Special Article

Critical laboratory values - an experience in Apollo Hospitals Dhaka

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Abstract

Reporting of laboratory critical values has become important for patient safety as described by recent guidelines in National Patient Safety Goals of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). The use of critical values reporting was adopted as a requirement in the Clinical Laboratory Improvement Amendments (CLIA'88)[1]. Herein, we reported the results of an analysis of 4260 consecutive laboratory critical values from July 2007 to June 2008 at our institution, a large tertiary medical center. We evaluated critical value reporting by parameters, laboratory speciality (Clinical Chemistry & Hematology), clinical care area (IPD, OPD, Emergency), and Turn around time. Factors leading to delays in critical value reporting are identified, and we describe approaches to improving this important operational and patient safety

Introduction

Critical value reporting originally was highlighted by Dr. Lundberg[2], who defined a critical value as a result suggesting that the patient is in imminent danger unless appropriate therapy is initiated promptly. In the 30 years since Lundberg's observations, the concept of defining critical values and systems for reporting have been adopted widely by laboratories throughout the world[3]. The recent focus on patient safety has brought increased attention to the issue of laboratory critical value reporting. Critical value reporting parameters may be considered an important laboratory outcome measurement because they reflect clinical effectiveness, patient safety, and operational efficiency[4]. For the critical value reporting process to be effective, the organization must understand and address the variables involved in the process. The JCAHO requires health care organizations to track and improve the timeliness of reporting and receipt of critical test results by the responsible licensed caregiver. Moreover, the JCAHO has defined critical test results as not only laboratory tests but also imaging studies, electrocardiograms, and other diagnostic studies. Therefore, the process of critical value reporting is of interest across the health care organization.

In the present study, we analyzed 12 months of critical value data and more than 4260 individual critical results to understand the scope of critical value reporting and identify opportunities for process improvement.

Materials and Methods

Setting

The Apollo Hospitals Dhaka is a 450-bed tertiary care medical center. All major medical and surgical specialties are supported by the hospital, along with pediatric and obstetric services and extensive primary care and specialty outpatient practices. The Lab medicine department include Clinical Biochemistry-hematology (core laboratory), clinical pathology, microbiology, histopathology, immunology and transfusion medicine services, and in July 2007 to June 2008, the laboratories performed more than 516000 reportable tests, of which 36% were for inpatients, 57% for outpatients, and 7% for emergency department (ED) patients. Critical values reported from July 2007 to June 2008 were examined. Testing performed in the chemistry and hematology (core laboratory) was included in our critical value analysis. Histopathology and microbiology critical values were not included in the present study because our microbiology and histopathology laboratory uses a different documentation process for critical values.

Critical Callback Procedures

Table 1 and 2 shows the critical callback list for chemistry and hematology respectively that was in use at our institution at the time of the study[5]. Responsible Lab personnel (Biochemist, Lab Technologist) will ensure the validation of the RESULT by repetition of TEST or by RECALIBRATION of parameter if necessary and / or by CHECKING quality control result. If the RESULT is in the CRITICAL VALUE (Upper or Lower) the lab personnel would communicate with the RESPONSIBLE CAREGIVER [Consultant, Registrar, Medical Officer, Nurse and Operations associate (Clerical staff who perform clinical support function)] to inform the VALUES over phone. At the same time he/she will also inform the result to the concerned LAB DOCTOR (Consultant, Senior Registrar, Registrar). For out patient CRITICAL VALUE would be informed to RESPONSIBLE CONSULTANT or his/her medical Assistant (Medical officer). After receiving THE RESULT the receiver will RECONFIRM the result to the delivery end by calling back over phone. The Lab personnel will RECORD details of the CRITICAL CALL BACK (Parameter, Critical value, Informed Person, Date, Time, Confirmation call back) in a LOG BOOK.

