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How The Electronic Health Record Did Not Measure Up To The Demands Of Our Medical Home Practice

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ABSTRACT The American Recovery and Reinvestment Act (ARRA) of 2009 will soon provide billions of dollars to small physician practices nationwide to encourage adoption of electronic health records. Although shifting from paper to computers should lead to better and cheaper care, the transition is complex. In this paper we describe our struggles to adapt a commercial electronic health record to an innovative practice serving high-cost patients with chronic diseases. Limitations in the technology gave rise to medication errors, interruptions in work flow, and other problems common to paper systems. Our experience should encourage providers and policy makers to consider alternative software and informatics models before investing in currently available systems.

Policy makers and health administrators have placed great hope in electronic health records to improve the quality and reduce the cost of health care.¹ As a result of the American Recovery and Reinvestment Act (ARRA) of 2009, the United States is expected to provide billions of dollars to physicians and hospitals to help them implement electronic records.² There is also great interest in the potential of new models of care delivery, including the patient-centered medical home, to achieve the same goals.³

There have been some reports in the literature about the challenges of implementing electronic health records in traditional practices.⁴ However, none has described the particular challenges of making the technology work in the context of the medical home and similar models. Here we report our experiences using a popular commercial electronic health record in a small, innovative practice.

We found that the technology did not support the multidisciplinary team approach to care that is a hallmark of the medical home. We also found that it led to medication errors and other quality problems. Our experience suggests that policy

makers should consider alternative software before investing billions in the spread of current technology.

The Setting

In 2006 AtlantiCare, a large not-for-profit health system in southern New Jersey, and the Hotel Employees and Restaurant Employees International Union, Local 54 Fund, partnered with Renaissance Health, a health care innovation company based in Cambridge, Massachusetts. The Local 54 Fund is a Taft-Hartley trust that insures approximately 25,000 casino and hotel workers and their families in Atlantic City, New Jersey. The goal was to build a new primary care practice called the Special Care Center.

The new practice was designed from the ground up to care for the sickest, costliest patients. These patients typically had complex, chronic diseases such as diabetes, hypertension, asthma, chronic obstructive pulmonary disease, coronary artery disease, and congestive heart failure. Based on the ambulatory intensive care unit model,⁵ this practice combines features of the chronic care model⁶ and the patient-centered medical home to deliver more intensive out-

patient primary care to such patients.

Innovative features of the practice include the following: (1) extensive use of nonphysician “health coaches” to educate, motivate, and guide patients to manage their chronic illnesses; (2) a higher staff-to-patient ratio allowing for closer, more personalized care than in other types of practices; (3) daily interdisciplinary team “huddles”; (4) close tracking of chronic disease markers to guide therapy; (5) population health management using information technology (IT) to target interventions to the neediest patients; (6) integrated pharmacy, mental health, social work, and nutrition services; and (7) a rapid cycle of innovation—that is, a commitment, by design, to undergo frequent evaluation, change, and reevaluation of work flow and methods.

The practice opened in July 2007 to a limited group of patients by invitation only, targeting those expected to incur high costs. We used three methods to identify these patients: a computer model that predicted costs based on prior insurance claims data; direct application by patients with multiple chronic illnesses; and referrals by hospital case managers.

Instead of billing each encounter as fee-for-service, AtlantiCare and our insurance payer (Local 54 Fund) provided a global budget to care for an entire population of patients. To help remove barriers to care in a low-wage population, the practice waived copayments for office visits and prescriptions filled at an integrated pharmacy.

By the beginning of 2010, the practice had enrolled approximately 1,200 patients, whose prior medical spending averaged four times the population average. The practice was staffed by two full-time-equivalent physicians, a nurse practitioner, six health coaches (with credentials ranging from community health worker to registered nurse), two front-desk staff, an administrative director, a half-time data analyst, and a part-time social worker.

