Study the Existing Process and Find Out the Gaps Based on the Standard Manual Prepared in a Satellite Laboratory, Hyderabad

By

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MBA Hospital and Health Management

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Dr. Suman Seregta** student of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone dissertation training at **Apollo Diagnostics, Hyderabad** from February **15 th February, 2016 to 30 th April, 2016.**

The Candidate has successfully carried out the study designated to her during dissertation training and her approach to the study has been sincere, scientific and analytical. This training is in fulfillment of the course requirements.

I wish her all success in all future endeavors.

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TO WHOM IT MAY CONCERN

I write to confirm that **Dr. Suman Seregta** was placed at **Apollo Health and Lifestyle Limited** for her project. She worked on the project entitled **"Preparation and Implementation of Technical Manual For A Satellite Laboratory"** at Apollo Diagnostics, Hyderabad from 15.02.2016 to 30.04.2016. She has been innovative in developing the concepts and working structure for the project, and sincere in her attempt to complete the task with attention to detail. She has also made a brief report about current process and standard process of the industry.

Place: Hyderabad

Date: 30/4/16

Signature of the External Guide

(With stamp)

All the best

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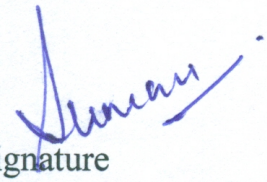
CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **"To study the existing process and find out the gaps based on the prepared standard manual in a satellite laboratory at Apollo Diagnostics, Hyderabad** and submitted by **Dr Suman Seregta**, Enrollment No. **IIHMR-U/MBA-HM/2014-2016/19-1631** under the supervision of **Dr.D.K.Mangal** for award of Postgraduate Diploma in Hospital and Health of the University carried out during the period from **2014 to 2016** embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.



Signature

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I take this opportunity to express my profound sense of gratitude and indebtness to all those who helped me throughout the duration of the project.

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At the end, Iam thankful to God and my heartfelt gratitude to my parents and friends who supported me throughout the course.

THANK YOU ALL

Dr. Suman Seregta

Management Trainee

CONTENTS

ABOUT ORGANISATION

APOLLO GROUP

Counted among Asia's leading healthcare providers today, Apollo Hospitals Group has scripted one of the most magnificent stories of success that India has seen. Born as a 150-bed hospital in 1983, the Group has blossomed into a global health care system by itself, with an expanding footprint in the Country and overseas. The Group's futuristic vision has ensured that it continues to be in a position of strength at every touch point of the healthcare delivery chain.

Apollo Health and Lifestyle Limited (AHLL) is an Apollo Group initiative to take healthcare services from the hospitals settings closer to home within neighborhood locations in order to serve the community better.

Apollo Clinic was introduced with the vision of servicing local communities and making world-class healthcare for day-to-day needs accessible with a presence in neighborhoods.

Apollo Sugar provides end-to-end care and management of Diabetes and related complications.

Apollo Cradle was the first to introduce the concept of an exclusive, standalone healthcare center for women and pediatric care.

Apollo Spectra provides world-class surgical care that is accessible and at an affordable cost.

Apollo Diagnostics provides a full spectrum of high precision diagnostic services based on which Apollo's healthcare practitioners design and deliver the most appropriate treatment plan to reduce patient's mortality and morbidity levels

VISION:

For the next phase of development is to ‘Touch a Billion Lives.’

MISSION:

Our mission is to bring healthcare of International standards within the reach of every individual. We are committed to the achievement and maintenance of excellence in education, research and healthcare for the benefit of humanity.

Apollo also pioneered the sensibility of Tender Loving Care (TLC) which continues to inspire hope, warmth and a sense of ease in patients and their families.

APOLLO DIAGNOSTICS

Apollo Diagnostics, a service fully dedicated to providing diagnostics for all age groups.

The diagnostic services provide Apollo's healthcare practitioners with information about the presence, severity and cause of diseases in patients.

A team of expert pathology technologist and state-of-the-art diagnostic equipment, guided by Apollo's 30-year legacy of excellence, ensure the quality and accuracy of test results.

With years of experience, Apollo diagnostics has been providing domestic and international patients with superior- quality and patient-focused medical care.

Quality healthcare will always be among their top concerns.

SEVICES PROVIDED:

1. Biochemistry
2. Clinical pathology
3. Cytopathology
4. Hematology
5. Histopathology
6. Immunology
7. Microbiology
8. Molecular genetics
9. Molecular diagnostics
10. Serology

LABS HIERARCHY:

- Referral lab
- Regional referral lab
- Satellite lab
- PCC

EXISTING COCO

- Habsiguda
- Kalyan Nagar
- L B Nagar
- Tarnaka
- JP Nagar
- Navodaya Colony
- Sriram Nagar
- Moula-Ali
- Padmaraonagar
- West Marredpalli
- Rajajinagar
- Malleswaram
- RR Nagar
- RT Nagar
- Rajajinagar
- Malleswaram
- RR Nagar
- RT Nagar
- Jainagar
- Vijaynagar

- Sahakarnagar
- Uttrahali
- Girinagar

REGIONAL LAB AND SATELLITE LAB

Deepam Lab

Deva Lab

Mysore Lab

Vijayawada Lab

Vimannagar lab

Kondapur lab

Koramangala lab

Thagyarajavnagar lab

PROJECT TITLE

TO STUDY THE EXISTING PROCESS AND FIND OUT THE GAPS BASED ON THE STANDARD MANUAL IN A SATELLITE LABORATORY at APOLLO DIAGNOSTICS, HYDERABAD

Introduction:

The Healthcare Technology and Healthcare industry is evolving rapidly with the growing requirements of the patients Apollo Health and Lifestyle Limited, India's first name in corporate healthcare, 'good health for all' is the abiding focus. Recognising the need for high quality diagnostics to nip developing health problems in the bud, Apollo offers a wide spectrum of tests through its hospital and clinic facilities across the Country. To expand the offering and increase its accessibility to a wider network of patients and doctors, Apollo Hospitals had launched Apollo Diagnostics, a service fully dedicated to providing diagnostics for all age groups. Apollo Diagnostics keeps itself acquainted with the advanced technology and keeps increasing the scope of services to cater to the complete needs of the patients while focusing on quality patient care.(1)

With years of experience, Apollo Diagnostics has been providing domestic and international patients with superior-quality and patient-focused medical care. Now Apollo diagnostic has come with a concept of satellite laboratory. Satellite laboratories, or limited service laboratories, are located permanently away from the central laboratory, with one or several analyzers operated by either laboratory or non-laboratory personnel. The objective of creating a satellite laboratory is to reach over the maximum population and provide the quality diagnostic services at tier II cities. (2)

The International Standard, based upon ISO/IEC 17025 and ISO 9001, specifies requirements for competence and quality that are particular to medical laboratories. A medical laboratory's fulfilment of the requirements of this International Standard means the laboratory meets both the technical competence requirements and the management system requirements that are necessary for it to consistently deliver technically valid results.(3)

Literature Review:

- A well-prepared procedure manual provides a foundation for the lab's quality assurance program. Its purpose is to ensure consistency while striving for quality. The procedure manual may be used to: [4]

- Document how tests are performed
- Train new personnel
- Remind personnel of how to perform infrequently ordered tests
- Troubleshoot testing problems
- Measure acceptable test performance when evaluating staff

- According to ISO requirements the labs must have written procedural documents for its procedures.[3]

Medical laboratory services are essential to patient care and therefore have to be available to meet the needs of all patients and the clinical personnel responsible for the care of those patients. Such services include arrangements for examination requests, patient preparation, patient identification, collection of samples, transportation, storage, processing and examination of clinical samples, together with subsequent interpretation, reporting and advice

RESEARCH QUESTION:

Whether the satellite labs are following the standard procedures or not?

OBJECTIVES:

- To set a standard manual of technical requirements in a satellite laboratory.
- To study and compare the existing process with the standard manual in a satellite laboratory and recommend process improvement.

RESEARCH METHODOLOGY:

The study will be conducted over a period of 70 days from 16 Feb,2016 to 30 April,2016 in Apollo Diagnostics, Hyderabad.

There will be two sets of data which will be generated during the course of the study:

- ✓ First set of data would be based on the review of existing laboratory documents and telephonic as well as face to face interviewing of the employees.
- ✓ Second set of the data will be based on the standards established in NABL guidelines and ISO 15189 2012 for medical laboratories.

The motive of the study will be to analyse the gaps and redesign the manual that fills the gap for a laboratory to consistently deliver technically valid results.

The project has been divided into following parts:

1. To prepare a layout for satellite laboratory both infrastructure and technical requirements.
2. To study the existing reference ranges with the standard, prepare and recommend the new ranges in the satellite labs.
3. To prepare and implement the final interpretations in the report format.
4. To prepare min max table for particular parameters.
5. To prepare and implement the sample rejection form.
6. Recommendations for continuous improvement

LAYOUT FOR MEDICAL LABORATORY

Can be divided into two phases:

- Phase 1 (infrastructure and staff hiring)
- Phase 2 (technical process)

Phase 1

Infrastructure requirement:

1 .Space (600sft)

Waiting area
Reception area
Sample collection area
Sample processing area
Chief of lab area

2. Privacy and Confidentiality®

Almirha	1
Lockers	1

3. Power (electricity for essentials)

Consumed electricity load
Power generator (small) 10 KVA capacity 1
UPS capacity – (15 KVA capacity) 1

4. Water supply (water, sanitation and hygiene for infection control 1k)

- ✓ Safe drinking water

5. Environment maintaince (for maintaining temperature and humidity)

AC's	3 (two ton)
Temperature monitor (room temp)	1
Refrigerator temp monitor	1

6. IT requirements

Phone (1 set)
Internet (1 Broadband and 1 ILL system used with capacity of 2MBPs)
Interface
LIS (2 computers, 1 barcode printer, 1 barcode scanner, 2 thin client, 1printer with scanner)

7. Legal requirements

Shop and establishment
Pollution control
Trade license
Biomedical waste agreement
DM and HO registration
Police clearance

8. Housekeeping

9. Equipment installation (IQ, OP, PQ)

9. Furniture

Office table	1
Chairs	5(1reception, 2waiting area, 1consultant,1 patient)
Work tables (slab mode)	3

9. Bio medical waste management and agreements

10. Toilets (1)

Staff
Patients

11. Fire safety

Fire extinguisher	2

12. Security /2 CCTV

13. Technical representative visit

14. Staff hiring process

Identify vacancy and evaluate need
Develop position description
Develop recruitment plan (sources of recruitment, etc.)
Implement recruitment plan
Selection process (interview)
Select/ hire
Finalize recruitment

Phase-2

Technical requirement

1. Manpower

- ✓ Appointment of pathologist
- ✓ Recruitment of technician by pathologist
- ✓ Job specific training, education and assessments: pathologist
- ✓ Medical Examination of Staff
- ✓ Vaccination of Staff
- ✓ Planning of different training programes

