

MTN 020
FBC CLOTTED TUBE – HOW TO PREVENT
MISSING WINDOW PERIODS & PDs

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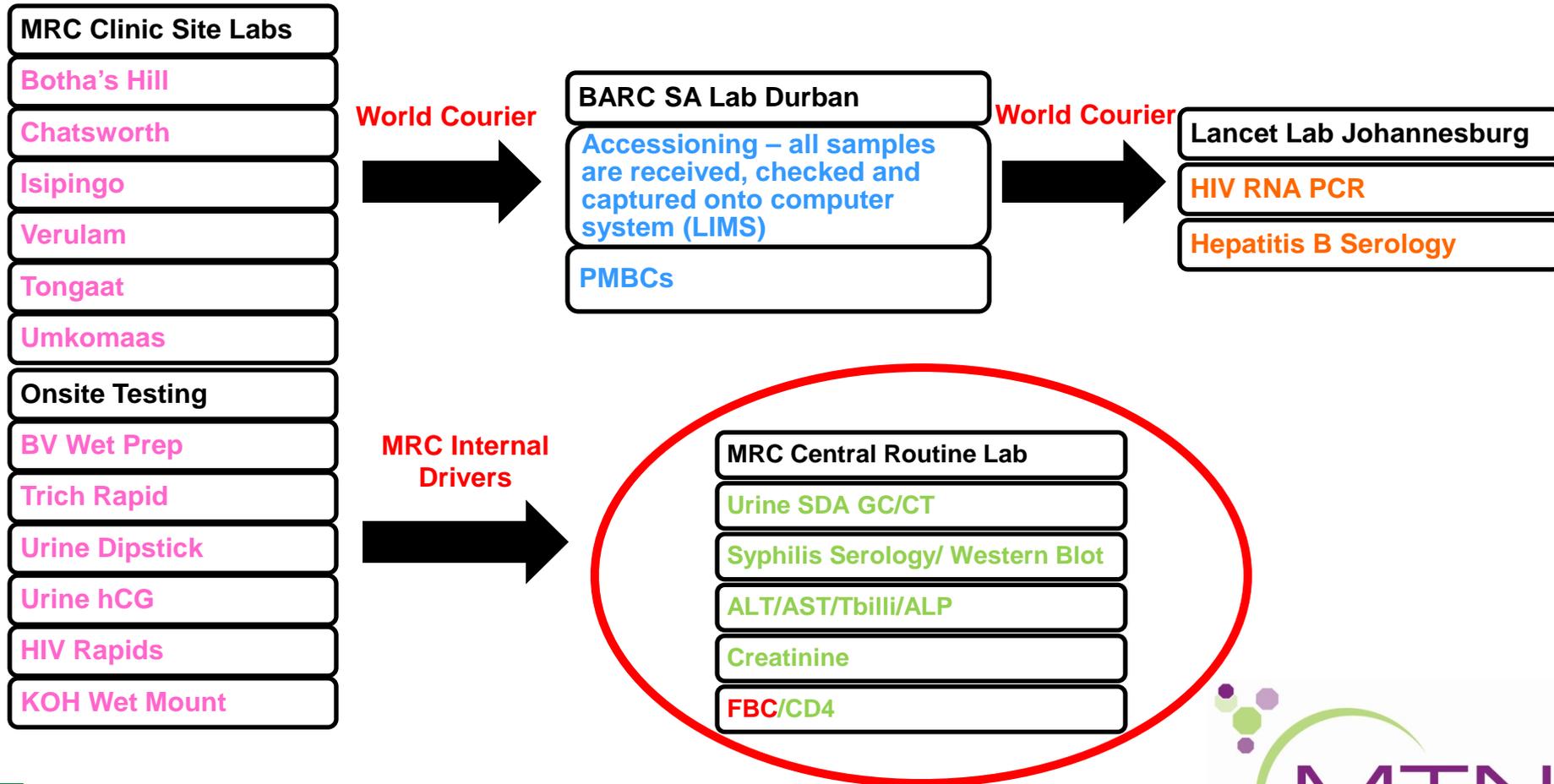
MTN REGIONAL MEETING 2013



South African Medical Research Council
BUILDING A HEALTHY NATION THROUGH RESEARCH

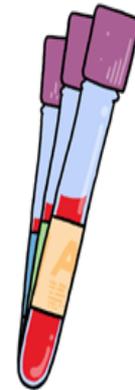


FLOW OF LAB WORK?