Because we were building the practice from scratch and planned to use objective clinical data to optimize patient management, we decided to use an electronic health record rather than paper charts. AtlantiCare had previously engaged in a process in which its clinicians, administrators, and IT department selected an ambulatory electronic record to use in their own practices. AtlantiCare would also subsidize and support the use of the system by referring physicians. AtlantiCare chose eClinicalWorks (Westborough, Massachusetts) based on its widespread use—the system had 34,000 reported physician-users—as well as its features, reputation, and pricing. The Special Care Center became one

of the first sites to launch eClinicalWorks systemwide.

The Special Care Center was designed from the beginning as a paperless practice, without paper charts or a file room. Desktop computers were installed in all exam rooms and work areas, and each clinician and health coach received a tablet computer that linked to a secure wireless network. All incoming documents were scanned and then shredded immediately.

The Benefits

From the beginning, we experienced several of the benefits of using an electronic health record. Because charts were always accessible, we did not have to hunt down documents scattered throughout the office. We had information available whenever we needed it, including via a secure Web interface that allowed us to access clinical information remotely while on call. Also, because notes were typewritten, we did not have to spend time attempting to understand either our own or our partners’ frequently illegible handwriting. And because our medication lists were also stored electronically, prescribing refills for patients who take an average of eight medications each required a fraction of the time it would have taken by hand.

The electronic health record also facilitated easy communication with consultants, as notes and medical summaries could be printed quickly. Another benefit was an ability, although limited, to use the electronic record system to send clinical messages among the team members coordinating care.

The Challenges

Our electronic health record implementation also presented a large set of challenges that would complicate any medical practice.

SLUGGISH AND UNRELIABLE SOFTWARE About a year into the practice, the system began to slow down. At times, several seconds to a minute elapsed between each click or action, dramatically slowing down work flow and often requiring a rebooting of the system. This would cause a delay of several minutes more and require us to repeat the prior documentation process.

Several times, the system failed to operate for minutes to hours at a time, forcing us to practice “blind.” At those times, the benefits of a paperless practice turned into a huge liability as we were forced to see patients without any documentation. In the end, system stability was finally restored, and both down time and delays were eliminated. But it took several weeks of, first, lobbying for action by our IT department,

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Higher Prior Medical Spending

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eClinicalWorks, and several external IT consultants, and then waiting for intensive diagnostic and therapeutic work to be completed.

E-PRESCRIBING Electronic prescribing posed another challenge. When we started the practice, we printed all of our prescriptions from the electronic health record, signed them, and had either the patients or staff members carry them downstairs to the integrated pharmacy to be filled. Several months later, as planned, we were told that the outbound electronic prescribing module was running. But we discovered a large security glitch that allowed any user to send an electronic prescription in the name of any other provider. It took the better part of six months to finally get this glitch resolved. During this time we continued to print, sign, and run paper prescriptions up and down stairs.

Often prescriptions were misplaced in this process, leading to delay and rework. When the electronic record vendor finally provided an update that solved the security issue, we started to send all of our prescriptions to our pharmacy electronically, which saved time and reduced the chance of errors.

COMMUNICATING LAB RESULTS One of our primary reasons for using an electronic health record initially was to receive lab results electronically. That way, we would be able to use clinical data to track treatment outcomes, target interventions to our needier patients, and facilitate our own quality improvement. Our corporate IT department has been working with Wellogic (Cambridge, Massachusetts) to create an interface between AtlantiCare's clinical lab system and eClinicalWorks. But by the beginning of 2010, despite more than two years of work, we still had not received any lab values as electronic data.

Instead, we continue to receive lab data on paper documents that we scan and store as portable document format, or PDF, files, which means that we cannot trend them, search them, or use them as data elements. The electronic health record does have the capability to use flow sheets to track values over time. However, we have not been able to use this feature because the lab data have yet to arrive in electronic form.

CLINICAL ALERTS AND WARNINGS Clinical alerts and warnings of drug-to-drug interactions and other problems are touted as a way in which electronic health records can improve patient safety. Very soon after starting with eClinicalWorks, however, we turned off this feature because it was alerting us to potential problems involving almost every single patient.

For instance, if we treated a patient with insulin and metformin, a very common and recommended combination of therapies, the sys-

tem alerted us to the risk that the drugs could lower blood sugars—a fact well known even to all second-year medical students. If we treated a patient with a statin to lower cholesterol and omeprazole to control gastric acid, we received an alert because of a single case report in the literature of a patient who had a problem taking these two drugs together.

