



Successfully Measuring Healthcare Analytics & Process Improvement (HAPI)

**Becker's Health IT + Revenue Cycle Conference
Chicago, IL
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HAPI

Healthcare
Analytics &
Process
Improvement

Healthcare
Analytics,
Prediction,
Process
Improvement &
Estimating
Risk



Early Appeal for Healthcare Analytics

“I am fain to sum up with an urgent appeal for adopting this or some uniform system of publishing the statistical records of hospitals. If they could be obtained . . . They would show subscribers how their money was being spent, what amount of good was really being done with it, or whether the money was doing mischief rather than good.”

Florence Nightingale
“Some Notes on Hospitals” (1863)



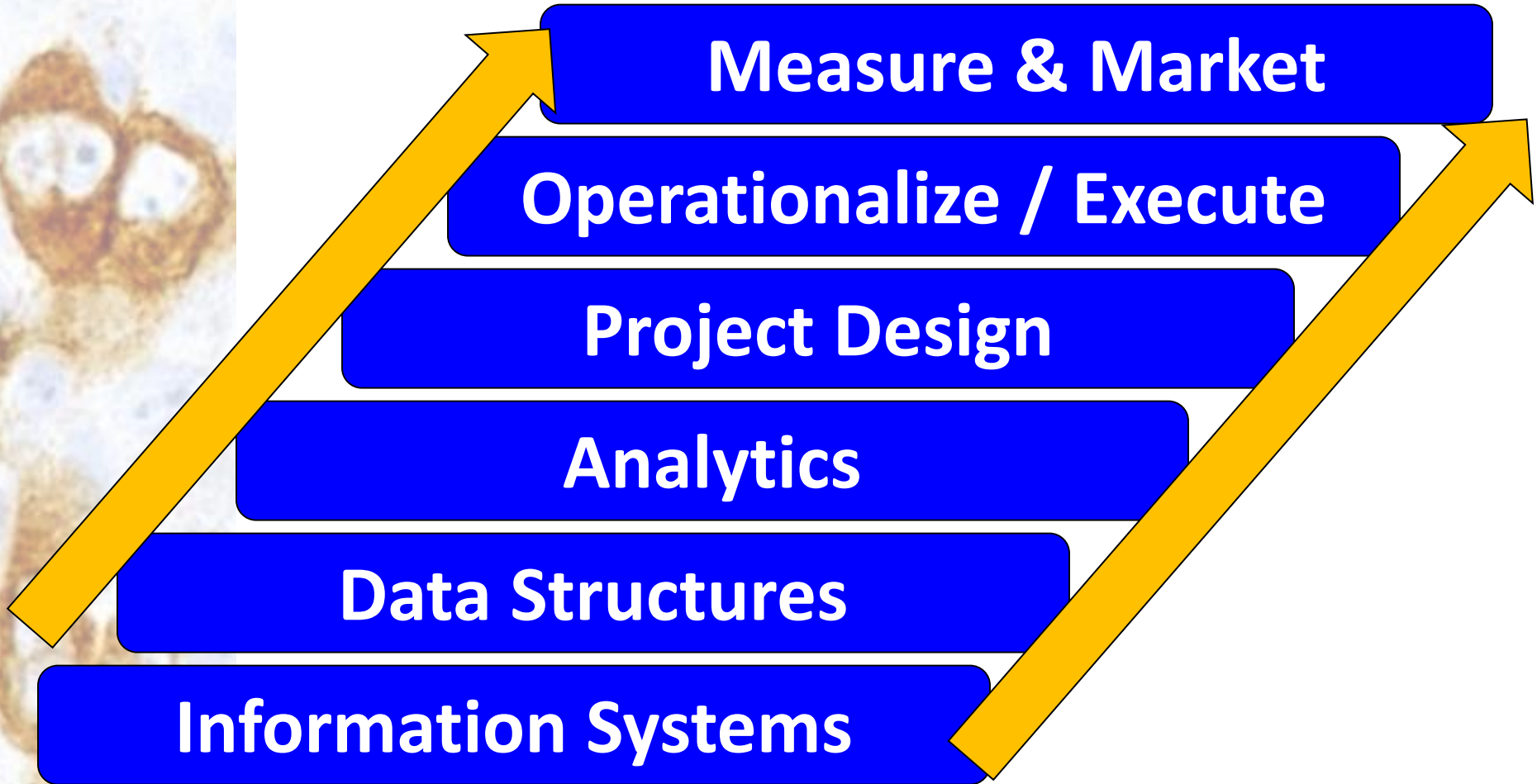
Healthcare Value

1. Improve patient outcomes
2. Improve patient satisfaction

$$\text{Value} = \frac{\text{Benefit}}{\text{Cost}}$$

3. Decrease costs
4. Simplify operational tasks/improve efficiency

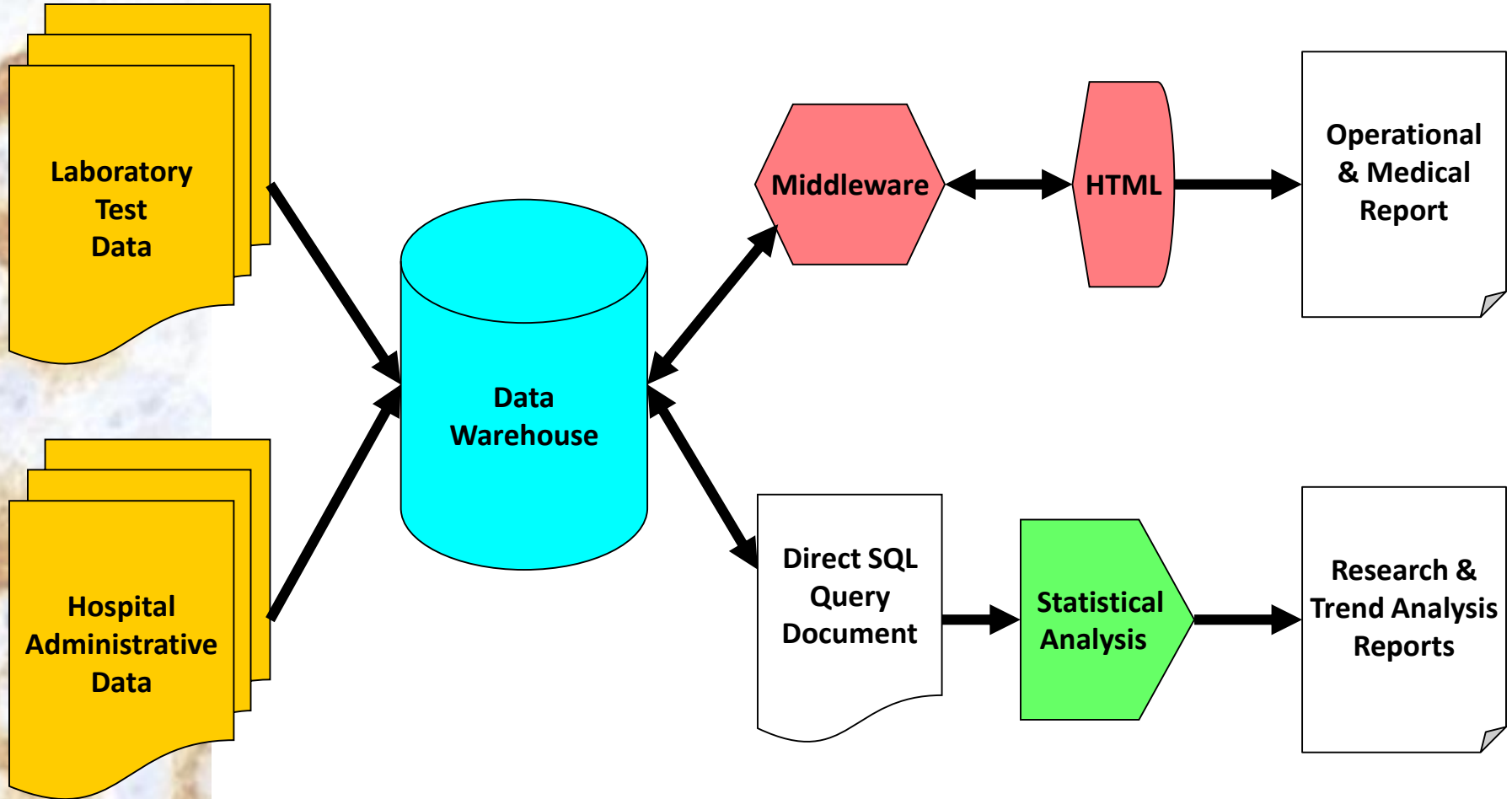
Laboratory Analytics Value Flow



Examples



Laboratory Data Warehouse



LAN Laboratory Portal

Clinical Lab Home Page - Microsoft Internet Explorer provided by University of Colorado Hospital

File Edit View Favorites Tools Help

Back Forward Stop Search Folders Favorites

Address <http://medms2/clinlab/> Go Links

University of Colorado Hospital Clinical Laboratory

ABCDEFGHIJKLMNOPQRSTUVWXYZ

Quick Test Lookup Submit Start Date End Date Mnemonic

Tests with CPT Submit Start Date End Date Mnemonic

Tests with SIM Submit Start Date End Date Mnemonic

Fax Nbr for Client Submit Start Date End Date Mnemonic

Lookup Fax Number Submit Start Date End Date Mnemonic

Other Reports

Caution: Data for this system is 24 hours behind Cerner

List Samples for Test

Submit Start Date End Date Mnemonic

List Low Samples for Test

Submit Start Date End Date Mnemonic Cutoff

List High Samples for Test

Submit Start Date End Date Mnemonic Cutoff

List Range of Samples for Test

Submit Start Date End Date Mnemonic Low High

ClinLab Home

- Web Links
- Employee Resources
- Reports
 - Client Services
 - TAT
 - Workload
 - Blood Bank
 - ICD-9
 - Instrument Comparison
 - LCC
 - Micro
 - Other
 - Post Analytical Storage
- Management
- Cerner - Web
- AllScripts
- Document Imaging
- Emergency Procedures
- Engineering Service Request
- Forms
- Lab Week Pictures

Close all

Done Local intranet

Data Warehouse: Project ROI (Actual)

