

**COST AND PRODUCTIVITY ANALYSIS TOOL**  
**CONCEPTUAL DESIGN UPDATE**  
November 17, 2009

## **INTRODUCTION**

This document is an update on the possible conceptual design for the Cost and Productivity Analysis Tool (CAPAT). It does not discuss implementation details. The objective of this document is to provide a more detailed description of the components of the system and their integration. The goal for the current design is to develop a straightforward and user-friendly system that integrates existing Microsoft Office tools eliminating the need for external software.

## **CONCEPTUAL DESIGN**

CAPAT consists of two major components:

- 1) Calculator (Microsoft Excel)
- 2) Archive (Microsoft Access)

The Calculator will be developed using Microsoft Excel and will be a component used by each participating lab. Each lab will enter relevant data from its LIMS, financial system, and other sources into the Calculator. The Calculator will evaluate specific cost and productivity measures based on this data. The Calculator will then automatically structure and send the data via email. The email will contain an attached Excel spread sheet generated by the calculator with the data to be added to the Archive.

The Archive will be a database developed in Microsoft Access that stores the cost and productivity data that participating labs provide. The Archive will store data from all the participating labs for multiple time periods. The Archive will have a user interface that will allow users to generate customized queries and reports for comparing lab cost and productivity measures across labs.

## **CAPAT PROCESS FLOW**

Periodically, each participating lab will gather relevant data from its LIMS, financial system, and other sources and enter it into its own copy of the Calculator. (The expected period is one year, but some labs may wish to use the Calculator more often.)

The calculator will evaluate specific cost and productivity measures for that lab based on this data and provide corresponding reports to administrators of that lab.

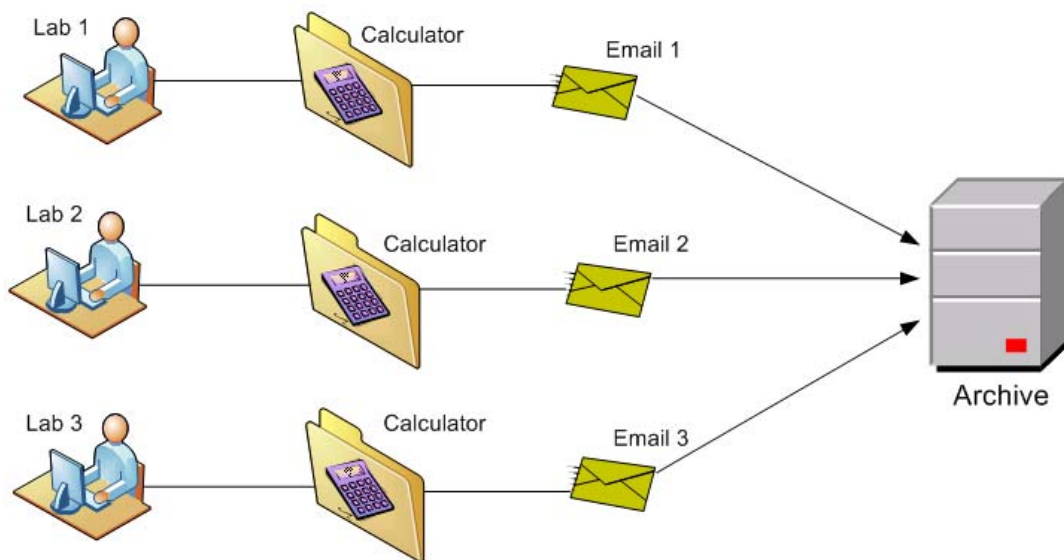
In addition, the calculator will generate cost and productivity data about this lab for this time period for the Archive, and each lab will add its cost and productivity data to the Archive.

Two software applications will be developed for making connections between the excel framework on the client side and the access Archive on the server side.

The client side will use an application in .NET framework (compatible with both excel and access). The application will read and structure the data from the Calculator and send it to the server where the data can be added to the Archive.

Administrators from the participating labs and other authorized users can access the Archive at any time to run standard and customized reports to compare lab cost and productivity measures across labs.

Figure 1 shows the process flow.



**Figure 1:** CAPAT process flow.

## CALCULATOR

The interface of Calculator is shown in **Figure 2** (this is in Office 2007; it will look different in Office 2003). The following example is data for an HIV Test provided by the Wyoming Public Health Laboratory Department of Health (refer to **Appendix A** for further details).

