IT Tools for Chronic Disease Management: How Do They Measure Up?

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About the Authors

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About ECG Management Consultants

ECG (**www.ecgmc.com**) is a health care management consulting firm. The IT division helps health care providers make information technology decisions regarding system strategic planning and selection, implementation, and operations improvement.

About the Foundation

The California HealthCare Foundation, based in Oakland, is an independent philanthropy committed to improving California's health care delivery and financing systems. Formed in 1996, our goal is to ensure that all Californians have access to affordable, quality health care. For more information, visit us online **www.chcf.org**.

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Executive Summary

CHRONIC ILLNESSES TAKE A HUGE TOLL ON American lives. Systematic and comprehensive health care can benefit both chronically ill patients and providers by enhancing their encounters, improving clinical outcomes, and reducing administrative costs. An effective tool in this approach to care is information technology, including chronic disease management systems (CDMSs) and electronic medical records (EMRs).

To better understand how these two tools compare in the treatment and management of chronic disease, the authors invited a broad range of CDMS and EMR vendors to submit detailed information about their products and companies, and to briefly demonstrate these products. Of 29 vendors who received a request for information and price quotes, 10 responded.

A steering committee reviewed the information submitted by companies, then used various criteria to score the products and vendors according to product function, corporate qualifications, services, and technology. Subsequently, attendees at a recent health care conference watched demonstrations of eight of the 10 products and rated them.

Overall, CDMSs scored higher in the product's ability to support chronic disease management, while EMR vendors provided better support in terms of training and implementation. However, it should be noted that the time to fully implement an EMR is significantly longer, and therefore the necessary level of support is greater. EMRs also tend to have more technically advanced and scalable products than CDMSs. During product demonstrations, CDMS vendors slightly outperformed their EMR counterparts in all respects. However, in real time at the point of care, CDMS capabilities are often not used to their fullest extent, and typically rely on manual data entry because they are not linked to other clinical systems. The results show that on a per-physician basis, CDMSs require a smaller investment in time, effort, and money, making them significantly less expensive than EMR systems.

I. Background

CHRONIC CONDITIONS ARE THE MAJOR CAUSE of illness, disability, and death in the United States, even though much is known about how to prevent chronic disease and how to delay or avoid many related complications.[1] An estimated 81 million Americans will have multiple chronic conditions by 2020.[2] One study found that 14 percent of diabetes patients had heart disease and that 77 percent had hypertension.[3] To address such complex illnesses, at least one researcher has suggested that chronic disease care should focus on the patient and all of his or her diagnoses and symptoms, not on any single disease.[4] This approach would include assessing patients and their care over time, and managing potential comorbidities.

Information systems generally offer a number of benefits in health care, including higher quality of care, better patient safety, more efficient information processing, and lower administrative costs.[5,6] Among these computerized tools are chronic disease management systems (CDMSs) and electronic medical records (EMRs).

There has been little research on the comparative value of CDMSs and EMRs in the realm of chronic-disease care. Is one system better than the other? To help answer that question, the California HealthCare Foundation asked ECG Management Consultants to gather and assess information on a broad number of CDMS and EMR vendors' tools. Vendors were asked to submit detailed information about their products and companies and to briefly demonstrate them. Evaluation of the information and demonstrations provided a glimpse of the relative strengths and weaknesses of CDMSs and EMRs in managing chronic illnesses.

CDMSs enable health care providers to manage patients who have one or more chronic conditions, such as diabetes, asthma, cardiovascular disease, or depression. Such systems, unlike EMRs, do not document the entire patient encounter, but rather focus specifically on chronic disease and preventive care. Because clinicians typically do not input information into CDMSs during patient visits, these systems often require both electronic and paper documentation.

Use of CDMSs is not widespread. They have not received the kind of attention EMRs have garnered in recent years, such that many clinicians are not familiar with them. Indeed, most clinicians incorrectly equate "chronic disease management system" with "disease-specific registry," an electronic system that registers and tracks cases of a particular disease or health condition in a given population, and provides access to related information. Registries do not enable providers to manage patients who have multiple chronic illnesses.