It is understandable that the electronic health record's vendor and its partners want to be cautious for liability reasons. But like the boy who cried "Wolf!" these alerts went so far that they ceased to be useful, and full-fledged "alert fatigue" was in danger of setting in.

BURDEN ON PHYSICIANS As in many other practices that have implemented electronic records, we found that documentation time for physicians actually increased compared to paper charting. We found that the system of point-and-click templates, designed to facilitate quick notes, was inadequate for the variability of patients in our practice. The notes generated by such methods yielded documents that were difficult to read for future reference.

Most current electronic health records require that the clinician structure and enter many pieces of data that previously were done in the paper environment by other staff. Although this requirement may improve the accuracy of the data entry, it causes most clinicians to spend additional time after hours completing patient notes, even two years after the record was implemented.

ACCURATE MEDICATION LISTS Perhaps our biggest challenge has been maintaining accurate medication lists for our patients. By design, our patients are all on multiple medications. When needed, we are aggressive in intensifying their care by prescribing complex and changing regimens. Knowing at any given time what medications patients are being prescribed is critical to improving the management of their conditions. Getting the information wrong can lead, and has led, to real, adverse clinical consequences.

A root cause of our medication-list inaccuracies has been the interdisciplinary nature of our care model. Most electronic health records, eClinicalWorks included, are designed and tested for use by a single user in a single office setting. The complexities of multiple practices across a health system, coupled with the complexities of multiple users in an interdisciplinary practice, have had unintended consequences.

Various software design flaws have led to medication errors. For instance, our electronic health record specifically requires that clinicians list on each note for each visit every medication a patient is using in a "Current Medications" section. This requirement is intended to promote

medication reconciliation for safety, but it has had unintended consequences. Medication lists have had missing items or have been rendered empty because users have neglected to meet the software's reconciliation requirement. Often these users are nonmedical staff such as social workers who rightly feel that they have no business reviewing medications.

On other occasions, the users are specialists who fail to reconcile the myriad of medications that a patient is taking when at least some of these medications fall outside their particular scope of knowledge. On many occasions, reconciliation proves impossible, because the patients themselves do not know what they are taking or do not have their medications on hand.

Other electronic health records we have used do not require reconciliation, which leads to an opposite problem: medication lists are lengthy and out of date, filled with accumulated medications that were prescribed once and never properly deleted. Indeed, the task of keeping an up-to-date medication list is difficult and fraught with potential errors.

Additionally, medication lists have been corrupted when multiple users have interacted with the same patient and the same chart simultaneously. In these cases, the electronic health record, designed for a single user, did not correctly handle changes made in one note while another note was open. This led to the recording of inaccurate information.

Also, our medication lists have not always been able to interact perfectly with outside electronic prescribing systems. For example, changes made in our electronic health record were not always relayed to our third-party electronic prescribing module, leading to errors. As a result, providers have spent inordinate amounts of time sifting through charts to correct medications and dosages. At worst, these problems have led to the wrong medications' being prescribed and dispensed to patients.

EMERGING AND WORSENING PROBLEMS Our experience has been that complex software systems, like complex paper systems, come with a set of liabilities. Unlike the known liabilities of a paper charting system, whose origins and solutions lie within the control of a practice, the problems posed by the electronic health record were beyond our control. Resolving software glitches and errors required coordination with and cooperation of IT staff and software vendors outside the practice. These parties often had conflicting interests, leaving us with day-to-day work-flow problems that were difficult if not impossible to resolve. In the end, this amounted to a high unexpected cost of electronic health record implementation.

Any practice trying to implement an electronic health record could face problems with system instability, electronic prescribing, lab interfaces, data entry, alerts, and medication lists. These problems are all theoretically solvable, but the fact that our tech-savvy staff had difficulties—despite the backup of a large corporate IT department—should sound a cautionary note.

Stifling Innovation

Even more problematic for those of us trying to build a medical home practice—and presenting a major challenge for those hoping that electronic health records can help improve care—is that the current software is not configured to deliver the sort of proactive, team-based, transparent care that we need.

