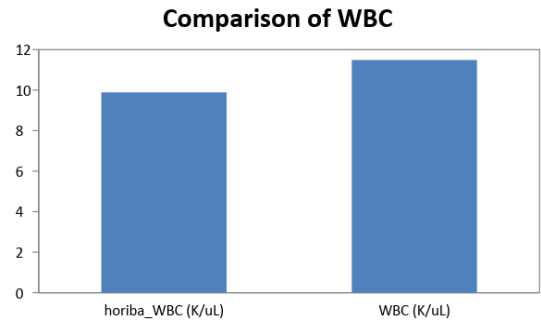|	Parameters	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	WBC(K/uL)-POCT	9.89	67	4.4957	0.5492
	WBC (K/uL)-Core Lab.	11.4907	67	7.79667	0.95251
Pair 2	Hb(gm/dL)-POCT	12.23	67	3.766	0.4601
	Hb(gm/dL)-Core Lab.	11.712	67	2.307	0.2818
Pair 3	PLT(K/uL)-POCT	235.46	67	95.073	11.615
	PLT(K/uL)-Core Lab.	234.85	67	110.966	13.557
Pair 4	CRP-(mg/L)-POCT	47.939	67	58.7809	7.1812
	CRP-(mg/L)-	50.8073	67	76.04038	9.28981

Comparison of WBC

Figure 1

WBC Total count values: Mean value comparison between POCT and Core Lab. results: Figure – 1. The standard deviation of POCT and Core Lab. values for WBC Total counts are 4.495 and 7.796 respectively and the p value is 0.076.
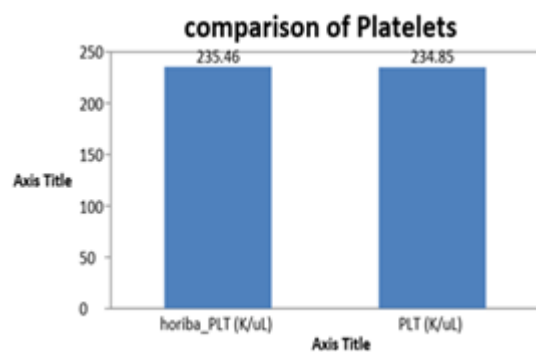

comparison of Platelets

Figure 2

Platelet count values: Mean value comparison between POCT and Core Lab. results: Figure – 2. The standard deviation of POCT and Core Lab. values for platelet counts are 95.073 and 110.966 respectively and the p value is 0.931.
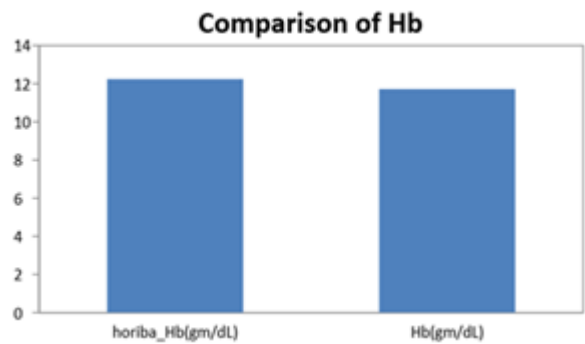

Comparison of Hb

Figure 3

Haemoglobin values: Mean value comparison between POCT and Core Lab. results: Figure-3. The standard deviation of POCT and Core Lab. values for haemoglobin levels are 3.376 and 2.307 respectively and the p value is 0.174
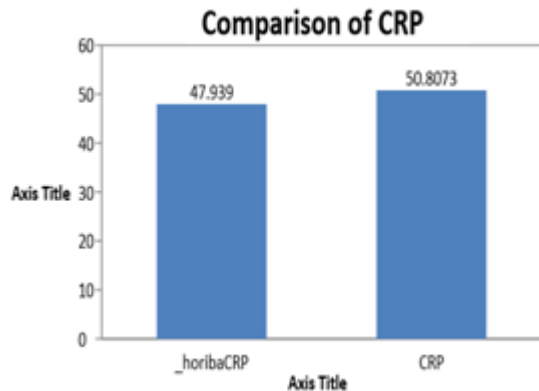
Figure 4

CRP Values: Mean value comparison between POCT and Core Lab. Results: Figure-4

The standard deviation of POCT and Core Lab. values for CRP results are 58.780 and 76.040 respectively and the p value is 0.712.

The primary advantages provided by POCT devices are increased portability and speed. Using POCT, caregivers can perform, analyse obtain, and act on test results at the bedside in a matter of minutes, significantly faster than if samples were sent out to a central laboratory. If used effectively, POCT has the potential to decrease delays to treatment initiation, increase ED efficiency, influence patient care positively, and alleviate the negative effects of overcrowding of ED.[17]

With advances in technology, it has become increasingly possible to perform common clinical investigations outside of the laboratory at the point of care with a reasonable level of accuracy. Using point of care testing can significantly reduce the turnaround time and ER patients' length of stay [18].[19]

7. Conclusion

Our preliminary study with smaller sample size and minimum number of blood parameters for evaluation brings forth the conclusion that the turnaround time for the reports by POCT is the shortest, within five minutes, when compared with core laboratory testing and the accuracy of the values for all the four parameters studied, by POCT is comparable with that of core laboratory values. Taking into account the benefits of accuracy of the values and unimaginably fast turnaround time of POCT, large multicentric studies including larger population and more number of parameters could able to throw further light on the application and incorporation of POCT in the health care system, especially in the reduction of ED flow turnaround time apart from its other advantages.

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