Calculator - Microsoft Excel

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**Test Cost Calculator**

**Instructions:**  
Enter values in the white boxes below. Values in the the yellow boxes will be calculated automatically.

**Test Lab and Name:**

WY Public Health Laboratory Department of He  
HIV

**Required consumables:**

	Cost per specimen
Double mailing container Enzyme	\$5.50
HIV reagent cost/test Enzyme	\$3.37
Consumables Enzyme	\$1.50
Western Blot reagent cost/test	\$34.00
Consumables Blot	\$1.50

Delete Add to list

**Test Supplies Cost** **\$45.87**

**Labor categories:**

	Time per specimen (hours):	Direct labor rate (\$/hour):
Lab scientist	0.10	\$38.50
Technician	0.10	\$22.00
Clerical	0.20	\$24.00

**Direct Labor Cost** **\$10.85**

**Total Direct Cost** **\$56.72**

Indirect cost rate (%): 40%

**Indirect Cost** **\$22.69**

**Total Test Cost** **\$79.41**

**Notes about this test:**

HIV testing includes a Enzyme-immunoassay (EIA) screening test and a western blot for confirmation of positive EIA tests.

**Notes about this form:**

Consumables includes supplies, reagents, disposables, and controls, all on a per-specimen basis.  
The Test Supplies Cost is the sum of all items listed under Required Consumables.  
The Direct Labor Cost is the sum (over the labor categories listed) of the product of the time per specimen and the labor rate.  
The Total Direct Cost equals the sum of the Test Supplies Cost and the Direct Labor Cost.  
The Indirect Cost equals the Total Direct Cost multiplied by the Indirect cost rate.  
The Total Test Cost equals the Total Direct Cost plus the Indirect Cost.

Save Send

Ready

**Figure 2:** A screenshot of the Calculator with the Wyoming HIV Test data. The first two fields in the Calculator are the test and the name of the lab which can be selected from a dropdown menu. For this example a 40% indirect cost rate was used and the time per specimen for each labor category is arbitrary.

Once the data is entered, the Calculator evaluates the specific cost and productivity measures (the fields shown in yellow on **Figure 2**).

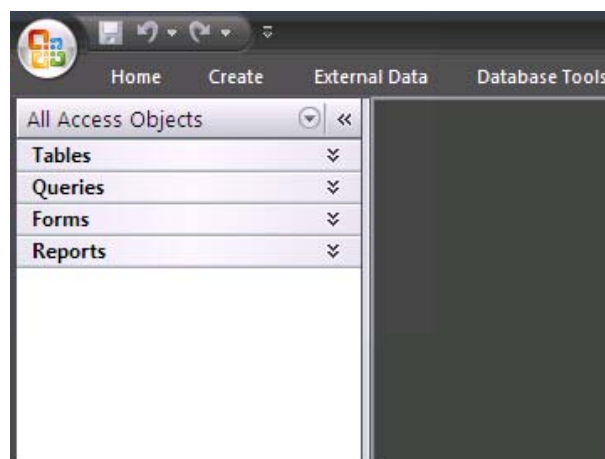
At the bottom of the Calculator the user is presented with two buttons: 'Save' and 'Send'. For the current example the save option was selected.

The data has now been saved and structured and must now be added to the Archive.

## THE ARCHIVE

The Archive consists of four main elements: Tables, Forms, Queries, and Reports.  
(The data used in the Archive is for demonstration purposes only.)

Figure 3 shows a screen shot of the four main elements that constitute the Archive.




**Figure 3:** The four main elements that constitute the Archive:  
Tables, Queries, Forms, and Reports.

Tables are the core element of the Archive. Similar to a spreadsheet, a Table will store all the cost and productivity data of the participating labs. The Archive will have the three following Tables.

- 1) Public Health Labs  
The Public Health Labs Table will contain general information pertaining to each participating lab (i.e. lab name, city, state, and address)
- 2) Tests  
The Tests Table will contain all the tests/procedures and their specific cost and productivity data as evaluated by the Calculator.
- 3) Cost Details  
The Cost Details Table will contain cost-specific data such as the required consumables and labor details as entered in the Calculator.