2. Visit by regional technical representative for training

3. Laboratory equipments

- ✓ Ortho clinical diagnostic(vitros 250)BIOCHEM
- ✓ Horiba -60(sysmax 3 parts)HAEMO
- ✓ Centaur CP(semen's diagnostic)IMMUNO
- ✓ Incubator 1
- ✓ Microscopes(high resolution) 2
- ✓ Differential counter 2
- ✓ Centrifuge 1
- ✓ Vidal shaker 1
- ✓ Thermometer 2
- ✓ Stopwatch 2
- ✓ Refrigerators 3
- ✓ Water bath 1
- ✓ Pipettes(variable) 3

4. Reagents (listed ones)*

5. IQ, OQ& PQ verification

6. Validation of the equipment

7. Quality

<u>Handing over quality documents from HO</u>

<u>QSP and SOP's</u>

- ✓ SOP for on and off procedure of all instruments and their maintaince daily/weekly/monthly.
- ✓ SOP for recording temperature and relative humidity.
- ✓ SOP for micropipettes operations.
- ✓ SOP for patient preparation.
- ✓ SOP for patient handling.
- ✓ SOP for sample collection.
- ✓ SOP for spillage of sample.
- ✓ SOP for sample rejection.
- ✓ SOP for sample transportation and packaging.
- ✓ SOP for post exposure prophylaxis.
- ✓ SOP for sample tracking.
- ✓ SOP for sample archiving.
- ✓ SOP for hand washing technique.
- ✓ SOP for barcode breakdown.
- ✓ SOP for authentication release of report.
- ✓ SOP for report delay.
- ✓ SOP for attach and transcribe report.
- ✓ SOP for urgent sample.
- ✓ SOP for Risk Assessment.
- ✓ SOP for Bio Medical and waste management.
- ✓ SOP for fire safety.
- ✓ Logs **(**unity software, QC rejection and corrective action form, QC rejection logs)
- ✓ QC reconstitution procedure and aliquot preparation
- ✓ Special request forms
- ✓ Informed consent and Counseling forms
- ✓ Internal audit
- ✓ Quality indicators(assessed monthly)
- ✓ EQAS (reviewed monthly)

- ❖ Quality manuals DOS
- ❖ Sample collection manuals
- ❖ Safety manuals
- ❖ **Verbal Test Authorization**

- **Test Order Read Back**

8. Reference Laboratory Selection

9. Reporting Outside Results

10. Reference Laboratory Report Retention

11. Reference Laboratory Results Reporting

12. Quality control program & software requirements (runs different program for every department)

- ✓ 25 samples: 1 control level
- ✓ >25 samples: 2 control levels

13. Review of Quality control (daily bases)

14. Labeling of reagents and equipments

15. Inventory Management

16. Standards for records and reports

- ✓ Report format
- ✓ **Standard reference ranges**
- ✓ **Standard Interpretations written in the reports**
- ✓ Result modification log and errors in test results
- ✓ Archiving reports
- ✓ Report Retention and Retrieval
- ✓ Revised Report or Multiple revisions

17. Standards for personnel safety (safety manuals**)**

- ✓ Safety equipment and material safety data sheets
- ✓ Safety training
- ✓ Safety incident reporting
- ✓ Fire drill training

18. IT requirements

- ✓ Installation of computers
- ✓ Certificate for insta software
- ✓ Mail id creation for lab and staff
- ✓ Tagging of authorized doctor signature to the report
- ✓ Interface verification for all the reports by the pathologist
- ✓ Indenting system for login id credentials or rights
- ✓ IT dummy checks(report format)

- ✓ Reference range

19. Fire Prevention Policies

20. Chemical Hygiene Plan

21. Safety eye wares and Emergency Eyewash

22. Suggestion box

23. Continual Improvement

- **A checklist is made on the basis of the above prepared manual .According to the manual all the listed things should be checked before you open a new satellite laboratory, and the study is conducted in existing Satellite Laboratories of Apollo Diagnostics to know about the technical status.**

DATA COLLECTED ON THE BASIS OF TECHNICAL MANUAL IN SATELLITE LABORATORY(S L)

Table 1

TECHNICAL REQUIREMENTS	WARANGAL	RAJAMANDRY	HUBLI	MYSORE	MANGALORE	VIZAG
Space	1000sqf	790sqf	500sqf	650sqf	570sqf	1200sqf
Privacy and Confidentiality	No	No	No	No	No	No
Power						
UPS	1 (10 kva)	1 (10 kva)	1 (10 kva)	1 (10 kva)	1 (15 kva)	1 (10 kva)
Generator	1(10 kva)	1(10 kva)	1(10 kva)	1(10 kva)	1(10 kva)	1(10 kva)
Safe Water supply	Yes	Yes	Yes	Yes	Yes	Yes
Environment maintaince						
AC's	Four	two	Three	Three	Three	Three
Temperature monitor (room temp)	No	No	No	No	No	No
Refrigerator temp monitor	No	No	No	No	No	No
Legal Requirements						
Shop and establishment	No	No	No	No	Applied	No
Pollution Control	No	applied	Yes	No	Yes	No
Trade license	Applied	Applied	No	Yes	Applied	Yes
Biomedical waste agreement	YES	YES	Yes	Yes	Yes	Yes
DM and HO registration	No	applied	Applied	Yes	Applied	Yes
Housekeeping	1 part time	1 part time	1 part time	1 part time	Two	1 part time
Equipment installation (IQ,OP,PQ)	YES	YES	Yes	Yes	Yes	Yes
Bio medical waste management and agreements	YES	YES	YES	Yes	Yes	Yes
Fire safety(Extinguisher)	No	No	No	No	No	No
Security /2 CCTV	No	No	No	Yes	No	No
Technical representative visit						
Staff hiring process						

Manpower	Five	five	Five	Six	Four	Four
Job specific training, education and assessments	Yes	yes	Yes	Yes	Yes	Yes
Medical Examination of Staff	No	No	No	No	No	No
Vaccination of Staff	No	No	No	No	No	No
Visit by regional technical representative for training						
Laboratory equipments						
Ortho clinical diagnostic(vitros 250)BIOCHEM	One	One	one	One	One	One
Horiba -60(sysmax 3 parts)HAEMO	One	One	one	One	One	One
Centaur CP(semen's diagnostic)IMMUNO	One	One	one	One	One	One
Incubator	One	one	one	One	One	One
Microscopes(high resolution)	Two	two	two	Two	Two	Two
Differential counter	One	one	one	One	One	One
Centrifuge	One	one	one	One	One	One
Thermometer	No	No	no	One	No	No
Stopwatch	One	one	one	One	One	Two
Refrigerator	Two		three	Two	Two	Two
Water bath	One		one	One	One	One
Pipettes	Three	three	three	Three	Three	Three
Reagents lists	Yes	yes	Yes	Yes	Yes	Yes
IQ, OQ& PQ verification	Yes	Yes	Yes	Yes	Yes	Yes
Handing over quality documents from HO						
QSP and SOP	No	No	yes	Yes	No	Yes
QC reconstitution procedure and aliquot preparation	No	yes	Yes	No	Yes	Yes
Logs (unity software, QC rejection and corrective	Yes	No	yes	Yes	No	No
action form, QC rejection logs)						
SOP for Report Rejection(Haemolyzed sample)	No	No	no	yes	no	No
Work instructions form	No	No		yes	No	Yes

Special request forms	No	yes	yes	yes	Yes	Yes
Counseling forms	No	No	no	yes	Yes	Yes
Quality indicators(assessed monthly)		yes	-	no	No	Yes
EQAS	Yes	-	no	yes	Yes	
Quality manuals DOS	No	yes	yes	yes	Yes	Yes
Sample collection manuals	Yes	yes	no	yes	Yes	Yes
Safety manuals	No	No	no	yes	Yes	-
Verbal Test Authorization	-		yes			Yes
Test Order Read Back	Yes	-	yes			Yes
Reporting Outside Results	Yes	-	-	-	Yes	-
Reference Laboratory Report Retention	Yes				Yes	
Reference Laboratory Results Reporting						
Quality control program & software requirements	Yes	yes	yes	yes	Yes	Yes
Review of Quality control	Yes	yes	yes		Yes	Yes
Labeling of reagents and equipments	Yes	yes	yes	yes	Yes	Yes
Inventory control	Yes	yes	yes	yes	Yes	
Standards for records and reports						
Report format			-			
Result modification log and errors in test results						
Archiving reports						
Report Retention and Retrieval						
Revised Report or Multiple revised						
Standards for personnel safety (safety manuals)*****		No	no	yes	Yes	Yes
Safety equipment and material safety data sheets	Yes					

□ Safety training	Yes					
□ Safety incident reporting	Yes					
□ Fire drill training	No	No	no	no	No	No
IT requirements		Yes	yes	yes	Yes	Yes
Installation of computers						
Certificate for insta software						
Mail id creation for lab and staff						
Tagging of authorized doctor signature to the report						
Interface verification for all the reports by the pathologist						
Indenting system for login id credentials or rights						
IT dummy checks(report format)						
Reference range						
Safety eye wares and *Emergency Eyewash	-	No	No	No	No	No
Fire Prevention Policies	-	No	No	No	No	No
Chemical Hygiene Plan	-	No	-	No	No	No
Fist Aid Box	No	No	No	No	No	Yes
Interface Problem	Yes	No	No	Yes	Network problem	Sometimes
	Network				Manpower	
	Problem					

RECOMMENDATIONS:

1. Medical Examination of all the employees should be a part of hiring process.
2. Vaccination of laboratory staff.
3. Temperature monitor and refrigerator temperature monitor for every satellite laboratory.
4. Fire extinguishers for satellite labs.
5. Thermometers and First Aid Box in the satellite labs.

6. CCTV cameras in every satellite labs.
7. Fire drill training for every staff.

Reference ranges for certain parameters were not age specific , there were greater chances of error. So, ranges with different age groups are recommended.