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Critical laboratory values

Critical Value list

Table: 1

Parameter	Low	High
Ammonia	None	>40 µmol/L
Amylase	None	>200 U/L
Arterial pCO_2	<20 mm Hg	>70 mm Hg
Arterial pH	<7.2 U	>7.6 U
Arterial pO_2 (adults)	<40 mm Hg	None
Arterial pO_2 (newborns)	<37 mm Hg	92 mm Hg
Bicarbonate	<10 mEq/L	>40 mEq/L
Bilirubin, total (newborns)	None	>15 mg/dL
Calcium	<6 mg/dL	>13 mg/dL
Carbon dioxide	<10 mEq/L	>40 mEq/L
Cardiac TroponinI (cTnI)	None	>0.5 ng/ml
Chloride	<80 mEq/L	>115 mEq/L
CK	None	>3-5x upper limit of normal (ULN)
CK-MB	None	> 3x upper limit of normal
Creatinine(except dialysis patients	None	>5.0 mg/dL
Glucose	<2.5 mmol/l	>25 mmol/l
Glucose (New born)	<1.6 mmol/l	> 16.6 mmol/l
Magnesium	<1.0 mg/dL	>4.7 mg/dL
Phosphorus	<1 mg/dL	None
Potassium	<2.8 mmol/l	>6.0 mmol/l
Potassium(newborns)	<2.5 mmol/l	>8.0 mmol/l
Sodium	<120 mmol/l	>160 mmol/l
BUN (except dialysis patient)	2 mg/dL	>80 md/dL

Clinical Chemistry

Table: 2

Hct (packed cell volume)	<20 vol%	>60 vol%
Hb	<7 m/dL	>20 gm/L
Platelet count (adult)	<40,000/cu mm	>1,000,000 /cu mm
Platelet count (pediatric)	<20,000/cu mm	>1,000,000/cu mm
aPTT	None	>78 secs
PT Positive test for fibrin split products, protamine sulfate, high heparin level	None	>30 secs or > 3x control level
Fibrinogen	<100 md/dL	>700 mg/dL
WBC Presence of blast cells, sickle cells New diagnosis of leukemia, sicks cell anemia, aplastic crisis	<2000/cu mm	>30,000/cu mm

Hematology

Critical laboratory values

Data Collection and Analysis
All data were obtained from reports generated by clinical chemistry and hematology that has been recorded into critical call back log.

Results
Critical Value Reporting
During the period of the study (12 months), the chemistry and hematology laboratories reported 4260 critical values. During the same period, these laboratories reported more than 516000 tests results. Therefore, tests with critical values represented approximately 0.82% of the total test results reported. The majority of critical callbacks (62%) resulted from testing performed in the chemistry laboratory (Fig: 1).

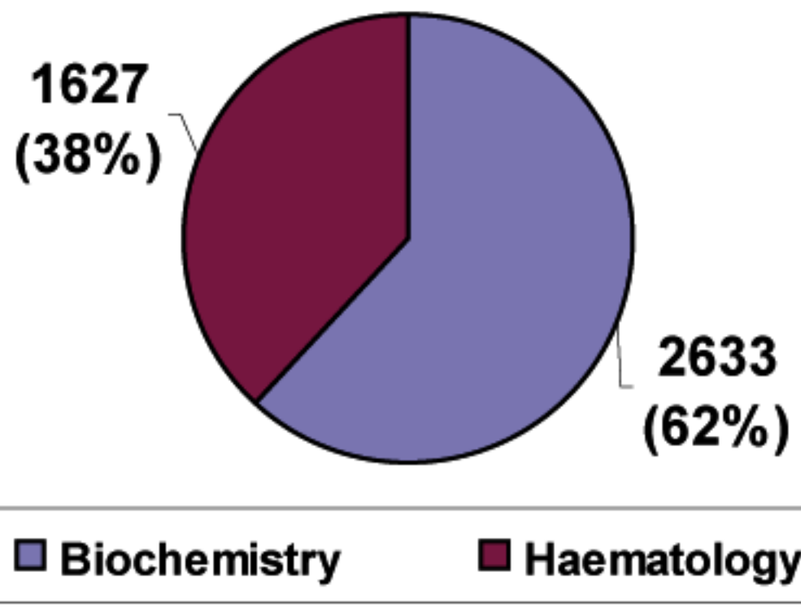

Figure 1: Evaluation of Critical Value by Laboratory Specialty

Critical Call Back In Core Lab
(July 2007 - June 2008)

Hematology laboratory accounted for 38% of critical callbacks. In the clinical chemistry the parameter most commonly called back were potassium (650) followed by Troponin I (365) (Fig: 2).

