Costs and Benefits of an Enterprise Electronic Medical Record
– Theory and Operations –

Joint Conference on
Medical Informatics in Taiwan
Saturday, 22 November 2008

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Agenda

- Physician Offices and Hospitals in the US.
- Paying for Medical Care in the US.
- Physician Office and Hospital EMRs.
- Legacy Health System and its EMR Project.
- EMR Costs.
- EMR Benefits.
- Managing to Obtain the Benefits.
- Conclusions.

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Physicians in the US
(1 of 3)

- US population: 300 Million.
- US Physicians: 600,000 (1:500).
- Practice setting:
  - 70%: Office-based (including surgeons who have offices and operate in hospitals and outpatient surgery centers).
  - 20%: Hospital-based (emergency, anesthesia, radiologists, pathologists).
  - 10%: Government: Veterans Administration, Public Health Service, others.

Physicians in the US
(2 of 3)

- Of the office based physicians:
  - 50% are Primary care (family medicine, internal medicine, obstetrics/gynecology, pediatrics) and shrinking fast.
  - 28% are Medical Specialists and growing.
  - 22% are Surgical Specialists and growing.

- 75% own all or part of their practice.

Hing, Characteristics of Office-Based Physicians and Their Practices: US 2003-04, Series 13, No. 164, Hyattsville MD: Natl Cent Health Stat 2007.

Physicians in the US
(3 of 3)

- Office Type:
  - 36% of doctors in solo practice.
  - 43% in single-specialty office.
  - 21% in a multi-specialty office.

Hing, Characteristics of Office-Based Physicians and Their Practices: US 2003-04, Series 13, No. 164, Hyattsville MD: Natl Cent Health Stat 2007.

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Paying for Medical Care in the US (1 of 3)

- Government (50%) provides insurance for:
  - The elderly or disabled: Medicare.
  - The poor: Medicaid.
  - The military: Department of Defense and the Veterans Administration (VA).
- Many people have private insurance (35%) paid by:
  - Their employer.
  - Themselves.
- Some people (15%) have no insurance and end up paying very little of their bill. Often causes them to go bankrupt. Causes hospital to shift bill to other payers (above).

Paying for Medical Care in the US (2 of 3)

- Most hospital care (75–90%) is fixed fee based on diagnosis (Diagnostic Related Groups (DRGs)) so the incentive is to manage costs.
- Some hospital care (10–25%) is paid based on charges so if you use less resources, your revenue and net income will go down.
- Most physician office care is paid based on charges, so less incentive to manage costs. Not true for Health Maintenance Organizations like Kaiser.

Cleverly Healthc Fin Mgt 2003;57(4):64–70. Thompson. JHIM 2007;21(3):49–60.

Paying for Medical Care in the US (3 of 3)

- Physician sends bill for Professional Fee to insurance company (if patient has insurance).
- Hospital sends bill for Facility Fee to insurance company (if patient has insurance).
- Patients & their insurance companies end up with multiple bills from:
  - Multiple physicians.
  - Multiple hospitals.
  - Multiple labs and imaging centers.

Health Maintenance Organizations (HMOs) have a Fixed Monthly Fee

Covers all inpatient care, outpatient care, and medications. No billing is required because providers are employed by the HMO. Examples:

- Kaiser Permanente covers 8 Million people.
- US Government Veterans Administration is for injured and retired military.

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US Medical Payment System Gives Rise to Medical Software

- Much early computer use in healthcare was for billing.
- In the US, most clinical computer systems were built by academic hospitals, such as:
  - Brigham and Women's Hospital-Boston, Massachusetts.
  - Regenstrief Institute–Indianapolis, Indiana.
  - LDS Hospital–Salt Lake City, Utah.
- Approximately 40 year history of clinical computing in the US.
- Electronic Medical Record (EMR): the record used in a given facility or organization.
- Electronic Health Record (EHR): an EMR than can send and receive coded data from another EMR.

Many Commercial EMR Vendors in US

- Niche hospital systems: emergency department, intensive care, anesthesia, obstetrics, and others.

- Hospital EMRs.
- Physician Office EMRs (also called outpatient or ambulatory systems).

- Hospital billing systems.
- Physician office billing (practice management) systems.

- Enterprise systems: all of the above.

Most US Physicians Don't Have an EMR

The larger the office, the more likely the office is to use an EMR:

Solo doc:	7%	of practices have an EMR.
2 docs:	9%	
3–5 docs:	13%	
6–10 docs:	17%	
11+ docs:	27%	

Hing, EMR use by office based physicians and their practices, US 2006: Advance Data from Natl Center for Health Statistics, 26 Oct 2007, 393:1–7.

Hospital EMRs Classified by Function
5050 out of about 6000 US Hospitals

Stage 7:	fully electronic, interoperable EHR	0.1%
Stage 6:	physician documentation, full clinical decision support, full digital images	1.0%
Stage 5:	closed loop medication ordering+admin	1.3%
Stage 4:	docs order at computer, decision support	1.9%
Stage 3:	nursing documentation, error checking, digital images outside of radiology	33%
Stage 2:	clinical data repository & med vocabulary	33%
Stage 1:	electronic ancillaries: lab, rad, pharmacy	13%
Stage 0:	lab, rad, pharm not yet all electronic	17%

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Puerto
Lempira
Port-au-Prince
Santo
Domingo
Guatemala
City
Tegucigalpa
Caribbean Sea
Coro
Caracas
Barranquilla

Portland Metro Area:

2 Million people.

13 competing hospitals.

Legacy Health System

Metropolitan Area of Portland, Oregon

- 5 hospitals – 1100 beds – 53,000 admissions per year.
- 200,000 emergency department (ED) visits per year.
- 40 clinics – 300,000 visits per year.
- 10,000 employees, not-for-profit.
- Also serves Vancouver, Washington.
- 250 employed physicians:
  - 150 in offices (including surgeons).
  - 100 in the hospital only.
- About 1000 private physicians use our hospitals.

