Information Technology and Primary Care
A Discussion Paper

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Project Overview

Gordon T. Moore, Harvard Pilgrim Healthcare Inc., received a grant from the Robert Wood Johnson Foundation's Pioneer Portfolio in July 2005 to examine the role of information technology, specifically electronic medical records, in the primary care setting. Moore's work included the development of a discussion paper, the convening of a small workgroup of information technology (IT) and practice systems experts, and a working paper that summarized the workgroup meeting, focusing on how IT can contribute to the basic functions of primary care.

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1. Background

No one disputes that primary care functions will need to be available to the public in the future, no matter how they are delivered or by whom. Yet, no blueprint exists for exactly what these functions will be and how they will fit in the structure of health care. This uncertainty contributes to the conflicting voices among primary care professional groups as they vie to define their proper place in the American health care system of the future.

What can we say about how primary care functions will be delivered? Although the patient will always be one party, the supplier of primary care medical services may look very different in the future. Information technology (IT) may transform the delivery of care. Primary care will probably comprise some combination of manpower and "smart" information technology. How human intelligence and smart technology are blended will surely drive who is able to deliver services, what they do, and what training and skills they will need.

If delivering the basic functions is the starting point of a good 21st century primary care model, the challenge for primary care is to employ new technologies to design the best fit between functional needs, the delivery of care, and limited resources. A core principle of design should be that services are delivered by the method that delivers the best results at the lowest cost, recognizing that maximizing access to services is highly dependent on the costs of care.

The system should be designed so that patients can achieve the greatest health benefit for what they can afford. In this mode of optimizing cost-effectiveness, the doctor has no prior claim on services that can be delivered as effectively by other less expensive personnel or computers as by the doctor. The issue becomes one of appropriate allocation of functions and responsibilities across sectors such as self directed care supported by IT, doctors' services, other health personnel, and even public health. What is up for grabs is who is doing what. Although some have questioned this assumption, most observers believe that at least some of these functions will be delivered by a doctor trained as a generalist.

1.1. Working Group Meeting

On June 14, 2006, eight invited experts attended a workshop to develop ideas about how primary care functions can best be delivered to produce value for patients. We started from the supposition that information technology is the new wild card in this design process. Its use, when viewed as infrastructure to support the delivery of primary care functions, could generate quite a different optimized model of primary care than we now have. For this reason, the Working Group proposed to examine the interaction between information technology and primary care in the United States.

Participants first developed a rough working draft of possible primary care functions in the future. This was accomplished by starting with a proposed list that represented a first draft of the primary medical functions needed by patients. This list was supplemented in a blue sky exercise by the participants, and then grouped into like categories of primary care needs following an outline by Bodenheimer.

Working off the list of functionalities, participants then generated ideas about what IT support could be available to caregivers and patients that would facilitate meeting these functions at the least cost and highest level of effectiveness and efficiency.

The background questions were:

- In what ways can IT deliver services direct to patients that replace those currently delivered by people?
- What support can IT provide to lay or professionals such that a minimum amount of high level professional intervention is needed?
- What support can IT provide to high level professionals such that they provide their functions better (cost, quality, satisfaction).
- What support can IT provide to high level professionals that would enable them to take responsibility for the delivery of services now transferred to the specialist medical sector or, at the least, reduce the costs through managing the specialist sector more effectively?
- What support can IT provide to high level professionals that would enable them to carry out new functions that are not now available but would be of benefit to patients and the system?
- What types of training will be needed to implement such a delivery system blending human intelligence and machine functionalities?

These elements – patient need, information technology support, provider capacities – interact in complex ways, reinforcing and competing. An objective of the workshop was to come up with a very rough formulation that incorporates the patient, information technology, and professional functions into a new optimized system of care.

2. Primary Care Functions

In an unpublished paper, Bodenheimer proposes eight core functions of primary care:

- Uncomplicated acute care for simple and well-known problems (e.g., colds, cystitis, etc)
- Preventive care
- Care of patients with stable chronic conditions
- Care of patients with uncontrolled chronic conditions
- Patient education/self management support for all patients with chronic conditions or risk factors for chronic disease
- Most acute problems more complex than the very simple and well-known
- Complex patients with multiple co morbidities
- Acute-on-chronic care (e.g., pneumonia complicating COPD)

To these predominantly clinical actions, the working group added functions in three new categories; these included:

- Management of Patient Care: Making the system work for patients

- System Design, Maintenance, and Improvement: Making the system better
- Relationship: Assuring that patients have a personal relationship with a skilled health care professional

Each of these four function categories (clinical care; management of patient care processes; system design, maintenance, and improvement; and relationships) will be discussed separately in the next section.