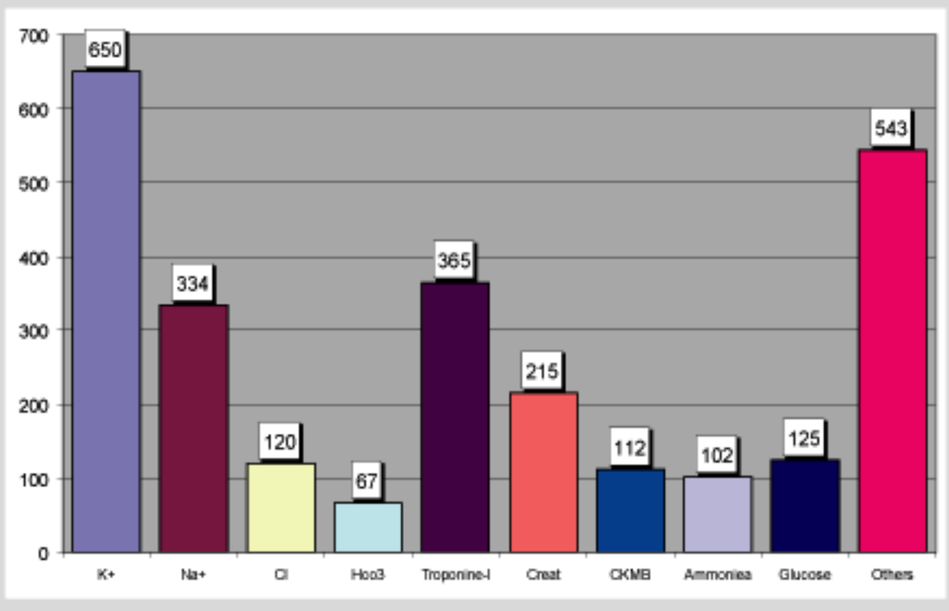

Figure 2: Evaluation of Critical Value by Parameter

Clinical Biochemistry

And in Hematology the highest call back was done for hemoglobin (465) followed by prothombin time (432) (Fig: 3).

