SHORT COMMUNICATION

# LABORATORY BLOOD TESTING IN PAEDIATRIC INTENSIVE CARE UNIT OF A UNIVERSITY HOSPITAL: ARE WE DOING IT APPROPRIATELY?

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Retrospective chart review of all children (aged-one month to 16 years) admitted in our paediatric intensive care from June to November 2016 was done to determine the indication of different laboratory tests. LBT indications were defined into: diagnostic/case findings/screening tests to make a diagnosis; haemostatic tests (to monitor function or identify before clinical signs and symptoms) and therapeutic /monitoring tests to get the level of drug directly or getting level of marker as a guide to therapy. Laboratory tests reports which were within normal range more than once were labelled as in-appropriate tests. In total 274 patients, Haemostatic tests were performed for mean of 35.18±56.72 times (range of 0–429), monitoring for mean of 9.38±20 times (range 0–165), and therapeutic tests (3.26±11.25). Most common tests included serum Sodium levels (7.83±12.73), Serum Potassium (8.19±12.80), bicarbonate (7.75±11.9). 13.40±9.11 tests were done on first day and 13.0±8.49/day tests were performed afterwards. Cumulatively 54.31±74.21 tests were performed/ patients out of which 18.5±37.82 were inappropriate.

**Keywords:** Laboratory testing; PICU; Indications

**Citation:** Sohail H, Bibi S, Hakeem M, Haque A, Abbas Q. Laboratory blood testing in paediatric intensive care unit of a university hospital: Are we doing it appropriately? J Ayub Med Coll Abbottabad 2020;32(3):422–4.

## INTRODUCTION

Laboratory Blood Testing (LBT) is frequently required in evaluation of acute critically ill patients in paediatric intensive care unit (PICU). The several benefits of LBT include helping make a quick diagnosis, early recognition of abnormal internal milieu in critically ill patients and monitoring the response to therapy. However, the excessive use of LBT is common in intensive care units which increases the resource utilization, contributes to iatrogenic anaemia, discomfort to patient if required frequent arterial or venous puncture and sometimes erroneous lab result lead to incorrect diagnosis and treatment.[1] 16–40% of LBT are labelled as inappropriate in intensive care unit.[2,3] Our data indicate that the laboratory investigation contributes about 20% cost of ICU care, which is a substantial one, like other reports.[4] Few quality improvement projects for optimal uses of LBT have been described in the literature.[5,6]

The purpose of this study is to assess the use of LBT in PICU based on modified indications of LBT which has been described in the method section. This audit will help us in designing future prospective study as a quality improvement project.

## MATERIAL AND METHODS

Retrospective review of medical records of all children (age-1mo to 16yr) admitted in our PICU from June to November 2016 was done after ethical approval (4546-Ped-ERC-16). The indication of LBT was defined in three major categories. 1) diagnostic/case findings/screening tests (All tests ordered to make a diagnosis either directly or indirectly, for example, blood culture in suspected sepsis, Procalcitonin and C - reactive protein to support the diagnosis of sepsis. ANA as a case-finding test for Systemic Lupus Erythematosus); 2) haemostatic test (All laboratory tests done repeatedly at intervals to monitor function of an organ system or identify derangements in organ function before the onset of clinical signs and symptoms. For example, serial Hb in case of haemorrhagic shock or K in case of tumor lysis syndrome / acute cardiogenic shock with infusion of Furosemide) and 3) therapeutic /monitoring tests (All test done to check the level of drug in blood directly or checking level of a marker as a guide to therapy, For example, Vancomycin or Valproic Acid level, APTT for heparin infusion or Glucose for Insulin. Serum creatinine for Aminoglycosides and Alanine Transaminase for Anti Tuberculous Therapy drugs

Test results which were in normal range more than once were labelled as In-Appropriate tests. Outcome was to assess the daily and cumulative tests performed on individual

patients, indications of LBT and appropriateness of the tests. Data was collected on a structured proforma and included demographic and clinical data (admitting diagnosis, PRISM III score (to measure the severity of illness, the worst values in first 24 hours of admission were taken to calculate it), presence of arterial and venous lines and name, number and indications of LBT done in PICU). Results are presented as mean with standard deviation and frequency with percentage.

## RESULTS

Total 274 patients' records were assessed. Median age was 24 months with inter quartile range (IQR) of 100 (103 (37.5%) patients, were <12 months) and 169 (61.7%) were males. Admitting diagnosis included respiratory diseases (75, 27.4%), central nervous system diseases (CNS) (56, 20.4%), sepsis/infection (42, 15.3%), cardiovascular system (CVS) diseases (16, 5.8%), post-operative patients (26, 9.5%) and other miscellaneous conditions. Median PRISM III score was 6 with IQR of 8. Cumulative patients' days were 1167 while median length of stay was 3 with IQR of 3. Central vascular access (central venous line or arterial line) was present in 156 (56.9%).

