Advanced Technologies to Lower Health Care Costs and Improve Quality

MASSACHUSETTS TECHNOLOGY COLLABORATIVE

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EXECUTIVE SUMMARY

*"There are advanced technologies which can dramatically lower health care costs **and** improve quality. The technologies are proven. The associated benefits are known. But there are barriers in the system which impede their implementation. We can change that."*

Mitchell Adams – Executive Director, Massachusetts Technology Collaborative

Massachusetts is home to a life sciences "Super Cluster" consisting of an extraordinary aggregation of the world's leading institutions and companies in biomedical research and education, health care delivery, medical devices, biotechnology, pharmaceuticals, and information technology. It is the envy of the world, and an essential element in our region's future economic vitality.

"The return of double-digit health care inflation threatens employers' ability to preserve jobs while maintaining good benefits, and has a severe impact on the Commonwealth's industrial competitiveness. "

Richard C. Lord – President and CEO, Associated Industries of Massachusetts

But while we have what is arguably the best health care available, the cost of services is very high, and annual increases have recently returned to the double-digit range. It is a national problem. Growth in health care spending in the United States has outpaced all other major sectors and threatens to reach crisis levels. In 2001, $1.4 trillion was spent on health care [1] – an amount that represents 14.1 percent of gross domestic product (GDP) and an increase of 8.7 percent over 2000. It is expected that health care costs could grow to 17.7 percent of GDP by 2012. [2] And the expenditure category presenting the greatest stress on state budgets currently is health care costs.

At the same time, the quality of our health care system suffers as a result of medical errors, fragmented care and inadequate systems. Widely cited estimates from the Institute of Medicine report, *To Err is Human,* indicate that the cost of medical errors in terms of human life is substantial. Other studies have shown that the financial cost is huge. The *total* costs associated with these events – including all health care costs, disability, lost productivity and income – could reach $29 billion. [3]

There exist advanced technologies which can dramatically lower health care costs and improve quality. While capital expenditures for equipment and training are required, the cost savings associated with implementing these technologies going forward can be much greater, such that substantial net financial benefits are possible. These technologies cross a spectrum of disciplines including biotechnology, medical devices and information technology.

This report focuses specifically on a set of seven advanced technologies that have demonstrated substantial net financial benefits and improved quality of care and health outcomes. They were selected from among a wide array of technologies for their demonstrated ability to *simultaneously* reduce costs and improve quality. They represent only a sample of *all* of the technologies that could benefit health care in Massachusetts. Technologies with the potential to yield dramatic administrative savings but no direct clinical benefit, for example, have not been addressed here. There are a host of non-information-based technologies that also

have dramatic effects. *(See Appendix A for a more complete list.)* The seven selected information-based technologies are highlighted here and discussed in more detail in subsequent sections of the report.

1. **Electronic communication between patients and their physicians** has been shown to measurably decrease overall claims costs while improving patient access and communication and enhancing practice efficiency. As a result, at least six payers – including, locally, Blue Cross Blue Shield of Massachusetts – have undertaken pilots to reimburse physicians for their use of electronic communication tools with patients for the delivery of non-urgent care.

2. With over one billion prescriptions worth $154 billion written in the United States in 2001 and three million preventable adverse drug events associated with outpatient prescriptions alone, [1] there are significant opportunities to reduce drug costs and the errors associated with the largely manual process that takes place today. More importantly, medication errors account for one out of 131 ambulatory deaths and one out of 854 inpatient deaths. [3] **Electronic prescribing** (or e-prescribing) tools that provide up-to-date payer formulary information at the time a physician writes a prescription, and that support the electronic transmission of that legible prescription to a pharmacy, can markedly reduce drug costs and improve patient safety associated with the prescription process. A coalition in Rhode Island is currently piloting an e-prescribing solution for statewide implementation, [4] and Tufts Health Plan has announced the expansion of its e-prescribing pilot across Massachusetts.

3. **Ambulatory computerized physician order entry** (CPOE) systems that facilitate physician orders at the point-of-care for medications, laboratory and radiology tests provide significant opportunities for improving quality while reducing costs. It is estimated that the use of advanced ambulatory CPOE systems nationwide could eliminate more than two million preventable adverse drug events. [1]

4. Similarly, point-of-care tools that provide **inpatient CPOE** can reduce errors, improve health care quality, and lower costs in the hospital setting. Preventable adverse drug events are a leading cause of death in the United States (exceeding deaths attributable to motor vehicle accidents, breast cancer, or AIDS). The total costs associated with such events represented four percent of national health expenditures in 1996. [3]

5. Coordinating patient care across a community when patients are seen at multiple provider organizations – especially when many of these institutions do not have electronic patient records – can be paper-intensive and fraught with rework and delays. Several communities across the country have been piloting efforts to share electronic patient information by secure means. The results from these two early **regional data sharing** initiatives (in Santa Barbara, California, and Seattle, Washington) have shown some early success in improving quality and reducing health care costs in the community. A similar effort is just now being proposed for Massachusetts.

6. A recent mandate by the Leapfrog Group (a consortium of 140 public and private employers and organizations that provide health care benefits) requiring hospitals to maintain a board-certified intensivist onsite 24x7 to monitor intensive care units (ICUs), represents a significant investment for smaller hospitals with lower volumes of ICU patients. [5] New technology allows physicians to fully monitor patients remotely, thereby

reducing costs by expanding the ability of one intensivist to cover multiple ICUs using remote monitoring or **e-ICU** applications.

7. There are a wide range of tools that support the management of chronic diseases. Not only have **disease management** applications been shown to increase patient involvement and therefore satisfaction with their overall care, but the most sophisticated tools integrated with a physician practice's core clinical systems have been shown to effectively improve the quality of care for these patients and reduce costs for populations of patients across a community.

Published research and current uses of these technologies at leading health care organizations across the country have demonstrated their ability to reduce costs and improve quality. Indeed, if Massachusetts were to increase adoption of these technologies statewide, there would be an opportunity to significantly reduce health care costs for employers throughout the Commonwealth while simultaneously improving the overall health care of its citizens.

For Massachusetts alone, the potential for savings is enormous. It is estimated that $2.5 billion could be saved if the Commonwealth were to widely adopt all seven of these information technologies. Given the significant concentration of nationally-recognized health care organizations, the power of the political infrastructure, and the demonstrated history of success in collaboration, Massachusetts is certainly poised to undertake the planning and collaboration necessary to increase adoption of these technologies. Given the importance of a vibrant business economy to the long-term future of Massachusetts, the Commonwealth can ill afford *not* to increase adoption of these technologies.

The following table highlights the financial benefits that each of these technologies represents for Massachusetts, calculated for the purposes of this analysis at a likely best-case adoption rate of 75 percent.

Table 1: Summary of Projected Net Savings for Massachusetts from Emerging Health Care Technologies [6]

Emerging Technology	Projected Net Annual Benefit (Assuming 75% Adoption Rate)
Electronic Patient-Physician Communication	***$ 167.8 million***
E-Prescribing	***$ 140.7 million***
Ambulatory CPOE	***$ 290.3 million***
Inpatient CPOE	***$ 966.0 million***
Disease Management	***$ 710.0 million***
Regional Data Sharing	***$ 23.8 million***
E-ICU	***$ 177.4 million***
Total	***$ 2.48 billion***

Barriers that Impede the Adoption of Emerging Information Technologies in Health Care

Compared to other industries, spending on information technology in health care lags. Despite growing evidence of the effectiveness of electronic medical record systems for outpatient practice, it is estimated that less than one-in-five primary care physicians use them. Less than ten percent of primary care physicians use even more basic systems that support electronic prescribing. [1] And fewer than five percent of hospitals are using computerized physician order entry systems, [5] although the benefits associated with the use of these systems have clearly been demonstrated.

Barriers to the adoption of these technologies include:

- **There is a lack of information about true costs, benefits and experience associated with these technologies**. The resulting uncertainty is a **major barrier** to organizational adoption.
- In many cases, the **purchase and implementation costs** for these advanced technologies are significant – especially when the competition for capital dollars is tight and operating margins are shrinking at most health care organizations.
- For many of these advanced technologies, **the benefits do not accrue to the purchasers who use them**. While measurable financial savings from population health management and the improved formulary compliance accrue to payers, for example, the provider organizations that must actually use advanced technologies to achieve these improvements are unlikely to invest their limited resources to purchase them, especially when they receive no reimbursement, no reward and little direct benefit for doing so.
- **Performance standards** detailing best practices and outcome expectations in most cases have not been established.
- The **cultural resistance and inertia** against physician adoption of these advanced technologies can be great if use of them takes more time or represents significant change in the way a physician practices. Training and education are necessary.
- In many cases, the **vendor products are immature**, making the selection of a vendor riskier and implementation more complicated.
- In the case of several of these advanced technologies, **legal and regulatory barriers** – e.g., those associated with patient privacy and use of the Internet for transmitting personal health information, or requirements for actual as opposed to electronic signatures on prescriptions – have prevented more rapid adoption.
- Finally, the required **infrastructure and data/terminology standards** necessary for the interoperability of some of these advanced technologies are not yet present. Unlike other industries that long ago established technology standards, connecting disparate systems and exchanging information across multiple entities in health care is still an extremely complicated endeavor.

Recommendations: A Call to Action

Increasing the adoption in Massachusetts of these advanced health care technologies will require vision, leadership and collaboration among key stakeholders from across the Commonwealth. While a number of pilots and demonstration projects are already underway, (see “Case-in-Point” highlights), the success of these efforts must be publicized and their wider adoption nurtured if they are to take hold. Similarly, getting newer, yet-to-be-piloted technologies off the ground will also require vision, leadership and collaboration. In both cases,

leaders in Massachusetts must facilitate the creation of rewards and incentives and eliminate key barriers so that current initiatives can proceed more effectively and new efforts can begin.

There are some specific actions that could be undertaken to help spur adoption.

1. **Organize the initiative, foster collaboration and eliminate barriers** by:

   - ***Charging a statewide public/private task force, or series of focused task forces*** to develop specific recommendations for action within three to six months; and
   - When the work is done, ***convening a statewide summit*** to share the vision with key stakeholders and generate commitment and energy for the new agenda.

2. **Establish early funding, reimbursement and other incentives** by:

   - ***Implementing bonus incentives*** for provider organizations that adopt certain technologies, or base a portion of their capitation payment on IT adoption;
   - ***Reimbursing physicians for using technology*** on a per-visit or per-transaction basis;
   - ***Developing collaborative arrangements between payers and providers*** to share in the costs of implementing these advanced technologies (i.e., **eliminate the *disconnect* by aligning the cost burden with financial benefit**);
   - Using the state Department of Public Health ***licensing process*** to encourage hospitals and physician practices to adopt certain technologies; or
   - Working with the "Leapfrog Regional Rollout Committee" to ***speed up the adoption timeline and associated requirements for CPOE***. Accelerated implementation should be accompanied by financial assistance to meet capital needs where necessary.

3. **Secure capital funding** by:

   - ***Seeking private foundation and grant funding*** to design, test and implement pilots of emerging technologies across the Commonwealth;
   - ***Seeking sources of public funding*** for specific IT initiatives in Massachusetts (such as that proposed nationally in at least one instance to provide physician reimbursement for the adoption of technologies such as e-prescribing);
   - ***Providing low- or no-cost revolving loans*** to provider organizations for the adoption of certain technologies (such as one Federal proposal being urged by several national health care IT organizations);
   - ***Reallocating financial savings*** to those who implement these advanced technologies but for whom significant benefits do not accrue (i.e., **eliminate the disconnect**); or
   - ***Sharing technology resources*** across stakeholder entities.

4. **Establish a "trusted third party"** to complete studies to provide data and standards to identify the technologies that can reliably lower cost and improve quality. This addresses one of the significant barriers – the lack of information about true costs, benefits and experience.

This Initiative in Context

It is not news to many of the state's health care leaders that there are advanced technologies that can lower costs significantly and improve quality. In fact, there are a number of important projects and pilots underway in Massachusetts right now in which the power of these technologies is being put to work. Some examples are identified in the report, in particular those highlighted in box frames entitled "A Case-in-Point".

The contribution of this initiative nonetheless may be substantial. This report shows that there is very significant financial benefit to Massachusetts if the adoption of these technologies can be hastened, that there are systemic barriers impeding their adoption, and that a collaborative effort to eliminate the obstacles can be undertaken.

1. SEVEN ADVANCED TECHNOLOGIES

The following sections of the report describe each of the seven advanced technologies that have significant potential to reduce costs and improve quality for health care in Massachusetts.

Electronic Patient-Physician Communication

Newly empowered patients frustrated by poor access to appointments and long waits in the physician's office are increasingly interested in communicating online with their physicians. [7] They do so to request appointments, refill prescriptions, and ask clinical questions that might otherwise require a lengthy exchange of phone calls or time-consuming face-to-face visits.

Description

There are at least three basic means by which patients and physician practices are communicating electronically. While the simplest method – using Internet-based e-mail such as that available through American OnLine, Netscape and Microsoft Exchange – is the least expensive, it is also the least secure. And while some electronic medical record (EMR) and physician office system products offer secure patient communication tools, they can only be deployed by practices that have – or are willing to purchase – an EMR system. A third approach that is gaining acceptance involves patient and physician users communicating electronically through a specialized messaging product hosted on a secure Website. This approach requires the up-front purchase of very little technology (a PC with Internet access), and provides a more secure means of communicating electronically than Internet-based e-mail. This latter method is the approach analyzed in this report.

Benefits

In addition to the improved access and service benefits that patients receive, recent studies have shown that electronic communication between physicians and their patients – particularly when it replaces face-to-face office visits – can decrease per-member-per-month claims costs for health plans while positively impacting physician office productivity and workflow.

Improved quality

Online patient-physician communication can enhance the quality of communication between physicians and their patients – potentially even improving the relationship itself. In some cases, physicians and patients can even access and update a secure health record that includes allergies, medications and past medical conditions. Physicians, in turn, can send preventative self-care reminders and customized educational materials to patients based on their conditions. Overall, electronic communication is self-documenting, creating a more complete record for patient care and legal liability. [8]

A Case-in-Point: *Electronic Patient-Physician Communication Piloted at Blue Cross Blue Shield of Massachusetts*

The Problem: Patients want better access to physicians and more control over their health care interactions.

