Section: Biochemistry

Original Research Article

AUDIT OF 'RESAMPLE' IN CLINICAL BIOCHEMISTRY LABORATORY OF PSG IMSR & HOSPITAL

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ABSTRACT

Background: Pre-analytical errors, particularly sample rejection and resampling, remain a major challenge in clinical biochemistry laboratories, adversely affecting turnaround time, patient comfort, and clinical decision-making. Hemolysis is a leading cause of sample rejection, especially in inpatient settings. The aim is to audit the frequency, causes, patterns, and operational factors associated with sample rejection and resampling in a clinical biochemistry laboratory and to evaluate corrective measures.

Materials and Methods: A retrospective and prospective audit was conducted in the Clinical Biochemistry Laboratory of PSG Institute of Medical Sciences and Research over four months (July, August, September, and November 2016). Consecutive sampling was used. Data were retrieved from the sample rejection register, Laboratory Information System (LIS), archived request forms, and environmental monitoring records. Quantitative analysis was performed using Microsoft Excel and IBM SPSS 17. Focused Group Discussions (FGDs) were conducted with nursing staff from selected wards and with OPD phlebotomists to qualitatively explore causes and operational challenges.

Results: Out of 297,616 samples processed, 856 samples were rejected, yielding an overall rejection rate of 0.28%. Hemolysis accounted for 80% of rejections. Inpatient samples constituted 93.6% of rejected specimens, with a rejection rate 13.6 times higher than outpatient samples. Rejections were more frequent during early morning hours (05:00–07:00), on Sundays in proportionate terms, and with heparinized samples. Operational delays in sample transport, receipt, centrifugation, and communication of rejection were identified as major contributory factors. FGDs highlighted procedural lapses in phlebotomy, delayed processing, pneumatic tube handling issues, and inconsistent instructions as key drivers of hemolysis.

Conclusion: Sample rejection in the studied laboratory was low overall but predominantly driven by hemolysis in inpatient samples. Operational inefficiencies and pre-analytical practices significantly contributed to resampling. Targeted corrective measures focusing on standardized phlebotomy practices, improved staffing patterns, optimized sample transport, and LIS-based automation are essential to reduce resampling and improve patient care.

Keywords: Sample rejection; Resampling; Hemolysis; Pre-analytical errors; Clinical biochemistry laboratory; Turnaround time; Laboratory Information System; Quality indicators; Phlebotomy; Patient safety.

INTRODUCTION

Clinical laboratory plays an important role in the diagnosis and management of patient. Correct and timely results facilitate the patient care. Errors and delay hinders the patient care.

Sample quality is a pre-requisite for good quality of the result. Sample rejection and requesting resample are undesirable. This is a major cause of Turnaround Time (TAT) exceed. It increases the TAT by

108minutes in one study.[1-3] As the results are delayed, treatment decision making is delayed and sometimes it may be critical. This also gives further hardship and discomfort to the patient. The sample collection personnel will lose confidence and may loss rapport with the patient. Though the analysis may be proceeded for some analytes, it is 'do not process' for others like potassium. The laboratory personnel may be over indulging in requesting resample without realizing the difficulty faced by the sample collection personnel and patients.

The aim of this study is to audit resampling i.e. to analyze the policy, procedure, criteria and implementation of sample rejection, to examine the root cause analysis of sample rejection, to analyze the overall statistics of sample rejection and resampling. This might give an insight to reduce resampling. This audit is limited to 'resample' in clinical biochemistry laboratory.

Aim:

- To analyze the existing procedure, frequency and pattern of 'sample rejection' and 'resample' in the clinical biochemistry laboratory.
- To explore the cause for resample.
- To plan and implement appropriate mitigation
- To assess the effectiveness of mitigation.

Objectives:

1. To examine the procedure of sample rejection
2. To determine the frequencies of various reasons of resample in the clinical biochemistry laboratory
3. To determine and describe category-wise 'resample' data (Type of collection container, ward, collection staff, type of test, duty shift)
4. To deduce patterns of failure
5. To explore the cause for errors leading to resample
6. Propose appropriate corrective measures
7. To implement corrective measures
8. To study the effect of corrective measures

Standards:

Standards: ISO 15189: 2012 NABL 112

Quality manual of PSGH Diagnostic Centre Revision No 07 Page 54 of 79 Rejection Criteria – PSGH DC

Source of evidence:

1. Lysed note
2. HIS

Exceptions (if any): Precious sample may be processed and result given with a note that the sample doesn't fulfil acceptance criteria.

Sampling Period: July, August, September and November 2016

Sampling Method: Consecutive sampling

MATERIALS AND METHODS

Institutional human ethics committee approval was obtained for the retrieval of details of rejection of sample in the clinical biochemistry laboratory of PSG IMSR Hospital.

The procedure of sample rejection is inferred from quality manual, quality system procedure and sample collection manual.