2.1. Clinical Care Functions

Many of the primary care functions noted by the work group easily sorted themselves into Bodenheimer's clinical categories. By and large, these represented examples of excellent clinical decision-making, the bread and butter of primary medical care. For example, under Uncomplicated acute care for simple and well-known problems (e.g., colds, cystitis, etc.), the group included: Diagnosis of ill formed problems; turning symptoms into a diagnosis and "Naming the problem; and treatment of simple problems). There were few surprises among the eight categories of clinical care. We will not consider further the details of these clinical activities in this section. In the section under IT support for functions, however, we will return to the eight Bodenheimer categories to discuss how IT could help achieve their fulfillment at the most reasonable cost.

2.2. Process and Logistical Functions

However, the participants cited a large number of functions in the operational process arena. Some of these were clearly activities that supported excellent clinical care in each of the eight Bodenheimer categories. Interestingly, however, many of these process functions had benefits in their own right, quite independent of the support they provided to clinical decision-making and care. The three categories that we will develop further are: Management of patient care; Systems design, maintenance, and improvement; and Relationship.

2.2.1 Management of Patient Care: Making the System Work for Patients

Management of patient care referred to activities that related to the operational and logistical aspects of the primary care system. These activities were not clinical decisions related to diagnosis and treatment (absolutely critical functions but assumed to have been addressed in Bodenheimer's eight clinical categories) but rather process attributes that complemented good clinical decision making and improved results by enhancing the processes of care. These included such elements as providing first access to primary care, triaging care within the sectors of primary care and between primary care, specialist, and hospital. Functions also included coordinating care between different providers, managing care so that all outcome measures of quality, cost, and service were met, and providing trusted advice to patients when they were making consequential decisions about their health and health care.

This category is best understood as facilitation and process support rather than direct clinical services. For example, a number of the functions were those that moved the patient and their problem expeditiously through the complex system of health care. In this category were: accelerating access to care; making referrals; and coordinating the logistics (tests, specialists, treatments). In a sense, this is akin to the help a travel agent gives to a tourist. It isn't meant to be one of the experiences of travel (one rarely enjoys making the reservations or getting from point to point) but rather a vital infrastructure that, if it goes wrong, greatly reduces the desired outcomes of a trip—the reasons why you take the holiday in the first place. Another example is the advice function about what is going on and how best the patient can think through their own decisions about care.

The following are the functions that were identified by the Working Group in this category:

- Serve as first point of entry to medical care system
- 24 hour accessibility
- First access information and advice for the "worried well"
- (disclosure) Information about the cost of care
- (disclosure) Physician specific patient care outcomes
- Primary care is the node of a complex care system of specialists that needs to managed
- Skilled referral; triaging
- Explaining the system so that patient's expectations are appropriate
- Coordinating care between specialists and the interface between hospital and office
- Managing hospital care when it doesn't fit an available specialist (or is uncomplicated)
- Mediating/connecting/activating the health system and the individual patient
- Managing patient expectations
- Trusted medical decision advice when patients have skin in the game
- Navigating through the care system; managing transitions in care (pre-op, post-op, and institutionalization)
- Pacing workups and tracking care - where is it, is it being carried out according to specifications
- Complete understanding of all treatments – why this, not that
- Clarify hospital management
- Patient preferences regarding costs – helping patients decide what is worth paying for and what is not, and discussing risks and benefits
- Incorporating patient values into overall care plan
- Triaging of resources against clear EBM decision rules or benefits restrictions. Clinical decision making using case-specific Bayesian reasoning and EBM
- Access to EBM when it exists and to best practices when it doesn't
- Management of the specialist sector – identifying who is best

<u>2.2.2 System Design, Maintenance and Improvement</u>
By systems design, maintenance, and improvement, we meant the monitoring, trouble shooting, diagnosis, and formulation of "re-engineering" at the systems level. The

outcome attributes of good system design are such measures as safety, reliability, cost, convenience, efficiency, and effectiveness.

