OREGON HEALTH CARE QUALITY CORPORATION
A nonprofit partnership for quality improvement

Office of Oregon Health Policy and Research

Potential Impact of Widespread Adoption of Advanced Health Information Technologies on Oregon Health Expenditures

David M. Witter, Jr.
Thomas Ricciardi, PhD

Prepared for
Oregon Health Care Quality Corporation and
Office for Oregon Health Policy and Research

Project support provided by
Northwest Health Foundation
State of Oregon, Division of Medical Assistance Programs

September 2007

Potential HIT Impact on Oregon's Health Expenditures
TABLE OF CONENTS

Potential HIT Impact on Oregon's Health Expenditures

EXECUTIVE SUMMARY

Health expenditures in Oregon have continued to increase at a rapid and an unsustainable rate. There has been growing recognition of the critical role advanced health information technologies (HIT) can play in reducing errors and improving patient safety, improving the quality of health care and lowering costs. Advanced health information technologies include electronic health records (EHR) systems with capabilities for the authorized and secure electronic exchange of information between hospitals, physicians and other service providers. These advanced systems go significantly beyond the conversion of paper-based medical records into electronic form; they include a wide range of capabilities that assist and support physicians and other providers in taking care of patients.

The driving force for adopting advanced health information technologies is the potential it provides for improving the quality and safety of health care. However, the financial costs and misaligned business incentives present significant barriers to implementation. Understanding the financial savings and costs of these implementations, and how they accrue to stakeholders is important in identifying incremental steps in working toward widespread implementation.

This study quantifies the potential impact of the widespread adoption of these advanced technologies on Oregon's health expenditures. The Oregon health expenditures impact estimate is based on published national models of the potential savings and costs that may be expected from the comprehensive adoption of advanced health information technologies. The approach makes a major assumption that advanced comprehensive HIT systems will be installed throughout Oregon over time and actively used to their full potential to improve health care delivery and to take advantage of possible efficiencies.

The projected overall Oregon health expenditure savings from the widespread adoption of health information technologies are $1.7 billion per year. About half of those savings would accrue to the Portland tri-county area, and another one-third to the six counties in the Willamette Valley, due to a higher concentration of healthcare providers. Of the total statewide savings, $0.6 billion is due to avoidable services, and $1.1 billion is due to increased clinical and operational efficiencies. Employers would benefit from $6.1 million in time-loss reductions.

Advanced electronic health records and information exchange benefit patients, physicians and the community when:

… a 40 year old woman avoids a repeat pulmonary angiogram because the previous negative study is electronically available from another emergency department. No delay in care or wasted time tracking down the information.

… a patient confirms or updates his medical history and medications on the clip board or touch screen rather than filling out another set of blank forms. More complete and accurate patient records, less patient frustration.

The cost impact for the required healthcare information technology systems statewide is estimated at between $0.44 billion and $0.75 billion per year. These estimates include both one-time and operating/maintenance costs. The cost estimates include (a) the widespread implementation of advanced HIT systems by providers, and (b) development of health information exchange services between providers.

The net potential savings in Oregon from the widespread adoption of advanced health information technologies are between $1.0 and $1.3 billion annually. This level of savings would yield a net reduction of 4.3% to 5.9% on Oregon's health expenditures. Such savings are possible within 12 years with aggressive implementation efforts.

Achieving these savings will require substantial effort by physician groups, safety-net providers, hospitals and health systems to implement advanced electronic health record systems and to facilitate the secure authorized electronic exchange of clinical information between providers. Accelerating the adoption of advanced HIT systems is complicated by the inconsistent incentives between the providers incurring the costs of advanced HIT systems and those who benefit from avoided services, reduced inefficiencies and productivity improvements

… a physician is alerted to a lower cost generic and alternative brand-named drug to control blood pressure and cholesterol rather than the higher-cost medications.

… a pharmacy avoids dispensing the wrong medication with electronic prescriptions rather than hand-written prescriptions. Hospitalizations and office visits for adverse drug events avoided, less wasted time for physician and pharmacy.

… a physician office retrieves patient records electronically from multiple locations. Practice avoids transcription costs, paper charts, filing costs, and misplaced records.

… a primary care physician's referrals to specialists automatically include or provide access to the patient's history and relevant data. Consultant tests, reports and images are immediately available to the referring physicians and integrated into their EHRs.

… nurses and physicians spend more time confirming information and making decisions on more complete information and less time repeatedly collecting information already documented elsewhere.

As the Oregon Health Fund program under Senate Bill 329 develops its comprehensive plan for improving Oregon's health care delivery system, it should consider the potential savings from the widespread adoption of advanced health information technologies, the barriers and mixed incentives affecting HIT adoption, and public policies that could encourage and accelerate widespread adoption.

Potential HIT Impact on Oregon's Health Expenditures

In 2006, health care expenditures in Oregon exceeded $20 billion[1]. The increases in expenditures from 2001 to 2006 have averaged 7.5% per year. From 2001 to 2004 Oregon health care expenditures averaged 13.1% of Oregon Gross State Product.[2] For at least the last twenty years various groups have discussed the possible impact that health information technologies could have on lowering health care costs and slowing the continuing escalation. In 2001 and 2002 the Institute of Medicine issued its landmark reports *To Err is Human: Building a Safer Health System* (2000) and *Crossing the Quality Chasm: A New Health System for the 21st Century* (2001). Since that time there has been growing recognition of the critical role of health information technologies to help reduce errors and improve patient safety, improve the quality of health care and lower costs.

The driving force for adopting advanced health information technologies is the potential it provides for improving the quality and safety of health care. However, the financial costs and misaligned business incentives present significant barriers to implementation. Understanding the financial savings and costs of these implementations, and how they accrue to stakeholders is important in identifying incremental steps in working toward widespread implementation.

Question:

What is the potential impact of advanced health information technologies on Oregon's health care expenditures?

Introduction

The purpose of this report is to estimate the aggregate potential impact of health information technology adoption on Oregon health care expenditures. This report relies on modeling methods from national studies for estimating savings from

- avoided services,
- products and services provided at lower costs,
- better productivity and efficiency of physicians and nurses, and
- administrative processing efficiencies.

[1] Personal health expenditures are a specific category within the National Health Expenditure reports used by the Federal government for reporting heath expenditures at the Federal and state level. Personal health expenditures include expenditures by organization providing hospital care, physician and other professional services, home health and nursing home care, prescription drugs, other medical products (durable and non-durable). Category definitions are available at http://www.cms.hhs.gov/NationalHealthExpendData/downloads/quickref.pdf

[2] Analysis of National and Oregon Health Expenditures based on actual and projected data for 2000 to 2016.

Approach:

Assume comprehensive health information technology systems are installed throughout Oregon and actively used to take advantage of possible efficiencies.

- **What savings would be projected?**
- **What is the projected cost for the required systems?**
- **What is the net potential impact on Oregon's health care expenditures?**

Advanced Health Information Technologies

This report focuses on the adoption of advanced health information technology systems commonly described as electronic health records systems with capabilities for the electronic exchange of information between hospitals, physicians and other service providers. Advanced systems go significantly beyond the conversion of paper-based medical records into electronic form. Advanced systems include a wide range of capabilities that assist and support physicians and other providers in taking care of patients. These capabilities include online order processing, clinical decision support, electronic communications and connectivity. Health information, such as lab results, medication lists, and problem lists, moves seamlessly between providers when needed, is automatically recognized and understood, and is appropriately integrated into the current providers EHR.

This report uses the term "health information technologies" or "HIT" to mean systems with these advanced capabilities. Appendix B: Advanced Health Information Technologies provides additional information on the HIT capabilities, the recommendation of the Institute of Medicine (IOM) regarding HIT for improving quality and patient safety, and the current and future state of electronic health records.

Methods Overview

The Oregon health expenditures impact estimate is based on modeling the potential savings and costs that should be expected from the comprehensive adoption of advanced health information technologies in Oregon. Published estimates of national savings and costs were reviewed and deconstructed into their component parts. These published national models include:

- Center for Information Technology Leadership: The Value of Computerized Provider Order Entry in Ambulatory Care Settings (CITL-ACPOE)
- Center for Information Technology Leadership; The Value of Healthcare Information Exchange and Interoperability (CITL-HIE&I)
- The RAND Health Information Technology Project
- The Costs of a National Health Information Network

In addition, two studies were undertaken as part of local health information exchange planning efforts that were expanded to cover the State of Oregon regarding:

- Impact of Missing Information
- Processing Savings

Since the published studies occurred at different points in time and with differing assumptions, the savings were updated and standardized to 2006 health expenditure levels to estimate the impacts in Oregon. Savings components from the various studies were selected to create unique comprehensive synthesized estimates of savings. Appendix D: Savings Projections describes the various studies and derived savings estimates.

The determination of the net savings (potential savings minus costs) is critically dependent on the manner in which the costs of HIT systems are treated. Published analyses of cost estimates distinguish one-time costs of acquisition and implementation from ongoing annual operating and maintenance costs. Since the goal of this report is to determine the impact on Oregon's health expenditures, an approach which only addresses the ongoing annual cost would underestimate the real costs from a typical accounting and financing perspective where one-time cost are amortized over their useful life. This report calculates the annual cost burden as 40% of the one-time costs of implementation. Appendix E: Cost Projections describes the rationale for this costing approach and range of costs estimated for Oregon.

Net savings are calculated as the potential saving yet to be achieved less the annualized cost burden (amortized one-time costs and annual ongoing costs) of implementing the HIT systems beyond the current level of deployment.

Oregon Savings Estimate

Oregon health expenditure savings from the widespread adoption of health information technologies are about $1.7 billion per year as detailed in Table 1. These savings are focused on estimates that could be derived from published sources that are related to avoidable services and efficiency improvements. The approach relies on a major assumption that advanced comprehensive HIT systems will be installed throughout Oregon over time and actively used to their full potential to improve the health care delivery and take advantage of possible efficiencies. Table 1 shows the components that contribute to the overall Oregon savings estimates. Appendix D provides additional information about the various studies and rationale for selection of savings components.

Table 1. Oregon Potential Annual Savings, Millions of 2006 Dollars

Source of Savings	Expenditure Category[3]	Oregon Savings
AVOIDABLE SERVICES		
Ambulatory visits due to adverse drug events*	Physician	0.9
Ambulatory visits due to missing information****	Physician	20.6
Outpatient laboratory tests***	Physician	26.4
Outpatient radiology studies***	Physician	42.6
Outpatient medications - drug utilization***	Drugs	93.9
Employer time loss savings on avoided visits and test****	Employer	6.1
Hospitalizations due to adverse drug events*	Hospital	24.8
Emergency dept hospitalizations due to missing information****	Hospital	0.5
Inpatient laboratory tests***	Hospital	27.7
Inpatient medications - drug utilization***	Hospital	34.6
Inpatient length of stay reductions***	Hospital	342.6
Total Avoidable Services Savings		**620.7**
REDUCED INEFFICIENCIES AND PRODUCTIVITY IMPROVEMENTS		
Outpatient transcriptions eliminated***	Physician	22.3
Outpatient chart pulls eliminated***	Physician	19.9
Ambulatory Physician/Staff Productivity		
- Lost time looking for missing information****	Physician	8.6
- Repeated histories/med lists due to missing information****	Physician	20.2
Outpatient test ordering and report processing efficiencies		
- Laboratory tests: ordering physicians and laboratories**	Physician	317.5
- Radiology studies: ordering physicians and imaging centers **	Physician	196.9
Outpatient prescription processing efficiencies		
- Physician office Rx processing efficiencies**	Physician	5.9
- Hospital emergency/outpatient department Rx efficiencies**	Hospital	5.3
- Pharmacy Rx processing efficiencies**	Drugs	11.9
Referral and communications efficiencies between providers		
- Physician referrals and consultation report processing**	Physician	102.2
- Hospital outpatient referrals and report processing**	Hospital	43.3
Inpatient nurses productivity improvement***	Hospital	118.8
Inpatient medical records services eliminated***	Hospital	23.5
Public health reporting processing efficiencies		
- Physician and laboratory reporting efficiencies**	Physician	1.3
- Public health department efficiencies**	Public Health	1.1
Processing efficiencies between providers and payers		
- Physician efficiencies**	Physician	95.5
- Hospital efficiencies**	Hospital	19.5
- Payer organization efficiencies**	Payers	106.2

[3] National Health Expenditure categories are used by the Federal government for reporting heath expenditures at the Federal and state level. Independent laboratory and imaging center services are grouped with physician services for NHE reporting. Category definitions are available at http://www.cms.hhs.gov/NationalHealthExpendData/downloads/quickref.pdf.

Source of Savings	Expenditure Category[3]	**Oregon Savings**
Inpatient & emergency dept report distribution efficiencies		
- Hospital report processing – routine*****	Hospital	0.7
- Hospital report processing - non-routine*****	Hospital	0.9
- Physician office report processing – routine*****	Physician	0.9
- Physician report processing - non-routine*****	Physician	3.3
- Payers report processing - non-routine*****	Payer	0.7
Total Efficiency/Productivity Savings		**1,126.4**
Total Savings		**1,747.1**

* See Appendix D for additional details for estimates based on the Center for Information Technology Leadership's Ambulatory Care Provider Order Entry study.
** See Appendix D for additional details for estimates based on the Center for Information Technology Leadership's Health Information Exchange and Interoperability study.
*** See Appendix D for additional details for estimates based on the RAND Health Information Technology Project study.
**** See Appendix D for additional details for estimates based on the Missing Information Savings Analysis.
***** See Appendix D for additional details for estimates based on the Processing Savings Analysis.

In aggregate 36% ($621 million) of the Oregon savings derive from avoided services and 64% ($1,126 million) derive from reduced inefficiencies and productivity improvements.

Community-wide Savings: The $1.7 billion of potential savings that are eventually achievable with the widespread adoption and use of advanced health information technologies are benefits to the community as a whole. The avoided services savings most immediately benefit the payers of those services. Payers include patients, health plans (commercial plans, self-insured employer plans, Medicare, Medicaid fee-for-service and Medicaid managed care) as well as providers who function as the payers for uncompensated care rendered to the uninsured and under-insured. The efficiency and productivity savings most immediately benefit the providers and plans that have lower operating costs. Eventually all these savings should translate into lower health care expenditures for the community as a whole.

Savings Distribution Across Oregon

The distribution of savings are estimated for four regional areas based on the natural market areas and largest concentrations of population. The Portland Tri-Counties includes Clackamas, Multnomah and Washington counties. The Willamette Valley region includes the remaining six Willamette Valley counties south of the Portland area: Benton, Lane, Linn, Marion, Polk and Yamhill counties. Deschutes (Bend area) and Jackson (Medford area) counties are grouped together as the two next largest populated counties. The remaining 25 Other Counties are the most rural counties in Oregon.

Table 2 shows the regional distribution for Oregon's population, licensed physicians and hospital activity as measured by inpatient discharges and total hospital expenses. See Appendix C for additional information on Oregon's health care environment. These data provide a reference for understanding the geographic variation in savings from HIT implementation.

