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# How Moving Averages Can Help Enhance Quality Control and Improve your Laboratory

July 22, 2015

# Moving Averages in the Lab – Why?

- Enhances Organization's Quality Assurance program in a cost effective manner
- Provides a 'real time' quality tool to reassure staff that they are producing quality results in lean staffing environment (less stress)
- Decreases re-work
- Positively Enhances the Lab's Reputation with Physicians and Nursing Staff

# Moving Averages in the Lab – What does it do?

- “Normalizes” result data so that the lab can gauge the likelihood that a trend will continue
- Proactively monitors instrument stability between QC cycles in the background
- Uses Error and Warning Thresholds to automatically push notifications to key laboratory staff, and in conjunction with auto-verification allows for a true “walk away” process
- Enables preemptive intervention before the process fails by detecting shifts, trends & momentum

# Value of Moving Average / Moving Medians

- Value...

*Instantly and automatically detect and notify when analytical errors occur without increasing operational costs.*

- How?

- ✓ ...By continuously monitoring results production
- ✓ ...That detects analytical errors days before traditional QC,
- ✓ ...Using revenue generating samples

# Moving Averages Compliments QC

## Standard QC

- QC is a “snapshot” in time
- Usually performed post maintenance & calibration
- Potential for hours (or days) before some errors are detected
  - ✓ Once a shift – 60-70% of test volume between 6 am to 11 am or
  - ✓ Once per day (100% of test volume before next data point)
- Matrix Effects

## Moving Averages

- Real-Time, proactive process providing continuous monitoring using Patient Samples
  - ✓ Early detection of shifts and drifts hours / days before traditional QC
    - Continuous data points to detect shifts/drifts
- Automatically “pushes” instrument status stability notifications
  - ✓ Provides data points, while producing revenue generating activities
    - No Instrument out of production
    - No Dedicated resource (walk away) with notification capabilities
    - No non-reimbursed reagent material or control material
- QC can be run at recommended regulatory intervals (Cost savings in \$ and time)

# Real-time Moving Averages / Moving Medians

Providing an enterprise-wide quality assurance

- Monitor any test, any connected instruments
  - ✓ from anywhere on your network
  - ✓ Levy-Jennings Charts to compare multiple instruments
  - ✓ Monitor same tests different ways – Unlimited Protocols
- Monitors in Real-time
  - ✓ Provides detection and notification actions
- Has twelve algorithms including:
  - ✓ Moving Averages, Moving Medians, Exponentially-Weighted Moving Averages.
- User-defined filter criteria to segment data
- Ability to generate values for your patient population

# Moving Averages / Moving Medians

Twelve different statistical algorithms available

Base Package	
<ul style="list-style-type: none"><li>• Moving Means</li><li>• Bull's Algorithm</li></ul>	<ul style="list-style-type: none"><li>• Exponentially Weighted Moving Averages</li></ul>
Add-on Algorithms 1	
<ul style="list-style-type: none"><li>• Moving Medians</li></ul>	
Add-on Algorithms 2	
<ul style="list-style-type: none"><li>• Moving Mean * 1 Log</li><li>• Moving Mean * 1000 Log</li></ul>	<ul style="list-style-type: none"><li>• Moving Mean * 1 Square Root</li><li>• Moving Mean * 1000 Square Root</li></ul>
Add-on Algorithms 3	
<ul style="list-style-type: none"><li>• Moving Median * 1 Log</li><li>• Moving Median * 1000 Log</li></ul>	<ul style="list-style-type: none"><li>• Moving Median * 1 Square Root</li><li>• Moving Median * 1000 Square Root</li></ul>

- Additional custom algorithms may be developed & added

# Getting Started (Outline)

- *Establish your average of “normal” population (AON)*
  - ✓ *Create a Protocol*
    - *Name / Description*
    - *Filters - Segment to exclude QC, Abnormal patients, fluid type*
    - *Automatic results exclusion - Exclude clearly bad results ( +/- 4 SD)*
    - *Calculation Method*
    - *Automatically calculate Target Mean and Target SD – Calculate your values using your patient population*
    - *Series - (New Series)*
      - » *What instrument(s) and analyte(s) to monitor*
  - ✓ *Copy Protocol - Lather, Rinse, Repeat*
- *Monitor*
  - ✓ *Moving Averages Desktop - Thin Client or Web Browser*



# Defining “Normal” Population

- Some hospital labs may elect to exclude patients at certain wards:
  - ✓ Pediatric
  - ✓ Hematology/oncology
  - ✓ Dialysis
  - ✓ ICU and ED (trauma) patients
  
- Other criteria:
  - ✓ Diagnosis Code / Text
  - ✓ Patient Demographics (Age, Sex, Ethnicity, etc.)
  - ✓ Inpatient vs. Outpatient
  - ✓ Assays where population is not “normal”
  - ✓ Result values outside a defined range (ex. 4SD + - mean)