Initially the data of 3 months July-September 2016 was collected. The rejection details are noted from Sample rejection register. The same details are collected from the LIS also for triangulation.

S.No.	DATA from rejection register	DATA from LIS	Description
1	Date	Date	
2	Barcode no	Barcode no	Patient OP/IP number
3	Sample received time	Sample received time	Sample reaches the lab by pneumatic tube system. The sample and request form are taken out of the transport container and kept in a test tube rack. The laboratory technician examines the sample and request for appropriateness and receives the sample. This time is noted as sample received time.
4	Ip/op	Ip/op	In patient or outpatient sample
5	Ward	Department ward	The origin of the sample
6	Type of tube	Type of tube	Type of container Green – Heparin Lavender – EDTA Gray – fluoride Red (Bio)– clotting accelerator ABG – ABG syringe
7	Sample for which tests	Sample for which tests	Which all tests requested in that tube
8	Reason for rejection	Reason for rejection	
9	Rejection time		
10	Number of time rejected	Number of time rejected	
11	Rejection authorized by		
12	Resample time	Resample time	
13		Routine or urgent	

We have retrieved the test request forms from the archive. Time of sample collection and collected by whom are collected from these request forms. The following reports are obtained from LIS - Total sample per day and per month, Total OP and IP per month, Ward wise rejection number and percentage every month.

As some of the columns in the register are empty without entry, we instructed the technicians to update the register concurrently. After that we took the data of November.

The ambient temperature and humidity of the laboratory are noted from the temperature monitoring register labeled as 'TEMPERATURE MONITORING PSGHDC/BC/REG/TM/26'. The temperature (highest and lowest) and humidity (mean) details are taken from weather report site https://www.timeanddate.com/.

We made the data entry in Microsoft Excel. Later we exported the data to IBM SPSS 17. We used bar diagram, histogram, pie diagram to describe the data. After analyzing the data, huge disparity was there between IP and OP data. To explore the reason we thought of conducting Focused Group Discussion. We requested Nursing Superintendent to arrange for FGD with 3 groups formed from the nursing staffs of 18 wards. We also did a FGD with the phlebotomist of the OPD sample collection center. The outcome of the FGD is analyzed qualitatively.

RESULTS & DISCUSSION

Procedure for sample rejection

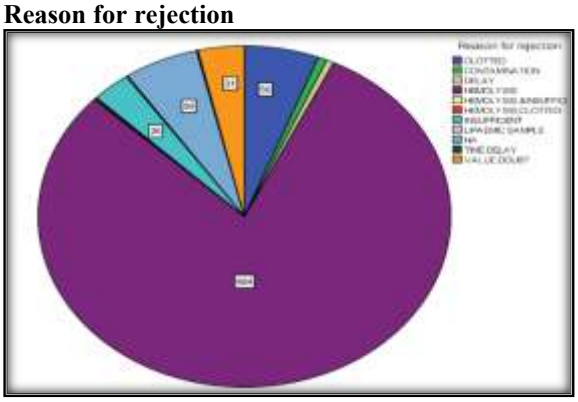
For OP patients the samples are collected at 'OP Sample Collection Centre – Male' and 'OP Sample Collection Centre – Female' by trained phlebotomist. All IP samples are collected by the nursing staff posted in corresponding ward. Sample reaches the clinical biochemistry laboratory by mostly pneumatic transport and at times by carried by ward attenders. The personnel posted at pneumatic tube receiving point opens the transport bottle and take out the sample and the requisition slip. The sample is then arranged in the test tube rack. The clinical chemistry technician receives the sample and sends it for centrifugation. After centrifugation, the sample was examined for lysis, clot or lipemia. The sample was evaluated against the rejection criteria (refer Annexure I). In case of hemolysis, the lysis index is checked with ABL. If the sample qualifies for rejection the faculty in charge is contacted for authorization. The rejection is noted in the register. The concerned ward is informed. The rejection details are noted in LIS. Though the instruction is there to use LIS only for recording, usually the records are maintained both in LIS and the register.

Sample rejection

The study period was four months – July, August, September and November of 2016.

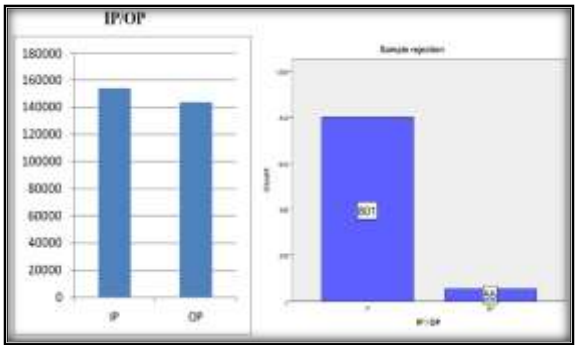
Total number of sample processed by clinical biochemistry lab was 2, 97,616. In this 856 samples were rejected.[1] This amounts to 0.28%. The rejection rates reported in other studies are: Liyun Cao 0.26%,[3] University Hospital in Porto Alegre 0.57%,[4] Aysenur Atay et all 0.65%,[1] Zeliha Gunnur Dikmen 2.5%.[2]

Reason for rejection



Out of 856 rejections in the study period, 684 (80%) is due to hemolysis. 'Clotted' and 'reason not available' accounts for 50 (5.8%) each. 'Value doubt' and 'insufficient' contributes 31 (3.6%) and 26 (3%). Other reason contributes 15 (1.75%).