Realized Cost Savings (2005)*

Annual savings	\$746,200
Pct of total laboratory costs	4.5%

Profitability (actual figures 1998-2005)*

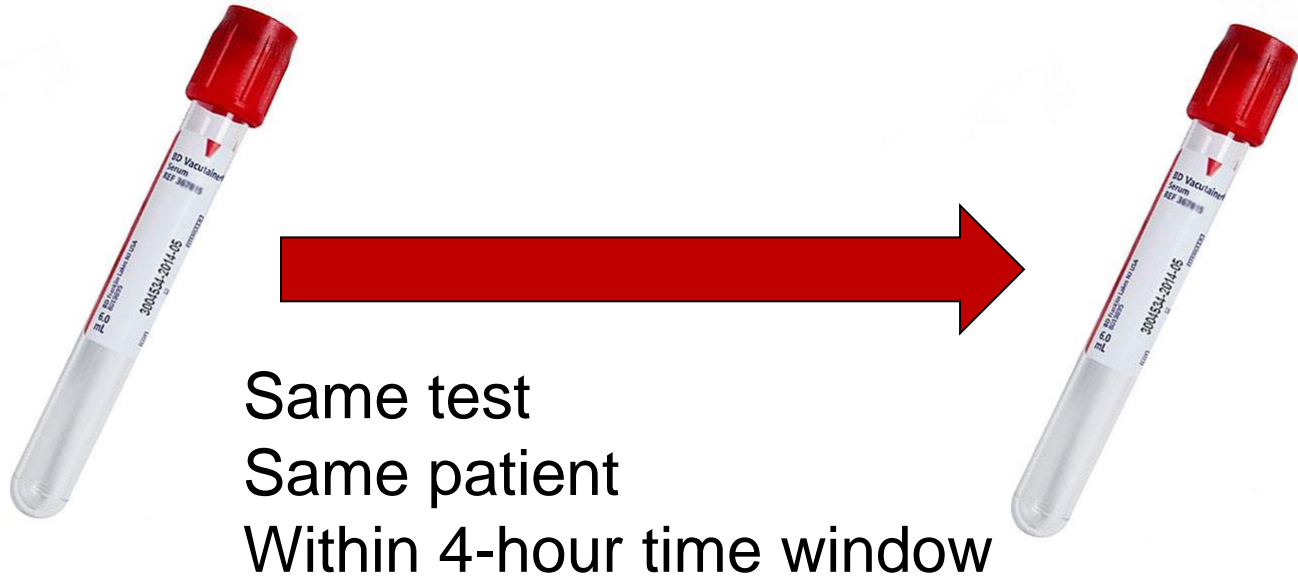
Payback period (actual)	1.47 y
NPV	\$2,968,639
MIRR	59.4%

****Still being used!**

*Brimhall BB, Hall TE, Walczak S. *AMIA Annu Symp Proc* 2006;865

** Boyer PJ, Brimhall BB, Williamson C, et al. *J Pathol Inform* 2014;5:S14

Duplicate Laboratory Testing



Duplicate Test Orders

ONCE First occurrence Today at 11

Modifv Discontinue

Starting Procedure Duplicate

PROCEDURE DUPLICATE: PLEASE REVIEW

Procedure Duplicate Action

Do you want to stop ordering the order currently being placed?

1. Basic metabolic panel - ONCE 3/26/14 1130 to 3/26/14 [Show order information](#) [\[Remove All\]](#)

1. [\[Remove\]](#)

OR

Do you want to discontinue the following orders that already exist?

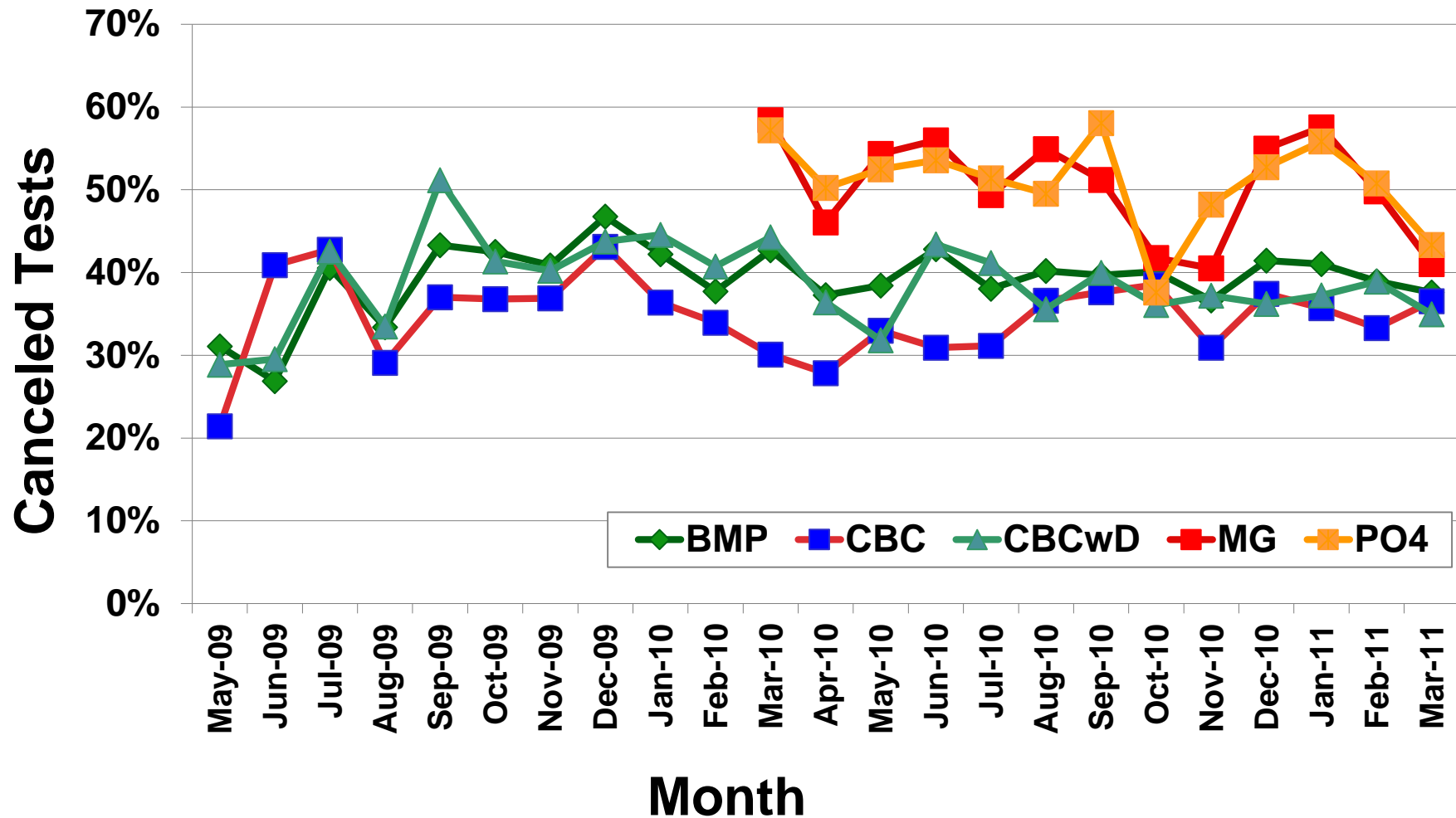
1. [Basic metabolic panel](#) - ONCE 3/26/14 1130 to 3/26/14 Status: Sent [Show order information](#) [\[Discontinue All\]](#)

1. [\[Discontinue\]](#)

Order duplicate found. Continue to accept these orders?

Modifv Discontinue

Canceled Tests

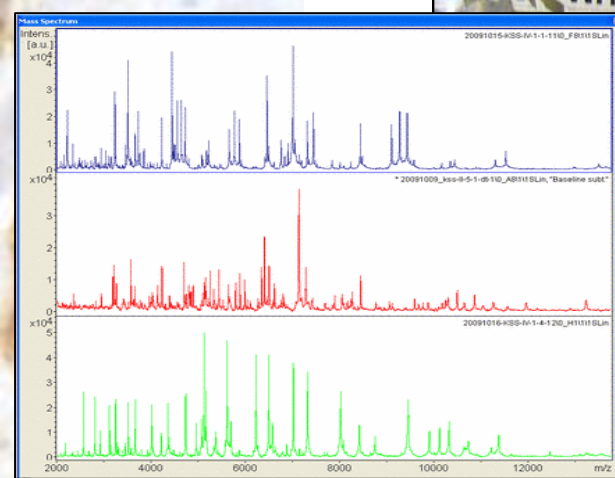
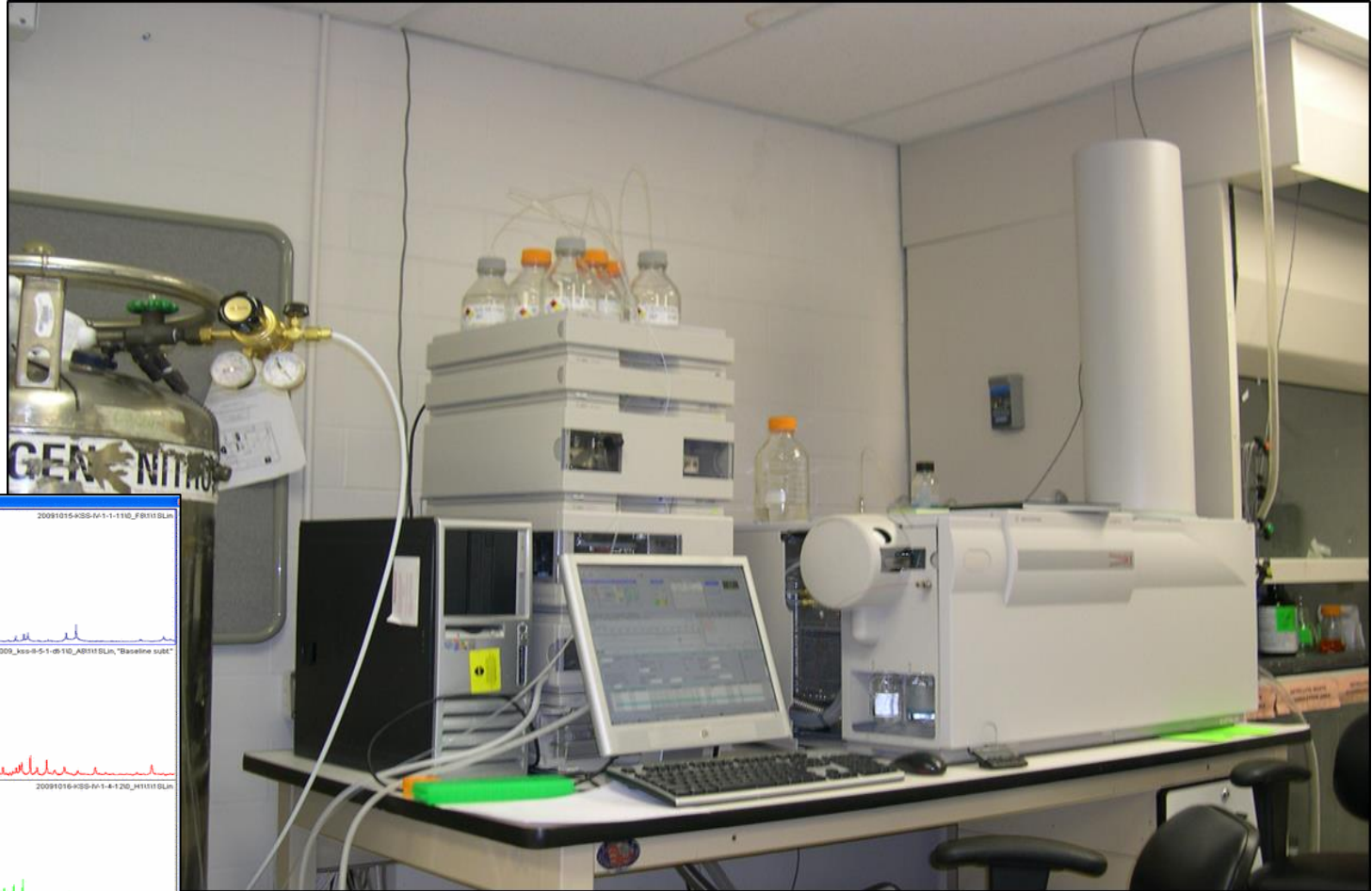
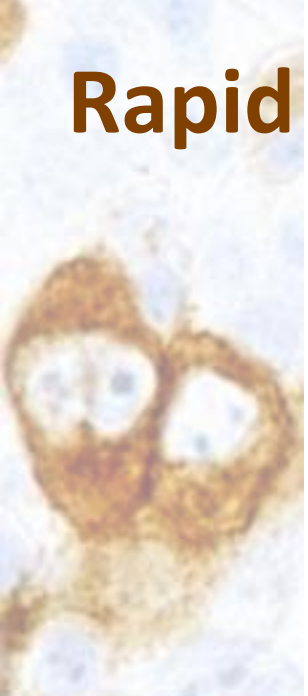