# Protocol Definition – Defining “Normal” Population

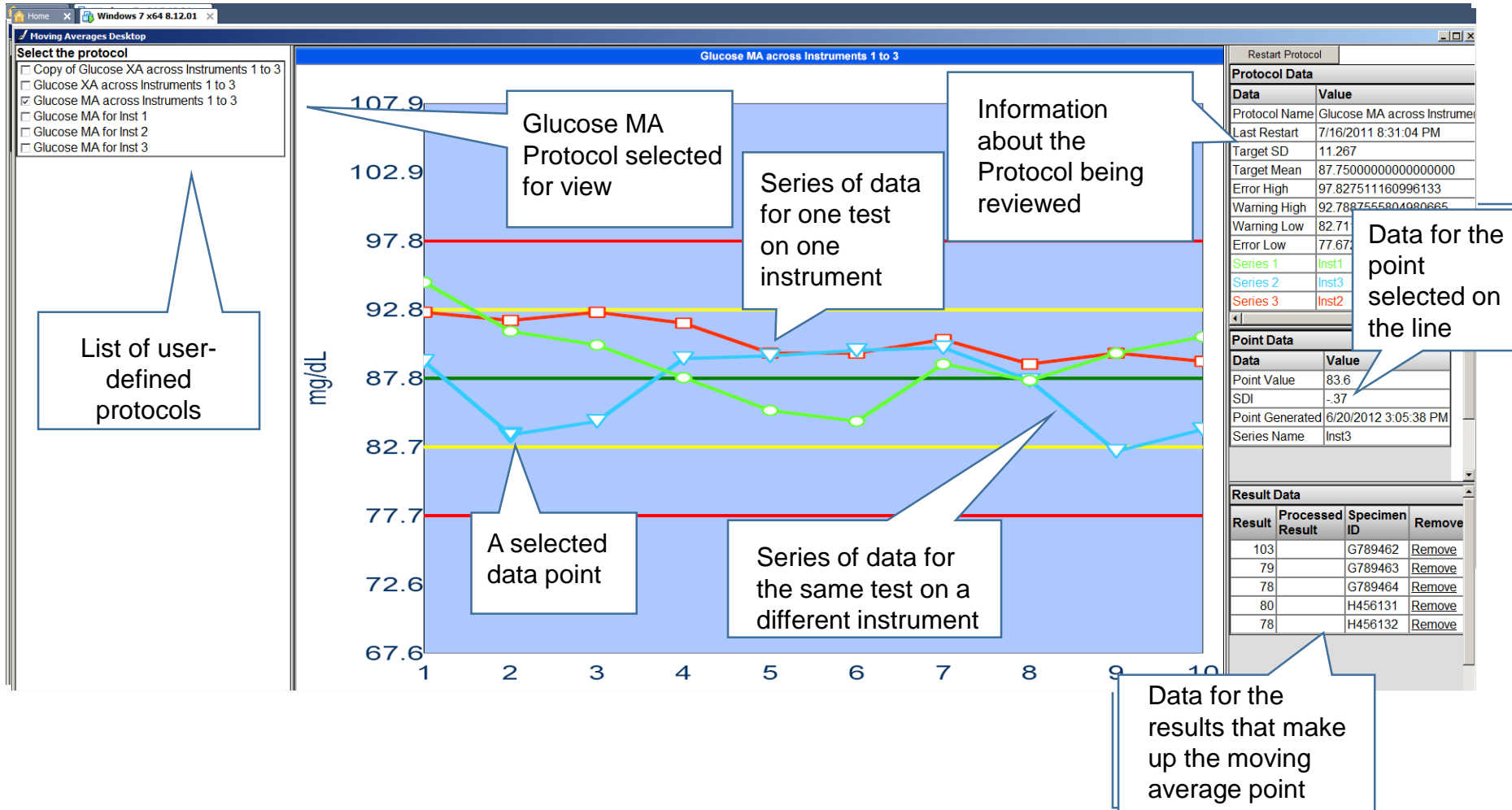
The image displays a software interface for defining a protocol. The main window, titled "Protocol Configuration", shows the "General Protocol Options" for a protocol named "Glucose MA across Instruments 1 to 3". The description is "fasting glucose values". The "Filter\*" field is set to "Click to edit filters".

Overlaid on this are three dialog boxes:

- Filter Wizard - Step 1 of 3:** Asks "Which Data Element do you want to filter?". A list of data elements is shown, with "Location - Ward" selected. A red arrow points from this selection to the next dialog.
- Filter Wizard - Step 2 of 3:** Shows the selected filter: "Exclude all specimens where Location - Ward contains 'Intensive Care Unit'". A red arrow points from this text to the final dialog.
- Filter Wizard - Step 3 of 3:** Shows the final filter setup. The name "Intensive Care Unit" is entered. The "Turn on this filter for the Current Protocol" checkbox is unchecked. The "Review Filter" section shows the final filter definition: "Exclude all specimens where Location - Ward contains 'Intensive Care Unit'".