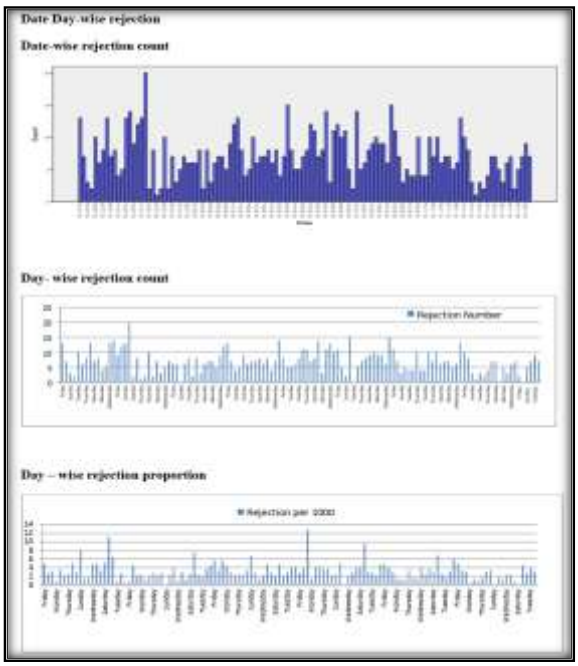
Our study	Aysenur Atay,[1]	Zeliha Gunnur Dikmen,[2]	Liyun Cao,[3]	University Hospital in Porto Alegre,[4]
Hemolysis 80% Clotted 5.8% Reason not available 5.8% Value doubt 3.6% Insufficient 3% others 1.75%	Hemolysis 8% Clotted specimen 24% Insufficient 34% Unintelligible requests 32%	Fibrin clots28% Inadequate volume9% Clotted samples35% Inadequate volume 13%	Contamination 5.1% Inappropriate collection container/ tube 15.2% Quantity not sufficient 15.1% Labeling errors 14.7% Hemolyzed specimen 9.4% Clotted specimen 9.3%	Clot 43.8% Insufficient sample volume 24% Hemolyzed sample 17.9%



When compared to other studies hemolyis is the major cause. The volume insufficient % is very low. Our nursing staffs somehow collect enough sample. We are getting enough sample from 2 day old babies for Bilirubin level and TSH screening. The mislabeling, test request form deficiencies have come down drastically because of interventions undertaken before this study.

The total number of sample in the study period is 2, 97,616 in which IP is 1, 53,808 and OP is 1, 43,808. So the IP % is 51.7% and OP is 48.3%. Total number of resample in the study period is 856 in which IP is 801 and the Op is 55. So, 93.6% of rejected samples are IP and 6.4% of rejected samples are OP.

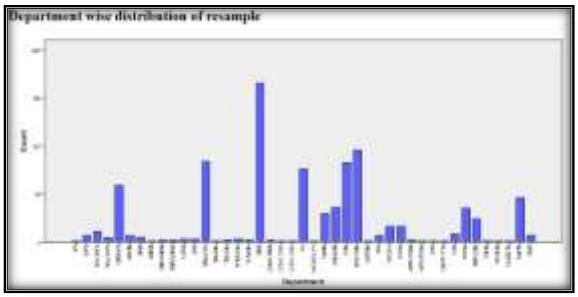
Though the IP and OP sample numbers are almost equal, IP sample collection has 13.6 times more rejection than the OP sample collection. This is much higher than the Cuhadar S study in which it is 2-4 times higher for non laboratory phlebotomists.[5] But in Aysenur Atay et all study the IP: OP ratio is 16.5.[1] Though IP patient may be sicker than OP patient, this huge disparity should be explored. We decided to do a focused group discussion to study this phenomenon.



The date wise sample rejection count is showing a wave pattern. Day wise number of rejection also shows wave form with troughs near Saturday and Sunday. But, the day wise 'Rejection per 1000 sample is also showing some wave pattern with peeks on most Sundays.

