C!TL

Center for Information Technology Leadership

Improving Healthcare Value

The Value of Computerized Provider Order Entry in Ambulatory Settings

Executive Preview

ABOUT CITL

Center for Information Technology Leadership

CITL (Center for Information Technology Leadership), chartered by Partners HealthCare in Boston and supported by HIMSS (Healthcare Information and Management Systems Society), is a nonprofit research organization that helps the healthcare community make more informed IT decisions. Focusing on healthcare *value*, we examine major issues affecting the industry through biannual reports and symposiums. CITL's rigorous, uncompromising approach involves a mix of research techniques, including literature reviews, expert assessments, and market research.

CITL's reports are published and distributed by HIMSS, an organization that provides leadership in healthcare for the advancement and management of information technology and management systems. HIMSS, with more than 13,000 members, encourages emerging technologies and promotes public policies that will improve healthcare delivery through the use of information technology.

Ambulatory Computerized Provider Order Entry (ACPOE) was selected by CITL as the subject of this Executive Preview. In short, research found that adoption of ACPOE will significantly improve quality, cut costs, and improve the bottom line of organizations that use it. To help healthcare IT (HIT) leaders make critical decisions regarding ACPOE, CITL is providing the following:

• E X E C U T I V E P R E V I E W
This document features strategic-level conclusions that are intended to trigger planning discussions.

• F U L L R E P O R T
CITL's in-depth report, featuring an *interactive software model* to help HIT leaders calculate the potential value of ACPOE to their organizations, will be available in March 2003.

• S Y M P O S I U M
CITL's symposium on ACPOE, to be held April 14-15, 2003, in Oak Brook, Illinois, will illuminate the findings of the Full Report and give HIT leaders an opportunity to gauge the value of ACPOE systems in their environments.

For more information about ordering the Full Report and registering for the Symposium, visit www.citl.org or www.himss.org.

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Introduction | CITL !

Information technology is an essential component of a transformed US healthcare delivery system. In *Crossing the Quality Chasm*, the Institute of Medicine (IOM) called for a new healthcare system that is safe, effective, patient-centered, timely, efficient, and equitable.[1] In its 2002 report, *Fostering Rapid Advances in Healthcare*, the IOM describes how information and communications technology infrastructure are fundamental to achieving all six of those quality aims.[2] Yet, many healthcare delivery systems and individual practitioners are uncertain about how to use IT to catalyze this transformation.

In this report from the Center for Information Technology Leadership (CITL), we focus on one critical component of healthcare's evolving information and communications technology infrastructure – Ambulatory Computerized Provider Order Entry (ACPOE) – and comprehensively analyze its potential to help transform US healthcare. ACPOE is crucial because it is the lever with which providers can best apply clinical evidence at the point of care and fully utilize IT as part of comprehensive quality improvement and disease management programs.

Most attention on Computerized Provider Order Entry (CPOE) to date has focused on inpatient care. CPOE has decreased serious inpatient medication errors by 55%,[3] and this finding among others created a sense of urgency around implementing inpatient clinical IT systems. Most notably, The Leapfrog Group, a growing coalition of Fortune 500 healthcare purchasers that supports quality and safety measures in hospitals, made inpatient CPOE one of its first three priorities. This has resulted in some payers offering financial incentives for installing CPOE.[4]

But the majority of US healthcare is delivered in ambulatory clinical settings. Americans made 823 million office visits in 2000, up from 697 million in 1995.[5] The sheer volume of outpatient encounters suggests that IT could have a profound impact on care. There is far less evidence, however, for the value of clinical systems in ambulatory care, and payers do not yet generally provide incentives for installing such systems.

Given the IOM reports and purchaser efforts, physicians and healthcare delivery systems are now interested in using IT to improve outpatient practices. Many ambulatory providers have long used practice management systems for scheduling, billing, and other administrative functions, but they have been wary of adopting clinical systems due to concerns about return on investment, impact on clinical workflow, and the stability of vendors in the marketplace. As business owners of their practices – 88% of ambulatory care visits in the year 2000 were to practices owned by physicians[6] – physicians have been hesitant to invest in new systems without demonstrated benefit.