Mean diagnostic tests done were 4.05±3.94 (range of 0-23), screening tests (mean 0.69±1.65, range of 0–10), case finding test (0.27±1.12, range 0-10). Haemostatic tests were performed for a mean of 35.18±56.72 times (range of 0–429), monitoring for a mean of 9.38±20 times (range 0–165), and therapeutic tests were performed for a mean of 3.26±11.25.

Haematological tests were performed for 3.72±6.8 times and biochemistry for 47.97±67 times. Most commonly done tests included serum Sodium levels (7.83±12.73), Serum Potassium (8.19±12.80), bicarbonate (7.75±11.9), serum calcium (2.73±2.8), serum albumin (1.78±0.83), blood gas analysis (9.93±15.3), serum magnesium (2.05±1.81), blood urea nitrogen (2.93±3.67), creatinine (3.34±4.36), and blood glucose levels (1.51±14.33).

A mean of 13.40±9.11 tests were done on first day and mean 13.0±8.49 tests were performed per day afterwards. Cumulatively 54.31±74.21 tests were performed per patients out of which 18.5±37.82 were deemed unnecessary. (Table-1) Patients age, gender, mechanical ventilation, inotropic support was not associated with number of unnecessary tests ($p$=>0.05)

**Table-1: Basic Demographic and outcome Data of the Study Population (n=274)**

| Variable | Mean (SD)/ Frequency (%) |
|---|---|
| Age (months, median with interquartile range IQR) | 24 (100) |
| Gender (Male) | 169 (61.7) |
| PRISM III (Median with IQR) | 6 (8) |
| Length of Stay (Median with IQR) | 3 (3) |
| Central Vascular access (arterial or central venous line) | 156 (56.9) |
| **Indications for Laboratory Blood Testing** | |
| Screening Tests | 0.6 (1.5) |
| Hemostatic Laboratory Tests | 36.29 (58.0) |
| Case finding tests | 0.2 (1.0) |
| Diagnostic and Therapeutic tests | 3.46 (11.4) |
| **Individual Laboratory Blood Testing** | |
| Sodium | 7.83 (12.73) |
| Potassium | 8.19 (12.80) |
| Chloride | 7.7 (11.96) |
| Bicarbonate | 7.7 (11.96) |
| Calcium | 2.7 (2.8) |
| Magnesium | 2 (1.8) |
| Albumin | 1.7 (0.8) |
| Blood gas Analysis | 9.9 (15.3) |
| Blood Urea Nitrogen | 2.9 (3.67) |
| Creatinine | 3.3 (4.36) |
| Glucose | 13.5 (14.3) |
| C Reactive Protein | 1.5 (0.5) |
| Blood Culture and Sensitivity | 0.8 (1.4) |
| Tests done on First Day | 13.75 (9) |
| Number of Tests done per day after first day | 13.37 (8) |
| Cumulative Tests done per patient | 56.47 (74.97) |
| Unnecessary Tests | 19.85 (39.36) |

## DISCUSSION

Our study shows that almost one third of tests done were inappropriate. Our PICU lacks a standard guideline for ordering laboratory tests hence a consistent decision for ordering these tests remains elusive. Patients admitted in PICU are subjected to a greater number of blood draws for different reasons (e.g monitoring, screening etc). Studies also shows that this increase blood testing doesn't translates to better patient outcomes.[6] So this means that there are many opportunities where these tests can be easily avoided which then translates into cost saving as well as less blood loss and less need for transfusion specially in younger infants.[7,8] Our study shows that diagnostic tests were performed in majority of patients., and in individual category it was biochemistry tests, like electrolytes which were performed most commonly. In a study by Anderson et al in their intensive care unit showed that 41% of tests were deemed un-necessary. Similar to our study they also showed that the most common tests done were electrolytes monitoring. Our study revealed that a mean of 13 tests were performed per patient per day which is similar to those shown by Anderson *et al*, however our average length of stay was less than

their adult population. Similarly, they also showed that patient's status (ventilatory, hemodynamic etc) was not associated with number of unnecessary tests as shown in our study.

This study provides valuable insights to ordering LBT in our PICU which is an opportunity decrease the practice variation. We intend to initiate a quality improvement project to reduce the unnecessary LBT and improve our practices regarding ordering LBT through checklists, nursing empowerment, increased awareness of physicians and continuous practice surveillance.

Our study is limited with a small time-bound sample size from single centre study. However, it provides a valuable insight into the test ordering habits of physicians and provides an opportunity for improved decision making while ordering LBT in PICU which can lead to cost and resources saving and also can help in reducing the morbidity.

## CONCLUSION

Around one third of tests performed in PICU were deemed unnecessary and could be avoided. Electrolytes monitoring are major unnecessary test performed in our PICU.

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| *Submitted: January 1, 2020* | *Revised: March 20, 2020* | *Accepted: May 19, 2020* |
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