FINAL REFERANCE RANGES

TEST NAME	Units	AGE	EXISTING REFERENCE RANGE	REC0MMENDED RANGES
ABSOLUTE EOSINOPHIL COUNT	Cells/cu.mm	Adult	20 - 500	20 - 500 Cells/cu.mm
ABSOLUTE LYMPHOCYTE COUNT (ALC)	Cells/cumm	Adult	1000 – 3000	1000 - 3000 Cells/cu.mm
ABSOLUTE NEUTROPHIL COUNT	Cells/cu.mm	Adult	2000 – 7000	2000 - 7000 Cells/cu.mm
ALBUMIN – FLUID	g/dL	Adult	Nil	Nil
ALBUMIN – SERUM	g/dL	Adult	3.5 - 5	0- 4 days: 2.8- 4.4 g/dL **(TIETZ Clinical Chemistry 6th Edition)**
				4days - 14yr: 3.8 - 5.4 g/Dl
				14 - 18 yrs: 3.2 - 4.5 g/Dl
				adult(20-60 yrs): 3.5-5.2 g/dL
				60 - 90 yrs: 3.2 - 4.6 g/Dl
				> 90 yrs: 2.9 - 4.5 g/Dl
BILIRUBIN (INDIRECT)	mg/dl	Adult	0 - 1.1	0 - 1.1 mg/dl
BILIRUBIN SERUM - TOTAL/DIRECT/INDIRECT				
BILIRUBIN DIRECT	mg/dL	Adult	0.1 - 0.2	Billirubin(Direct) Adult: 0.0 - 0.3 mg/dL
				Neonate: 0.0 - 0.6 mg/Dl
BILIRUBIN INDIRECT	mg/dL	Adult	0.2 - 0.8	Billirubin unconjugated(indirect): 0.0 - 1.1 mg/dL
	mg/dL	Adult	0.2 - 1.0	
BILIRUBIN TOTAL				Total: 0.1 - 1.2 mg/dL **(HENRY'S Clinical diagnosis)**
				Newborn total serum: 1 – 12
BLOOD GROUP ABO & Rh FACTOR				
BLOOD UREA NITROGEN*	mg/dL	Adult		Cord: 21 - 40 mg/dL **(TIETZ Clinical Chemistry 6th Edition)**
				Premature (1wk): 3 – 25
		(TABLE:2)		Newborn: 4 – 12
				Infant/ Child: 5 – 18

				Adult: 6 – 20
				Adult >60 yr: 8 – 23
C B C WITH ESR (AUTOMATION + STANDARD METHOD)*				
CELL COUNT- BODY FLUID				<5 cells/µL **(HENRY'S Clinical diagnosis)**
CHLORIDE – CSF	mmol/L	1 -120	118 - 132	1 - 120 yr: 118-132 mmol/L
CHLORIDE – CSF	mmol/L	0 - 1	110 - 130	0 - 1 yr: 110 -130 mmol/L
CHLORIDE – FLUID				
CHLORIDE - SERUM / PLASMA	meq/l	Adult	98 - 107	Cord: 96 - 104 mEq/L **(TIETZ Clinical Chemistry 6th Edition)**
				Premature: 95 - 110 mEq/L
				0 - 30 days: 98 - 113 mEq/L
				Adult: 98 - 107 mEq/L
				> 90 yrs: 98 - 111 mEq/L
CHLORIDE – SWEAT				Normal: 5 - 35 mEq/L **(TIETZ Clinical Chemistry 6th Edition)**
				Marginal: 30 – 70
				Cystic fibrosis: 60 – 200
CHOLESTEROL, FLUID				CHILD **(TIETZ Clinical Chemistry 6th Edition)**
				Desirable: < 170 mg/dL
				Borderline high:170-199 mg/dL
				High: > 199 mg/dL
				ADULT
				Desirable: < 200 mg/dL
				Borderline high:200-239 mg/dL
				High: > 239 mg/dL

CK (CPK): CREATINE KINASE – SERUM				Male: 55–170 U/L **(TIETZ Clinical Chemistry 6th Edition)**
				Female 30–135
COMPLEMENT LEVEL - C3	g/l		0.9 - 1.8	Adult(20-60yrs): 0.9 - 1.8 g/L
COMPLEMENT LEVEL C4	g/l	Adult	0.1 - 0.4	Adult(20-60yrs): 0.1 -0.4 g/L
COMPLETE BLOOD COUNT PCV	%	1 - 6	34 - 40	1-6 yr: 34 - 40 %
		6 - 12	35 - 45	6 - 12 yr: 35 - 45 %
		Adult	Male: 40 - 50	Adult: Male: 40 - 50 %
			Female: 36 - 46	Female: 36 - 46 %
COMPLETE URINE EXAMINATION(Blood)				
Colour			Pale Yellow	Pale Yellow
Bile Pigments:			Negative	Negative
Bile Salts(Hays Test):			Negative	Negative
Ketone			Negative	Negative
Crystals:			Nil	Nil
Nitrite				
RBC	/hpf	Adult	0 - 2	Adult: 0 - 2 /hpf
Glucose:			Nil	Nil
Specific Gravity		Adult	1.015 - 1.030	1.015 - 1.030
Casts:	/hpf		Nil	Nil
Leucocyte Esterases		Adult	24 - 180	Adult: 24 - 180
Transparency:			Clear	Clear
WBC/Pus Cells	/hpf	Adult	0 – 5	Adult: 0 - 5 /hpf
Reaction:			7.2 - 7.8	7.2 - 7.8
Tc/Sqc(Transitional/Squamous epithelial cells)	/hpf	Adult	2-3	Adult: 2-3 /hpf
Urobilinogen			Normal(<1mg/dl)	Normal(<1mg/dl)
Ph		Adult	4.6 – 8	Adult: 4.6 – 8

C-REACTIVE PROTEIN; CRP (QUANTITATIVE)				
CREATININE - SPOT URINE	mg/dL	Adult	25 - 400	Adult: 25 - 400 mg/dL
CREATININE CLEARANCE TEST - 24 HOURS	mL/day	adult(14-120)	600 - 2500	Adult(14-120): 600 - 2500 mL/day
	mL/day	1 to 3	500 - 600	1 to 3yr: 500 - 600 mL/day
	mL/day	3 to 5	600 - 700	3 to 5yr: 600 - 700 mL/day
	mL/day	5 to 8	650 - 1000	5 to 8yr: 650 - 1000 mL/day
	mL/day	8 to 14	800 - 1400	8 to 14yr: 800 - 1400 mL/day
CREATININE, SERUM	mL/day	Adult	0.5 - 1.3	Adult Male: 0.66–1.25 mg/dL
				Female: 0.52–1.04 mg/dL
				Child creatinine<2yr: 0.3-0.6mg/dL(**HENRY'S Clinical diagnosis**)
DIFFERENTIAL LEUCOCYTIC COUNT (DLC)				
ERYTHROCYTE SEDIMENTATION RATE (ESR)	mm/hr	0 to 70	(F) 0 - 20	Female 0 to 70 : 0 - 20 mm/hr
		70 to 120	0 - 35	70 - 120: 0 – 35
	mm/hr	0 to 70	(M) 0 - 14	Male 0 - 70yr: 0 - 14 mm/hr
		70 to 120	0 - 30	70 - 129yr: 0 – 30
FOLLICLE STIMULATING HORMONE (FSH)- SERUM	mIU/mL	Adult	Mestruating Female: Follicular Phase (2.5-10.2)	FSH Female:
			MidCycle Phase (3.4-33.4)	Follicular phase: 2.5 - 10.2 mIU/mL
			LutealPhase 1 (1.5-9.1) :	Midcycle peak: 3.4 - 33.4 mIU/mL
			Post Menopausal (23.0-116.3)	Leutal phase: 1.5 - 9.1 mIU/mL
			Males:(13-70 yrs): 1.4 - 18.1	Pregnant: < 0.3 mIU/mL
				Postmenopausal: 2.3 - 116.3 mIU/mL
				Male(13-70yr): 1.4 - 8.1 mIU/mL

FREE T3 (FT3)	pg/mL	Adult	2.3 - 4.2	2.3 - 4.2 pg/dL
FREE T4 (FT4)-SERUM	ng/dL	Adult	0.89 - 1.76	Newborn(1-4dy): 2.2-5.3**(TIETZ Clinical Chemistry 6th Edition)**
				Children(2wk-20yr): 0.8 - 2 ng/dL
				Adults(21-87yr): 0.8 - 2.7 ng/dL
				Pregnancy 1st tri: 0.7 - 2 ng/dL
				2nd & 3rd trimester: 0.5-1.6 ng/dL
Free Thyroid Panel	µIU/mL	Adult	0.35 - 4.94	Adult: 0.35 - 4.94 µIU/mL
		0 to 2	0.8 - 8.2	0 - 2 yr: 0.8 - 8.2 µIU/mL
		2 to 18	0.7 - 5.7	2 - 18 yr: 0.7 - 5.7 µIU/mL
FSH AND LH, SERUM	mIU/mL	Adult	Menstruating Female: Follicular Phase (1.9-2.5) MidCycle Peak (8.7-76.3) LutealPhase 1 (0.5-16.9) Pregnant :<1.0-1.5 Post Menopausal (15.9-54.0) Contraceptives:0.7-5.6	Menstruating Female: Follicular Phase (1.9-2.5) mIU/mL MidCycle Peak (8.7-76.3) mIU/mL LutealPhase 1 (0.5-16.9) mIU/mL Pregnant :<1.0-1.5 mIU/mL Post Menopausal (15.9-54.0) mIU/mL Contraceptives:0.7-5.6 mIU/mL
GAMMA GLUTAMYL TRANSPEPTIDASE (GGT)	U/L	Adult	Male: 15 - 85	Male: 15 - 85 U/L
			Female: 5 - 55	Female: 5 - 55 U/L
GLOBULIN: (CALCULATED) – SERUM	g/dL	Adult	2.8 - 4.5	Adult: 2.8 - 4.5 g/dL
GLUCOSE - FLUID	mg/dL	Adult	60 - 300	Adult: 60 - 300 mg/dL
GLUCOSE – CSF				Adult: 40 - 70 mg/dL**(TIETZ Clinical Chemistry 6th Edition)**
				Infant, child: 60 - 80 mg/dL

GLUCOSE - SERUM/PLASMA - FASTING AND 2 HOURS OF 75g glucose				
GLUCOSE CHALLENGE TEST GCT 50gm	mg/dl	Adult	0 - 140	Adult: 0 - 140 mg/dL
GLUCOSE CHALLENGE TEST GCT 75gm				
GLUCOSE TOLERANCE TEST (GTT, 3), GESTATIONAL, 75 G	mg/dL	Adult	0 - 92, 93 - 100, 101 – 153	Adult: 0 - 92, 93 - 100, 101 - 153 mg/dL
GLUCOSE TOLERANCE TEST (GTT, 6), 2.5 HOURS, 75 g GLUCOSE	mg/dL			
GLUCOSE TOLERANCE TEST (GTT, 9), EXTENDED, 5 HOURS, 75 G	mg/dL			
GLUCOSE TOLERANCE TEST(Serum or plasma)				**Oral Fasting**: 70–110 mg/dL **(HENRY'S Clinical diagnosis)**
				30 min: 30–60
				60 min: 20–50
				120 min: 5–15
				180 min: Fasting level or below
				Intravenous Fasting: 70–110
				5 min: Maximum of 250
				60 min: Significant decrease
				120 min:Below 120 mg/dL
				180 min: Fasting level
GLUCOSE, FASTING	mg/dL	Adult		Serum: 70–110 mg/dL **(HENRY'S Clinical diagnosis)**
				Whole blood 60–100 mg/L
GLUCOSE, FASTING (F) AND POST PRANDIAL (PP), 2 HOURS (POST MEAL)	mg/dL	Adult	70 - 140	Adult: 70 - 140 mg/dL
	mg/dL	Adult	70 - 140	
GLUCOSE, RANDOM;				
GLUCOSE-6-PHOSPHATASE DEHYDROGENASE (G6 PD)	U/gHb	Adult	4.6 - 13.5	Adult: 4.6 - 13.5 U/g Hb