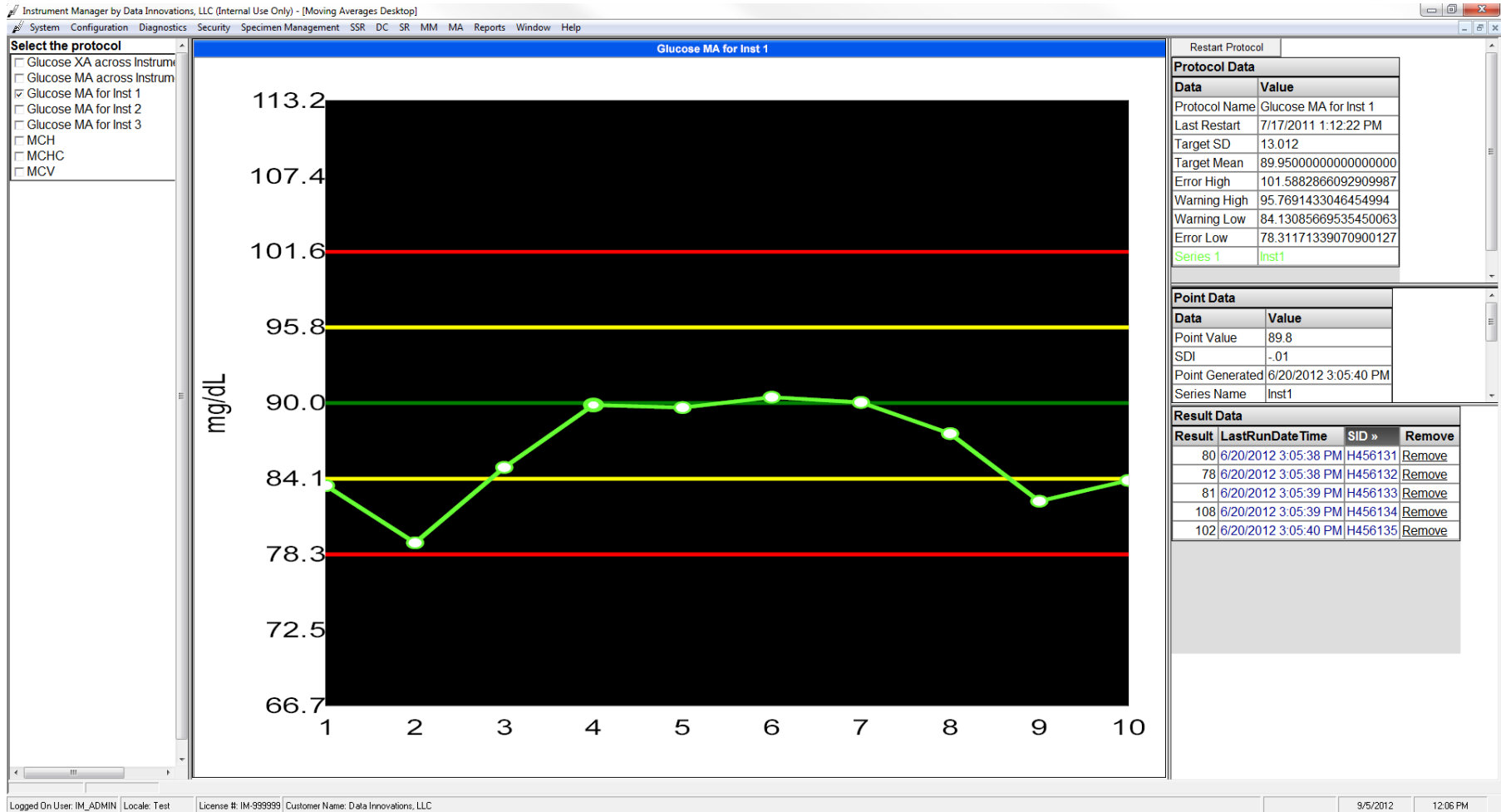
The "Protocol Configuration" window also shows other sections like "Automatic result exclusion" and "Protocol Details".