Duplicate Testing Alerts

Annualized Totals

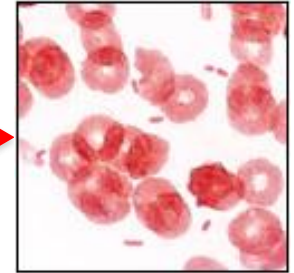
Test	Total	Canceled	Percent Canceled	Variable Cost	Total
BMP	12,706	5,204	41.0%	\$40,730	\$63,875
CBC	6,728	2,296	34.1%	\$9,574	\$17,668
CBC W/ DIFF	5,880	2,387	40.6%	\$9,954	\$18,368
MG	3,591	1,914	53.3%	\$6,393	\$16,346
PO4	5,100	2,718	53.3%	\$5,925	\$15,166
TOTAL	34,005	14,519	42.7%	\$72,576	\$131,423

Rapid Bacterial Identification



Current Methods

Fast, inexpensive, limited



Slow, expensive, accurate



Initial Financial Analysis

Item	Investment	Year					Total
		1	2	3	4	5	
Cost of instrument	(\$312,387)	\$0	\$0	\$0	\$0	\$0	(\$312,387)
Service contract	\$0	\$0	(\$19,178)	(\$19,178)	(\$19,178)	(\$19,178)	(\$76,710)
Cost savings from reagents	\$0	\$33,408	\$33,408	\$33,408	\$33,408	\$33,408	\$167,040
Sum of cash flows	(\$312,387)	\$33,408	\$14,230	\$14,230	\$14,230	\$14,230	(\$222,058)
PV cash flows	(\$312,387)	\$33,408	\$13,553	\$12,907	\$12,293	\$11,707	(\$228,519)

Payback Period

Payback period (years)	20.60
Payback period (months)	247.25
Payback period (weeks)	1,071.43

Net Present Value

Discount rate	5%
Project NPV	(\$228,519)

Modified Internal Rate of Return

Discount rate	5%
Reinvestment rate	2%
MIRR	-22.34%

Literature: Diagnostic Efficiency

Reduced Time to Bacterial Identification

Mean reduction = “34.3 hours”

Lagace-Wiens, P.R.S., Adam, H.J., Karlowski, J.A., et al. (2012). *J Clin Microbiol* 50:3324-3328. [University of Manitoba, Winnipeg, MB]

Mean reduction = “1.45 days” (34.8 hours)

Tan, K.E., Ellis, B., Lee, R., et al. (2012). *J Clin Microbiol* 50:3301-3308. [Johns Hopkins University, Baltimore, MD]

Mean reduction = “28.8 hours”

Vlek, A.L.M., Bonten, M.J.M., & Boel, C.H.E. (2012). *PLoS ONE* 7:e32589. [Univ. Medical Center, Utrecht, NL]

Implications for Patient Care

Reduced time to appropriate therapy: 28.8% of patients (treating physician), 44.6% of patients (stewardship team)

Tamma, P.D., Tan, K., Nussenblatt, V.R., et al. (2013). *Infect Control Hosp Epidemiol* 34:990-995. [Johns Hopkins University, Baltimore, MD]

Increase in proportion of patients receiving appropriate treatment at 24 hours: 11.3%

Vlek, A.L.M., Bonten, M.J.M., & Boel, C.H.E. (2012). *PLoS ONE* 7:e32589. [Univ. Medical Center, Utrecht, NL]

Percent with modification of empirical therapy: 35.1%

Clerc, O., Prod'homme, G., Vogne, C., et al. (2013). *Clin Infect Dis* 56:1101-1107. [Univ. of Lausanne, Lausanne, CH]

Diagnostic Cost Accounting Data

Queried Diagnostic Groups	
MSDRG Code	Interpretation
870	Septicemia with mechanical ventilation
871	Septicemia without mechanical ventilation with major complications/comorbidities
872	Septicemia without mechanical ventilation without major complications/comorbidities

Operational Inputs	
Patients	755
Patients with LOS > 2d	710
Mean LOS (d)	7.49

Expenses	Total	Per Admission	Per Day
Mean Fixed Costs	\$2,958,004	\$4,166	\$556
Mean Variable Costs	\$7,826,845	\$11,024	\$1,472
Mean Total Costs	\$10,784,849	\$15,190	\$2,028

New Financial Analysis

Item	Investment	Year					Total
		1	2	3	4	5	
Cost of instrument	(\$312,387)	\$0	\$0	\$0	\$0	\$0	(\$312,387)
Service contract	\$0	\$0	(\$19,178)	(\$19,178)	(\$19,178)	(\$19,178)	(\$76,710)
Cost savings from reagents	\$0	\$33,408	\$33,408	\$33,408	\$33,408	\$33,408	\$167,040
Cost savings from earlier discharge	\$0	\$1,253,967	\$1,253,967	\$1,253,967	\$1,253,967	\$1,253,967	\$6,269,836
Sum of cash flows	(\$312,387)	\$1,287,375	\$1,268,198	\$1,268,198	\$1,268,198	\$1,268,198	\$6,047,778

Payback Period

Payback period (years)	0.24
Payback period (months)	2.91
Payback period (weeks)	12.62

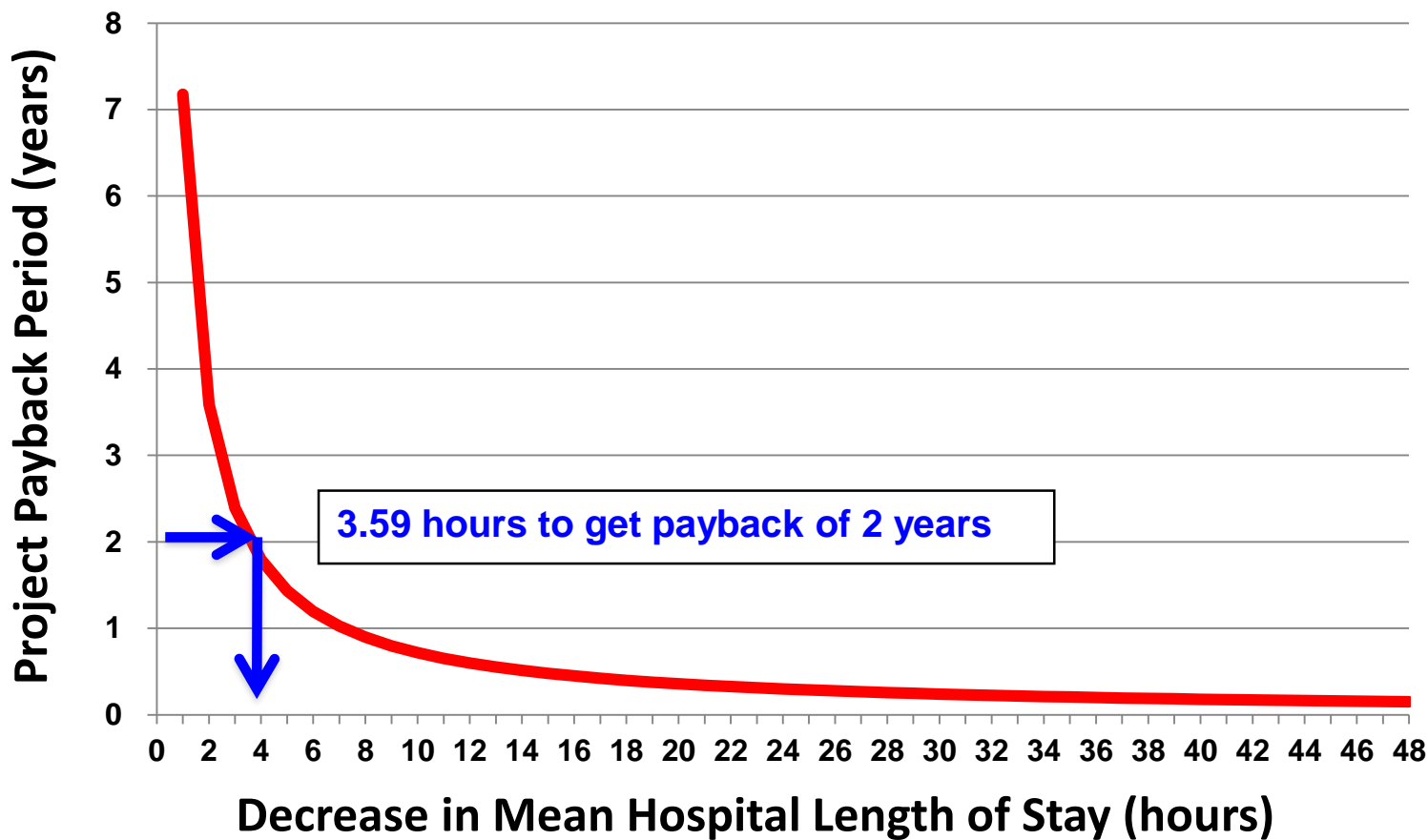
Net Present Value

Discount rate	5%
Project NPV	\$5,471,954

Modified Internal Rate of Return

Discount rate	5%
Reinvestment rate	2%
MIRR	80.79%

Sensitivity Analysis



Hospital Blood Donor Center



One View of Donor Center

Revenue and Expense view of operation

- Revenue: billed CPT codes for therapeutic phlebotomies
- Expenses greatly exceed revenue resulting in substantial net loss
- Therefore the operation should be closed