Figure 4 shows a screen shot of the three Tables of the Archive showing that the Public Health Labs Table has been opened.

Public Health Labs Table is opened and appears as a tab.

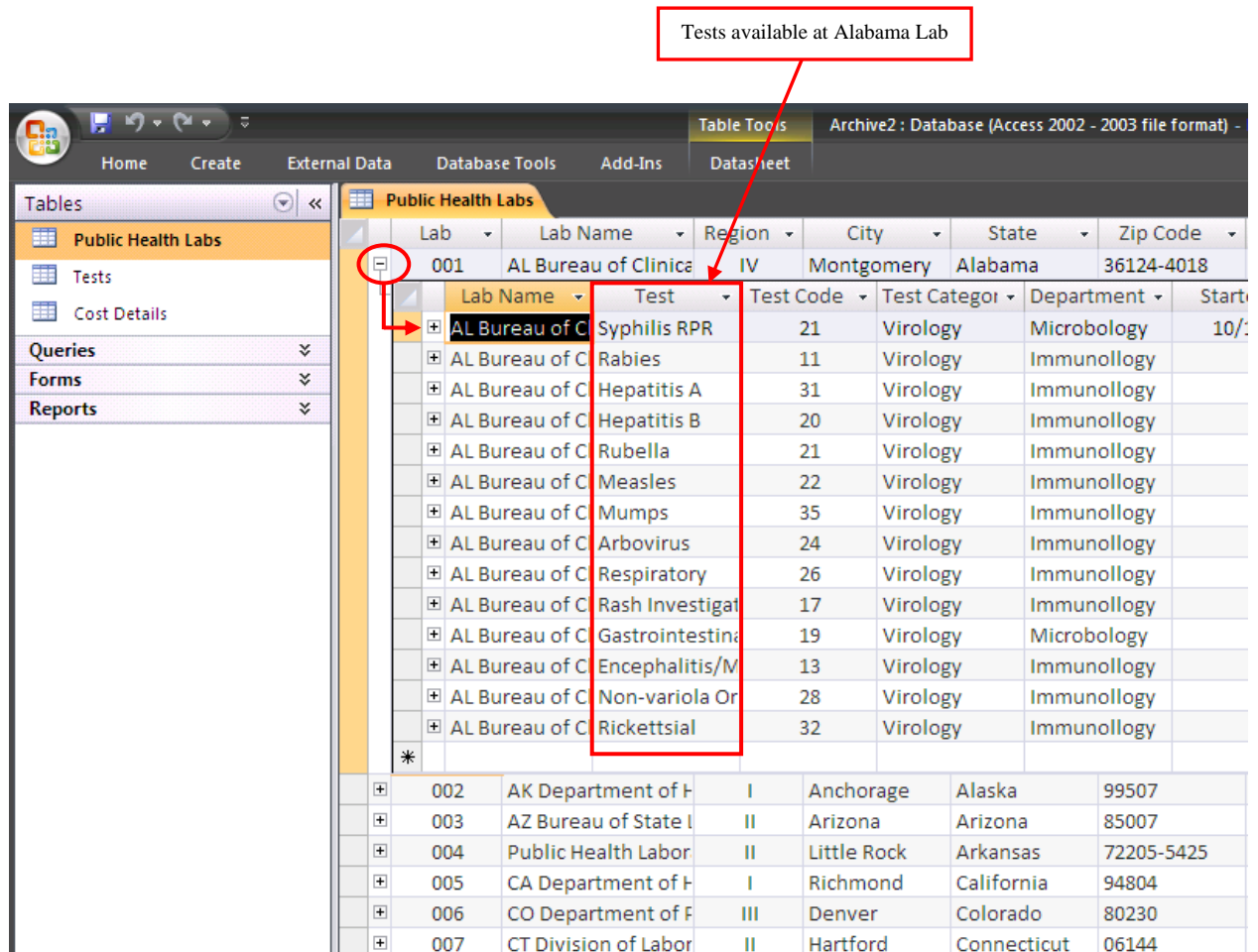


Lab	Lab Name	Region	City	State	Zip Code
001	AL Bureau of Clinical	IV	Montgomery	Alabama	36124-4018
002	AK Department of H	I	Anchorage	Alaska	99507
003	AZ Bureau of State I	II	Arizona	Arizona	85007
004	Public Health Labor	II	Little Rock	Arkansas	72205-5425
005	CA Department of H	I	Richmond	California	94804
006	CO Department of F	III	Denver	Colorado	80230
007	CT Division of Labor	II	Hartford	Connecticut	06144

**Figure 4:** The three Tables of the Archive. The Public Health Lab Table has been opened.

The three Tables have a defined relationship between each other. The ‘+’ symbol circled in red on **Figure 4** indicates the Table has a relationship to another Table. The relationship between Tables allows proper organization and direct access to each Table without having to open each Table separately.