In that sense, CDMSs occupy the middle ground between registries and EMRs, which are much more comprehensive—and much more expensive—than CDMSs. EMRs provide "secure, real-time, point-of-care, patient-centric information" to clinicians "where and when they need it," and incorporate evidence-based decision support. In effect, the EMR "automates and streamlines the clinician's workflow, closing loops in communication and response that result in delays or gaps in care." It "also supports the collection of data for uses other than direct clinical care, such as billing, quality management, outcomes reporting, resource planning, and public health disease surveillance and reporting."[7] EMRs often include flow sheets or forms specifically designed for common diseases, like diabetes, that make it easier for clinicians to monitor important information over time.

Ideally, all of the information necessary to monitor and treat a chronic-disease patient—everything from current and past medical diagnoses to lab reports and medications—is available in an EMR. This information extends well beyond that which the clinician gathers when a patient visits the office or clinic. However, tools in many EMRs were not created specifically for the purpose of managing chronic disease.

CDMS and EMR systems offer a number of similar functions, though individual products vary. Generally, both types provide at least some support for multiple diseases and conditions, reminders and alerts, electronic prescribing, patient education materials, ways to document patient-clinician encounters, decision support, standardized and ad hoc reports, population management, and care protocols and care guidelines that are prebuilt or can be customized. In the real world, though, clinicians may use only a few of the functions in either system.

Finally, neither system offers robust, culturally appropriate, care-management queues for clinicians, nor patient education materials in languages other than English, and in some cases, Spanish.

Table 1 on the following page lists the advantages and disadvantages of CDMSs and EMRs.

Table 1. Advantages and Disadvantages of CDMSs and EMRs*

CDMS	EMR	Generally Common to Both
Advantages		
• Population-based • More specific and flexible targeting of patients who have chronic conditions, including built-in guidelines and protocols • More-advanced stratification tools, such as risk and severity • Suitable for organizations with little capital or infrastructure • Time from purchase to implementation is potentially short	• Large amount of clinical data available • Complete and documented opportunistic care at every patient visit, regardless of reason • Communication tools for members of care team and for patient • Documentation tools and templates • Ability to assign evaluation and management codes • Complete implementation, project management, and support services • Advanced technology and R&D	• Standard and ad hoc reporting functions • Reminders and alerts at the point of care • Relevant data easily accessible at the point of care • Outreach tools, such as call-back lists and reminder letters, are built in • Patient education and instruction
Disadvantages		
• Data typically limited to identified medical conditions • Not all patient interactions are recorded or documented • Typically limited to office visits • Limited flexibility in recording miscellaneous and patient-reported information • Fewer implementation and support services • Less-advanced technology • Focus is on the condition or disease, not on the patient	• Handle one patient and one problem at a time • Functions for managing chronic disease are less advanced, less specific to this population • Very expensive • More difficult to implement and maintain • Long implementation before full benefits are realized	• Patients are not automatically identified as belonging to particular populations • Difficult to handle comorbidities • Reminders and alerts are not prioritized according to importance • Do not provide robust, culturally appropriate, care-management queues for the provider; no patient education materials in languages other than English

*It should be noted that the categories in this table refer to better-performing systems and that substantial variations exist among vendors.

II. A Road Test: CDMSs vs. EMRs

VENDORS WERE ASKED TO PROVIDE FOUR categories of information—about product function, corporate qualifications, services, and technology—as well as price quotes. Product function is critical; the optimal CDMS or EMR offers consistent, intuitive, and user-friendly tools and means of navigation. But this consideration often overshadows other important factors—a company's financial and services track record, for example, and the technology behind its product—that the authors believe also should be assessed.

Each of the four information categories included at least four criteria for evaluation purposes (Table 2).

The seven criteria for evaluating "disease management product functionality"—functions the steering committee deemed essential in caring for patients who are chronically ill—were:

- **General functionality.** The ability to easily access the system, navigate among modules and applications, and view a complete patient profile across different diseases.

Table 2. Information from Vendors

Disease Management Product Functionality	Corporate Qualifications
1. General functionality	1. Corporate information
2. Care management	2. Product information
3. Point-of-care functions	3. Financial information
4. Decision support	4. Client base and references
5. Patient self-management	
6. Population management	**Technology**
7. Reporting	
	1. General technology infrastructure
Vendor Services	2. Hardware
	3. Software
1. Training and documentation	4. Security and compliance with the Health Insurance Portability and Accountability Act
2. Implementation help	5. Interfaces
3. Customization services	6. Health Level 7 functional
4. Maintenance and ongoing support services	7. HL7 functional specifications specific to chronic disease management*

*Subset of the HL7 functional criteria for EMRs relevant for chronic disease care.