WHAT HAPPENED AT HPRU CENTRAL ROUTINE LAB [CRL]?

- FBC (EDTA tube) test was processed by a medical technologist
- The sample was clotted
- The med tech failed to notify the site involved on the day the incident occurred
- The COMMENT was entered, authorised and verified by Med Tech 1 BUT Med tech 2 didn't release the PTID so the result - pdf on email didn't go out within 24hours and a hard copy wasn't printed for the site



<http://www.noc.nhs.uk>

WHAT HAPPENED AT HPRU CENTRAL ROUTINE LAB [CRL]?

 **HIV PREVENTION RESEARCH UNIT
CENTRAL ROUTINE LABORATORY** 

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FINAL PATHOLOGY REPORT

Report for:	Participant ID	Specimen No
Dr Vancloster	: Quarterly(M3) - 03.0	
Gender:	Study Name	Collection Date & Time
	: MTN 020	: 10/Jan/2013 09:22
C.R.S	Site Name	Received Date & Time
	: C.R.S	: 10/Jan/2013 14:27
	DOB	Report Date & Time
	: [REDACTED]	: 11/Jan/2013 14:21
	Age	Report No
	: 30 years	: 26031
	Sex	
	: Female	
	Weight	
	: NA	

Haematology Sample Type: Blood
Tests ordered: FBC DIT

Test	Result	Ref Indicator	Ref Range	DAIDS Grading
Sample Rejected	Yes			
Rejection Reason	FBC Sample Clotted			
Comment	Please send repeat sample.			

Reported by : [REDACTED] 11/01/2013 12:53
Authorised by : [REDACTED] 11/01/2013 14:21

Page 1 of 1

Medical Research Council of SA
HIV Prevention Research Unit
District: Pieter C. Hooge
Lab Manager: Mrs R. Maharaj MT 79324

LABORATORY MANAGEMENT REVIEW

MRC HPRU Laboratory follows Laboratory Management Review and troubleshooting using the RASPAE Model that the Lab Manager has presented at M2012

POSTER # 551

South African Medical Research Council
BUILDING A HEALTHY NATION THROUGH RESEARCH

Is Your Laboratory FDA Compliant: A Look Into A Laboratory Management Review [LMR] Process
-It's as simple as ABC

Rashika Maharaj, Lakshmi Jagalur, Karusha Padayatche, Karusha Chanderhuri, Presha Raipal, Resha Broodhran, Gita Ranjee, and the MTN 003 team
HIV Prevention Research Unit (Durban) - Medical Research Council of South Africa
M2012 Sydney Australia

BACKGROUND
The Medical Research Council of South Africa (MRC), HIV Prevention Research Unit (HPRU), has been involved in multiple HIV prevention trials at 7 community based clinical sites, where the primary and secondary endpoints are mostly laboratory outcomes e.g. HIV and sexually transmitted infections. High Quality Assurance (HQ) is paramount to achieving successful study endpoints. It is vital to ensure laboratory Quality Control (QC) errors are assessed regularly at the clinic and outsource level. We report on a Laboratory Management Review (LMR) tool in conjunction with a problem solving model that is useful in clinical trials.

OBJECTIVE
To conduct a real time analysis of a Laboratory Management Review (LMR) tool in conjunction with a problem solving model that is useful in clinical trials.

METHODS
We conducted pre-analytical, analytical and post-analytical areas of the MRC HPRU Laboratory and the outsource laboratory data using a newly developed tool for LMR called RASPAE.

The RASPAE Model:
-Root Cause investigation;
-An analysis of the data;
-Solution identification, selection and implementation; Corrective Action
-Preventative Actions.
-Action plan and
-Evaluate Solution (The RASPAE Model)

The Quality Assurance/Quality Control (QA/QC) Error logs from 7 on-site clinical laboratories (CL) and one outsource laboratory (OL) were used to assess the utility of this model from January 2011 through October 2011.

RESULTS
Figure 1: An example of site specific errors emanating from request forms and lab reports.

RESULTS
Figure 2: Difference in the total errors over last 3 months vs. last 7 months.