Table 2. Regional Distribution of Oregon Population, Licensed Physicians, and Hospital Activity

	Portland Tri-Counties	Willamette Valley - 6 Counties	Deschutes & Jackson Counties	25 Other Counties
Population, July 2006	**42.5%**	**27.0%**	**9.5%**	**20.9%**
Physicians (MD/DO) July 2006	59.1%	19.3%	9.1%	12.4%
Hospital discharges 2005	49.3%	20.4%	10.5%	19.8%
Hospital expenses 2005	50.6%	21.0%	11.0%	17.3%

The Portland Tri-County area has the highest concentration of physicians and hospital activity compared to its relative proportion of the population. The 25 Other Counties have the lowest concentration of physicians and hospital activity compared the relative proportion of the population.

Regional savings are estimated for each savings component detailed in Table 1 using data from the missing information and processes savings analyses, hospital discharges and hospital expenses as detailed in Appendix D and shown on Table D-9. Table 3 shows the regional savings for total avoidable services savings, total efficiency and productivity savings, and total potential savings.

Table 3. Potential Annual Savings by Region, Millions of 2006 Dollars.

Source of Savings	Total Oregon Savings	Portland Tri-Counties	Willamette Valley – 6 Counties	Deschutes & Jackson Counties	25 Other Counties
Total Avoidable Services Savings	620.7	293.36	177.53	62.38	87.42
Percentage distribution	100.0%	47.3%	28.6%	10.1%	14.1%
Total Efficiency /Productivity Savings	1126.4	502.28	320.32	119.14	184.68
Percentage distribution	100.0%	44.6%	28.4%	10.6%	16.4%
Total Potential Savings	1747.1	795.64	497.85	181.53	272.10
Percentage distribution	100.0%	**45.5%**	**28.5%**	**10.4%**	**15.6%**

The 25 Other Counties savings (15.6%) are less than their proportion of the Oregon population (20.9%). The Portland Tri-County area has the highest savings (45.5%) compared to its share of Oregon's population (42.5%)

Potential Savings Impact by Payers

In July 2006, approximately 10.1% of Oregon's population was covered by the Oregon Health Plan, 15.6% of the population was uninsured with no health plan coverage, and 74.3% had some type of health plan coverage as described in Appendix C. Although the savings broadly accrue to society as a whole, the savings from avoided services ($621 million per year) will occur through the various payer intermediaries. For patients with health plan coverage, avoided services will reduce the payments made by health plans including Medicare, Medicaid, self-insured plans and commercial insurance plans. The avoided services savings also accrue to

patients who will have lowered out-of-pocket costs. For uninsured patients the payers are predominantly the physicians, safety net clinics and hospitals that end up financing the uncompensated care they provide. When services are avoided, the costs of uncompensated care rendered to the uninsured absorbed by physicians, hospitals and other providers would be lower.

Any savings from avoided services resulting from HIT adoption would accrue to these populations based on their relative rates of service utilization and the levels of cost for that utilization. Information is not available to estimate the financial savings distribution among categories of payers. However, Appendix C: Oregon's Health Delivery System includes estimates of the populations covered by various types of health plans and the estimated population of uninsured Oregonians based on data from various public sources (Table C-4). Appendix C, Table C-6 shows estimates of the coverage burden for Oregon's 3.7 million population among various types of health plans after eliminating multiple and supplemental coverage by age category.

Savings from efficiencies and productivity improvements most immediately accrue to the providers and other stakeholders that achieve the efficiencies. Over time, efficiency and productivity savings dampen and/or delay the need for price increases in the fees charged to patients. It is assumed that the impact of these savings would have the same distribution among payers as avoided services.

Oregon Cost Projection

The projected Oregon annualized cost impact for completing the widespread adoption of health information technologies is $0.44 to $0.77 billion per year. Projected costs are expressed as a range due to the difficulties in deconstructing cost estimates from published studies, lack of other publicly available data, and estimating costs for specific HIT functionalities.

Annualized Cost Estimates: The published costs estimates identify two primary cost parameters:

- **one-time costs** or capital costs of software and hardware acquisition, customization, implementation, conversion efforts, initial training and short-term productivity loss, and
- **operating/maintenance costs** for software licenses and maintenance fees, hardware upgrades, internal or contracted systems support and ongoing training. These costs are typically expressed as a percentage of the one-time costs (range of 17.5% to 30%).

These two costs must be translated into **annualized costs** that can be compared to the potential annual savings estimates. This report calculates the annualized cost burden, including the amortization of one-time cost and annual operating/maintenance costs, as 40% of the one-time costs of implementation. Appendix E provides additional information on the rationale for this approach.

Average and Highest Cost Scenarios: To develop the range for the cost estimates for this analysis, the one-time costs from the studies were grouped by provider or stakeholder type. Within each type, the average one-time cost of the studies with an estimate for that type was

computed as the **lower bound** of the likely one-time cost. The highest one-time cost within each type was chosen as the **upper bound** of the likely one-time cost. The sum of average or highest costs across the provider/stakeholder types establishes two aggregate one-time cost estimates.

Table 4 shows the lower and upper bound costs derived from the average cost and highest cost scenarios for HIT implementation in Oregon.

Table 4. Annualized Costs Yet-to-be Incurred for Completing Oregon HIT Implementation, Millions of 2006 Dollars

Stakeholder Type	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario
Hospitals	150.0	212.0
Physicians	250.0	495.3
Laboratories	5.4	9.2
Imaging Centers	2.4	3.4
Pharmacies	20.2	26.7
Public Health	0.1	0.1
Payers	5.2	9.2
Hosting organizations	0.3	0.3
Subtotal Annualized Costs	433.7	756.2
Oregon HIE Utility Annual Cost	10.0	10.0
Total	443.7	766.2

The provider and other stakeholder costs included in the Subtotal Annualized Costs are derived from the average and highest cost scenarios. The Oregon Health Information Exchange (HIE) annual costs are added to the subtotal separately assuming an application service provider (ASP) model for the delivery of health information exchange functionalities. This cost was estimated separately from the other cost components as discussed in Appendix E.

Net Savings

The projected Oregon net savings achievable with the widespread adoption of advanced health information technologies is $1.0 to $1.3 billion per year. The projected net annual savings are the potential annual savings estimated for Oregon less the estimated annualized cost are shown in Table 5.

Table 5. Potential Oregon Net Annual Savings from Advanced HIT Adoption, Millions of 2006 Dollars

	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario
Potential Annual Savings		
Avoided Services	620.7	620.7
Reduced Inefficiencies	1,126.3	1,126.3
Total Savings	1,747.1	1,747.1
Total Annualized Costs	443.7	766.2
NET ANNUAL SAVINGS	**1,303.4**	**980.8**

Impact on Oregon Health Expenditures

POTENTIAL SAVINGS: The projected Oregon potential savings (before costs) from the widespread adoption of health information technologies represent 8% of Oregon's total personal health expenditures. These potential savings include 9% of hospital care, 15% of physician services and 6% of prescription drugs expenditures.

Table 6 shows the potential savings (before costs) by health expenditure categories and the rate that those savings represent of Oregon health expenditures.

Table 6. Oregon Potential Annual Savings Rates (Before Costs), Millions of 2006 Dollars

Expenditure Category	Oregon Health Expenditures	Oregon Potential Savings	Oregon Savings Rates
Hospital Care	7,169.0	642.2	9.0%
Physician Services*	5,811.0	885.0	15.2%
Prescription Drugs	1,710.0	105.8	6.2%
Subtotal	14,690.0	1,633.0	11.1%
Other Categories	5,615.0	not estimated	not estimated
Total Personal Health Expenditures	**20,305.0**	**1,633.0**	**8.0%**
Administration & Net Cost of Private Health Insurance	1,724.0	106.9	6.2%
Public Health Activity	679.0	1.1	0.2%
Total Health Services & Supplies	**22,708.0**	**1,741.0**	**7.7%**
Employer Time-Loss Savings		6.1	
Grand Total Oregon Potential Savings		**1,747.1**	

* For purposes of measuring health expenditure, the National Health Expenditure survey includes independent laboratories and imaging centers in the physician services category.

Savings to health plans represent 6% of the administration and net cost of private insurance category.

Employer sick leave, time-loss and staff replacement costs are not included in the National Health Expenditures categories but are important sources of savings and have been added at the end of the table.

NET POTENTIAL SAVINGS: The projected Oregon net potential annual savings (after costs) from the widespread adoption of health information technologies is 4.3% to 5.9% of Oregon's total personal health expenditures. Net savings are 5.9% to 6.8% for hospital care expenditures, 6.4% to 10.7% for physician services expenditures and 4.6% to 5.0% for prescription drugs expenditures.

Table 7 shows the net potential savings (after costs) by health expenditure categories and the range of savings rates they the represent of Oregon health expenditures for the lower and higher cost scenarios.

Table 7. Oregon Net Potential Annual Savings Rates (After Costs), Millions of 2006 Dollars

Expenditure Category	Oregon Health Expenditures	Oregon Net Savings	Oregon Net Savings	Oregon Savings Rates	Oregon Savings Rates
		Lower Estimate	Higher Estimate	Lower Estimate	Higher Estimate
EXPENDITURE CATEGORIES					
Hospital Care	7,169.0	425.7	488.3	5.9%	6.8%
Physician Services	5,811.0	373.1	622.2	6.4%	10.7%
Prescription Drugs	1,710.0	78.3	84.9	4.6%	5.0%
Subtotal	14,690.0	877.1	1195.4	6.0%	8.1%
Other Categories	5,615.0	not estimated	not estimated		
Total Personal Health Expenditures	**20,305.0**	**877.1**	**1,195.4**	**4.3%**	**5.9%**
Administration & Net Cost of Private Health Insurance	1,724.0	96.7	100.9	5.6%	5.9%
Public Health Activity	679.0	1.0	1.0	0.1%	0.1%
Total Health Services & Supplies	**22,708.0**	**974.8**	**1,297.3**	**4.3%**	**5.7%**
Employer Time-Loss Savings		6.1	6.1		
Total Oregon Net Savings		**980.9**	**1,303.4**		

Limitations

There are a number of technical limitations to this analysis. As is the case with any modeling project it is subject to numerous assumptions and judgments. This project relies on published

savings estimates from other projects since those are the only sources of data readily available. Cost information from other studies is several years old. No source could be identified for recent real-world HIT costs. The existing levels of HIT adoption in Oregon are approximations used for the modeling. Such estimates affect both the potential savings yet to be achieved and the HIT costs for adoption.

In addition to the technical limitations of modeling, some experts have expressed skepticism about HIT savings and cost modeling including:

- EHR-supported health care transformation is too immature for developing credible estimates of the costs and benefits (Walker, 2005).[4]
- Too much hope and hype are involved in predicting EHR impacts (Himmelstein, 2005).[5]
- The primary rationale for EHR systems should be to improve quality and that net costs savings are likely to be elusive (Goodman, 2005).[6]
- As currently implemented EHRs are not yet associated with better quality ambulatory care (Linder, 2007).[7]

The Linder article notes that with the clinical information available for the study, the authors were unable to detect improvements in quality indicators based on the presence of ambulatory EHR systems in use in 2003/2004. The authors could not determine whether the systems in use had advanced capabilities such as clinical decision support. Linder et al note that their results may be due to the rudimentary nature of EHR systems in 2003/2004, lack of clinical decision support and quality tools, lack of incentives to use clinical decision support and quality tools in busy ambulatory care practices, and differences between EHR implementations in many ambulatory care practices versus hospitals and other setting that have demonstrated quality improvements.

In spite of this skepticism, this analysis makes a major assumption that **advanced comprehensive HIT systems** will be installed throughout Oregon **over time** and **actively used to their full potential** to improve the health care delivery and take advantage of possible efficiencies. Given the major differences between the advanced capabilities of developing HIT systems versus the capabilities of systems already in place (manual, limited function HIT systems and some moderately advanced systems) it seems unlikely that the savings and cost estimates are grossly unrealistic.

An additional set of limitation relate to the barriers that stand in the way of HIT implementation. As described below, these issues are important to policy makers who desire to accelerate adoption and achieve the potential savings.

---

[4] Walker JM. Electronic medical records and health care transformation, Health Affairs, 24:5 September/October 2005, 1118-1120.

[5] Himmelstein DU, Woolhandler S. Hope and hype: predicting the impact of electronic medical records, Health Affairs, 24:5 September/October 2005, 1121-1123.

[6] Goodman C, Savings in electronic medical record systems? Do it for the quality, Health Affairs, 24:5 September/October 2005 1124-1126.

[7] Linder JA, Ma J, Bates DW, Middleton B, Stafford RS, Electronic health record use and the quality of ambulatory care in the united States, Archives of internal Medicine, 167:13 July 19, 2007, 1400-1405.

Cost – Benefit Mismatch: The savings identified benefit the entire community through improved health care quality and patient safety, lower health care costs and reduced inefficiencies. There is a mismatch between the beneficiaries of the savings and quality/safety benefits on the one hand and the providers and other stakeholders that will incur the cost to implement and adopt advanced HIT systems on the other. This mismatch of incentives creates significant barriers to the rapid adoption of advanced HIT systems.

Avoided Services are Lost Revenues: Savings generated when services can be avoided represent a lost of revenue to the providers of those services. While most providers would avoid providing unnecessary services, revenue losses may create a real financial impact on some categories of providers. If providers were to increase rates to offset revenue losses, some of the projected saving may erode. If providers are functioning at or near capacity, revenues lost from avoided services may be replaced by revenues from services provided to new or existing patients.

Adoption Timelines: This study does not consider the timelines for the implementation and adoption of advanced EHR systems in physician practices and hospitals or the implementation of health information exchange service utilities to facilitate the movement of clinical information between providers. Many health systems and physician practices are making substantial investments in advanced HIT systems. The widespread adoption of advanced HIT systems to generate the full savings projected in this reports will likely take ten to fifteen years. While substantial savings can be realized from advanced systems within a few years, the report does not attempt to estimate the savings realized under alternative adoption rate scenarios.

HIT Costs and Financing: This report does not address the costs or financing of HIT adoption for the various types of provider organizations or health information exchange services. At the current level of EHR system costs some organization may have difficulties financing HIT investments, especially smaller physician practices, safety net clinics and smaller hospitals.

Adoption is More than HIT Implementation: The leveraging of advanced HIT systems to generate the identified savings as well as achieve improvement in quality and patient safety is much more than implementing electronic systems to replace of paper-based and manual processes. Workflow processes for administrative staff and clinicians will need to be modified to take advantage of the capabilities of advanced systems. Full adoption and realization of potential savings within a care setting will likely take several years.

Next Analysis Opportunities

The scope of this analysis was limited by available resources. There are opportunities to extend this analysis is several ways. Priorities for additional analysis include the following areas.

Policy Impact Modeling: The modeling in this analysis could be adapted for prospective modeling of HIT and other impacts on Oregon health expenditures. The adaptations could include estimating the timing for realization of the savings under alternative policy scenarios.

Such prospective modeling could be useful as the Oregon Health Fund program under Senate Bill 329 develops its comprehensive plan.

Additional Impacts: This report did not estimate the potential financial benefits from improved disease prevention, chronic care management and disease management services that could be leveraged to substantial advantage **once** advanced and interoperable electronic health record systems are widely adopted. The RAND HIT Project and some other projects have generated basic data that could be used to estimate the impacts for Oregon.