GLUCOSE-URINE	mg/dL			Adult: 1 - 15 mg/dL**(TIETZ Clinical Chemistry 6th Edition)**
HCV Tri Dot				
HDL CHOLESTEROL - SERUM / PLASMA		Adult	0 - 4.5	Adult: 40 - 60 mg/dL **(TIETZ Clinical Chemistry 6th Edition)**
HEMOGLOBIN	g/dL	0 - 1	14 - 22	0 - 1 yr: 14 - 22 g/dL
		Adult	(M) 13 - 17	Adult Male: 13 - 17 g/dL
			(F) 12 - 15	Adult Female: 11.5 - 16 g/dL **(HORIBA Reference Range)**
HEMOGRAM (CBP+ ESR)				
TLC	cells/cumm	0 - 1	10000 – 26000	0 - 1 yr: 10000 - 26000 cells/cumm
	cells/cumm	2 - 3	7000 - 23000	2 - 3yr: 7000 - 23000 cells/cumm
	cells/cumm	4 - 14	6000 - 22000	4 - 14 yr: 6000 - 22000 cells/cumm
	cells/cumm	Adult	4000 - 11000	Adult: 4000 - 11000 cells/cumm
MCHC	g/dL	0 - 1	30 - 36	0 - 1 yr: 30 - 36 g/dL
	g/dL	2 - 12	31 - 37	2 - 12 yr: 31 - 37 g/dL
	g/dL	Adult	31.5 - 34.5	Adult: 32 - 36 g/dL **(HORIBA Reference Range)**
ESR	mm/hr	Adult	0 - 35	Men(17 - 50 yr): 10 or < **(DACIE and LEWIS)**
				51 - 60 yr: 19 or < mm/hr
				61 - 70 yr: 14 or < mm/hr
				> 70 yr: 30 or < mm/hr

				Women(17 - 50yr):12 or< mm/hr
				51 - 60 yr: 19 or < mm/hr
				61 - 70 yr: 20 or < mm/hr
				> 70 yr: 35 or <
HAEMATOCRIT	%	0 - 3	45 - 75	0 - 3yr: 45 - 75 %
		4 - 7	42 - 66	4 - 7yr: 42 - 66 %
		8 - 14	33 - 53	8 - 14 yr: 33 - 53 %
		Adult	(M) 40 - 50	Male: 40 - 54 **%(HORIBA Reference Range)**
			(F) 36 - 46	Female: 37 - 47 %
MCH	pg	0 - 12	31 - 37	0 - 12 yr: 31 - 37 pg
		Adult	27 - 32	Adult: 27 - 32 pg
PLATELET	lakhs/cumm	Adult	1.5 - 4.5	Adult: 1.5 - 4.5 lakhs/cumm
MONOCYTE	%	Adult	2 - 10	Adult: 2 - 10 %
EOSINOPHIL	%	0 - 12	0 - 7	0 - 12 yr: 0 - 7 %
		Adult	1 - 6	Adult: 1 - 6 %
LYMPHOCYTE	%	0 - 1	43.7 - 70	0 - 1 yr: 43.7 - 70 %
		1 - 6	32 - 60	1 - 6 yr: 32 - 60 %
		6 - 12	20 - 38.4	6 - 12 yr: 20 - 38.4 %
		Adult	20 - 40	Adult : 25 - 50 % **(HORIBA Reference Range)**
RDW	%	Adult	11.6 - 14	Adult: 11 - 16 %**(HORIBA Reference Range)**

RBC	millions/cu mm	0 - 1	5 - 7	0 - 1 yr: 5 - 7 millions/ mm^3
		2 - 12	4 - 5.2	2 - 12 yr: 4 - 5.2
		Adult	(M) 4.5 - 5.5	Male: 4.5 - 5.5
			(F) 3.8 - 4.8	Female: 3.8 - 4.8
MCV	fl	0 - 1	100 - 120	0 - 1 yr: 100 - 120 fl
		2 - 6	75 - 87	2 - 6 yr: 75 - 87 fl
		6 - 12	77 - 95	6 - 12 yr: 77 - 95 fl
		Adult	83 - 101	Adult: 83 - 101
HIV RAPID		Adult	0 - 0.9	Adult: 0 - 0.9
INSULIN - SERUM – RANDOM	mU/L	Adult	3.5 - 25	Adult: 3.5 - 25 mU/L
INSULIN (FASTING) – SERUM	mU/L	Adult	3.0 – 25	Adult: 3.5 - 25 mU/L
INSULIN (PP) – SERUM				
IRON – SERUM	µg/dL	Adult	Female: 50 - 170	Female: 37–170 µg/dL
			Male: 65 - 175	Male: 49–181
IRON AND IRON BINDING CAPACITY-SERUM				
LDH: LACTATE DEHYDROGENASE – FLUID	U/L			
LDH: LACTATE DEHYDROGENASE – SERUM	U/L	Adult	135 - 214	Adult: 313 – 618 U/L**(VITROS REFRANCE RANGE)**
LDL CHOLESTEROL - SERUM / PLASMA (CALCULATED VALUE)	mg/dL	Adult	60 - 150	Adult: 60 - 150 mg/dL
LDL CHOLESTEROL - SERUM / PLASMA (DIRECT LDL)	mg/dL	Adult	30 - 99.9	Adult: 30 - 99.9 mg/dL
LDL CHOLESTEROL / HDL CHOLESTEROL	mg/dL	Adult	30 - 150	Adult: 30 - 150 mg/dL
LH FSH PROLACTIN-PROFILE*	ng/mL			

LH: LEUTINIZING HORMONE – SERUM	mlU/ml			Females normal menstruation
				Follicular phase: 1.9 - 12.5 mlU/ml
				Midcycle phase: 8.7 - 76.3 mlU/ml
				Luteal phase: 0.5 - 16.9 mlU/ml
				Pregnant: < 0.1 - 1.5 mlU/ml
				Postmenopausal: 15.9 – 54
				Contraceptive: 0.7 - 5.6
				MALES(20-70): 1.5 - 9.3 mlU/ml
				> 70: 3.1 - 34.6
				Children: < 0.1 -6 mlU/ml
LIPID PROFILE HDL	mg/dL	Adult	35 - 75	Adult: 35 - 75 mg/dL
LIVER FUNCTION TESTS (LFT) PROTEIN	g/dl	Adult	(M) 6.3 - 8.2	Adult: 6.3 - 8.2 g/dL
			(F) 6 - 8.2	
MAGNESIUM – SERUM	mg/dL	Adult	1.6 - 2.3	Newborn2-4dys: 1.5-2.2 mg/dL **(HENRY'S Clinical diagnosis)**
				5mon-6yr: 1.7-2.3
				6 - 12 yr: 1.7 - 2.1
				> 12yr: 1.6 - 2.6
MONOCYTE COUNT, ABSOLUTE	Cells/cumm	Adult	200 - 1000	Adult: 200 - 1000 Cells/cumm
PCV	%	0 - 1	45 - 75	0- 1yr: 45 - 75 %
		1 - 6	34 - 40	1 - 6 yr: 34 - 40 %
		6 - 12	35 - 45	6 - 12 yr: 35 - 45 %
		Adult	(M) 40 - 50	Male: 40 – 50
			(F) 36 - 46	Female: 36 – 46
PLATELET COUNT AND MORPHOLOGY	lacs/cumm	Adult	1.5 - 4.1	Adult: 1.5 - 4.1 lacs/cumm

POTASSIUM - 24 HR URINE*	mmol/day	Adult	25 - 125	Adult: 25 - 125 mmol/day
POTASSIUM – FLUID	mmol/L			
POTASSIUM - SERUM / PLASMA	mEq/L	Adult	3.5 - 5	Newborn:3.7 -5.9 mEq/L **(TIETZ Clinical Chemistry 6th Edition)**
				Infant: 4.1 - 5.3
				Child: 3.4 - 4.7
				Adults: 3.5 - 5.1
PLASMA				Male: 3.5 - 4.5
				Female: 3.4 - 4.4
POTASSIUM - SPOT URINE	mmol/L	Adult	20 - 40	
PREGNANCY TEST (Card Method)			Positive/ Negative	
PROLACTIN – SERUM	ng/mL	Adult	(M) 2.1 - 17.7	Cord blood-45-539 ng/mL**(TIETZ Clinical Chemistry 6th Edition)**
			(F) 1.8 - 20.8	**Children stage1**: Male: <10 **Female**: 3.6 – 12
				Children stage 2 – 3
				Male: < 6.1 ng/mL
				Female: 2.6 – 18
				Children stage 4-5
				Male: 2.8 - 11 ng/mL
				Female: 3.2 - 20 ng/mL
				Adult Male: 3.0 - 14.7
				Female: 3.8 – 23
				Pregnancy third trimester: 95 - 473 ng/mL
PROSTATIC SPECIFIC ANTIGEN (PSA TOTAL)	ng/mL	Adult	0 - 4	Males 40-49yr: 0-2.5 **ng/mL(TIETZ**

				Clinical Chemistry 6th Edition)
				50 - 59 yr = 0 - 3.5 ng/mL
				60 - 69 yr = 0 - 4.5 ng/mL
				70 - 79 yr = 0 -6.5 ng/mL
PROTEIN, TOTAL - 24 HR URINE*	mL/day	1 - 3	500 - 600	1 - 3 yr: 500 - 600 mL/day
		3 - 5	600 - 700	3 - 5 yr: 600 - 700 mL/day
		5 - 8	650 - 1000	5 - 8yr: 650 - 1000 mL/day
		8 - 14	800 - 1400	8 - 14 yr: 800 - 1400 mL/day
		Adult	600 - 2500	Adult: 600 - 2500 mL/day
	mg/day	Adult	1 - 149	Adult: 1 - 149 mg/day
	g/dl	Adult	6.4 - 8.2	Adult: 6.4 - 8.2 g/dl
PROTEIN, TOTAL – CSF				Premature:15-130mg/dL(TIETZ Clinical Chemistry 6thEDITION)
				Full term newborn: 40 - 120 mg/dL
				< 1month: 20 - 80 mg/dL
				> 1month: 15 - 40 mg/dL
				Ventrical fluid: 5 - 15 mg/dL
PROTEIN, TOTAL - SERUM / PLASMA	g/dL	Adult	6.3 - 8.2	7mon-1yr:5.1 -7.3 g/dL**(TIETZ Clinical Chemistry 6th EDITION)**
				1 - 2yr: 5.6 - 7.5 g/dL
				>2 yr: 6.0 - 8.0 g/Dl
				Adult, ambulatory: 6.4 - 8.3 g/dL
				Adult, recumbent: 6.0 - 7.8 g/dL
				>60yrs : Lower by 0.2
RENAL FUNCTION TEST	mg/dl	Adult	(M) 3.5 - 8.5	Male: 3.5 - 8.5 mg/dl