- **Care management.** The ability to (1) modify or add to the list of diseases or conditions the system supports; (2) modify existing care protocols and alerts/reminders that help providers manage patients in the office or clinic and between visits; (3) facilitate hand-offs and communications among members of care teams; and (4) support measures to maintain patients' current health and prevent additional problems.

- **Point-of-care functions.** The availability of (1) a patient summary screen that can be customized; (2) a current and complete display of the patient's previous care and outcomes; and (3) prebuilt and user-developed tools for documenting patient visits, such as templates, check lists, and flow sheets.

- **Decision support.** Access to features such as guidelines and protocols, and the ability to add and/or augment them.

- **Patient self-management.** The ability to capture data about a patient's self-care behavior, and to provide self-care tracking and documentation to the patient.

- **Population management.** The ability to (1) configure patient populations in the system using standard formats that can be customized; (2) track patient populations and provider panels; and (3) accommodate different medical conditions, initiatives for tracking or improving patient health, cultural diversities, and approaches to care.

- **Reporting.** The ability to produce both standard and ad hoc reports at the individual-patient and aggregate levels so clinicians, health care organizations, regulators, and government agencies can monitor quality of care and track outcomes.

Corporate qualifications included the types of products a company sells, its financial stability and viability, its clients, and references. Ideally, vendors have extensive experience in their field,

a balance sheet indicating that net income and revenue are on the upswing, and a strong investment in research and development.

Vendor services included a proven ability—especially in rural and inner-city health care settings—to deliver, implement, maintain, support, enhance, and correct defects in their products effectively and in a timely manner. Do the companies provide training and full documentation? Are they willing and able to customize their product to meet an organization's needs? Do they offer a wide range of implementation and support services that are available upon request, even though a client might not need such services?

In the technology category, the authors wanted to know, among other things, if a product:

- Is state-of-the-art and part of a larger strategy to stay ahead of technological advances in the industry.

- Supports related software applications.

- Responds to user inputs quickly enough.

- Is sufficiently scalable and flexible to accommodate future growth in an organization's information technology system.

- Can interface with existing or planned computer systems using established tools and standards, such as Health Level 7 (HL7).

- Is adequately secure—whether, for example, it meets the security requirements of the Health Insurance Portability and Accountability Act.

Not-to-exceed price quotes were to take into account different sizes of multispecialty health-care settings: 1-5, 6-10, 11-25, and 50+ physicians. The quotes encompassed purchasing and operating costs, including those for software, licensing, any necessary hardware, implementation, training, maintenance, software upgrades, supplies, tools, taxes, and other procurement costs and ongoing vendor expenses. (Price quotes were rough estimates, given that vendors did not

have details about potential clients' current information systems and requirements.) Also, vendors were to propose a CDMS or EMR configuration that would best meet the needs of an office or clinic that has a limited amount of information technology already in place.

In chronic disease care in California, there is a broad spectrum of potential users for these two information systems, including physician group practices, community health clinics, health centers, and management service organizations. The authors strove to focus their comparison on these audiences, with an emphasis toward those providing care to under- or uninsured patients in rural and inner city areas.

Ten of 29 vendors responded to the request for information and price quotes (see Appendix A). Three of the 10 sell CDMSs; three sell a stand-alone, chronic-disease-management module that comes with an EMR; and four sell such a module integrated into an EMR.

Demonstrations

Vendors also were invited to demonstrate their products at a November 2005 conference, "Chronic Disease Care: Better Ideas for Solving Real World Problems," sponsored by the California HealthCare Foundation. Eight of the 10 companies that had previously submitted product and corporate information agreed to make a 10-minute presentation.[7] To guide these presentations and ensure some degree of consistency among them, the authors asked that each vendor show how their CDMS or EMR would handle a particular clinical case scenario—that of a 50-year-old woman with Type 2 diabetes and a history of deep venous thrombosis. (See Appendix B for case details.)