# Moving Averages Desktop



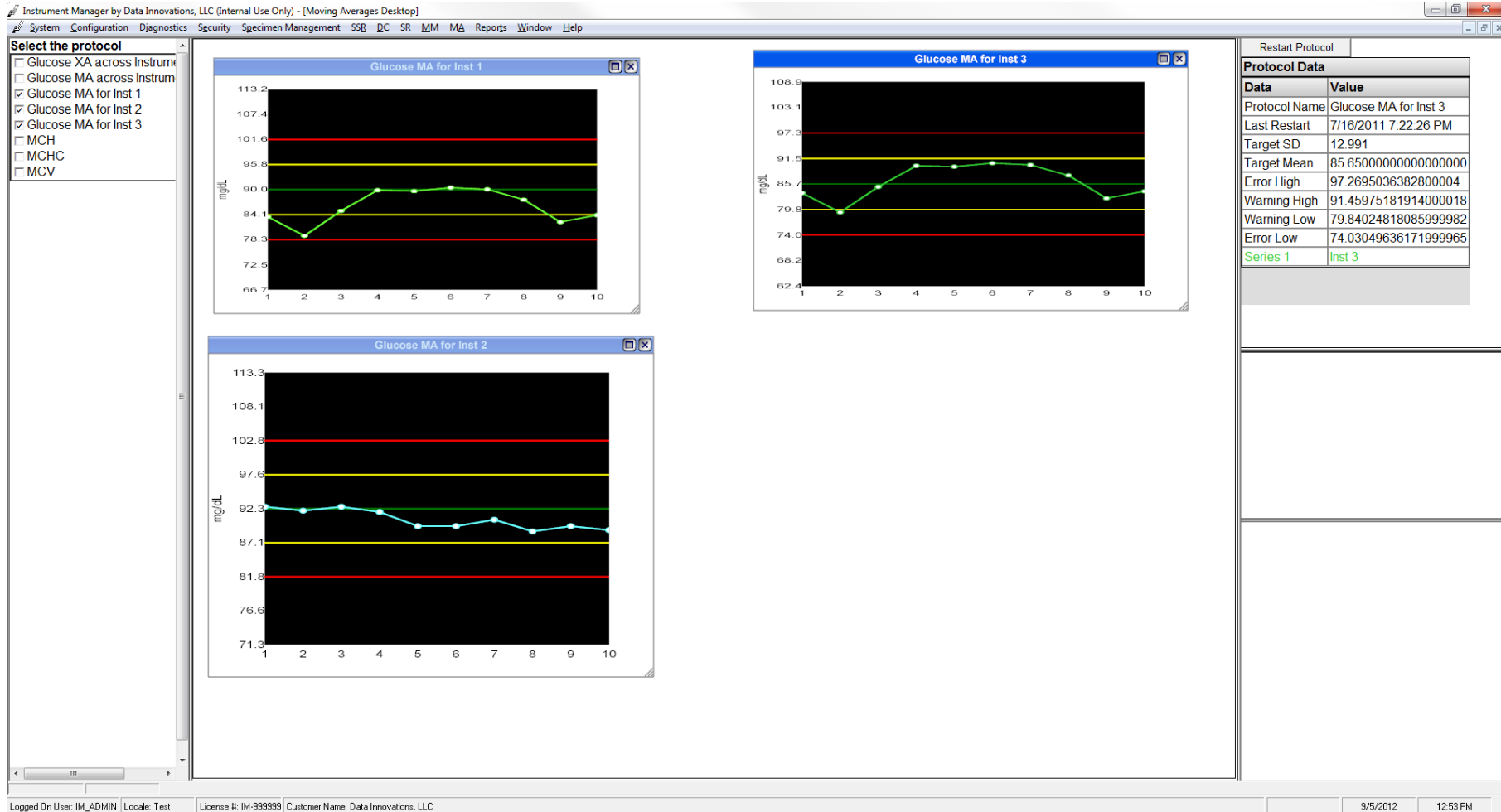
# Moving Averages Desktop

Monitor assay / individual instrument performance



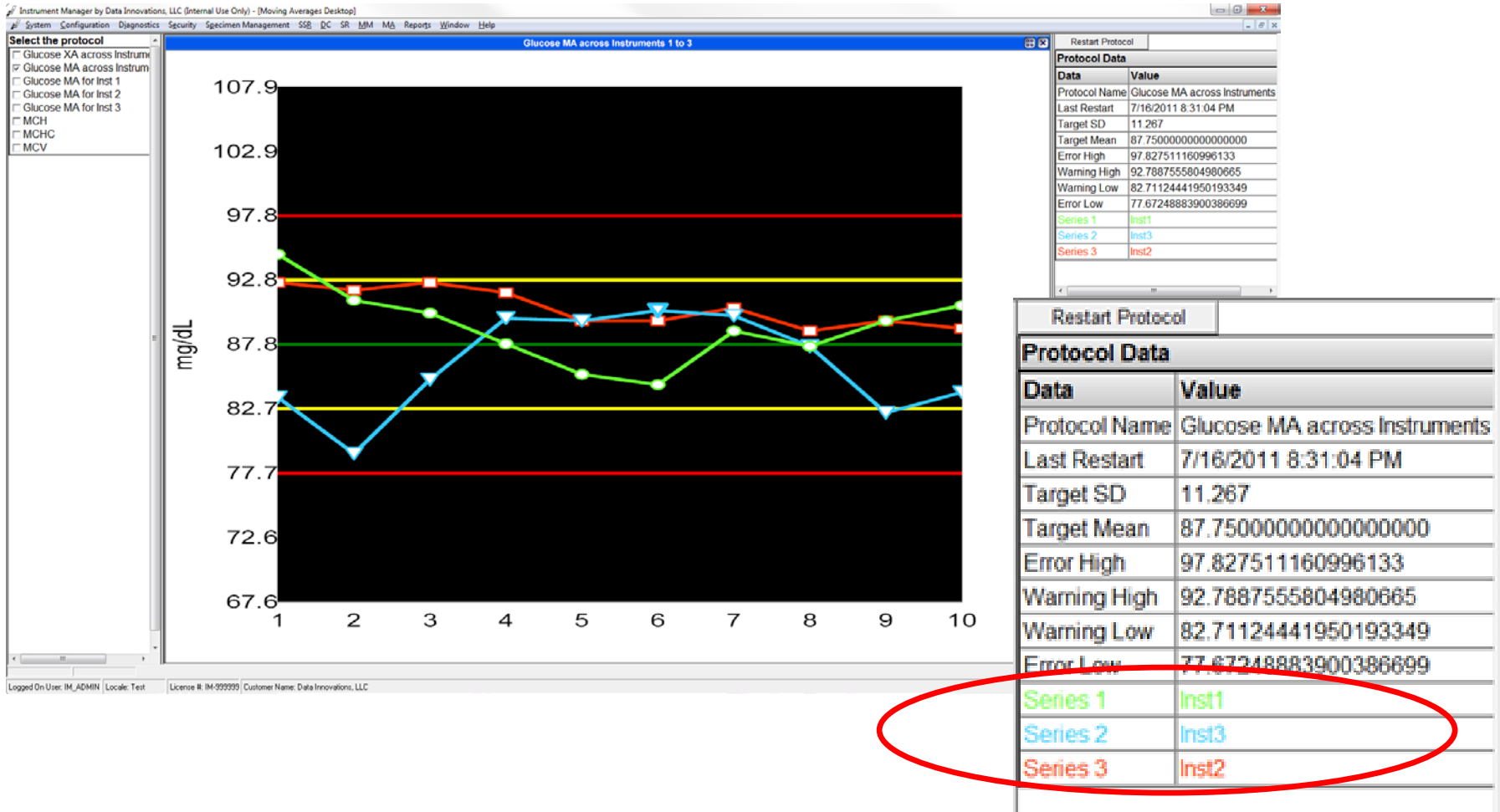
# Moving Averages Desktop

## Compare Multiple Instruments for an assay



# Moving Averages Desktop

Multiple instrument series comparison for an assay



# Moving Averages Desktop

## Standard MA vs. Exponential MA

Instrument Manager by Data Innovations, LLC (Internal Use Only) - [Moving Averages Desktop]