			(F) 2.5 - 6.2	Female: 2.5 - 6.2 mg/dl
RETICULOCYTE COUNT*	%	0 - 1	1.2 - 4	0 - 1 yr: 1.2 - 4 %
		1 - 12	0.3 - 1	1 - 12 yr: 0.3 - 1 %
		Adult	0.5 - 2.5	Adult: 0.5 - 2.5 %
SERUM ELECTROLYTES Sodium Na+	meq/L	Adult	135 145	Adult: 135 145 meq/L
SODIUM - 24 HR URINE	mmol/day	Adult	40 - 220	6-10yr Male: 41-115 (TIETZ Clinical Chemistry 6th Edition)
				10- 14yr : 63 - 177 mmol/day
				Adult : 40 – 220
				6 - 10yr Female: 20 - 69 mmol/day
				10 - 14 yr: 48 – 168
				Adult Female: 27 – 287
SODIUM - SERUM / PLASMA*	mEq/L		131 - 144	Newborn:133-146mEq/L**(TIETZ Clinical Chemistry 6th Edition)**
				Infant: 139 - 146 mEq/L
				Child: 138 - 145 mEq/L
				Adult: 136 - 145 mEq/L
				> 90yrs: 132 - 146 mEq/L
SODIUM - SPOT URINE	mmol/L	Adult	0 - 10	Adult: 0 - 10 mmol/L
STOOL EXAMINATION, OCCULT BLOOD RBC*		0 -1	5 - 7	0 - 1 yr: 5 – 7
		2 - 12	4 - 5.2	2 - 12 yr: 4 - 5.2
		Adult	0 - 2	
REACTION		Adult	7.2 - 7.8	Adult: 7.2 - 7.8
STOOL EXAMINATION, PH & REDUCING SUBSTANCES				
TESTOSTERONE, TOTAL, SERUM	ng/dL	Adult	14 - 76	Cord male: 13 - 55 ng/dL **(TIETZ**

				Clinical Chemistry 6th Edition)
				Female: 5 - 45 ng/dL
				Premature M: 37 - 98 ng/dL
				Female: 5 – 22
				Newborn Male: 75 – 400
				Female: 20 – 64
				Prepubertal child 1-5mnth:1 – 177
				Female: 1-5
				6 - 11 months M: 2 – 7
				Female: 2 – 5
				1 - 5 yr M: 2 – 25
				Female: 2 – 10
				6 - 9 yr M: 3 – 30
				Female: 2 – 20
				Puberty, Tanner Stage:
				1 M : 2 – 23
				1 F : 2 – 10
				2 M : 5 – 70
				2 F : 5 – 30
				3 M : 15 – 280
				3 F : 10 – 30
				4 M : 105 – 545
				4 F : 15 – 40
				5 M : 65 – 800
				5 F : 10 – 40
				Adult M :260 - 1000 ng/dL
				Adult F : 15 - 70 ng/dL

THYROID STIMULATING HORMONE (TSH), SERUM	µIU/mL	0 - 2	0.8 - 8.2	0 - 2yr: 0.8 - 8.2 µIU/mL
		2 - 18	0.7 - 5.7	2 -18 yr: 0.7 - 5.7 µIU/mL
		Adult	0.35 - 5.5	Adult: 0.35 - 5.5 µIU/mL
TOTAL LEUCOCYTE COUNTS AND DIFFERENTIAL LEUCOCYTE COUNTS	$10^3/mm^3$	0 - 1	6000 - 16000	0 - 1yr: 6 -16 $10^3/mm^3$
		3 - 14	6000 - 22000	3 - 14 yr: 6 - 22 $10^3/mm^3$
		Adult	4000 - 10000	Adult: 4000 – 10000 $10^3/mm^3$
NEUTROPHIL	%	0 - 1	51 - 71	0 - 1 yr: 51 -71 %
		1 - 7	35 - 55	1 7 yr: 35 -55 %
		7 - 14	30 - 50	7 - 14 yr: 30 - 50
		Adult	40 - 80	Adult: 40 - 80
LYMPHOCYTE	%	0 - 1	43.7 - 70	0 - 1 yr: 43.7 -70 %
		3 - 14	21 - 40.9	3 - 14yr: 21 - 40.9 %
		Adult	20 - 40	Adult: 20 - 40 %
MONOCYTE	%	Adult	2 - 10	Adult: 2 - 10 %
EOSINOPHIL	%	0 - 12	0 - 7	0 - 12 yr: 0 - 7 %
		Adult	1 - 6	Adult: 1 - 6 %
BASOPHIL	%	Adult	0 - 2	Adult: 0 - 2 %

Total BETA- HCG (Tβ-HCG)-SERUM	miU/mL	Non Pregnant - < 0.1 -5		Non Pregnant - < 0.1 -5 miU/mL
		Post Gestation Weeks		Post Gestation Weeks
		0.2 - 1 Week : 5 – 50		0.2 - 1 Week : 5 – 50
		1 - 2 Week: 50 – 500		1 - 2 Week: 50 – 500
		2 - 3 Week: 100 – 5000		2 - 3 Week: 100 – 5000
		3 - 4 Week: 500 – 10000		3 - 4 Week: 500 – 10000
		4 - 5 Week: 1000 – 50000		4 - 5 Week: 1000 – 50000
		5 - 6 Week: 10,000 – 100000		5 - 6 Week: 10,000 – 100000
		6 - 8 Week: 15,000 – 200000		6 - 8 Week: 15,000 – 200000
		2 Months: 10000 – 100000		2 Months: 10000 – 100000
TOTAL CHOLESTEROL-SERUM	mg/dL	0 - 16(M)	Cord Blood : 46 - 98	Male 0 -16: Cord Blood : 46 - 98mg/dL
			1 - 2 Years : 17 - 190	1 - 2 Years : 17 -190
			2 - 16 Years : 135 - 250	2 - 16 Years : 135 – 250
	mg/dL	Adult	<200 - Desirable	Adult: <200 - Desirable mg/dL
			200-239 - Borderline High	200-239 - Borderline High
			>=240 - High	>=240 – High
		0 - 16(F)	Cord Blood : 46 - 98 1 - 2 Years : 17 - 190 2 - 16 Years : 135 - 250	Cord Blood : 46 - 98 mg/dL 0 - 16(F) : 1 - 2 Years : 17 - 190 2 - 16 Years : 135 – 250
		Adult	<200 - Desirable 200-239 - Borderline High >=240 - High	Adult: <200 - Desirable mg/dL 200-239 - Borderline High >=240 – High

TOTAL IRON BINDING CAPACITY (TIBC) - SERUM	µg/dl	Adult	250 - 450	Male: 261 – 462 µg/dL **(VITROS Refrance Range)**
				Female: 265 – 497
TOTAL LEUCOCYTE COUNT (TLC)	cells/cumm	0 - 1	10000 -20000	0 - 1 yr: 10000 -20000 cells/cumm
		2 - 3	7000 - 23000	2 - 3 yr: 7000 - 23000 cells/cumm
		4 - 7	7000 - 18000	4 - 7 yr: 7000 - 18000 cells/cumm
		8 - 14	7000 - 16000	8 - 14 yr: 7000 - 16000 cells/cumm
		Adult	4000 - 11000	Adult: 4000 - 11000 cells/cumm
TOTAL PROTEIN AG – RATIO	g/dL	Adult	6.4 - 8.7	Adult: 6.4 - 8.7 g/dL
TOTAL RBC COUNT	millions/Cumm	0 - 1	5 - 7	0 -1 yr: 5 -7
		1 - 12	4 - 5.2	1 - 14 yr: 4 - 5.2
		Adult	(M) 4.5 - 5.5	(M) 4.5 - 5.5
			(F) 3.8 - 4.8	(F) 3.8 - 4.8
TRIGLYCERIDES – SERUM	mg/dl	Adult	10 - 40	Normal: <150 mg/Dl
				Borderline High: 150–199 mg/Dl
				High: 200 – 499 mg/dL
				Very High: ≥ 500 mg/dL
UREA - 24 HR URINE	g/dL	Adult	26 - 46	Adult: 26 - 46 g/Dl
	mL/day	1 - 5	500 - 700	1 - 5yr : 500 -700 mL/day
		5 - 8	650 - 1000	5 - 8 yr: 650 -1000 mL/day
		8 - 14	800 - 1400	8 - 14 yr: 800 - 1400 mL/day
		Adult	600 - 2500	Adult: 600 - 2500 mL/day

UREA - SERUM / PLASMA	mg/dl	Adult	(M) 19 - 43	Male: 19 - 43 mg/dl
			(F) 15 - 36	Female: 15 - 36 mg/dl
UREA - SPOT URINE	mg/dL	Adult	30 - 85	Adult: 30 - 85 mg/dL
CREATININE - SPOT URINE(Modified Jaffe:Alkaline Picrate)	mg/dL	Adult	25 - 400	Adult: 25 - 400mg/dL
URIC ACID – SERUM	mg/dL	Adult	(M) 3.5 - 8.5	Male : 4 – 8.5 mg/dL **(HENRY'S Clinical diagnosis)**
			(F) 2.5 - 6.2	Female : 2.7 – 7.3 mg/dL
URIC ACID - SPOT URINE	mg/dL	Adult	1 - 38	Adult: 1 - 38 mg/dl
CREATININE - SPOT URINE(Modified Jaffe:Alkaline Picrate)	mg/dL	Adult	25 - 400	Adult: 25 - 400 mg/dL
URINE - ALBUMIN/PROTIEN				
URINE UROBILINOGEN				
URINE- BENCE JONES PROTEINS				
URINE ELECTROLYTES	meq/L			
URINE FOR CALCIUM OXALATE			negative	Negative
URINE FOR CALCIUM/CREATININE RATIO			negative	Negative
URINE FOR CHYLE				
URINE FOR EOSINOPHIL COUNT			1.015 - 1.03	1.015 - 1.03
URINE FOR GLOBULIN			negative	Negative
URINE FOR HEMOGLOBIN				
URINE FOR KETONES			negative	Negative
URINE FOR NITRITES			negative	Negative
URINE PH				
URINE PROTEIN / CREATININE RATIO				
VITAMIN B12 –SERUM	pg/ml	Adult	211 - 911	Adult: 160–950 pg/mL **(HENRY'S Clinical diagnosis)**