Legacy's New System Installation

- In 2008–2011 we will replace eight partial and niche systems from multiple vendors with an Enterprise EMR and Billing System.
- All the hospitals and all Legacy physician offices will be on one electronic medical record and billing system.
- The patient will have a web front-end into this same EMR and billing system.
- We are building an economic model to set expectations for financial return and to set goals for administrators to achieve.

Legacy Health System

Current Applications

- Vendor A: Partial hospital EMR and partial office EMR (4 hospitals and 35 clinics).
- Vendor B: Full hospital EMR and full office EMR (1 hospital and 5 clinics).
- Vendor C: Physician Office Billing System (for all clinics).
- Vendor D: Hospital Billing System (for all hospitals).

REPLACING WITH

- Vendor E: A single Enterprise system.

The Financial Model

- Costs, both Capital and Operational, including the cost of labor of Legacy's Information Services staff.
- Benefits, from both avoided costs and increased revenue.
- Costs and Benefits phased in over a six year time frame.
- Inpatient (IP) means Admitted to the Hospital.
- Outpatient (OP) means
  - Emergency Department.
  - Ambulatory Hospital-based Clinics.
  - Mostly means Legacy-employed Physician Offices.

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Costs of an Enterprise EMR & Billing System

- Capital Costs.
- One-Time Operating Expenses.
- On-Going Operating Expenses.

Capital Costs
(1 of 2)

- Software License for EMR.
- Software Licenses required from other vendors.

- Central Hardware (servers).
- Central Hardware Operating Systems.
- Central Hardware Thin Client Licenses (Citrix).
- Replacement Hardware as equipment ages.

- Peripheral Hardware (personal computers, laptop computers on wheels, tablets, printers).
- Network Hardware (wired and wireless).
- Any construction in hospital or clinic for project.

Capital Costs
(2 of 2)

- Implementation Services from Vendor.
- Implementation Services from Outside Consultants.
- Labor to build EMR by Employed Staff.
- Travel for everyone above.

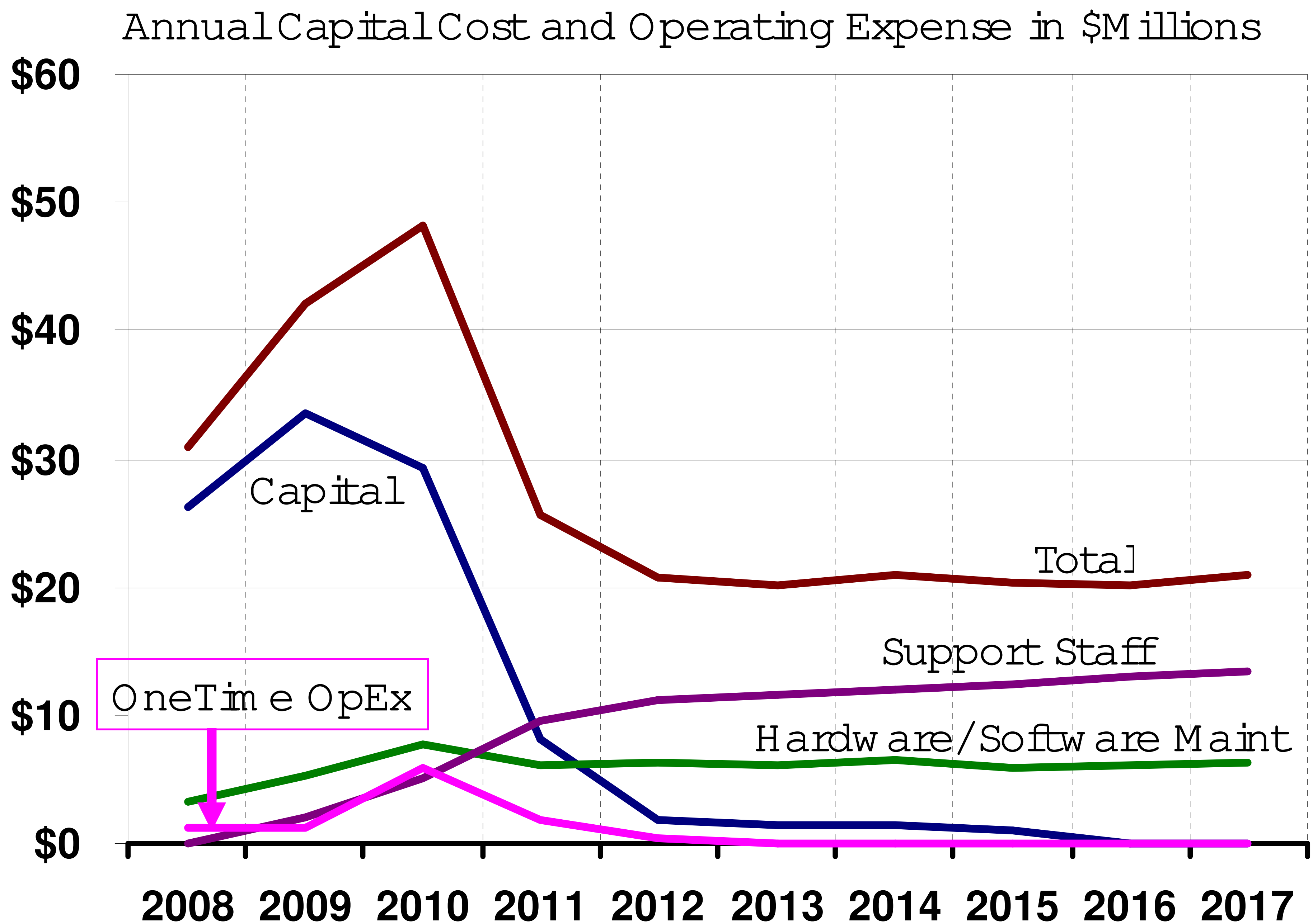
- Interface equipment to patient monitors.
- Interface software licenses.
- Interface building and implementation services.