There were seven criteria for evaluating the CDMS and EMR demonstrations:

- A complete patient profile using key demographic and clinical data.

- Ease of entry into the system, either at the time of a patient's visit or using documentation after the visit.

- The clinical usefulness of reminders and alerts.

- Ease of and applicability to acting on a reminder or alert. In other words, a reminder or alert may be clinically applicable, but suggested actions in response to it may not be.

- Ease of generating standard reports.

- Whether necessary information appears on standard reports.

- Ease of creating ad hoc reports.

Evaluation and Scoring

A steering committee of eight representatives from the California HealthCare Foundation, the Tides Foundation Community Clinics Initiative, ECG Management Consultants, and other stakeholders rated the four categories of information from vendors on a scale of 0 to 4. They referred to the criteria in each category to evaluate the information for each product, assigning a score of 0 for no answer, 1 for unacceptable (meets few requirements), 2 for average (meets most requirements), 3 for good (meets all major requirements), or 4 for excellent (meets or exceeds all requirements).

Subsequently, attendees at the November 2005 conference watched the product demonstrations and later filled out an evaluation card for each one, using the same 0 to 4 scale. They submitted a total of 450 completed evaluation cards. The highest-rated CDMSs and EMRs were those that received the highest average scores for both product/corporate information and product demonstration.

III. Results

TABLE 3 SUMMARIZES THE AVERAGE SCORES FOR CDMSs vs. EMRs in managing chronic disease. Although the results are not statistically significant, they reveal interesting differences.

As a group, the EMRs scored better than the CDMSs in terms of services, technology, and general HL7 functions, but the CDMSs fared better in terms of overall product functionality, meeting the HL7 standards specifically for chronic disease management, and performance in the demonstrations. The two types of systems received similar corporate-qualifications ratings. In the demonstrations, CDMSs outperformed EMRs, but not by a large margin.

Vendor Information

- In the first vendor-information category, "Disease Management Product Functionality," the most dramatic difference between CDMSs and EMRs was in population management; CDMSs had an average score of 3.44 vs. 2.18 for EMRs. The former can identify and track patient populations using multiple, configurable parameters, while the latter focus instead on case-by-case care of patients.

CDMSs also received higher average scores than EMRs based on three other criteria in this category. In declining order of the degree of score difference, these criteria were care management (3.29 vs. 2.69), reports (3.14 vs. 2.81), and general functionality (3.13 vs. 2.92).

Table 3. Average CDMS and EMR Evaluation Scores for Chronic Disease Care
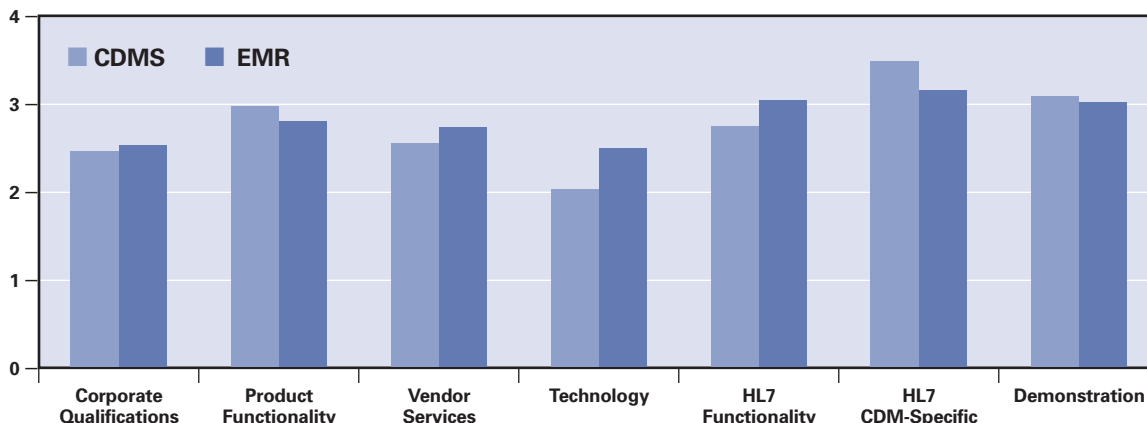
Regarding care management, CDMSs offered more-advanced, built-in care plans and protocols that can be modified from patient to patient, and had sophisticated, ready-to-use tools for tracking chronic disease outcomes. Regarding reports, the standard and ad hoc offerings in CDMSs were more robust and easier to use than those in EMRs; some were preconfigured specifically for chronic diseases. The difference in general functionality scores, though not large, reflected the availability in CDMSs of one complete, consolidated view of patient information across multiple diseases.