VLDL CHOLESTEROL - SERUM calculated	mg/dL		8 - 40	
VLDL CHOLESTEROL – SERUM	mg/dL		10 - 40	10 - 40 mg/dL **(Existing Refrance Range)**
LDL CHOLESTEROL - CALCULATED.	mg/dL		60 - 150	Optimal: <100 mg/dL **(TIETZ Clinical Chemistry 6th Edition)**
				Near/above optimal: 100-129 mg/dL
				Boderline high: 130 - 159 mg/dL
				High: 160 - 189 mg/dL
				Very high: > 189 mg/dL
WIDAL TEST (TUBE METHOD)				
LFT protein total	g/dL	Adult	(M) 6.3 - 8.2	Adult Male: 6.3 - 8.2 g/dL
			(F) 6 - 8.2	Adult: Female: 6 - 8.2 g/dL
KFT RENAL PROFILE(CREATININE - SERUM / PLASMA)	mg/dL	Adult	(M) 0.8 - 1.3	Adult Male: 0.8 - 1.3 mg/dL
			(F) 0.6 - 1	Adult Female: 0.6 - 1 mg/dL
KFT RENAL PROFILE (ALBUMIN - SERUM)	g/dL	Adult	3.4 - 5	Adult: 3.4 - 5 g/dL
CHLORIDE - SERUM / PLASMA	meq/l	Adult	95.00 - 106.00	0-30 days: 98 - 113 mEq/L**(TIETZ Clinical Chemistry 6th Edition)**
				Adult: 98 - 107 mEq/L
				> 90 yrs: 98 - 111 mEq/L
POTASSIUM – SERUM	meq/L	Adult		Newborn: 3.7 - 5.9 mEq/L**(TIETZ Clinical Chemistry 6th Edition)**
				Infant: 4.1 - 5.3
				Child: 3.4 - 4.7
				Adult: 3.5 - 5.1
RENAL (KIDNEY) FUNCTION TESTS,MINI URINE RT, CREATININE,			negative	

URIC ACID, BUN, PROTEINS, ELECTROLYTES				
UREA - SERUM / PLASMA	mg/dL	Adult	15 - 37	
CREATININE - SERUM / PLASMA	mg/dl	Adult	Male: 0.66–1.25	0 - 1yr: 0.04 - 0.33 mg/dL **(TIETZ Clinical Chemistry 6th Edition)**
			Female: 0.52–1.04	2 - 5 yr: 0.04 - 0.45 mg/dl
				6 - 9 yr: 0.20 - 0.52 mg/dl
				10yr: 0.22 - 0.59 mg/dl
				Adult Male: 0.62 - 1.10 mg/dl
				Adult Female: 0.45 - 0.75 mg/dl
ANTI - THYROID ANTIBODIES	µIu/mL	Adult	0 - 12	
TOTAL T4: THYROXINE – SERUM	µg/dL	Adult	4.5 - 10.9	Hypothyroid: 0.0-5.5 µg/dL **(CENTAUR Refrance Range)**
				Hyper: 10.8 - 19.1
				Pregnant euthyroid: 6.4 - 10.7
				Sick euthyroid: 1,9 - 13.3
				Adult: 4.5 - 10.9 µg/dL **(EXISTING RANGE)**
TOTAL T3: TRI IODOTHYRONINE – SERUM	ng/mL	Adult	0.6 - 1.81	Cord(>37 week): 5 - 141 (TIETZ Clinical Chemistry 6th Edition)
				Children 1-3days:100 - 740 ng/dL
				1-11 months: 105 - 245 ng/dL
				1 - 5 yr: 105 - 269 ng/dL
				6 - 10yr: 94 - 241 ng/dL
				11 - 15 yr: 82 - 213 ng/dL
				Pregnancy 1st tri: 81 - 190 ng/dL
				2nd &3rd trimester: 100-260 ng/dL
				Adult : 0.6 - 1.81 ng/dL **(EXISTING RANGE)**

VOMITUS FOR OCCULT BLOOD			Positive/Negative	
URINE FOR CYTOLOGY				
GLUCOSE - ASCITIC / PERITONEAL FLUID				
GLUCOSE - PLEURAL FLUID				
ARTHRITIS PROFILE				
GLUCOSE & URINE FOR GLUCOSE	ng/Ml		25.9 69.1	
BILIRUBIN CONJUGATED (DIRECT) – SERUM	mg/dl		0 - 0.2	
IGE (TOTAL)				

RECOMMENDATION:

- ✓ **The above recommended reference values are given age wise; it should be implemented in the system so that the reference ranges in the reports are more specific.**

- **Interpretations are the important part of a report format. It is useful for both physicians as well as patients. It gives an overview of a particular condition related to that parameters. So, interpretations for particular parameters are recommended in Apollo Diagnostics reports.**

FINAL INTERPRETATION:

TABLE3

TEST NAME	INTERPRETATIONS
ALBUMIN	A low albumin suggests liver diseases. Low albumin levels can also be seen in inflammation, shock, malnutrition and in Crohns disease or celiac disease, or when large volumes of protein are lost from the intestines. High levels can be seen in dehydration.
BILIRUBIN SERUM – TOTAL	Lower than normal bilirubin levels are usually not a concern. Elevated levels indicates liver damage or disease, premature infants may be affected at lower levels. In Gilbert's syndrome levels are high. Central nervous system damage is rare when total serum bilirubin (TSB) is <20 mg/dL, premature infants may be affected at lower levels.
BLOOD GROUP ABO & Rh FACTOR	Rh negative mother carrying Rh positive baby than Rh incompatibility is there. If you're Rh positive, Rh incompatibility isn't a concern. **Female Rh Male Rh Baby's Rh factor Precautions** Rh- Rh+ Could be Rh+/ Rh- Rh immune globulin injection
BLOOD UREA NITROGEN	Urea nitrogen/creatinine ratio. Lower ratios denote acute tubular necrosis, low protein intake, starvation or severe liver disease. High ratios with normal creatinine levels may be noted with catabolic states of tissue breakdown, prerenal azotemia, high protein intake, etc. High ratios associated with high creatinine concentrations may denote either postrenal obstruction or prerenal azotemia superimposed on renal disease.
ESR	ESR is used to diagnose certain specific inflammatory diseases, temporal arthritis, systemic vasculitis and polymyalgia rheumatic. Low ESR can be seen in conditions like polycythemia, leukocytosis and some protein abnormalities. The complete blood picture (CBP) is often used as a broad screening test to diagnose various conditions, such as anemia, infection, inflammation, bleeding disorder or leukemia.

CHLORIDE - 24 HR URINE	Low values indicate appropriate renal reabsorption of these ions, whereas elevated values indicate inappropriate excretion (renal wasting). Urinary sodium and chloride excretion may be dissociated during metabolic alkalosis with volume depletion where urine sodium excretion may be high while urine chloride excretion remains appropriately low.
CHLORIDE – CSF	Cerebrospinal fluid chloride levels generally reflect systemic (blood) chloride levels. Decreased chloride levels of cerebrospinal fluid in patients with amyotrophic lateral sclerosis
CHLORIDE - SERUM / PLASMA	In normal individuals, serum chloride values vary little during the day, although there is a slight decrease after meals due to the diversion of chloride to the production of gastric juice. High level indicates dehydration, starvation, Addison disease, or increased salt intake. Low levels can be seen in Cushing syndrome, Conn syndrome, congestive heart failure, malabsorption syndrome, and diarrhea.
CHLORIDE – SWEAT	Sweat testing is the standard method for diagnosing cystic fibrosis. A result between 40 to 59 mmol/L does not give a clear diagnosis.If the result is 60 mmol/L or greater, cystic fibrosis is present.
CK (CPK): CREATINE KINASE – SERUM	High level seen in all types of muscular dystrophy, especially in Duchenne type, in which the levels are up to 50 times the upper limit of normal value. Enzyme activity in serum is highest during infancy and childhood (7-10 years of age) and can be seen before the disease is clinically evident. Higher values noted in viral myositis, polymyositis, malignant hyperthermia.
COMPLEMENT LEVEL - C3	Low levels seen in disease activation in systemic lupus erythematosus (SLE).
COMPLEMENT LEVEL C4	Low levels seen in acquired autoimmune disorders, in active phase of lupus erythematosus, and in rheumatoid arthritis.
COMPLETE BLOOD COUNT	**Platelets** :Thrombocytopenia causes are Cancer treatments such chemotherapy or radiation, auto immune disorders.A high platelet count are in conditions: cancer,anaemias,rheumatoid arithritis, tuberculosis.**TLC:** Low in patients undergoing Chemotherapy or Radiation therapy, Aplastic anemia, Influenza, Typhoid, Malaria, Dengue,tuberculosis.High values in new born babies, Viral, fungal, bacterial or parasitic infections,Rheumatic arthritis, acute stages of gouts,Leukemia.**RBC**: Low value in Bone marrow failure,anaemia, pregnancy,hemorrhage,leukaemia,nutritional deficiencies.High values present in Congenital heart disease, Pulmonary fibrosis, hypoxia, kidney tumors.
C-REACTIVE PROTEIN; CRP (QUANTITATIVE)	Elevated values are seen in an acute inflammatory

	process.After onset of an acute phase, the serum CRP concentration rises rapidly (within 6-12 hours and peaks at 24-48 hours) and extensively. Concentrations above 100 mg/L are associated with severe stimuli such as major trauma and severe infection (sepsis)
CREATININE CLEARANCE TEST - 24 HOURS	Low creatinine clearance have low glomerular filtration rate (GFR) and can be seen in progressive renal diseases, including drug effects or decreases in effective renal perfusion.Increased levels are most commonly seen during pregnancy or in patients with diabetes mellitus, also seen in large dietary protein intake.
CREATININE, SERUM	High level indicates blocked urinary tract, kidney damage or failure, infection, dehydration. Low values found in conditions involving the muscles and nerves that lead to decreased muscle mass, malnutrition.S
FREE T3 (FT3)	Elevated free triiodothyronine (FT3) values are associated with thyrotoxicosis or excess thyroid hormone replacement.
FREE T4 (FT4)-SERUM	Elevated values suggest hyperthyroidism or exogenous thyroxine.Decreased values suggest hypothyroidism.Free thyroxine (FT4) works well to correct total T4 values for thyroxine-binding globulin alterations, but may give misleading values when abnormal binding proteins are present or the patient has other major illnesses
GAMMA GLUTAMYL TRANSPEPTIDASE (GGT)	High levels are seen in any forms of liver disease, though the highest elevations are seen in intra- or post-hepatic biliary obstruction. Elevated values also indicate alcoholic cirrhosis..The finding of normal GGT activity and increased ALP activity is consistent with skeletal disease.
GLUCOSE – CSF	Cerebrospinal fluid (CSF) glucose levels may be decreased in any central nervous system infection, although levels are typically normal in viral meningitis, low in bacterial meningitis, and may be normal or low in fungal meningitis.CSF glucose levels are normally about 60% of blood glucose levels.
GLUCOSE TOLERANCE TEST (GTT)	To get reliable results, good health (not any other illnesses, not even a cold) is required. Patient not taking any medicines that could affect the blood glucose. On test morning no smoking or coffee is recommended. Test is conducted by measuring blood glucose levels times over a period of 3 hours. Person without diabetes, the glucose levels in the blood rise following drinking the glucose drink, but then they fall quickly back to normal. In diabetic, glucose levels rise higher than normal after drinking the glucose drink and come down to normal levels much slower. Person is diabetes when oral glucose tolerance tests show the blood glucose level at 2 hours is equal to or more than 200 mg/dL.