Profit & Loss Statement						
Acme Web Pros Plus						
For the month ended June 30, 2017						
	JUN 2017	MAY 2017	APR 2017	MAR 2017	FEB 2017	JAN 2017
Income						
Branding & Design	200.00	400.00	-	3,250.00	-	-
Consulting Fees	300.00	-	-	-	-	-
Digital Marketing	500.00	-	-	785.00	1,200.00	1,200.00
Sales	-	-	-	285.00	-	-
Web Design Income	1,100.00	800.00	-	1,950.00	-	-
Total Income	2,100.00	1,200.00	-	6,270.00	1,200.00	1,200.00
Gross Profit						
	2,100.00	1,200.00	-	6,270.00	1,200.00	1,200.00
Operating Expenses						
Dues and Subscription Fees	775.00	75.00	600.00	200.00	300.00	100.00
Other Expense	-	-	1,000.00	-	-	-
Parking fees	-	100.00	-	-	-	-
Postage & Shipping Fees	-	-	23.95	-	-	-
Travel Expenses	870.00	500.00	-	-	-	-
Web Hosting	-	400.00	400.00	40.98	(32.92)	32.92
Total Operating Expenses	1,645.00	1,075.00	2,023.95	240.98	267.08	132.92
Operating Income	455.00	125.00	(2,023.95)	6,029.02	932.92	1,067.08
Net Income	455.00	125.00	(2,023.95)	6,029.02	932.92	1,067.08

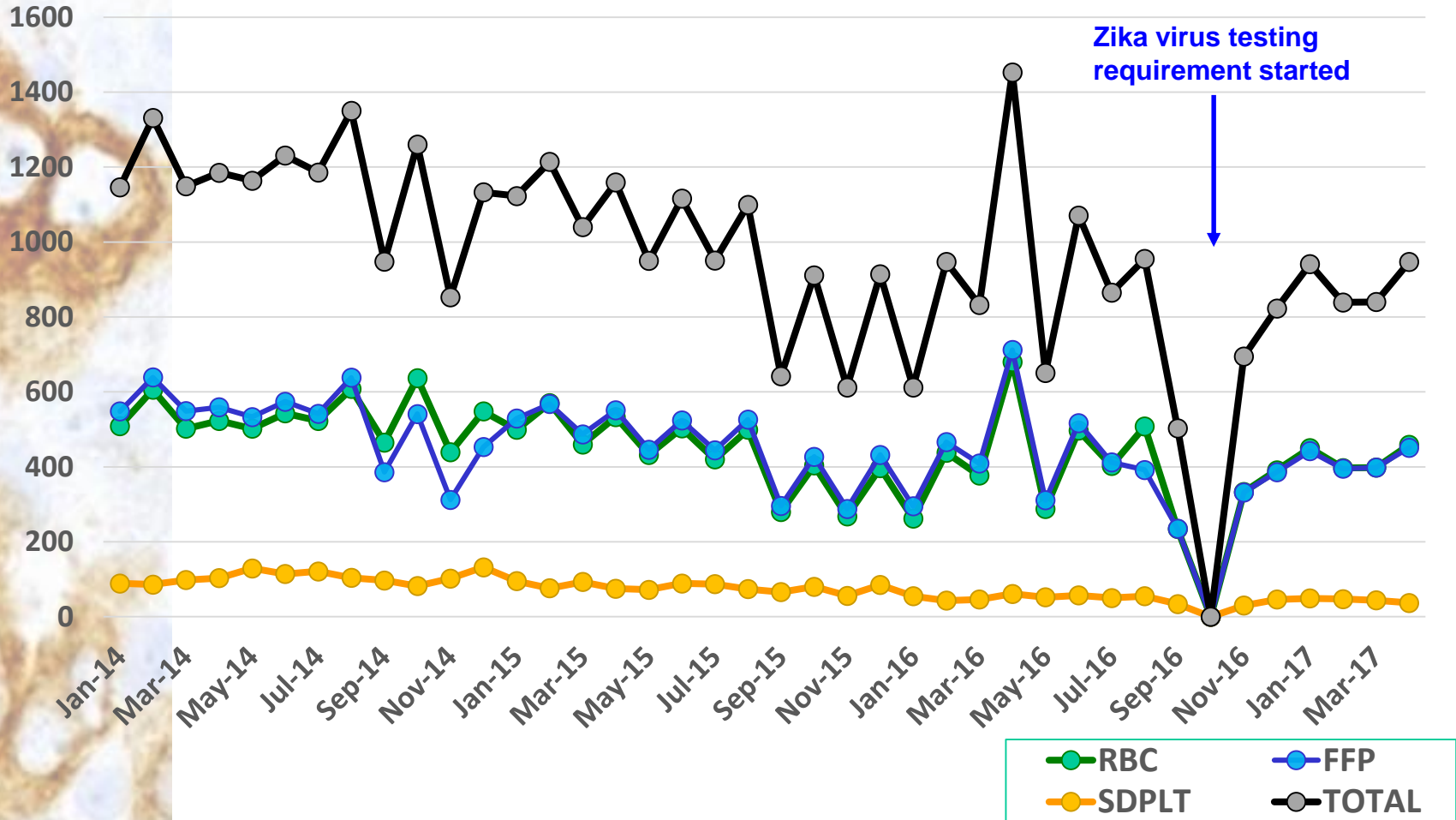
Contribution Analysis (TTM)

	Whole Blood	Platelet	Total	Percent
Outside Cost	\$1,579,425	\$579,960	\$2,159,385	100.0%
Less Consumables	\$218,632	\$199,769	\$418,401	19.4%
Less Testing	\$312,380	\$37,246	\$349,626	16.2%
Less Supplies	\$8,020	\$956	\$8,976	0.4%
Less Incentives	\$87,557	\$10,440	\$97,997	4.5%
Contribution to Labor	\$952,835	\$331,549	\$1,284,384	59.5%
Less Labor	\$352,642	\$62,231	\$414,873	19.2%
Less Recruiting	\$92,604	\$16,342	\$108,946	5.0%
Contribution to Local Fx	\$507,589	\$252,976	\$760,564	35.2%
Regulatory Costs	\$3,698	\$653	\$4,351	0.2%
Common Supplies	\$5,863	\$1,035	\$6,898	0.3%
Equipment Costs	\$229,311	\$40,466	\$269,777	12.5%
Contribution to Overhead	\$268,716	\$210,822	\$479,538	22.2%