CONCLUSION
The root cause analysis found the most common reasons for errors were high work volume especially during heavy seasonal periods, after modifications to already complex protocols. Preventive actions included re-training, monitoring of laboratory staff by senior laboratory staff, providing incentives for good performance, and staff rotation to lower volume sites to minimize daily workloads of busy clinics. LMR encompasses the RASPAE, an tool that permit the detection, correction and prevention of deviations at the laboratories. The tool monitors for trends after corrective actions were completed and affirmatively assesses the quality of the solutions. This model has shown improvement to MRC laboratory quality by 65 % and can be adopted by other clinical research sites to improve their laboratory processes internally and externally.

- ✓ **R**=Root Cause investigation;
- ✓ **A**=Analysis of the data,
- ✓ **S**=Solution identification, selection and implementation; Corrective Action
- ✓ **P**=Preventative Actions;
- ✓ **A**=Action plan; and
- ✓ **E**=Evaluate Solution



ROOT CAUSE INVESTIGATION

At Clinic level-Laboratory site staff

- The medical technologist at site failed to track the e-version result within 24 hours (NB: The TAT for an e-version lab result is 24 hours and 48 hours for a hard copy lab report)
- The lab QA/QC RA failed to track the hard copy lab report within 48 hours

At MRC HPRU CRL

- Three working days later at the MRC HPRU CRL a LIMS incomplete specimen report was printed and it was noted that the PTID result had not been released on the system
- The e-version was then sent immediately to site HOWEVER the participants window period had closed on the day the LIMS incomplete specimen report was printed and therefore the participant couldn't be called in.

ANALYSIS OF DATA

At Clinic level-Laboratory site staff

- There was no eversion result at site
- There was no hard copy result at site
- No emails of request to the MRC HPRU CRL within the 24-48hours period
- The participant schedule database showed - Window period was near end, if repeat was requested this would be out of window period and a PD

Parameter	Value	Unit
MRC_HPRU [Full blood count & CRP]		
HbC	4.88	10 ¹² /L
Hb	14.2	g/dL
HCT	42.4	%
MCV	90	fL
MCH	29.7	pg
MCHC	33.1	g/dL
RDW	11.9	%
Platelets	236	10 ⁹ /L
PLT	6.2	10 ⁹ /L
WBC	7.2	10 ⁹ /L
Neutrophil %	41.2	%
Absolute Neutrophils	2.98	10 ⁹ /L
Alb Neutrophil	2950	#/mm ³
Lymphocyte %	44.7	%
Absolute Lymphocytes	3.22	10 ⁹ /L
Alb Lymphocyte	3220	#/mm ³
Monocyte %	7.2	%
Absolute Monocytes	0.53	10 ⁹ /L
Alb Monocyte	500	#/mm ³
Eosinophil %	4.6	%
Absolute Eosinophils	0.33	10 ⁹ /L
Alb Eosinophil	470	#/mm ³
Basophil %	0.8	%
Absolute Basophils	0.06	10 ⁹ /L
Alb Basophil	60	#/mm ³
CRP	100-43256.6	
patient		
patient Age	26	
patient Sex	00201067 0000000	
patient Weight	6.6	
clin for site	1019800	
change time	18/11/2012	

At MRC HPRU CRL

- LIMS incomplete specimen report was printed 3 days later
- LIMS illustrated that Med tech 2 failed to press release icon to release the result





SOLUTION IDENTIFICATION, SELECTION AND IMPLEMENTATION, CORRECTIVE ACTION

- The site med tech and lab qa qc ra failed to follow up on the result as per **JD**
- The CRL med tech failed to notify site about the clotted FBC tube within 24hrs
- CRL did not print the report as the results were released and the PTID was not verified with the lab report

SOLUTION IDENTIFICATION, SELECTION AND IMPLEMENTATION, CORRECTIVE ACTION

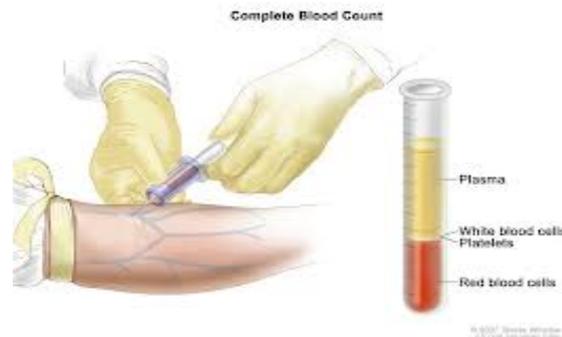
Corrective action

- Investigation with supporting documents reviewed
- Minuted meeting with the lab manager and staff members involved
- CRL completed Laboratory incident report and sample rejection log
- Site completed a laboratory note to file [LN2F] explaining the incident to place with the lab report
- Lab manager reviewed and approved the incident report & LN2F
- Site contacted the participant to visit the clinic for a repeat FBC blood draw
- Participant returned to site for the repeat blood draw but her month 3 window was closed therefore this is regarded as a protocol deviation as a missed test under code 15 on PD CRF