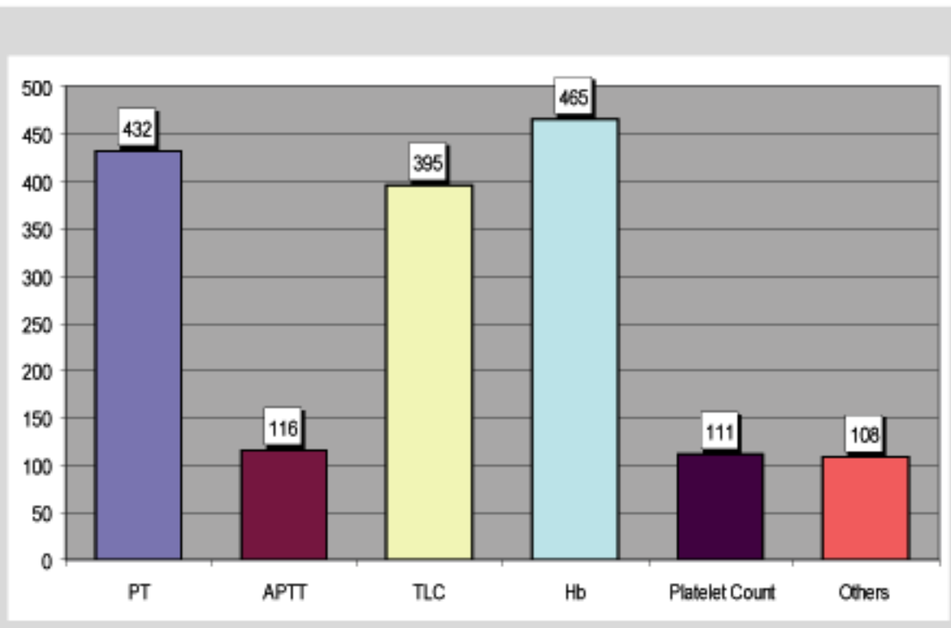

Figure 3: Evaluation of Critical Value by Parameter

Hematology

Analysis of call volumes by clinical care area showed that inpatient critical value call volumes were high throughout the 24-hour day. We have recorded 2740 call back in our log book for inpatients (Fig: 4)

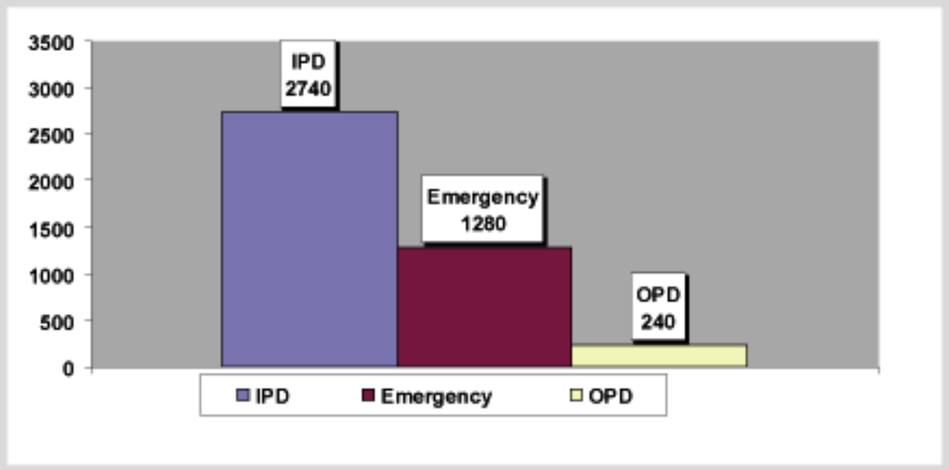

Figure 4: Evaluation of Critical Value by Clinical Care Area

(IPD, EMERGENCY, OPD)

Outpatient critical value calls were prominent from 9:00am until 5:00pm, during the study period it was about 1280. ED critical value calls were highest during the day, but all times of day had a significant number of calls. As expected, these call volumes correlate with outpatient, inpatient, and ED specimen throughput (data not shown).

The "in-laboratory" turnaround time for each critical value was determined to assess the timeliness of critical value reporting. Turn around time is the time period between receiving of a sample and generation of report[4]. For the 4260 critical values, the mean time from the value entering

the critical callback queue to the time when the critical value information was conveyed to the patient location or ordering clinician was 69 minutes (OPD, IPD and emergency) and for IPD and emergency the mean time was 40 minutes. Delays in critical value reporting correlated with testing performed on outpatients and testing ordered on requisitions lacking the name of the ordering clinician or the ordering location. Tests performed in settings where there is continuous technologist presence (eg, blood gases) were called back faster than tests performed in other areas. This information was useful as we began to implement measures to improve critical value reporting in all areas of the laboratory.

Table: 3

Both OPD & IPD

Minimum	Maximum	Mean
20 minutes	120 minutes (OPD)	69 minutes

IPD & Emergency

Minimum	Maximum	Mean
20 minutes	60 minutes	40 minutes

Evaluation of Critical Value by Turn Around Time

Discussion

In this study, we provide a comprehensive view of the critical value reporting process in a large medical center. We provide details regarding the scope, volume, timing, and operational aspects of critical value reporting. Many of these parameters should be applicable to a variety of settings. This analysis provides a context for comparison and process improvement.