However, CDMSs scored lower in terms of patient self-management (2.18 vs. 2.62), mostly because the EMRs had a wide array of easily communicated patient-education materials. Scores were about equal for point-of-care functions (2.75 vs. 2.79) and decision support (2.75 vs. 2.82), though the guidelines and protocols in CDMSs can be augmented and expanded more easily.

■ The "Corporate Qualifications" category of vendor information yielded similar average scores for CDMSs (2.46) and EMRs (2.52). Generally, CDMS companies had more products (either currently on the market or in the pipeline) directly related to chronic disease and preventive care, more clients in rural and inner-city areas, and references that more often mirrored those particular markets. EMR vendors, on the other hand, typically had a stronger corporate history and strategy, more employees dedicated to chronic-disease solutions, and greater financial stability.

■ In the "Vendor Services" category, CDMS vendors received lower average scores than EMR vendors (2.52 vs. 2.78). The latter typically take a more systematic approach to training and problem-solving when it comes to implementing, customizing, and providing ongoing support for their products. Importantly, however, the time to fully implement an EMR is significantly longer, and the necessary level of support is greater.

■ Results for the "Technology Category" show that CDMS vendors also scored lower in terms of technical infrastructure (2.24 vs. 2.60) and hardware (1.42 vs. 1.89).[8] The EMR companies described platforms and configurations that are technically more advanced and more scalable to larger organizations. In addition, there is evidence that past and future enhancements to EMRs add or will add considerable value, making the products more usable.

The RFP process included an assessment of both the vendor's ability to create interfaces to other systems and how well they could meet the HL7 functional criteria. As might be expected, the EHR vendors in general scored higher on the HL7 criteria (as it pertains to EHR systems).[9] However, for the subset of the HL7 functional criteria that relate most directly to chronic disease management, the CDMS vendors scored higher than the EHR vendors, indicating that they had deeper functionality in that specific area.

As the price quotes[10] from participating vendors indicate, CDMSs are much less expensive to install and maintain on a cost-per-physician basis (Table 4). These findings also point to the economies of scale that can be achieved in larger medical practices and clinics that purchase either a CDMS or EMR. Purchasing groups might be a solution for organizations that otherwise could not afford such a system.

Demonstrations

The CDMS vendors outperformed their EMR counterparts in all respects during the product demonstrations. Cumulative scores for CDMSs were slightly higher than those for EMRs. CDMSs were able to display relevant patient information on a fewer number of screens, which required less navigation. They also incorporated evidence-based guidelines and enabled providers to dictate goals and intervals between health care activities tailored to each patient. In addition, the reporting options in CDMSs were both patient-specific and population-focused.

Table 4. Average Total Cost per Physician

	CDMS	EMR
Physician practices (1-5)	$8,222	$33,985
Physician practices (6-10)	$5,417	$25,980
Physician practices (11-25)	$3,617	$19,061
Clinic corporations (50+)	$2,937	$16,883

IV. Discussion

WHILE BOTH CDMSS AND EMRS OFFER A
number of benefits, this survey revealed shortcomings in all
of the products from participating vendors. For example,
none uses algorithms to automatically identify all patients who
have the same medical condition, which would enable better
population management. Algorithms based on clinical guide-
lines could help identify at-risk patients automatically and rank
possible treatments in terms of their greatest potential impact
on outcomes. These systems also need more-refined tools
for treating comorbidities, such as reminders that address a
patient's multiple medical conditions, to ensure that care
is integrated and complete.