Implementation Incentives: The RAND HIT Project studied the impact that incentives can have on the speed of adoption. Accelerating early adoption by the maximum number of providers creates tremendous leverage in achieving recurring savings. The underlying data developed in this project could be used to evaluate alternative incentives and other policy scenarios.

Electronic Communications: Some data is available regarding the role of electronic communications between clinicians and patients that avoids office visits and other services. An impact analysis of electronic communications would need to consider the issue of clinician payments to cover the clinician time commitments and offset lost revenue from fewer.

Special Populations: One aim of this analysis was to assess the potential savings impact on uninsured and publicly-financed patient care. The available data and project resources limited the scope of these explorations. Additional analysis on potential savings impacts may be useful to policy makers.

Regional Impacts: Basic data about health care delivery volumes and related information across the geographic regions in Oregon limited the geographic analysis of savings. Data could be collected regarding the extent of existing and planned HIT deployment in Oregon to better identify the levels of adoption and yet-to-be incurred costs.

Other Care Settings: Savings and costs were not estimated for a number of health care delivery settings including skilled nursing facilities, home health care, long-term care facilities, mental health facilities, rehabilitation services and correction facilities. Savings were also not specifically estimated for community health centers as a subset of general ambulatory care services. Estimates for some of these settings could be useful for public policy makers and could be developed depending on the availability of sufficient data on these settings.

Conclusion

The widespread adoption of advanced health information technology systems in Oregon will not only improve the quality of health care services and patient safety but also limit the growth of Oregon health expenditures. This report identifies $1.7 billion in potential savings per year from avoidable services, reduced inefficiencies and productivity improvements or 7.7% of Oregon's $22.7 billion of expenditures for health services and supplies. Annualized costs to achieve these

savings range from $4.3 to 7.6 million. The net potential savings after costs are $1.3 billion per year or 5.7% of Oregon health expenditures. These estimates do not include potential savings from improved disease prevention, chronic care management and disease management services; or for skilled nursing facilities, home health care, long-term care facilities, mental health facilities, rehabilitation services or correctional facilities.

Achieving these substantial savings will require substantial effort by physician groups, safety-net providers, hospitals and health systems to implement and adopt advanced electronic health record systems and facilitate the secure and authorized electronic exchange of clinical information between providers. Accelerating the implementation and adoption of advanced HIT systems is complicated by the differential incentives between providers incurring the costs of advanced HIT systems and diverse beneficiaries of savings from avoided service, reduced inefficiencies and productivity improvements.

As the Oregon Health Fund program under Senate Bill 329 develops its comprehensive plan for improving Oregon's health care delivery system, it should consider the potential savings from the widespread adoption of advanced health information technologies, the barriers and mixed incentives affecting HIT adoption, and public policies that could encourage and accelerate widespread adoption.

Appendix A: Funding Sources and Acknowledgements

Funding Sources: The Oregon HIT Savings and Cost Assessment project described in this report was commissioned by the Oregon Health Care Quality Corporation and Office for Oregon Health Policy and Research with support from the Northwest Health Foundation and the Oregon Division of Medical Assistance Programs.

Acknowledgements: Nancy Clarke, Executive Director, Oregon Health Care Quality Corporation and Tina Edlund, Deputy Administrator, Office for Oregon Health Policy and Research were instrumental in commissioning this project, seeking support, and providing information and advice throughout the effort.

Jody Pettit, MD, Health Information Technology Coordinator, Office for Oregon Health Policy and Research was particularly helpful in providing information from a clinician's perspective and responding to numerous questions that affected the evolution of these savings and cost assessments.

Prior Project Participation: The authors participated in two prior projects related to developing health information exchange services in Oregon. The Oregon Business Council's (OBC) Data Exchange Group, a sub-group of the OBC's Health Care Task Force, commissioned projects to (a) evaluate Oregon Health Information Exchange Options[8] and (b) develop a mobilization plan for a Metropolitan Portland Health Information Exchange (MPHIE)[9]. Some information and methods developed by the authors in these earlier projects were expanded for this project.

Disclaimer: The views presented in this reports are those of the authors and should not be attributed to the sponsoring or funding organizations or their directors, staff or employees.

[8] Davidson A, Forrester J, Gibson D, Pettit J. Oregon Health Information Exchange Options, Report to the Oregon Business Council Data Exchange Group, May 15, 2006 available at http://www.q-corp.org/q-corp/images/public/pdfs/OR%20HIE%20Options.pdf.

[9] See press release September 11, 2006, Oregon Business Council Announces Next Phase of Health Information Exchange Project available at http://www.q-corp.org/q-corp/images/public/pdfs/OBC%20press%20release.pdf and HIE Mobilization Executive Summary available at http://www.q-corp.org/q-corp/images/public/pdfs/HIE%20Mobilization%20Exec%20Summary.pdf.

Appendix B: Advanced HIT and Savings Opportunities

Electronic Health Information Technology Capabilities

In 1991 the Institute of Medicine (IOM) called for the elimination of paper-based records within ten years, an event that has clearly not occurred.[10] The IOM reinforced the essential role that information technologies could play in addressing patient safety issues and improving quality.

In 2003, the IOM described the key capabilities of an electronic health record system.[11] The overall capabilities include:

- longitudinal collection of electronic health information for and about persons including information about the individual and health care provided to the individual,
- immediate electronic access to person- and population-level information by authorized, and only authorized users,
- provision of knowledge and decision-support that enhance the quality, safety, and efficiency of patient care, and
- support of efficient processes of health care delivery.

The 2003 IOM key capabilities report identifies core functionalities in eight categories:

- Health information and data
- Results management
- Order entry/management
- Decision support
- Electronic communication and connectivity
- Patient support
- Administrative processes
- Reporting and population health management

The Federal government and multiple organizations have further elaborated the descriptions of the key functionalities for a comprehensive health information technology infrastructure ranging from care delivered to an individual in any local health care setting, including self-care, to an interconnected Nation Health Information Network (NHIN).

In estimating the costs of the NHIN, the Working Group on the Cost of National Health Information Network used an alternative framework for (1) functional domains related to health care providers and (2) interoperability functionalities for the exchange of data between provider organizations[12]. The provider-centric functionalities include:

---

[10] Institute of Medicine. 1991. *The Computer-Based Patient Record; An Essential Technology for Health Care*, eds. Dick RS, Steen EB, Washington DC National Academy Press.

[11] Institute of Medicine. 2003. *Key Capabilities of an Electronic Health Record System: Letter Report*. Committee on Data Standards for Patient Safety. Washington DC. Available at http://www.nap.edu/catalog/10781.html.

[12] Kaushal R, Blumenthal D, Poon EG, Jha AK, Franz C, Middleton B, Glazer J, Christino M, Fernandopulle R, Newhouse JP, Bates DW, The costs of a national health information network. Annals of Internal Medicine, 143 (3)

- Electronic health records (EHR),
- Results viewing,
- Computerized physician order entry (CPOE),
- Electronic claims submission,
- Electronic eligibility verification,
- Secure electronic patient communications, and
- Electronic prescription acceptance by pharmacies.

These functions occur across a variety of (1) inpatient and outpatient settings and (2) organizations including physician offices, hospitals, skilled nursing facilities, nursing homes, clinical laboratories, imaging centers, payers, and pharmacies.

Current & Future State of Health Records

The Current Status of Electronic Health Records

Effective clinical decisions depend on providers knowing the patient's medical history and recent status. Though Oregon has one of the highest adoption rates of electronic medical records in the country, many hospitals and most physician offices still rely on paper record-keeping for clinical care. As a result, apart from the narrow slice of care delivered by the provider for a given episode, much of the patient's history, lab and imaging test results, medications, allergies, and documented problems are generally not available to the provider. Results for a single patient from different sources are typically not aggregated or available to subsequent providers. Patient care occurs today with incomplete information available to providers.

Providers' medical record requests often result in incomplete information and are frequently not available in a timely fashion for care. Transmission of records is done on paper, by fax or mail -- slow, manual processes that are simultaneously not secure and yet do not allow rapid access to the provider who needs the data.

Administrative processes around patient care – registration, eligibility checking, referral authorization, billing, claims adjudication -- though better automated than clinical records, are still inefficient and hampered by waste, inefficiency, and duplicative work.

Characteristics of the Future State

Clearly, automation of physicians' medical record-keeping would help remedy the problem of incomplete patient information at the point of care. At a minimum, the history and physical, problem list, medications, allergies, lab and imaging results, and relevant recent orders and procedure reports would be available to authorized providers under the patient's control.

---

2 August 2005, 165-173,W37-38. Additional detail in Kaushal R, Bates DW, Poon EG, Jha AK, Blumenthal D. Functional gaps in attaining a national health information network: what will it take to get there in five years? Health Affairs 24(5) September/October 2005, pp.1281-1289.

In the ideal registration process, patients would *confirm* (rather than repeatedly and inconsistently reconstruct) history information for the provider at the beginning of the visit. Referral-specific, episode-specific, and disease-specific information would be available to the provider and patient based on the handoff from a referring physician. For example, if the primary care physician (PCP) referred a patient to a cardiologist for a workup on chest pain, the intake form would contain all the information the PCP provided, and might only require the patient to answer questions about the past cardiac history pain location, radiation, quality, frequency (rest or exertion) passing out etc. The patient would also be able to inspect their records at the time of registration, potentially correcting and reconciling any errors on the medication list as well as reducing the amount of "chart lore" such as incorrect or resolved diagnoses in the record.

In addition, care records from all locations would be aggregated longitudinally for the patient. The longitudinal EHR would include not only information from the hospital or doctor's office, but also data such as travel clinic immunizations and flu shots from the drugstore. Authorized providers would be able to incorporate their patient's data from all other locations of care -- as well as patient e-communications -- into the physician electronic medical records in a standardized, coded, computable format that could be used for electronic decision support.

Care decisions and physician orders for new tests, procedures, and electronic prescribing can occur electronically, with decision support from a system of triggers, alerts, warnings and reminders that intelligently and unobtrusively supplement the physician's knowledge of the patient's condition and desired treatment plans.

Documentation of an episode of care would be captured in electronic medical records (EMR) as seamlessly as possible, incorporating the physician workflow and the entire care team's contributions. Care delivery would contribute to a longitudinal EHR as a "by-product" of using electronic systems (including EMR) in the process of caring for the patient.

Information from a given episode would be seamlessly incorporated into the patient's longitudinal record, and the next provider or member of the care team would receive the appropriate, authorized set of patient information required to provide the next segment of care. For example, the patient's preferred pharmacy would receive an electronic order for an eligibility-checked prescription after the doctor's visit, perform a check of stock, and alert the patient with a call, email, or text message as to the time of pickup availability.

Aggregated, anonymous data would be used for quality measurement and outcomes research; physicians would be able to assess their own performance against national benchmarks and local standards. Physicians, patients, and purchasers would have a basis for comparison of different locations of care relative to outcomes and cost. Anonymous clinical data would also be available for population health activities including health services research, patient safety studies, and bio-surveillance.

Hospitals and physician offices are slowly implementing a range of automated systems to support the full range of functions described above. The systems include not only the EMR and administrative systems (practice management), but also departmental systems beginning with laboratory, radiology, and pharmacy. New infrastructure for data aggregation and

interoperability is required, including clinical data repositories, interfaces, and the associated controlled medical vocabulary. Significant work process and workflow re-engineering are required to take advantage of the new infrastructure. However, the desired state anticipates not only financial benefits to the state and local communities, but also to clinical quality, patient outcomes, and time savings for the care team.

Benefit & Savings Opportunities

The 2001 IOM's *Crossing the Quality Chasm* report recommended aims for quality improvement in the health system in five areas: Safe, Effective, Efficient, Patient-Centered, Timely and Equitable. Each of these areas has implications for the costs of health care as well as quality. As part of RAND's HIT Project (see Appendix E for additional information), they identified an impact taxonomy of subordinate categories for their analysis. The impact taxonomy includes:

Safe
- Reduce adverse drug events (ADEs)
- Reduce procedural errors (surgery, anesthesia, blood, etc.)
- Reduce infections, complications
- Reduce missed opportunities for appropriate care
- Increase consistency of performance of care systems

Effective
- Reduce mortality
- Reduce morbidity
- Increase health status
- Increase utilization of appropriate care
- Improve assessment of patient condition / status
- Provide appropriate preventative care
- Improve patient compliance

Efficient
- Reduce costs
- Increase revenue
- Cost of HIT systems
- Enhance provider education

Patient-Centered
- Improve patient satisfaction
- Increase utilization of patient-centered services
- Improve patient decision support

Timely
- Decreased waiting time at point of care
- Improve appointment availability
- Faster response to patient inquiries
- Faster results turnaround
- Miscellaneous process delays
- Reduction of unnecessary duplication (test, questioning, etc.)

Equitable
- Improved access in remote settings (e.g. telemedicine)

The savings identified by the various published studies primarily involve the categories of Safe, Effective, Efficient and Timely. As reflected in the published studies, the ability to estimate

financial savings and improvements in clinical care is limited by the availability of information in the published literature that can be translated into projects of savings related to HIT adoption.

One of the most frequently cited savings estimates for the entire United States comes from RAND's Health Information Technology Project. RAND estimated that HIT-enabled efficiency savings for inpatient and outpatient care could average more than $77 billion per year. [13] Additionally Hilstead's paper notes the potential for significant patient safety benefits from electronic record systems, especially those that can reduce the 200,000 inpatient adverse drug events and saving about $1 billion per year. Avoiding two-thirds of medication errors and adverse drug events in ambulatory care setting could result in annual national savings of $3.5 billion. RAND notes the potential for improvements in short-term preventive care through reminders to patients and clinicians about compliance with preventive care recommendations. While increased use of preventive services increases health care use, RAND concluded that the costs are not large and the health benefits are significant. Widespread adoption of advanced electronic health records systems also creates a platform for significant improvements in chronic disease prevention and disease management. RAND estimates that the potential combined savings of reducing chronic disease incidence attributable to long-term prevention and reduced acute care due to disease management are $147 billion per year.

[13] Hilstead R, Bigelow J, Bower A, Girosi F, Meili R, Scoville R, Taylor R, Can electronic medical record systems transform health care? Potential health benefits, savings and costs. Health Affairs, 24:5 September/October 2005, pp. 1102-1117.

Appendix C: Oregon's Health Delivery System

Selected characteristics of Oregon's health care delivery system are shown in Table C-1.

Table C-1. Selected Oregon Health Care Delivery System Characteristics

Selected Health Delivery System Characteristics	Oregon Total	Portland Tri-Counties*	Willamette Valley - 6 Counties**	Deschutes & Jackson Counties	25 Other Counties
Population July 2006 (thousands)[14]	3,690,505	1,569,170	997,125	351,230	772,980
Physicians (MD/DO) July 2006[15]	9,864	5,834	1,906	897	1,227
Hospitals in 2005[16]	58	13	12	5	28
Available Beds, December 2005	6,086	2,892	1,372	660	1,162
Hospitals Discharges 2005	1,483,801	730,913	303,067	155,523	294,298
Hospital Expenditures 2005 (millions $)	6,116.0	3,096.3	1,285.3	673.7	1,060.7
Oregon Health Plan (OHP), July 2006[17]	286,922	117,929	91,211	13,777	64,005
- Fully Capitated Health Plan enrollees	277,107	116,067	89,137	11,873	60,030
- Fee for Service, PCCM enrollees***	9,815	1,862	2,074	1,904	3,975
Oregon Uninsured 2004[18]	609,818	251,236	177,490	51,076	130,016

* Portland Tri-counties include Clackamas, Multnomah, Washington counties.
**Other Willamette Valley includes Benton, Lane, Linn, Marion, Polk, Yamhill counties.
*** PCCM is the OHP's Primary Care Case Management program

Derivative population statistics from the foregoing table are shown in Table C-2.