System Configuration Diagnostics Security Specimen Management SSB DC SR MM MA Reports Window Help

**Select the protocol**

- Glucose XA across Instrum
- Glucose MA across Instrum
- Glucose MA for Inst 1
- Glucose MA for Inst 2
- Glucose MA for Inst 3
- MCH
- MCHC
- MCV

Glucose MA across Instruments 1 to 3

Glucose XA across Instruments 1 to 3

Restart Protocol

Protocol Data	
Data	Value
Protocol Name	Glucose MA across Instruments
Last Restart	7/16/2011 8:31:04 PM
Target SD	11.267
Target Mean	87.750000000000000000
Error High	97.827511160996133
Warning High	92.7887555804980665
Warning Low	82.71124441950193349
Error Low	77.67248883900386699
Series 1	Inst1
Series 2	Inst3
Series 3	Inst2

Point Data	
Data	Value
Point Value	90.4
SDI	.24
Point Generated	6/20/2012 3:05:40 PM
Series Name	Inst3

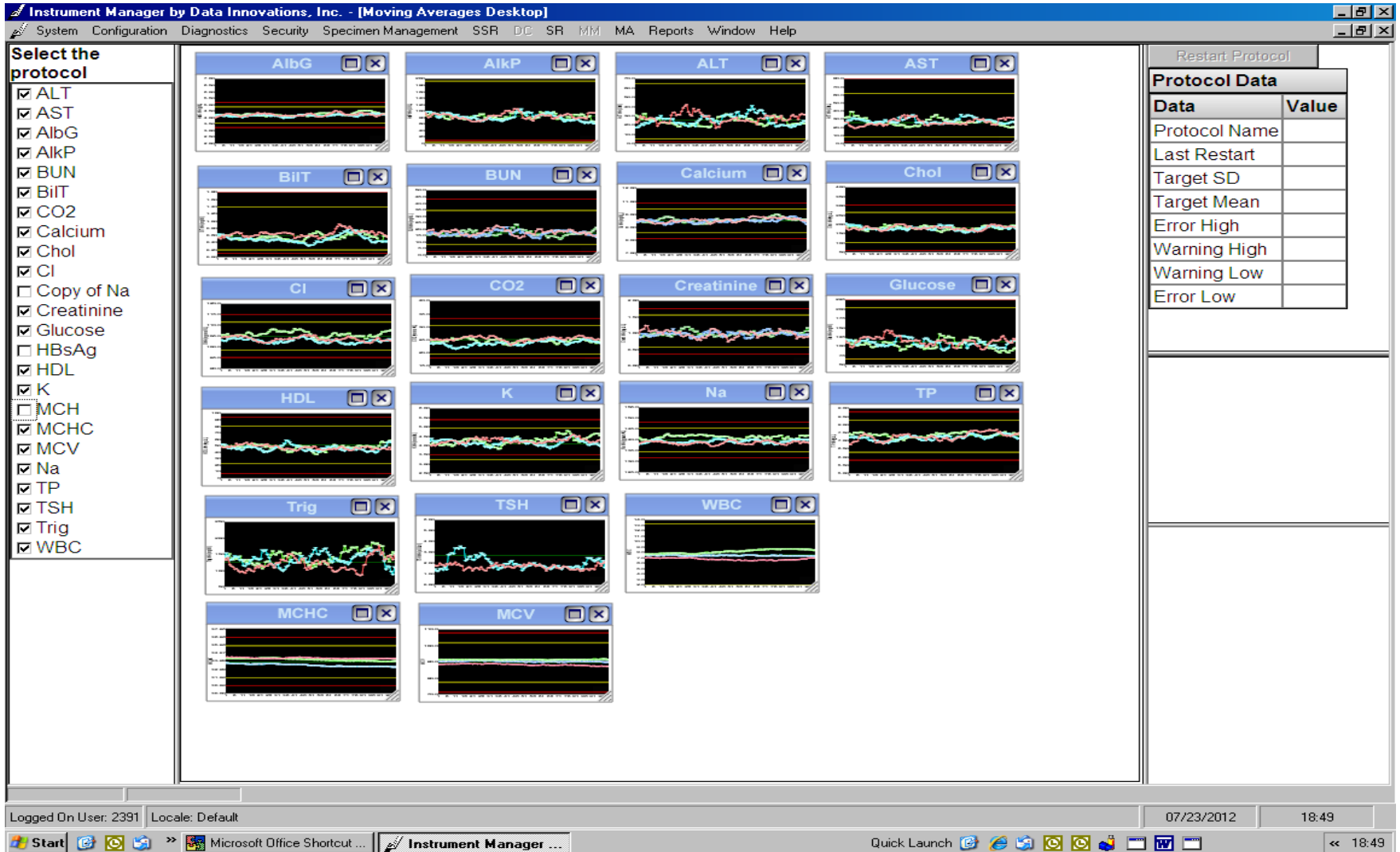
  

Result Data				
Result	LastRunDateTime	SID	Re	
81	6/20/2012 3:05:39 PM	H456133	Re	
108	6/20/2012 3:05:39 PM	H456134	Re	
102	6/20/2012 3:05:40 PM	H456135	Re	
79	6/20/2012 3:05:40 PM	H456136	Re	
82	6/20/2012 3:05:40 PM	H456137	Re	

Logged On User: IM\_ADMIN | Locale: Test | License #: IM-999999 | Customer Name: Data Innovations, LLC | 9/5/2012 | 12:55 PM

# Moving Averages Desktop Example

Screenshot from customer monitoring results in real-time





# Getting Started (Outline) - continued

That was fun ...what can I do now?