The Solution: BCBS-MA is piloting Web-based visits enabling patients to interact with physicians online.

The Results: In a recent study, health care claims were reduced by $3.69 per-member-per-month through the use of electronic patient-physician communication. Blue Cross anticipates a similar reduction in its own per-member-per-month claims costs – plus improved quality of the patient-physician interaction using e-communication technology.

Reduced costs
One of the more advanced forms of electronic patient-physician communication – online clinical consultations or "webVisits" – can replace face-to-face patient encounters and actually reduce the non-urgent visits a patient would otherwise need. In a recent health plan study, each patient user of a secure, Web-based messaging and online consultation tool experienced a statistically significant reduction in overall health care claims of $3.69 per member month. In addition, patient users were half as likely to report having missed work due to illness. [9]

Physician practices themselves should also experience cost savings through increased office productivity and reduced visit costs. The more advanced "on-line" office capabilities automate many routine tasks that drain staff time and tie up phone lines with prescription renewals, appointment scheduling, lab results follow-up and patient questions. One physician practice estimated the elimination of about 50 percent of patients' follow-up visits through its use of online patient communication and telephone care. [10] Because some of a practice's reimbursement is linked to risk arrangements, this represents financial savings for the practice – not to mention financial and time savings for the patient and associated employer savings.

Costs

Once a physician practice has a computer and an Internet connection – and virtually all do [11] – the incremental cost for using Web-hosted secure messaging applications is $50 per physician per month or less. [12]

Current Solutions and Marketplace Adoption

It is estimated that somewhere between 10 and 20 percent of physicians regularly communicate electronically with their patients. Examples of vendor products currently available in the marketplace include Medem, MyDocOnline and RelayHealth.

Net Benefit to Massachusetts with Increased Adoption

If electronic patient-physician communication tools were widely adopted by 75 percent of all physicians across Massachusetts that do not already have or use online consultations, over $150 million in savings could result from the reduction in health care claims costs associated with fewer office visits.

Table 2: Net Benefit to Massachusetts of Electronic Patient-Physician Communication

Savings from Reduction in Total Health care Claims	**$173.4 million annually**
Projected Costs	**$ 5.6 million annually**
Net Benefit to Massachusetts	**$167.8 million annually**

The benefit calculations do not incorporate any additional savings from improved physician office productivity or reduced employer costs associated with reduced employee absenteeism, nor do the costs include any additional physician reimbursement for online visits.

Calculation of the net benefit of electronic patient-physician communication for Massachusetts was predicated upon the following data, calculations and key assumptions:

- The total number of practicing physicians in Massachusetts is 20,628; [13]
- The current percentage of physicians who regularly communicate online with patients for purposes of this analysis is considered no more than 10; [12]
- The total number of health plan-enrolled members in Massachusetts is 5,802,000 [14] (though this number may be high given the latest unemployment figures);
- The surveyed percentage of member patients likely to use online consultations is 90[15] (though the likely percentage calculated for this report is 75 given that some patients may not likely gain Internet access via home or work); and
- The reduction in total health care claims through patient-physician use of online consultations is $3.69 per patient/member per month. [9]

Barriers to Adoption

The three most often-cited barriers to increased physician adoption of electronic patient-physician communication are:

1. The **lack of reimbursement** to physicians for non visit-based care;
2. The **workload increases** that physicians fear will come with online communication; and
3. The perceived **liability, security and patient privacy issues** associated with electronic communication.

At least seven health plans – including Blue Cross Blue Shield of Massachusetts – have conducted pilots whereby they reimburse physicians for use of electronic communication with patients. [16,17,18,19,20,21,22,23,24] Testimonials from physicians and organizations that communicate electronically with patients have actually pointed to *improvements* in physician practice workflow and productivity associated with use of online communication tools. And recently released professional liability [25] and national privacy/security [26] guidelines provide clearer guidance to physicians for communicating electronically with patients.

Adoption Incentives

The most common incentive for increasing adoption of electronic patient-physician communication is payer-based reimbursement. The seven pilots of payers reimbursing physicians for online consultations show payments to physicians in the range of $20 to $25 per e-visit and patient copayments of $5 to $15. These studies show that when health plans sponsor and pay physicians to communicate electronically with patients, physician adoption increases.

Other approaches that might be considered include:

- Implementing bonus incentives for physicians who implement e-visits; and
- Developing special arrangements between payers and providers for practices that implement e-visits.

E-Prescribing

Not only is prescription-writing one of the largest sources of medication *errors*, but significant opportunities exist to reduce drug *costs* by migrating patients to less expensive alternatives. Using electronic tools that provide alerts to physicians to generate safe, formulary-compliant prescriptions and then transmitting those electronically to the patient's pharmacy can decrease medication errors and reduce drug costs.

Description

Electronic prescription-writing or "e-prescribing" solutions automate the prescription-writing process for ambulatory physicians. Using handheld devices or personal computers, the physician reviews a patient's past medication history and the latest drug and insurance formulary information, writes a new prescription or authorizes a refill, and sends them through a secure network to the patient's pharmacy. (These capabilities were used for the analysis in this report, although not all e-prescribing solutions provide this full range of capability). From the physicians' perspective, e-prescribing can either exist in standalone mode (where physicians use handheld devices with no connection to a practice's other clinical systems to generate prescriptions) or as an integrated application (whereby e-prescribing is one component among the broader capabilities of the comprehensive electronic medical record [EMR] system used by a physician practice to manage patient care functions).

Benefits

E-prescribing offers patients decreased wait times for prescriptions and reduced errors when prescriptions are electronically transmitted to and more easily read by pharmacists. Health plans and payers seeking to manage health care costs can more effectively control drug expenditures through improved formulary adherence when physicians use e-prescribing tools combined with online formulary information. And new evidence points to quantifiable savings and efficiencies for the physician practice that uses e-prescribing technology to generate prescriptions. [27,28]

Improved Quality

Patient safety can be improved when e-prescribing solutions alert physicians that a medication or dosage inappropriate for a particular patient is about to be prescribed or its dosing is inappropriate. If the physician has more complete drug and dosing information at hand when the prescription is written, adverse drug events can be reduced. [29] The State Board of Pharmacy estimates that 90 percent of the prescriptions filled improperly in Massachusetts each year "are a result of either the wrong drug or dosage having been prescribed." [30] A 2002 Harris survey reported that more than 75 percent of surveyed physicians felt that e-prescribing solutions enabled them to deliver better quality care.[31]

A Case-in-Point: *Tufts Pilots E-Prescribing Application*

The Problem: Physician compliance with drug formularies and the "hassle factor" of prescriptions for physicians, pharmacies and patients.

The Solution: Tufts piloted e-prescribing tools at 15 physician sites.

The Results: Physicians and office staff saved up to two hours per day managing prescriptions, and pharmacists saved almost an hour a day. Physicians using e-prescribing tools showed a shift towards use of generic medications. When projected across the entire health plan network, costs for new prescriptions could decrease by as much as 68 cents per member per month with the use of e-prescribing tools. As a result of this pilot, Tufts has announced the expansion of e-prescribing to 5,000 physicians.

Reduced Costs

Physician **office efficiency** can be improved when the time physicians spend writing prescriptions, handling questions from pharmacists about illegible prescriptions, and rewriting prescriptions to meet formulary requirements is reduced. One 22-physician specialty practice reported that almost 30 percent of its prescriptions generated a callback to the practice, incurring support staff costs and lost revenue of more than $175,000.[32] A recent Tufts Health Plan study involving 100 physicians found that those using an e-prescribing solution saved *up to* two hours per day in pharmacy management tasks [28] (though it's not clear whether such steep savings would be achievable across all physicians using an e-prescribing product). These increased efficiencies translated to $3,000 per physician per year at one 22-member cardiovascular group through reduced callbacks [32] and an average of up to $9,333 per physician per year at a two-person urban general internal medicine practice. [27]

Drug expenditures can be reduced when e-prescribing solutions prompt physicians to select generic and formulary medications over higher-priced name-brand and non-formulary drugs. One study of over 680,000 prescriptions written by more than 1,200 physicians using an e-prescribing solution reported that health plans could save between $0.75 and $3.20 in generic usage and formulary compliance per prescription written using an e-prescribing product.[33] The Tufts Health Plan study mentioned above reported that 50 percent of survey respondents switched to preferred drug therapies when prompted by the e-prescribing solution. [28]

E-prescribing solutions may also decrease drug-related **malpractice claims**, in some cases reducing malpractice insurance costs by 5-10 percent. [34]

Costs

The costs for e-prescribing vary based on whether the solution provides basic prescription-writing capability along with formulary look-up, or whether the application integrates with the physician's practice management system to provide access to patient demographic and clinical information. The unit cost to physicians using a fully-integrated e-prescribing solution includes the following:

Table 3: Estimated Costs of E-Prescribing (Integrated with Physician Practice Management System)

Component	Projected Cost per Physician
Wireless handheld device	$700
PC server	$1,500
Wireless network access points *(per physician practice)*	$500
Integration w/practice management system	$3,000
Implementation *(8 hours physician setup time)*	$400
Training *(vendor costs)*	$500
Software costs *($95 per physician user per month including support costs)*	$1,134
Initial First-Year Costs	$7,734
Annual Ongoing Costs	$1,134

Source: "Improving Drug Prescribing Practices in the Outpatient Setting," California HealthCare Foundation, October 2002; e-prescribing vendor contacts and other FCG sources

Standalone e-prescribing solutions are estimated to cost significantly less – approximately $1,000 per physician per year – though these solutions provide less functionality and potentially fewer benefits.

If e-prescribing solutions were widely adopted by physicians across Massachusetts, the total cost for purchasing and installing the hardware and using an integrated, Internet-based solution for the first year could approach $139 million. After the first year, ongoing annual costs would be $20.4 million.

Current Solutions and Marketplace Adoption

Two key stakeholders in the e-prescribing marketplace are the pharmacies that dispense the medications, and the pharmacy benefit managers (PBMs) that manage patient insurance and drug formulary coverage for insurers and employers – and in some cases dispense medications themselves through mail-order pharmacies and other venues. In general, the pharmacies control the electronic transmission of prescriptions from physicians' e-prescribing applications to the pharmacies, and PBMs control the most current pharmacy benefit and formulary information. In Massachusetts, RxHub is the entity that offers an e-prescribing connectivity for payer formulary information via three of the PBMs, and SureScripts is the entity that offers e-prescribing connectivity for electronic fax transmission of prescriptions to the local pharmacies.

At present, the marketplace appears to be consolidating around these two general approaches, though with the current competition between pharmacies and PBMs, these solutions do not appear to be converging yet. While full-fledged e-prescribing involves having up-to-date formulary information as well as transmitting prescriptions electronically to the pharmacies (rather than faxing them, in the absence of a true electronic transmission), having online access to updated formulary information produces greater benefit than electronic transmission.

A recent study by Medco Health Solutions reported that 13 percent of Boston physicians are currently using a range of e-prescribing solutions, [35] (though the specific approach and capabilities that each possesses is not known). Tufts Health Plan recently announced that it is expanding its deployment of e-prescribing via wireless Blackberry devices to 5,000 physicians.[36] One senior retail pharmacy executive predicted that most prescriptions will be electronic within five years. [37]

Net Benefit to Massachusetts with Increased Adoption

If e-prescribing solutions were widely adopted by 75 percent of the physicians across Massachusetts who aren't already using such tools, over $150 million in savings across the health system could result from improvements in physician practice efficiencies, increased use of generic and formulary medications, and decreased malpractice insurance. When costs are factored in, the ongoing net benefit to Massachusetts of e-prescribing is more than $140 million per year after year one. The following table summarizes the estimated costs and benefits to Massachusetts of e-prescribing.

Table 4: Net Benefit to Massachusetts of E-Prescribing

	Year 1	Years 2 and Beyond
Savings from Physician Practice Efficiencies	$ 83.0 million	$ 83.0 million
Savings from Increased Use of Generic and Formulary Drugs	$ 68.6 million	$ 68.6 million
Savings from Decreased Malpractice Insurance	$ 4.4 million	$ 4.4 million
Total Projected Savings	$156.0 million	$156.0 million
Projected Costs	$104.3 million	$ 15.3 million
Net Benefit to Massachusetts	$ 51.7 million	$140.7 million

Calculation of the net benefit of e-prescribing for Massachusetts was predicated upon the following data, calculations and key assumptions:

- E-prescribing solutions would be adopted by three-quarters of the remaining 87 percent of the Massachusetts physicians (17,946) [13] who do not currently use an e-prescribing solution;
- Average operational savings of almost $6,200 per physician would be achieved through increased staff efficiencies and the associated time savings from reduced callbacks (reflected in one study as a 30 percent reduction in calls between the pharmacist and the physician practice); [27,32]
- Savings in malpractice costs from e-prescribing would be five percent per year on a total of $118.7 million in Massachusetts malpractice claims; [27,38]
- Fifty-five million prescriptions are filled in Massachusetts each year; [39] and
- Increased use of generic and formulary drugs would lead to an average of $1.98 in cost savings per prescription for the 84.2 percent of Massachusetts residents who are insured through health plans or managed Medicaid. [33,40]

Barriers to Adoption

Five barriers to physician adoption of e-prescribing solutions are typically cited: [41]

1. The **costs** to purchase the technology and pay for it on an ongoing basis;
2. The **lack of benefits** that accrue to the physician practice directly;
3. The **added time** it takes to use the technology as compared to writing a prescription by hand on paper;
4. The **lack of interoperability** among e-prescribing solutions offered by different constituents (as described above), and the associated challenge of **integrating** each solution with physician practice management systems; and
5. **Legal issues** associated with e-prescribing.

Among these barriers, the costs of e-prescribing solutions to the physician practice and associated the interoperability/integration issues represent the most significant challenges.