PREVENTATIVE ACTION

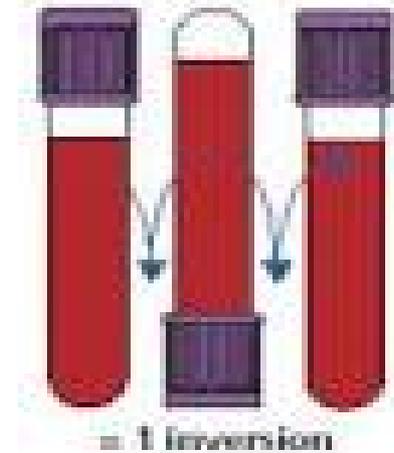
At Clinic level-Laboratory site staff

- Ensure the draw order of tubes are maintained to prevent cross contamination
- Ensure a full EDTA tube of blood is collected (NB: If the incorrect volume of blood : anticoagulant ratio is collected, this will result in a clot formation)



PREVENTATIVE ACTION

- Draw the participants blood using an EDTA tube then gently invert tube at least 8 times after specimen collection to ensure adequate mixing with the anticoagulant
- The site medical technologist and lab QA/QC RA to check the FBC tube once the nurse has delivered the specimen.
- Ship the FBC samples at an ambient temperature in appropriately labelled cooler boxes to HPRU Central Routine laboratory.



PREVENTATIVE ACTION

HPRU CRL

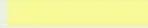
- Documented retrain of staff by the LIMS administration personnel to be conducted on the verifying and release of the **PTID** and not the test
- All sites to be notified immediately if a sample is unsuitable so a repeat sample can be taken
- LIMS sample unreleased reports to be done daily as OSR

PREVENTATIVE ACTION


Helping all people live healthy lives

BD Vacutainer® Order of Draw for Multiple Tube Collections

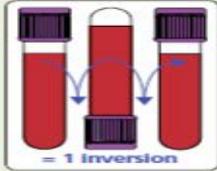
Designed for Your Safety Reflects change in CLSI recommended Order of Draw (H3-A5, Vol 23, No 32, 8.10.2)

Closure Color	Collection Tube	Mix by Inverting
BD Vacutainer® Blood Collection Tubes (glass or plastic)		
	• Blood Cultures - SPS	8 to 10 times
	• Citrate Tube*	3 to 4 times
 or 	• BD Vacutainer® SST™ Gel Separator Tube	5 times
	• Serum Tube (glass or plastic)	5 times (plastic) none (glass)
	• BD Vacutainer® Rapid Serum Tube (RST)	5 to 6 times
 or 	• BD Vacutainer® PST™ Gel Separator Tube With Heparin	8 to 10 times
	• Heparin Tube	8 to 10 times
 or 	• EDTA Tube	8 to 10 times
	• BD Vacutainer® PPT™ Separator Tube K ₂ EDTA with Gel	8 to 10 times
	• Fluoride (glucose) Tube	8 to 10 times

Note: Always follow your facility's protocol for order of draw

Handle all biologic samples and blood collection "sharps" (needles, needles, test adapters and blood collection sets) according to the policies and procedures of your facility. Obtain appropriate medical attention in the event of any exposure to biologic samples (for example, through a puncture injury) since they may transmit viral hepatitis, HIV (AIDS), or other infectious diseases. Utilize any built-in used needle protector if the blood collection device provides one. BD does not recommend reutilizing used needles, but the policies and procedures of your facility may differ and must always be followed. Discard any blood collection "sharps" in biohazard containers approved for their disposal.

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BD Technical Services
1.800.631.0174

BD Customer Service
1.888.237.2762

www.bd.com/vacutainer

* When using a winged blood collection set for venipuncture and a coagulation (citrate) tube is the first specimen tube to be drawn, a discard tube should be drawn first. The discard tube must be used to fill the blood collection set tubing's "dead space" with blood but the discard tube does not need to be completely filled. This important step will ensure proper blood-to-additive ratio. The discard tube should be a nonadditive or coagulation tube.