One Time Operating Expenses

- Training of information services staff at vendor's campus.
- Training of our end users (clinicians & billing staff).
- All development and implementation after first site goes live on software is an operational expense.

On-going Operating Expenses

- Annual maintenance fee on:
  - EMR software.
  - Required extra software.
  - Central hardware (servers).
  - Hardware operating system.
  - Thin client software (Citrix).
  - Interface hardware and software.
- Training of:
  - Technical staff in Information Services.
  - End users in clinical and billing areas.



Annual Capital Cost and Operating Expense in $Millions
$60
$50
$40
$30
$20
$10
$0
Capital
Total
Support Staff
Hardware/Software Maint
One Time OpEx
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

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Avoiding the Continuing Costs of the Current Systems once we turn them off

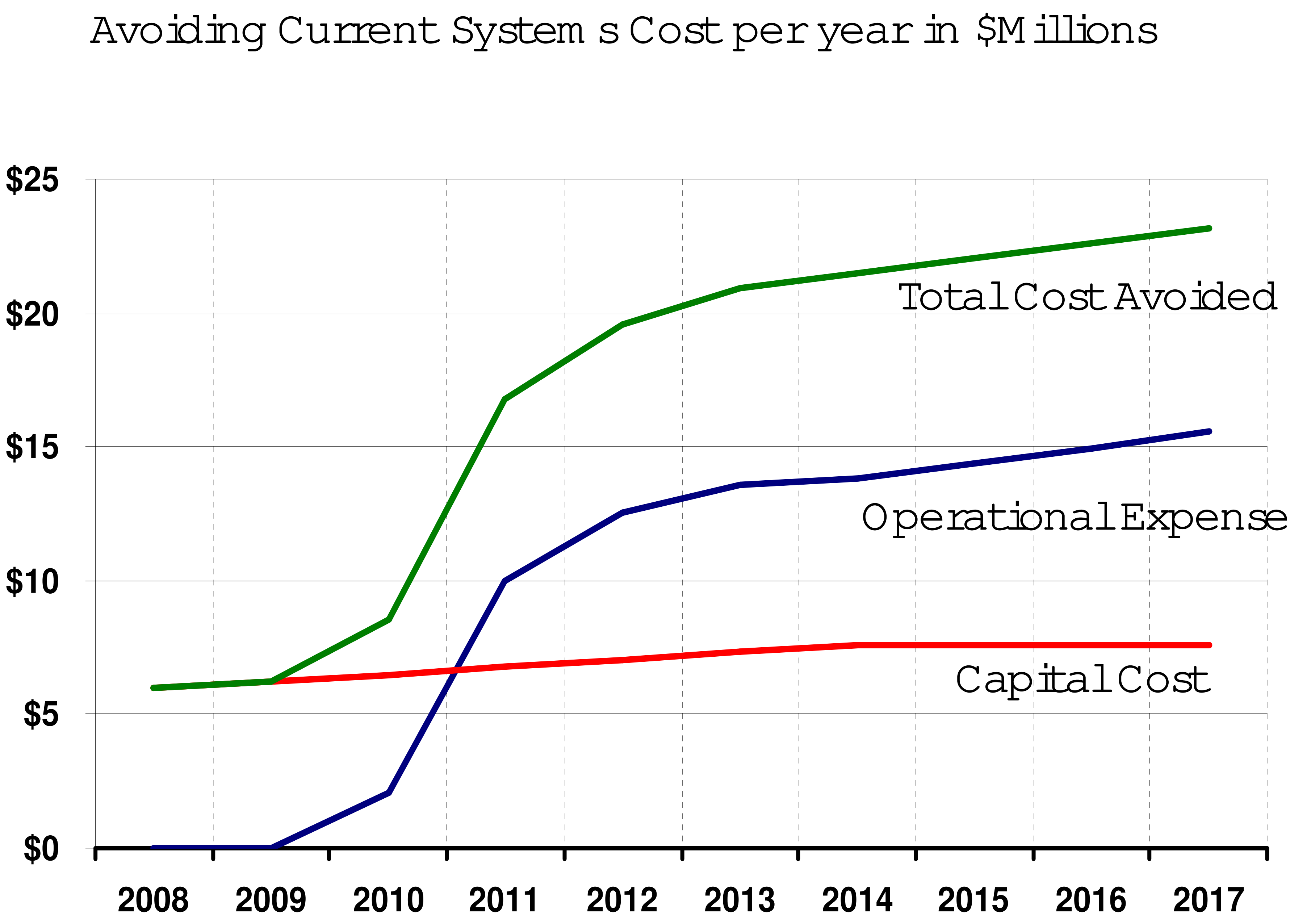
- Annual Maintenance Fees to Vendors:
  - Vendor A Hospital and Office EMR.
  - Vendor B Hospital and Office EMR.
  - Intensive Care Unit EMR.
  - Emergency Department EMR.
  - Hospital Billing.
  - Physician Office Billing.

- Information Services Labor to support current systems.
- Capital needed for replacement hardware.

Phase Out Costs of Old Systems

Cost Avoidance	2008	2009	2010	2011	2012	2013
Vendor A Hospital & Office EMR	0%	0%	0%	50%	100%	100%
Vendor B Hospital & Office EMR	0%	0%	0%	100%	100%	100%
Intensive Care Unit EMR	0%	0%	0%	100%	100%	100%
Emergency Department EMR	0%	0%	0%	90%	100%	100%
Hospital Billing	0%	0%	20%	50%	75%	100%
Physician Office Billing	0%	0%	10%	40%	60%	100%
IS Labor for Current Systems	0%	0%	30%	70%	90%	100%

Similar Phase In for Benefits of New System


Avoiding Current System s Cost per year in $Millions
$25
$20
$15
$10
$5
$0
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Total Cost Avoided
Operational Expense
Capital Cost

Aggressive Calendar to Install New System

Sep 2008:	Software load. Design and Build.
Apr 2009:	Testing.
Aug 2009:	Upgrade to new version.
Nov 2009:	Test new version.
Feb 2010:	Start 35 clinics. Finish Aug 2011.
Apr 2010:	Hospital #1.
Aug 2010:	Hospital #2.
Nov 2010:	Hospital #3.
Jan 2011:	Upgrade to new version.
Mar 2011:	Test new version.
Jun 2011:	Hospital #4.
Sep 2011:	Hospital #5.