- Setup Notification
  - ✓ Email
  - ✓ Pop up screen on selected computers
  - ✓ Light Pole
- Fine tune existing protocols
  - ✓ Filters - Segment to exclude other 'abnormal' patients
- *Act on warnings – looking for shifts and drifts*
- Establish multiple protocols for different patient populations (i.e. Outreach vs Inpatients)

# Protocol Definition – System Notifications

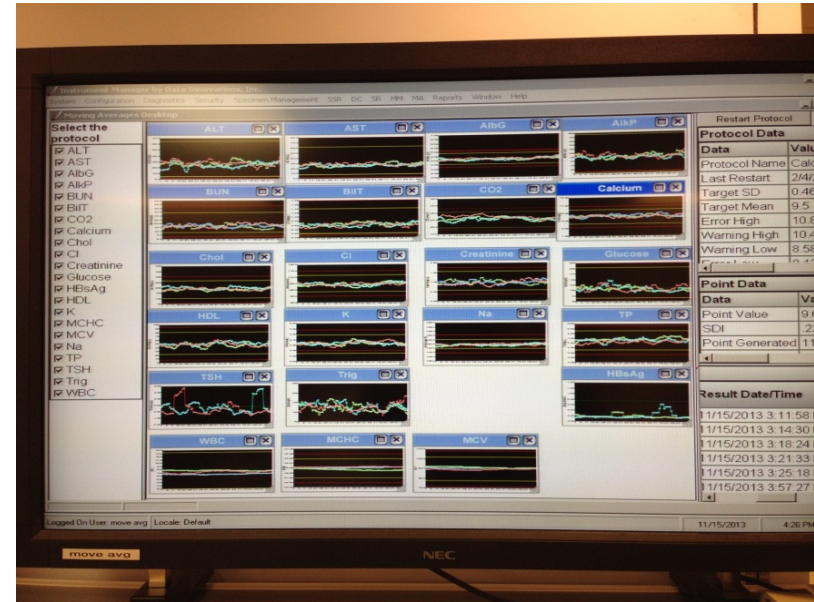
The screenshot shows the 'Protocol Configuration' window. The 'Warnings and Errors' section is expanded, showing a table with columns for the notification type and its configuration. A dropdown menu is open for the 'Notifier Event' field, showing several options. The status bar at the bottom indicates that changing items marked with an asterisk will require a restart.

Notification Type	Configuration
Error Low	
Warning Low	
Threshold Value	2 (Standard Deviations Below mean)
Notifier Event	MA - Warning Low
Start Holding for Verification	- None -
Mark out of service	MA - Error High
Warning High	MA - Error Low
Error High	MA - Warning High
	MA - Warning Low