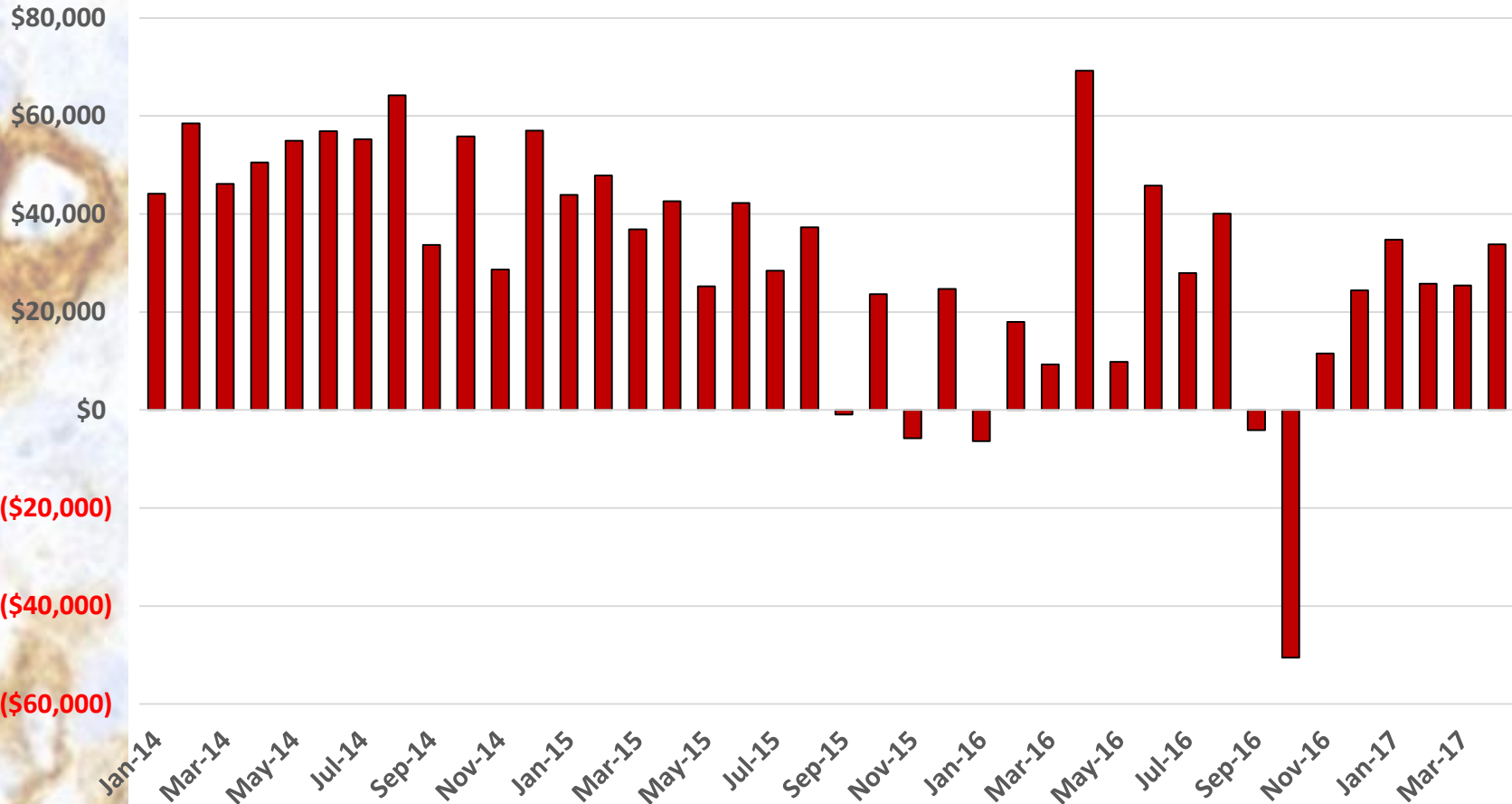
Seeing the Donor Center in New Light



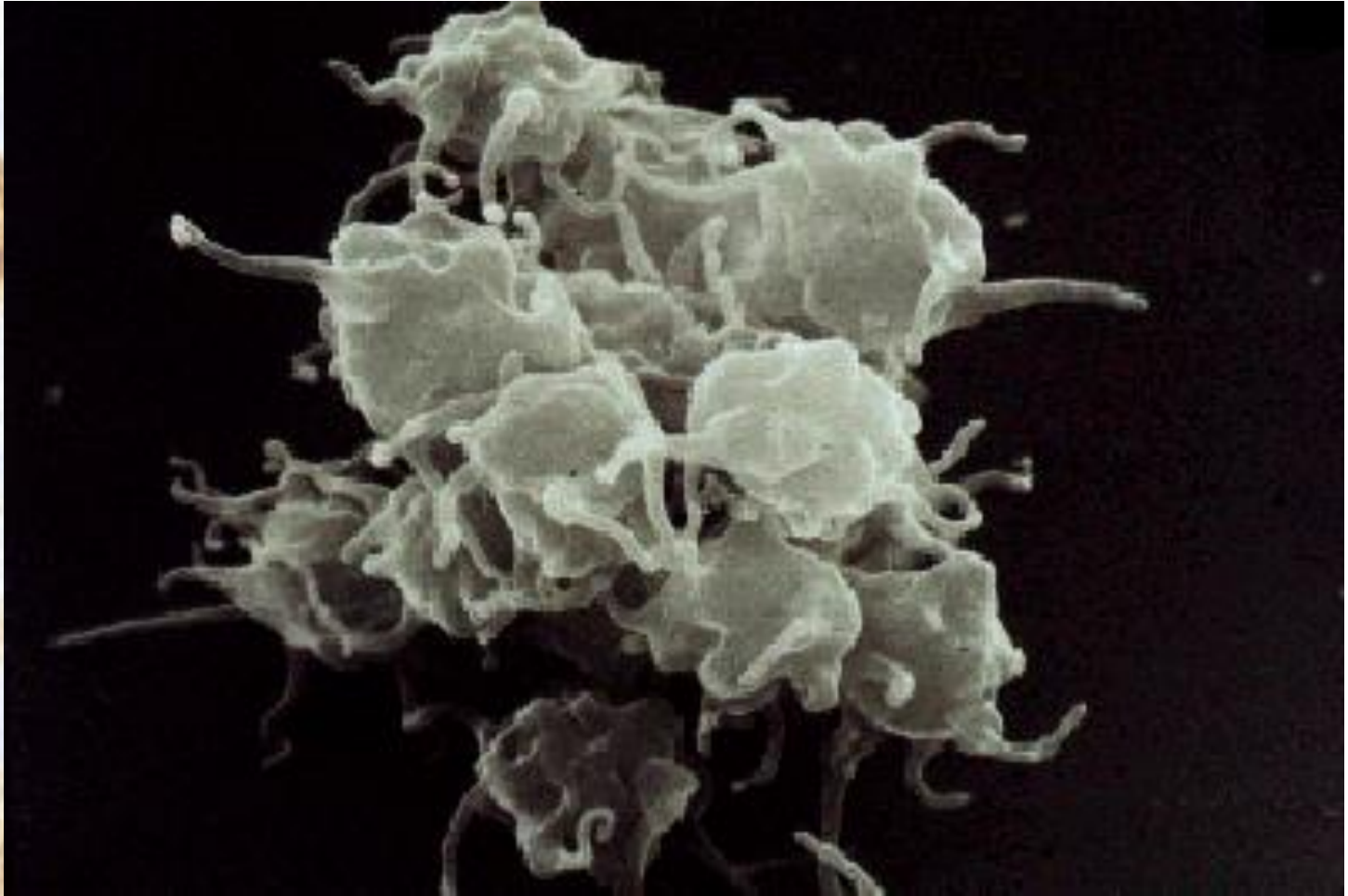
Blood Product Collections



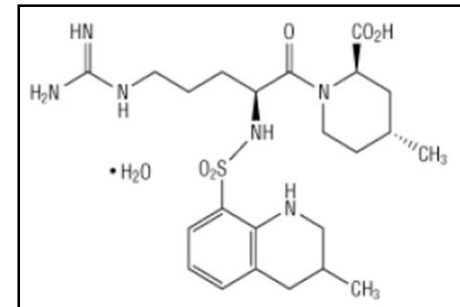
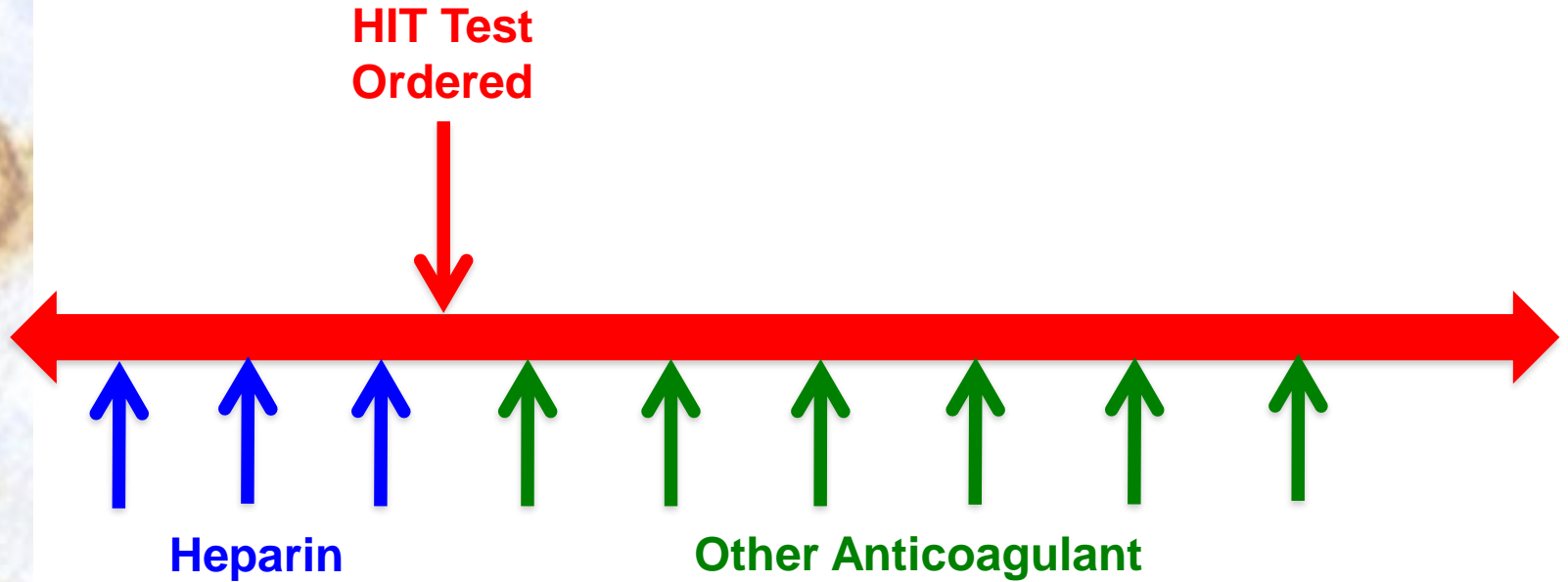
Donor Center Net Savings