Recently, however, many have adopted personal digital assistants (PDAs) and started using them for clinical reference. According to one survey, 35% of physicians had

PDAs in 2002, and 55% of them used PDAs to access drug information.[7] While PDAs hold great potential as memory aids and for retrieving information from electronic textbooks, their slower data input methods and smaller display areas are significant bottlenecks for complex applications such as ACPOE. Adoption of electronic medical records (EMRs) including ACPOE has been slow: A 2001 survey found approximately 16% of primary care physicians and 11% of specialists used an electronic medical record in practice.[8] Hospitals and healthcare delivery systems have also been slow to invest in CPOE and EMR systems. Recent surveys of CPOE usage in hospital care found that 32% of hospitals had a CPOE system in place or partially implemented, and only 13.7% of hospitals required its use by physicians.[9] Many academic medical centers have implemented ACPOE by adapting their existing inpatient CPOE systems. However, ACPOE uses different knowledge bases and decision rules, and researchers and vendors are now developing order-entry applications specifically for outpatient contexts.

Should providers invest in EMRs for ambulatory care? Should vendors invest in developing them? Without a clear understanding of the value proposition of these systems – their costs and benefits – it is impossible to answer these questions confidently. CITL set out to fill part of this knowledge gap by assessing the value of Ambulatory Computerized Provider Order Entry, a central component of such systems. Our goal was to critically assess the value of ACPOE across three broad dimensions: clinical, financial, and organizational. It is not our intent to assess specific products available in the market.

We define Ambulatory Computerized Provider Order Entry as a software application that supports the ordering of medications, lab tests, radiology studies, nursing interventions, and referrals. A key component of ACPOE is clinical decision support, which provides clinicians with a range of diagnostic and treatment-related tools aimed at improving patient care and reducing medical errors and costs. We describe ACPOE as distinct from ambulatory electronic medical records (AEMRs), which provide "paperless" medical records and remote access to them, and practice management systems, which support administrative functions such as scheduling and billing.

ACPOE systems may encompass many different features and levels of functionality. CITL created a taxonomy of features and functions and grouped systems into five classes: Basic Prescription (Rx), Basic Prescription and Diagnostic Orders (Rx-Dx), Intermediate Rx, Intermediate Rx-Dx, and Advanced Rx-Dx (see Figure 1).

This CITL Executive Preview presents our core findings regarding the costs and benefits of ACPOE across our functional classes. The CITL Full Report on ACPOE contains detailed findings, analysis, and comprehensive documentation of our research, as well as interactive software allowing readers to customize CITL's ACPOE value model to calculate ACPOE costs and benefits for their own enterprises.

Figure **1**

ACPOE System Classification

<table>
<tr><th></th><th>Basic
Rx-only</th><th>Basic
Rx-Dx</th><th>Intermediate
Rx-only</th><th>Intermediate
Rx-Dx</th><th>Advanced
Rx-Dx</th></tr>
<tr><td>Medication Order Entry</td><td colspan="2">Record prescription.
Print prescription for patient.</td><td>Same as Basic Rx, plus fax or email to pharmacy or pharmacy benefit manager.</td><td>Same as Intermediate Rx-only.</td><td>Same as Intermediate Rx-only, plus electronic data interchange (EDI).</td></tr>
<tr><td>Medication Decision Support</td><td colspan="2">Passive (user-initiated) references like click-through to electronic medical textbook. Not order or patient-specific.</td><td colspan="2">Active (system-initiated) order-specific decision support.
• Simple interaction checks (drug-drug, drug-allergy)
• Default doses and dose range checks
• Cost data
• Order sets</td><td>Same as Intermediate Rx-only, plus:
• Complex interaction checks (drug-drug, drug-allergy, drug-disease)
• Drug recommendations using calculated or inferred knowledge (drug choice guided by lab results, drug dosing)
• Corollary orders</td></tr>
<tr><td>Diagnostic Order Entry</td><td rowspan="2">None</td><td>Record order.
Print order for patient.</td><td rowspan="2">None</td><td>Same as Basic Rx-Dx, plus fax or email to lab or radiology. With or without result reporting.</td><td>Same as Intermediate Rx-Dx, plus EDI. With result reporting.</td></tr>
<tr><td>Diagnostic Decision Support</td><td>Passive references like click-through to lab manual. Not order or patient-specific.</td><td>Active order-specific decision support such as cost data, order sets, or pre-test preparation instructions.</td><td>Same as Intermediate Rx-Dx, plus:
• Order and test recommendations using extensive patient information, including calculated or inferred knowledge
• Corollary orders
• Preventive screenings and alerts</td></tr>
</table>

CITL | Research & Analysis Methods

To understand the value of ACPOE – the net financial, clinical, and organizational benefits resulting from computerized order entry in outpatient settings – we gathered and synthesized available evidence. We cast a wide net to retrieve applicable studies, searching the academic, commercial, and other available sources internationally. Our literature review included 1,981 studies, 72 of which were deemed relevant to ACPOE. Of these, 25 provided primary data on ACPOE value.