Increasing workload in the clinical laboratory makes it important to achieve efficient use of laboratory resources to maximize clinical benefits. Expansion of critical callback lists to include testing that does not meet the criterion of the "imminent danger" standard may dilute the urgency of a critical value call and lead to unnecessary interruptions for clinicians. For example, critical value calls for high creatinine levels will not be of clinical value for patients receiving dialysis and in many situations in which the high creatinine value is an expected finding. In addition, there are many clinical settings (chemotherapy, malignancy) in which the "critical" test result is expected and reporting of this value may not contribute to improved patient care. Communication by telephone, especially when performed by technologists, is a costly practice in terms of the resources required to complete the phone calls and document the process. For this reason, it is helpful to try to reduce the number of phone calls by careful review of the critical values list 5. In addition to determining which tests are to be included in the critical values list, another important strategy is to examine the consequences of changing the boundaries for critical value reporting. These boundaries must be defined in consultation with clinicians. Small changes in critical value reporting parameters may result in the addition or loss of thousands of phone calls for the laboratory staff.

Outpatient critical values present unique challenges in timely reporting to clinicians. One of the strongest correlates of delayed reporting of critical values was the specimen being obtained from an outpatient. Outpatient critical values are challenging to communicate to the responsible clinician because there often are different approaches in various practices for determining patient coverage. Unlike inpatients, there is no fixed patient location that can be phoned.

Another factor we identified as causing delays for outpatients was illegible or missing ordering provider information. We have noted that recent improvements in the critical value communication times have coincided with increased awareness of critical value monitoring. We presently are working with our outpatient practices to improve communication between the laboratories and the outpatient care centers.

Another contributor to delays in outpatient critical value reporting is the heterogeneity of the outpatient population, with specimens arriving from health OPD clinics, urgent care centers (Emergency), dialysis centers. The nature of outpatient specimen transport and processing often results in outpatient test results being generated in the evening when the outpatient clinic or physician's office is closed. The laboratory must have a mechanism to determine on-call coverage and work with outpatient practices to improve the communication processes.

The potential for technological solutions to improve the process of critical value reporting is evident in numerous reports[06,07]. The use of information technology to automatically communicate with the responsible provider has been demonstrated to reduce the critical value reporting time in controlled settings. For implementation of automated critical value reporting, interfaces from the LIS (Laboratory Information System) to technologies that facilitate bidirectional communication (such as e-mail or 2-way pagers) need to be developed. An important component in such a system is the ability of the automatic reporting system to reliably determine the identity of the

responsible provider. At larger medical centers, this task can be challenging because there may be different coverage lists, tests ordered by consultants unknown to the primary caregiver, and patient transfers to different locations. An electronic reporting system potentially could create dangerous delays in communication if not properly implemented. The system needs to have an "acknowledgment" function such that the laboratory can ensure that the responsible caregiver received the result[08]. Electronic systems also require an escalation procedure so that lack of acknowledgment of the critical result prompts an alternative approach for communication. Rules-based logic can be applied to laboratory values to build alerts that take into account not only the result value, but also other related results, a change in the current test result from previous results (ie, delta checks), patient demographics, ordering provider, and other parameters to customize the alerting to the patient's condition and the needs of the clinical team for notification. For example, many oncology physicians do not want to be notified regarding patients with neutropenia. Similarly, there is little usefulness in notifying a diabetologist of low glucose values for patients seen in an outpatient clinic because many of these "critically low" results will be falsely low or no longer relevant. The ability to provide a physician-specific critical values list could eliminate a large number of unnecessary critical value calls. These systems, when interfaced with automated alerting systems, will have the potential to improve patient safety and provide more context-sensitive critical value reporting. At present, practical implementation of this scenario would be constrained by regulations (particularly the JCAHO National Patient Safety Goals) that require all critical results to be communicated.

Conclusion

"Every laboratory should have at its disposal a procedure to notify critical results. A consensus should be reached with clinicians to establish a specific list of critical limits according to the type of patient and the timeliness of laboratory tests[09]". We are proud to be the pioneer in Bangladesh to introduce the system of Critical Call Back in Lab medicine department of Apollo Hospitals Dhaka which was highly appreciated by the survey team of Joint Commission on Accreditation of Healthcare Organizations (JCAHO) during our accreditation process.

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