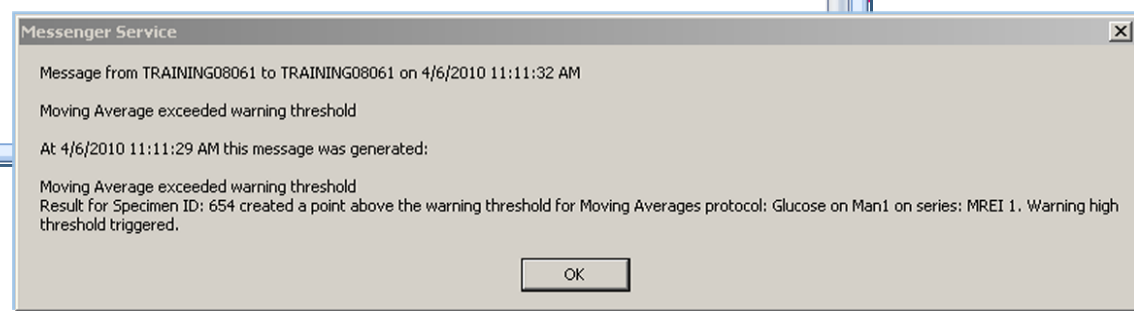
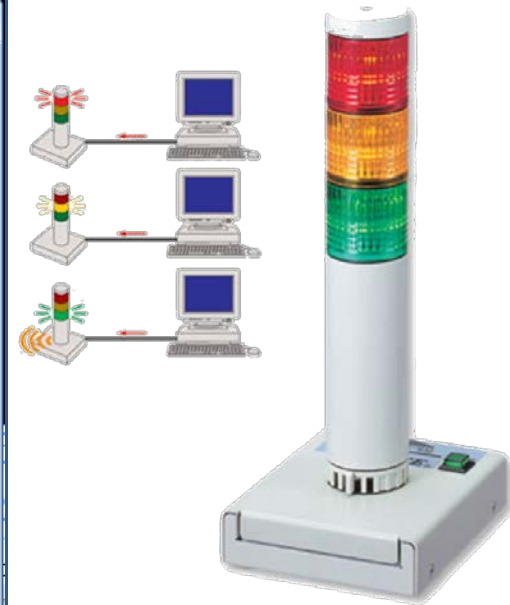
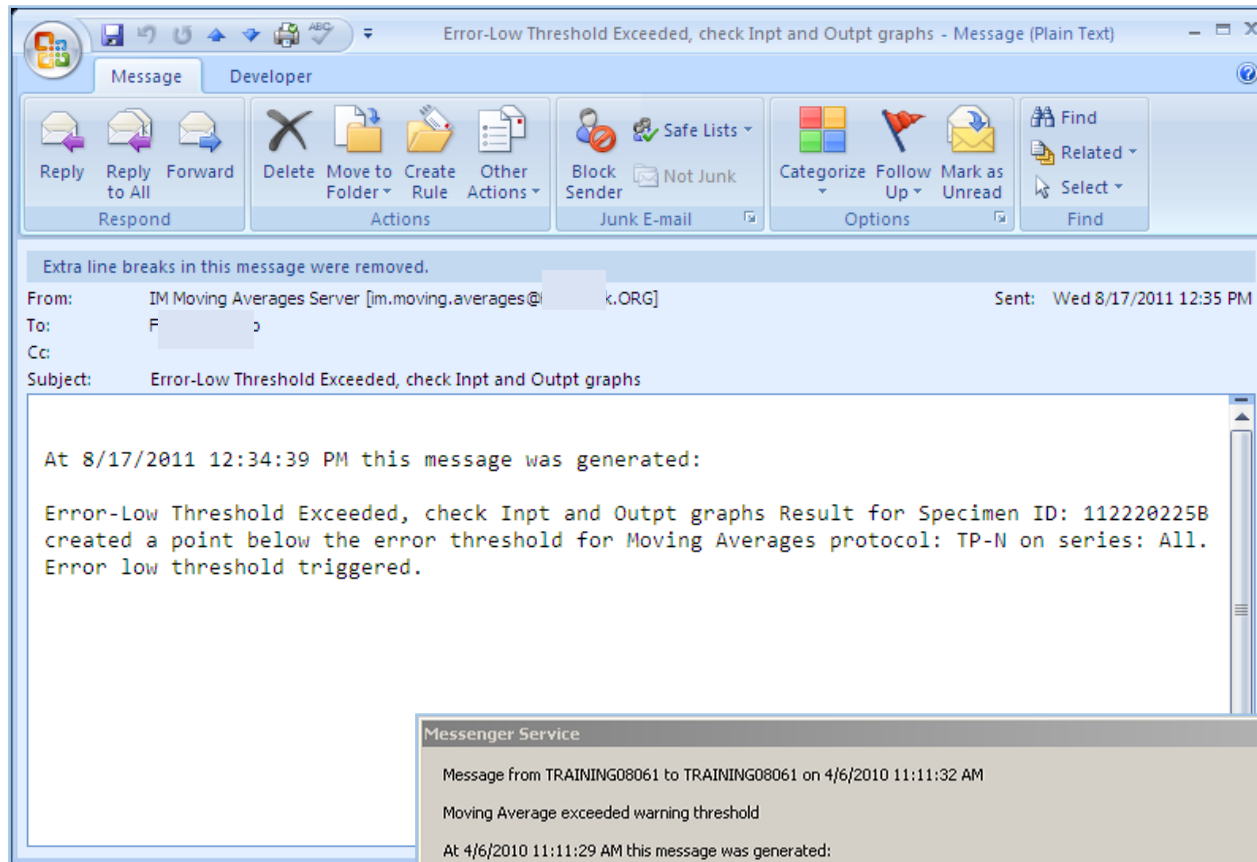
Changing items marked with \* will require a restart. Changing items marked with ~ will suggest a restart.

# Methods of Monitoring / Notifications

- Status Screen
- Moving Averages Desktop
  - ✓ Thin Client
  - ✓ Web Browser
- Notifier
  - ✓ Email
  - ✓ Pop up screen on selected computers
  - ✓ Light Pole



# Moving Average Threshold Violation Notifications



# Earlier Detection

Lab Manager was notified by IM before lab or QC notice issue

From: IM Moving Averages Server [im.moving.averages@Hitch]  
To: Frank A  
Cc:  
Subject: Error-High Threshold Exceeded, check Inpt and Outpt graphs

Sent: Wed 11/16/2011 12:20 PM

At 11/16/2011 12:20:23 PM this message was generated:

Error-High Threshold Exceeded, check Inpt and Outpt graphs Result for Specimen ID: 113201230C created a point above the error threshold for Moving Averages protocol: Na-All Pts exclusion set at 3.0 sd on series: C2. Error high threshold triggered.

**From:** Timothy  
**Sent:** Wednesday, November 16, 2011 12:49 PM  
**To:** Frank A. POITTO;  
**Subject:** C502 Na issue

C502 ISE's were shut off just after rounds today because we began to see the ISE issue again. Diane had seen a couple repeat Na's by that time that she couldn't feel good about.