Becton Drive
Franklin Lakes, NJ 07417
www.bd.com/vacutainer



ACTION PLAN

At Clinic level-Laboratory site staff

- Clinic requested to ensure long window periods between safety/STI testing requests - to allow repeats and remain within windows
- Extra vigilance of site staff to follow-up on outstanding e-versions and hard copy results within TAT - any deviations will be reported to the lab manager
- Poor Performance letter to staff responsible for the error
- Assessment of measures in 1 month proved the action plan works - No PDs to date in such events

ACTION PLAN

HPRU CRL

- A communication book was put in place to notify staff of urgent messages to follow up
- Unsuitable sample messages are sent out via core talk SMS to site clinician, med tech, CRS management
- LIMS administration will create instant messaging for any urgent messages that need to be addressed
- LIMS administrator will try to implement a system to prevent the **test** from being authorized instead of the PTID
- Poor Performance letter to staff responsible for error
- Assessment of measures in 1 month proved action plan works - No PDs to date in such events

ACTION PLAN

The screenshot displays the CoreTalk Desktop application interface. At the top, a status bar shows 'CoreTalk 2006 RC 9.3.5.0 © Backbone Technologies' and includes icons for SMS, Internet, Signal (74%), and Outstanding Items (12). Below this is a 'CoreTalk Desktop' header. The main content area features a 'Remote Office Management' section with sub-sections for 'SMS/Email Forwarding' and 'Advanced scheduler functionality'. The 'SMS/Email Forwarding' section explains how CoreTalk forwards emails to a cell phone via SMS. The 'Advanced scheduler functionality' section describes the scheduler's capabilities and lists two modes: 'Standard' and 'Categories'. A sidebar on the right contains a search bar and a grid of icons for 'Manage Contacts', 'Manage Groups', 'Plan My Life', 'Send SMS', 'Add Note / Task', 'Communications History', 'Reports', 'SMS Promo', 'Complaints/Praise', 'Marketing Pages', 'SMS/E-mail Forwarding', and 'Database Integration'. At the bottom of the sidebar are buttons for 'E-mail Forwarding', 'Sms To E-mail', and 'Sms Forwarding'. The Windows taskbar at the very bottom shows the Start button and the application title 'CoreTalk 2006 RC 9.3...'.



ACTION PLAN

The screenshot displays the CoreTalk 2006 RC 9.3.5.0 interface. At the top, there's a status bar with 'SMS' and 'Internet' icons, a 'Signal' indicator at 74%, and 'Outstanding Items' count of 12. The main area is titled 'SMS Multiple Recipients' and is divided into three panels: 'Add Recipients', 'View Recipients', and 'Compose SMS'.

Add Recipients Panel: Shows a search bar and a list of 296 results. The list has columns for 'Cell Number', 'Name', and 'Surname'. Below the list are buttons for 'Add All', 'Add Selected', 'Add From Group', and 'Add Other Number'.

Cell Number	Name	Surname
+27034559006	CoreTalk	Help-Desk
0825747984	Vaughn	Redman
0802697350	Coretalk	CRM
0718631491	Lonetalk	Support
0797700412	Lucas	Maret
0823076124	Kumershini	Hanipersad
+27025533256	Shatika	Gappoo
0725887734	Nicky	Govender
	Vijay	Ouddera
	Arendeni	Palmer
	Yuki	Sookrajh
	Nicola	Courni
	Sarita	Naidoo
	Zola	Msiska
	Elaine	Smith
	Samantha	Sukdeo
	Zakir	Gattoor
	Jessica	Phillip
	Brodie	Daniels
+27047441179	Unknown	Contact
0834485186	Jaystree	Reddy
+27024407184	Vijay	Ouddera
+27724702297	Palmer	Arendeni
08027011027	Yuki	Sookrajh
0785308077	Nicola	Courni
+27792163786	Sarita	Naidoo
0739897993	Zola	Msiska
0765910202	Elaine	Smith
0844444892	Samantha	Sukdeo
+27833768085	Zakir	Gattoor
003775279	Jessica	Phillip
0735879229	Brodie	Daniels
+27722699970	Unknown	Contact
0845696004	Ashley	Isaac
0721950370	Yugashnee	Pillay
0838985332	Ishpank	Naidoo

View Recipients Panel: Shows a search bar and a list of 0 results. Below the list are buttons for 'Remove Selected' and 'Remove Group'.