[14] Center for Population Research, Portland State University data for July 2006.
[15] Analysis of Oregon Board of Medical Examiners data for July 2006.
[16] All hospital data from analysis of DataBank2005 data from Office of Oregon Health Policy and Research website.
[17] Analysis of Oregon Health Plan data for July 2006.
[18] Analysis of uninsured data from Profile of Oregon's Uninsured 2004 data, Office of Oregon Health Policy and Research, March 2006.

Table C-2. Selected Oregon Population Statistics

Proportion of Oregon or Area Population that are:	Oregon Total	Portland Tri-Counties	Willamette Valley - 6 Counties	Deschutes & Jackson Counties	25 Other Counties
Under 18, July 2006	23.6%	24.3%	23.5%	22.7%	23.0%
Ages 18-64, July 2006	63.9%	65.8%	64.0%	62.8%	60.2%
Age 65 & Over, July 2006	12.5%	9.9%	12.6%	14.5%	16.8%
Oregon Health Plan, July 2006	10.2%	8.7%	11.3%	9.1%	12.4%
Oregon Uninsured 2004	17.0%	16.5%	18.2%	15.5%	17.2%

National and Oregon health expenditures provide a useful framework for assessing the impact of HIT adoption on health care costs. While there are some limitations and issues with National Health Expenditures (NHE) data, these data represent the best available comparative benchmark. Table C-3 shows the estimated National and Oregon health expenditures by the type of organization that provides the services. These data represent the actual NHE and Oregon expenditures reported for 2004 with NHE inflation adjustments from 2004 to 2006.

Table C-3 National and Oregon Health Expenditures, 2006 Estimates[19]

	National (in millions)	Oregon (in millions)	% Oregon of National
POPULATION, JULY 1, 2006[20]	299,398.484	3,690.505	1.23%
NATION HEALTH EXPENDITURES			
Hospitals*	$651,761	$7,169	1.1%
Physicians**	447,007	5,811	1.3%
Other Professional Services	60,909	853	1.4%
Dental Services	92,838	1,485	1.6%
Home Health care	53,376	267	0.5%
Prescription Drugs***	213,714	1,710	0.8%
Other Non-Durable Medical Products	36,297	581	1.6%
Durable Medical Products	25,234	303	1.2%
Nursing home Care	126,063	1,009	0.8%
Other Personal Health Care	62,033	1,117	1.8%
Subtotal: Personal Health Care Expenditures	$1,769,231	$20,305	1.14%
Administration & Net Cost of Private Health Insurance	$156,753	$1,724	1.1%
Public Health Activity	61,723	679	1.1%
Subtotal Health Services & Supplies	$1,987,707	$22,708	1.14%%
Research	$41,718	$458	1.1%
Structures & Equipment	$93,063	1,024	1.1%
Total National Health Expenditures	$2,122,488	$24,190	1.14%

* Includes laboratory and imaging services provided by hospitals.

[19] Inflation adjusted estimates based on Center for Medicare and Medicaid Services 2004 data for Oregon Personal Health Care Expenditures, All Payers, 1980-2004 and projected inflation adjustments for National Health Expenditure Amounts and Annual Percent Change by Type of Expenditure: Selected Calendar Years 2000-2016.

[20] U.S. Census Bureau and Oregon Center for Population Research at Portland State University population estimates for July 1, 2006. The U.S. Census Bureau estimate of Oregon's population as of July 1, 2006 is 3,700,758.

** Includes laboratory and imaging services provided by physicians and independent laboratories or imaging centers.
*** Includes operational costs of pharmacies.

Health Plan Coverage

Health plan coverage data for Oregon are reported by a number of public agencies for regulatory, public policy and administrative purposes. The reports include primary, secondary and dual coverages of some persons as well as some double counting of some groups. An estimate of the Oregon coverage including multiples coverage situations is shown in the Table C-4.

Table C-4. Estimated Health Plan Coverages Derived from Public Reports, July 2006[21]

	Ages < 18	Ages 18-64	Ages 65+	Total	% of population
Uninsured, no coverage[22]	109,907	461,910	3,231	575,048	15.6%
Medicare[23]	#	76,003	457,847	533,850	14.5%
OHP/Medicaid via FCHPs[24]	166,368	95,451	15,289	277,107	7.5%
OHP/Medicaid via FFS, other[25]	49,270	53,869	26,157	129,295	3.5%
13 Oregon Domestic Insurers[26]	480,372	1,298,782	196,138	1,975,292	53.5%
10 Largest Foreign Insurers[27]	93,575	252,998	57,722	404,295	11.0%
92 Smaller Foreign Insurers	19,832	53,619	22,758	96,209	2.6%
Self-insured Coverage Estimate[28]	182,348	493,014	#	675,362	18.3%
Other Non-Reporting Insurers[29]	unknown	unknown	unknown	unknown	unknown
Oregon Department of Corrections	6	12,918	305	13,229	0.4%
Oregon Veterans[30]	166	228,839	133,100	362,104	9.8%
Total Reported Lives	1,101,843	3,027,402	912,547	5,041,791	136.6%
Ratio to Oregon Population	126.3%	128.5%	197.7%	136.6%	

Assumed to be insignificant and is treated as zero.

Individuals in the Medicare Advantage program are reported twice, once under Medicare and once under the insurer categories since the recipients receive their coverage through a Medicare Advantage participating health plan rather than directly through Medicare. Traditional Medicare enrollees with a supplemental Medicare coverage plan are also counted twice since they have primary and secondary/supplemental coverage. Several of the OHP/Medicaid fully capitated health plans (FCHPs) are insurance companies resulting in a double counting of those enrollments. Medicaid also covers some Medicare individuals if they meet certain criteria.

[21] Witter & Associates analysis of reported data from various cited sources.
[22] Oregon Office of Health Policy and Research, Oregon Population Survey estimates for August/September 2006.
[23] Centers of Medicare and Medicaid Services, Medicare coverage data for July 2004 and 2005 estimated forward to July 2006.
[24] Oregon Health Plan/Medicaid data for July 15, 2006 for enrollment covered through Fully Capitated Health Plans (FCHPs).
[25] Oregon Health Plan/Medicaid data for July 15, 2006 for enrollment in Fee for Service (FFS) and other coverages.
[26] Oregon Insurance Division data for domestic (Oregon incorporated) reportable health plans July 2006.
[27] Oregon Insurance Division data for foreign (incorporated elsewhere) reportable health plans, July 2006.
[28] Estimate of self-insured coverage from Health Insurance in Oregon, draft January 2007 report, Oregon Insurance Division.
[29] Coverage for some out-of state company employees or retirees would not be subject to reporting to the Oregon Insurance Division. No source of information is available to estimate this category but it is assumed to be small.
[30] United State Department of Veterans Affairs data for September 30, 2005.

Some insurers provide stop-loss coverage to employer self-insured plans that results in double counting the same lives.

In addition to these identified issues, some families have primary coverage through more than one employer-supported health plan.

The results of the 2006 Oregon Population Survey provide the latest estimates of insurance coverages, as shown in Table C-5.

Table C-5. Statewide Health Coverages, Oregon Population Survey, Summer 2006

	Ages < 18	Ages 18-64	Ages 65+	Overall
Uninsured, no coverage	12.6%	19.6%	0.7%	15.6%
Just one health plan	84.1%	71.1%	39.3%	70.2%
More than one health plan	3.3%	9.3%	60.0%	14.2%

Health Plan Risk Bearing: The primary responsibility for the payment of services for Medicare Advantage enrollees and Medicaid enrollees covered through a Fully Capitated Health Plan (FCHP) is shifted from Medicare and Medicaid to the health plan. The health plans receive a premium-like payment for the covered services. The insurer or FCHP health plan bears the risk for any differences in the premiums they receive and the payments they make to providers. The effective coverage burden on the various types of health plans can be approximated by eliminating identifiable double counting, secondary/supplemental coverages, and discounting the impact of dual coverages among insurers as shown in Tables C-6 and C-7.

Table C-6. Estimated Oregon Effective Coverage Burden by Health Plan Type, July 2006

	Ages < 18	Ages 18-64	Ages 65+	Total
Uninsured, no coverage	109,907	461,910	3,231	575,048
Medicare	#	61,649	251,466	313,115
FCHPs for OHP/Medicaid	166,368	95,451	15,289	277,107
OHP/Medicaid for FFS, other	49,270	45,271	220	94,760
13 Oregon Domestic Insurers	347,550	1,075,833	173,322	1,596,705
10 Largest Foreign Insurers	59,238	183,370	18,011	260,619
92 Smaller Foreign Insurers	4,872	15,081	-	19,953
Self-insured Coverage Estimate	135.075	418,121	#	553,196
Other Non-Reporting Insurers	unknown	unknown	unknown	unknown
Oregon Veterans	##	##	##	##
Total Oregon Population	872,279	2,356,685	461,539	3,690,503

Assumed to be insignificant and is treated as zero.

Not considered in this analysis. No practical method for estimating the coverage burden for veterans could be identified.

Table C-7. Estimated Oregon Effective Coverage Burden Distribution by Health Plan Type

	Ages < 18	Ages 18-64	Ages 65+	Total
Uninsured, no coverage	12.6%	19.6%	0.7%	15.6%
Medicare	#	2.6%	54.5%	8.5%
FCHPs for OHP/Medicaid	19.1%	4.1%	3.3%	7.5%
OHP/Medicaid for FFS, other	5.6%	1.9%	0.0%	2.6%
13 Oregon Domestic Insurers	39.8%	45.7%	37.6%	43.3%
10 Largest Foreign Insurers	6.8%	7.8%	3.9%	7.1%
92 Smaller Foreign Insurers	0.6%	0.6%	-	0.5%
Self-insured Coverage Estimate	15.5%	17.7%	#	15.0%
Other Non-Reporting Insurers	unknown	unknown	unknown	unknown
Oregon Veterans	##	##	##	##
Total Oregon Population	100.0%	100.0%	100.0%	100.0%

Assumed to be insignificant and is treated as zero.
Not considered in this analysis. No practical method for estimating the coverage burden for veterans could be identified.

The costs for health care provided to the 15.8% uninsured represents a burden on the entire community. The uninsured burden is initially borne by hospitals, physicians and other care providers. Ultimately that cost is distributed to other payers via cost-shifting. Similarly, payments by Medicare or Medicaid that are below costs are distributed to other payers via the cost shifting. This table also reflects that substantial portions of the coverage burden and risk for Medicare and Medicaid are placed with insurers and FCHPs.

State of Oregon Employees: In May 2006, the Public Employees Benefit Board was responsible for offering health plan coverage for 49,667 employees of which 46,604 (93.8%) were enrolled in health plans offered by Kaiser Permanente, Regence BlueCross Blue Shield of Oregon, Providence Health Plans, or Samaritan Health Plans. With an average family size of 2.5 persons, PEBB offered health plans cover approximately 116,500 lives.

Appendix D: Savings Projections

Savings estimates from the comprehensive adoption of electronic health information technologies (HIT) vary among the various published studies for several reasons, including:

- scope of technologies projected for adoption,
- types of savings estimated, and
- availability of data to make savings estimates.

The projected savings used in this analysis is a synthesis of selected savings estimates from various studies. This Appendix describes the savings estimates from various studies and identifies the components used to develop the Oregon savings estimate.

Benefit Estimation Methods

A number of models have been published for estimating the benefits of various health information technologies. For the most part, these studies have focused on estimating benefits and savings for the whole United States or specific provider settings. The key studies include:

- Wang SJ et al, A cost-benefit analysis of electronic medical records in primary care. Am J Med April 2003.
- Brailer DJ et al, Moving Toward Electronic Health Information Exchange, Interim Report on the Santa Barbara County Data Exchange (SBCDE), California Health Care Foundation, July 2003.
- Johnston D et al, The value of computerized provider order entry in ambulatory settings. Center for Information Technology Leadership (HIMSS) report, 2003.
- PSI/FCG, Value of community clinical information sharing network, 2004.
- Walker J et al, The value of health care information exchange and interoperability. Health Affairs, January 2005; and companion CITL report (HIMSS) report 2004.
- Hilstead R et al, Can electronic medical record systems transform health care? Potential health benefits, savings and costs. Health Affairs, September/October 2005; and supporting RAND reports MG272, MG408, MG409, MG410.
- Miller RH et al, The Value of Electronic Health Records in Solo or Small Group Practices, Health Affairs, September/October 2005.

These studies use a variety of techniques to estimate savings. Unfortunately, the variety of methodologies creates difficulties in comparing the results between the studies and in applying the methods to state or local circumstances.

As a general approach, the RAND HIT Project methodology[31] provides the most useful approach that can be adapted to various circumstances. It provides the foundation for the savings estimates herein.

[31] Girosi F, Meili R, Scoville R, Extrapolating evidence of health information technology savings and costs. MG410. Santa Monica, CA, RAND Corporation, 2005.

POTENTIAL Savings Calculations: For any given savings opportunity category, benefits are calculated with the following sequential process:

1. Determine the Base Savings at 100% adoption assuming zero current adoption.
2. Subtract the maximum possible savings that is ultimately achievable when fully deployed and adopted (typical range of 85 to 95%).
3. Subtract the existing level of adoption and benefits already achieved.
4. The result represents the Potential Savings.

This basic calculation methodology can be further refined to consider the speed of adoption, implications based on financial sponsorship mix, alternative adoption incentive strategies, and other policy analysis scenarios.

Issues in Projecting Benefits

Data Sources: The few published studies directly focused on estimating the savings from health information technology adoption are noted above. Most of the published studies rely on extensive literature reviews of other published data, analysis generated by project teams and expert panel judgments. The extensive literature review processes seek to identify information from the published literature that can be applied to estimate savings or other benefits. The RAND HIT Project review and assessment process included 1,430 publications. Among the expert panels used in the various studies, there is substantial overlap in participation of the same individuals across the panels. The repeated participation by these panelists seems to have contributed to better delineation of the core costing issues over time and various study improvements.

Criteria for Savings Selections: The criteria for selection of the savings components from the various studies include:

- avoid double counting any functional type of savings,
- where a particular type of saving was estimated in multiple studies, select the estimate with the best methodology and underlying data sources.

Center for Information Technology Leadership

The Center for Information Technology Leadership (CITL) was formed in 2002 by Boston-based, non-profit Partners HealthCare System as a research organization to help guide the healthcare community in making more informed strategic IT investment decisions.

CITL – Ambulatory Provider Computerized Order Entry (ACPOE)

Ambulatory Provider Computerized Order Entry (ACPOE) was the first research topic undertaken by CITL. The goal was to determine the value of ACPOE systems in improving quality and reducing costs. Results of the CITL – ACPOE study are reported in:

- Johnston D, Pan E, Walker J, Bates DW, Middleton B, The value of computerized provider order entry in ambulatory settings. Center for Information Technology Leadership (HIMSS) report, 2003.