Adoption Incentives

Several approaches could help spur adoption of e-prescribing solutions across the Commonwealth:

- Massachusetts could offer private and small group practice physicians a tax credit for the purchase and ongoing use of e-prescribing solutions. The federal government is currently considering reimbursement incentives for Medicare-eligible physicians who adopt e-prescribing solutions by 2006; [42]
- Offer low- or no-cost revolving loans to physician practices that implement e-prescribing solutions; and
- The ongoing costs for e-prescribing solutions could be financed through the savings that payers and PBMs gain from improved formulary compliance and increased ordering of generic medications. These savings could be distributed in the form of bonus or per-transaction payments to physicians; given special consideration during contract negotiations between payers and providers who use e-prescribing; or used to fund the ongoing costs for e-prescribing systems.

Ambulatory CPOE

While a minority of physicians currently use electronic medical records (EMRs) in the ambulatory setting, there is growing evidence that they can be effective tools for increasing practice efficiencies and decreasing costs. [43] Ambulatory EMR capabilities vary widely, with tools that range from creating documentation of the physician office visit to e-prescribing and computerized physician order entry (CPOE). For the purposes of this report, only the costs and associated benefits of an ambulatory EMR with CPOE are being considered.

Description

Ambulatory CPOE supports the electronic ordering of medications, diagnostic tests, interventions and referrals by outpatient providers. [1] While e-prescribing can be viewed as a sub-set of this functionality, ambulatory CPOE is seen as broader capability used for ordering more than just medications. Advanced ambulatory CPOE capabilities also incorporate clinical decision support algorithms that alert physicians when orders are inappropriate and guide the physician to the best orders based on information (including test results) received and stored in the patient's record. As a result of this decision, support and record management capability – often embedded within a more comprehensive ambulatory EMR – the associated costs and benefits of ambulatory CPOE are projected to be much larger than for e-prescribing or electronic ordering alone. Ambulatory CPOE capabilities might be seen as a progression *beyond* those of e-prescribing.

A Case-in-Point: *Ambulatory CPOE Addresses Drug Formulary Challenges at Harvard Vanguard*

The Problem: Managing multiple payers' pharmacy benefits is a complicated undertaking.

The Solution: Harvard Vanguard Medical Associates (HVMA) used the CPOE capabilities in its ambulatory EMR to guide physicians towards more cost-effective and formulary-compliant medications.

The Results: HVMA projects up to $2 million in annual savings for each of two payers, partially attributable to its use of ambulatory CPOE.

Benefits

Ambulatory CPOE systems have demonstrated a wide (and growing) range of quality and cost benefits for patients, payers and physicians themselves. With guided orders, alerts and access to patient-specific clinical information, physicians can make better clinical decisions that lead to improved patient safety, decreased errors and more efficient resource utilization. [1]

Improved Quality

Ambulatory CPOE systems – like their inpatient counterparts – can help reduce adverse drug events. Access to patients' past medical information and most recent test results and prescriptions coupled with system alerts to assist physicians in making the best clinical decisions can reduce the incidence of adverse drug events resulting from inappropriate medications.

Reduced Costs

A growing body of evidence points to savings that accrue to both payers and providers through physician use of ambulatory CPOE. [44]

1. **Insurers and employers who pay a majority of health care costs** can experience savings when physicians use ambulatory CPOE systems through several mechanisms:
   - Drug savings of up to 28 percent when physicians prescribe less expensive generic medications; and

- Laboratory and radiology savings of up to 20 percent through decreased duplicate testing and more prudent ordering of appropriate tests. [1]

2. **Physicians** who use ambulatory CPOE systems themselves – and the delivery organizations they work for – can also experience cost savings and increased revenue through several mechanisms:
   - Increased revenue can result from more accurate charge capture and coding, with fewer rejected claims as a result;
   - Productivity gains can be realized through increased practice efficiencies;
   - Malpractice insurance costs are often 5 to 10 percent lower for practices using an ambulatory EMR with CPOE; and
   - Decreased costs can result from decreased paper expenses, medical record staff and transcription costs. [45,46]

Costs

The costs of ambulatory EMRs and CPOE systems can vary widely – for two main reasons: 1) the functionality they provide varies so much from product to product, and 2) the costs for installing an office-based system that supports communication across multiple physicians and sites can be significantly higher than those for a one or two-physician practice. Cost figures for ambulatory EMR and CPOE systems reported in trade journals provide little or no context for the type of system or the specific cost components (capital and operating) that these prices reflect. Recent responses by two ambulatory CPOE vendors to a request-for-proposal issued by a large multi-site physician practice showed that annual costs for basic hardware and software alone were $5,000 per physician per year. When other essential hardware and operating costs (including implementation and ongoing support) were factored in, the annual per-physician cost became $18,000. [47] The Center for Information Technology Leadership (CITL) at Partners HealthCare in Boston estimated even higher costs associated with ambulatory CPOE systems. [1]

Since CITL had already undertaken extensive research to build a detailed model for estimating the costs and benefits of ambulatory CPOE systems nationally, this model was used by CITL to project the costs and benefits for these systems across Massachusetts for the purposes of this report. The result of these calculations is provided below.

Table 5: Estimated Costs of Advanced Ambulatory CPOE

Component	Projected Cost per Physician
Acquisition costs include license or subscription fees; development of interfaces to other systems (such as practice management and laboratory); development of knowledge bases and customization of EMR software; implementation costs and training fees **Initial First-Year Costs**	$44,940 - $377,600*
Ongoing costs include ongoing license or subscription fees, maintenance and infrastructure costs **Annual Ongoing Costs**	$5,257 - $32,000*

**depending on size of physician practice*

Source: Calculations based on the analytical model in "The Value of Computerized Provider Order Entry in Ambulatory Settings," Center for Information Technology Leadership, 2003.

Average per-physician costs can be higher for these same systems when purchased by smaller practices because the costs for central hardware required to run the system regardless of practice size are spread over fewer physicians.

Current Solutions and Marketplace Adoption

Several dozen vendors offer ambulatory EMR products with a range of CPOE capabilities. Some hospital-based clinical information system vendors offer ambulatory CPOE capability as an adjunct to their inpatient suite of products; other vendors offer standalone CPOE products designed specifically for ambulatory sites. Because few true industry standards exist for EMR and CPOE systems, comparing products and integrating them with other practice-based systems is difficult. In addition, some of the products offer more well-developed CPOE capabilities than others. As a result of the breadth of product offerings and the lack of standards, selecting an appropriate vendor product is a difficult undertaking for many physician practices.

Survey data reflecting current physician adoption of ambulatory EMR and CPOE products are difficult to interpret. One survey of group practices showed that 28 percent of practices were using an ambulatory EMR, though their level of CPOE capabilities was not specified. Among these respondents, larger practices were more likely to be using an EMR than smaller ones. [48] Given the target audience for this survey, the industry-wide level of adoption across *all* physician practices is likely to be lower. Another survey showed that 31.6 percent of physician practices had invested in an EMR by 2002, with another 14.5 percent planning to do so within the subsequent 12 months. [49] Again, the level of ambulatory CPOE capability was not surveyed, and level of survey responses from small (one- to two-physician) practices is not known. Given the likely skewed responses from larger groups and lack of clarity about actual CPOE capabilities and use, the true adoption rate for ambulatory CPOE is more likely to be in the 10 to 20 percent range.

Net Benefit to Massachusetts with Increased Adoption

Assuming a 75 percent physician adoption rate, the total costs and benefits of implementing ambulatory CPOE across Massachusetts (based on calculations from the CITL model) are indicated in the following table.

Table 6: Net Benefit to Massachusetts of Ambulatory CPOE

	Annual Average After Five Years
Total Projected Savings	**$ 1.1 billion**
Projected Costs	**$ 833.1 million**
Net Benefit to Massachusetts	**$ 290.3 million**

The savings above reflect calculations for: optimal medication, laboratory and radiology usage (e.g., eliminating overuse, misuse and underuse); reduction in medication errors; and other rudimentary EMR savings.

It is projected that advanced ambulatory CPOE systems implemented across Massachusetts would eliminate up to 47,000 preventable adverse drug events (ADEs), up to 3,100 life-

threatening ADEs, up to 29,000 ADE-related visits, and up to 4,300 ADE-related hospitalizations per year.

Barriers to Adoption

Ambulatory CPOE adoption is made more difficult for a number of oft-cited reasons: [50]

1. Lack of funding and necessary resources;
2. Cultural resistance and lack of support from medical staff;
3. Difficulty finding the "right" solution from among all those in the vendor marketplace that meets a practice's requirements;
4. Difficulty moving from paper to electronic records; and
5. Lack of industry standards.

As more physician practices begin using ambulatory EMR and CPOE systems, however, evidence of their effectiveness and ease-of-use has been increasing. [43]

Adoption Incentives

Several approaches could help spur adoption of ambulatory CPOE across the Commonwealth:

- A state coalition or task force could seek out and widely publicize ambulatory CPOE success stories including actual costs and benefits achieved – and even provide resources or offer guidance with selecting and implementing systems;
- Payers could offer rewards or bonus incentives to provider organizations that adopt ambulatory CPOE. California's Pay-for-Performance program is an example of one payer-based program that pays physicians a bonus for implementing certain technologies – among which ambulatory EMRs and CPOE would qualify; [95]
- The Department of Public Health could set target dates for the adoption of EMR and CPOE for physician practices as part of the licensing process;
- The Leapfrog Regional Rollout Committee could require physician practices to adopt ambulatory CPOE adoption in advance of the likely forthcoming recommendation from The Leapfrog Group; and
- Low- or no-cost revolving loans could be made available for physician practices wishing to implement ambulatory CPOE systems.

HIMSS, the Health Care Information and Management Systems Society, has recently been joined by more than 70 major information technology companies and 80 senior health care executives in calling for the universal adoption of electronic health records (EMR systems), [51] and leading health care organizations are calling for the federal government to issue standards for clinical data systems. [52]

Inpatient CPOE

Computerized physician order entry (CPOE) has received much attention in health care of late. Its ability to improve quality of care and reduce errors has been widely studied and results published in many leading medical journals. A growing number of health care vendors now offer packaged applications with CPOE capabilities, and organizations such as The Leapfrog Group have begun setting forth standards by which health delivery organizations can evaluate their CPOE capabilities.

Description

CPOE is a computer application that is used by physicians to enter diagnostic and therapeutic patient care orders. In most cases these orders are communicated electronically to the departments and personnel responsible for carrying them out, either by directly interfacing to specific departmental computer systems that execute the order (such as laboratory or pharmacy systems), or by staff printing out the orders in the appropriate locations for execution. For CPOE applications electronically interfaced to departmental systems, confirmation of the order and the ensuing result (in the case of tests) is then transmitted back to close the ordering loop.

The power of CPOE is not in automating the order-writing function for the physician but in incorporating clinical decision support during the order-entry process. Clinical decision support capabilities range from very basic edits that check for data types and required fields, to offering a list of default orders or order sets, to highly complex dosing calculations that consider patient characteristics, recent test results and knowledge-based rules. A more complete list of the range of clinical decision support tools is discussed in the Leapfrog Group Report on CPOE called "Computerized Physician Order Entry: A Look at the Marketplace and Getting Started." [53]

Benefits

Benefits from CPOE can be improvements to care quality – typically through care standardization and reduced medication errors; and also as cost reductions by providing more cost-effective treatment alternatives, reducing duplicate orders, and lowering resource utilization.

Improved Quality

Medication safety is by far the most widely-cited benefit of CPOE. Numerous studies have quantified the rates of medication errors, adverse drug events, and potential adverse drug events. According to the Institute of Medicine Report, *To Err is Human*, between 50,000 and 100,000 deaths each year are attributable to adverse drug events (ADEs). [3] Studies in New York, Utah, and Colorado demonstrated that ADEs constitute 19 percent of all adverse events in hospitals, and that overall 2.9 percent to 3.7 percent of admissions are complicated by ADEs. [89]

A Case-in-Point: *Industry-Leading Experience with Inpatient CPOE at Partners Healthcare*

The Problem: Adverse drug events cost $6,000 each; up to 28 percent of them are considered preventable.

The Solution: Partners expanded its use of inpatient CPOE across two hospital organizations.

The Results: Partners found a 55 percent reduction in serious medication errors and $5 million to $10 million in documented savings through its use of inpatient CPOE at Brigham and Women's Hospital.

CPOE can play a significant role decreasing the number of ADEs. A study performed at Brigham and Women's Hospital demonstrated a 55 percent reduction in serious medication errors and 17 percent decrease in ADEs. [29] A study at LDS hospital (Salt Lake City, Utah) showed a 70 percent reduction in ADEs related to antibiotics. [54]

CPOE can also offer multiple tools to assist in standardizing care delivery, including use of order sets that execute multiple, associated tests; recommendations for corollary or secondary orders; and display of current practice guidelines for care and treatment. Representative findings from studies conducted over the past several years include:

- Increased compliance with recommended orders from 21.9 percent to 46.3 percent;
- Reduction in inappropriate antibiotic use of 75 percent; and
- Increased use of preferred H2 blocker from 15.6 percent to 81.3 percent [89]

Finally, the speed of electronic delivery of orders provides opportunities to decrease turnaround time for medication delivery, lab specimen collection and completion of other diagnostic tests. For example, Montefiore Medical Center in New York demonstrated a 58 percent reduction in medication turnaround time after the implementation of CPOE, and estimated savings of two hours per day for each ward clerk, 20 minutes per day per nurse, and 200 minutes per day per pharmacist. [89]

Reduced Costs

Reduced costs from CPOE are achieved through the reduction of medication errors/ADEs and through the use of decision support capabilities that improve resource utilization and lower the hospital length of stay. Representative examples of cost reductions associated with CPOE include:

1. $500,000 reduction in pharmacy charges through a dosage recommendation change from a single drug (representing 92 percent switch to a new dose); [89]
2. Reduction in drug costs ($340 to $102 per patient), hospital length of stay (from 12.9 to 10.0 days) and overall hospital costs (from $35,283 to $26,315) from CPOE use for antibiotic ordering; [54]
3. Reduction in total inpatient charges of 12.7 percent with CPOE use; [55]
4. Reduction in emergency department expenditures by $26 per visit; [56] and
5. Reduction of preventable inpatient ADEs with a cost of $6,000 per admission. [29]

Costs

The costs for inpatient CPOE for a typical 500-bed hospital are indicated in the following table.