We also contacted more than 35 vendors about their current ACPOE offerings and their future plans to develop and market these applications. We requested detailed information on current products, their prices, and demonstrated benefits. Our sample included traditional healthcare IT vendors, ePrescribing tool vendors, and other enterprises offering order-related knowledge bases.

Finally, we engaged an Expert Panel to provide additional insight on the current maturity, costs, and benefits of ACPOE. This panel represented ACPOE users from a range of outpatient settings – solo and small practices to large physician groups in integrated delivery networks (IDNs) to hospital-based outpatient clinics.

Through this blend of research methods, we compiled a comprehensive collection of evidence on ACPOE value. We organized all research results using CITL's value framework, which differentiates among three major types of value: financial, clinical, and organizational (see Figure 2).

Figure **2** ***Healthcare IT Value Dimensions***

Financial

- Cost reductions from decreased administrative, clinical staffing, and resource requirements (i.e., elimination of paper chart pulls and transcription services).
- Revenue enhancements from improved charge capture and charge entry to billing times.
- Productivity gains from increased procedure volume, reductions in average length of stay, and increased transaction processing rates.

Clinical

- Care process advances from better adherence to clinical protocols and improvements in the stages of clinical decision-making (i.e., initiation, diagnostics, monitoring and tracking, and acting).
- Improved patient outcomes from reductions in medical errors, decreases in morbidity and mortality, and expedited recovery times.

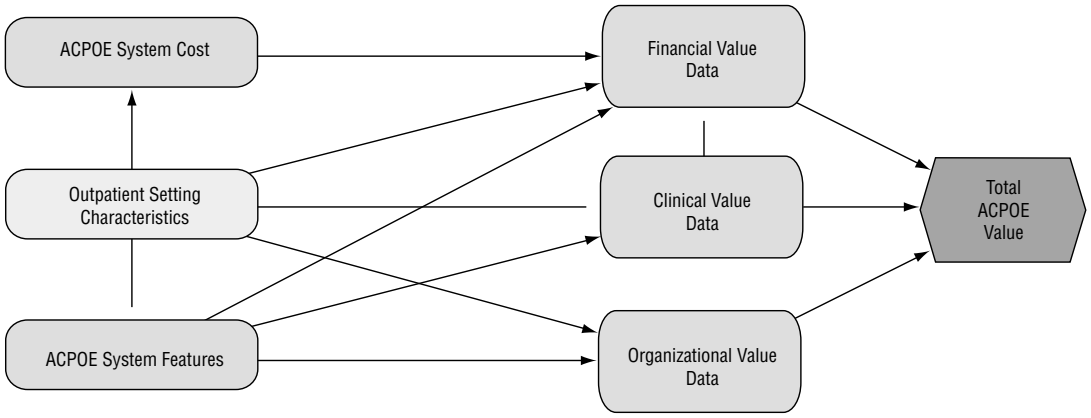
Organizational

- Stakeholder satisfaction improvements from improved access to healthcare information, decreased wait times, and more positive perceptions of care quality and clinician efficacy.
- Risk mitigation from decreases in malpractice litigation and increased adherence to federal, state, and accreditation organization standards.

While the evidence from the literature demonstrated remarkable clinical, financial, and organizational benefits, it was not on its own comprehensive enough to draw system-wide conclusions about ACPOE's impact. Culling additional data from our Expert Panelists, vendors, and ACPOE system users, we developed an analytic model that projects ACPOE's total value for the United States and outpatient providers. To account for the wide variability in size, clinical specialization, and technology used in ambulatory care settings, we included factors (ACPOE utilization rates and provider capitation rates) that discounted the impact of ACPOE and produced more conservative projections. We used Lumina's Analytica software to model these data and factors through a comprehensive influence diagram – a symbolic representation of how different variables interact to create value (see Figure 3). [10,11]

Figure **3**

Top-Level View of ACPOE Value Model



At the model's highest level, ACPOE value is predicated on several core factors: system costs, outpatient setting characteristics, system features, and published data and expert opinion on ACPOE's financial, clinical, and organizational value. By defining parameters for these core variables and the relationships among them, CITL projected the total value of ACPOE.