The ACPOE study examined the clinical, financial and organizational benefits of CPOE systems. CITL created a taxonomy of five classes of ACPOE systems based on varying capabilities of medication and diagnostic test ordering and decision support capabilities as follows:

- Basic Prescription Orders (Rx),
- Basic Prescription and Diagnostic Orders (Rx-Dx),
- Intermediate Rx,
- Intermediate Rx-Dx, and
- Advanced Rx-Dx.

Clinical decision support is a key component of ACPOE systems. In basic systems, clinicians can *pull* decision support content via links to decision support content. Intermediate and advanced systems use *push* support mechanisms to provide clinical decision support based on the clinicians interactions with the system. ACPOE systems also vary based on their ability to transmit orders electronically ranging from merely printing the entered orders (Basic) to fax or email orders (Intermediate) to robust electronic data interchange (EDI) connecting providers to laboratories, pharmacies and others.

This analysis only considers the Advanced Rx-Dx level in assessing the potential savings that could ultimately be achieved with widespread HIT adoption for Oregon.

The potential savings for the nation and Oregon from implementing Advanced Rx-Dx ACPOE systems using the CITL methodology are shown in Table D-1.

Table D-1. Estimated Potential Savings with CITL – ACPOE Methodology

CITL - ACPOE Savings	NHE Category[32] *	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2002	Adjusted to 2006*		Allocation for 2006
Dollar valuation		millions of 2002 dollars	millions of 2006 dollars		millions of 2006 dollars
Medication savings	Drugs	29,919.6	31,093.8	0.8%	248.8
Laboratory test savings	Physician	5,244.3	5,328.4	1.3%	69.3
Imaging study savings	Physician	11,585.4	11,771.2	1.3%	153.0
Avoided ADE* visits	Physician	71.6	72.8	1.3%	0.9
Avoided ADE hospitalizations	Hospital	2,215.9	2,251.4	1.1%	24.8
Total ACPOE Savings		49,036.8	50,517.6	0.8%	496.8

[32] National Health Expenditure categories are used by the Federal government for reporting heath expenditures at the Federal and state level. Independent laboratory and imaging center services are grouped with physician services for NHE reporting. Category definitions are available at http://www.cms.hhs.gov/NationalHealthExpendData/downloads/quickref.pdf.

Study estimates adjusted to 2006 dollars and 2006 estimated adoption rates.
* ADE: adverse drug events.

Medication savings estimated for ACPOE systems are generated through information provided to clinicians during the ordering process on:

- switching from brand name to generic drugs,
- switching from expensive brand name drugs to more cost-effective brand alternatives,
- switching from brand name drugs to generic therapeutic alternatives, and
- reducing over-use where medications are used inappropriately or unnecessarily.

Laboratory test and imaging study savings are generated by ACPOE systems that display test indications, costs, prior results, and the probability of abnormal results to physicians during the ordering process.

Medication errors resulting in adverse drug events (ADEs) not only represent adverse clinical consequences to patients but also results in additional office visits, emergency room visits, hospitalizations and longer lengths of stay during hospitalization. ACPOE systems can provide advice to avoid drug interactions and dosing errors. The saving estimated by CITL deal with avoided visits and hospitalization.

Use in Synthesized Savings Estimates: The CITL-ACPOE savings estimates for medication, laboratory tests and imaging study savings are not used in the synthesized savings estimates. These savings components are better addressed in RAND study described below. The ADE visits and hospitalization savings estimated by the CITL-ACPOE study are included in the synthesized savings estimates.

CITL – Health Information Exchange and Interoperability (HIE&I)

CITL subsequently examined technologies the electronic flow of information among healthcare organizations focusing on the value of health information exchange and interoperability (HIE&I). Results of the CITL-HIE&I analyses are reported in:

- Pan E, Johnston D, Walker J, Adler-Milstein J, Bates DW, Middleton B, The value of healthcare information exchange and interoperability. Center for Information Technology Leadership (HIMSS) report 2004.
- Walker J, Pan E, Johnston D, Adler-Milstein J, Bates DW, Middleton B, The value of health care information exchange and interoperability. Health Affairs, January 2005, W5-10 – 5-18.

The HIE&I study examined the financial benefits and costs of health information exchange and interoperability of health information. CITL created used four categories for staging the level of electronic information exchange and information interoperability. They considered their earlier ACPOE functions including clinical decision support as part of HIE&I functionalities. The four levels specified are:

- Level 1 – Today's prevailing phone and mail communications,
- Level 2 – Machine-transportable data (standard fax),

- Level 3 – Machine-organizable data (e-mail and electronic messaging), and
- Level 4 – Machine-interpretable data (interoperable data exchange with standardized message formats and content).

The study considered the benefits of information flow and interoperability between particular providers and other stakeholders including:

- Outpatient providers and independent laboratories,
- Outpatient providers and radiology centers,
- Outpatient providers and pharmacies,
- Providers and public health departments, and
- Providers and payers.

This analysis and report uses the Level 4 capabilities in assessing the potential savings that could ultimately be achieved with widespread HIT adoption for Oregon.

The potential savings for the nation and Oregon from implementing Level 4 HIE&I connectivity using the CITL methodology are shown in Table D-2.

Table D-2. Estimated Potential Savings with CITL – HIE&I Methodology

CITL - INTEROPERABILITY BENEFITS	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2003	Adjusted to 2006		Allocation for 2006
Dollar valuation		millions of 2003 dollars	millions of 2006 dollars		millions of 2006 dollars
Outpatient Providers & Laboratories					
- Reduced tests	Physician	4,033.1	3,775.3	1.3%	49.1
- Efficiencies on remaining tests	Physician	26,093.3	24,425.3	1.3%	317.5
Outpatient Providers & Radiology Centers					
- Reduced tests	Physician	8,642.3	8,089.8	1.3%	105.2
- Efficiencies on remaining tests	Physician	16,178.8	15,144.6	1.3%	196.9
Outpatient Providers & Pharmacies					
- Physicians	Physician	483.2	452.3	1.3%	5.9
- Hospitals	Hospital	502.1	478.4	1.1%	5.3
- Pharmacies	Drugs	1,582.1	1,487.0	0.8%	11.9
Providers & Other Providers					
- Physicians	Physician	8,397.3	7,860.6	1.3%	102.2
- Hospitals	Hospital	4,134.8	3,939.3	1.1%	43.3
Providers & Public Health Depts					
- Physicians	Physician	103.5	96.9	1.3%	1.3
- Public Health Departments	Public Health	103.5	100.9	1.1%	1.1
Providers & Payers					
- Physicians	Physician	8,478.0	7,346.9	1.3%	95.5

CITL - INTEROPERABILITY BENEFITS	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2003	Adjusted to 2006		Allocation for 2006
Dollar valuation		millions of 2003 dollars	millions of 2006 dollars		millions of 2006 dollars
- Hospitals	Hospital	1,856.9	1,769.2	1.1%	19.5
- Payers	Payers	9,836.0	9,656.8	1.1%	106.2
Total Interoperability Savings		90,424.9	84,623.3	1.3%	1,060.9

Savings from reduced tests (laboratory tests and radiology/imaging studies) under the HEI&I analyses not only results from the benefits of ACPOE but also with enhanced access to prior test results through health information exchange services.

Savings from efficiencies on the remaining tests accrue since the ordering processes, results reporting and integration of information into provider electronic record systems are enhanced for greater efficiencies.

Savings between providers (physician offices, hospital emergency rooms, and hospital-based clinics) and pharmacies result from the substantial efficiency improvements from electronic ordering and minimizing the wasted time of physicians and pharmacists in clarifying and processing prescription orders. Clinical care improvements occur from developing more complete and accurate medications lists, reducing duplicate/overlapping prescriptions, minimizing drug interactions and adverse drug events, and medical abuse.

Savings from improving the efficiencies in communication between providers occur as electronic process replace labor-intensive paper-based processes for requesting consultations, distribution and processing of consultation reports, and requests for information between providers.

Savings between providers and public health departments occur as electronic processes replace labor-intense paper-based processes for vital statistics and reportable conditions.

Savings between providers and payers occur with connectivity that allows the complete implementation of electronic information interchange exchange of eligibility inquiry and response, claims submission, claims attachments, claims status inquiry, remittance advices, referrals and preauthorizations and coordination of benefits.

Use in Synthesized Savings Estimates: The CITL-HEI&I savings estimates for laboratory tests and imaging study savings are not used in the synthesized savings estimates. These savings components are better addressed in the RAND study described below. The other CITL HEI&I savings estimates are included in the synthesized savings estimates.

RAND HIT Project

In 2003, the RAND Health Information Technology (HIT) Project team began a study to (1) better understand the role and importance of EMRs in improving health care and (2) inform government actions that could maximize the benefits of EMRs and increase their use. RAND's analyses and publications use the terms "Health Information Technology" (HIT) and "Electronic Medical Record Systems" (EMR-S) interchangeably. RAND uses EMR-S to describe a comprehensive cluster of functionalities including:

- the Electronic Medical Record (EMR) containing current and historical patient information,
- Clinical Decision Support (CDS) functions providing reminders and best-practice guidance for treatment,
- a Clinical Data Repository (CDR) which stores EMR information,
- Computerized Physician Order Entry (CPOE) functionality facilitating orders tied to patient-information and -treatment pathways.

The works of the RAND HIT Project are reported in a series of publications. This analysis is primarily based on:

- Hilstead R et al, Can electronic medical record systems transform health care? Potential health benefits, savings and costs. Health Affairs, September/October 2005;
- Girosi F et al, Extrapolating evidence of health information technology savings and costs. MG410.

The full series of publications include:

- Richard Hillestad, James Bigelow, Anthony Bower, Federico Girosi, Robin Meili, Richard Scoville, and Roger Taylor, "Can Electronic Medical Record Systems Transform Healthcare? Potential Health Benefits, Savings, and Costs," *Health Affairs*, Vol. 24, No. 5, September 14, 2005.
- Roger Taylor, Anthony Bower, Federico Girosi, James Bigelow, Kateryna Fonkych, and Richard Hillestad, "Promoting Health Information Technology: Is There a Case for More-Aggressive Government Action?" *Health Affairs*, Vol. 24, No. 5, September 14, 2005.
- James Bigelow et al., "Technical Executive Summary in Support of 'Can Electronic Medical Record Systems Transform Healthcare?' and 'Promoting Health Information Technology'," *Health Affairs*, Web Exclusive, September 14, 2005.
- James Bigelow, Kateryna Fonkych, Constance Fung, and Jason Wang, *Analysis of Healthcare Interventions That Change Patient Trajectories*, Santa Monica, Calif.: RAND Corporation, MG-408-HLTH, 2005.
- Federico Girosi, Robin Meili, and Richard Scoville, *Extrapolating Evidence of Health Information Technology Savings and Costs*, Santa Monica, Calif.: RAND Corporation, MG-410-HLTH, 2005.
- Kateryna Fonkych and Roger Taylor, *The State and Pattern of Health Information Technology Adoption*, Santa Monica, Calif.: RAND Corporation, MG-409-HLTH, 2005.
- Richard Scoville, Roger Taylor, Robin Meili, and Richard Hillestad, *How HIT Can Help: Process Change and the Benefits of Healthcare Information Technology*, Santa Monica, Calif.: RAND Corporation, TR-270-HLTH, 2005.

- Anthony G. Bower, *The Diffusion and Value of Healthcare Information Technology*, Santa Monica, Calif.: RAND Corporation, MG-272-HLTH, 2005.

The potential savings for the nation and Oregon from 90% adoption within fifteen years using the RAND HIT Project methodology are shown in Table D-3.

Table D-3. Estimated Potential Savings with RAND HIT Project Methodology

RAND HIT-ENABLED EFFICIENCY SAVINGS	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2004	Adjusted to 2006		Allocation for 2006
Dollar valuation		millions of 2004 dollars	millions of 2006 dollars		millions of 2006 dollars
OUTPATIENT					
Transcription	Physician	1,714.0	1,714.3	1.3%	22.3
Chart pulls	Physician	1,530.8	1,531.1	1.3%	19.9
Laboratory test	Physician	2,032.4	2,032.7	1.3%	26.4
Drug utilization	Drugs	11,822.7	11,736.2	0.8%	93.9
Radiology studies	Physician	3,274.5	3,275.1	1.3%	42.6
Subtotal		20,374.4	20,289.4	1.0%	205.1
INPATIENT					
Nurses productivity – efficiency	Hospital	12,032.8	10,802.7	1.1%	118.8
Nurses shortage - market effect	Hospital	1,647.2	1,479.3	1.1%	16.3
Nursing subtotal	Hospital	13,680.0	12,281.9	1.1%	135.1
Laboratory test	Hospital	2,805.1	2,518.3	1.1%	27.7
Drug utilization	Hospital	3,506.9	3,148.3	1.1%	34.6
Length of stay	Hospital	34,693.1	31,146.4	1.1%	342.6
Medical records	Hospital	2,379.4	2,136.2	1.1%	23.5
Subtotal		57,064.5	51,231.1	1.1%	563.5
Total RAND Savings		**77,438.9**	**71,520.5**	**1.1%**	**768.6**

Transcription savings occur when physicians directly enter information into electronic health record systems rather than dictate clinical notes that then require transcription services, clinician review with resulting edits and corrections before filing in the patient records. While this may take more clinician time at the time of a visit, the total clinician time may be less. EHR records are also instantly available to all other users without the delay in transcription and filing.

Chart pull savings occur because there is no physical paper record that must be located, pulled and delivered to the clinician for a visit and subsequently refilled. Information is available for clinician visits on-line.

Laboratory savings occur because EMR-S equipped with computerized physician order entry (CPOE) functions, clinical decision support (CDS), and interoperability with other providers can avoid unnecessary tests by providing physicians access to test results ordered by other providers and alerting physicians to new test orders that may be superfluous.

Drug utilization savings occur because CPOE and CDS features can be structured to identify preferred formulary recommendations, cost-benefit characteristics of specific drugs, less expensive alternative drugs (generics and lower cost brands), contraindicated medications, discontinuation recommendations and others.

Radiology and imaging study savings occur with increased access to prior study results and improved communication between ordering physicians and radiologists, minimizing repeat or inappropriate studies.

Nursing efficiency and productivity improvements occur as nursing documentation systems reduce the amount of time nurses spend on documentation, repeated/redundant data collection, patient assessment, preventing missing charges, and order processing. Decision rules facilitate coordination of services with ancillary departments and other caregivers. In addition to the reduction in unproductive time for nurses, RAND also considered the impact on the growing nursing shortage and expected market effect of wage increases on the nursing shortage. The preceding table distinguishes the "nursing productivity – efficiency" component from the "nursing – market effect" component. The market effect component is ignored in estimating the impact on health care expenditures in Oregon.

Laboratory tests savings in an inpatient setting occur for the same reasons as in the outpatient setting. Additionally, structured order sets and care protocols help standardize test ordering and further reduce redundancy.

Length of stay reductions occur because advanced information systems help minimize delays in various ordering processes (transcription of orders, sequencing, scheduling), time spent searching and locating information, and minimize errors.