REGISTRY SHORTCOMINGS Central to the principles of a patient-centered medical home practice is the use of IT to support optimal patient care.³ Our experience was that the data-analysis capabilities of our electronic health record lagged behind our needs. Like many of the more advanced electronic systems available, eClinicalWorks includes several registry functions in its core product. In demos, the vendor proudly shows how it can be used to track chronic care outcomes.

We have not yet succeeded in having this function work correctly in practice. When eClinicalWorks was first in place, only one person could use the registry at a time. Thus, if anyone else, anywhere in the health system, decided to do a query—and then forgot to log out before switching screens, which was very easy to do—no one else could use the registry until the IT department manually reset it.

Worse, even after this problem was fixed, we found that the queries often gave erroneous results that did not agree with our manual calculations. Neither our IT department nor eClinicalWorks could explain these discrepancies. When asked about it, eClinicalWorks usually responded by telling us that no one else was complaining about these registry inaccuracies.

When we looked deeper, we found even more problems. Many lab values such as hemoglobin A1c, used to measure long-term blood sugar control in diabetic patients, actually had several variants in the system—for example, HGBA1c or HBAlc. Consequently, many results could be stored in one of many different places in the record or had no place to be stored.

In any case, even after two years of concerted effort by a large corporate IT department, we still could not get our lab results transmitted directly from the lab into the system as data. And even if the registry did work, it could only do one query

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Potential Problems

Any practice trying to implement an electronic health record could face problems with system instability, electronic prescribing, lab interfaces, data entry, alerts, and medication lists—all theoretically solveable, but our tech-savvy staff had problems.

at a time. As a result, pulling up the “dashboard” of quality metrics that we report on regularly required dozens of repeated queries, taking hours of an analyst’s time.

Our struggles point to a vulnerability of many current electronic health record products: they are designed to manage work flow, clinical notes, and billing—not to analyze data. Registry functions generally are not as well integrated or as reliable as more basic functions such as making appointments and documenting clinical data. Moreover, there is no widely accepted standard for storing or communicating clinical data within a system or between systems, such as between a laboratory and a physician electronic health record. The potential of computerized data systems to improve clinical outcomes can be realized only if this functionality is designed into software at the outset.

TEAM-BASED CARE A second issue is the inability of our electronic health record to deal with the sort of multidisciplinary team-based care we practice. All practitioners, including social workers and health coaches, have to use the same traditional note template designed for physicians, which starts with a chief complaint and concludes with an assessment and plan. This note is inappropriate for nonphysician staff.

The system also does not deal well with multiple notes that are open at the same time, which often occurs when patient sees different team members on the same day. It can assign patients to doctors but cannot assign patients to health coaches or social workers. Consequently, we cannot generate lists of patients by health coach or by other type of provider very easily. What’s more, clinical messages can only be sent to one person at a time, so information cannot be sent to the entire team caring for a patient simultaneously. There is no adequate functionality to manage staff by assigning tasks and tracking the progress of these tasks.

A POOR FIT Other issues include a lack of functionality for nontraditional visits. An example is scheduling or documenting group visits. The electronic health record does not have an easy way to trigger proactive care such as follow-up on a patient based on acuity or after a certain interval. The eClinicalWorks system does have a patient portal, but we have not tried it yet because few of our patients currently use e-mail. More helpful for us would be a portal for text messages, as virtually all of our patients use cell phones.

An innovative medical home practice requires a medical record that can facilitate changing methods of care. By recapitulating the traditional paper chart in electronic form, most currently available electronic health records serve to

reinforce current practice patterns instead of encouraging innovation.

Most current electronic record systems, including our own, are built to work with a fixed and traditional office work flow. Our electronic record was not robust or flexible enough to allow for continuous changes in process and roles that are hallmarks of rapid-cycle redesign in an innovative practice.

Missing from the system were clinical dashboards that allow physicians to quickly monitor a patient’s important clinical markers without manually assembling these data from various sources within the chart. Also missing were reports that compile data across a population of patients to support quality improvement. Nor did the functionality exist to manage and coordinate teams of caregivers in a modern interdisciplinary practice.

