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HEALTH RECORDS FOR SAFER CARE—FAITH, HOPE, AND REALITY

***HOW CONSUMERS NOW CAN CONTROL THEIR MEDICAL INFORMATION
AND HELP PHYSICIANS PROVIDE BETTER CARE***

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Contents

The Mantra of Faith and Hope	2
Medical Records Versus Medical Bills	2
The Latest Failure to Launch	3
The Dawn of One Truly New Idea	4
The Perfect Record—Rhetoric, Reality, and Responsibility	5
The Personal Health Record Becomes the First Certified Medical Record	6
Patient Command—Solving the Most Personal Challenges of Medical Information	7
Personal Records—High Tech, Low Touch, and Ready Today	8
Privacy, Privacy, Privacy	9
The Final Word—a New Trusted Agent	9
Sidebars	
Characteristics of a Personal Health Record that Will Make It Attractive and Useful to Consumers	12
Characteristics of a Personal Health Record that Will Make It Useful to Clinicians as an Accepted Supplement to Their Institutional Medical Record	14
Glossary	16

The Mantra of Faith and Hope

Throughout my medical career I have heard the mantra that patients must have faith in their physicians and physicians must provide hope to their patients. I believe this is true—with one important exception: Patients should have no faith that the medical records their physician or healthcare system keeps for them are complete or accurate.

As long as we ask physicians or other providers of healthcare to fix this problem, there is little hope for change.

The following pages outline our rigorous rationale for a new reality, one that offers a trustworthy electronic medical record managed by those who will benefit most: patients. Our version of a personal health record (PHR) will reward people's faith with better care, greater efficiency, and, significantly, thoroughgoing privacy protections.

Medical Records Versus Medical Bills

For decades, we have been promised that the U.S. healthcare system will catch up with the rest of American society in the automated management of clinical data. Today, however, the vast majority of medical records still remains scrawled on papers jammed into filing cabinets or carefully boxed in hospital basements. The excuses for this are countless, including the complexity of medical data, the need for doctors to control their workflow, the lack of standards for the data, and the unease that often accompanies discussions of computers combined with the emotions that often accompany decisions about healthcare.

But there's really only one fundamental reason we do not have a modern electronically based medical record system: money. No one in our complex and unstructured healthcare system is paid to maintain a personal health record for any person. As a result, very few providers are willing to invest both the resources and the necessary substantial time and effort to create and maintain a comprehensive medical record system.

What they have invested in are financial and administrative systems. This is because hospitals and doctors are paid not for the data they collect but for accurate and concisely constructed bills—bills that document procedures and tests. These bills and their arcane billing codes are remarkably uniform across all health-care systems. An entire industry exists just to ensure that the right code—meaning one that means the most money—is carefully recorded and fully justified before it is sent for payment. In fact, the majority of medical research that examines and attempts to improve health-care practices relies mostly on these financial or administrative billing data to evaluate the process and quality of medical care.

It's like evaluating your airline flight by examining your itinerary and cost of your ticket—important information, but far from a complete and accurate picture of what happened during your trip. (For example, did the plane take off and land on time? Was

the flight diverted? Was there turbulence? Heaven forbid, was the plane involved in an accident?)

It would be one thing if, by not having complete personal health records, we were missing only a better way to evaluate our medical care. The real tragedy, though, is that none of us is as safe as we should be.

Unlike our airline pilot, who has a meticulous flight plan, full computer support, updated weather information and air traffic controllers to help plan and monitor every move, the physicians and others who treat us rely on piecemeal electronic and paper records. They're often incomplete and wrong. Study after study has shown that about 20 percent of any doctor's, hospital's, or other provider's medical records is either missing or just wrong. Sometimes they are other people's test results, sometimes just mistakes in a diagnosis that never get corrected. These missing and erroneous data can mean repeating recent tests or making mistakes in diagnosis and treatment, some with serious, even fatal, outcomes.

The Institute of Medicine estimates that, because we are running our medical system without the protections that are now fundamental to other industries like air travel, thousands of patients are dying prematurely each year, the equivalent of many 747s falling out of the sky. Not all these deaths and mistakes are due to incomplete or erroneous records, but the lack of protection that a comprehensive individual medical record would provide is certainly a major contributor.