Medical record savings occur because the physical paper records are replaced by on-line accessible records.

Use in Synthesized Savings Estimates: The RAND savings estimates for the market effect on nursing salaries are not used in the synthesized savings estimates. The other RAND savings estimates are included in the synthesized savings estimates. The RAND study methodologies for estimating the savings for medications, laboratory tests and imaging studies are used in preference to the estimated from the CITL studies. The RAND savings for laboratory tests and imaging studies also used in preference to the avoided services results from the missing information study described below since they cover a broader scope.

Local Health Information Exchange Estimates

The estimates in this report are also based on statewide expansions of previous work prepared for planning an information exchange in the Portland metropolitan area.[33] The initial focus of the information exchange would be a results and reports retrieval system serving the Portland tri-county area of Clackamas, Multnomah and Washington counties. Services would be expanded to include southwest Washington and others as soon as feasible. The area encompasses about 1.6 million lives, 4,000 physicians, four large health systems and several smaller systems. The health systems and physicians would share the following data with other authorized providers:

- Patient registration and demographic data,
- Laboratory results,
- Imaging reports,
- Dictated summaries from hospitalizations,
- Dictated summaries from emergency department visits, and
- Other readily available e-data.

The potential annual savings eventually achievable (ten years or more) for the tri-county area were estimated to be in excess of $20 million per year, with over $12 million per year achievable within five years. The sources of the savings include:

- Avoided duplicative services (visits, laboratory tests, imaging studies),
- Reductions in manual and paper processing,
- Non-routine paper processing,
- Physician productivity (more efficient use of MD's time)
- Practice office productivity (more efficient use of staff time) and
- Avoided time-loss for employees and employers.

The methodologies used for estimating savings were based on methods (1) reported in the national savings estimates from CITL, RAND and others studies, and (2) specific methods that could be applied to a metropolitan Portland results and reports retrieval system.

The Tri-County area estimates are expanded to cover the state of Oregon and the following selected regional areas:

- Tri-Counties: Clackamas, Multnomah and Washington counties,
- South Willamette Valley: Benton, Lane, Linn, Marion, Polk and Yamhill counties,
- Deschutes (Bend area) and Jackson (Medford area) counties combined, and
- 25 Other Counties.

These county groupings were selected to cluster the recognized metropolitan statistical areas for analysis purposes.

[33] See press release September 11, 2006, Oregon Business Council Announces Next Phase of Health Information Exchange Project available at http://www.q-corp.org/q-corp/images/public/pdfs/OBC%20press%20release.pdf and HIE Mobilization Executive Summary available at http://www.q-corp.org/q-corp/images/public/pdfs/HIE%20Mobilization%20Exec%20Summary.pdf.

Missing Information Savings Analysis

The analyses of avoidable services by CITL and RAND were based on a broader set of functionalities than contemplated in the metro-Portland work. CITL and RAND projected savings assuming advanced functionality of electronic patient records systems with ACPOE, clinical decision support, and interoperability. The Portland estimates only on addressed the missing information related component of avoidable services.

Information regarding the impact on missing information in primary care clinics is available from a Colorado consortium of practice-based research network participating in the Applied Strategies for Improving Patient Safety medical error reporting study. The impact of missing clinical information is reported in:

- Smith PC, Araya-Guerra R, Bublitz C, Parnes B, Dickinson LM, Van Vorst R, Westfall JM, Pace WD, Missing clinical information during primary care visits. JAMA 293(5):565-571, February 2, 2005.

Smith reports that 13.6% of primary care visits had missing information. The consequences of missing clinical information reported by Smith are:

- Delays in care: 25.5% of missing information visits,
- Additional laboratory tests: 22.3% of missing information visits,
- Additional visits: 20.9% of missing information visits,
- Additional imaging studies: 10.9% of missing information visits.

This information was sufficient for development of estimates of avoidable ambulatory visits, laboratory tests, imaging studies, and inpatient admissions through Emergency Departments. Inefficiencies in ambulatory practices from missing information were developed based on time spent unsuccessfully looking for missing information and the additional time physicians spent repeating the collection of the patient's history and medications lists that should have been available. Avoidable services also result in wasted time spent by patients seeking the additional services. This wasted time also impacts employer costs for the time-loss cost of sick leave benefits and cost of replacing staff in essential positions. An analysis of 2005 Oregon Benefit Survey[34] data indicates that about 39% of non-farm employees (private and government employers) have a sick leave benefit. The total economic impact on employers and employees from time taken off work for avoidable health care systems is in excess of $7 million per year with 39% impacting employer costs and 61% representing lost wages to employees taking time off. The impact of time-loss for avoidable services was not estimated for care-givers taking time off from work for other family members or for workers less than age 18 or over age 64.

The savings estimates for Oregon and the Nation from the impact of missing clinical information are shown in Table D-4.

[34] Ayre A, Oregon Employee Benefits 2005, available at http://www.qualityinfo.org/pubs/benefits/benefits2005.pdf.

Table D-4. Estimated Potential Savings based on Oregon Missing Information Analysis

OREGON MISSING INFORMATION STUDY	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2006	Adjusted to 2006	.	Allocation for 2006
Dollar valuation		millions of 2006 dollars	millions of 2006 dollars	.	millions of 2006 dollars
Avoidable services					
- Ambulatory visits	Physician	1,701.0	1,701.0	1.3%	20.6
- Ambulatory laboratory tests	Physician	499.0	499.0	1.3%	5.9
- Ambulatory imaging studies	Physician	1,464.0	1,464.0	1.3%	17.3
- Admissions through Emergency Departments	Hospital	61.0	61.0	1.1%	0.5
Physician/Staff Productivity					
- Lost time looking for information	Physician	731.0	731.0	1.3%	8.6
- Repeated Work H&PE/Med Lists	Physician	1,727.0	1,727.0	1.3%	20.2
Employer time loss savings		190.0	190.0	1.6%	3.0
Total Missing Info Savings		**6,183.0**	**6,183.0**	**1.2%**	**73.1**
Recalculated Employer Savings		364.0	364.0	1.7%	6.1

Employer time-loss savings are shown twice in the table. The first listing shows the employer time-loss and replacement cost savings based on the avoidable services resulting from missing information. The RAND analyses estimates for avoidable laboratory test and imaging studies include avoidable tests resulting from missing information and resulting ACPOE and clinical decision support systems. The recalculated employer savings is calculated using the RAND-based estimates of avoided laboratory and imaging along with the missing information-related avoidable visits.

Use in Synthesized Savings Estimates: The savings estimates for the avoidable laboratory tests and imaging studies caused by missing information are not used in the synthesized savings estimates. The RAND savings for laboratory tests and imaging studies are used since they cover a broader scope that includes avoided services resulting from ACPOE and clinical decision support derived savings. The recalculated employer savings is used in the synthesized savings estimates rather than the employer savings just related to avoided missing information services savings. Avoidable visits, avoidable admissions and physician and staff productivity are included in the synthesized savings estimates.

Processing Savings Analysis

The metro-Portland estimated savings from reducing labor-intensive processing of discharge summaries, emergency department summary, laboratory test reports and imaging study reports. The accessibility to electronic reports and the integration of electronically available information into clinician electronic records systems results in significant efficiencies. Estimates were narrow in scope given the goals of the project. For this statewide savings estimate, the

calculation methods were expanded in scope to consider the processing savings eventually attainable with the broad adoption of electronic processing statewide.

The savings estimates from processing efficiencies are shown in Table D-5 by the type of organization processing the information.

Table D-5. Estimated Potential Savings based on Oregon Processing Savings Analysis

OREGON PROCESSING SAVINGS STUDY	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2006	Adjusted to 2006	.	Allocation for 2006
Dollar valuation		millions of 2006 dollars	millions of 2006 dollars	.	millions of 2006 dollars
Hospital summaries - routine	Hospital	58.0	58.0	1.2%	0.7
Hospital summaries - non-routine	Hospital	79.0	79.0	1.1%	0.9
Hospital lab/rad - routine	Hospital	656.0	656.0	1.4%	9.3
Hospital lab/rad - non-routine	Hospital	99.0	99.0	1.5%	1.5
Physician summaries - routine	Physician	67.0	67.0	1.3%	0.9
Physician summaries - non-routine	Physician	259.0	259.0	1.3%	3.3
Physician lab/rad- routine	Physician	197.0	197.0	1.5%	3.0
Physician lab/rad - non-routine	Physician	3,000.0	3,000.0	1.5%	43.8
Payers summaries- non-routine	Payer	56.0	56.0	1.3%	0.7
Payers lab/rad - non-routine	Payer	25.0	25.0	1.6%	0.4
Total		**4,496.0**	**4,496.0**	1.4%	**64.5**

The savings estimates from processing efficiencies are shown in Table D-6 by the type of information being processed.

Table D-6. Estimated Potential Processing Savings by Type of Information

OREGON PROCESSING SAVINGS STUDY by Document Type	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2006	Adjusted to 2006	.	Allocation for 2006
Dollar valuation		millions of 2006 dollars	millions of 2006 dollars	.	millions of 2006 dollars
Hospital Discharge Summaries	mixed	165.0	165.0	0.9%	1.5
Emergency Room Visit Summaries	mixed	177.0	177.0	1.1%	2.0
Hospital-based Ambulatory Surgery Summaries	mixed	87.0	87.0	1.6%	1.4
Free-standing ASC Ambulatory Surgery Summaries	mixed	90.0	90.0	1.7%	1.5
Hospital Laboratory Results Distribution	mixed	2,461.0	2,461.0	1.4%	34.4
Free standing Laboratory Results Distribution	mixed	839.0	839.0	1.6%	13.3
Hospital-based Imaging Results Distribution	mixed	610.0	610.0	1.5%	9.1
Free Standing Imaging Practices Results Distribution	mixed	66.0	66.0	1.7%	1.1
Total Processing Benefits		4,495.0	4,495.0	1.4%	64.3

Use in Synthesized Savings Estimates: The savings estimates for processing inefficiencies are related to laboratory tests and imaging studies are not used in the synthesized savings estimates. The CITL-HIE&I savings for reduced inefficiencies in processing laboratory tests and imaging studies are used since they cover a broader scope. The other processing savings components are included in the synthesized savings estimates.

Synthesized Savings Estimate

The synthesized or composite saving estimate is based on selecting the most methodologically sound estimates from the various national and local studies. The synthesized - composite savings estimate is shown in Table D-7 by the components selected from each study. Table 1 presents the same results grouped by avoidable services and reduced inefficiencies and improved productivity.

Table D-7. Oregon and National Potential Annual Savings Synthesis, Millions of 2006 Dollars

Source of Savings	Expenditure Category[35]	National Savings	Oregon % NHE	Oregon Savings
CITL - ACPOE BENEFITS				
Avoided visits due to adverse drug events (ADE)	Physician	72.8	1.3%	0.9
Avoided ADE hospitalizations	Hospital	2,251.4	1.1%	24.8
CITL - INTEROPERABILITY BENEFITS				
Outpatient Providers & Laboratories				
- Efficiencies on remaining tests	Physician	24,425.3	1.3%	317.5
Outpatient Providers & Radiology Centers				
- Efficiencies on remaining tests	Physician	15,144.6	1.3%	196.9
Outpatient Providers & Pharmacies				
- Physicians	Physician	452.3	1.3%	5.9
- Hospitals	Hospital	478.4	1.1%	5.3
- Pharmacies	Drugs	1,487.0	0.8%	11.9
Providers & Other Providers				
- Physicians	Physician	7,860.6	1.3%	102.2
- Hospitals	Hospital	3,939.3	1.1%	43.3
Providers & Public Health Depts				
- Physicians	Physician	96.9	1.3%	1.3
- Public Health Departments	Public Health	100.9	1.1%	1.1
Providers & Payers				
- Physicians	Physician	7,346.9	1.3%	95.5
- Hospitals	Hospital	1,769.2	1.1%	19.5
- Payers	Payers	9,656.8	1.1%	106.2
RAND – OUTPATIENT				
Transcription	Physician	1,714.3	1.3%	22.3
Chart Pulls	Physician	1,531.1	1.3%	19.9
Laboratory Test	Physician	2,032.7	1.3%	26.4
Drug Utilization	Drugs	11,736.2	0.8%	93.9
Radiology	Physician	3,275.1	1.3%	42.6
RAND – INPATIENT				
Nurses Productivity (efficiency piece)	Hospital	10,802.7	1.1%	118.8
Laboratory Test	Hospital	2,518.3	1.1%	27.7
Drug Utilization	Hospital	3,148.3	1.1%	34.6
Length of Stay	Hospital	31,146.4	1.1%	342.6
Medical Records	Hospital	2,136.2	1.1%	23.5
MISSING INFORMATION STUDY				
Avoidable services				
- Ambulatory visits	Physician	1,701.0	1.3%	20.6
- Admissions through Emergency	Hospital	61.0	1.1%	0.5
Physician/Staff Productivity				

[35] National Health Expenditure categories are used by the Federal government for reporting heath expenditures at the Federal and state level. Independent laboratory and imaging center services are grouped with physician services for NHE reporting. Category definitions are available at http://www.cms.hhs.gov/NationalHealthExpendData/downloads/quickref.pdf.

Source of Savings	Expenditure Category[35]	National Savings	Oregon % NHE	Oregon Savings
- Lost time looking for information	Physician	731.0	1.3%	8.6
- Repeated Work H&PE/Med Lists	Physician	1,727.0	1.3%	20.2
Employer time loss savings		364.0	1.7%	6.1
PROCESSING SAVINGS STUDY				
Hospital summaries – routine	Hospital	58.0	1.1%	0.7
Hospital summaries - non-routine	Hospital	79.0	1.1%	0.9
Physician summaries – routine	Physician	67.0	1.3%	0.9
Physician summaries - non-routine	Physician	259.0	1.3%	3.3
Payers summaries- non-routine	Payer	56.0	1.1%	0.7
Total		150,226.7	1.2%	1,747.1

Savings Distribution Across Oregon

The distribution of savings across regions of the State can be estimated based on a combination of factors that most closely relate to the individual components of the synthesized-composite savings estimates. The Oregon-based estimates developed for missing information and processes savings included explicit calculations on a regional basis. The regional distribution for some savings components derived from national savings estimates are best allocated using volume factors for hospital activities. Table D-8 shows the estimated savings distribution factors across Oregon derived from the missing information and processing analyses as well as other factors related to the regional distribution as described in Appendix C.

Table D-8. Savings Distribution Factors Across Oregon

	Savings Distribution Factor	Portland Tri-Counties	Willamette Valley - 6 Counties	Deschutes & Jackson Counties	25 Other Counties
Avoidable services savings	Avoided	47.2%	28.6%	10.1%	14.2%
Employer time-loss savings*	Employer	53.6%	31.8%	9.1%	5.5%
Processing savings	Process	39.5%	30.7%	11.1%	18.7%
Population, July 2006		42.5%	27.0%	9.5%	20.9%
Physicians (MD/DO) July 2006		59.1%	19.3%	9.1%	12.4%
Hospital discharges 2005	Discharges	49.3%	20.4%	10.5%	19.8%
Hospital expenses 2005	Expenses	50.6%	21.0%	11.0%	17.3%

* Employer time-loss savings for non-farm employment where employers incur sick leave or replacement costs related to avoidable services...