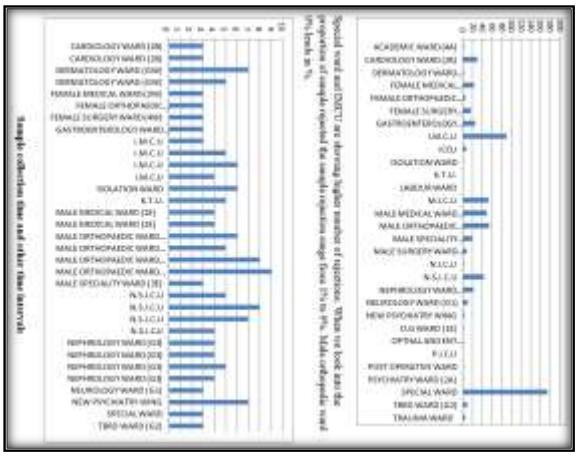
	Number of rejection	Rejection Per 1000
Monday	117	2.5
Tuesday	102	2.0
Wednesday	126	2.6
Thursday	155	3.3
Friday	144	3.2
Saturday	118	3.1
Sunday	92	5.4

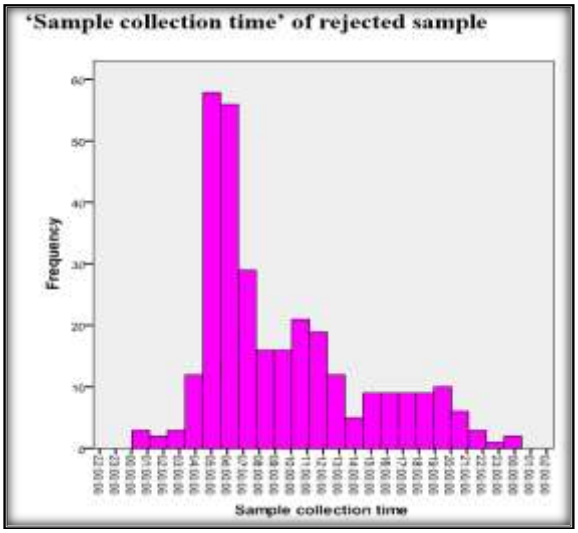
Samples are less on Sundays and hence the number of rejection may be less. In Sundays there is no OP sample collection; only IP sample collection. As we see later, the proportion of sample lysis is 13 times higher with IP sample collection than OP sample collection, could explain the paradox of increase proportion in Sundays.



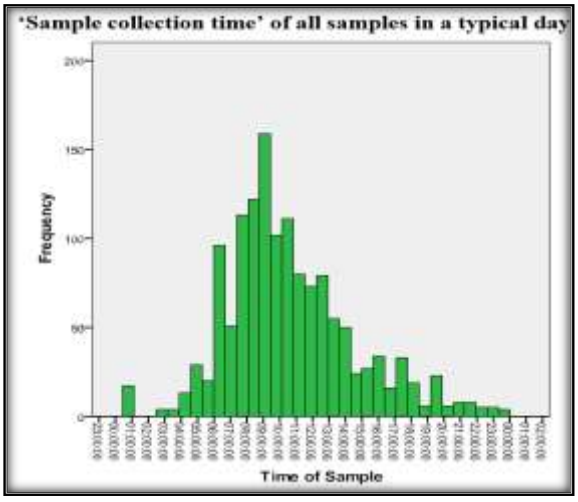
The number of rejection is highest in Medicine department followed by Neurosurgery, Gastroenterology, Neurology and Cardiology. This is consistent with the number of sample originating from these departments.

Ward wise distribution of resample Ward wise number of rejection.





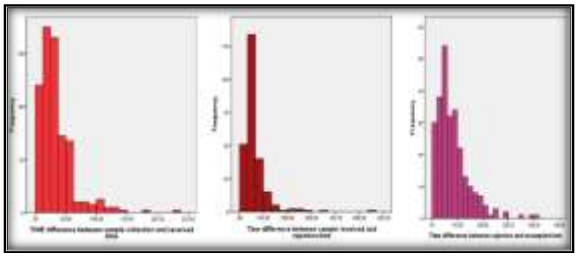
The rejected sample is showing a peek at 5am-6am. This corresponds to the peak of IP sample collection. The sample collection time in a typical day is showing an extended peak from 6.00am to 2.00pm. This includes both OP and IP sample. This is consistent with the claim that the morning samples are rejected more by the nursing staffs in Focused Group Discussion.



The time lag between 'time of sample collection' and 'time of sample reception' is from 0 minutes to 60 minutes. The 'time of sample collection' is entered manually in LIS for IP sample and it is billing time for OP sample. For IP sample the 'the computer system time' will be the default time in the 'time of sample collection field'. The technician has to edit the time to 'time of sample collection written in the request form. If this is not done, the default time is taken. So, 'the time of sample collection' and 'the time of sample reception' are default time of the computer system in this case and the time interval becomes zero.