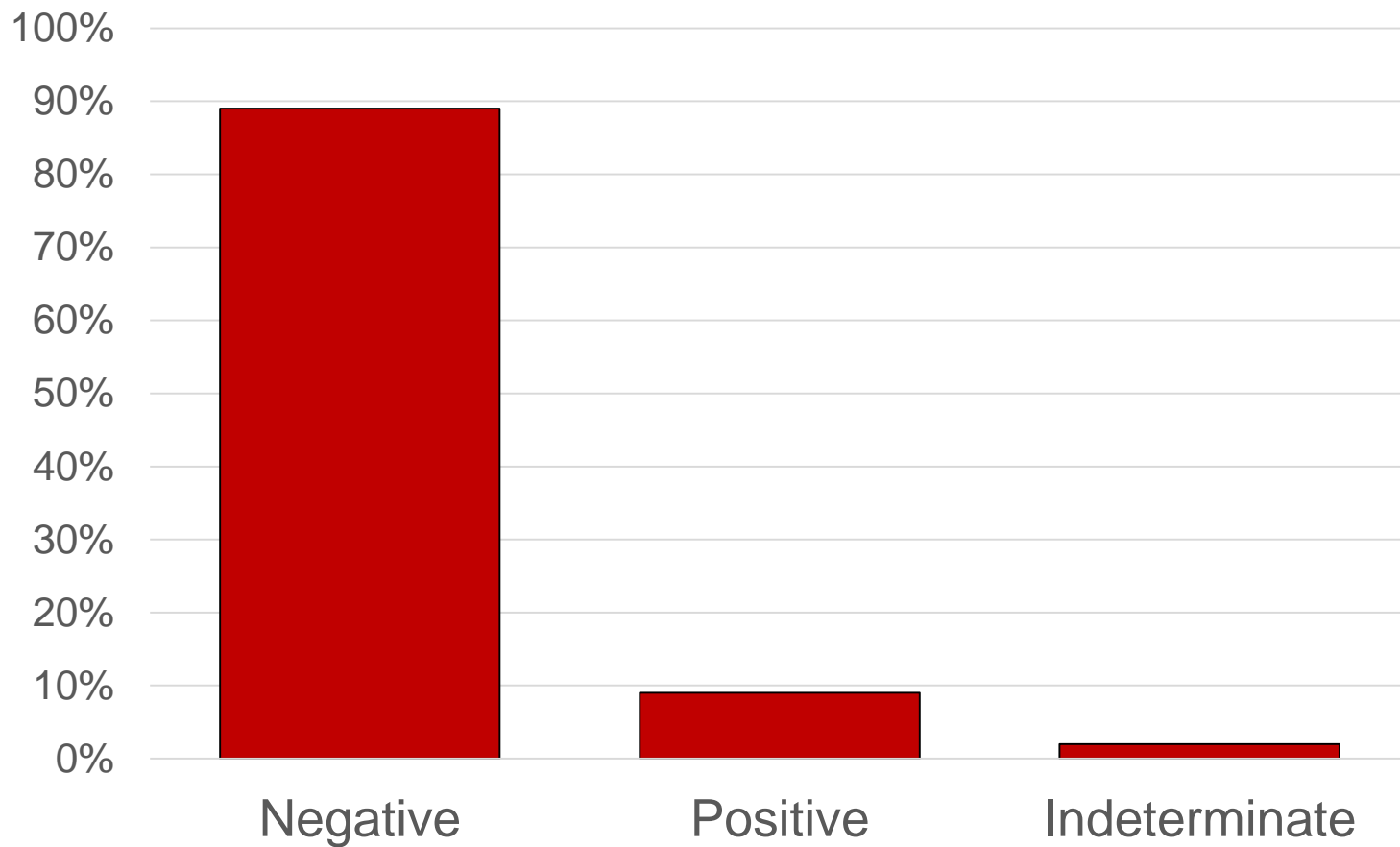
Heparin-Induced Thrombocytopenia



Expensive Anticoagulants



Test Result Distribution

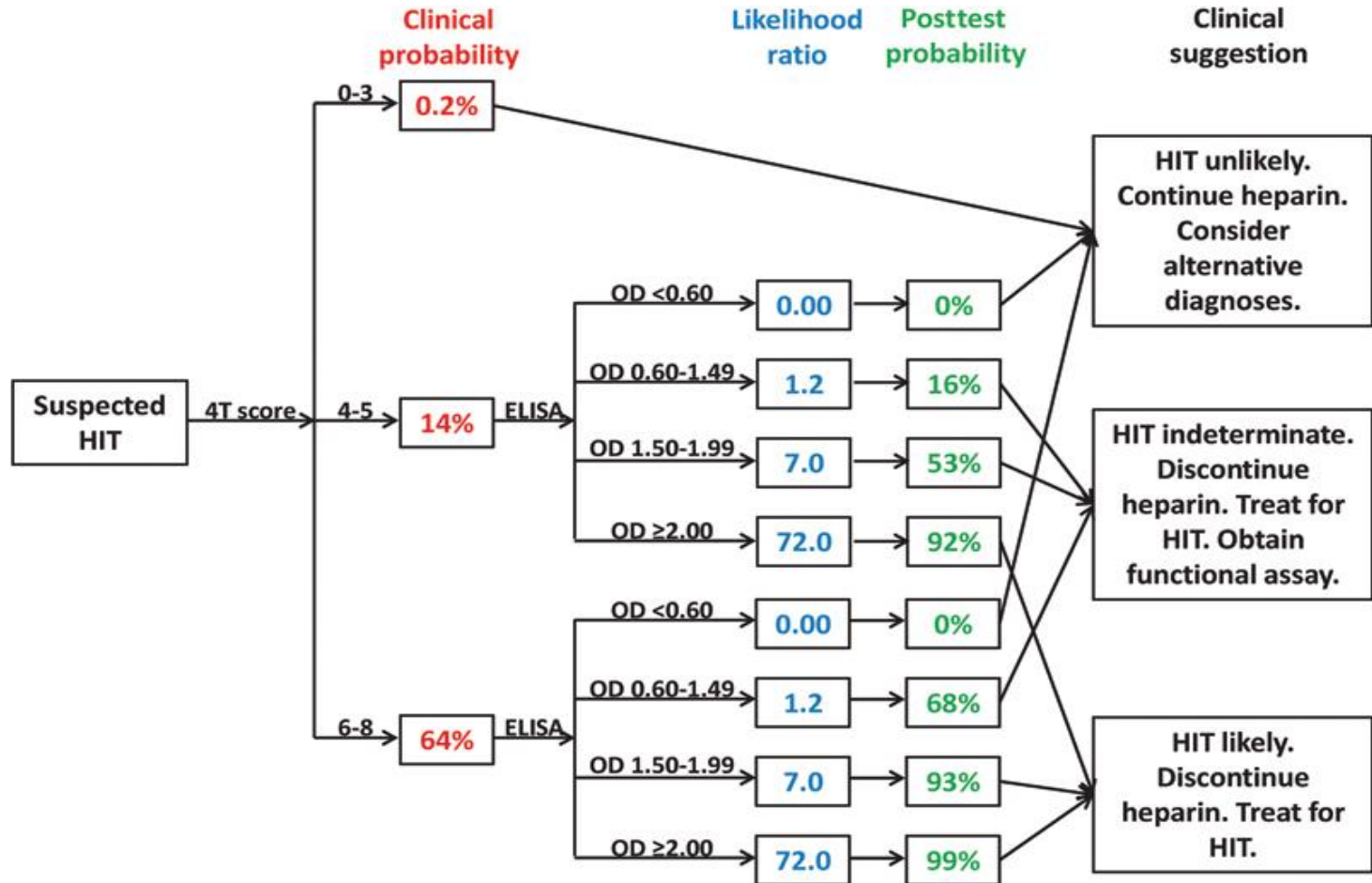


HIT 4Ts Pre-Test Probability Score

Category	2 Points	1 Point	0 Points
Thrombocytopenia	Plt fall >50% AND plt nadir \geq 20K/uL	Plt fall 30%-50% AND plt nadir 10K-20K/uL	Plt fall <30% AND plt nadir \leq 10K/uL
Timing of platelet count fall	Clear onset fall 5- 10 d OR plt fall \leq 1 day IF heparin exposure within previous 30d	Consistent with fall 5-10d but not clear (e.g., missing data) OR onset after 10d OR fall \leq 1d (previous heparin exposure prior 30-100d)	Platelet fall <5d without recent heparin exposure
Thrombosis or other sequelae	New thrombosis (confirmed) OR skin necrosis at heparin injection sites OR acute systemic reaction after heparin bolus	Progressive or recurrent thrombosis OR non-necrotizing skin lesions OR suspected thrombosis (not proven)	None
Other causes of thrombocytopenia	None apparent	Possible	Definite

Adapted from: Cuker A. Semin Thromb Hemost 2014;40:106-114

Bayesian Analysis of HIT Testing



EMR Alert with Questions

Antiplatelet Antibody Order Form - UHSTEST, BECK

UHSTEST, BECK 16590748 / 100071648 7y1m (Aug-07-2007) Male

01
Allergies: ABREVA, TREE NUTS, LATEX

Order: Heparin Dependent Platelet AB IGG Order ID: 001NYM5RB

Requested By: Arora, Komal Template Name:

Messages:

Request Date: Sep-25-2014 Request Time: Routine

Specimen Type: Blood Specimen Source:

Attending Physician: Olson, John, MD (16369) Indication: Thrombosis; Heparin related

Degree of Platelet Fall: More than 50% fall in platelet count from baseline.

Timing of Platelet Fall: Onset of platelet fall between 5-14 days after exposure to Heparin.

Thrombosis: New thrombosis; Acute systemic reaction following thrombosis

Other Causes of Thrombocytopenia: No other etiology for drop in platelet count.

Conditional Order: ☐ Max # of activations: 1

Special Instructions:

Ordering Provider Information: Provider Name = Arora, Komal / UHS Number = 24388

LAB Collection Info: RED TOP TUBE 7mL (CERNER Code: 1600000)

Ordering Visit Information: Ordering Visit Status: ADM Ordering Visit Number: 100071648

LAB Indication:

Evidence Available:

Sunrise Clinical Manager

Based upon your answers on this order form, the risk of HIT in this patient is HIGH. Heparin should be stopped and anticoagulation with a Direct Thrombin Inhibitor started. Testing for Heparin Platelet Antibodies is indicated.

OK

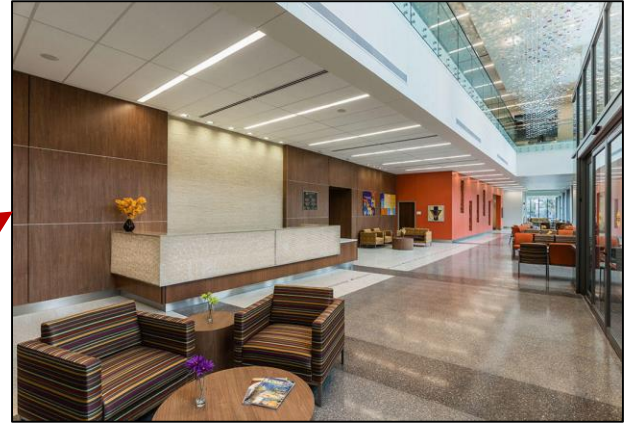
Repeat View Document Add Close

start Play Script Play Script Electronic Requisition ... Allscripts Gateway | ... Microsoft PowerPoint ... 4:06 PM

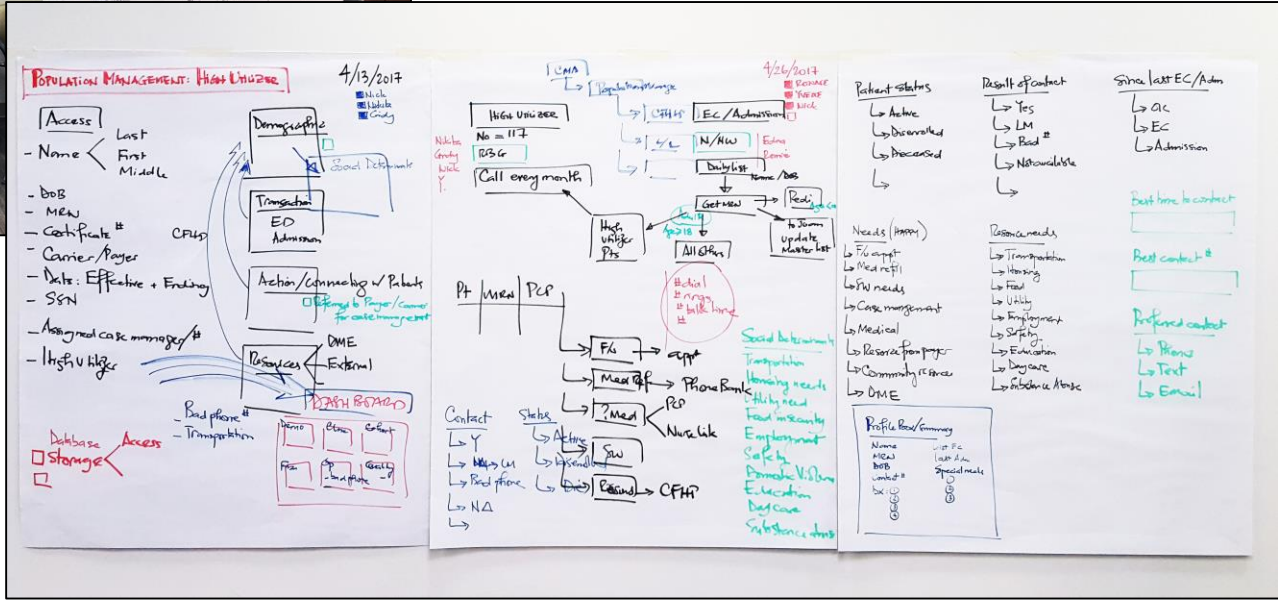
Changes Over Time

	2007	2011	Change
HIT Tests	224	67	-157
Test Variable Cost	\$26,320	\$7,872	(\$18,448)
Drug Variable Cost	\$313,964	\$93,909	(\$220,055)