The Benefits of an Enterprise EMR

- Unnecessary Lab Tests.
- Unnecessary Radiology Exams.
- Better Drug Use.
- Adverse Drug Events.
- Length of Stay.
- Nursing Overtime.
- Hospital Unit Clerk Labor.
- Hosp Pharmacy Productivity.
- Transcription.
- Medical Records Labor.
- Lab Staff Labor.
- Charge and Order Entry.
- Paper Forms.
- Better Charge Capture.
- Less ED Diversion.
- Convert Chart Space.

Model Assumptions

- One integrated, enterprise system for Hospital and Office EMR and Billing.
- Physician is entering 80-90% of the IP orders at the computer – Computerized Physician Order Entry (CPOE) with Clinical Decision Support (CDS).
- Physician is entering 100% of the OP orders at the computer, with CDS.
- Hospital responsible for IP drugs; doctors write OP prescriptions to be filled at outside drug stores and the patient or insurance pays for those drugs.
- Adjustments will be made for decreased revenue due to decreased charges.
- Bar-coded medication verification is part of new EMR.
- This model does not include benefits from PACS (Picture Archiving and Communication System).

Decreased Unnecessary and Duplicate Lab and Radiology Tests

- Doctors have more of the record available with EMR.
- Doctors can see prior results more easily.
- Clinical Decision Support warns of duplicates.
- Doctors get advice about which test is preferred.
- Doctors are shown the cost of the test.
- Range of studies suggest 10-15% decrease in labs and radiology exams.
- 5-7% decrease used in this model.

Bates. Am J Med 1998;104(4):361-8
Bates. Am J Med 1999;106(2):144-150.
Wu. J Healthcare Inf Mgt 2002;16(4):50-55.
Girosi. Pub Number MG 410. Rand Corp, Santa Monica, CA. 2005.
Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.
Thompson. JHIM 2007;21(3):49-60.

Decreased Drug Use

- Doctors get pertinent advice about which drug is preferred.
- Clinical decision support based on physiological parameters limits drug use, dosing, and duration.
- EMRs make it easier to show literature references pertaining to the order at hand.
- Peer-vetted, literature-based Order Sets narrow variation and promote best practice.
- EMRs can automatically limit duration of antibiotics and risky drugs.
- 5% decrease in IP drug cost used in this model.

Tierney JAMA 1993;269(3):379-383
Evans. NEJM 1998;338(4):232-238.
Girosi. Pub Number MG 410. Rand Corp, Santa Monica, CA. 2005.

Decreased Adverse Drug Events (ADEs)

- ADEs involve patient harm, without or with error.
- ADEs: 6–9% of hospital admissions. (Used 7%).
- CPOE, CDS, and Bar-coded Med Verification all help.
- ADEs: 28-70% are preventable. (Used 40% in model).
- Bates: of the errors causing preventable ADEs:
    - 56% occurred at ordering stage. (Used 44%).
    - 6% occurred at transcription stage.
    - 4% occurred at dispensing stage.
    - 34% occurred at administration stage. (Used 10%).
- $5000 average cost of ADE used in model.

Bates JAMA 1995;274:29–34. Bates JAMA 1997;274:29–34. Bates JAMA 1997;277(4):341–342. Bates JAMA 1998;280:1811–6.
Raschke JAMA 1998;280:1317–1320. Thompson JHIM 2007;21(3):49–60.

Decreased Length of Stay

- Assumes Plans of Care are built into EMR.
- Recovers only the nursing cost – $275 per day.
- Figures opportunity for each of the top 30 Diagnostic Related Groups (DRGs).
- Calculated savings if Length of Stay brought to within 117% of ideal used in this model.
- About 5000 patient-days opportunity in this model.

Dexter NEJM 2001;345(13):965-970. Meltzer Ann Int Med 2002;137:866-874. Laughlin Nurs Mgt 2003;34(12):51-52. Girosi Pub NoMG 410 Rand Corp, Santa Monica, CA 2005. Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006. Fishbane et al. Arch Int Med 2007;16(15):1664-9. Casale et al. Ann Surg 2007:246:613-23. Thompson JHIM 2007;21(3):49-60.

Decreased Inpatient Nursing Overtime

- Time savings is not enough to put fewer nurses on the floor but efficient charting can avoid overtime.
- Nurses use more standardized charting forms than doctors and can do more documentation at point of care.
- Nurses need to transmit more information at end of shift and computers are good at that.
- Nurses tend to work in a single location, and more likely to get paid training, support from clinical leaders.
- Nurses save time with the medication process.
- 60-70% overtime reduction used in this model.

Smith Nurs Case Mgt 1998;3:266-270. The Nursing Shortage: Can Technology Help? Prepared by First Consulting Group for California Health Foundation 2002. Wong Crit Care Med 2003;31(10):2488-2494. Girosi Pub NoMG 410 Rand Corp, Santa Monica, CA 2005. Poissant et al. JAMIA 2005;12(5)505-16. Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006. Featherly Healthc Quart 2007;10(1):101-110.

Decreased Inpatient Unit Secretary Labor

- Unit secretaries great visitors, enter orders, insert papers in the chart, schedule tests and procedures, and respond to requests for patient information.
- Decreased unit secretary labor with CPOE and complete electronic documentation by nurses and doctors.
- Magnitude of savings determined by whether a given floor can eliminate a second secretary position or get by without any secretary at all.
- 20% fewer hours used in this model.