Compose SMS Panel: Includes buttons for 'Add Profile' and 'Add Template', a message length indicator 'Message: 1 SMS' 0 Character(s)', and buttons for 'Clear', 'Copy', and 'Paste'. It also has 'Send Now' and 'Send Later' buttons, a 'Request Delivery Report' checkbox, and a 'Create/Manage Templates' button. At the bottom, it shows 'SMS Credit: 2000033'.

ACTION PLAN

CoreTalk 2006 RC 9.3.5.0 © Backbone Technologies

coretalk SMS Internet Queue 0 Sent 1 Signal 74% Outstanding Items 12 Back Forward

Communications History

In Order To Search For Specific History, Use The Search Bar As Well As The Buttons To The Right Of The Search Bar

Search Search all message
 Last 5 Day(s) Specific Day

19 / 672 Results Incoming Outgoing

To View More Results, Scroll Down The List Or Click 'Show All'

Date & Time	Description	Cell Number	Name	Surname	Message	Status	Cor
02 Oct 2013 12:55	SMS Sent	0781910804	Pinkie	Nzama	Reference Range Study/PTID:330Site/WestvilleNext s...	Message Sent	N/A
30 Sep 2013 12:35	SMS Sent	0837771082	Suresh	Basdeu	Reference Range Study/PTID:Site:VerulamNext sche...	Message Sent	N/A
30 Sep 2013 12:07	SMS Sent	0725515982	Nompumelelo	Cele	Reference Range Study/PTID:Site:verulamNext sched...	Message Sent	N/A
30 Sep 2013 12:05	SMS Sent	0784892780	Happyness	Cele	Reference Range Study/Name: HaappnessSite:Verul...	Message Sent	N/A
29 Sep 2013 18:02	SMS in	0732571082	Pregie	Naicker	I got my drivers. Is that okai		N/A
29 Sep 2013 18:00	SMS Sent	0732571082	Pregie	Naicker	Reference Range Study/Name: Pregie NaickerSite:Va...	Message Sent	N/A
29 Sep 2013 18:00	SMS Sent	0830963508	Sipho	Mthembu	Reference Range Study/PTID:Site:VerulamNext sche...	Message Sent	N/A
29 Sep 2013 12:12	SMS Sent	0837833521	Prem	Sookraj	Reference Range Study/PTID:Site:VerulamNext sche...	Message Sent	N/A
29 Sep 2013 12:09	SMS Sent	0842710872	Victor	Dlamini	Reference Range Study/Name: VictorSite:VerulamVis...	Message Sent	N/A
25 Sep 2013 12:47	SMS Sent	0824003880	Fikile	Shangase	Reference Range Study/PTID:326Site/WestvilleNext s...	Message Sent	N/A
25 Sep 2013 12:43	Cancelled	0836217928	Conella	Ndulula	Reference Range Study/PTID:326Site/WestvilleNext s...		N/A
19 Sep 2013 16:49	SMS Sent	+27722513464	Kemusha	Chunderduni	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Message Sent	N/A
19 Sep 2013 16:48	SMS Sent	+27723510284	Beth	Spooner	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Short message received ...	N/A
19 Sep 2013 16:48	SMS Sent	+27725194459	Avashri	Naidoo	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Short message received ...	N/A
19 Sep 2013 16:49	SMS Sent	+27726711836	Renale	Toise	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Short message received ...	N/A
19 Sep 2013 16:48	SMS Sent	+27726722073	Amanda	Michael	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Message Sent	N/A
19 Sep 2013 16:48	SMS Sent	+27796930039	Varnika	Ramdhani	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Short message received ...	N/A
19 Sep 2013 16:40	SMS Sent	+27798400318	Vinila	Naicker	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Short message received ...	N/A
19 Sep 2013 16:48	SMS Sent	+27823505966	Fátima	Noor-Mahomed	MRC > Sample Clotted/PTID: 308-00039-75Site: RK/K...	Message Sent	N/A
16 Sep 2013	SMS Sent	+37836873926	Mhali	Mahsen	Short message received ...		N/A



ACTION PLAN

The screenshot shows the CoreTalk 2006 RC 9.3.5.0 interface. At the top, there are status indicators for SMS, Internet, Queue (0), Sent (1), Signal (74%), and Outstanding Items (12). The main heading is "Communications History". Below this, there is a search bar with the text "Find Any Matches" and several filter buttons: "Search all message", "Last 5 Day(s)", and "Specific Day". There are also buttons for "Incoming" and "Outgoing".