The Latest Failure to Launch

This shortfall is well recognized. Every few years we go through a period of hype and enthusiasm for a new technology or a new combination of existing players that will improve the situation. But because we keep relying on the same players to fix a problem none of them has true responsibility for creating, we never really make progress. We are now beginning the downside of one such spike in interest. It began, at least symbolically, with President Bush's 2004 State of the Union address, when he proclaimed that Americans would have electronic medical records in 10 years—the Republican medical equivalent of Kennedy's "moon shot."

The eventual foundation for the program was a concept called Regional Health Information Organizations, or RHIOs. These are coalitions of health-care system providers, hospitals, and doctors who would share medical information around a city, state, or other geographic region. The basic concept made some sense in the abstract (all the proposed solutions do until you try them out), but the proposed method for the transfer and collection of information about a particular person from the various places his health-care data might reside made a trip to the moon seem like a walk in the park.

The proposed solution to establishing complete medical records for individuals was called "record locator technology." Under this plan each RHIO would send out a

signal—to individual doctor’s offices, hospitals, pharmacies, etc.—to try to locate every piece of medical data on an individual.

But clinical data lack the national standards we have created for financial data. Doctor’s offices and other places where you go for care use different ways to identify you and different codes for storing your clinical data. Significantly, they also use many different brands of electronic medical systems, few of which can exchange data easily or directly—or at all. This means we can’t even locate all of the information on an individual within a single hospital, much less across a community or state. RHIOs also were unable to solve data privacy and security problems, and they could not figure out how to deal with the potential legal liability that resulted. So, well-meaning but grossly under-financed, RHIOs enjoyed their 15 minutes of fame. Now they are struggling to survive as the immensity and impossibility of their task become increasingly evident.

The Dawn of One Truly New Idea

At the height of the RHIO “moon shot,” however, another idea came to national discussion: that of a patient-controlled personal health record, or PHR, a compilation of documents centered not around any one doctor, hospital, or provider, but around the patient instead. This seemingly logical concept was remarkably novel for physician- and provider-centered American healthcare.

Because of our historical doctor-centered healthcare perspective, PHRs were and still are frequently presented as “secondary” or “shadow” records. As the discussion progressed, though, some thinkers began realizing that people might actually be capable of managing their own medical data. It seemed like a quintessential American idea, and the politicians—this time from both sides of the aisle—jumped in. Their enthusiasm for electronic health records that can be exchanged seamlessly among computer systems increases with each passing year.

The way to make this happen is to recognize that, while it remains enormously complicated for professionals to reorganize and re-invent their clinical information systems so each can harmonize with another, it is much easier for individuals to assemble all their personal data. For example, Mary Smith knows that her records exist with her local doctor and the local pharmacy. She can put that information together without customized programming, special interfaces between incompatible computers, and everyone in the country agreeing that the symbol for systolic blood pressure is SBP. She can use English (or Spanish or other primary languages); her computer then can store her information in a computer language called XML, which the vast majority of computers now can be programmed to use.

Mary has an absolute legal right to collect her health information under HIPAA—the Health Insurance Portability and Accountability Act. In the grand tradition of unintended consequences, HIPAA was passed to enable people to maintain health insurance as they changed employers; but now it comprehensively guarantees that Mary is entitled to her health-care data no matter where it is stored. In fact, if Mary’s doctor

and hospital don't provide her health-care records to her, they can face federal penalties. That is why doctors and hospitals will pay attention to Mary's request, especially if a PHR system makes it easy for them to comply.

Unfortunately, healthcare information technology is so dominated by providers and insurers and industry-based information experts that something so logical as a PHR immediately attracted criticism.

Typically, critics lament that "patients won't take responsibility for their healthcare data" or that "doctors won't trust it." The gripe that I find most interesting is, "Unless the PHR is perfect—unless it is 'pristine'—no one will use it."

The Perfect Record—Rhetoric, Reality, and Responsibility

To those of us who have spent our adult lives trying to encourage incremental improvements in the information doctors and hospitals use to treat patients, the concept of a "pristine" medical record would be laughable if it weren't so tragic. Remember, at least 20 percent of the information in any doctor's, hospital's or other provider's medical records is wrong. Doctors are cautioned from their earliest hours in medical school never to correct, erase, or change anything in a medical record lest they get sued. So "pristine" may apply to a fine automobile or an extensively automated and checked tax return, but there is no pristine medical record in this country—unless, that is, a patient created it!

For here is one of modern life's ultimate paradoxes. Who has the most to gain from ensuring that a medical record is accurate, up to date, and complete? It is the patient or the patient's loved ones who will suffer if a life-threatening allergy is not recorded or a dangerous drug interaction is missed.