Table 7: Estimated Costs of Inpatient CPOE

Component	Projected Cost per 500-Bed Hospital
***One Time Capital Costs*:** hardware, software, network, end user devices, and implementation assistance	$4.85 million
***One Time Operating Costs*:** Information Services resources and other hospital staff and physicians working on the CPOE project	$3.05 million
***Annual Ongoing Costs*:** hardware, software and network maintenance; Information Services (IS) staffing to support CPOE; and non-IS clinical resources	$1.35 million

Source: Based on actual figures from five hospital case studies cited in the report, "Computerized Physician Order Entry: Costs, Benefits and Challenges," written for the American Hospital Association (AHA) and the Federation of American Hospitals by First Consulting Group, January 2003

This baseline projection includes the following cost assumptions:

- The organization's current computer network does not require any upgrades in order to support CPOE;
- CPOE is implemented as an add-on module to the hospital's core clinical information system product already installed;
- CPOE implementation includes interfaces to laboratory, radiology and pharmacy systems, or the system is integrated with these modules; and
- No other clinical and business applications are required.

For smaller hospitals of approximately 250 beds, a scaled-down cost model includes $5 million in one time costs ($3 million in capital and $2 million in operating costs) and $700,000 in annual ongoing costs. Details and all assumptions for both cost models are described in the American Hospital Association and Federation of American Hospitals sponsored CPOE report. [89]

Current Solutions and Marketplace Adoption

Adoption of CPOE in hospitals nationwide has been low. Based on the results of a recent Leapfrog survey, [57] only six hospitals in Massachusetts have implemented CPOE, with nine others making good progress towards installation. A growing number of health care information system vendors offer packaged solutions with CPOE capabilities.

Net Benefit to Massachusetts with Increased Adoption

For the purposes of this model, only benefits that could be generalized and quantified across all Massachusetts hospitals and the entire patient population were included. These are represented by the following:

1. **Reduction of inpatient ADEs** – Based on findings from a study at Brigham & Women's Hospital, [29] preventable inpatient ADEs cost $6,000 each and occur at a rate of 1.46 percent. With 809,857 discharges per year in Massachusetts hospitals, [58] the benefit impact of CPOE in reducing preventable ADEs approaches **$50 million** annually if 75 percent of the Commonwealth's hospitals adopt CPOE.

2. **Improved utilization of inpatient resources** – Based on a Regenstrief study [55] that demonstrated a 12.7 percent reduction in charges per admission with the use of CPOE, savings could amount to nearly **$950 million** annually across Massachusetts, assuming

809,857 discharges, an average cost of $13,400 per case, and a CPOE adoption rate of 75 percent. [58]

3. **Improved utilization of Emergency Department (ED) resources** – Based on a Regenstrief ED study, [56] savings of $26 per encounter were achieved in 50 percent of the ED cases when prior patient clinical data was available at the point of care. The potential savings when applied to Massachusetts' ED visits is nearly **$25 million** annually if CPOE were adopted at 75 percent of the Commonwealth's hospitals.

The total estimated annual benefit for inpatient CPOE, assuming **75 percent adoption**, is **$966.0 million.** These figures exclude the savings for the six hospitals that have already implemented CPOE. This estimate represents a low estimate because niche benefits (e.g., antibiotic medications, brand-to-generic medication switching, intensive care unit length-of-stay decreases) and other intangible benefits cited in the literature were not included.

Calculation of the net benefit of inpatient CPOE for Massachusetts was predicated upon the following data, calculations and key assumptions:

- **Hospitals with CPOE already installed:** Four Massachusetts 500-bed hospitals and two 250-bed hospitals have already installed CPOE and have not been included in the cost/benefit calculation.
- **Hospitals with CPOE installation in progress:** Of the nine hospitals underway with CPOE implementation, three are in the 500-bed size category and six are in the 250-bed size category. For the purposes of this model, these hospitals were calculated to incur 50 percent of ongoing costs in Year 1 and 100 percent of the ongoing costs in Years 2 and beyond (capital costs for these hospitals were assumed to have already been committed or spent). 37.5 percent of the benefits were accrued in Year 1 and then 75 percent in Year 2 and beyond.
- **Hospitals not started with CPOE:** Of the remaining Massachusetts hospitals, 50 percent of one-time costs were calculated for Year 1, 50 percent of one-time and ongoing costs in Year 2, and 100 percent ongoing costs in Years 3 and beyond. Benefits were excluded for Year 1, calculated at 37.5 percent in Year 2 and at 75 percent in Years 3 and beyond.

Table 8: Net Benefit to Massachusetts of Inpatient CPOE

	Year 1	Year 2	Years 3 and Beyond
Estimated Savings	$ 73.7 million	$ 581.7 million	$1.0 billion
Projected Costs	$121.9 million	$137.9 million	$ 34.0 million
Net Benefit to Massachusetts	($48.2 million)	$443.8 million	$966.0 million

Barriers to Adoption

Implementing CPOE has a significant impact on most of the care delivery processes in a hospital and on the interactions among physicians, nurses, and pharmacists. The people, process and technology changes and resources associated with an effort of this size and complexity are extremely challenging, often resulting in financial challenges, political struggles

and technical problems. Some of the most significant barriers to implementing CPOE specifically include:

Cost: The high cost of CPOE is a hurdle for many provider organizations – most of which are suffering from deteriorating profit margins due to declining reimbursement. Access to capital for new technology is scarce; as a result, CPOE funding competes with other capital requests such as major building renovations and medical equipment purchases. Lack of adequate financial support for IT and difficulty proving quantifiable benefits and a return on investment have been the top two IT implementation barriers cited in 2000 and 2001 HIMSS Leadership Survey. [59]

Redesigning care processes: Implementing CPOE alters the way physicians, nurses, and pharmacists perform their work and the way they communicate with each other. Achieving this level of organizational change requires consistent support from leadership plus dedicated resources and commitment from all areas of care delivery. During the design process, clinical workflow must be carefully analyzed and modified to support the transition from paper to automated systems. For example, nurses must be informed about new orders in the absence of traditional paper orders, hospital policy must be established for issuing and executing verbal orders, and a wide range of clinical staff must agree on the level of clinical decision support checking that will be performed at the time of ordering, order verification, and medication administration.

Technology challenges: There are many technical hurdles associated with implementing and supporting CPOE. For example, vendor CPOE applications are considered relatively immature in their overall development life cycle. Most vendors have only a handful of clients who have completed implementations, while some vendors are still in their testing stages. In addition, communication between CPOE and pharmacy applications involves a highly complex real time interface that some vendors are still developing. These products still require duplicate data entry of orders in the pharmacy which negates some benefits of CPOE. Finally, the technological environment and infrastructure for CPOE must provide 24 hour uninterrupted access with sub-second computer response times.

Time to install: Once a vendor is selected (which can take approximately four to six months), configuring the system for use at the hospital, implementing a pilot, and rolling out the application hospital-wide can take two to three years. [89]

Level of risk: Many health care organizations would prefer to assume the role of "early follower" rather than "leading edge risk taker" when it comes to projects of the magnitude and expense of inpatient CPOE. With the increased awareness of CPOE installation failures, some organizations are taking a wait-and-see attitude. However, product maturity and vendor experience with implementations are helping to mitigate some of the risks for installing CPOE.

Physician adoption: Switching from handwriting to computer ordering requires changes to physician work patterns. Adding this level of change to an already hectic schedule is not a trivial request. Success in altering the practice requires the organization's leadership to clearly and continuously communicate to physicians what they and their patients will gain from the use of CPOE. Even with vocal physician champions and executive management commitment, many times it takes months and lots of "carrots" to ensure adoption.

Adoption Incentives

Several approaches could help spur adoption of inpatient CPOE across the Commonwealth:

- A state coalition or task force could seek out and widely publicize ambulatory CPOE success stories including actual costs and benefits achieved – and even provide resources or offer guidance with selecting and implementing systems.
- The Commonwealth or a coalition of employers could set target dates for the implementation of CPOE.
- Payers and/or employers could offer reimbursement or bonus incentives (much like the Leapfrog Group) for health care institutions with CPOE installed.
- The Commonwealth could provide or facilitate grant funding.
- Offer low- or no-interest loans for the purchase of CPOE systems.

Disease Management Tools

With improved life expectancy and more people developing chronic disease, [60,61] stakeholder interest in disease management approaches for reducing health care costs and improving quality is on the rise. Health plan spending on disease management was estimated to have grown from $68 million in 1997 to about $1 billion in 2002. [62] Employers have found disease management useful as well: estimates of employer usage of disease management programs range from 30 to 44 percent. [62,63] And there are at least two dozen independent companies that offer disease management programs to health plans, employers and providers. [63] Effective disease management approaches involve a range of information technology tools to identify populations of patients at risk, track the health status of patients with chronic illness, and help patients manage their own care more effectively.

Description

For the purposes of this report, three categories of disease management tools are considered:

1. **Predictive modeling** involves tools that apply sophisticated mathematical models and analysis to identify patients whose medical conditions or health status are most likely to lead to significant dollars spent on health care (therefore leading health care providers to more closely manage these patients to prevent serious hospitalization and thereby reducing the overall costs associated with their care).

2. **Patient registries** are primarily database tools used to track and manage patients with certain disease states so that clinical interventions are completed as required and patients are kept healthier through preventive care.

3. **Patient-focused disease management tools** can include a wide range of devices that patients use to help monitor and manage their own health remotely – connecting them from home to the physician office.

While use of many of these tools is still early, each of them has produced early evidence of their contribution to reducing costs and improving quality.

Benefits

The benefits of using disease management tools include improvements in patients' overall health status as well as reduced costs through better identification of at-risk patients, tracking and management of patients to specific care standards, and collaborative partnering with patients in the care process.

Improved Quality

Use of disease management tools and programs has demonstrated improved patient compliance with clinical protocols – particularly for patients with chronic diseases such as diabetes, congestive heart failure (CHF) and asthma. In one report from a predictive modeling vendor, predictive modeling tools

A Case-in-Point: *HPHC Uses Disease Management Tools to Decrease Acute Hospitalizations*

The Problem: The incidence of chronic disease affects both the quality of life for members as well as the cost to a health plan of providing patient care.

The Solution: HPHC adopted predictive modeling tools alongside a disease management program to identify and care for high-risk patients.

The Results: Acute hospitalization for high-risk patients decreased from 16.73 to 6.71 percent .

and algorithms were able to identify three times as many high-cost patients than traditional queries and generated a 50 percent higher return-on-investment. [64] In one study by a disease management vendor using patient outreach tools, the number of enrolled patients with diabetes receiving an HgA1C test increased more than 55 percent, while patients with a cardiovascular condition taking low-dose aspirin increased more than 25 percent. [65] In several studies by a vendor of patient-focused disease management tools, patients using a remote, home-based device were 93-95 percent compliant with their medication regimen, up from 34-63 percent compliance before they started. [66]

Reduced Costs

Given the complexities of chronic disease and the multiple factors that affect patients' health, it is especially difficult to accurately attribute specific cost savings to any one disease management technology. One disease management organization that utilizes its own predictive and patient registry-like tools to address patients with chronic disease has demonstrated savings of between $36 and $52 per member per month for the diabetic patients that they manage, with admissions per 1,000 diabetes program members decreasing by 27 percent in the program's second year. [67] This same organization reports that it can reduce a health plan's costs for a particular disease population by 12 to 20 percent in the first year of an integrated disease management program. [62] Using predictive modeling tools along with disease management programs, employer Pitney Bowes was able to limit its medical cost increases to nearly half those of most companies. [68] It is important to note, however, that most of these results reflect the use of disease management technologies *alongside* an outcomes-based disease management program. Use of information technology certainly helps, however: one consultant projected a "threefold to sevenfold reduction in disease management program costs using information technology." [69]

One patient registry vendor demonstrated annual incremental revenue of $6,800 in one primary care physician office using the tool with 180 chronic condition patients – a benefit representing twice the annual operating costs of the application. [70]

In studies of the patients using a remote, home-based monitoring device, emergency room visits and inpatient admissions fell dramatically. [71]

Costs

The costs for many of these disease management tools can vary widely, depending on how they are deployed and whether they are coupled with disease management programs. The cost of predictive modeling applications, for example, can vary depending on whether the buyer is a health plan, employer or provider and whether or not analysis and disease management services are purchased as well. There are only a small number of patient registry applications on the marketplace today; one such tool is estimated to cost physicians $2,800 per year. The cost of home-based patient monitoring devices can range from $30 up to $250 per month plus installation costs.

Current Solutions and Marketplace Adoption

The use and adoption of many of disease management tools does not yet appear to be higher and may be even lower than the overall rate for adoption of IT in health care. [72] While more health plans are employing these tools as a means to better manage health care costs, and the soaring revenues for several of the vendors in this market segment indicate growing adoption of their products, the number of providers and patients currently using these tools has not been

well studied or documented. One estimate projects that only 18 percent of any eligible chronic disease population is currently in a disease management program. [73]

Anecdotal information indicates that many of the nation's major health plans have purchased and are using **predictive modeling** tools, though to what degree is not clear. In fact, conversations with the Massachusetts payer organizations participating in this study indicate that they all own and use at least one – and in some cases, multiple – predictive modeling tools. Physician use of **patient registries** is believed to be significantly lower. In one late-2000/early-2001 study of the adoption of technology by physicians, hospitals and health systems, Web-based patient registries were in use by less than 5 percent of the surveyed provider organizations (though interest in implementing a patient registry approached 20 percent among those that lacked one). [74] Use of **disease management tools for remote patient monitoring** and facilitation of care is also believed to be low: again, less than 5 percent of hospitals and health systems reported using any home-based monitoring devices linked to patient records. [74]

Because the market is considered relatively immature, there are a significant number of vendors offering products, particularly in the patient-focused disease management space. Several of the disease management vendors also offer clinically-oriented case management services to accompany their product offerings.