The Nursing Shortage: Can Technology Help? Prepared by First Consulting Group for California Health Foundation 2002. Han Jpn J Clin Onc 2005;35(8)470-4. Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

Increased Inpatient Pharmacy Productivity

- Inpatient Pharmacists or Pharmacy Technicians enter the doctor's handwritten order.
- Pharmacists verify the clinical need and use of drug.
- Pharmacy technicians dispense meds and pharmacist checks for accuracy.
- Model assumes that pharmacists would take on other clinical duties instead of being laid off.
- Little literature support at this time.
- Model assumes labor as 25% Pharmacist and 75% Pharmacy Technician.
- 25% labor savings used in this model.

Decreased Physician Transcription

- Physician Office Transcription can decrease to near zero.
- Inpatient Daily Progress Notes move to computer but they are handwritten now so no financial savings with EMR.
- Inpatient dictation/transcription may still be used for:
  - History and Physicals.
  - Consult Notes.
  - Operative and Procedure Notes.
  - Discharge Summaries.
- 90% decrease in OP transcription and 35% decrease in IP transcription used in this model.

MacDonald, Achieving Tangible IT Benefits in Small Physician Practices, Calif Heal Care Found 2002. Girosi. Pub Number MG 410. Rand Corp, Santa Monica, CA. 2005. Poissant et al. JAMIA 2005;12(5)505-16.

Decreased Medical Records Labor
(called Health Information Management in US)

- With less need for paper chart, there is less labor:
  - Finding.
  - Assembling.
  - Pulling.
  - Filing.
  - Copying.
  - Transporting.
- 35% IP labor decrease used in this model.
- 50% OP labor decrease used in this model.

Greene Top Heal Inf Mgt 2002;23:26-36. Girosi. Pub Number MG 410. Rand Corp, Santa Monica, CA. 2005. Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

Decreased OP Lab Clerk Order Entry Labor

- In Physician Office, paper lab slips sent to Lab for entry into lab system. OP EMR with CPOE avoids this.
- Literature does not specifically document lab order entry but many articles on decreased labor to manage orders and patient charts.
- 50% decrease in outpatient lab order entry labor used in this model.

Decreased Ancillary Department Order, Charge, and Result Entry Labor

- Lab labor already accounted for in previous slides.
- This slide accounts for clerical labor in radiology, nutritional services, physical therapy, employed physician offices.
- Literature does not specifically document ancillary order, charge, result entry but many articles on decreased labor to manage orders and patient charts.
- 20% labor decrease used in this model.

Greene Top Heal Inf Mgt 2002;23:26-36. Girosi. Pub Number MG 410. Rand Corp, Santa Monica, CA. 2005. Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

Decreased Preprinted Paper Forms

- Assumes electronic patient signing at registration.
- Includes forms for:
  - Patient permissions and authorizations.
  - Nursing, therapist, and physician documentation.
  - Orders.
- Literature has little specification of form use.
- 70% decrease in printed forms used in this model.
- Model includes 33% increase in use of plain computer paper.

Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

Increased Revenue due to faster charging, higher charge levels, fewer missed charges

- Fewer forgotten charges.
- Fewer days before final bill is sent out.
- Fewer declined charges because of more complete documentation.
- Charging at higher level of illness and injury is supported by more complete documentation.
- 0.25% higher revenue used in this model ($2.75M).
- 6 days less in Accounts Receivable and Discharge Not Yet Final Billed→ $18M recovered at 6% interest, used in this model.

Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

Featherly Healthcare Quart 2007;10(1):101-110.

Increased Revenue due to Increased Admissions due to Less Ambulance Diversion

- If ambulances pass you by because your Emergency Department (ED) patients cannot get a hospital bed, you lose ED revenue and hospital admission revenue.
- Efficient EMRs can increase patient throughput and have the effect of more hospital beds without the brick and mortar expense.
- Legacy had 5300 hours on ED diversion in a year, 90% estimated due to hospital being full → about 2.5 lost admissions per hour.
- $4.2 Million a year in lost income used in this model.

Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

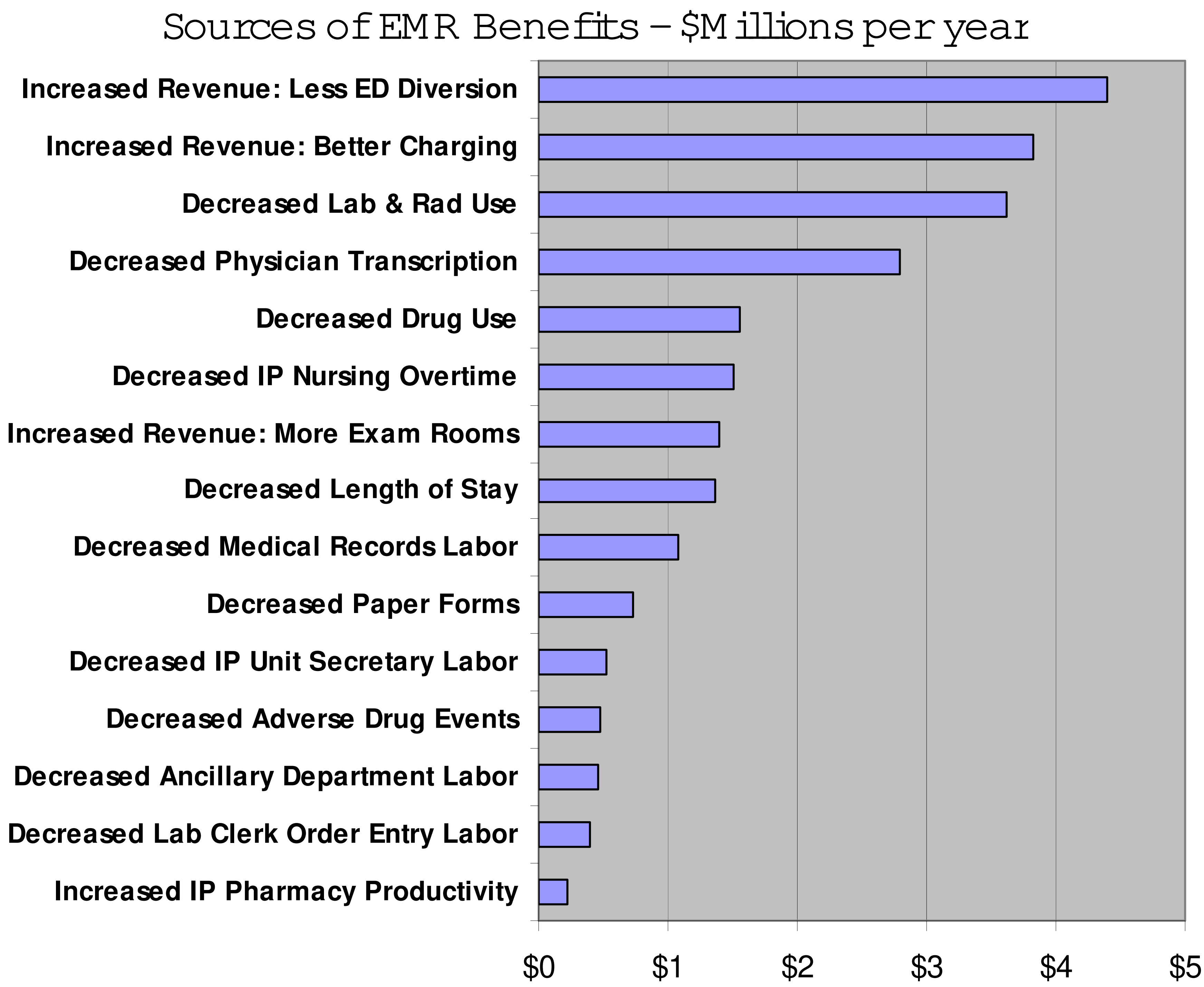
Increased Revenue due to Converting Space Previously Used to Store Paper Charts

