Message

From: Ian Gibbons [/O=THERANOS ORGANIZATION/OU=FIRST ADMINISTRATIVE GROUP/CN=RECIPIENTS/CN=IGIBBONS]
Sent: 2/22/2010 3:44:40 PM
To: Elizabeth Holmes [/O=THERANOS ORGANIZATION/OU=FIRST ADMINISTRATIVE GROUP/CN=RECIPIENTS/CN=Eholmes]; Sunny Balwani [/O=THERANOS ORGANIZATION/OU=FIRST ADMINISTRATIVE GROUP/CN=RECIPIENTS/CN=Sbalwani]
CC: Gary Frenzel [/O=THERANOS ORGANIZATION/OU=FIRST ADMINISTRATIVE GROUP/CN=RECIPIENTS/CN=Gfrenzel]
Subject: RE: System 4.0 PPT
Attachments: List of analytes (GC and cell counting).xls

The attached presents my analysis of how the analytes you listed would be measured in System 4.0. Essentially all are possible in the proposed system

There are a few notes and caveats:

1. I propose RBC counts and Hematocrit be calculated from hemoglobin measurements. RBCs can also be counted by fluorescence cytometry but this is difficult. Direct hematocrit measurement would require yet another technology not envisioned in the proposed System 4.0.
2. LDL would be calculated from total and HDL-cholesterol
3. HbA1cwould require a special antibody we do not have access to.
4. eGFR is a calculated parameter (from BUN and Creatinine)
5. Bicarbonate/CO2 measurement in plasma would require UV optics (340 nm: OK for the proposed system if it has a spectrometer). This analyte does not count as a blood gas but rather a measure of blood acid/base balance (n other words, an electrolyte). **Again I remind us that CO2 is volatile and would be rapidly lost (seconds) from a blood drop causing false results.**
6. Note that uric acid can be measured in plasma. I'm not sure what problem you saw with that analyte.

From: Elizabeth Holmes
Sent: Friday, February 19, 2010 1:13 PM
To: Ian Gibbons; Sunny Balwani
Cc: Gary Frenzel
Subject: RE: System 4.0 PPT

Here's the general chemistry panel we want to have – it includes the most commonly run tests and the tests on quests general chemistry panel with the exception of uric acid. Is there a blood surrogate for that?

1. **Complete blood count (CBC)**
    a. RBCs
    b. WBCs
    c. Platelets
    d. Hemoglobin (A1C)
    e. Hematocrit
    f. Mean Corpuscular Volume

2. **Blood chemistry tests/Basic Metabolic Panel**
    a. Glucose
    b. Calcium
    c. Electrolytes
        i. Sodium
        ii. Potassium
        iii. Bicarbonate
        iv. Chloride
    d. Kidneys
        i. BUN (Blood urea nitrogen)
        ii. Creatinine

3. **Blood enzyme tests**
    a. Creatinine kinase

    b. Troponin

4. **Blood tests to assess heart disease risk**
    a. Lipoprotein Panel
        i. Total cholesterol
        ii. LDL
        iii. HDL
        iv. Triglycerides
    b. High-Sensitivity C-Reactive Protein (CRP)
    c. Homocysteine
5. **Alanine Transaminase (ALT, SGPT)**
6. **Albumin**
7. **Alkaline Phosphatase**
8. **Aspartate Transaminase (AST, SGOT)**
9. **Bilirubin, Direct & Total**
10. **Carbon Dioxide**
11. **Ferritin**
12. **Gamma Glutamyltransferase (GGT)**
13. **Glomerular Filtration Rate, Estimated (eGFR)**
14. **Iron & Total Iron Binding Capacity (TIBC)**
15. **Lactate Dehydrogenase (LD)**
16. **Magnesium**
17. **Microalbumin**
18. **Phosphorus (Phosphate)**
19. **Protein, Total**

From: Ian Gibbons
Sent: Thursday, February 18, 2010 11:39 AM
To: Sunny Balwani; Elizabeth Holmes
Cc: Gary Frenzel
Subject: System 4.0 PPT

As requested …

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1. Complete blood count (CBC)	Methods and notes	Link
a. RBCs	Calculated from hemoglobin	
b. WBCs	Cell counting	
c. Platelets	Cell counting	
d. Hemoglobin (A1C)	Immunoassay; NOTE critical Ab needed	
e. Hematocrit	Calculated from hemoglobin	
f. Mean Corpuscular Volume	Measured during cell counting	
Added: Hemoglobin	Color	
2. Blood chemistry tests/Basic Metabolic Panel		
	Color	
a. Glucose		
b. Calcium	Color	
c. Electrolytes		
i. Sodium	Color	http://www.diazyme.com/products/reagents/DZ114B.php
ii. Potassium	Color	
iii. Bicarbonate	UV spectroscopy (340 nm)	Sample is plasma or serum! Can be measured by CO2 release + ISE or enzymatically (see Tietz pp 1371-2)
iv. Chloride	Color	http://www.bioxys.com/i_Assay_Kits/DICL.pdf
d. Kidneys		
i. BUN (Blood urea nitrogen)	Color	
ii. Creatinine	Color	http://www.bioassaysys.com/DICT.pdf
3. Blood enzyme tests		
a. Creatinine kinase	Color/Enzyme or immunoassay	
b. Troponin	Immunoassay	
4. Blood tests to assess heart disease risk		
a. Lipoprotein Panel		
i. Total cholesterol	Color	
ii. LDL	Calculated from total and HDL cholesterol	
iii. HDL	Color	
iv. Triglycerides	Color	
b. High-Sensitivity C-Reactive Protein (CRP)	Immunoassay	
c. Homocysteine		http://www.diazyme.com/products/reagents/DZ568A.php
4. Alanine Transaminase (ALT, SGPT)	Color/Enzyme or immunoassay	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_ALT_GenChem.htm
5. Albumin	Color	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_Albumin.htm
6. Alkaline Phosphatase	Color/Enzyme or immunoassay	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_AlkPtase.htm
7. Aspartate Transaminase (AST, SGOT)	Color/Enzyme or immunoassay	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_AST.htm
8. Bilirubin, Direct & Total	Color	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_BilirubinDirect.htm
Bilirubin total	Color	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_BilirubinTotal.htm
9. Carbon Dioxide		<http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_CarbonDioxide.htm
10. Ferritin	Immunoassay	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_Ferritin.ht
11. Gamma Glutamyltransferase (GGT) <>		http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_GGT.htm
12. Glomerular Filtration Rate, Estimated (eGFR) <>	Calculated	Calculated from BUN and Creatinine
13. Iron	Color	http://www.clonagen.com/clonagen/b957ce8c-86e8-4f68-becb-35adfff4cb79/quantichrom_iron_assay_kit_product.aspx http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_Iron.htm
Total Iron Bnnding Capacity	Color	http://www.pointescientific.com/products/PI/I7517.pdf http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=TS_eGFR.htm
14. Lactate Dehydrogenase (LD)	Color/Enzyme or immunoassay	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_LactateDehydrog.htm
15. Magnesium	Color	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_Magnesium.htm
16. Microalbumin	Color	URINE
17. Phosphorus (Phosphate)	Color	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_Phosphorus.htm
18. Protein, Total	Color	http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_ProteinTotal.htm
		http://www.questdiagnostics.com/hcp/intguide/jsp/showintguidepage.jsp?fn=GeneralChemistry/hcp_ig_testnameindex_ProteinTotal.htm
Added		
19 Uric acid	Color	http://www.bioassaysys.com/DIUA.pdf