Net Benefit to Massachusetts With Increased Adoption

For the purposes of this model, only benefits that could be generalized and quantified across all Massachusetts hospitals and the entire patient population were included. These are represented by the following:

1. **Predictive modeling** – The net benefit of predictive modeling tools for Massachusetts would be difficult to calculate given that all the major health plans and several large provider organizations already have these tools and given that it's not clear to what extent they're already using them. The advantage of using these tools more extensively would be to better identify high-cost/high-risk patients so that they can be enrolled in disease management programs.

2. **Patient registries** – While no studies have been published that report cost *savings* associated with the use of patient registries, one source reports that a primary care physician using a patient registry with 180 chronic condition patients achieved annual incremental revenue of $6,800. [75] When extrapolated across 75 percent of all primary care physicians in Massachusetts, this incremental revenue could approach $40 million annually – yielding a net benefit after costs of **$23 million**.

3. **Patient home monitoring devices** – One vendor of patient home monitoring devices has published a series of reports citing benefits achieved through the use of its product for diabetic and CHF patients. When considering the range of results achieved for congestive heart failure, use of the home devices resulted on average in $7,830 reduction in costs per patient per year (mostly through reduced hospitalizations and emergency room visits). [76,77,78] The reduction in costs for diabetics on average was $747 per patient per year. [79] When extrapolated across 75 percent of the CHF and diabetic patients across Massachusetts, the net benefit is projected at **$687 million per year**.

The total estimated annual benefit for disease management tools at a 75 percent physician- and patient-adoption rate across Massachusetts is **$710 million**, as outlined in the following table.

Table 9: Net Benefit to Massachusetts of Disease Management Tools

Estimated Savings/Increased Revenue	
Predictive Modeling	**Not included**
Patient Registries	**$ 39.1 million annually***
Patient Home Monitoring Devices	**$ 861.0 million annually**
Projected Costs	
Predictive Modeling	**Not included**
Patient Registries	**$ 16.1 million annually**
Patient Home Monitoring Devices	**$ 174.0 million initially****
Total Net Benefit to Massachusetts	**$ 710.0 million annually**

**Represents incremental revenue **ongoing annual costs would be lower after initial installation*

Calculation of the net benefit of disease management tools for Massachusetts was predicated upon the following data, calculations and key assumptions:

- The cost for patient registries is estimated at $2,800 per primary care physician per year (which is probably a high estimate). [75]
- Cost saving estimates for patient home monitoring devices were only calculated for congestive heart failure (CHF) and Type 2 diabetes – the two chronic diseases for which actual savings data have been published. Cost savings attributable to decreased hospitalizations and emergency room costs from across five CHF studies and one diabetic study were each averaged to determine the respective per-patient-per-year savings.
- The cost of patient home monitoring devices was calculated at $125 for initial installation of each patient device and $360 per patient per year for ongoing costs.

Barriers to Adoption

There are a number of barriers that prevent more widespread adoption of disease management tools – several of which are related to the cost and funding.

1. Payer-investment in disease management tools and programs when **patients routinely switch employers and health plans** makes these stakeholders less willing to invest in such tools and programs when they're only likely to benefit other payers down-the-line.

2. Providers are typically unwilling to invest in and maintain disease management tools when the **benefits do not accrue to them**.

3. While the individual costs for many of these tools are not high, the cumulative **costs for purchasing and installing them across a provider-patient community** becomes more significant.

4. **Obtaining – and maintaining – patients' participation** in any disease management program can be difficult. Patient noncompliance with treatment plans is a significant problem in-and-of-itself; engaging patients in an active disease management program can be even more challenging. Furthermore, getting patients who are elderly or on fixed incomes access to and comfortable with technology can be difficult. **Gaining physician buy-in** for health plan-sponsored disease management programs can also be difficult.

Both patients *and their physicians* must be vested in any disease management program in order to ensure its success.

5. Given that both patients and physician practices currently experience a range of access to and usage of computer systems, effectively **integrating disease management tools with other systems** already in place can be difficult. As a result, patient registries and home monitoring tools must often operate in standalone mode, unconnected with the day-to-day computer systems that patients and physicians typically use – making their regular use less routine and more difficult.

6. Occasionally, fears of **patient privacy** being breached when clinical data are transmitted electronically are cited as barriers to adoption, though newly-released federal standards for privacy and security should reduce these concerns.

There are several other challenges related to the successful deployment of disease management tools which don't necessarily affect initial adoption but which can impact their overall effectiveness. They include:

1. **Disease management technologies are only tools.** Achieving tangible results from any disease management effort requires that these technologies be used in conjunction with disease management programs such as case management outreach, home visits and regular communication with the patient.

2. **Accurately identifying patients** with certain chronic diseases or who are at risk of incurring higher health care costs can be difficult – especially when patients receive care from multiple providers across a community and detailed, aggregated clinical data for these patients (beyond that available solely from claims information) are not always readily available.

3. Patients with at least one chronic disease often have ***multiple*** **chronic diseases** [80] so disease management efforts must be sufficiently broad and integrated in order to effectively address these multi-disease patients.

Adoption Incentives

Most incentives considered effective at increasing adoption of disease management tools involve support from the stakeholders that benefit from use of the tools – the health plans and employers. Examples of adoption incentives include:

- Payers and employers could reimburse physicians on a per-patient-per-year basis for their use of patient registries and patient home monitoring devices.
- Payers and employers could pay physicians an annual bonus for use of patient registries and patient home monitoring devices.
- Payers and employers could give special consideration for physician adoption of disease management systems during contract negotiations.
- Because use of home monitoring tools is still relatively early, a pilot demonstration project of these tools would make an ideal candidate for special grant funding.

Regional Data Sharing

Health care delivery involves a complex matrix of care providers and ancillary services. Physicians can practice in groups or solo. Care can be delivered in hospitals, public health clinics, ambulatory clinics, and private physician offices. Pharmacies, imaging centers and laboratories are all important players in supporting the care delivery process. Additionally, patients receive care typically from a group of primary care and specialty caregivers based on their location, illness and insurance coverage.

Coordinating the patient's clinical information from all of these sources is overwhelming. Responsibility for sharing data usually falls on the patient and involves time and effort for administrative staff in the hospital and physician practice who handle the paper charts, make copies, fax, mail and re-file. As with many manual processes involving multiple parties in different locations, there are many opportunities for delays and mistakes.

Regional data sharing is a solution addressing the current fragmentation of clinical information across care delivery sites.

Description

Regional data sharing provides a single view of a patient's clinical information across a community so that it can be readily accessed by any authorized person, regardless of care location. The approach typically involves three technical components: algorithms for efficiently and confidently identifying a patient based on name, date of birth and other key elements; a robust regional data network across which patient information is transmitted and shared among health care entities; and means for securing the network, restricting patient information, and issuing passwords so that only authorized users can access patient information. There are only a few such environments operational at this time, most limited to a small geographic region or selected care delivery sites. The progress made by the Santa Barbara County Care Data Exchange has been used in this report as a basis for analysis since it is the only such pilot that so far has published cost/benefit results. [81]

A Case-in-Point: *CareGroup Implements Secure Data-Sharing Portal*

The Problem: Patients' medical histories are not always readily available when they present in an emergency room for treatment.

The Solution: CareGroup implemented a Web-based data retrieval system to provide access to patient information across multiple hospital sites.

The Results: CareGroup estimates annual savings of over $1 million and increased annual revenues of $3-4 million through its use of this data-sharing system.

Benefits

Regional Data Sharing benefits encompass both care quality and operational efficiencies:

Improved Quality

Numerous studies and research reports have identified care quality improvements when providers have access to complete patient information at the point of care. [82, 83] Areas of improvement include:

- Fewer admissions from the Emergency Department;
- Fewer medication errors and adverse drug events;
- Fewer readmissions;
- Decrease length of stay;
- Fewer inpatient admissions and outpatient visits; and

- Fewer duplication of services

While these studies have shown that technology offers real quantifiable benefits within a specific setting, the majority of the research is focused on one aspect of care delivery – inpatient stays or emergency department care. Results of how technology impacts the entire care continuum in a regional environment are very limited or still in development for the few data sharing projects in operation.

Reduced Costs

The other area of benefit is in the form of improved operational efficiency – mostly due to labor cost reduction. The savings are based on the effort spent managing traditional paper-based data-sharing processes and understanding the impact that exchanging data electronically will have in reducing these expenses. For example, with data available online in every hospital and physician practice location, lab test results and radiology reports do not need to be mailed by the central laboratory. Central access to clinical data also results in a significant number of requests to either send out or receive patient data from other sources.

In the Santa Barbara study, benefits were divided into two categories: 1) intrinsic benefits of providing a central source for an organization's own data; and 2) benefits from having all of the patient's data available from other sources. Benefits were quantified by category and organization. The results showed that certain organizations received more value from centralizing their own data (e.g., from imaging centers and owned hospitals), while others placed higher value on access to regional data (e.g., non-owned labs and physicians).

Only the operational efficiencies are included in the analysis for this report so as to eliminate any potential overlap between regional data sharing and the CPOE applications, and because there are limited regional quality results available to otherwise use for comparison.

Costs

Financial analysis for the Santa Barbara initiative was based on a care community/region model. Within each region there exists a specific number of hospitals, imaging centers, independent labs, PBMs, major group practices and solo practices. In the Santa Barbara example, large regions included ten major hospitals, five imaging centers, three labs, five PBMs, five major group practices and 5,000 physicians. Medium regions encompassed six hospitals, two imaging centers, one lab, five PBMs, two major group practices and 1,000 physicians.

The following table summarizes the costs for each component and shows the total costs by region size and level of penetration.

Table 10: Projected Costs of Regional Data Sharing

Component	Unit Cost
Hospital	$120,000
Imaging Center	$110,000
Laboratory	$110,000
Group Practice	$120,000
Solo Physician	$ 40
Large Region* - Low penetration: 3 hospitals, 2 imaging centers, 1 lab, 1 PBM, 1 major MD practices, 750 solo MDs	$1,000,000
Large Region - High penetration: 7 hospitals, 4 imaging centers, 2 labs, 3 PBMs, 3 major MD practices, 1,750 solo MDs	$2,200,000
Medium Region** - Low penetration: 2 hospitals, 1 imaging center, 1 lab, 1 PBM, 1 major MD practices, 150 solo MDs	$ 800,000
Medium Region - High penetration: 4 hospitals, 2 imaging centers, 1 lab, 3 PBMs, 2 major MD practices, 350 solo MDs	$1,400,000

Source: "Santa Barbara County Care Data Exchange: Moving Toward Electronic Health Information Exchange: Interim Report," July 2003

For comparative purposes, the following assignments were constructed, based on the current Massachusetts Hospitals by Regions map: [84]

- Massachusetts Regions 2 Central, 3 Northeast and 4C Boston are comparable to Santa Barbara's "Large" regions;
- Massachusetts Regions 1 West, 4A Metro North, 4B Metro South and 5 Southwest are comparable to Santa Barbara's "Medium" regions.

Using this model, if regional data sharing solutions were implemented across the state, the total cost would exceed $12.0 million for a high level of penetration.

Current Adoption

There are no regional data sharing solutions installed in Massachusetts at this time, though the Massachusetts Health Data Consortium has introduced such a proposal, entitled "MA-SHARE" (see sidebar). Some multi-site health delivery organizations (such as CareGroup) have employed some of the same technology tools used for regional data sharing to provide intra-organizational access to clinical data across their enterprise. (See the CareGroup case study in the Appendix of this report for details.)

Net Benefit to Massachusetts With Increased Adoption

If regional data sharing solutions were widely adopted by

A Case-in-Point: *Massachusetts Health Data Consortium Undertakes Regional Data-Sharing Initiatives*

In May 2003, the Massachusetts Health Data Consortium kicked off a regional data-sharing initiative intended to improve patient safety and administrative efficiency. Its MA-SHARE program has been funded by major health care organizations in the region and its Advisory Committee includes key leaders from public and private stakeholders. Demonstration projects in the planning stages include: community-wide bioterrorism surveillance, medication information exchange, credentialing simplification, and secure e-mail. These projects are designed to overcome many long-standing barriers such as inaccessible data, incompatible technologies, and the lack of standards to assure data privacy and security.

70 percent of the hospitals, two-thirds of the independent laboratories, 60 percent of the pharmacy benefit managers and 25 percent of the providers across Massachusetts, over $36 million in savings across the health system could result from improvements in operational efficiencies. The following table summarizes the cost and benefit figures for regional data sharing.

Table 11: Net Benefit to Massachusetts of Regional Data Sharing

	High Penetration
Savings from Web Enablement of Online Systems	$ 9.8 million
Savings from Regional Network Data Sharing	$ 26.2 million
Total Projected Savings	$ 36.0 million
Projected Costs	$ 12.2 million
Net Benefit to Massachusetts	$ 23.8 million

The savings projected assumed that Massachusetts regions are comparable to the Santa Barbara regions in terms of both organization types and numbers.

Barriers to Adoption

Barriers to adoption of a regional data sharing solution:

1. **Technology complexities** to uniquely identify patients and interfaces with many different clinical applications;
2. The sophisticated **governance model** to handle decision making and oversight;
3. Getting the needed **level of collaboration** among all participants in order to have a comprehensive patient data view; and
4. **Legal issues** about data sharing.

Adoption Incentives

The most likely source of funding for regional data sharing would be from public assistance or grant funding administered through a collaborative similar to the Santa Barbara data sharing model. Regional data sharing efforts also necessitate sharing of resources across a given community, with group purchasing and multi-entity implementation with shared or allocated expenses.

Remote ICU Monitoring

There are a number of remote monitoring and telemedicine applications that offer promise to health care. With more widespread availability of satellite communications, high-speed Internet and other broadband communication channels, physicians can now communicate with each other and with patients from remote locations and exchange large amounts of diagnostic and clinical information. One example of such remote communication involves remote monitoring of a hospital's intensive care unit (ICU).

Description

Remote ICU monitoring allows a "virtual" ICU team at a remote location to provide ongoing surveillance and care for a hospital's ICU patients. The "virtual" ICU team – generally consisting of a physician, nurse, and associated clerical staff – can track a patient's condition through four screens that display 1) real time video of the hospital room, 2) the patient's real time vital signs, 3) the patient's electronic medical record, and 4) alerts to drastic changes in heart rate. When intervention becomes necessary, the virtual staff can communicate with on site personnel through the ICU's real time video and audio capabilities.