There is a considerable delay between 'sample collection' and sample reception. This may be due to

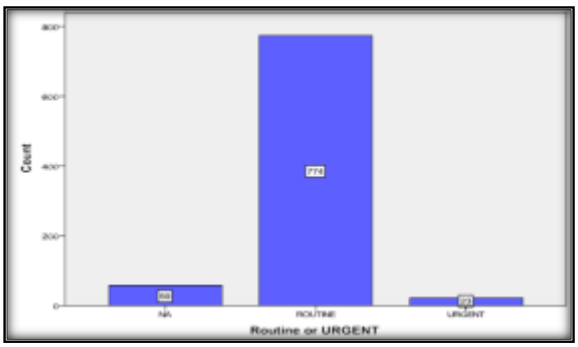
1. The sample peak starts from 6.00 am. But only three night duty technicians are there. The first morning shift starts at 7.00am. So, there is duty hand over at 7.00 am which will hinder the sample receiving process. Even after the beginning of morning shift, only minimal (3-4) technicians are there. Senior lab technicians join at 8.00 am. As there is an instruction to avoid 9.00am to 06.00pm shift, other technicians join at 10.00am. The lab achieves its full capacity to process sample only by 10.00 am.
2. The technicians are claiming that the ward nurses are not sending the sample immediately.
3. The ward nurses are claiming that there were some confusing instruction from lab – sometimes the instruction is to send the sample immediately and sometime the instruction is to keep it for 15 minutes to avoid hemolysis.



There is also considerable time delay between 30 minutes to 2 h in most cases and more so in some cases. The sample should be centrifuged before deciding the rejection. The Hb content of the serum/plasma has to be analyzed in ABL to decide on rejection. The technician has to call the faculty in charge of the laboratory to get the approval for rejection. But this is causing hardship for the nursing staffs and clinician as evidenced in focused group discussion.

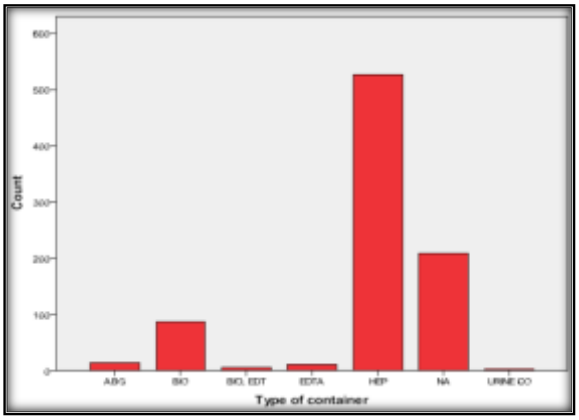
Routine or urgent

It is affecting both routine and urgent samples. For some samples (especially the rejection noted in register only) this data is not available. Though this is consistent with the proportion of routine and urgent sample, the rejection of urgent sample causes undesirable time delay which may critically affect the care of patient.



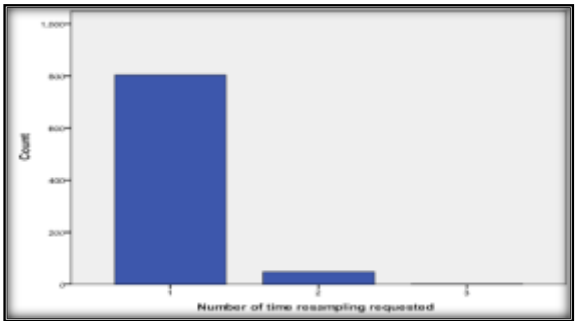
Type of container

Surprisingly the rejection is more with heparin container. Earlier unpublished study on effect of pneumatic tube transport on sample integrity also showed the signs of hemolysis in heparin container. The category 'Bio-EDTA' indicates the sample collected for Troponin. Without any instruction from laboratory side, nursing staffs are always sending two samples – one EDTA and one red tube – clot sample. The EDTA sample processed first. If it is hemolysed, the clot sample is processed.



Number of time resample is requested

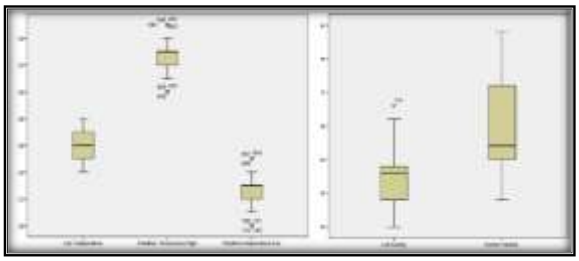
Usually resample is requested once. But sometimes the first resample is also rejected and one more resample is requested. Rarely, it had gone up to 3rd and 4th resample. In the study period it is mostly 1st resample (805/856). But 2nd resample do have considerable share (49/856). There were two incidents of 3rd resample.



Environmental conditions of the laboratory

The laboratory temperature usually ranges from 24 C to 28 C and the relative humidity is below 60%. As a

part of hospital 'green policy' we use only chillers to regulate temperature. The environmental conditions are in the upper limit of acceptable condition for instrument functioning. But the sample may deteriorate faster in these conditions.