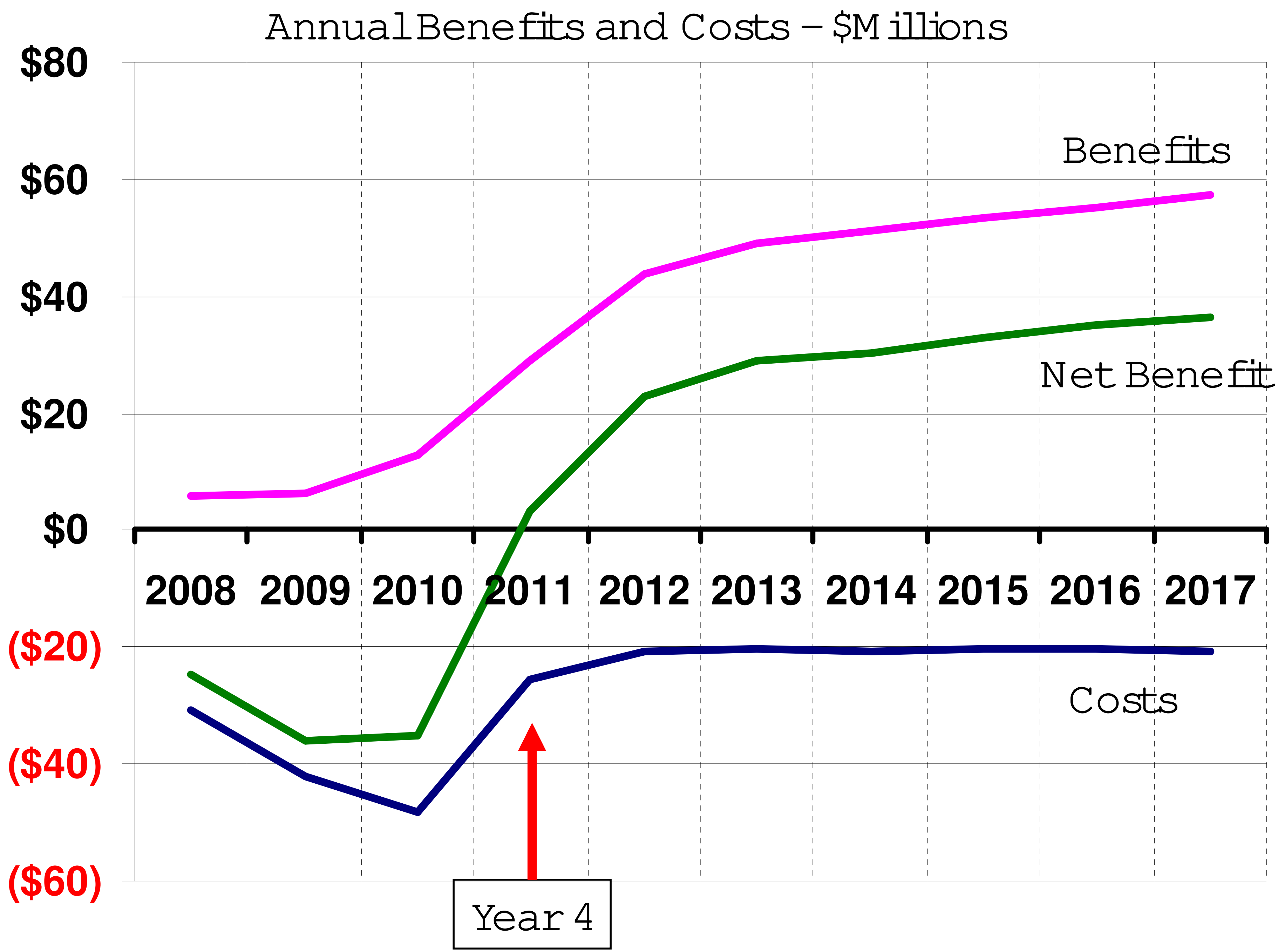
- Chart room in offices with 10-12 doctors can take up the space of two exam rooms.
- Typically the space can be recovered two years after EMR is implemented as need for the paper chart diminishes over time.
- Addition of 14 exam rooms used in this model.