Conclusions

It is perilous to draw broad conclusions from the experience of a single practice, particularly one such as the Special Care Center, which is unique in design and environment. That said, we believe that our experiences provide important lessons for the many practices about to implement electronic health records, especially those engaged in practice redesign, as well as those that support such endeavors.

REALITY CHECK We certainly appreciate many of the benefits of using an advanced electronic health record and would again choose to take this path instead of choosing paper charts. However, the myriad challenges of using it in a real clinical setting—despite tech-savvy physicians and staff, the support of a large corporate IT department, and the fact that we started from scratch and thus didn’t have to change from a paper system—should serve as a reality check for some of the wildly positive scenarios of widespread health IT adoption.

Even a widely used, award-winning system like the one we chose has ongoing design issues that can lead to inefficiencies and stifle innovation at best—and can lead to dangerous medical errors at worst. We do not believe that these issues are limited to our own experience with a single software product. We believe that the complexity of software systems, coupled with the business interest to rapidly deploy these systems, leaves electronic health records susceptible to flaws and patients susceptible to medical errors.

INTRODUCING NEW KINDS OF ERRORS Others, too, have found that although computerization can remove some types of errors—for example, those that stem from poor handwriting—they can also introduce a new set of potentially dan-

gerous mistakes into care.⁷ Other studies have shown that practices using electronic health records are not significantly more likely than others to show broad improvements in quality metrics.⁸ Our experience shows that the failure to realize quality improvements is likely to be because of functions that are not used, such as the alerts, or do not work well or consistently, such as the registries.

The medication error potential is not trivial. We have documented corrupted medication lists in about 3 percent of our current patients. The reaction of our IT support team and eClinicalWorks to these errors is often to blame human error, such as the opening of multiple notes simultaneously.

In other industries such as aviation, however, it is understood that simply telling people not to do things is not adequate. Systems must be designed with the assumption that procedural mistakes will occur and with features that prevent such mistakes from leading to errors. It is also interesting to us that medical devices like intravenous pumps, which can cause potential medication errors, are closely regulated by the Food and Drug Administration and held to very high standards of performance. On the other hand, electronic health records, which can cause similar or more serious medication errors, are not held to such comparable public scrutiny, and indeed are often shielded from liability in their contracts with providers.⁹

DIFFICULT TO APPLY TO TEAM-BASED CARE Perhaps even more worrisome is that these current systems often are poorly designed for the kind of team-based, proactive, patient-centered care that the patient-centered medical home and other models are calling for. Indeed, the very core structure of current electronic health records, which attempt in the end to create a series of visit notes similar to those in a paper chart, is at odds with the notion of creating the continuous healing relationships¹⁰ that are at the core of innovative models of chronic care management.

The design of both traditional paper charts and electronic ones as chronologically organized files in a folder drives users to think of patients in the way their data are recorded: as a collection of discrete clinical encounters with little atten-

tion given to the connections between these encounters. eClinicalWorks and other current electronic systems do not use technology to facilitate analysis of patient data across the continuum of their care.

APPROPRIATE FOR BILLING AND CODING Our system and others like it seem primarily driven by the imperative to allow doctors to document, code, and bill visits at a more intensive—and thus higher-paying—level. Although these features allow for increased practice revenue in a fee-for-service setting, they do nothing to improve care. Indeed, they lead to notes that are cluttered with marginally useful pieces of information to support a higher charge, but relatively little useful clinical information to improve future care.

In an environment such as ours, which is motivated by outcomes and not how many widgets come off the line each day, this is a big problem. Many other sites attempting to implement patient-centered medical home models have also noted that current electronic health record systems are inadequate for this task. Indeed, this is one of the largest barriers to successful practice transformation.¹¹

ADDITIONAL SOFTWARE After many months and countless battles trying to adapt our electronic health record, we decided about a year ago to simply use other software as adjuncts to meet our needs. So we now use several other systems in parallel. These include Docsite—a Web-based registry based in Raleigh, North Carolina—to track our chronic care markers; a home-built customer relationship management system to track recruiting; and various Microsoft Excel and Word documents to track patients needing interventions. These systems are all managed by a part-time data analyst.