As mentioned earlier, one difference between the two systems
is the greater likelihood that EMRs are used at the point of
care during patient visits. In practice, though, such use may
be limited because managing chronic disease—sometimes
multiple illnesses and treatments—can be time-consuming.
Similarly, using a CDMS at the point of care for chronic
disease management, while the patient is in the office or on the
telephone, may be unrealistic. Unlike EMRs, CDMSs do not
document all of the care a patient receives; thus, they may
exclude treatments or other factors that have a bearing on the
patient's chronic illness or office visit, and may require both
electronic and paper documentation. In conversations with
safety-net clinics, the authors learned that a CDMS or a
chronic-disease module in an EMR that does not interface
with other data systems, and therefore requires significant data
entry by clinicians, is of little value during patient visits.

A medical practice or clinic can purchase a CDMS at low
cost, implement it quickly, and immediately begin leveraging
tools—alerts and reminders, protocols, reports, and the like—
that have been designed specifically for managing chronic ill-
nesses. These tools can be used "out of the box" or customized,
at the point of care for individual patients or at higher levels
to track entire populations.

However, the authors are not aware of many organizations
that tap CDMS capabilities to their fullest extent, in real time
at the point of care. Nor are there many examples of CDMSs
connected to other clinical systems providing quick access
to more data and eliminating the need for manual data entry.
Furthermore, many CDMSs are only available or used in

primary care offices, not in other clinical settings; that means missed opportunities to manage chronically ill patients and to update CDMS records.

EMRs require a much bigger investment of money, time, and effort than CDMSs do. They often are described as an "all or nothing" proposition because the organization commits to building all of the necessary data interfaces and ultimately exploiting most or all of the tools in EMRs to reap the rewards. Among those rewards are more-comprehensive, real-time clinical data; complete documentation of all patient encounters; and the ability to manage all patients, not just those who are chronically ill, across the entire continuum of care.

Some EMR functions, such as validating evaluation and management codes, may not be available in CDMSs. In addition, EMRs can electronically transmit orders for tests, procedures, and medications, and they come with advanced tools—including patient and provider portals—that enable electronic communication among all parties.

On the downside, it can take as long as several years for clinicians to fully integrate EMR functions into their daily work. Some of the functions most critical for managing disease, such as reports and health-maintenance reminders and alerts, usually are the last to come online and may have to be customized. For these and other reasons, small health care organizations may conclude that EMRs are not worth the investment. Indeed, some small providers with a CDMS say the system adequately meets their information technology needs.

EMR vendors typically are large firms with a long track record. They have impressive capital resources and invest heavily in research and development. Through regional offices and corporate headquarters, the current power players

provide sophisticated technical training and support before, during, and after an EMR has been installed.

Most CDMS vendors, in contrast, are relatively small and new to the market. Whether or not a vendor will survive and continue to provide technical support and upgrades is a legitimate concern for buyers, but it is wrong to assume that such companies and their products are inferior with respect to chronic disease care. In many cases, nascent vendors feel more compelled to attract and retain clients by being especially attentive to customers' special needs.

One option for providers who want to leverage information technology for chronic disease management as soon as possible is to invest in a CDMS now, then transition to an EMR down the road when, presumably, EMR products will have improved, standards are more widely adhered to, and prices fallen. This strategy requires some forethought because the CDMS must be able to convert data to an EMR format. Buyers can gauge this capability by road-testing a CDMS using sample problem lists, medications lists, or other relevant information. If an organization plans to use a CDMS for population management and an EMR for patient management, a fully functional interface between the two is essential.

Finally, moving from paper to electronic documentation and introducing a CDMS or EMR into the exam room often meets resistance from clinicians and office staff. This situation calls for effective change management and training.

How Some Providers Use CDMSs

After vendors submitted information about their products and companies for this survey, the authors contacted five health care providers to get a better sense of how clinicians are actually using CDMSs to manage chronically ill patients.[11] These organizations were Redding Rancheria

Indian Health Clinic in Redding, California; Redwood Community Health Coalition in Santa Rosa, California; West County Health Centers in Guerneville, California; Luther Midelfort Clinic in Eau Claire, Wisconsin; and Delaware Health Net in Georgetown, Delaware.

They had purchased either MediTracks from i2i Systems or Patient Planner from DocSite. Four of the five use these tools at the point of care (relying on printed patient-summary sheets, but rarely logging in to the CDMS during patient visits) and for outreach and reporting. Redding Rancheria Indian Health Clinic uses MediTracks for outreach and reporting, but not at the point of care.