! CITL | Benefits

Improved Patient Outcomes

Nationwide adoption of advanced ACPOE systems will eliminate more than 2 million adverse drug events and more than 190,000 hospitalizations per year.

Outpatient order entry systems can provide a broad range of clinical benefits – from increased compliance with guidelines to better management of patients with chronic disease. In this Executive Preview, we focus on one of the best-documented clinical benefits of ACPOE — improved medication safety. Adverse Drug Events (ADEs) are defined as injuries "resulting from an intervention related to a drug" and can be classified as preventable and non-preventable.[12] ADEs are considered preventable if errors can be identified in any part of the medication process – prescribing, transcribing, dispensing, consuming, or monitoring. An example of a preventable ADE is a penicillin-allergic patient who, because of incomplete allergy documentation, is prescribed this drug and suffers an allergic reaction after consuming it. Preventable ADEs do not include injuries from side effects or idiosyncratic reactions.

While an advanced ACPOE system could theoretically avert most preventable ADEs, the real world impact is typically much less. The differences are due to human factors such as providers ignoring ACPOE warnings or patients ignoring instructions, system factors such as verbal orders bypassing ACPOE systems, or data factors such as incomplete allergy documentation or outdated drug interaction databases. There are also concerns that ACPOE systems may introduce errors into clinical care. However, CITL's literature review identified little evidence of ACPOE's negative impacts, and CITL's Expert Panel estimates on the net effects of ACPOE include potential negative outcomes attributable to ACPOE.

In modeling ACPOE's impact on ADEs, we calculated the number of preventable ADEs by applying published estimates of ADEs per visit[13] to the average annual ambulatory provider visit volume,[14] resulting in an estimated 38 ADEs per provider-year. We then reduced this estimate to the subset of ADEs that are considered preventable by ACPOE — about 14 per outpatient provider per year. Adjusting for incomplete ACPOE adoption, we expect the typical outpatient provider to eliminate nine ADEs per year with advanced ACPOE. Since almost two-thirds of patients with ADEs require at least one additional follow-up visit, this ADE reduction also eliminates nearly six additional ADE-related visits per year. In addition, for every five years of use, a provider can expect to avoid four admissions and three life-threatening ADEs.

Based on the total US outpatient visit volume,[15] we estimate there are more than 8 million outpatient ADEs per year. Applying similar reductions to calculate the proportion of preventable ADEs, we project that more than 3 million preventable outpatient ADEs occur annually. Even after adjusting for incomplete

ACPOE adoption, nationwide adoption of advanced ACPOE is still likely to eliminate more than 2 million ADEs per year in the United States. This would avoid nearly 1.3 million visits, more than 190,000 admissions, and more than 130,000 life-threatening ADEs.

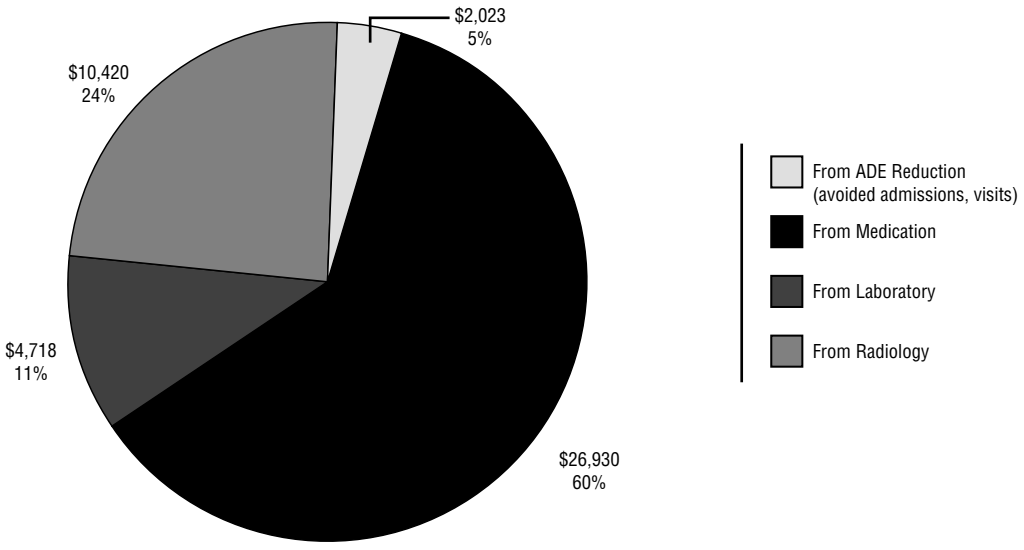
Cost Savings

Nationwide adoption of advanced ACPOE systems will save the US healthcare system approximately $44 billion per year in reduced medication, radiology, laboratory, and ADE-related expenditures.