Focused group discussion FGD

It is evident that lysis of blood sample is rampant in IP sample collection when compared with OP collection. But the reason for this phenomenon is not evident. So, we decided to explore this phenomenon with 'Focused group discussion'. We selected the following wards, showing high sample rejection rates.

Cardiology ward (2b), dermatology ward (GW), female medical ward (2w), female orthopaedic ward (3b), female surgery ward (4w), gastroenterology ward (Ge) I.M.C.U, isolation ward, k.t.u., male medical ward (2e), male orthopaedic ward (3w) male speciality ward (3e), n.s.i.c.u, nephrology ward (g3), neurology ward (g1) new psychiatry wing, special ward, tbrd ward (g2). Discussed this issue with nursing superintendent and requested her to arrange for FGD. Nursing superintendent obtained permission from medical superintendent and arranged for FGD. The nursing staffs were selected from the above mentioned wards and sent for FGD as three different groups on three different days (15th, 16th and 17th February 2017). The FGD venue was 4th floor seminar hall which is spacious, silent, with good seating arrangement and near to all wards. The place was inspected before FGD and the circular seating arrangement was done. One or two supervisory staffs also came to witness the procedure and they were kept out of the circle. Refreshments were served in the middle of the session and each session started by 11.00am and lasted for about 1 hour. Audio recording to record the discussion was done and informed the participants before we began. The session started with briefing about the phenomenon, ensuring confidentiality of the information and instructing them that they can talk about their experience or whatever they have seen or heard about. Ensured that nothing would be considered wrong and used the following probes.

What they think as a cause

Which sample they have the premonition that they are likely to get rejected Relation to any particular type of container/condition

The session went on well on the day 1 with rich information. On day 2, one of the supervisory staff contributing to discussion more and started controlling the response of other staffs. On day 3, again the discussion went on with and we had rich information. The audio recording was transcribed on the same day.

Also conducted FGD one session with the phlebotomist of the collection centre after obtaining permission from medical superintendent diagnostics. This was arranged in the radiology department class room near the male and female collection. This session was conducted on 21st February 2017 from 3.00pm to 4.00pm. The number of participant was less (5) but each contributed well to the discussion.

The indexing of the transcript was done and 5 themes evolved. They are

1. Hardships of resample
2. Delay
3. Reason for lysis
4. Suggestions to avoid lysis
5. General suggestions to improve the process

Hardships of resample

From the wards, samples are sent in the morning and the results are ready at the time for rounds. The staff has to spend lot of time in making intercom calls to the lab. At times the patient is shifted to operation theatre and the results are not ready. When the staff calls the lab, they ask for resample. The lithium sample is taken in the morning before the next dose. If the sample gets rejected they have to wait till next morning for resample. If that also get rejected, it is hard to face the patient and the doctor. Sample sent for Troponin assay as an urgent sample. As a precaution, staff sends two samples – one EDTA and one clot. If the EDTA sample gets rejected, the result is not available in time. The lab keeps on telling that the sample is in processing.

Delay

Sending sample in the morning is always a problem. The samples are sent by 5.30 am.

The sample doesn't show 'received at lab' status till 8.00am. Most often the resample is requested after 9.00am. Why the rejection was not informed earlier? Receiving is not done properly from 6.00am to 9.00am. Sometime, the technicians requesting the resample also give the instruction not to send resample before 9.00am.

The person at pneumatic tube receiving is doing day duty and night duty also. So, so he sleeps at night. He is not removing the transport capsule out of the port. So other inbound capsule gets stalled on the way. The capsule is not emptied carefully. Sometimes the capsule is sent back to the nursing station with few tubes left in side. After a long delay only we will be aware of missing of the sample. When we search the sample will remain in the nursing station itself.

In night duties and Sunday duties, results are getting delayed. But the neurosurgeons want report in 30 minutes.

Reason for lysis: Most of the nursing staff felt that the delay in the receiving process is the reason for lysis. They felt that OP collection is doing better, since they send sample immediately. Other reasons are vigorous shaking, quality of the container, heparin

tubes. They also felt that the samples sent through the ward attender do not lyse. When asked which is the most common predictive feature which will forewarn them that a particular sample will lyse, they said sample collected drop by drop or air bubble coming in between is the one.

The phlebotomist also confirmed that if the blood flow is slow, the sample will lyse. So they do venepuncture at different site and discord the earlier sample partially collected. They also observed that in wards, the nursing staff collects blood in syringes and pour them into the collection containers much later after returning to the nursing stations. The tilting and mixing of anticoagulants are also not done or done in a vigorous manner. Another main mistake was not allowing the area to become dry before doing the venepuncture. In OP collection centre they are using surgical spirit. In ward they are using AHD solution, which will take more time for drying.

Suggestions to reduce hemolysis

The suggestions given by phlebotomist to avoid hemolysis are Use surgical spirit to clean the area and allow the area to become dry. Use AH for culture only. In case of AHD wait for 30s.