So, in response to the claim that patients will not take responsibility for their own medical information, we humbly suggest that, if we create an easy to use, reliable and trusted PHR system, millions of Americans will do just that: take responsibility.

Most people reading this article know at least one person—the mother of a child with a chronic disease, for example, or the child of a chronically ill parent—who has a carefully edited and seriously collected medical record. Some have placed them on the Internet, but many carry them tight to their person whenever they encounter the health-care system.

These papers and collected records document exactly what happened when a son had his first heart operation. They contain a copy of the latest operative report, with highlighting of the line in the report that describes the child's reaction to the blood-thinning drug heparin, a reaction that the parent has traced through the Internet to a recently discovered gene that makes some persons exquisitely sensitive to this drug made from horse livers. The mother uses her medical record collection to demand not only that the surgeon planning her son's next procedure knows this information, but that the warning also is in bold red print on the front of her son's chart. This may be a crude way

to get a medical system to pay attention to one piece of essential and potentially life saving data, but to date it's the only reliable way.

Will doctors trust information from a patient? When patients bring medical information from “outside” sources, many physicians treat it as if it had come from another solar system. “I don’t know where or how that lab test was done,” they will say. “How can I know if I can trust it? I will have to repeat that test myself.”

The Personal Health Record Becomes the First Certified Medical Record

OK, doctor, we hear you, but what if we established a PHR that had been systematically checked for input accuracy, and whose every piece of information—the source, the time, and the method used to record it—were available for the doctor to see?

This is the problem that my colleagues and I having been thinking about and working on for the past nine years. It has taken us this long not because we are mentally deficient, but because healthcare mimics life: what seems like a simple concept turns out to demand robustness almost beyond reckoning to get both the basic idea and all the pesky details right. This has to be a “go” technology before it can change a decades-long bottleneck, and that is exactly what we have designed in a system called Patient Command[®].

Patient Command is a “Health Record Bank.” It’s like your financial bank, except that you deposit your medical information rather than money. It is secure, and you, the patient, control what is deposited and what is withdrawn and sent to others (such as a new doctor or a hospital).

We have designed a record that patients control, that doctors find credible and useful, and that is secure. It enables patients to collect updated medical data from all their doctors and hospitals. The information can be available whenever and wherever needed.

So what we propose is the world’s first comprehensively checked and certified-for-accurate-input medical record. In other words, a medical record created by the patient with help from a trusted agent whose only mission is to help the patient assemble the most accurate and complete personal health record possible.

We accomplish this mission, essentially, with a two-step process. We use the error- and range-checking that is now standard in many hospital-based electronic medical records and add internal-consistency checks. For example, suppose yearly cholesterol checks have indicated that a person has slightly high values of, say, 120 mg. Suddenly, an entry of 330 mg appears in the record. The trusted agent’s computers would immediately highlight the new information and note that it needs to be reviewed for input accuracy. If it was accurately input—if the doctor’s record really did say 330mg—then the patient may need to go back to the doctor to check more deeply. In any case, functions like this would make the PHR more accurate than its disparate sources because,

unlike those sources, all the input has been vetted and internally reconciled. This new standard for the quality of medical information compiled by the patient would empower physicians to use the data in the PHR as a primary source for treatment decisions.

And, as I said before, each entry shows its source and method of input. That way, a doctor can decide how much weight to give each particular item of information—how much to trust it.

Now the doctor can evaluate each piece of information in the PHR. No PHR system available today lets doctors do that. Sure, within a hospital or laboratory there is an audit trail for tests and procedures, and in places (probably fewer than 10 percent of hospitals today) that require doctors to enter their notes into a computer system, these notes are also annotated. But when a patient asks for a copy of this information, none of that source material is transferred. There's no way later on for a doctor to evaluate its source and method of input. This is big deficiency, and Patient Command fixes it.

Of course, doctors and hospitals would maintain their own primary records, but now would also be informed by, and in turn update, the patient's PHR. Think about what it could mean if all essential information is available any time your doctor needs it, and you can constantly check on it because it is under your control. Revolutionary? Maybe. Remarkable? Perhaps. Rational? Definitely!

Patient Command is a “go” today because the technology needed to make it operational already exists; nothing need be invented.