Table D-9 shows the estimated distribution of saving for the four regions for each component of savings estimated and the basis on which the regional distribution is allocated.

Table D-9. Distribution of Potential Savings by Region, Millions of 2006 Dollars.

OREGON SAVINGS BY REGION	Savings Distribution Basis	Total Oregon Savings	Portland Tri-Counties	Willamette Valley-6 Counties	Deschutes & Jackson Counties	25 Other Counties
AVOIDABLE SERVICES						
Ambulatory visits due to adverse drug events*	Avoided	0.9	0.43	0.26	0.09	0.13
Ambulatory visits due to missing information****	Avoided	20.6	9.72	5.89	2.07	2.92
Outpatient laboratory tests***	Avoided	26.4	12.46	7.54	2.66	3.74
Outpatient radiology studies***	Avoided	42.6	20.11	12.17	4.29	6.04
Outpatient medications - drug utilization***	Avoided	93.9	44.32	26.83	9.45	13.31
Employer time loss savings on avoided visits and test****	Employer	6.1	3.27	1.94	0.55	0.33
Hospitalizations due to adverse drug events*	Avoided	24.8	11.71	7.09	2.50	3.51
Emergency dept hospitalizations due to missing information****	Avoided	0.5	0.24	0.14	0.05	0.07
Inpatient laboratory tests***	Avoided	27.7	13.07	7.91	2.79	3.93
Inpatient medications - drug utilization***	Avoided	34.6	16.33	9.89	3.48	4.90
Inpatient length of stay reductions***	Avoided	342.6	161.71	97.88	34.47	48.55
Total Avoidable Services Savings		620.7	293.36	177.53	62.38	87.42
Percentage distribution		100.0%	47.3%	28.6%	10.1%	14.1%
REDUCED INEFFICIENCIES AND PRODUCTIVITY IMPROVEMENTS						
Outpatient transcriptions eliminated***	Process	22.3	8.81	6.85	2.48	4.17
Outpatient chart pulls eliminated***	Process	19.9	7.86	6.11	2.21	3.72
Ambulatory Physician/Staff Productivity						
- Lost time looking for missing information****	Avoided	8.6	4.06	2.46	0.87	1.22
- Repeated Work H&PE/Med Lists due to missing information****	Avoided	20.2	9.53	5.77	2.03	2.86
Outpatient test ordering and report processing efficiencies						
- Laboratory tests: ordering physicians and laboratories**	Avoided	317.5	149.86	90.71	31.94	44.99
- Radiology studies: ordering physicians and imaging centers **	Avoided	196.9	92.94	56.25	19.81	27.90

OREGON SAVINGS BY REGION	Savings Distribution Basis	Total Oregon Savings	Portland Tri-Counties	Willamette Valley-6 Counties	Deschutes & Jackson Counties	25 Other Counties
Outpatient prescription processing efficiencies						
- Physician office Rx processing efficiencies**	Process	5.9	2.33	1.81	0.66	1.10
- Hospital emergency/outpatient department Rx efficiencies**	Process	5.3	2.09	1.63	0.59	0.99
- Pharmacy Rx processing efficiencies**	Process	11.9	4.70	3.65	1.32	2.23
Referral and communications efficiencies between providers						
- Physician referrals and consultation report processing**	Process	102.2	40.37	31.38	11.34	19.11
- Hospital outpatient referrals and report processing**	Process	43.3	17.10	13.29	4.81	8.10
Inpatient nurses productivity improvement***	Expenses	118.8	60.15	24.97	13.09	20.60
Inpatient medical records services eliminated***	Discharges	23.5	11.58	4.80	2.46	4.66
Public health reporting processing efficiencies						
- Physician and laboratory reporting efficiencies**	Process	1.3	0.51	0.40	0.14	0.24
- Public health department efficiencies**	Process	1.1	0.44	0.34	0.12	0.21
Processing efficiencies between providers and payers						
- Physician efficiencies**	Process	95.5	37.72	29.32	10.60	17.86
- Hospital efficiencies**	Process	19.5	7.70	5.99	2.17	3.65
- Payer organization efficiencies**	Process	106.2	41.95	32.60	11.79	19.86
Inpatient & emergency dept report distribution efficiencies						
- Hospital report processing – routine*****	Process	0.7	0.28	0.22	0.08	0.13
- Hospital report processing - non-routine*****	Process	0.9	0.36	0.28	0.10	0.17
- Physician office report processing – routine*****	Process	0.9	0.36	0.28	0.10	0.17
- Physician report processing - non-routine*****	Process	3.3	1.30	1.01	0.37	0.62
- Payers report processing - non-routine*****	Process	0.7	0.28	0.22	0.08	0.13
Total Efficiency/Productivity Savings		1126.4	502.28	320.32	119.14	184.68

OREGON SAVINGS BY REGION	Savings Distribution Basis	Total Oregon Savings	Portland Tri-Counties	Willamette Valley-6 Counties	Deschutes & Jackson Counties	25 Other Counties
Percentage distribution		100.0%	44.6%	28.4%	10.6%	16.4%
Total Savings		1747.1	795.64	497.85	181.53	272.10
Percentage distribution		100.0%	45.5%	28.5%	10.4%	15.6%

* Estimates based upon the Center for Information Technology Leadership's Ambulatory Care Provider Order Entry study.
** Estimates based upon the Center for Information Technology Leadership's Health Information Exchange and Interoperability study.
*** Estimates based upon the RAND Health Information Technology Project study.
**** Estimates based upon the Missing Information Savings Analysis.
***** Estimates based upon the Processing Savings Analysis.

Appendix E: Cost Projections

Cost Projection Overview: Cost estimates for implementing various health information technology functions vary widely among the various published studies. The published analyses distinguish one-time costs of acquisition and implementation from ongoing annual operating and maintenance costs. The published studies express annual ongoing maintenance/operational costs as a percentage of the one-time costs (range of 17.5% to 30%). Since the goal of this report is to determine the impact on Oregon's health expenditures, an approach which only addresses the ongoing annual cost would underestimate the real costs from a typical accounting and financing perspective where one-time costs are amortized over their useful life. Determining the useful life of a major information technology investment is difficult. Complex HIT investments for large hospitals and health systems may involve installations staged over several years with the core systems used for well over ten years. System upgrades and additional system components would be added over time. For such large complex installations, amortizing the one-time costs at 10% per year over ten years with annual maintenance costs of 30% of one-time costs would represent a reasonable approximation in determining an annualized cost impact. HIT investments in smaller health care organizations (small hospitals, clinics or physician groups) seem likely to have shorter useful lives, perhaps five years. For small installations, amortizing one-time costs at 20% per year over five years with annual maintenance costs of 20% of one-time costs would represent a reasonable approximation in determining an annualized cost impact. Therefore, this report calculates an annual cost burden is 40% of the one-time costs of implementation.

Cost Estimation Issues

Data Sources: There are relatively few published studies estimating the costs of health information technology adoption. Most of the published studies rely on other published data, vendor supplied information, analysis generated by project teams and expert panel judgments. Among the expert panels used in the various studies, there is substantial overlap in participation of the same individuals across the panels. The repeated participation by a these panelists seems to have contributed to better delineation of the core costing issues over time and various study improvements.

One-Time and Ongoing Costs: The available studies have estimated both one-time costs for initial implementation and ongoing or annual operating and maintenance costs thereafter. The ongoing operating and maintenance costs are expressed as a percentage of the one-time costs although the rates vary across studies. The scope of one-time costs across the studies is fairly consistent. One-time costs include software licenses, hardware, interface purchase or development, implementation and integration costs, and training costs. Some studies (CITL and RAND) have included the temporary reduction in provider productivity during the implementation period as one-time costs.

For purposes of evaluating the alternative cost models and their possible application for Oregon estimates, only the one-time costs are shown below. Like the published studies considered, the ongoing operating costs will be considered as a percentage of the one-time costs as discussed below.

Annualized Cost Impact:
The purpose of this report is to address the question of the magnitude that comprehensive HIT adoption can make on health care expenditures in Oregon. This analysis takes a different approach than the published national cost estimations. The national estimates use one-time and ongoing cost parameters to consider total costs over the various adoption periods and scenarios in the studies. This analysis considers the net savings/benefits if HIT adoption and the impact on total health expenditures.

The issue in developing an annual cost impact is to determine how to amortize the one-time costs. When a company purchases a piece of manufacturing equipment it is easy to estimate the life of the equipment and determine a depreciation methodology to amortize the cost over the life of the equipment. The published HIT adoption studies do not address the amortization of the one-time costs. The published studies address software and hardware upgrades in their definitions of the ongoing costs. Under the assumptions of the published studies, the recurring annual HIT costs after full implementation would only be the ongoing level of costs ignoring the amortization of the one-time costs. The ongoing level of costs approach assumes that the original investment in software, hardware and other costs never requires replacement.

One might hope that as health information technologies become fully-developed, sophisticated, mature and stable products, they would only need maintenance and upgrades to support their continuing operations. If that were the case, using an annual ongoing operation cost with a low rate of amortization of the initial one-time costs would be considered appropriate. Since we have not reached the point of fully developed, sophisticated, mature and stable health information technologies, it seems reasonable to assume that major upgrades and replacements will be required before we reach utopia.

It would be inappropriate to only compare the ongoing annual cost against the estimated savings since it would underestimate the real costs from a typical accounting and financing perspective. An annualized cost needs to include an appropriate amortization of one-time costs over their useful life. Determining the useful life of a major information technology investment is difficult. Complex HIT investments for large hospitals and health systems may involve installations staged over several years with the core systems used for well over ten years. System upgrades and additional system components would be added over time. For such large complex installations, amortizing the one-time costs at 10% per year over ten years with annual maintenance costs of 30% of one-time costs would represent a reasonable approximation in determining an annualized cost impact. HIT investments in smaller health care organizations (small hospitals, clinics or physician groups) seem likely to have shorter useful lives, perhaps five years. For small installations, amortizing one-time costs at 20% per year over five years with annual maintenance costs of 20% of one-time costs would represent a reasonable approximation in determining an annualized cost impact. Therefore, this report calculates an annual cost burden is 40% of the one-time costs of implementation.

The most comprehensive approach to costing the adoption of advanced HIT capabilities was completed by the Working Group on the Cost of National Health Information Network.[36] The Working Group estimated national costs as follows:

- capital (one-time) costs to advance the present levels of information technology functionalities to a model NHIN = $102.7 billion,
- operating costs (annual) to advance the present levels of information technology functionalities to a model NHIN = $26.9 billion, a rate of 26% of one-time costs,
- first year (one-time) costs for national interoperability = $52.97 billion, and
- operating costs (annual) for national interoperability = $20.82 billion.

As an example of the methods used in this report, translating these cost parameters into a single annualized cost for comparison purposes yields a national annualized cost of $62.3 billion.

Scope, Functionality, Cost Differences: The CITL, RAND and NHIN Working Group studies cover a core set of HIT functionalities. They differ in their treatment of health information exchange interoperability components and the types of providers involved in the savings and costs they estimated. Each study did specify costs by type of provider (hospitals, physician offices, laboratories, imaging centers, pharmacies) or other stakeholders (payers, health information exchanges, employers). It seems likely that some costs may be treated inconsistently between studies and the various provider types. While each study used different time periods over which the advanced HIT functions would be implemented, the types and total amounts of one-time costs identified between studies seem comparable. These differences and difficulties in deconstructing prohibited developing a synthesized cost estimate comparable to the methods used in developing the synthesized savings estimates.

Cost Inflation and Normalization:
Each of the studies described below is based on cost estimates from different years. The costs estimated by each study were based on (1) product price estimates during the various time periods and (2) the scope of additional deployment for the technologies. To estimate consistent costs across the studies, estimates were developed for the total one-time base cost for deploying the technologies assuming a zero rate of current adoption. The one-time base cost was then inflation adjusted from the year in which the study occurred to 2006 dollars. Since many technology cost components have decreased over time, some cost components in 2006 would be lower than in the period when the study occurred and some (especially wage-rate driven components) would be increased. After reviewing various Bureau of Labor Statistics price indexes for technology components , it seemed reasonable to use a composite inflation adjustment of half (0.50) of the rate of increase for National Health Care Expenditure or about 3.75% per year. Once the base one-time costs were determined in 2006 dollars, then an estimated rate of adoption was consistently applied to each study.

Average and Highest Cost Scenarios: To develop the range for the cost estimates for this analysis, the one-time costs from the studies were grouped by provider or stakeholder type.

[36] Kaushal R, Blumenthal D, Poon EG, Jha AK, Franz C, Middleton B, Glazer J, Christino M, Fernandopulle R, Newhouse JP, Bates DW, The costs of a national health information network. Annals of Internal Medicine, 143 (3) 2 August 2005, 165-173,W37-38.

Within each type, the average one-time cost of the studies with an estimate for that type was computed as the lower bound of the likely one-time cost. The highest one-time cost within each type was chosen as the upper bound of the likely one-time cost. The sum of average or highest costs across the provider/stakeholder types establishes two aggregate one-time cost estimates.

CITL – ACPOE Cost Estimates

The 2003 CITL – Ambulatory Computerized Provider Order Entry (ACPOE) study estimated the costs of ACPOE systems using data from the published literature, vendors, national associations and agencies and ultimately expert panel judgments. While expressing confidence in the cost calculation for individual practices, the report notes that concerted efforts to widely implement ACPOE would likely lead to "fierce vendor competition and significantly lower pricing."

Since most of the functionalities of the ACPOE were also reflected in the CITL – Health Information Exchange and Interoperability (HIE&I) study, the CITL-ACPOE costs were not used in this analysis.

CITL – HIE&I Cost Estimates

The 2004 CITL – Health Information Exchange and Interoperability (HIE&I) study estimated the costs of HIE&I system components including new internal clinical systems for providers, interfaces between providers and other stakeholders. CITL did not attempt to estimate the cost of internal systems for laboratories, radiology centers, pharmacies, payers or public health departments. CITL projected most costs using published data and CITL developed estimates of acquisition and annual costs. CITL estimates annual costs at 20% of the one-time cost for provider systems and 17.5% of the one-time cost for interfaces used by providers and other stakeholders.

One-time costs for the CITL HIE&I implementation are shown in Table E-1.

Table E-1. Estimated One-Time Costs based on CITL – HIE&E Study

CITL – HIE&I ONE-TIME COSTS	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2003	Adjusted to 2006	.	Allocation for 2006
Dollar valuation		millions of 2003 dollars	millions of 2006 dollars	.	millions of 2006 dollars
Clinician office system cost	Physician	90,260.0	97,030.0	1.3%	1,261.4
Hospital system cost	Hospital	14,430.0	15,512.0	1.1%	201.7
Provider interface cost					
- Clinician office systems	Physician	27,886.8	29,978.0	1.3%	389.7
- Hospital systems	Hospital	4,653.2	5,002.0	1.1%	65.0
Stakeholder interface costs					
- Lab	Physician	371.2	399.0	1.3%	5.2
- Radiology	Physician	334.1	359.0	1.3%	4.7
- Pharmacy	Drugs	3,266.7	3,512.0	0.8%	45.7
- Public Health	Public Health	30.9	33.0	1.1%	0.4
- Payer	Payers	2,190.2	2,354.0	1.1%	30.6
Total HIE&I One-Time Costs		**143,423.1**	**154,179.0**	1.3%	**2,004.4**

RAND HIT Project Cost Estimates

RAND estimated the hospital one-time adoption costs based on published literature and data provided by twenty-seven hospitals using a spending model driven by hospital characteristics such as bed size, operating expenses and teaching status. The model was not specifically related to the electronic medical record system (EMR-S) functionality characteristics. RAND estimated hospital ongoing annual costs at 30% of the one-time costs.