The main table displays a list of communications. The columns are: Date & Time, Description, Cell Number, Name, Surname, Message, Status, and Cor. A pop-up window titled "- Vaneshree Govender" is overlaid on the table, showing a message: "MRC > Sample Clotted PTID: 308-00039-7 Site: RK Khan Result Details: Please send repeat sample for FBC diff and CD4".

Date & Time	Description	Cell Number	Name	Surname	Message	Status	Cor
19 Sep 2013 16:48	SMS Sent	+27825877926			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	+27826867162			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	+27826136333			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	+27836633803			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	+27847596461			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	0728032485			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	0798464696			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	0823381437			Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	0833103175	Sumeshen	Naidoo	Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	0835281744	Samiksha	Byroo	Short message received ...	N/A	
19 Sep 2013 16:48	SMS Sent	0845749002	Lakshmi	Jagesur	Short message received ...	N/A	
18 Sep 2013 12:19	SMS Sent	0790364878	Zibuyile	Cele	Reference Range StudyPTID:Site:WestvilleNext sche...	Message Sent	N/A
18 Sep 2013 12:18	SMS Sent	0824205003	Nokukhanya	Katamzi	Reference Range StudyName: NokukhanyaSite:Wes...	Message Sent	N/A
18 Sep 2013 12:17	SMS Sent	0839529007	Nompumelelo	Chamane	Reference Range StudyName: NompumeleloSiteW...	Message Sent	N/A
17 Sep 2013 18:00	SMS Sent	0788609165	Precious	Shangase	Reference Range StudyName: PreciousSite:Westbill...	Message Sent	N/A
17 Sep 2013 18:00	SMS Sent	0738168274	Innocent	Mchunu	Reference Range StudyName: InnocentSite:Westbill...	Message Sent	N/A
17 Sep 2013 18:00	SMS Sent	0717817922	Emmanuel	Nyathi	Reference Range StudyPTID:Site:WestvilleNext sche...	Message Sent	N/A
17 Sep 2013 15:41	SMS Sent	+27722513464	Kenusha	Chunderduri	MRC > Sample ClottedPTID: 308-40100-4Site: R K K...	Short message received ...	N/A



EVALUATE SOLUTION

- Monthly laboratory management review showed no occurrence of any window period missed for clotted FBC. All sample rejections can occur at site level via SOP available on benches and upon arrival at CRL
- A monthly review illustrates that from this one incident, these preventative measures have been working well



MRC HPRU LAB FAMILY

Research Lab



Interns



Nirosha Gokul



Kieara-Lee Ramtahal



MRC HPRU LAB FAMILY



Director HPRU
Prof Gita
Ramjee



Lab Manager
Rashika Maharaj



Assistant to Lab
Manager
Ishina
Hemchund



Unit Lab Co-
ordinator
Lakshmi Jagesur



Assistant Unit
lab Co-ordinator
Resha
Bhoodram



Med Tech
Samiksha Byroo



Med Tech
Ziningi Dwayisa



Med Tech
Thabile Zondi



Med Tech
Nirmala
Ramluckan



Med Tech
Rabia Imamdin



Med Tech
Keshia Chithray



Lab QA/QC RA
Kerusha
Chunderduri



Lab QA/QC RA
Kerusha
Padayachee



Lab QA/QC
Candice Chetty



Lab QA/QC RA
Kumari Naicker



QA/QC RA
Natasha
Gounden



Lab QA/QC RA
Meryl Reddy



Med Tech
Hassen Bhayat

Chatsworth

Botha's Hill

Isipingo

Tongaat

Verulam

Umkomaas





REFERENCES

- MTN 020 Lab note to file 05
- HPRU Central lab – Laboratory incident investigation form
- BD vacutainer order of draw for multiple tube collection

ACKNOWLEDGEMENTS

- Prof. Gita Ramjee (Director of HPRU)
- Rashika Maharaj (HPRU Lab Manager)
- Shanthie Govender (Acting Central Lab Co-ordinator)
- Network Lab for guidance and support throughout MTN studies