GLUCOSE (RANDOM;FASTING)	Fasting plasma or serum glucose > or =126 mg/dL after an 8-hour fast, 2-Hour plasma or serum glucose > or =200 mg/ dL during a 75-gram oral glucose tolerance test (OGTT), Random glucose >200 mg/dL, plus typical symptoms. Random glucose >200 mg/dL, plus typical symptoms can be considered diagnostic for diabetes Patients having fasting serum glucose between 101 and 126 mg/dL, or whose 2-hour value on oral glucose tolerance is between 140 and 199 mg/dL. They have a markedly increased risk of developing type 2 diabetes.
	Indications for screening and testing include strong family history, marked obesity, history of babies over 9 pounds, and recurrent skin and genitourinary infections. Glucose levels < or =25 mg/dL in infants <1 week are life threatening similar are glucose levels < or =40 mg/dL in infants >1 week. Glucose levels > or =400 mg/dL are critical.
GLUCOSE-6-PHOSPHATASE DEHYDROGENASE (G6 PD)	Hemolytic disease may be associated with deficiency of any 1 of 20 erythrocyte enzymes. The most commonly encountered is a deficiency of glucose-6-phosphate dehydrogenase (G-6-PD).Abnormal values are usually 0% to 20% of normal mean.
GLUCOSE-URINE	Elevated urine glucose concentration reflects either the presence of hyperglycemia or a defect in proximal tubule function.As a screening test for diabetes mellitus, urine glucose testing has a low sensitivity (though reasonably good specificity).
HBS AG SCREENING(RAPID)	A result confirmed as positive by hepatitis B surface antigen (HBsAg) confirmatory test or a positive screen result indicates acute or chronic hepatitis B virus (HBV) infection.Specimens with reactive screen results but negative,repeat testing is recommended at a later date if clinically indicated.Confirmed presence of HBsAg is frequently associated with HBV replication and infectivity, especially when accompanied by presence of hepatitis B envelope (HBe) antigen and HBV DNA.
HDL CHOLESTEROL - SERUM / PLASMA	High levels have increased risk for coronary heart disease (CHD). Values > or =80 to 100 mg/dL may indicate metabolic response to certain medications such as hormone replacement therapy, chronic liver disease, or some form of chronic intoxication, such as with alcohol, heavy metals, or industrial chemicals including pesticides.HDL values < or =5 mg/dL occur in Tangier disease, in association with cholestatic liver disease, and in association with diminished hepatocyte function
HEMOGLOBIN	Low hemoglobin with low RBC count and low hematocrit indicates anemia present in excessive loss of blood, An abnormal or unstable result is indicative of a hemoglobin

	variant present. Other confirmatory tests should be performed to identify the hemoglobinopathy (Hemoglobin Electrophoresis)
INSULIN – SERUM	Insulin levels are low in patients with type 1 diabetes mellitus.Levels are normal or elevated in the early stage of type 2 diabetes. In the late stage of type 2 diabetes Insulin levels decline.In normal individuals, insulin levels parallel blood glucose levels.
IRON –SERUM	Used for screening of chronic iron diseases, particularly hereditary hemochromatosis. In hereditary hemochromatosis, serum iron is usually >150 mcg/dL and percent saturation is >60%. In advanced iron overload states, the percent saturation often is >90%.
LDH: LACTATE DEHYDROGENASE – SERUM	High levels seen in megaloblastic anemia, untreated pernicious anemia, Hodgkin's disease, abdominal and lung cancers, severe shock, and hypoxia. Moderate to slight increases in myocardial infarction (MI), pulmonary infarction, pulmonary embolism, leukemia, hemolytic anemia, infectious mononucleosis, progressive muscular dystrophy (especially in the early and middle stages of the disease), liver disease, and renal disease.
LDL CHOLESTEROL - SERUM / PLASMA	Risk factors are family history of coronary heart disease (CHD), hypertension, cigarette smoking, obesity, diabetes mellitus, and low HDL cholesterol. Complications due to fat malabsorption may be present in affected individuals. Undetectable LDL-C is highly suggestive of abetalipoproteinemia. Related polyneuropathy may exist in affected individuals.
LH and FSH : SERUM	In females high levels are observed in Complete testicular feminization syndrome, Precocious puberty, Menopause, Primary ovarian hypodysfunction, Polycystic ovary disease and Primary hypogonadism in males. Decreased in Primary ovarian hyper function in females, Primary hypergonadism in males and failure of the pituitary or hypothalamus.
MAGNESIUM – SERUM	Symptoms of magnesium deficiency do not typically appear until levels are < or =1.0 mg/dL. Levels > or =9.0 mg/dL may be life-threatening.Low levels are due to elevated C-reactive protein, hypertension, cardiovascular disease, osteoporosis.
POTASSIUM - 24 HR URINE	Urine excretion of >30 mEq/d in a hypokalemia is inappropriate and indicates kidneys are the primary source of the lost K+.Potassium levels can be affected by how the kidneys are working, the blood pH, the amount of potassium you eat, the hormone levels in your body, severe vomiting, and taking certain medicines, such as diuretics and potassium supplements.

POTASSIUM – FLUID	Plasma K=values less than 3.0 mEq/L are associated with marked neuromuscular symptoms and are evidence of a critical degree of intracellular depletion. K(+) values < 2.5 mEq/L are potentially life-threatening.
POTASSIUM - SERUM / PLASMA	At level <3.0 mmol/L neuromuscular symptoms and critical degree of intracellular depletion are seen. < 2.5 mmol/L are potentially life-threatening. High level can be an acute medical emergency, particularly if it increases over a short period of time. Values >6.0 mmol/L, are potentially life-threatening and >10.0 mmol/L are fatal.
PROLACTIN – SERUM	Moderately high concentrations are not a reliable guide for determining a prolactin-producing pituitary adenoma is present. After start of medical therapy, failure to suppress prolactin levels may indicate tumors resistant however,some patients will show tumor shrinkage despite persistent hyperprolactinemia. In patients with asymptomatic hyperprolactinemia, assessment for macroprolactin is done.
PROSTATIC SPECIFIC ANTIGEN (PSA TOTAL)	PSA concentration <2.0 ng/mL, the probability of prostate cancer in asymptomatic men is low. When total PSA concentration is >10.0 ng/mL, the probability of cancer is high .The total PSA range of 4.0 to 10.0 ng/mL is described as a diagnostic "gray zone," in which the free:total PSA ratio helps to determine the relative risk of prostate cancer.
PROTEIN, TOTAL - 24 HR URINE	Urinary protein levels may rise to 300 mg/24 hours in healthy individuals after vigorous exercise. Low-grade proteinuria may be seen in inflammatory or neoplastic processes involving the urinary tract.
SODIUM - 24 HR URINE	Urinary sodium (Na+) excretion varies with dietary intake, and during the night Na+ excretion is only 20% of the peak rate during the day. Low levels in kidney are due to diuretic therapy, adrenal insufficiency. In hypervolemic states, a low urine Na+ (<10 mEq/L) may indicate nephrotic syndrome in addition to non-renal causes.
SODIUM - SERUM / PLASMA	Sodium values <120 mEq/L result in weakness, values <100 mEq/L in bulbar or pseudobulbar palsy; and values between 90 and 105 mEq/L in severe signs and symptoms of neurological impairment.Hypernatremia causes dehydration, drugs such as steroids, endocrine diseases such as diabetes.
TESTOSTERONE, TOTAL, SERUM	In males: Low levels indicate partial or complete hypogonadism. Cause is either primary or secondary/tertiary testicular failure. Primary testicular failure is due to elevated LH and FSH levels and low total bioavailable and free testosterone levels. Secondary/tertiary hypogonadism shows low testosterone and low LH/FSH levels. Elevated levels of testosterone are seen in

	precocious puberty. In females levels be observed in primary or secondary ovarian failure. High level seen in Congenital adrenal hyperplasia.
THYROID STIMULATING HORMONE (TSH), SERUM	TSH levels will be high in primary hypothyroidism and in primary hyperthyroidism.Low levels will be in primary hypothyroidism and significantly high, in secondary and tertiary hypothyroidism.High or low TSH in normal free thyroxine is often referred as subclinical hypo- or hyperthyroidism, respectively. Sick, hospitalized patients may have falsely low or elevated TSH.
THYROXINE (T4, TOTAL), SERUM	Values >11.7 mcg/dL in adults are seen in hyperthyroidism and patients with acute thyroiditis.Values <4.5 mcg/dL in adults are seen in hypothyroidism, myxedema, cretinism, chronic thyroiditis, and occasionally, subacute thyroiditis. High (T4) is seen in pregnancy and patients on estrogen medications.Low total T4 is seen in patients on treatment with anabolic steroids.
TRI IODOTHYRONINE (T3, TOTAL) SERUM	Values >200 ng/dL in adults are related with hyperthyroidism or increased thyroid hormone-binding proteins. Abnormal levels (high or low) of thyroid hormone-binding proteins may cause abnormal T3 concentrations in euthyroid patients.
TRIGLYCERIDES – SERUM	Cases having coronary heart disease risk factors, both borderline-high (150-199 mg/dL) and high values (>200 mg/dL) require attention. Triglyceride >1,000 mg/dL may lead to abdominal pain and can be life-threatening.
UREA - 24 HR URINE	Glomerular filtration rate, dietary protein intake, protein catabolic rate, hydration state, affect the urinary excretion of urea
URIC ACID - 24 HR URINE	Urinary uric acid excretion is elevated significantly in a patients with uric acid stones.Uric acid excretion can vary in response to a variety of pharmacologic agents. Urine uric acid levels are high in conditions like leukemia and polycythemia and after intake of food rich in nucleoproteins.
URIC ACID - 24 HR URINE	Urinary uric acid excretion is elevated significantly in a patients with uric acid stones.Uric acid excretion can vary in response to a variety of pharmacologic agents. Urine uric acid levels are high in conditions like leukemia and polycythemia and after intake of food rich in nucleoproteins.
URIC ACID – SERUM	High levels are >8.0 mg/dL in males or >6.1 mg/dL in females. If body is making high uric acid, the level in the urine gets too high. If kidneys aren't working properly, the level of uric acid in the urine can get too low. High levels of uric acid seen in gout.
URINE - ALBUMIN/PROTIEN	High Proteinuria >300 mg/day. Proteinuria is seen in both

	renal (eg, glomerulonephritis, renal tubular diseases, pyelonephritis) and nonrenal diseases (eg, myeloma, congestive heart failure, dehydration).
URINE UROBILINOGEN	Urinary urobilinogen may be increased in the presence of a hemolytic process such as hemolytic anemia, infectious hepatitis, or with cirrhosis.
URINE FOR PROTEIN/CREATININE RATIO	In a random urine specimen, a protein/creatinine can be used to approximate 24-hour excretion rates. The normal protein-to-creatinine ratio for males 18 to 83 years is <011 mg/mg creatinine and for females 18 to 83 years is <0.16 mg/mg creatinine.
URINE PH	Urine pH is affected by diet, medications, systemic acid-base disturbances, and renal tubular function. pH may affect urinary stone formation. For example, urine pH <6.0 may help reduce the tendency for calcium phosphate stones and pH >6.0 may reduce the tendency for uric acid stone formation.
URINE- BENCE JONES PROTEINS	Bence-Jones proteins in urine are a sign of multiple myeloma or rare condition called Waldenstrom macroglobulinemia. About 50% to 80% of people with multiple myeloma have Bence-Jones proteins in urine.Can be present in monoclonal gammopathy of undetermined significance.Some cases of lymphoma.
URINE FOR HEMOGLOBIN	Hemoglobinuria is an indicator of intravascular hemolysis. The test is sensitive to myoglobin as to hemoglobin.. RBCs may be missed if lysis occurred prior to analysis; the absence of RBCs should be confirmed by examining a fresh specimen. The presence of myoglobin is confirmed by MYGLU / Myoglobin, Urine.
URINE FOR KETONES	Increased ketones may occur during physiological stress conditions such as fasting, pregnancy, strenuous exercise, and frequent vomiting. In diabetics due to a lack of insulin, starvation, or with other abnormalities of carbohydrate or lipid metabolism, ketones may appear in the urine in large amounts before serum ketone is elevated.
URINE PH	Urine pH is affected by diet, medications, systemic acid-base disturbances, and renal tubular function. pH may affect urinary stone formation, urine pH <6.0 may help reduce the tendency for calcium phosphate stones and pH >6.0 may reduce the tendency for uric acid stone formation
VITAMIN B12 –SERUM	A serum vitamin B12 level <180 ng/L may cause megaloblastic anemia and peripheral neuropathies. Patients with serum B12 levels between 150 and 400 ng/L are considered borderline. If the vitamin B12 level is <150 ng/L, intrinsic factor-blocking antibody (IFBA) testing is performed. IFBA test is negative gastrin level is evaluated. If the serum vitamin B12 level is >400 ng/L, no further testing is performed.