Use the median cubital vein mostly, even in edematous patient it is the good site.

If the flow is not good, change the site. Discard the small amount of sample collected until then.

Use vacutainer for collection than the syringe. Initial it will look difficult. But, later it will become easy.

Complete the mixing of sample and anticoagulant as early as possible. Be very gentle while mixing. Slight tilting is all that need to mix well.

All quality related events, resample, reprick, hematoma, etc, fill the register concurrently. Work as a team

Suggestions for improving the process

The delays have to be reduced. The IP sample come to the lab with barcode label having the patient demographic information only where as the OP sample barcode label have the information about the test to be performed . This is because the tests are selected in billing and the barcode label generated at collection centre by the clerical staff posted there. If the nursing staff could fill automated request form in LIS and take the barcode label print out, the sorting time in the lab will be reduced. After collection of blood, the nursing staff may read the barcode label. The time stamp created in LIS at that time will be the sampling time. This automation will help in monitoring any delay in receiving and processing.

Vacutainer may be used in wards also. The turbulence produced in the vacutainer itself is sufficient to mix the anticoagulant and improve the quality of the sample.[6]

If do not process list/sample rejection criteria are available in the laboratory, it will be help full.

The focused group discussion gave the insight about the sample hemolysis, delays in the process and hardships encountered. FGD also paved way for discussing corrective action and sensing the acceptability of corrective actions.

Our FGD findings are consistent with the study of Giuseppe Lippi.[7] Wet alcohol transfer from the skin to the blood specimen, small-gauge needles, difficulty in locating easy venous access, small or fragile veins, unsatisfactory attempts, vein missing, partial obstruction of catheters and other collection devices, application of a negative pressure to the blood in the syringe, excessive shaking or mixing of the blood after collection, exposure to excessively hot or cold temperature, centrifugation at a too high speed for a prolonged period of time are identified as causes for in vitro hemolysis. In vivo blood cell lysis can originate from hereditary, acquired, and iatrogenic conditions, such as autoimmune hemolytic anemia, severe infections, intravascular disseminated coagulation and transfusion reactions.

Application of tourniquet for more than 1minute is identified as main reason for hemolysis in the study done by Saleem et all.[8] In vitro hemolysis during sample collection or handling is caused small gauge needles, inappropriate blood collection devices, prolonged venous stasis, fragile veins, vigorous mixing or shaking, according to Adrijana Dorotić.[9]

CONCLUSION

1. The current sample rejection rate in our Clinical Biochemistry Laboratory is 0.28%.
2. Hemolysis of sample especially for electrolyte analysis constitutes 80% of rejections.
3. The rejection rate of IP sample is 13.6 times of OP samples.
4. The rejection number is low in Sundays but rejection proportion is high.
5. The department wise and ward wise rejection corresponds to sample load.
6. Rejection is more for the sample collected between 05.00am and 7.00 am.
7. Heparin tube sample is more prone for rejection.
8. Resample, second resample and at time third resample were asked for.
9. Resample cause immense hardship for the person collecting sample and for the patients especially – difficulty to find OP patient, patient already shifted to operation theatre, emergency tests like Troponin T/I, and timed sample like Lithium
10. The delay in sample receiving and delay in informing sample rejection affect the functioning of nursing staff and patient care.
11. Delay in receiving and processing sample, pneumatic tube transport, blood coming as drops or air bubbles, vigorous shaking, poor quality of container, not allowing the area to dry are perceived as reason for hemolysis by nursing staffs
12. Not identifying good vein with good flow, not using vacutainer adopters, not using surgical spirit, not mixing gently are perceived as reason for hemolysis by phlebotomy staffs.

Corrective actions

1. Vacutainers have to be used in vacutainer mode only with the adopter in the wards also with few exceptions.
2. Surgical spirit may be used as a cleaning agent because of its quick drying property.
3. Blood has to be collected from medium sized vein with good flow only.
4. The nursing staffs may be trained in doing a clean phlebotomy in median cubital vein or nearby vein.
5. The nursing staff may be trained in the procedure of gentle mixing.
6. The pneumatic tube receiving area should be better staffed. Extended duty hours should not be given.
7. The test request form filling may be automated. Bar code printer and bar code reader may be installed in all nursing stations. The test request form is filled and the bar code having the information of tests to be performed in that particular sample may be printed and used for labeling the tube. After the sample collection, the bar code label is read and the time stamp is recorded in LIS.
8. The receiving process may be simplified by just reading the bar code label. The time delay shall be monitored.
9. The laboratory should record all sample rejection in LIS only. There should not be any double work of writing in the register also. If they want a system to track the resample, the provision should be made in LIS itself.
10. Laboratory should function in its full capacity mode from 7.00am. We should provide accommodation at hostel for laboratory technician. This will facilitate to give more staff for 7.00am to 4.00pm shift.
11. Until 7.00am, only the night duty staffs are available in the lab. Sample start flooding from morning 5.00am. On the top of this, if all ABG samples are sent to the lab, one staff has to be dedicated to do this test alone as this test is time sensitive and urgent. We have provided the IMCU with an ABG analyzer. That analyzer should be used instead of sending all samples down to the laboratory.
12. Quality indicators and targets may be defined and monitored.