All five organizations indicated in interviews that they are very pleased with the technology and functions of their CDMSs, and that both i2i Systems and DocSite provide excellent customer service and support. Among other findings:

■ At four of the five organizations, patient data from a practice management information system were interfaced with the CDMS. The fifth organization fed demographic data about all current patients to the CDMS in one sweep, when the system was installed. The five organizations enter all relevant clinical information by hand, though one set up its CDMS to receive lab results directly.

Overall, few patient data stream automatically to CDMSs.

■ Three of the practices rely solely on providers to indicate a patient's disease status, which activates management tools. Two of the practices also use their CDMS to automatically activate such tools for patients who have had a clinician encounter in which a chronic-disease diagnostic code was assigned. For example, diabetes patients are automatically identified as needing ongoing disease management.

■ The most common uses of CDMSs during office visits are to order printouts of clinical information about patients, for alerts, and for recommended interventions. Clinicians at these organizations typically do not access their CDMS during patient visits. One reason for this approach is the disruption that a computer in the exam room might cause. Another is an insufficient number of available devices. All five providers rely on data-entry and clinical staff to update the CDMS after each patient visit based on hand-written notes in the chart.

■ The CDMSs generate mailing labels and letters to remind patients of upcoming and overdue visits and services. Providers use their systems to print batches of letters at specified intervals, and to print lists of patients who need follow-up.

■ All five organizations generate standard and ad hoc reports in their CDMSs to track patients and monitor clinicians' and the organization's performance in terms of patient outcomes and maintaining or improving quality. Standard reports are routinely created to monitor progress on treatment measures, such as regular testing of hemoglobin A1c and average hemoglobin A1c results; these are transmitted internally or to outside agencies. The organizations use ad hoc lists to identify patients who are part of a population being tracked, who are candidates for outreach, and who may need follow-up because they have not complied with guidelines or whose test results are abnormal.

V. Conclusion

CDMSs AND EMRs OFFER OPPORTUNITIES TO improve the management of chronic diseases for millions of Americans. However, an information survey and a demonstration of products on the market revealed strengths and weaknesses in both systems that medical practices and clinics should carefully weigh before they invest in either type.

Providers, vendors, and others in health care could promote the adoption of information systems for chronic disease management by consulting with and educating each other, perhaps through collaboratives and an annual conference. Collaboratives would help buyers make better-informed choices by connecting them with providers who, having purchased a CDMS or EMR, are familiar with the complex technical, functional, and financial issues. Such collaboratives might also be a source of start-up capital for small medical practices and clinics that otherwise cannot leap this barrier.

Appendix A. Participating Vendors

Chronic Disease Management Systems

Patient Planner
DocSite, LLC
48 Mount Vernon St., Suite100
Winchester, MA 01890
(781) 721-0005
www.docsite.com

i2i MediTracks
i2i Systems, Inc.
5213 El Mercado Parkway,
Suite A
Santa Rosa, CA 95403
(866) 820-2212
(707) 575-7100
www.i2isys.com

PECSYS
The Aristos Group
P.O. Box 684715
Austin, TX 78768
(425) 483-7346
aristos.com

Electronic medical records (Stand-alone CDM Module)

Intergy EHR
Emdeon Practice Services
2202 N. West Shore Blvd.,
Suite 300
Tampa, FL 33607-5749
(877) 932-6301
(850) 434-1824
www.medicalmanager.com

Misys EMR
Misys Healthcare Systems
8529 Six Forks Road
Raleigh, NC 27615
(866) 647-9787
www.misyshealthcare.com

CareManager
Kryptiq Corp.
3600 N.W. John Olsen Place,
Suite 300
Hillsboro, OR 97124
(503) 906-6300
www.kryptiq.com

Electronic medical records (Integrated CDM Module)

TouchWorks EHR
Allscripts, LLC
2401 Commerce Drive
Libertyville, IL 60048-4464
(800) 654-0889
(916) 933-8599
www.allscripts.com

NextGen EMR
NextGen Healthcare Information Systems, Inc.
5045 Robert J. Matthews
Parkway, Suite 102
El Dorado Hills, CA 95762
(916) 941-6912
www.nextgen.com