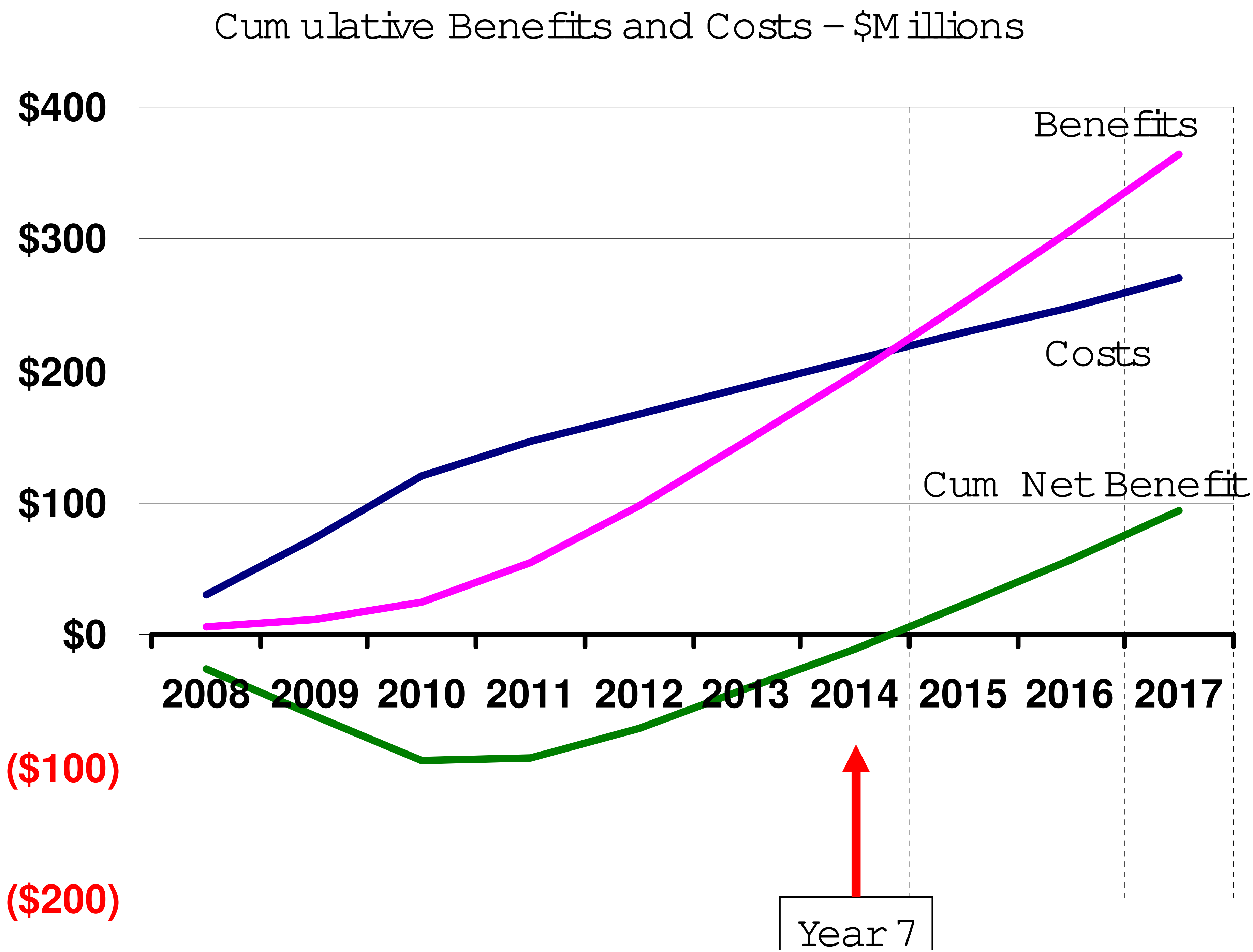
Awarding IT: Improving Healthcare; HIMSS Davies Award; HIMSS 2006.