Patient Command—Solving the Most Personal Challenges of Medical Information

Rather than tell you all the wonderful enabling things that Patient Command does to break the logjam (you can go to the demonstration website www.patientcommand.com to see for yourself), let us talk about one of the most difficult and complex challenges that any PHR will ever face: that we may not want to tell our doctor everything we know about our health history or, at least, tell a particular doctor everything. Like the fallacy of the “pristine” medical record, the idea that patients tell their doctors everything is an ideal principle, not a universal practice.

Remember the time you were in the emergency room because you broke your ankle playing soccer with your son? The medical history form the nurse gave you asks if you have ever been treated for a sexual transmitted disease (STD). In fact, you had—20 years ago, while serving in the military. But what bearing does that have on getting a cast on your leg today? How do you handle this? Do you lie on the form? Or do you check the box and pray that the nurse doesn't ask in front of your son what sexual disease you had?

Now think about facing that situation of having your own PHR based on Patient Command technology. First of all, on arrival at the ER, you could provide the nurse with immediate Internet access to your medical records, so there would be no need to record

on paper, yet again, the information already spread across multiple doctors' offices and tucked into desk drawers at home. Your PHR would supply everything the form asked for, all verified and documented as to source and date. As for the STD, your PHR would also indicate that there was some information about your medical history that was not available except by your specific, real-time authorization. If the doctor or nurse asked you about what was withheld, you could say that it was about something that happened a long time ago that you didn't think had any relevance to your ankle. OK, the doctor responds, but if anything happens as a result of the withheld information, the responsibility is yours. Of course, because the responsibility for the information you furnish (and what you forget or get wrong) always is yours. Your PHR now allows you to manage this challenge deftly.

This is big. Unlike a traditional medical record, where anyone with access from the doctor can view anything in your record, you now have complete access control. This is just one of the patient-centric features in Patient Command's PHR.

Our "go" technology is partly a matter of timing. In the 1990s, I started a medical decision-support company that created software designed to help doctors in intensive-care units interpret how well they were caring for their patients. The system, called APACHE, worked very well—there are thousands of scientific articles that support its accuracy and it is still considered the gold standard for clinical severity measurements. APACHE, however, did not attract a big enough customer base to stay independent because all the information that had to go into it (98 different items!) could not be input automatically. This is the same reason it is still so hard to find a complete personal health record today: the different computer systems that doctors and hospitals use can't communicate with one another. That, and the fact that an estimated 70 percent of medical records are kept on paper in doctors' offices and are not in computers to start with!

Personal Records—High Tech, Low Touch, and Ready Today

So why is the time right for a patient controlled PHR? Because we designed Patient Command so that it would not require any immediate changes by doctors and hospitals *and* so that it would not depend on connections among various computer systems. (It uses those connections when they exist, and otherwise uses alternate ways to get information.)

"Interoperability," the seamless connection among medical computers from different hospitals and doctors, has been the holy grail of the U.S. healthcare information technology community for my entire professional life. It will be impossible to achieve for decades to come—if ever—and may never be needed if a rational PHR meets the goals of interoperability today. Enabling the system to accept data in any form—paper records that are faxed or mailed to a secure site, for example, or electronic transfer of records from a provider's computer system directly to the PHR—can do this. You just need to set up the system properly and devise a means for quality control, which is what Patient Command does.

We envision storefront kiosks in shopping malls and coffee shops where patients can input data and help centers where patients and their families can receive help from trained medical-record professionals, all components of a secure, private, trusted-agent network. These data can then be given to their doctor in any desired form—paper, electronic, through the Internet or delivered by hand. Regardless of format, the physician will know that all the data has been screened for the accuracy of its input and the source is recorded and prominently displayed.

Privacy, Privacy, Privacy

How does a PHR meet the demands for medical data to be fully protected? Again, a patient-centric PHR model is far more secure than systems today, systems where paper charts lie open on desks, and where anyone with the password can access all your electronic data. With a trusted-agent storing and managing the PHR—an agent that is independent of any provider of care, any health insurer, and any employer—the secure server will not be available to these organizations without the patient’s express authorization in advance. To give the patient oversight and control, a comprehensive audit trail of everyone who looks at or adds information to the patient’s records will be constantly updated and always available.

Moreover, with a personal and personally controlled PHR, the user can determine both who sees a copy of the records and the level of the PHR’s security. The records will be stored in encrypted form, and there will be levels of security including constant monitoring to frustrate hackers. Access protection can range from a password and personal-information question to biometric identification through thumbprints or retinal scans. Although most people may not want this level of security, it demonstrates again what becomes possible when the main medical record centers around an individual instead of being a small part of a large health-care provider’s database.