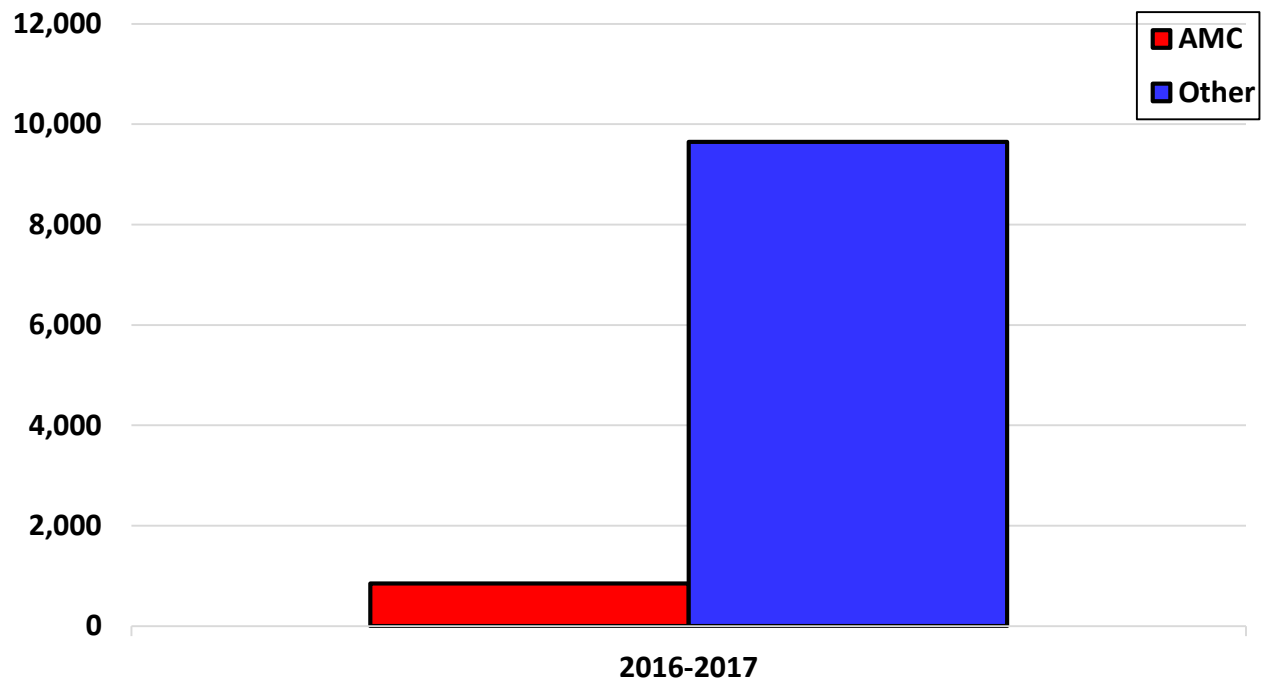
Post-Hospitalization Care



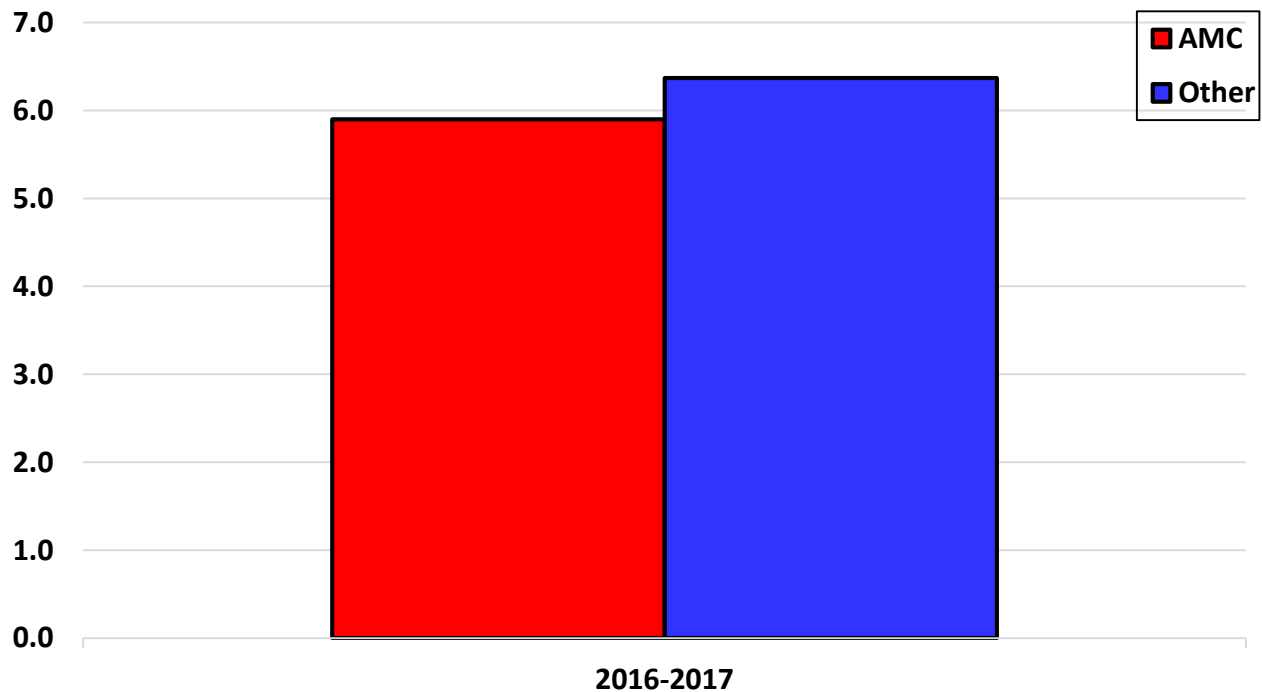
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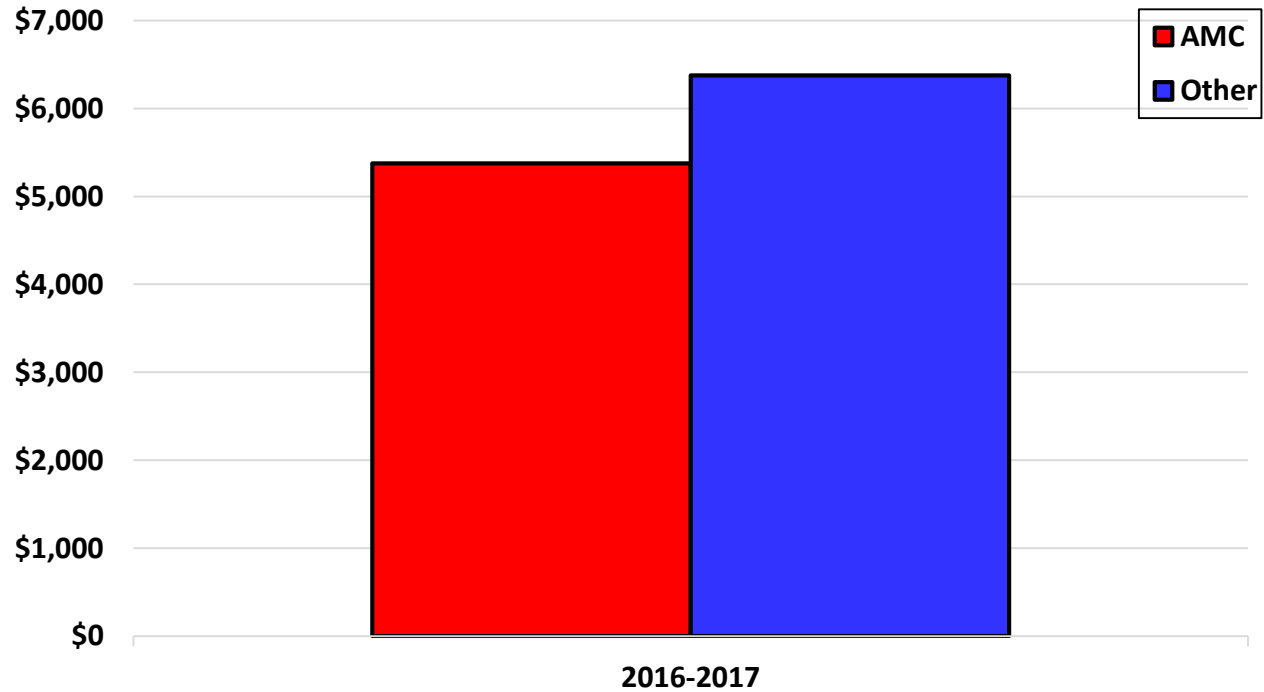
Total Hospitalizations



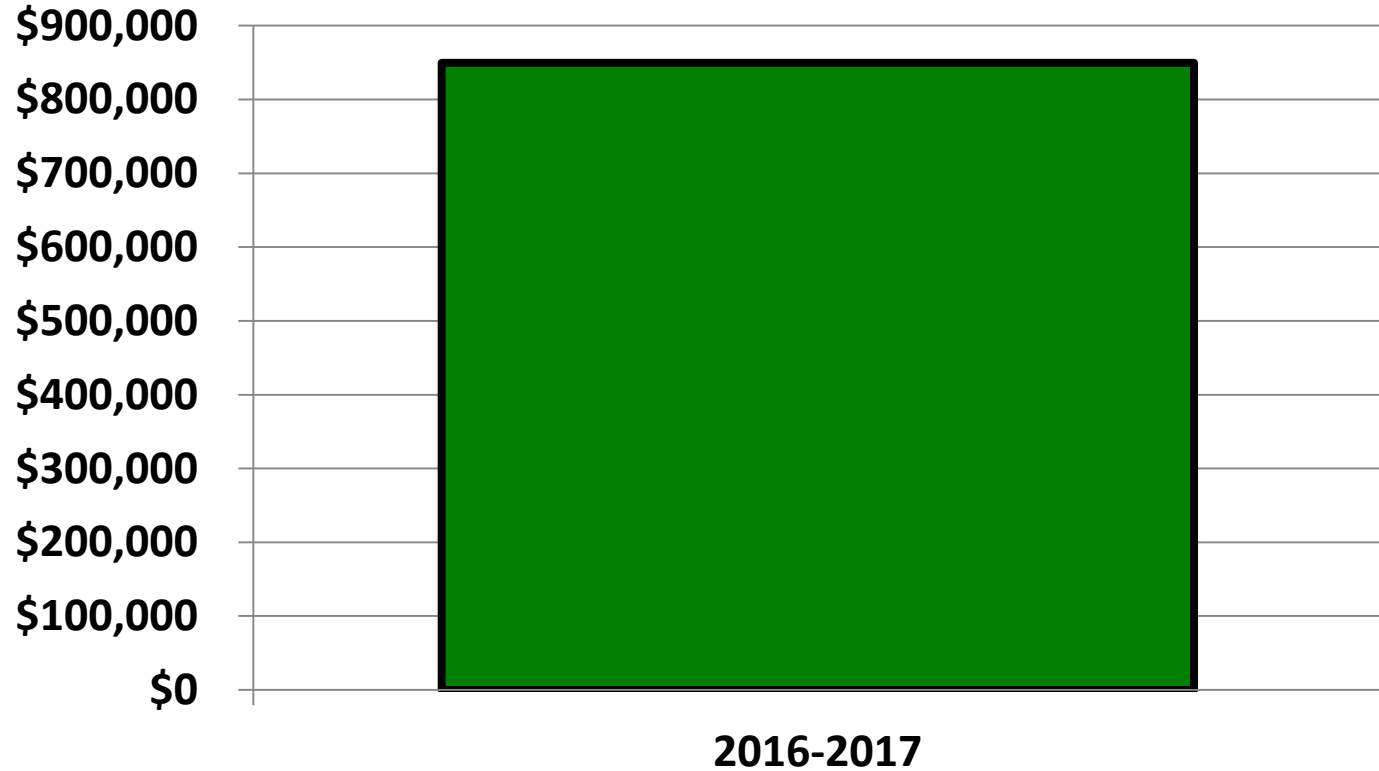
Average Hospital LOS (days)