Benefits

Remote ICU monitoring solutions offer a number of quality and cost benefits to the health care community:

Improved Quality

The closer vigilance offered by remote ICU monitoring has led to a number of quantifiable patient care quality benefits:

1. **Reduction in severity-adjusted hospital mortality** for ICU patients. One health system study showed a 25 percent reduction in hospital mortality through use of the remote ICU monitoring application. [85] Another hospital study showed a mortality reduction of 30-33 percent. [86]
2. **Decreased incidence of ICU complications** of 44 to 50 percent from the Hopkins study. [86]
3. **Support for the Leapfrog requirements** for 24-hour coverage of an intensivist in hospital ICUs.

Reduced Costs

Cost reductions from the use of remote ICU monitoring systems stem from **decreased hospital lengths-of-stay**, both in the ICU and on the medical units, and other associated decreased costs:

1. The health system study cited above showed a 17 percent decrease in ICU length-of-stay and an associated decrease in length-of-stay once the patient had been transferred to a medical unit. General ICU patients transferred out of the ICU stayed an average of 9.1 additional days, down from 10 days. For vascular patients, the stays decreased from 8.5 days to 6.5 days. [85] The second hospital study showed an ICU length-of-stay decrease of 30-33 percent. [86]
2. Use of ancillary services is reduced by 6 to 18 percent reflecting lower use of supplies, laboratory tests, therapies, and medications. [85]

3. Need for nursing hours is reduced by 4 percent. [85]

Increased Revenue

By lowering hospital lengths-of-stay, the organizations that have implemented a remote ICU monitoring solution have been able to achieve "new" capacity. In one study the hospital added 15-20 percent more ICU capacity which translated to $274,000 in additional revenue.

Costs

For purposes of this study, published articles and data provided by a remote ICU monitoring vendor have been incorporated into the analysis.

The unit cost per ICU bed has been estimated at approximately $30,000 to $50,000, according to one report posted on the vendor's Website. The ongoing costs are reported by the vendor as 20 percent of the up-front purchase costs.

If remote ICU monitoring solutions were widely adopted by hospitals across Massachusetts, the total cost for purchasing and installing the equipment could range from $45 to $75 million.

Current Solutions and Marketplace Adoption

There is only one relatively new solution on the marketplace that supports remote ICU monitoring – VISICU's eICU application. There are no known implementations of VISICU's eICU in Massachusetts – nor do there appear to be other companies providing a similar service. VISICU is in the process of implementation at Advocate in Chicago and St. Luke's in Kansas City and is implemented at Sutter Health in California and New York Presbyterian in New York City.

Net Benefit to Massachusetts with Increased Adoption

If remote monitoring solutions were widely adopted by hospitals across Massachusetts, over $249.9 million in savings across the health system could result from improvements in hospital lengths-of-stay and related services. The following table summarizes the net benefits to Massachusetts reflecting 75 percent adoption of remote ICU monitoring.

Table 12: Net Benefit to Massachusetts of Remote ICU Monitoring

	Year 1	Years 2 and Beyond
Savings from cost reductions and care quality improvements	$ 187.4 million	$ 187.4 million
Projected Costs	$50.0 million	$ 10.0 million
Net Benefit to Massachusetts	$ 137.4 million	$177.4 million

Calculation of the net benefit of remote ICU monitoring for Massachusetts was predicated upon the following data, calculations and key assumptions:

- VISICU estimates that the economic benefit of implementing eICU is approximately $150,000 per year for each ICU bed. The actual magnitude of the benefit will depend

upon several variables: the value of added capacity, hospital cost structures, patient acuity, and payer mix.
- There are 1,666 ICU beds in Massachusetts. This includes 1,154 medical/surgical, 351 neonatal, and 163 coronary ICU beds. [87]
- Up-front purchase cost per bed is based on the average of the $30,000 to $50,000 range ($40,000). Annual operating costs are calculated at 20 percent of the purchase cost ($8,000).

Barriers to Adoption

Since there are relatively few implementations, knowledge of potential barriers to adoption of eICU solutions are limited. The following list is a start:

1. **Acceptance by physicians** – In the ICU hospital study cited above, several options were provided that allowed physicians a range of coverage for their patients;
2. The **costs** to purchase the technology and pay for it on an ongoing basis; and
3. **Remote access** and **interoperability** issues between the monitoring and clinical applications.

Adoption Incentives

Several approaches could help spur adoption of remote ICU monitoring solutions:

- The Commonwealth could provide tax incentives for companies like VISICU to introduce their products in the Massachusetts area.
- High-speed Internet access is a key technology required to support this solution. Incentives that would lower the ongoing cost of high-speed Internet access would also speed up adoption.
- Because adoption of remote ICU monitoring is still relatively early, a pilot demonstration project of this application would make an ideal candidate for special grant funding.

2. ADOPTION BARRIERS AND CHALLENGES

If the financial and clinical benefits alone were sufficient justification for implementing these advanced technologies, then adoption would be higher and health care would be further ahead in reducing costs and improving quality. But for a number of reasons, even demonstrating tangible benefits is not enough to propel adoption. Myriad barriers and challenges stand in the way of more rapid adoption of advanced health care technologies.

Lack of information about the true costs, benefits and experience. Information about what it takes to purchase and install these systems and the actual benefits of doing so has not been widely published for many of these advanced technologies – even though industry experts agree that the associated benefits should be compelling. A recent focus on inpatient CPOE has only just led to an increase in published information about the costs, benefits and challenges of the technology beyond earlier years of research by several nationally-recognized academic medical centers. But that is not the case for most of these advanced technologies. Their adoption is still too early for credible implementation and usage experience to be available.

High costs versus competing needs. In many cases, the initial purchase and associated implementation costs for these advanced technologies are known to be significant. Administrative and clinical executives at health care facilities cite the lack of financial support as the biggest barrier to implementing information technology. [88] Only organizations with the financial resources and strategic vision to undertake such an investment purchase these systems – especially when competition for capital dollars is high. Inpatient CPOE is one such example. Initial costs for installing inpatient CPOE can range up to $8 million or more per hospital, with annual operating costs exceeding $1 million. [89] Only a minority of hospitals across the country have implemented CPOE. Only when external pressures (like those from the employer-based Leapfrog Group for Patient Safety) provide incentives do many organizations find a way to reallocate resources and make these investments.

Benefits don't accrue to the purchaser. In the case of several of the advanced technologies profiled in this report, the benefits of the technology do not accrue to the user-purchaser. For example, e-prescribing applications have been shown to help payers and pharmacy benefit managers reduce their drug costs through better formulary management and higher use of generic medications. Physicians who typically purchase these systems, however, reap no financial benefit (since they do not reap drug formulary savings and are not reimbursed for using these systems) and have few rewards or incentives for purchasing them. Ambulatory CPOE, disease management, physician/patient communication and other applications have a similar "cost-benefit disconnect."

Cultural resistance and inertia. Physicians' resistance to change is commonly cited as a significant barrier that limits more widespread deployment of IT.[90] While physician adoption of information technology does appear to be slowly improving, physicians understandably resist new systems that require dramatic change in how they practice – particularly if these systems take more time to use and provide few benefits to physicians themselves. A 2001 survey reported that among physicians who don't use the Internet, one-third don't do so because they find navigation difficult, and almost half (44 percent) leave computer work to their office staff. [91] "I think there are physicians who get comfortable with a way of doing things and resist change," said one respondent to another survey. [92] In addition, some physicians are critical of using computerized systems like CPOE and e-prescribing to care for patients, regarding such an

approach as "cookbook medicine" (though, in fact, these systems can better support the ability to quickly access and manage large amounts of patient data and information about current clinical practices). In the larger setting, adoption of technology and the associated operational changes can be a significant cultural challenge for whole organizations and for communities of caregivers. The use of many of these advanced technologies represents wholesale change in the way care is delivered. The benefits can be worthwhile, but the required effort to overcome cultural resistance can be enormous.

Vendor product immaturity. In a few instances, development of the technologies is still early enough that the market has not yet "shaken out," making the vendor leaders – or even the predominant approach – less-than-obvious. Early adoption of technology can be risky when vendors exit the market or if unproven approaches fail. The complexity of health care coupled with this vendor market immaturity means that many solutions must be tailored to an organization's needs. There are few "off-the-shelf" applications that are easy to install without a significant preparation. In addition, vendor product immaturity in an emerging market means that evidence of the effectiveness of the technology is often lacking. Finally, there are few industry-wide benchmarks or standards in place for the use and performance of some of these technologies.

Legal/regulatory barriers. In a few cases, legal and regulatory concerns associated with these advanced technologies prevent more rapid adoption. Lack of adequate patient privacy protections, for example, is often cited by cautious physicians as a reason for not adopting electronic communication with patients. Similarly, concerns were raised by privacy advocates in the past when regional data sharing efforts were proposed as Community Health Information Networks (or "CHINs"). Newly-finalized national privacy and security regulations – along with new technical capabilities for transmitting and protecting electronic information – should minimize some of these concerns. In addition, laws requiring actual signatures should be changed to permit electronic signatures where appropriate.

Required infrastructure and lack of standards. Finally, for some of these technologies, the infrastructure to support the application requires significant coordination among competing health care entities. Furthermore, a lack of industry-wide standards means that integrating disparate clinical systems, exchanging patient information and collaborating among entities is complicated – if not impossible. "[Patients] have office records, and hospital records and pharmacy records but there's no single uniform record and certainly not an automated one right now," reported one national health care quality expert. "We don't create information systems that they share," he added. [93]

Undertaking a regional data-sharing effort across the Commonwealth, for example, will require not just the technical infrastructure to simultaneously distribute and protect patient-identifiable data across a wide-area network, but cooperation among hospitals, physician practices, public health agencies, pharmacies, pharmacy benefit managers and laboratory vendors throughout design and implementation as well. Similarly, successful implementation of e-prescribing in Massachusetts will require agreement to be reached between several competing approaches that are technically and politically divergent. There are a number of efforts underway nationally to address the adoption and implementation of standards for clinical systems in health care. [94]

The need for training and education. The new technologies require new ways of doing things, a changed mindset and new knowledge. Adoption of many of them may require business process engineering. Implementation for users requires training and education which can be a material part of initial cost.

3. RECOMMENDATIONS: A CALL TO ACTION

Increasing the adoption in Massachusetts of health care technologies that reduce costs and improve quality will require a concerted action agenda. And it will require leadership and collaboration among key stakeholders from across the Commonwealth.

1. Organizing the Initiative, Fostering Collaboration and Eliminating Barriers

Once Massachusetts leaders agree that technologies exist for lowering health care costs and improving quality, they can mobilize key stakeholders and create an environment that fosters the statewide adoption of technology. This can be accomplished through a number of specific initiatives.

Charge a statewide public/private task force, or series of focused task forces to develop specific recommendations for action steps to eliminate the listed barriers within three to six months.

The health care system is exceedingly complex. The problems posed by this initiative are correspondingly difficult but not intractable. The solutions will require the focused attention and commitment of senior executives in all of the key sectors of the system. Beyond this representation, the essential ingredient will be collaboration, because the solutions will involve multiple changes to the way business is now done, each one of which will affect multiple parties.

The task force or focused sub-groups should include the following representation; employers, physicians, hospitals, ambulatory service providers, insurers/payers, government (state administration and legislative leadership, and federal agencies), pharmacies and pharmacy benefit managers, health policy specialists and special associations with cross-sector representation.

Focused task forces or sub-committees of a primary task force might be formed to tackle actions with regard to barriers affecting one or a group of the technologies, or a particular category of barrier. For example one group might be tasked with dealing with barriers to the implementation of e-prescribing, and another charged with addressing legal and regulatory barriers.

Convene a statewide summit to share the vision with key stakeholders and generate commitment and energy for the new agenda. When the work of the task force and sub-groups is finished, a specific and detailed list of actions will be presented. And just as development of the solutions required broad-based participation, implementation of the action agenda will require collaboration of all the players in the system. The agenda could be presented at a highly-visible public forum to give the initiative the attention it deserves and propel the Commonwealth in an on-going course readily implementing emerging technologies which can lower costs and improve quality.

2. Funding, Reimbursement and Other Incentives

Once organizing efforts were in place, this public/private task force could then investigate specific initiatives for rewarding adoption by providers. It is recognized that present fiscal constraints in the budget preclude state funding as a significant source.

Implement bonus incentives for provider organizations that adopt certain technologies, or base a portion of their at-risk payer funding on IT adoption. Under California's Pay-for-Performance program, for example, six health plans have designated ten percent of a bonus set aside for physician groups to be paid when they implement certain information technology capabilities. [95] Self-funded employer groups could similarly provide bonus incentives for technology adoption.

Reimburse physicians for using technology on a per-visit or per-transaction basis. Providers using electronic patient-provider communication to reduce the need for face-to-face visits, for example, could be reimbursed for each online patient consultation. At least six health plans nationally are already piloting such a mechanism. Legislation has also been introduced in Wisconsin that would increase Medicaid payments by one percent for hospitals that implement CPOE and electronic medical record systems. [96] Massachusetts could consider its own approach along these lines.

Develop collaborative arrangements between payers and providers to share in the costs of implementing these advanced technologies. Adjusting capitation payments during the contracting process to reflect physician investment in technologies that benefit a health plan's members is an example of one possible approach.

As California has done, include in the state Department of Public Health ***licensing process*** target dates for hospitals and physicians to adopt certain technologies (e.g., e-prescribing and CPOE).

Work with the Leapfrog Regional Rollout Committee to ***speed the adoption timeline and associated requirements for CPOE***. Accelerated implementation should be accompanied by financial assistance to meet capital needs where necessary.

3. Capital Funding for Pilots and Demonstration Projects

A number of funding opportunities will require further investigation and long-term planning with entities outside of the immediate Massachusetts health care marketplace.