A properly designed PHR also will give the individual the choice to have his data aggregated with others for medical research—and to be acknowledged when they are. The same control will extend to the appearance of condition-associated advertisements—the consumer ought to be able to decide and control such issues.

Patients and their authorized care-givers will be able to search the electronic version of the PHR, so that, for instance, a patient’s latest lipid results can be directly linked to the most recent professional recommendations for treatment management. The Internet-based information the patient takes to the physician is thus likelier to be relevant, useful and time-saving.

The Final Word—a New Trusted Agent

To accomplish these and other critical goals, a “trusted agent” is essential. None exists now in U.S. healthcare. Sure, when you ask consumers whom they trust in healthcare, most will identify their physician, but few, if any, would cite their insurer,

their health plan, or their employer. For consumers to trust the entity storing their PHRs, the entity must be an independent agent that is responsible and responsive to the consumer alone.

Right now, federal legislation is being proposed that would facilitate the formation of such trusted agents, but new legislation is not necessary for a patient-centered PHR like Patient Command to begin operations tomorrow. The proposed legislation involves describing the operating principles for Health Record Banks. Drafters specifically chose the word “bank” because that is how these entities would function, as secure banks (much like financial institutions) for health-care data. If such legislation is enacted, it will be important that the banks’ autonomy and independence are maintained. If this is done, the principles of trust, security, and patient control—the essentials of privacy—can be protected.

Coalitions of providers and insurers have tried to establish PHRs before, but concerns over privacy have kept people from signing up in sizable numbers. The government, through Medicare, also is testing providing data for PHRs, a potentially useful step; but we don’t believe that people want the government to control their medical data any more than they want the government to control their medical care.

So what is stopping this great idea of PHRs from moving forward? Mainly, the arguments I have addressed in this article. Some “experts” say that people will not take responsibility for their records, that doctors will not use them, and that patient-controlled records will not be “perfect” and, therefore, will be ineffective. Yet consumers have become comfortable with completing many medical tasks electronically, such as managing pre-tax health savings accounts, using home tests for pregnancy or hepatitis C, checking for prostate cancer, and measuring their own blood lipid levels. Diabetics now routinely check their own blood sugar and can electronically send results to their doctor. Individuals can even mail in an HIV screening test or ask for a copy of their complete genetic profile. Not everyone agrees that all these are good trends, but they leave no doubt that consumers can become comfortable with tasks that once were managed only by medical professionals. And there is little doubt that younger generations see managing computer records as a normal, familiar part of life.

So, if consumers are increasingly comfortable with completing certain medical tasks, we come back to the central questions we started with: what do people want from doctors and healthcare, and what do doctors want to spend their time at work doing? Patients want doctors who care, who can give them hope, who are competent, who will give them information and discuss it with them.

If PHRs make it easier for doctors to be the confident and guiding decision makers most patients prefer, doctors will use and encourage the use of PHRs. Furthermore, it is time—indeed, past time—to stop asking doctors and busy, complicated health-care systems to manage our personal health data. With today’s tools and technology, people can do that better and more easily.

When this happens, patients will have even more confidence in their physicians, because those doctors will be even better able to provide meaningful and realistic care. The reason is that, for the first time in America, the accuracy and completeness of a patient's medical record need not be a principle of faith but a matter of fact.

SIDEBARS

Characteristics of a Personal Health Record that Will Make It Attractive and Useful to Consumers

1. A Trusted Agent Capability. A PHR created and controlled through a Health Record Bank such as Patient Command[®] will enable personal protection of medical data that is currently unobtainable.

- The Health Record Bank's primary mission is to protect the privacy and integrity of an individual's medical information. (A Health Record Bank offers a secure electronic repository for storing and maintaining a patient's health and medical records from multiple doctors, hospitals, and similar sources. It assures that the patient always has complete control over who accesses the information. The Health Record Bank acts as the agent for patients who deposit their medical records with it.)
- A properly designed PHR will include a detailed audit trail every time anyone gets access to the record.
- The patient will allow access only to specified individuals, and then only to those portions of the medical record to which the patient grants explicit prior authorization.
- Emergency exemptions will be possible, and consumers also can choose from a range of emergency access options based on their personal preferences.
- Privacy is a basic right that we honor and protect in many ways in the United States (even when some think certain privacy protections may not be in the individual's best interests). It is time we extend this basic right to medical records. The way to do that is through consumers' control of their records.