Figure 5 shows a screen shot of the Test Table for the Alabama Lab 001 accessed from the Public Health Table after clicking on the '+' symbol.



Tests available at Alabama Lab

Lab	Lab Name	Region	City	State	Zip Code
001	AL Bureau of Clinical Microbiology	IV	Montgomery	Alabama	36124-4018

Lab Name	Test	Test Code	Test Category	Department	Start Date
AL Bureau of Clinical Microbiology	Syphilis RPR	21	Virology	Microbiology	10/1/2000
AL Bureau of Clinical Microbiology	Rabies	11	Virology	Immunology	
AL Bureau of Clinical Microbiology	Hepatitis A	31	Virology	Immunology	
AL Bureau of Clinical Microbiology	Hepatitis B	20	Virology	Immunology	
AL Bureau of Clinical Microbiology	Rubella	21	Virology	Immunology	
AL Bureau of Clinical Microbiology	Measles	22	Virology	Immunology	
AL Bureau of Clinical Microbiology	Mumps	35	Virology	Immunology	
AL Bureau of Clinical Microbiology	Arbovirus	24	Virology	Immunology	
AL Bureau of Clinical Microbiology	Respiratory	26	Virology	Immunology	
AL Bureau of Clinical Microbiology	Rash Investigation	17	Virology	Immunology	
AL Bureau of Clinical Microbiology	Gastrointestinal	19	Virology	Microbiology	
AL Bureau of Clinical Microbiology	Encephalitis/Meningitis	13	Virology	Immunology	
AL Bureau of Clinical Microbiology	Non-variola Orthopoxvirus	28	Virology	Immunology	
AL Bureau of Clinical Microbiology	Rickettsial	32	Virology	Immunology	

**Figure 5:** Accessing the Test Table from the Public Health Labs Table.

Similarly the Cost Details Table can be accessed via the Test Table (refer to **Figure 6**).

Lab	Lab Name	Region	City	State	Zip Code	Lab Name	Test	Test Code	Test Category	Department	Start Date
001	AL Bureau of Clinical	IV	Montgomery	Alabama	36124-4018	AL Bureau of Clinical	Syphilis RPR	21	Virology	Microbiology	10/1/2010
							Reagents	1.2	Professional Staff	0.1	30
							Diluents	1.5	Clinical Scientists	0.1	20
							Calibration Materials	2.3	Assistants/Aides	0.2	18
							Reference Fluids	0.75			
							Rinse/wash solutions	12.4			
							Cleaning Solutions	7.45			
							Deionized Water	6.8			
							Analyzer-specimens	5.99			
							*				
	AL Bureau of Clinical						Rabies	11	Virology	Immunology	
	AL Bureau of Clinical						Hepatitis A	31	Virology	Immunology	
	AL Bureau of Clinical						Hepatitis B	20	Virology	Immunology	
	AL Bureau of Clinical						Rubella	21	Virology	Immunology	
	AL Bureau of Clinical						Measles	22	Virology	Immunology	
	AL Bureau of Clinical						Mumps	35	Virology	Immunology	
	AL Bureau of Clinical						Arbovirus	24	Virology	Immunology	