Increased Revenue due to Changing Practice to Care for Higher Acuity Patients

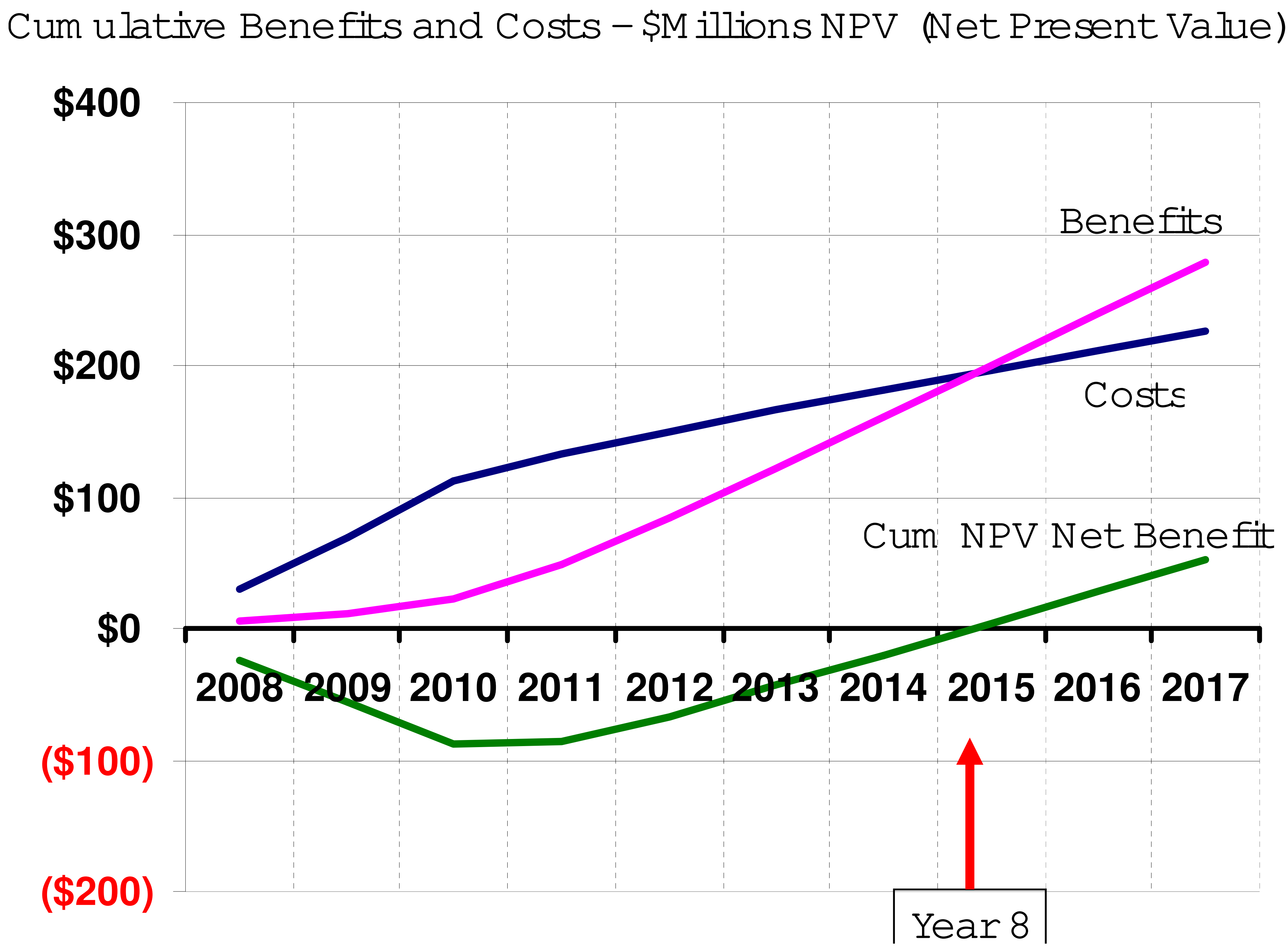
- With the patient accessing their doctor's EMR online, there is decreased need for routine visits.
- With EMRs, more patient-physician interaction can occur online and on the phone.
- Doctor's schedule can accommodate more new patients, and more ill patients, on the same day they call.
- Offering patients openings on same day increases loyalty.
- Insurance companies starting to pay for e-care.
- If Fee-for-Service, then increased revenue for ill patients that need to be seen that day.
- If Health Maintenance Organization, then costs are decreased by doing more care appropriately online.
- Proposed benefit only; not used in this model.


Sources of EMR Benefits – $Millions per year
Increased Revenue: Less ED Diversion
Increased Revenue: Better Charging
Decreased Lab & Rad Use
Decreased Physician Transcription
Decreased Drug Use
Decreased IP Nursing Overtime
Increased Revenue: More Exam Rooms
Decreased Length of Stay
Decreased Medical Records Labor
Decreased Paper Forms
Decreased IP Unit Secretary Labor
Decreased Adverse Drug Events
Decreased Ancillary Department Labor
Decreased Lab Clerk Order Entry Labor
Increased IP Pharmacy Productivity
$0
$1
$2
$3
$4
$5


Annual Benefits and Costs – $Millions
$80
$60
$40
$20
$0
($20)
($40)
($60)
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Benefits
Net Benefit
Costs
Year 4



Cumulative Benefits and Costs – $Millions
$400
$300
$200
$100
$0
($100)
($200)
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Benefits
Costs
Cum Net Benefit
Year 7


Cumulative Benefits and Costs – $Millions NPV (Net Present Value)
$400
$300
$200
$100
$0
($100)
($200)
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Benefits
Costs
Cum NPV Net Benefit
Year 8

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Are Decreased Costs and Increased Revenue due to EMR or to Workflow Optimization?

- Benefits often come from operational improvements made at the same time as EMR implementation but may not be directly attributable to the EMR.
- Since EMR implementation can dramatically change workflows, it is a good time to optimize workflows if the organization has the will to do it.
- General areas of improvement for EMR installers:
  - Billing improvements.
  - Improved patient flow.
  - Reduced or reallocated staff.

EMRs Promote Continuous Process Improvement

- Some process improvement can be done with paper methods but it is so time consuming, most hospitals are limited to doing 2-4 such studies at a time.
- EMR continues to deliver financial improvements because clinicians and administrators can get the data they need to evaluate process change.

Featherly Healthcare Quart 2007;10(1):101-110.

Capturing the Benefit

- An administrator needs to be assigned for monitoring each of the workflow changes made possible by the EMR.
- Organizations need to standardize processes across different nursing units and different facilities.
- Process change needs to be measured quarterly.
- Budgets set to include EMR efficiencies.
- Performance pay or bonus based on results.

Model is Financial Only – and Only for the Health System – and Does Not Include Quality Benefits to the Patient

- Patient is back to home and work faster.
- Fewer medical misadventures due to unneeded tests.
- Better use of drugs and avoided drug injury.
- Providers have complete data at time of care.
- EMR data can be used for research.
- Physician more likely to deliver indicated care.
- EMR data can be accessed by the patient online.
- Patient doesn't have to reenter data at each office.

Agenda

- Physician Offices and Hospitals in the US.
- Paying for Medical Care in the US.
- Physician Office and Hospital EMRs.
- Legacy Health System and its EMR Project.
- EMR Costs.
- EMR Benefits.
- Managing to Obtain the Benefits.
- Conclusions.

Conclusions

- We embark on EMR implementation because we believe it is required to manage complex and chronic care effectively and efficiently.
- We need more literature on proven financial and clinical benefits of implementing EMRs.
- We need to engage in Optimized Workflow Change at the time we implement the EMR in order to get the full benefit from the EMR.
- Prepare your organization for deep expense in the early years to get large financial benefits later.

Thank you.

Questions?