EpicCare Ambulatory EMR
Epic Systems Corp.
1979 Milky Way
Verona, WI 53593
(608) 271-9000
www.epicsystems.com

eClinicalWorks EMR
eClinicalWorks, LLC
Westborough Executive Park
112 Turn Pike Road
Westborough, MA 01581
(866) 888-6929
(508) 836-4466
www.eclinicalworks.com

Appendix B. Case Scenario

MRS. SMITH IS 50 YEARS OLD AND HAS Type 2 diabetes mellitus. She is 5-feet-3-inches tall and weighs 249 pounds, with a calculated body mass index of 44.2, suggesting marked obesity. Her blood pressure is 184/96, her pulse is 84, her respirations are 18, and her temperature is 37° C. Mrs. Smith also smokes one pack of cigarettes each day and is homeless at times. She is on Coumadin (1 mg/day) for a history of deep venous thrombosis; her last international normalized ratio was 2.5. Her sister and mother both died of breast cancer.

Mrs. Smith presents to the community clinic with a sore back. With her chart is a current diabetes-management and Coumadin-management document prepared from an EMR or CDMS. This document contains historical information about the management of both of these conditions. Mrs. Smith frequently misses clinic appointments, and the clinic wants to do all it can for her during the appointments she does keep.

The EMR or CDMS also indicates that Mrs. Smith is a year overdue for a screening mammogram and has never had a PAP smear at this organization. Mrs. Smith states that she had a PAP exam six months ago by a local ob/gyn whom she has seen for years. She would like to start having her PAP exams at the community clinic. The date of her last PAP was entered into the system with a note to follow up with her ob/gyn. Mrs. Smith is scheduled for a mammogram (identified by the EMR or CDMS), which will occur at the end of this visit.

Mrs. Smith's blood pressure is rechecked and found to be 180/98. She stopped taking her blood pressure medication about six months ago. The clinic has a board-mandated goal of reducing the overall blood pressure of its hypertensive patients. Mrs. Smith will start on the clinic's hypertension protocol and was asked to return in two weeks for a recheck.

During the visit, Mrs. Smith received a flu vaccine and an EKG; both reminders were on her patient-management sheet produced by the EMR or CDMS. The Coumadin dose was reduced and she is scheduled for a lab, a pro time, and an international normalized ratio.

Endnotes

1. Institute for Health & Aging, University of California-San Francisco. Robert Wood Johnson Foundation. Chronic Care in America: A 21st Century Challenge. November 1996.

2. Fortin M, Bravo G, Hudon C, et al. "Prevalence of multimorbidity among adults seen in family practice." *Annals of Family Medicine.* 2005;3:223-228.

3. Robbins JM, Webb DA, & Sciamanna CN. "Cardiovascular comorbidities among public health clinic patients with diabetes: The Urban Diabetics Study." *BMC Public Health*. 2005;5:15.

4. Grumbach K. "Chronic illness, comorbidities, and the need for medical generalism." *Annals of Family Medicine.* 2003;1:4-7

5. U.S. Department of Health & Human Services. Office of the National Coordinator for Health Information Technology (ONC). Executive Summary. Undated.

6. Ibid. "Thompson launches 'decade of health information technology.'" July 21, 2004.

7. HIMSS Electronic Health Record Committee. HIMSS Electronic Health Record, Definitional Model, Version 1.1. September 24, 2003.

8. "Technical infrastructure" includes the overall architecture of an information system, Internet/intranet function, system performance, remote access, system backup processes and disaster recovery plans, and data storage and retrieval capabilities. "Hardware" refers more specifically to servers, desktop configuration, peripherals, and connectivity methods.

9. Health Level Seven Inc. (www.hl7.org) says the purpose of its functional model is to encourage the development of EMR systems in a way that will "improve the quality of care, reduce the cost of care, and provide better access to more fine grained clinical data."

10. These were rough estimates, given that vendors did not have details about potential clients' current information systems and requirements. Optional products unrelated to chronic disease management are not included in the price quotes, nor are any purchasing and operating costs related to hardware or interfaces, the need for which likely varies among care providers.

11. The authors also contacted organizations that have EMRs, but none responded to an interview request. According to vendors, many EMRs must be fully implemented before the disease and population-management features can be used; few health care providers have reached that point.