Decision support tools that help avoid ADEs and suggest cost-effective medication, laboratory, and radiology ordering are important sources of direct cost savings from ACPOE, and CITL projects approximately $44 billion in savings from these sources (see Figure 4). CITL's model focuses on projecting financial benefits for the United States and outpatient providers during the first five years after ACPOE system implementation. All costs and benefits are in US 2002 dollars.

Figure **4**

Breakdown of National Estimated Cost Savings From ACPOE
(in Millions of US Dollars)



CITL predicts that ACPOE can save the United States nearly $27 billion in medication expenditures annually. These savings include switches from brand-name to generic medications, switches from expensive medications to less expensive alternatives in the same therapeutic class, and more appropriate drug utilization. Among these tactics, brand-name to generic switches resulting from ACPOE have been studied the most. [16,17] Avoiding ADEs is another source of national cost savings from ACPOE. CITL's

model calculates that the United States would save more than $2 billion annually from avoided ADE-related hospitalizations alone. This estimate is based on CITL's projection of avoided ADE-related hospitalizations nationally and a reported cost of $10,375 per ADE-related hospitalization.[18]

CITL's model projects annual savings of more than $10 billion in radiology and nearly $5 billion in laboratory costs. Like medication-related decision support, studies have evaluated the impact of clinical decision support for lab ordering. Systems that display test cost, prior results, and the probability of abnormal results to physicians during order entry can save 5% to 15 % in lab expenditures.[19,20,21]

ACPOE significantly reduces costs per provider as well. However, under most current provider reimbursement methods, the bulk of savings from ACPOE accrue to payers. Using average national capitation data to calculate the proportion of cost savings accruing to providers, CITL estimates that a typical provider using an advanced ACPOE system would save close to $28,000 per year – including more than $17,000 in medications, nearly $7,000 in radiology, $3,000 in laboratory expenditures, and $1,000 from ADE-related hospitalizations.

ACPOE systems almost certainly also produce significant long-term benefits from improved guideline compliance and the resulting clinical outcomes. However, these long-term benefits are difficult to quantify, and CITL found little published evidence.

Provider Revenue Enhancement

Using advanced ACPOE, providers can eliminate more than $10 in rejected claims per outpatient visit.

Rejected claims are a significant source of lost revenue for healthcare providers. Sources estimate that more than 30% of a provider organization's claims may be rejected initially,[22,23,24,25] with eventual losses ranging from 5% to 10% of total revenues. In compiling this report, CITL focused on claims rejected for diagnosis or procedure problems. Most of these claims are billed by consultants and ancillary service providers for procedures performed at a referring provider's request, such as MRI scans, EKGs, colonoscopies, and laboratory tests.

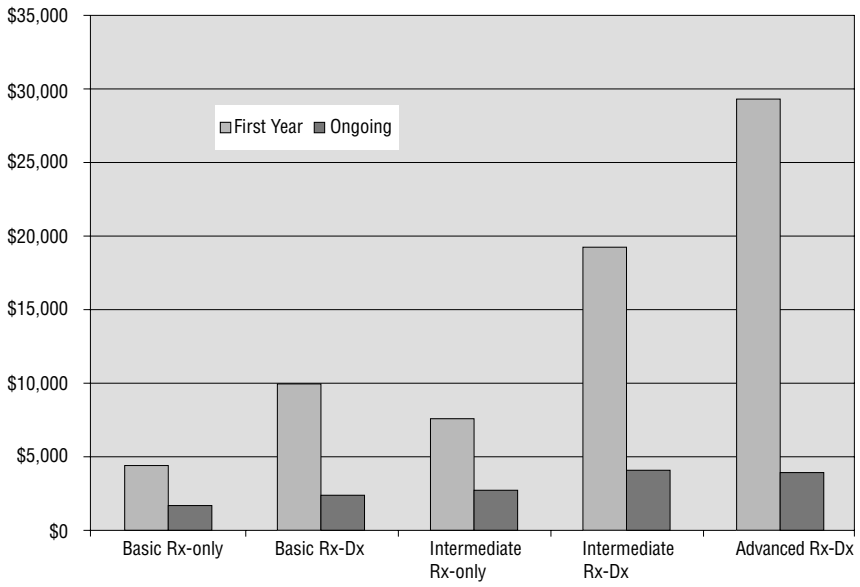
A recent study evaluated the potential impact of an AEMR with advanced ACPOE on outpatient claims rejections at an academic medical center. Based on inpatient experiences and expert opinion, researchers estimated that an AEMR with advanced ACPOE could reduce these errors by 40% through highlighting missing diagnosis codes and suggesting appropriate codes from the patient's record. [26]