RAND estimated ambulatory EMR-S costs based on a very inclusive definition of an EMR-S and publicly available comparative information about 80 EMR-S products. The comparative data on one-time costs included software, hardware and setup costs and averaged about $13,400 per physician. Additionally RAND included $3,000 for additional hardware (e.g., printers) and a productivity loss of about $5,600. The productivity loss was calculated as 15% lost revenue for three months with average yearly revenue of $150,000 per physician. RAND estimated ambulatory ongoing annual costs at 20% of the one-time costs.

RAND separately estimated the costs of the connectivity infrastructure to allow entities belonging to a health information exchange or other network for sharing patients' clinical information. RAND relied on cost models and scenarios developed for the Santa Barbara County Data Exchange (SBCDE).[37] RAND used two methods to scale-up the costs to a national

[37] Brailer DJ, Augustinos N, Evans L, et al, Moving Toward Electronic Health Information Exchange, Interim Report on the Santa Barbara County Data Exchange (SBCDE), California Health Care Foundation, July 2003.

connectivity cost estimate using the SBCDE model. While both methods generated similar results, one expert suggested that the estimates "might be the lower bound and that the true cost might be twice as high." RAND estimated connectivity ongoing annual costs at 30% of the one-time costs.

One-time costs for the RAND estimates are shown in Table E-2.

Table E-2. Estimated One-Time Costs based on RAND HIT Project Study

RAND HIT ONE-TIME COSTS	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2004	Adjusted to 2006	.	Allocation for 2006
Dollar valuation		millions of 2004 dollars	millions of 2006 dollars	.	millions of 2006 dollars
Hospital EMR-S	Hospital	42,223.0	45,390.0	1.1%	499.3
Ambulatory EMR-S	Physician	9,542.0	10,258.0	1.3%	133.4
HIE Connectivity	All PHC	2,924.0	3,143.0	1.1%	34.6
Total RAND One-Time Costs		**54,689.0**	**58,791.0**	1.1%	**667.3**

Cost of NHIN Working Group Estimates

In August 2005, cost estimates for implementing a comprehensive National Health Information Network (NHIN) were published by the Cost of NHIN Working Group[38]. An expert panel delineated a model NHIN defined as achievable and desirable in five years rather than an ideal infrastructure. The Working Group estimates the costs of achieving a model NHIN defined as moving from the current levels of IT investment to the model NHIN in five years including the key functional requirements of provider and other stakeholders systems as well as the interoperability required to link providers for the purpose of data exchange. The Working Group estimated annual ongoing costs at 25% of the one-time costs.

One-time costs for upgrading existing provider and stakeholder system with sufficient capabilities to participate in an NHIN and interoperability costs for NHIN participation are shown in Table E-3.

[38] Kaushal R, Blumenthal D, Poon EG, Jha AK, Franz C, Middleton B, Glazer J, Christino M, Fernandopulle R, Newhouse JP, Bates DW, Annals of Internal Medicine, 143 (3) 2 August 2005, 165-173,W37-38.

Table E-3. Estimated One-Time Costs based on NHIN Cost Working Group Study

NHIN ONE-TIME COSTS	NHE Category	National Savings	National Savings	Oregon % NHE	Oregon Savings
Programmatic period		Study year 2005	Adjusted to 2006	.	Allocation for 2006
Dollar valuation		millions of 2005 dollars	millions of 2006 dollars	.	millions of 2006 dollars
UPGRADE IT FUNCTIONALITIES					
Physicians Office	Physician	18,250.0	22,043.0	1.3%	286.6
Hospitals	Hospital	50,740.0	61,854.0	1.1%	680.4
SNF & home health	Home Health	33,250.0	35,813.0	0.5%	179.1
Laboratories	Physician	191.0	1,411.0	1.3%	18.3
Pharmacies	Drugs	140.0	385.0	0.8%	3.1
Total Upgrade Costs		102,571.0	121,506.0	1.0%	1,167.5
INTEROPERABILITY					
Physicians Office	Physician	31,450.0	32,472.0	1.3%	422.1
Hospitals	Hospital	2,310.0	2,385.0	1.1%	26.2
Other Providers	Home Health	6,600.0	6,815.0	0.5%	34.1
Laboratories	Physician	910.0	940.0	1.3%	12.2
Imaging Centers	Physician	840.0	867.0	1.3%	11.3
Pharmacies	Drugs	10,400.0	10,738.0	0.8%	85.9
Payers	Payers	370.0	382.0	1.1%	4.2
Hosts					
- Central	All PHC	90.0	93.0	1.1%	1.0
- Super	All PHC	10.0	10.0	1.1%	0.1
- National	All PHC	2.0	2.0	1.1%	-
Total Interoperability Costs		52,982.0	54,704.0	1.1%	597.2
Combined NHIN Costs		**155,553.0**	**176,210.0**	1.0%	**1,764.7**

Small Group Practice Electronic Health Record Costs

In September/October 2005, Miller et al reported results of their analysis of the value of electronic health records in solo or small group practices.[39] The study analyzed fourteen small physician practices that had used their EHR systems over two years. The average costs reported per provider are shown in Table E-4.

[39] Miller RH, West C, Brown TM, Sim I, Ganchoff C, The Value of Electronic Health Records in Solo or Small Group Practices, Health Affairs, September/October 2005, pp. 1127-1137.

Table E-4. Miller Study Results for EHR Initial and Ongoing Costs

MILLER STUDY EHR COSTS	Average Cost per FTE Provider
INITIAL COSTS	
Software training, installation	22,038
Hardware	12,749
Lost revenues from reduced productivity	7,473
Other	1,145
Total Initial Costs	43,826
ONGOING COSTS	
Software maintenance and support	2,439
Hardware replacement	3,187
Systems support - internal or contractors	2,047
Contractors	
Other	739
Total Ongoing Costs	8,412
Ratio: Ongoing to Initial Costs	19.2%

The Miller one-time/initial costs and the ongoing costs are nearly twice the level of per physician costs as estimated by the RAND's HIT Project. In aggregate, the NHIN cost estimates are more consistent with Miller's findings than the RAND estimates.

Oregon Health Information Exchange Costs

Cost estimates for the central utility that will manage health information exchanges services is also calculated as a statewide expansion of work previously calculated for metro-Portland. Annual operating costs for the first two to four years were estimated at about $3.4 million assuming an application service provider model. The major components of operating costs include the ASP vendor contract, central exchange staff and administrative costs, adoption support services, and consumer engagement support.

Funding at $3.4 million per year would allow phased implementation for the metropolitan Portland area over two to three years. In the first several years a large portion of the ASP contract would represent one-time costs related to installation and implementation costs. In later years the full-amount of the ASP vendor costs are just the annual ongoing costs.

Additionally, the four major health systems would each be expected to incur about $150,000 in internal costs each year to participate. Full implementation throughout the Portland area would increase total internal support costs for hospitals, laboratories, and physician practices to over $1,000,000.

Statewide Health Information Exchange Costs: Without making assumptions about how many health information exchanges might eventually be established in Oregon, their structure,

technologies, or operations, it is possible to scale-up the Portland costs to develop a statewide cost estimate yielding an annual cost impact for health information exchange services of about $7 million per year. This includes annual operating costs and amortization of one-time costs over five years. Additionally hospitals, physicians and other providers would incur about $3 million per year in in-kind costs to support participation in the exchange.

The NHIN cost estimate for Hosts (central, super and national) seems unrealistically small compared to the estimates derived from metro-Portland estimates. This analysis and report therefore estimates the total Oregon Health Information Exchange costs as a combination of the NHIN host costs estimate and the Oregon statewide estimate. Since the Oregon HIE cost of $10 million per year is already annualized (due to the ASP model) it receives separate add-on treatment after the other annualized costs are calculated. The Oregon estimate was scaled up to develop a national estimate.

Base One-Time Costs Range

As described above, developing a single synthesized cost estimate was not possible with the information available. Identification of range estimates for the costs seems preferable. To develop the range for the cost estimates, the one-time costs from the various studies were grouped by provider or stakeholder type. Within each type, the average one-time cost of the studies with was computed as the lower bound of the likely one-time cost. The highest one-time cost within each type was chosen as the upper bound of the likely one-time cost. The sum of average or highest costs across the provider/stakeholder types establishes two aggregate one-time cost estimates.

Base Costs vs. Yet-to-be Incurred Costs: The various published studies use differing assumptions about the existing level of HIT adoption and the ultimate level of adoption that reflects the **yet-to-be incurred cost** to accomplish full adoption. To improve comparison of costs between studies, this analysis uses the published cost data to calculate a **base cost** for each cost element. The base cost represents the cost that would be incurred if the existing level of adoption was zero and the ultimate adoption rate was 100%. Base costs were standardized to 2006 dollars.

Table E-5 shows the average and highest **base level** one-time costs for the nation and Oregon by provider or stakeholder type.

Table E-5. Lower and Upper Bounds for Base Level One-Time Costs

BASE ONE-TIME HIT COSTS	National One-Time Costs	National One-Time Costs	Oregon One-Time Costs	Oregon One-Time Costs
Base Costs before Adjustment for Existing Adoption	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario
	millions of 2006 dollars	millions of 2006 dollars	millions of 2006 dollars	millions of 2006 dollars
Hospitals	44,236.0	64,239.0	500.0	706.6
Physicians	64,120.0	127,008.0	833.5	1,651.1
Laboratories	1,375.0	2,351.0	17.9	30.6
Imaging Centers	613.0	867.0	8.0	11.3
Pharmacies	7,318.0	11,123.0	67.3	89.0
Public Health	33.0	33.0	0.4	0.4
Payers	1,368.0	2,354.0	17.4	30.6
Hosts	105.0	105.0	1.2	1.2
Total	119,168.0	208,080.0	1,445.6	2,520.7

Standardized Yet-to-be Incurred Costs: After calculation of the lower and upper bound costs, standard assumptions were applied to each category that (1) 20% of the one-time costs for each provider or stakeholder group has already been incurred with the current level of HIT adoption in Oregon and nationally, and (2) 95% of the one-time costs will need to be incurred in order to achieved the 90% adoption of functionalities that generate the projected savings. The results are standardized yet-to-be-incurred one-time costs as shown in Table E-6.

Table E-6. Range of One-time HIT Costs Yet-to-be Incurred for 90% Adoption

YET-TO-BE INCURRED ONE-TIME HIT COSTS	National One-Time Costs	National One-Time Costs	Oregon One-Time Costs	Oregon One-Time Costs
Costs after Adjustment for Existing Adoption and 95% Target Adoption	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario
	millions of 2006 dollars	millions of 2006 dollars	millions of 2006 dollars	millions of 2006 dollars
Hospitals	33,177.0	48,179.0	375.0	530.0
Physicians	48,090.0	95,256.0	625.1	1,238.3
Laboratories	1,031.0	1,763.0	13.4	22.9
Imaging Centers	460.0	650.0	6.0	8.5
Pharmacies	5,489.0	8,342.0	50.5	66.7
Public Health	25.0	25.0	0.3	0.3
Payers	1,026.0	1,766.0	13.1	23.0
Hosts	79.0	79.0	0.9	0.9
Total	89,377.0	156,060.0	1,084.2	1,890.6

Annualized costs are calculated as 40% of the one-time yet-to-be incurred costs as shown in Table E-7.

Table E-7. Range of Annualized HIT Costs Yet-to-be Incurred for 90% Adoption

ANNUALIZED COSTS	National Annualized Costs	National Annualized Costs	Oregon Annualized Costs	Oregon Annualized Costs
Costs for Completing Adoption of Advanced HIT Systems	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario	Lower Bound - Average Cost Scenario	Upper Bound - Highest Cost Scenario
	millions of 2006 dollars	millions of 2006 dollars	millions of 2006 dollars	millions of 2006 dollars
Hospitals	13,271.0	19,272.0	150.0	212.0
Physicians	19,236.0	38,102.0	250.0	495.3
Laboratories	413.0	705.0	5.4	9.2
Imaging Centers	184.0	260.0	2.4	3.4
Pharmacies	2,195.0	337.0	20.2	26.7
Public Health	10.0	10.0	0.1	0.1
Payers	410.0	707.0	5.2	9.2
Host	32.0	32.0	0.3	0.3
Subtotal Annualized Costs	35,751.0	62,425.0	433.7	756.2
Oregon HIE Annual Cost	9,090.9	9,090.9	10.0	10.0
Total	44,841.9	71,515.9	443.7	766.2

The Oregon HIE Annual Costs are added as separate cost item since the costs are calculated assuming an ASP service arrangement.

About the Authors

DAVID M. WITTER, JR

Mr. Witter is the principal in Witter & Associates providing consulting support to health care organizations seeking to improve quality performance through innovative solutions including health information technologies. Recent projects include cost-benefit and financing assessments for a regional health information exchange, analysis of Oregon EHR survey results, and program evaluation of the Oregon Chronic Disease Data Clearinghouse. Mr. Witter has over thirty years experience in the leadership, operations and finances of health care organizations. Mr. Witter spent six years at the Association of American Medical Colleges (Washington, DC) serving as Vice President of Enterprise (business) Development, Vice President of Information Resources (CIO) and Director of the Clinical - Administrative Data Service. Mr. Witter spent six years as president and CEO of the Academic Medical Center Consortium (Rochester, NY), an organization created by twelve major teaching hospital CEOs to conduct major health services research-based initiatives to improve quality and operations. Mr. Witter spent seventeen years at the Oregon Health Sciences University serving as, Interim University President, Vice President for Administration, Director of the Biomedical Information and Communication Center, University Hospital CEO, COO and CFO . Mr. Witter holds bachelor and master degrees in economics.

David M. Witter, Jr., MA, Principal, Witter & Associates
503-222-6469, witterdave@aol.com

THOMAS N. RICCIARDI, PhD

Dr. Ricciardi provides consulting services in technology planning and selection, medical informatics, and the use of clinical information for outcomes research. Recent projects include technology requirements and architecture design for a regional health information exchange, grant writing and program development for a personal health record system, and technology marketing services for secondary uses of clinical data. Dr. Ricciardi has 12 years of industry experience in healthcare information technology. He was Global Manager of Quality and Outcomes at GE Healthcare, responsible for the development and management of the nation's largest multi-center ambulatory EMR database for quality and outcomes research. Dr. Ricciardi also held a variety of roles in engineering, informatics, and technology management at GE Healthcare, MedicaLogic, and elsewhere. Dr. Ricciardi holds a bachelors degree in biology and PhD in Neuroscience and Behavior.

Thomas N. Ricciardi PhD, Tom Ricciardi PhD, LLC
503-680-5647, tom_ricciardi@comcast.net