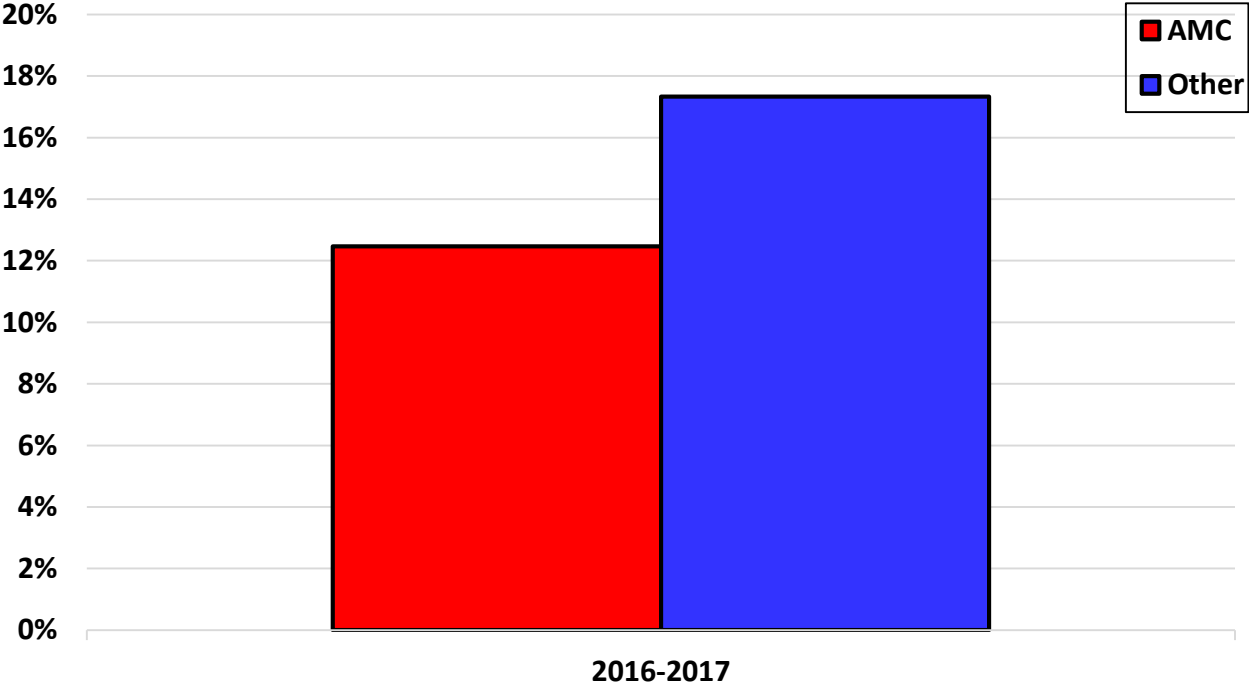
Average Hospital Variable Cost



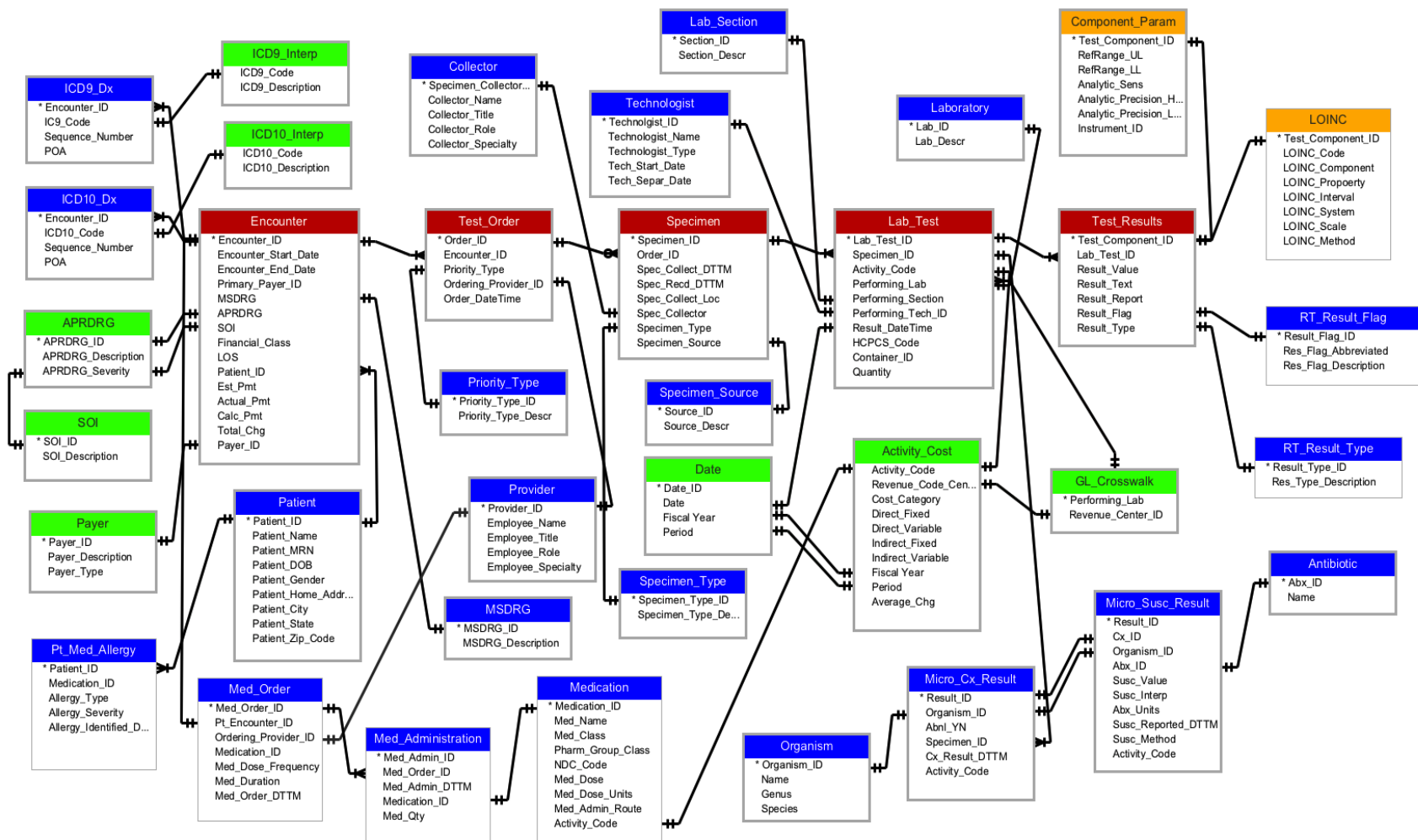
Average Annual Variable Cost Savings



Hospital Readmission Rates (30-days)

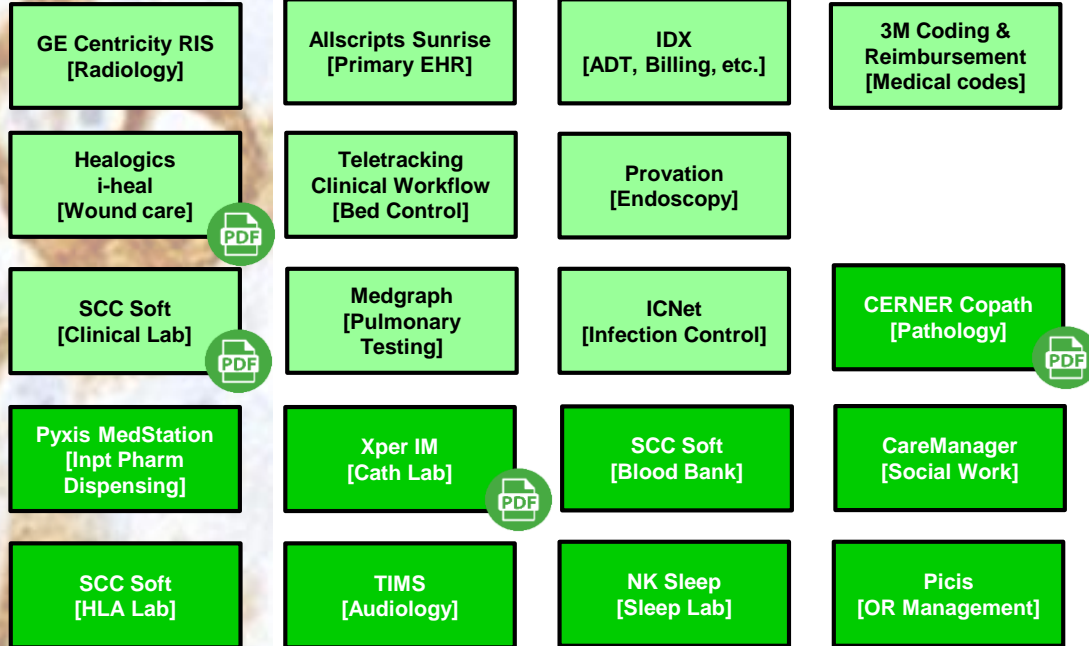


Integrated Data



Healthcare Data Stores

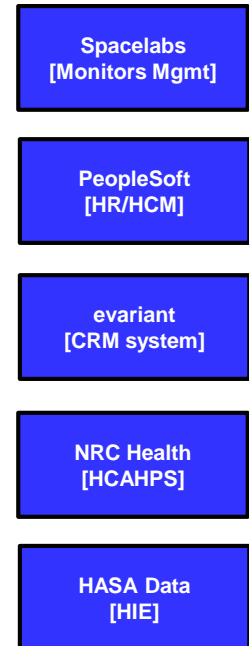
Medical



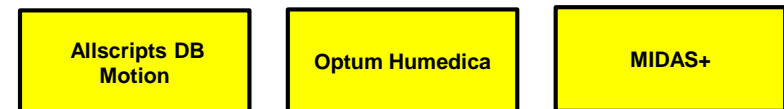
Finance



Other



Aggregate



Healthcare Analytics & Process Improvement



Questions