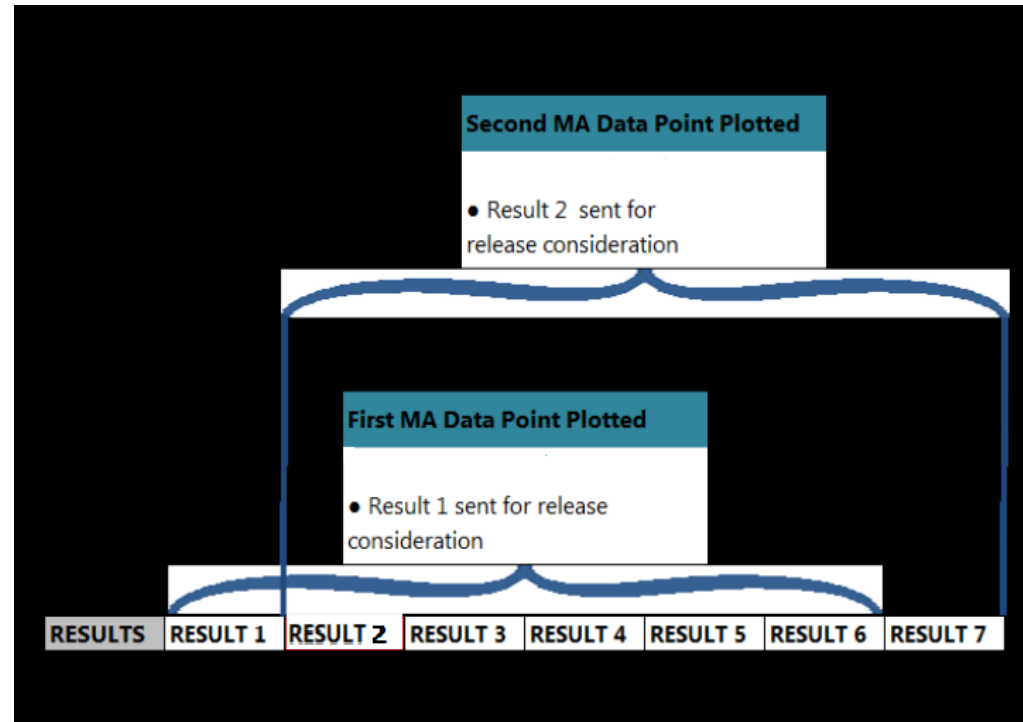
We actually turned the ISE's on on C501 (doesn't use the affected R2 probe system), and have contacted Dave . He will be here by 1500, and did confirm what we had done was "okay".

# Getting Started (Outline) - continued

There can't possibly be anything else this thing can do?

- Optional: Integrate in Autoverification
- Optional: MA/MM Bracketing

- ✓ Buffers result release
- ✓ Enhancement to QC program for autoverification
- ✓ QC Bracketing (in conjunction with the MA Bracketing functionality)



# Protocol Definition – System Actions

The screenshot shows the 'Protocol Configuration' window with a tree view on the left and a configuration table on the right. The 'Error High' section is expanded, and its 'Start Holding for Verification' row is selected, opening a dropdown menu.

Series	
Glucose: Chem1	
Glucose: Chem 2	

Warnings and Errors	
Error Low	
Warning Low	
Warning High	
Error High	
Threshold Value	3 (Standard Deviations Above mean)
Notifier Event	MA - Error High
Start Holding for Verification	Hold this test
Mark out of service	Do not hold tests

Changing items marked with \*\*\* will require a restart.

Dropdown menu options for 'Start Holding for Verification':  
Do not hold tests  
Hold this test  
Hold all tests

# Moving Averages Desktop

## Removing data points from MA Calculations

Result	Remove
92	Remove
106	Remove
82	Remove
90	Remove
101	Remove
102	Remove
90	Remove
112	Remove

**System Log**

Event

Event Date	Event Time	Description	User ID
4/16/2010	2:14:05 PM	N/A	IM_ADMIN
- MA Result Removed			
4/16/2010	3:12:07 PM	Test result:94 resulted on: 2010-04-16 14:36:42.000 with specimen ID: g100013 ...	IM_ADMIN
4/16/2010	3:05:48 PM	Test result:80 resulted on: 2010-04-16 14:36:42.000 with specimen ID: g100016 ...	IM_ADMIN
- Moving Averages			
4/16/2010	3:12:52 PM	Moving Averages General Configuration: Refresh Timer changed from "0" to "3"	IM_ADMIN
4/16/2010	3:01:57 PM	Moving Averages General Configuration: Chart Foreground Color changed from "0...	IM_ADMIN
4/16/2010	3:01:57 PM	Moving Averages General Configuration: Chart Background Color changed from "...	IM_ADMIN
4/16/2010	3:01:57 PM	Moving Averages General Configuration: Refresh Timer changed from "0" to "0"	IM_ADMIN

**Event Date/Time:** 4/16/2010 3:05:48 PM  
**User ID:** IM\_ADMIN  
**PC Name:** QBDKALVIM700build7  
**IP Address:** 10.11.102.238  
**Event:** MA Result Removed  
**Description:** Test result:80 resulted on: 2010-04-16 14:36:42.000 with specimen ID: g100016 with test code:Glu was removed from protocol Glucose MA series Glucose: Chem1 with reason: Outlier

Applied Filters: 1    Records returned by current filters: 148





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## What Makes Instrument Manager's Moving Averages Unique?

# Key Differentiators

- Filtering Mechanism: Ability Optimize Normal Population
- User Driven Real-Time Alerting
- User Driven Real-Time Actions
- Enterprise-Wide Solution Not Limited to a Work Area
- Manual Exclusion of Result Values with automatic Audit Trail creation
- Instrument independent for comparison (doesn't have to be same instrument)

# Need Help Getting Started?

## DI offers

- ‘Getting started’ sessions to educate on how to get started (no charge)
- Instructional courses on how to setup, configure and get the most from MA
- Customized configuration, installation and training – we will do the initial set up for you

# Questions?

Thank you for your time!

For more information please contact:

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