Annexure I

Rejection criteria – Clinical Biochemistry Laboratory
PSGH DC Clinical Biochemistry Laboratory
REJECTION CRITERIA – ROUTINE CHEMISTRY

Interference	Can be Processed	Analyze Hb level in ABL 800 OMINS & process If the Hb level as follow		Do not Process
Hemolytic	Ceruloplasmin, IgA IgG, IgM, ApoA, ApoB, Lipase, cholinesterase, Calcium , hs-CRP, Urea, Glucose,C3,C4	Amylase	< 0.26g/dl,	ALT , AST , LDH Magnesium , Ammonia, CK, UIBC, Bilirubin Direct, Electrolytes, Lithium
		Phosphorus& Albumin	<0.42g/dl	
		D-Dimer	<0.3g/dl	
		Protein & Iron	< 0.5g/dl	
		Creatinine & Cholesterol	<0.8g/dl	
		ALP	<2.5g/dl,	
		Uric Acid	< 5.0g/dl	
		GGT	< 5.5g/dl	
		TGL	<6.0 g/dl	
		LDL	< 10 g/dl	
		HDL	<15g/dl	
		Bilirubin Total	<1.0g/dl	
		Homocysteine	< 0.5	
Icteric (Bilirubin-Total)	Magnesium, UIBC, D-Dimer, ALT , AST LDH , GGT, ALP, Lipase, Iron, IgA, IgG cholinesterase, IgM ApoA, ApoB, Calcium, hs-CRP ,Ammonia, Phosphorus, Protein, Albumin, Ceruloplasmin, Prolactin	LDL	<40mg/dl	
		Cholesterol	<11mg/dl	
		TGL	<5.0mg/dl	
		HDL	<24mg/dl	
		TGL	<5.0mg/dl	
		HDL	<24mg/dl	
		Amylase	<52mg/dl	
		CK	<15mg/dl	
		Creatinine	< 5.0mg/dl	
		Uric Acid	< 39mg/dl	
		Dilute the sample with Saline by auto dilution mode to get the above concentration and then analyze)		
Lipemia (TGL)	ALP, GGT, LDH, Lipase, Amylase, cholinesterase, IgA, IgG, IgM, ApoA, ApoB, Uric Acid, Magnesium, Creatinine, D- Dimer, Ceruloplasmin, Proteins, Calcium	Bilirubin Total &Direct	<1400mg/dl	Iron & UIBC <200mg/dl
		HDL	<1800mg/dl	
		LDL	<1200mg/dl	
		Phosphorus	<1000mg/dl	
		D-Dimer	< 600mg/dl	
		Ammonia	< 400 mg/dl	
		Dilute the sample with saline to get the above concentration by auto dilution mode and then process		

REJECTION CRITERIA – Immuno Assay

Interference	Analyze Hb level in ABL 800 OMINS & process If the Hb level as follow	Do not Process
HEMOLYSIS	T3, FT4 - < 2.0g	Insulin, Folate, PTH IgE < 0.1 Trop-t <0.1 CA 19- 9 < 1.4
	TSH, Vit-B12, FSH, Pro BNP, LH- < 1.0g	
	PSA, AFP, CEA- < 2.2g	
	HCG, Prolactin, CK MB- < 1.5g	
	CA-125- < 3.2g	
	FT3- < 4.3g	
	Cortisol II - <0.5 g	
	PCT- < 0.9g	
	Ferritin- < 0.5g	
	Anti-TPO- < 1.5	
	IL-6- < 1.0 g/dL	
	Vit D- < 0.2 g	
LIPEMIA (TGL) in (mg/dl)	TSH, PSA, AFP, PTH, Vit-B12, Folate, CEA, PCT, Trop-t, CK MB Pro BNP, Prolactin- < 1500	
	T3, Insulin- <1800	
	FSH, LH-< 1900	
	FT4, FT3, CA 125-< 2000	
	IgE-< 2200	
	HCG-< 2400	
	Cortisol II-< 1500	
	Ferritin-< 3300	
ICTERIC (Bilirubin- Total) in (mg/dl)	PCT, Pro BNP-< 25	
	Trop-T- < 27	
	HCG-< 29	
	Prolactin-< 30	
	FT3, Folate-< 33	
	CK MB-< 34	
	T3-< 35	
	FT4, TSH-< 41	
	Cortisol-< 60	
	FSH-< 64	
	CEA, LH, CA 125- < 66	
	Insulin- < 90	
	IgE-< 37	
	PSA, AFP, Ferritin, PTH Vit-B12,- < 65	
	Testosterone- <0.6	

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