**Figure 6:** Accessing the Cost Table from the Tests Table.

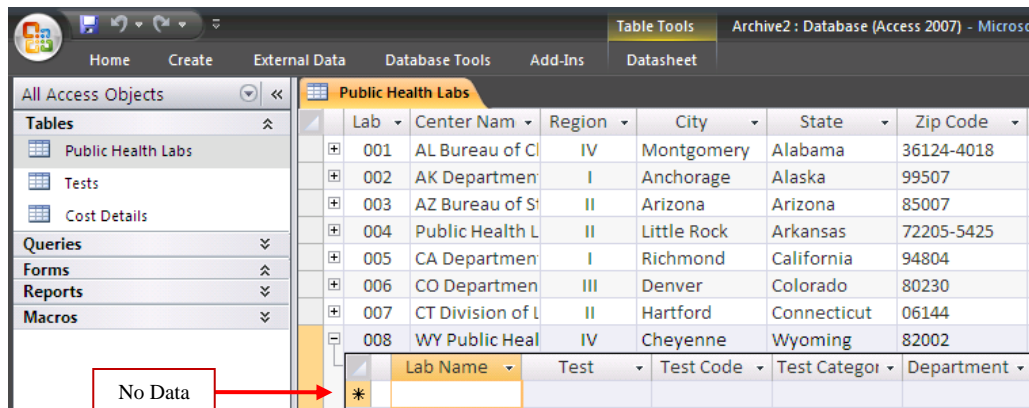
The second element of the Archive is Forms. Forms constitute the interface of the Archive. A Form allows a user to view and modify the data without directly accessing the Tables in the database. A Form will also allow a user to add an existing record, import new data, or execute Queries and Reports.

Figure 7 shows an example of a simple Form. By clicking on the buttons the Form will update the Archive by importing the new Wyoming HIV data entered in the Calculator.

**Figure 7:** A simple Form that imports new data into the Archive.



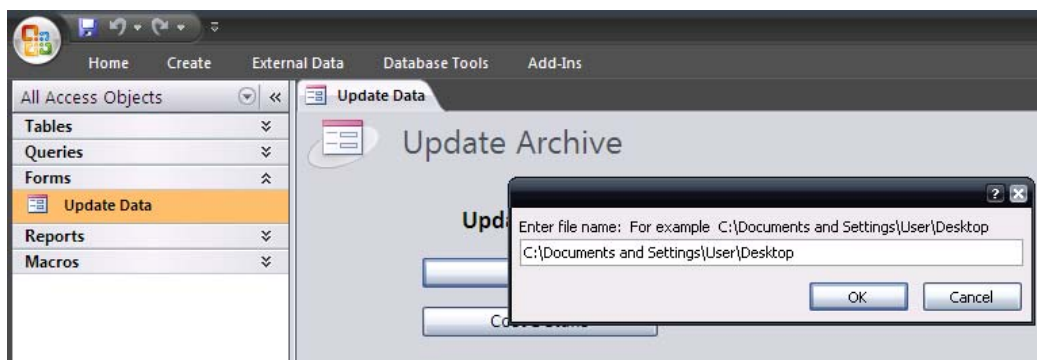
Prior to importing the data, notice that there is no data for the Wyoming Lab in the Public Health Labs Table in the Archive (refer to **Figure 8**).



Lab	Center Name	Region	City	State	Zip Code
001	AL Bureau of Cl	IV	Montgomery	Alabama	36124-4018
002	AK Department	I	Anchorage	Alaska	99507
003	AZ Bureau of St	II	Arizona	Arizona	85007
004	Public Health L	II	Little Rock	Arkansas	72205-5425
005	CA Department	I	Richmond	California	94804
006	CO Department	III	Denver	Colorado	80230
007	CT Division of L	II	Hartford	Connecticut	06144
008	WY Public Heal	IV	Cheyenne	Wyoming	82002

**Figure 8:** A screen shot showing that the Wyoming lab has no data.

Now, returning to the Update Archive Form clicking on a button will return a pop-up window asking the user to enter the location of the file (refer to **Figure 9**). The directory of the Calculator will be entered to import the Wyoming HIV data. For the current prototype both buttons must be clicked to properly import the data.



**Figure 9:** Entering the file name of the Calculator to import the Wyoming HIV data.

The data has now been imported and can be seen from the Public Health Lab Table (refer to **Figure 10**).

The screenshot shows the Microsoft Access 2007 interface. The 'Table Tools' ribbon is active, showing the 'Datasheet' view. The 'All Access Objects' pane on the left shows the 'Public Health Labs' table selected. The main window displays the 'Public Health Labs' table with 8 columns: Lab, Center Nam, Region, City, State, Zip Code, and St. The table contains 8 rows of data, with the 8th row (Lab 008, WY Public Heal) highlighted. A red dashed box highlights the 'WY Public Heal HIV' sub-table, which has 6 columns: Lab Name, Test, Test Code, Test Categor, Department, and St. The sub-table contains 5 rows of data, with the first row (Required co, Double mailing) highlighted.