WIDAL TEST (TUBE METHOD)	Important is the level of the O and H agglutinin titer levels. If below 1:160, it is normal. If,> 1:160, may have typhoid fever or salmonella related illness. The Widal test report can produce a false positive for typhoid as it cannot interpret the difference between person currently ill with typhoid and one who has recovered and is a carrier.
BILLIRUBIN	Elevated bilirubin levels (>2.5-3 mg/dL) cause jaundice. Conjugated hyperbilirubinemia is common in individuals with hepatocellular injuries and biliary obstruction and is also common in persons with sepsis.
CD4	Antiviral treatment is recommended in all patients with HIV infection, regardless of CD4 T-cell count.(7,8) Additionally, antibiotic prophylaxis for Pneumocystis jiroveci infection and other opportunistic infections is recommended for patients with CD4 count <200 cells/mcL.
TRIPLE MARKER	A triple marker screen test indicates potential complications with a pregnancy, as well as the presence of multiple fetuses. The results of the triple marker screen test shows likelihood of infant having a genetic disorder such as Down syndrome or spina bifida. Test results are not absolutely true . They merely show a probability.
DOUBLE MARKER	Mainly two markers are checked in blood : **Free Beta HCG:** High levels indicate risk for Down 'syndrome and in low level for Trisomy 18 and 21. **PAPP-A(Pregnancy Associated Plasma Protein):**Presence in low level indicates risk for Down's syndrome and Trisomy 18 and 21.Results are given on the basis of the levels as "SCREEN POSITIVE" which indicates HIGH RISK and "SCREEN NEGATIVE" shows LOW RISK for Down's syndrome, Trisomy 18 and 21. Results also depend on the mother's age and fetal age(given during Ultrasound). So, finally results are given in a Ratio: SCREEN POSITIVE: HIGH RISK- 1:10 AND CUT OFF RANGE IS 1:250 SCREEN NEGATIVE: LOW RISK-1:1000 AND ABOVE.
ANTI MULLERIAN HORMONE(AMH)	Menopausal women or women with premature ovarian failure, after cancer chemotherapy, have very low antimullerian hormone (AMH) levels, below 0.1 ng/mL.If serum AMH concentrations >3 ng/mL, hyper-response to ovarian stimulation may result. Patients with polycystic ovarian syndrome, AMH concentrations may be 2- to 5-fold higher than reference range values,it indicates irregular cycles.AMH levels above the normal female range predicts presence of testicular tissue, while an undetectable value suggests its absence.Boys with cryptorchidism,measurable AMH concentration is

	predictive of undescended testes, while an undetectable value is highly suggestive of anorchia or functional failure of the abnormally sited gonad.Granulosa cell tumors of the ovary may secrete AMH.
HBV- DNA(PCR)	HBV DNA indicates viral burden and viral replication.. Proposed cutoffs for consideration for antiviral therapy is 100,000 copies/mL or 20,000 IU/mL in HbeAg-positive patients with chronic hepatitis and 10,000 copies/mL or 2,000 IU/mL in HbeAg-negative patients. Indications for treatment are based not only on HBV DNA, but also on serumalanine aminotransferase (ALT) levels and severity of liver disease.HBV DNA can be measured both qualitatively and quantitatively using either polymerase chain reaction (PCR) . Loss of detectable HBV DNA by a solution phase hybridization assay is an earlier indicator of response to antiviral therapy than loss of HBeAg. PCR is the most sensitive assay in detection of HBV DNA.

- **One of the big challenge that diagnostics were facing was the error in reporting the results.There were many incidences of error in the values entered. So, to overcome this challenge we worked on a concept of min and max(the lowest and the highest values fed in the system below and above which no values can be entered, the system will automatically shows the error.)**

TABLE4

PARAMETER	UNITS	MIN	MAX	REFRANCE
Haemoglobin	g/Dl	4.5	23	WESTGARD
Platelet count	(lakhs/cumm)	10	1000	WESTGARD
Hematocrit	%	14	70	WESTGARD
Total Leucocyte count (TLC)	cells/cumm	0.5	30	WESTGARD
PTT	Sec		90	WESTGARD
Aspartate aminotransferase	U/L	8	300	WESTGARD
Alanine aminotransferase	U/L	5	300	WESTGARD
Alkaline phosphatase	U/L	35	400	WESTGARD
Vitamin B12	pg/mL	170	1200	WESTGARD
Calcium	mg/dL	7	14	WESTGARD
Fibrinogen	mg/dL	30	500	WESTGARD
Phosphorous	mg/dL	1.5	5	WESTGARD
Chloride	mEq/L	90	112	WESTGARD
Potassium	mEq/L	3	7.5	WESTGARD
Sodium	mmol/L	115	150	WESTGARD
Magnesium	mg/dL	1.2	5	WESTGARD
Creatinine	mg/dL	0.5	6	WESTGARD
BUN	mg/dL	6	50	WESTGARD
Uric acid	mg/dL	2	10.7	WESTGARD
Cholestrol	mg/dL	90	350	WESTGARD
Iron	ug/dL	30	400	WESTGARD
Glucose (F)	mg/dL	45	180	WESTGARD
Bilirubin (total)	mg/dl	0.1	20	WESTGARD
Creatine Kinase	U/L	100	1800	WESTGARD
GGT	U/L	5	150	WESTGARD
Total Protein	g/dL	4.5	8.9	WESTGARD
Albumin	g/dL	2	5.2	WESTGARD
Fibrinogen	mg/dL	30	500	WESTGARD
Triglycerides	mg/dL	20	400	WESTGARD
Cholesterol	mg/dL	90	350	WESTGARD
Thyroxine (T4) Total	ug/dL	4	14	WESTGARD
Prolactin, serum (hPRL)	ng/ml	1	300	WESTGARD

Follicle stimulating hormone(FSH) Male	**mIU/Ml**	**1**	**60**	**WESTGARD**
Luteinizing hormon(L H) Male	**mIU/Ml**	**1**	**100**	**WESTGARD**

- **NOTE: Above value quoted from Statland BE. Clinical Decision Levels for Laboratory Tests, Second Edition [Oradell NJ;Medical Economics Books, 1987.]**

Technicians in the labs used to reject the sample on their on basis. So, a sample rejection form was designed and implemented with all standards which has to be signed by the lab technician and lab director. (**TABLE 5)**

SAMPLE REJECTION FORM

Patient information	**Sample collection Date Time**	Registration no.
Name:	Blood Collection date	Referred by :
Age:	Urine Collection date	Collection centre:
Sex:	Sample Received date	
Contact no.	Fasting	
UHID no.	Non Fasting	

Specimens with above details have been received from centre in an unacceptable condition

Collection Device	**Unlabeled/ Incorrectly Labeled**	**Leaking Specimen**	**Outdated Specimen**	**Haemolyzed Specimen**	**Inadequate sample**	**Others**	**Remarks**
SST Tube							
EDTA Tube							
Urine Container							
Fluoride tube							
sCitrate tube							
Heparin tube							
Others							

Comments:

_____

Rejected By:

_____

Laboratory Technologist
(Signature & Date)

Approved By:

_____

Lab Director
(Signature & Date)

- **Finally a comparative study between different laboratories in Hyderabad was done to find out the gaps and suggestions were given.**

COMPATITIVE STUDY BETWEEN DIFFERENT DIAGNOSTIC CENTRES

TABLE6

SERVICES	VIJAYA DIAGNOSTICS	LUCID LABORATORY	Dr LAL PATH LAB	APOLLO DIAGNOSTICS
Service manager at centre	Present	Present	Not present	Not present
Systematic Job Distribution	Present	Present	Present	Lagging
Qualified staff	Present	Present	Present	Yes
Proper Dressed	Present	Present	Present	Not Properly Dressed
Patient Engagement(TV, Magazine stand)	Present	Present	Present	Recommended
Quality Policy	Displayed	Displayed	Displayed	Recommended
Suggestion Box	Present	Not Present	Present	Recommended
Excellent Knowledge of Staff	Present	Lagging	Present	Training Required
Proper Labeled Section	Present	Not all sections	Present	Recommended
All document displayed	Present	Not Present	Few	Few Documents
Fire Safety Instructions on Display	Present	Not Present	Present	Recommended
SOP Present	Yes	Yes	Yes	Recommended handbooks
CCTv Cameras	Present	Present	Present	Recommended
Map Of Different Locations of labs	Present	Not Present	Not present	Not Present
IEC Materials	Present	Not Present	Present	Few

FINDINGS:

1**. Technical manual was not present in the labs due to which many important documents were not registered in the labs.**

2. Interpretations were not present in the report format.

3. Training of the laboratory technicians were not a part of induction module.

4. Sample rejection forms were not present.

5. Errors in the values refrance ranges were major challenge.

RECOMMENDATIONS:

1. **All the documents including quality manuals, fire safety manual, personal safety manual, SOPs in the laboratory should be available in both hard and soft copy in every laboratory.**
2. **Basic Life supporting training for laboratory technicians.**
3. **Technical manual should be included along with all important laboratory documents.**
4. **Sample rejection form should be kept and filled by technician before rejecting a sample.**
5. **Once in two weeks telephonic review should be done for all the laboratory.**
6. **Trade license should be present before the laboratory becomes functional.**

References

1. *http://www.clinicalresearchsociety.org/*
2. *Clinical-Laboratory-Technical-Procedure-Manualsl.pdf*
3. *ISO 15189 (Third edition 2012-11-01)*
4. *http://www.aafp.org/practice-management/regulatory/clia/manual.html*