Combining the observed lost revenue per visit with the estimated reduction rate in rejected claims, CITL projects that advanced ACPOE could eliminate more than $10 in rejected claims per visit. Since diagnosis or procedure coding problems primarily affect specialists and ancillary service providers, CITL also predicts that multi-specialty organizations like IDNs will be the primary recipients of this benefit.

Determining the net financial value of ACPOE requires estimating the total costs for basic, intermediate, and advanced classes of ACPOE systems. These costs include initial and recurring costs to purchase and support a given class of system, as well as the opportunity costs during the implementation period – i.e., decreased patient revenues due to training, slower ordering times, and practice workflow changes. For each class of system, we combined available data from the literature, market research, and our Expert Panel into cost ranges. Figure 5 gives the average first-year and ongoing costs using cash-only financing for CITL's five ACPOE system classes.

Figure **5**

Annual ACPOE Costs Per Provider *(in US Dollars)*

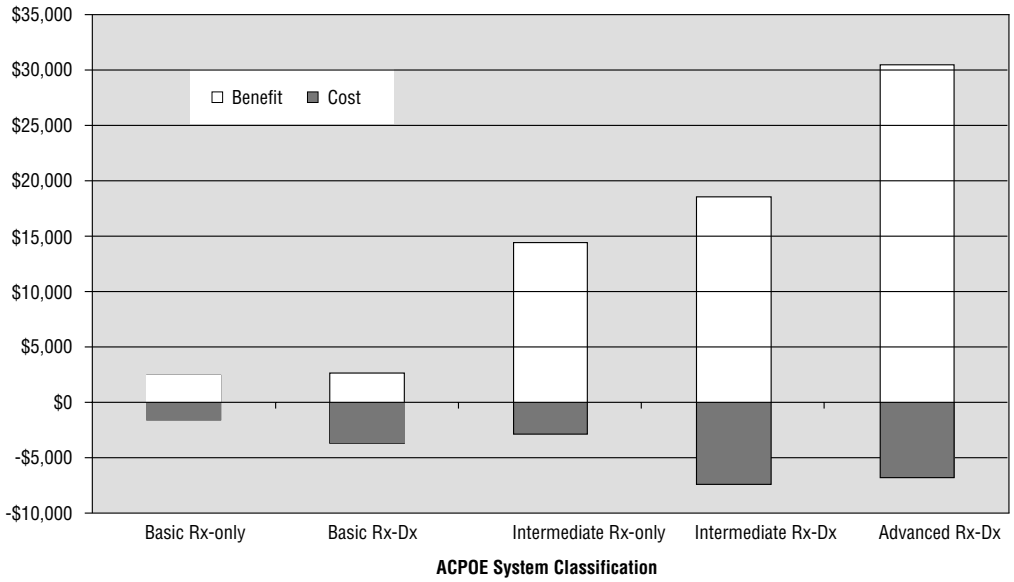


Our cost estimates reflect an axiom of IT adoption: Cost rapidly increases with system sophistication. Indeed, the first-year costs for advanced systems are substantial – more than $29,000 per provider – but they reflect estimates for more robust outpatient clinical systems: ambulatory electronic medical record systems with ACPOE as an included feature. Conversely, with first-year costs of less than $4,500 per provider, basic ACPOE systems with medication order capability define the entry-level to the ACPOE applications marketplace. While substantially less expensive than advanced systems in the first year, intermediate medication and diagnostic ordering systems are more expensive to maintain. This difference is likely due to the tendency of larger practices to adopt more sophisticated systems, achieving better economies of scale by spreading costs over more providers.

! CITL | The Bottom Line

CITL's ACPOE value model projects substantial clinical and financial value for the US healthcare system, outpatient providers, and patients. Considering these benefits in relation to the costs described above, providers will enjoy substantial returns for investing in more advanced ACPOE systems. Figure 6 compares the average annual cost versus annual benefit over five years of ACPOE system use.