This patchwork of systems currently works to meet our needs but is neither scalable or broadly replicable. Our experience suggests that providers should be aware of—and policy makers should be attuned to—the design and accountability of currently available electronic health records and consider other alternative software and informatics models before we invest billions of dollars in merely subsidizing the spread of current systems. ■

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Rushika Fernandopulle
Coauthors Rushika Fernandopulle and Neil Patel share a common vision for transforming primary care. Fernandopulle launched a chronic disease practice in Atlantic City, New Jersey, almost three years ago and hired Patel as one of two full-time doctors.

The goal of the practice, called the Special Care Center, has been to offer innovative, patient-centered care from the start. That has meant practicing evidence-based medicine, holding daily team meetings, negotiating global payments for patient care from payers, and having health coaches fluent in different languages. It also meant no paper files and, instead, a comprehensive electronic health record to help clinicians work together and track their patients.

Today the Special Care Center has evolved into a full-fledged medical home that mainly serves unionized employees of Atlantic City's

casinos. These aren't all well-paid waiters at fancy restaurants, but rather mostly low-wage earners such as housekeepers and kitchen help. Many are immigrants from Latin America, India, and other countries who struggle with English and send money home to support their families. And all have one or more chronic illnesses.

As the Special Care Center was devised, a key goal was eliminating the fragmentation of care that is typical of the experience of chronically ill people. That led its physicians to embrace the features that characterize the patient-centered medical home model, as Fernandopulle and Patel describe in their article. But the going wasn't always easy. Case in point: The electronic health record system was so riddled with bugs that Fernandopulle and Patel were forced at times to disable some of its features and eventually to patch together "fixes" from outside software.

Fernandopulle, 41, who was born in Sri Lanka and grew up in Baltimore, earned his medical and public policy degrees at Harvard and trained at the University of Pennsylvania and Massachusetts General Hospital. Board-certified in internal medicine, he has

worked as a practicing physician and as a health policy researcher and administrator with a strong interest in alternative practice design.

He was the first executive director of the Harvard Interfaculty Program for Health Systems Improvement, an effort to figure out ways to upgrade how the United States delivers care. With medical anthropologist Susan Sered, he coauthored the book *Uninsured in America: Life and Death in the Land of Opportunity*. He toured practices across the country, absorbing many of the good ideas that were taking root. "But the way most people look to improve care is incremental progress," he says. "You take existing practices and find one thing to change, and you change that. You make things better, but you don't change much."

In 2004, Fernandopulle left his Harvard post and founded Renaissance Health, a small company in Cambridge, Massachusetts, whose mission is to design and implement new models of care delivery. Later he opened the Atlantic City practice, gearing it exclusively toward chronically ill patients needing intensive care and health management. The practice is a partnership of

Renaissance Health; AtlantiCare, a large health system in southern New Jersey; and a trust set up by Local 54 of the Hotel Employees and Restaurant Employees International Union, which represents the casino workers. Employers and the union together run the trust's health plan and provides benefits to the workers.

Fernandopulle played a hands-on role in getting the Special Care Center up and running—even helping design the space and configure its electronic health record system. He also hired the initial staff, including the first medical director. He originally intended to merely consult with the practice, but a few months into its operations, he stepped into the role of interim medical director when a change in leadership was needed. Now, with a new director installed, he is back in the consultant's role.



Neil Patel

Patel, 31, is Special Care's associate medical director. Born and raised in Piscataway, New Jersey, he is the son of Indian émigrés from the Gujarat area of northwestern India. Patel earned his medical degree at the New Jersey Medical School and trained in family medicine at Boston University. During his residency he took advantage of opportunities to work in primary and HIV care in Lesotho, Africa; in obstetrics in Guayaquil, Ecuador; and in inpatient surgical care in Vadodara, India.

Patel's job at the Special Care Center is his first since completing his residency. Thanks to his upbringing, Patel is fluent in Gujarati, the language spoken in and around Gujarat. He's thus able to communicate easily with some of the Indian immigrants enrolled at the Special Care Center—making them truly feel as if they have a real medical home in the United States.