Seek private foundation and grant funding to design, test and implement pilots of emerging technologies across the Commonwealth. The California Healthcare Foundation contributed $10 million for the initial design and implementation of a regional data-sharing network in Santa Barbara, California. There may exist similar sources of funding for Massachusetts-based initiatives. The Robert Wood Johnson Foundation, for example, provides a significant source of funding to non-profit health care organizations across the country for the implementation and measurement of e-health technologies. The federal government is also currently considering paying grants to physicians who begin using e-prescribing tools starting in 2006. [98]

Seek sources of public funding for specific IT initiatives in Massachusetts. The Department of Health and Human Services administers grant funding through at least two sources: the Health Resources and Services Administration and the Bureau of Primary Care.

Provide low- or no-cost revolving loans to provider organizations for the adoption of certain technologies. A pool of state money could be set aside for loans to hospitals and physician practices against which they could borrow to purchase otherwise unaffordable technologies. For example, a special loan program could be established through the Massachusetts Health

and Educational Facilities Authority (HEFA). Credit enhancement and/or lower interest rates might be leveraged through a modest infusion of tobacco settlement or other funds. Health Technology Center, a San Francisco-based nonprofit IT research organization; and the National Alliance for Health Information Technology are both urging the federal government to adopt loan programs nationally. [99]

In some cases where financial benefits accrue to entities other than those who implement these advanced technologies, ***financial savings could be reallocated***. In the case of payers who realize savings from electronic consultations or e-prescribing, this reallocation could take the form of bonus payments or reimbursement to physicians (see above). In the case of pharmacy benefit managers that realize savings from e-prescribing, this reallocation might take the form of rebates to physicians, or use of these savings to subsidize the ongoing costs for e-prescribing systems.

Share technology resources across stakeholder entities. Because many of the recommended technologies are costly and complicated to implement, collectively purchasing and configuring them to support multiple organizations might be more efficient than each stakeholder purchasing and implementing its own system. Installing community-wide ambulatory CPOE systems, for example, might be more cost-effective than each physician buying his own system.

4. Establish a "Trusted Third Party"

Massachusetts could also ***establish a trusted third party*** – a "health care institute for new technologies that lower costs and improve quality" – that is funded, governed and advised by key stakeholders for the purpose of undertaking studies that demonstrate the costs, benefits and successes of implementing these technologies, and for issuing a "gold star endorsement" of the specific technologies that meet key standards and qualifications for delivering reduced costs and improved quality. Eliminating or reducing uncertainties with regard to costs, benefits, operational issues, and risks will address many of the barriers to adoption. Rhode Island has established such an entity, the Rhode Island Quality Institute.

5. And a Note of Caution

Just adding technology won't be enough. Other elements are necessary since the change required will be systemic. Leadership, culture and mindset change, and reengineering of process are often essential.

4. How to Get it Done – A Scenario

A Scenario for Moving Forward

The following e-prescribing scenario was developed to help illustrate how Massachusetts could move forward with one such technology. E-Prescribing technology has been selected because: 1) It requires collaboration from many different parties; 2) Pilots are already underway in Massachusetts; and 3) It illustrates many of the different types of barriers to widespread adoption.

With e-prescribing, physicians "write" prescriptions electronically. This creates an electronic record which permits the prescription to be checked for formulary compliance, allergies, potential interactions, and other contraindications. When the prescription is electronically sent to a pharmacy or pharmacy benefit manager (PBM) it is legible and can be integrated into the pharmacy computer without any transcription that could introduce errors. Many different parties benefit. If patients have chronic medications, refills can be ordered very quickly. Time spent by pharmacists, doctors, and office staff in clarifying orders is reduced or eliminated; the payers benefit from increased formulary compliance with fewer subsequent hassles for the payer – and the doctor. The process is much more convenient for patients as well.

There are also operational, legal and political challenges to be overcome to promote widespread adoption of the technology. Many of the e-prescribing technologies use software that is only available on one set of hardware. Therefore, a provider could be asked to use different devices for each payer that offers an e-prescribing solution. Massachusetts laws were written before e-prescribing was an option, and some current provisions prevent e-prescribing for some types of drugs. There are at least three major entities that would need to be equipped to accept electronic prescriptions and provide comprehensive statewide coverage: pharmacy benefit management firms, multi-state chain pharmacies, and independent pharmacies.

To overcome these barriers:

Adopting technology standards would enable one device to suffice for many different payers. The payers, pharmacies and PBMs would agree to a set of standards and specifications for e-prescribing applications that make them "device independent" (i.e., the application could run on any device that meets these requirements.) They would also agree on standards for data and formats for communication between payers, providers and pharmacies. This would enable all software application to be used by any provider, payer or pharmacy. By agreeing on and releasing these standards, all parties could choose software that would meet current and future needs.

Legislation would be passed that permits electronic signatures to be accepted as the equivalent of a paper signature. Current requirements that the physician handwrite a reason for not allowing substitution (of a generic equivalent) would be changed to a sufficient electronic equivalent. These two changes would permit e-prescribing for all medications except Class 2 controlled substances. Massachusetts could lobby for such a change at the Federal level.

Most of the costs of e-prescribing – the capital outlay, the learning time, the initial costs of entering prescriptions and the maintenance costs – typically fall to the provider, yet the benefits from savings in drug costs accrue to the payers. Payers could use their purchasing power to lower the costs of devices, and could fund a shared training, help desk and maintenance service with some of the savings. Also, by sharing first year savings with providers (through a per-prescription payment), payers could offset some of the providers costs of acquiring devices and investing time in learning to use them.

By leveraging the collaborative spirit of the Commonwealth's health care system participants, Massachusetts would eliminate barriers to widespread adoption of e-prescribing and set a leadership example for the nation.

5. About This Report

About the Massachusetts Technology Collaborative

The Massachusetts Technology Collaborative (MTC) is the state's development agency for the innovation economy. The organization works as a catalyst at the intersection of industry, government and academia to support the Massachusetts "innovation system".

In the 2002 edition of its hallmark series, the ***Massachusetts Index of the Innovation Economy***, MTC described our state's "Life Sciences Super Cluster", an unparalleled and integrated aggregation of biomedical research, clinical services, biotechnology, pharmaceuticals, information technology and related service sectors.

MTC is a quasi-public agency guided by leaders in government, universities and the high tech sector. Its focus is the state's emerging technology clusters (including renewable energy) as well as its established technology sectors.

More information about MTC is available at www.masstech.org.

About The New England Healthcare Institute

NEHI is an independent, non-profit research organization that develops practical solutions to health care problems by harnessing the commitment of the health care community and the regional resources of New England. Funded and supported by its diverse membership base, NEHI draws upon the knowledge and experience of leaders in multiple sectors of the health care industry to create truly informed and independent research.

NEHI's research focuses on valuable medical, information technology, and service innovations. These innovations often face significant barriers to adoption that potentially can be overcome if addressed early in the development process. NEHI clearly defines the costs, benefits, drivers, and barriers to the adoption of a wide range of health care innovations. Based upon evidence-based research, NEHI guides the development of demonstration models and policy recommendations that realign incentives to enable the adoption of beneficial innovations.

For more information on NEHI, including a list of Board Members and Member organizations, please visit: www.nehi.net

About First Consulting Group

First Consulting Group (FCG) is a leading provider of consulting, technology, outsourcing and research services for health care, pharmaceutical, and other life sciences organizations in North America and Europe.

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APPENDIX A: OTHER TECHNOLOGIES

While the seven information technologies addressed in this report have the greatest demonstrated potential to reduce health care costs and improve quality, this list is not comprehensive. There exist a number of additional information technologies *not* discussed in this report that also have the potential to improve quality and reduce costs. These include:

- *Ambulatory Electronic Health Records* (the advanced forms of which can be more comprehensive than some ambulatory CPOE systems);
- *Patient disease registries* (for chronic disease management);
- *Patient self-directed disease management tools;*
- *Physician Web portals* (providing access to a hospital's or health delivery system's clinical information);
- *Radiological Picture Archiving and Communication Systems* (PACS); and
- *Remote imaging and telemedicine systems*.

In addition, there exist a number of emerging medical technologies that improve health care quality and have the potential to reduce costs. These include:

- *Biotechnologies* such as vaccines, genetic testing and therapy, and stem cell technology;
- *Implantable devices;*
- New *diagnostic laboratory tests* and *imaging modalities;*
- *Medication delivery systems* (such as for insulin);
- *Minimally invasive surgical technologies* (such as coated stents);
- *Monitoring sensors;*
- *Neurostimulators;* and
- *Organ assistance and substitution.*

Finally, there exist a number of technologies that have the potential to dramatically lower costs – though without necessarily or directly impacting health care quality. These include:

- *Administrative simplification systems* for streamlining health plan functions such as member enrollment, eligibility verification, claims submission and payment;
- *Online registration and scheduling tools* through which patients can conveniently manage administrative functions on their own; and
- *Rounding/charge capture tools*.

APPENDIX B: CASE STUDIES

BLUE CROSS BLUE SHIELD OF MASSACHUSETTS PILOTS WEBVISITS

The Problem
Today's challenges for physicians – escalating practice costs, staffing shortages, increasing time pressures, and growing service expectations from patients – are making a difficult profession even more so. Concurrently, patients find routine access to their physician increasingly difficult and want more control over their health care interactions. National surveys have found that the majority of the over 70 percent of adults with Internet access would like to communicate online with their physicians.

The Solution
By shifting non-urgent matters online, physicians can focus resources on urgent patients' needs. BCBSMA has launched a ten-month pilot of online (Web) visits using a commercial vendor product. The system provides a convenient, confidential, and secure online system which gives patients and physicians another mode of interaction, thus improving access and communication and ultimately enhancing the quality and efficiency of care.

The product guides the patient though an interactive clinical interview, asking patients the kind of questions a physician would during a visit, and presents a succinct, structured message to the doctor. Patients can also schedule appointments, obtain test results, update personal information, request a prescription renewal, or ask simple questions online. Physician practices can use the system to respond to patient questions, to send preventive care reminders, and to transmit customized educational materials to patients. The service also automatically generates health plan claims or patient bills as appropriate. In the current experiment physicians are reimbursed $24 per online visit.

The Results
Since BCBSMA is the first health plan in the Massachusetts market to deploy this new technology, no quantifiable results are yet available for the Commonwealth. To date over 100 physicians and several hundred patients are using the service as part of the pilot.

The benefits of the service have been quantified in a similar pilot and a study conducted in California by investigators at University of California and Stanford and cited earlier in this report. The study analyzed claims data from June 2000 through May 2002 for 5,727 patients, revealing a statistically significant net reduction in both office-based care ($1.61 PMPM) as well as total cost of care ($3.39 PMPM) within the pilot groups as compared with matched controls. Users who responded to a satisfaction survey rated the service as easy to use (78 percent) and convenient when compared with a phone call to the doctor. When physicians responded to their messages by the next business morning, patients' ratings of convenience jumped to 95 percent, and 87 percent rated the quality of the Web visit favorable to an office visit. Patients who used the service were 50 percent less likely to miss work due to illness and notably, 77 percent reported that it took less than 10 minutes – substantially less time than required for travel and treatment in the office. The physicians' satisfaction results were equally impressive with 72 percent of all physicians likely to continue the service and 63 percent recommending it to a colleague. When physicians had 30 or more encounters, those scores surged to 86 percent and 93 percent respectively. Nearly three in four physicians (73 percent) rated reimbursement as important in motivating them to communicate online with patients.

A growing number of doctors and industry analysts conclude that online communication between doctors and patients is inevitable. The California study begins to demonstrate the potential value of Web visits to satisfy physician and patient needs while helping to control costs. Blue Cross Blue Shield of Massachusetts and their partnering physicians feel they have an opportunity to advance the field of online medicine by identifying best practices for communication, measuring outcomes of treatment, and leveraging this exciting new channel of care to deploy proactive, population-based, care management initiatives.

CAREGROUP IMPLEMENTS A SECURE WEB-BASED MEDICAL RECORDS RETRIEVAL SYSTEM ACROSS MULTIPLE ENTITIES

The Problem
When the emergency room (ER) facilities at Beth Israel and Deaconess hospitals were consolidated, CareGroup recognized that timely access to electronic medical records from both hospitals was critical to providing the best possible emergency care.

Critical ER patients must be stabilized regardless of whether their complete medical information is available. Clinicians typically cull as much information as they can from interviewing the patient, viewing the clinical record, and attempting to contact the primary care physician. For at least the 25 percent of ER patients that cannot provide reasonably complete medical histories, clinical records provide new, relevant information that patients did not or cannot relate.

After the two ER facilities were consolidated at one BI-Deaconess hospital, retrieving medical charts from the other hospital took up to three hours. This lack of clinical information not only hampers clinical judgment but also leads to unnecessary duplicate testing and costs.

The Solution
The hospital implemented an e-business solution termed CareWeb™ that utilizes Web-based retrieval to virtually merge the clinical data from the different systems in the two facilities so that the staff in the emergency department can view the electronic data in an integrated format. Because the data actually reside in its original system, keeping information synchronized across the systems is not an issue and there are no additional databases to maintain.

The "virtual integration" utilizes technical standards to permit a Web server to capture information from both hospitals' existing systems. The information is transmitted back to the user in a single unified presentation as Web pages. By clicking on "pull-tabs" resembling those used in medical charts, the user can easily navigate and retrieve additional information.

With the new system in place, a clinician in the ER can now type in a patient's name, and retrieve that patient's records on-screen within approximately two seconds. He has at his disposal a complete set of emergency data including a problem list, a medication list, allergy information, and full text notes recorded electronically which he can then view to deliver better patient care. He does not have to wait or search for the chart and data can never be lost or misplaced.

The Results
A conservative estimate indicates that before CareWeb™ at least two people were paid around the clock to retrieve records for the ER from the off-site campus facility. At a rate of $15 per hour, the cost of the search process equated to more than $260,000 annually. Most significant, however, was the amount of costly physician time that was spent dealing with the inefficient chart process. A physician would typically spend between 15-30 minutes searching for, making calls regarding, and waiting for a chart. With physicians earning from $150 to $200 per hour, spending up to two hours per shift searching for records represented an added cost of more than $380,000 per year. Of the 130 patients that visited the ER each day, from 10 to 13 patients' records were housed at the remote hospital. Retrieving records for the 10 percent of these cross-facility patients cost CareGroup roughly $640,000 annually.