Figure **6** ***Annual Cost-Benefit of ACPOE in First Five Years*** *(in US Dollars)*



These projections do not include important benefits like improved patient and provider satisfaction, revenue enhancement, or decreased malpractice risk. They also do not include societal benefits like reductions in lost workdays from ADE-related hospitalizations and visits. Accordingly, it is likely that widespread adoption of ACPOE would produce even greater benefits for all healthcare system stakeholders than those summarized below.

More sophisticated systems produce both superior financial returns and greater clinical benefits. Advanced systems, for instance, cost nearly five times as much as basic ACPOE but produce over 12 times greater financial returns. Enhanced revenue stemming from reductions in rejected claims is a key determinant of advanced ACPOE's financial value.

CITL's model projects that any class of ACPOE system will reduce preventable ADEs. However, the number of ADEs prevented by advanced systems is an order of magnitude greater than those prevented by basic systems.

Intermediate and advanced systems pay for themselves within two years of operations. In CITL's model, the common assumption that ACPOE systems have negative financial returns proves to be incorrect.

The US healthcare system will benefit significantly from widespread adoption of advanced ACPOE. CITL's model projects annual savings of approximately $44 billion and a decrease of more than 2 million ADEs annually with nationwide implementation of advanced ACPOE.

THE REPORT

CITL's Full Report on the value of ACPOE contains:

- Complete documentation and results of our research
- Value and savings projections from additional perspectives
- CITL's ACPOE value model software to support tailored analysis

! CITL | References

1 Edington M, ed. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC: Institute of Medicine; 2001.

2 Corrigan JM, Greiner A, Erickson SM. *Fostering Rapid Advances in Health Care: Learning from System Demonstrations.* Washington, DC: Institute of Medicine; 2002.

3 Bates DW, Leape LL, Cullen DJ, et al. Effect of Computerized Physician Order Entry and a Team Intervention on Prevention of Serious Medication Errors. *JAMA* 1998;280(15):1311-1316.

4 The Leapfrog Group. *New Hospital Patient Safety Information Gives Consumer the Power to Make More Informed Health Care Choices.* The Leapfrog Group. January 17, 2002.

5 Cherry DK, Woodwell DA. *National Ambulatory Medical Care Survey: 2000 Summary.* National Center for Health Statistics. 2002.

6 Ibid.

7 Manhattan Research. *Taking the Pulse: Physicians and Emerging Information Technologies.* Manhattan Research. 2002.

8 The Commonwealth Fund/Harris Interactive/Harvard School of Public Health. Internal data. 2001.

9 Ash J, Gorman P, Lavelle M, Lyman J, Fournier L. Investigating Physician Order Entry in the Field: Lessons Learned in a Multi-Center Study. *MedInfo.* 2001;10(Pt 2):1107-1111.

10 Analytica, version 2.0.5. Lumina Decision Systems, Los Gatos, CA. http://www.lumina.com

11 Nease RF, Owens DK. Use of Influence Diagrams to Structure Medical Decisions. *Med Decis Making.* 1997;17(3):263-75.

12 Leape LL, Bates DW, Cullen DJ. Systems Analysis of Adverse Drug Events. *JAMA* 1995;274(1):35-43.

13 Honigman B, Lee J, Rothschild J, et al. Using Computerized Data to Identify Adverse Drug Events in Outpatients. *JAMIA.* 2001;8(3):254-266.

14 American Medical Association. *Physician Socioeconomic Statistics 2000-2002.* AMA. 2000.

15 Pastor PN, Makuc DM, Reuben C, Xia H. Chartbook on Trends in the Health of Americans. Health, United States, 2002. *National Center for Health Statistics, 2002.*

16 Cap Gemini Ernst & Young. *TouchScript Medication Management System: Financial Impact Analysis on Pharmacy Risk Pools.* October 2000.

17 Cap Gemini Ernst & Young. *TouchScript Medication Management System: Brook Hollow Practice, Site Impact Analysis.* May 1999.

18 Jha AK, Kuperman GJ, Rittenberg E, Teich JM, Bates DW. Identifying Hospital Admissions Due to Adverse Drug Events Using a Computer-Based Monitor. *Pharmacoepidemiol Drug Saf.* 2001;10(2):113-119.

19 Tierney WM, McDonald CJ, Martin DK, Hui SL, Rogers MP. Computerized Display of Past Test Results: Effect on Outpatient Testing. *Ann Intern Med.* 1987;107:569-574.