2. Ease of Use. To gain acceptance, a PHR must be very easy to use. It should be as effortless to enter, edit, and transfer your medical record as it is to change your profile on Facebook.

- This will require a user interface that allows patients a variety of input methods (direct transmission from a hospital or clinic, e-mail for a doctor's office, e-mail from the patient, fax, U.S. Mail or express carrier to the Health Bank). The Health Bank also must recognize the wide variation in knowledge of medical terminology by patients and their families. This means having systems that help patients through the use of prompts and menus each time they put their records into the Health Bank.
- It is essential to have direct, not voice-prompted, 24 x 7 telephone assistance from the Health Bank's trained medical records customer care agents.

- A simple summary of medical data is challenging to many people. Patients must be able to get help face-to-face from a medical information specialist. These specialists can be located in help centers that are close to malls, coffee shops, and the increasingly popular walk-in clinics. The specialists would be able to assist in data entry and offer other support services on a confidential basis.

Characteristics of a Personal Health Record that Will Make It Useful to Clinicians as an Accepted Supplement to Their Institutional Medical Record

1. High Data Quality. The information in a PHR must be checked for both accuracy of transcription from the source from which it is obtained (*i.e.*, is it copied correctly?) and consistency with other information in the record. This data quality standard enables clinicians to rely upon information in the PHR for treatment decisions.
2. Timeliness. There needs to be a minimal delay in updating the PHR. Ideally, each time a patient has an encounter with the medical care system, from an office visit to a hospitalization, the new medical record information should be transmitted quickly to the Health Record Bank for checking and depositing in the patient's PHR.
3. Ability to Allow Input Using a Variety of Media and Methods. If the new information is not in electronic form (because the doctor uses paper records rather than an electronic record system), the new information can be deposited in the Health Record Bank through the mail or by fax. Even better, for systems such as Patient Command that use automated data checking, the patient can use a home computer to key in the new information using the paper copy from the doctor's office. Of course, the best input is always by direct electronic transmission from a hospital or doctor's office. Regardless, maintaining a complete record for a patient still would be easier than it is today, because the focus would be on moving newly generated data for the patient to a central Health Record Bank. (This is far less complex than proposed systems that try to find all the various places a patient's results may be stored among various doctors' office and hospitals and then pulling them together each time an updated record is needed.)
4. Ease of Use. Usability is the "third rail" of new clinical information systems. A PHR must be designed so that clinicians and others can support its use without disrupting their current workflow. Realistically, for most doctors' offices today this means relying on paper to make the transfer from office records to the patient's PHR. The ultimate goal will be for the PHR to be seen as the most efficient way for providers to create comprehensive individual patient records. To do this, some Health Record Banks such as Patient Command will offer free software applications that doctors can download and incorporate into their office routines. As PHRs become more common, medical practices will begin to distinguish themselves by becoming "PHR friendly." This will enable them both to offer more personalized patient care and to contribute (with minimal extra effort) to a comprehensive, up-to-date collection of data in the patient's Health Record Bank account.
5. Reduced Costs and Liability Risks. An important aspect of medical liability is maintaining documentation of the specifics of communications with the patient.

A PHR where both the clinician and patient have the opportunity to submit comments to the record is a powerful tool for fuller, more timely, more efficient patient-provider communication. The PHR also enables electronic discussion streams linked to recorded data. That makes consultations among several physicians, all of whom may be involved in a patient's care, more efficient and less expensive.

Glossary

EHR (Electronic Health Record) An institutional medical record created by a provider, such as a doctor or hospital, to document its clinical processes with respect to a patient.

PHR (Personal Health Record) A collection of electronic medical records about a patient that is assembled from a variety of doctors, hospitals, and other providers; it is owned and controlled by the patient. PHRs may contain text and images such as X-rays, CAT scans, MRIs, and PET scans.

Health Record Bank A secure electronic repository for storing and maintaining patients' health and medical records from multiple doctors, hospitals, and similar sources. It assures that patients always have complete control over who accesses their information. The Health Record Bank acts as the agent for patients who deposit their medical records with it.

HIPAA right of access to medical records The right of patients under HIPAA (the Health Insurance and Portability Act of 1996), on request to a doctor, hospital, or other provider, to receive copies of their medical records; if the records are in electronic form, patients are entitled to request and receive the copies in electronic form.

Interoperability The ability of electronic devices measured on a spectrum of capability, to operate and communicate usefully with one another, typically through standard protocols and data structures.