Today, CareWeb™ is saving CareGroup over $1 million annually from reductions in clinician search times, patient admission processing time, the volume of admitted patients, the length of hospital stays, and time spent in training. On the revenue side, the impact on patient retention and member attraction is projected to increase revenues by 3 to 4 million dollars annually. CareGroup anticipates CareWeb™ can save $50,000 to $100,000 per year by simply processing patients more rapidly and not having to divert ambulances as often. CareGroup also anticipates being able to reduce admissions by at least one patient per week, which represents another $50,000 saved annually ($1,400 per day at the hospital). Also, because CareWeb™ now enables more rapid intervention, CareGroup estimates reducing the average length of stay by two days or $5,000 (representing the cost of stay plus procedures) for about 50 cases per year. In a managed care environment, this represents another $250,000 in bottom line savings annually.

In terms of customer relations, physicians have related stories where the availability of these medical records has essentially allowed them to save patient lives by quickly identifying urgent situations that need addressing. Better patient care translates into better patient retention, which is estimated to be worth hundreds of thousands of dollars annually.

HARVARD PILGRIM HEALTH CARE USES PREDICTIVE MODELING TO DECREASE ACUTE HOSPITALIZATIONS

The Problem
Harvard Pilgrim Health Care (HPHC) wanted medical management tools that would improve the quality of life for its members while reducing the cost of services provided. Literature suggests that reaching out to members based on predictive identification of those at risk for future utilization not only decreases the cost of services but also increases member compliance and satisfaction with care.

The Solution
HPHC selected a vendor that had both the predictive models for identifying high-risk members as well as the philosophy, processes and software to assist in their management. HPHC also chose to purchase care management services from this vendor, allowing for a unified and rapid implementation.

The vendor employed analytic tools; care management processes that supported the specific types of outreach and care improvements required for the targeted members; and the technology that allowed staff to administer care plans and track performance. After detailed workflows were created and a training program was developed to support care management on HPHC products and work processes, the first registry of 1,500 members was created and outreach was initiated in September 2001.

The Results
Through this program, HPHC and its vendor partner identified 0.6 percent of the member population as appropriate for case management intervention (in line with an expected 0.5 to 1.0 percent). Most of these members – with few exceptions – were not yet on HPHC's "radar screen" for outreach and direct management. To date, a vast majority of identified members (94 percent) have enrolled in the care management program.

Since the focus of the program has been to identify members who are at high risk for requiring future acute hospitalization, the key success measure that HPHC focused on was the rate of acute hospitalization. To date, HPHC's acute hospitalization rate for both Medicare+Choice and commercial members who enrolled in the care management program has decreased from a pre-implementation average rate of 16.73 percent to a post implementation average of 6.71 percent.

HARVARD VANGUARD MANAGES MULTI-PAYER DRUG FORMULARIES WITH ITS AMBULATORY CPOE SOLUTION

The Problem
Up until 1999, Harvard Vanguard Medical Associates had an exclusive relationship with a single payer, Harvard Pilgrim Health Care. In 2000, the group added both Tufts Health Plan and Blue Cross Blue Shield of Massachusetts as payers. The addition of these two payers posed challenges to Harvard Vanguard in managing multiple pharmacy benefits for its 250,000 patients, including different lists of preferred drugs, different prior authorization requirements and processes, and different restrictions on prescription quantities.

The Solution
Harvard Vanguard already utilized an electronic medical record (EMR) system with ambulatory computerized physician order entry (CPOE) capabilities for order and referral processing, results reporting, and pharmaceutical prescribing. The group chose to add functionality to the ambulatory CPOE capabilities of its existing EMR product to support clinicians ordering the appropriate medications based on the patient's current medical condition, past clinical history, and insurance coverage in a multi-payer pharmacy environment. Three new capabilities were added:

Formulary management and cost-effective prescribing: Pharmacy administration staff worked with clinicians and EMR staff to design and implement system logic that prompts the clinician – based on the patient's insurance – to prescribe appropriately. These prompts appear as "pop-ups" on the screen when the clinician is entering a prescription. There are five types of prompts:

- ***Not covered:*** a drug is not covered by the patient's insurance.
- ***Quantity limit:*** a drug has a quantity limit under the patient's insurance and the details of the limit.
- ***Prior authorization:*** a drug requires prior authorization by the patient's insurance. In addition, the system provides the specific information required by that insurer, the phone number to call at the insurer, and a link to print a Prior Authorization Form.
- ***Tier 3:*** prompts the ordering clinician that a particular drug has a Tier 3 co-pay (more expensive for the patient) and offers the clinician alternative choices.
- ***Harvard Vanguard initiatives:*** Harvard Vanguard annually develops prescribing initiatives focused on identifying alternative medications that are either more cost effective or that provide greater clinical value. The system prompts the ordering clinician that a particular drug has an alternative option and gives the clinician "one-click" access to ordering the preferred drug.

Quality of care: Harvard Vanguard also chose to design quality-of-care enhancing features into the prescribing function. The system alerts the physician to all potential drug-to-drug interactions and also identifies allergies, preventing a clinician from inadvertently ordering a potentially harmful medication. Another feature is "Best Alerts" – "pop-up" windows that alert a clinician of important information regarding a particular drug. For example, if a clinician writes a prescription for certain diabetes medications for a patient with a diagnosis of Congestive Heart Failure (CHF), a message pops up warning the clinician that the medication causes fluid retention and can worsen the patient's CHF condition.

Efficient prescribing: Working with each specialty, the pharmacy and EMR staff developed specialty-specific preference lists for ordering medications. These lists facilitate the efficient and effective prescribing of drugs. Drugs on the list have pre-set prescription instructions (e.g., take one tab twice a day), quantities (e.g., 10-day supply), number of refills, and end dates, relieving the clinician of the need to type this information into the system. The lists also incorporate preferred versus non-preferred drugs, again easing the clinicians' order entry process and making it more likely that a clinician will choose the most cost-effective strength, dose, and directions.

The Results

From the clinicians' standpoint, the transition to multiple managing of several payers' pharmacy benefits was relatively seamless – a direct result of the supports and tools built into the EMR. Harvard Vanguard also managed this transition without adding resources to the pharmacy administration staff, representing a significant cost avoidance. Another measure of the effectiveness of the system is the reduction in actual pharmacy expense. Harvard Vanguard has significantly lower per-member-per month pharmacy expenses compared with other practices in the payers' networks.

	PMPM Difference From Network	**Total $ Impact/ Annual Savings**
Payer 1	$7.75 PMPM	$2,000,000
Payer 2	$7.07 PMPM	$1,900,000

While there are other interventions that have contributed to Harvard Vanguard's lower pharmacy costs, the EMR tools have been key to this success.

PARTNERS REDUCES MEDICATION ERRORS THROUGH WIDESPREAD IMPLEMENTATION OF INPATIENT CPOE

The Problem
A study of the incidence and nature of adverse drug events at Brigham & Women's Hospital (BWH) and Massachusetts General Hospital (MGH) [100,101] found that:

- 6.5 adverse drug events (ADEs) occurred for every 100 non-OB admissions;
- 28 percent of ADEs were preventable;
- 5.5 potential ADEs occur per 100 non-OB admissions; and
- The average cost of each ADE was $6,000.

Further analysis examined the nature of the information technology solution: [100]

- 56 percent of the ADEs occur at the time of ordering: the physician is unaware of, or forgets about, an allergy, a contra-indication, or a problematic laboratory result;
- 34 percent of the ADEs occur at the time of medication administration with some of these being due to order legibility problems; and
- For BWH, a provider order entry system could prevent an estimated 480 ADEs per year for an annual savings of $2.9 million.

The ordering process has limitations that can lead to adverse drug events and unnecessary test ordering. An internal BWH study examined the ordering of six common laboratory tests in the Surgical Intensive Care Unit and concluded that 35-50 percent of the tests were clinically unnecessary, often the result of "pre-programmed" ordering (for example, an order for routine blood tests, four times a day for four days).

The Solution
Widespread implementation of Computerized Physician Order Entry (CPOE) addressed the limitations of paper-based orderings. CPOE serves several functions.

First, when the physician (or nurse) enters a medication, radiology procedure, laboratory test, or other order into the computer, the computer subjects the order to a set of logic. This logic can check a medication order to determine, for example, if:

- A patient allergic reaction is possible;
- The medication is contra-indicated by other medications already being administered to the patient;
- A less expensive, therapeutically equivalent medication can be given;
- The medication dose is too high; or
- The medication would alter blood mineral levels in an adverse way.

Second, the order is electronically transmitted to the appropriate ancillary department, e.g., the pharmacy, clinical laboratory, or radiology. These departments can use electronic order queues to manage their work and reduce turnaround processing times.

Third, the order is accurately recorded for nursing and physician documentation and the medication administration record.

The Results

Analysis of CPOE's impact on medical care illustrates the power of its guiding a physician's decisions. The BWH found a 55 percent reduction in serious medication errors following the implementation of inpatient CPOE. [29]

Other documented benefits include: [102]

- Use of a preferred H2 Blocker (Nizatidine) as a percent of all H2 Blocker orders increased from 12 percent to 81 percent;
- The percent of medication doses exceeding the suggested maximum dose decreased from 2 percent to 0.6 percent;
- The percent of orders for a drug that curbs nausea for chemotherapy patients with the preferred frequency of three times daily increased from 6 percent to 75 percent; and
- The percent of bed rest orders with a consequent order for a blood thinning drug increased from 24 percent to 54 percent. [102]

BWH has documented from $5 to $10 million in savings per year. The range reflects different allocation strategies of semi-variable costs. Partners HealthCare System has subsequently implemented CPOE at Massachusetts General Hospital.

TUFTS HEALTH PLAN PILOTS E-PRESCRIBING

The Problem
Increased availability and use of medications offers greater treatment choices for patients but has also led to rising health care costs and increased prescription errors. Tufts Health Plan sought solutions to reverse this trend and improve the quality of care through more effective distribution of information to health care providers.

Tufts Health Plan's primary goal was to find a solution that would reduce prescription errors and increase patient compliance on medication use. In addition, Tufts sought to reduce the "hassle factor" for physicians, pharmacies, and consumers, while increasing formulary compliance and positively influencing the aggregate medical cost trend.

The Solution
Tufts Health Plan collaborated with its pharmacy benefit manager and a vendor of a handheld e-prescribing application to launch a pilot program that distributed Personal Digital Assistants (PDAs) loaded with the e-prescribing software to 15 physician sites comprised of 113 Tufts Health Plan network providers. The first sites went live with the technology in April 2001, and the pilot measurements officially ended on May 31, 2002. New sites were added throughout the pilot, with the final site going live in December 2001.

The e-prescribing software enables physicians to electronically generate a prescription in the office and securely fax them to the pharmacy. The e-prescribing system also identifies possible drug interactions and supplies formulary information for all health plans to the prescribers. In addition, some of the participating sites were able to view patient drug history. E-prescribing offers a solution to improve efficiency in the physician office and pharmacy, improve patient safety, and enable physicians to provide more effective patient care.

The Results
Results from prescription data, personal journals of the pilot groups, and user feedback from the year-long pilot demonstrate positive outcomes. Overall satisfaction ratings for the pilot averaged 4.25 for prescribers, 4.10 for office staff, and 4.67 for pharmacists (based on a 5 point scale where 5 = very satisfied). There was also a decrease in rejected prescriptions due to illegibility and interactions with other prescribed drugs. Telephone and fax volume between physician offices and pharmacies decreased by 76 percent for formulary issues, 81 percent for drug interactions, and 31 percent for illegible prescriptions.

Other efficiency improvements were also reported. Prescribers cited a decrease of up to two hours per day in total time the office spent on prescriptions, with the prescriber saving 30 minutes to two hours per day and the office staff saving the remainder. Pharmacists reported savings of almost an hour per day. Respondents estimated a savings of 2 to 10 minutes per patient by prescribing with the new system. This translates to an average time savings of 2 hours per office per day for a physician seeing an average of 21 patients per day which would either enable a provider to spend more time with each individual patient or would support increased revenue from additional patient visits.

The claims reduction applied to the entire provider network could reduce total network costs for new prescriptions by as much as 68 cents per member per month. However, given the variation in practice settings and incentives in the provider network, savings of 30 cents PMPM and 40 cents PMPM are more likely.

The pilot participants saw a decrease in prescribing of Tier 3 (non-preferred) brands with the majority of the shift moving to Tier 1 (generics) and a smaller portion of this shift from Tier 3 moving to Tier 2 (preferred brands). Pilot participants experienced a 6 percent increase in generic/Tier 1 utilization compared to a 4 percent increase in the control group. This increased generic/Tier 1 use led to an estimated savings of $0.041 PMPM for the pilot group.

Prescribers surveyed cited numerous case examples of how e-prescribing and the link to patient history impacted patient safety. These examples included:

- Identification of a diabetic who had not picked up the previous two months supply of insulin;
- Identification of a patient not taking the prescribed dosage correctly; and
- Verification that a patient had actually filled a narcotic prescription when the patient called for a new prescription claiming the original had been lost.

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- First year costs were calculated to include the purchase of necessary hardware and software for each advanced technology plus any additional costs associated with implementation. The projected net annual benefit reflects ongoing annual costs beyond Year 1 once implementation has been completed.
- The projected net benefits were calculated for most technologies at aggressive but achievable levels of adoption (typically 75 percent). The actual benefits achieved may not always be fully realized given some of the adoption challenges discussed in this report. Higher levels of adoption will yield higher levels of net benefit. The costs and benefits of systems that are already installed in Massachusetts are not included in the projected net savings.
- This report assumes the deployment of *software* applications with specific capabilities. In many cases, there is a range of vendors that can provide varying levels of capability, plus a range of hardware tools and devices that deliver and enable the capability for the end use. The solutions and approach can vary for each technology, and each approach may be associated with different levels of benefit.

As stated previously, significant gaps currently exist in the available research evidence regarding the costs, benefits and usage for some of the recommended technologies – especially given that their adoption is still early. Financial projections for this report were based on the most widely cited, sound evidence available today.

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