20 Tierney WM, McDonald CJ, Hui SL, Martin DK. Computerized Display of Abnormal Test Results: Effects on Outpatient Testing. *JAMA.* 1988;259:1194-1198.

21 Tierney WM, Miller ME, McDonald CJ. The Effect on Test Ordering of Informing Physicians of the Changes for Outpatient Diagnostic Tests. *NEJM.* 1990;322:1499-1504.

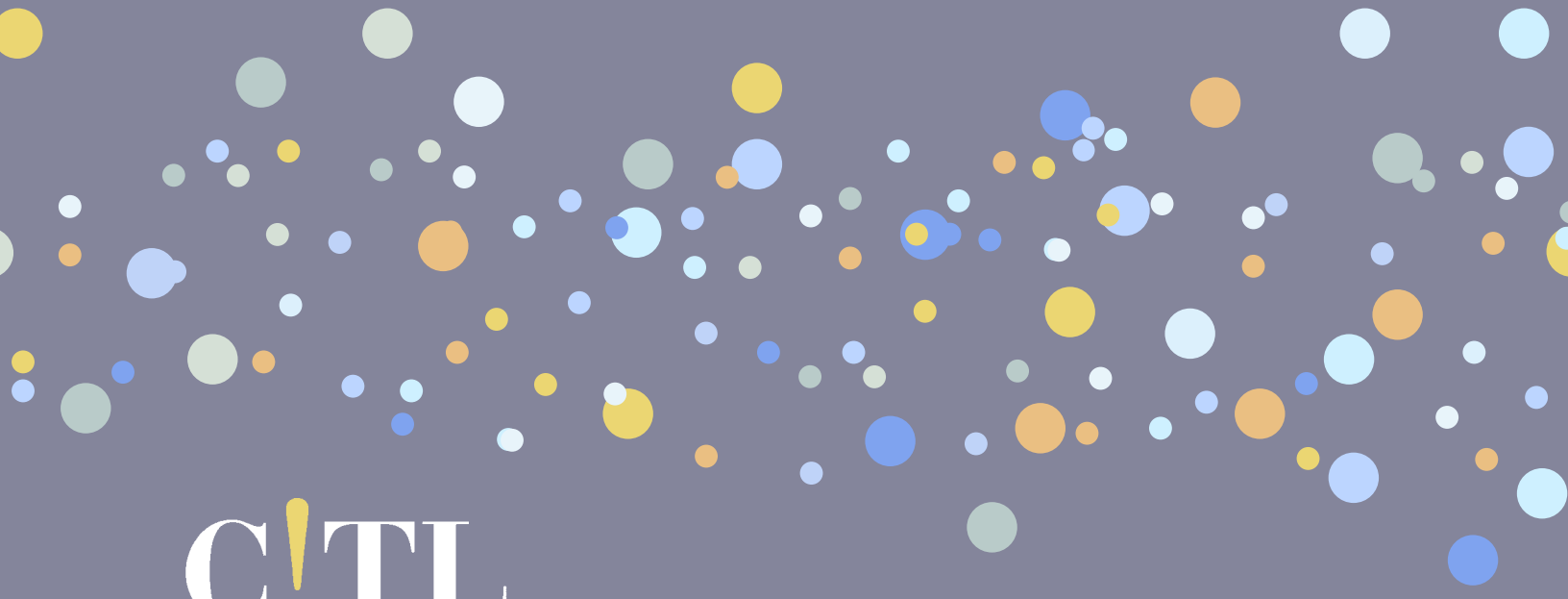
22 Industry Outlook. [Southwest Medical Billing Center website]. Available at: http://www.midsouthmedical.com/outlook.html. 2002. Accessed January 15, 2003.

23 The Need for Medical Billing. [Independent Billing Services website]. Available at: http://www.independentbilling.com. 2002. Accessed January 15, 2003.

24 General Info: The Need for Medical Billing. [Electronic Processing Services website]. Available at: http://www.epsmed.net/info.htm. 2002. Accessed January 15, 2003.

25 Electronic Claims Filing. [American Billing Systems website]. Available at: http://www.americanbilling.com/ecf.htm. 2002. Accessed January 15, 2003.

26 Blumenfeld BH, Wang SJ, Greim JA, Kuperman GJ. The Potential Economic Impact of Ambulatory Physician Order Entry at a Large Integrated Delivery Network. *Proc AMIA Symp.* 2002:977.



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