Lab	Center Nam	Region	City	State	Zip Code	St
001	AL Bureau of Cl	IV	Montgomery	Alabama	36124-4018	8140
002	AK Departmen	I	Anchorage	Alaska	99507	4500
003	AZ Bureau of Si	II	Arizona	Arizona	85007	250 M
004	Public Health L	II	Little Rock	Arkansas	72205-5425	201 S
005	CA Departmen	I	Richmond	California	94804	850 M
006	CO Departmen	III	Denver	Colorado	80230	8100
007	CT Division of L	II	Hartford	Connecticut	06144	10 Cl
008	WY Public Heal	IV	Cheyenne	Wyoming	82002	2300

Lab Name	Test	Test Code	Test Categor	Department	St
WY Public Heal HIV		1	Virology	Microbiology	
Required co	Cost per spe	Labor categ	Time per spe	Direct labor	
Double mailing	5.5	Lab scientist	0.1	38.5	
HIV reagent co	3.37	Technician	0.1	22	
Consumables E	1.5	Clerical	0.2	24	
Western Blot r	34				
Consumables E	1.5				
*					

**Figure 10:** Successfully importing the Wyoming HIV data into the Archive.

The other two elements of the Archive are Queries and Reports. Queries apply filters to the data in the Archive to retrieve specific records to compare lab cost and productivity measures across labs. A Report will allow a user to compile and organize the data in a presentable form.

The purpose of this document was to present in detail and with an example the function and interface of the possible conceptual design for the Cost and Productivity Analysis Tool (CAPAT)

## APPENDIX A

A copy of the first of two emails sent by Richard Harris from the Wyoming Public Health Laboratory Department of Health on an HIV Test data is shown below.

---

From: Richard Harris [richard.harris@health.wyo.gov]  
Sent: Wednesday, November 04, 2009 2:31 PM  
To: Jeffrey W. Herrmann  
Cc: Richard Harris  
Subject: FW: more examples needed

Here is example #1. HIV testing.

This is very crude. HIV testing includes a Enzyme-immunoassay (EIA) screening test and a western blot for confirmation of positive EIA tests. We do not charge for staff so I do not have FTE time involved in this, but some payroll numbers from our lab that could be helpful:

Lab scientist...\$38.50/hr (primary analyst)  
Technician.....\$22/hr (processes sample into lab and types information into LIMS)  
Clerical.....\$24/hr (test result mailing and admin support)

Payroll for our lab includes base pay, social security, retirement, medical insurance and longevity.

-----  
Cost per test

HIV Enzyme assay:

Double mailing container	\$ 5.5
HIV reagent cost/test	\$ 3.37
Consumables	\$ 1.5

Western Blot for positive HIV confirmation:

Western Blot reagent cost/test	\$ 34
Consumables	\$ 1.5

## APPENDIX B

A copy of the second email sent by Richard Harris from the Wyoming Public Health Laboratory Department of Health on an HIV Test data is shown below.

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From: Richard Harris [richard.harris@health.wyo.gov]  
Sent: Wednesday, November 04, 2009 5:36 PM  
To: Jeffrey W. Herrmann  
Subject: RE: more examples needed

Next example. (we don't have a standard system for calculating costs). If this gets confusing I can reorganize it.

Viral Vaccine serology for Rubella, Varicella, Mumps and Measles. These are tested on a analyzer called a minividas.

Cost of one analysis kit \$159

Tests/kit Rubella	49	Test Reagent cost/test	\$3.24
Tests/kit Measles	49	Test Reagent cost/test	\$3.24
Tests/kit Varicella	49	Test Reagent cost/test	\$3.24
Tests/kit Mumps	35	Test Reagent cost/test	\$4.54

Instrument maintenance cost of \$8500/year, I calculated \$1/test for maintenance at about 8,000 tests per year.

Cost of disposables (QC, paper, pipette tips etc.) \$ .10/test

An approximate cost/reportable test for Rubella, measles, and Varicella is \$4.34 and for Mumps is \$5.64