All systems are constructed and function around tradeoffs and unintended consequences. In a learning system, a goal is constant improvement. This is a primary care "need" because systematic observation and redesign lead to improvements that generate more and better care at lower costs to the consumers. Since primary care represents the most general functions in our health care system, we believe much of this activity should be undertaken by, or at least, with the professionals delivering primary care rather than by highly technical clinical specialists who see only their narrow sliver of health care or by non-clinical engineers who lack intimate knowledge of health care and its special characteristics.

Some of the functions cited by the working group are:

- Clinical research
- Practice-based learning and improvement
- Assuring that specialty diagnostic and therapeutic services are part of a coherent plan
- Building rapid feedback loops to detect failures in treatment and self management
- Clinical process improvement
- Being a system architect to develop a needs-responsive delivery system
- Providing performance feedback and advice to help the referral specialists become better.
- Assuring that referral services (specialists, lab, imaging, etc) document their performance in their discipline

<u>2.2.3 Relationship</u>

Relationship refers to a special bond between the patient and the provider of care. Any of Bodenheimer's eight functions could be delivered by care-giving methods that do not rely on an on-going relationship. While I am certain that Bodenheimer did not mean to leave out the importance of a primary care relationship, the working group picked functions that clearly were in this category and that warrant special identification.

- Patients need empowerment to participate in their health care to the extent they can
- Being an ally in managing a patient's health
- Motivating maximum patient success in self-management
    - End of life care
    - Reassurance
    - Building trust through
    - Reliability
    - Availability
    - Continuity
    - "Being there"
    - Understand how individual patients make an illness out of a disease; cultural sensitivity

- Customer service (from a pure business standpoint)

3. What IT Can Do to Help With the Four Primary Care Functions

The four categories – clinical care; management of patient care processes; system design, maintenance, and improvement; and relationship – are all targets for assistance through information technology. In the following section, we break IT into types of functionalities and then, in the section that follows, discuss the relevance of that element of support to each of the primary care functions.

The scope of information technology is huge. The workshop participants narrowed in on those applications that could enhance the four primary care functions described above and improve the value proposition of primary care. By"value proposition", I mean technical quality of care x perceived service divided by costs. We focused on elements of IT support that appeared to us to have the highest leverage on this equation, as it related to the identified primary care functions described earlier.

While some applications are already in development or available, most of the IT functionalities that we identified are still only spottily available and most need considerable development to become widely utilized and underpin the delivery of primary care functionalities to patients. We organized these suggested applications as follows:

- Informational continuity
- Workflow management
- Clinical decision support
- Patient computing
- System improvement

Each will be discussed separately.

3.1. Informational Continuity

Information is the cornerstone of medical care, and electronic access is the key to its availability. Neither individual nor collective medical information is easily accessed at any given point in time nor over time today. The best approximation to this currently is with claims information, especially when an individual's medical bills come to a common payment source such as their personal insurance company or Medicare.

Low participation by primary care doctors and other providers is the first major barrier to electronic informational continuity. We must overcome the resistance of clinicians to the use of electronic data entry in order to push past the threshold of participation that fosters ubiquity of information, integration of care, ease of clinical transactions, and better and easier communication.

Ubiquitous electronic information interoperability will only happen two things occur: first, when the cost of accessing and working in a digital environment is less than the increased income and net savings delivered to a doctor by working in such an IT supported environment; and, second, when a “tipping point” of participation is reached where the use is so widespread that late adopters are disadvantaged in not joining in.

First, then we must make it attractive for doctors to enter the digital world. Financial incentives would help, but the most important factor is to reduce acquisition and running costs. In addition, the benefits must lead to reduced work or additional income. These goals are best achieved by focusing on order entry systems rather than the comprehensive electronic record. Order entry can be standardized and comprises the vast majority of critical information about the patient that is needed to facilitate the transitions between primary care, specialists, hospitals, and other elements of the care system.

By simplifying the EMR and emphasizing order entry functions, purveyors of EMR's could reduce their development costs and make it easier to achieve standardization and interoperability. Simplification of the EMR should also make it easier for doctors to learn and use. Decreasing the entry of subjective data will reduce the need for doctors to master complicated information entry rules. Learning to use such a system should be less time-consuming. In such a system, any clinically important notes can be entered as a short free text message and the details can be kept by the doctor in whatever form they find useful. Order entry lends itself to the easiest doctor-machine interface – point and click.

Finally, doctors will be more inclined to switch to an EMR environment because doing so delivers tangible benefits in terms of enhanced income and reduced work effort. Doctors must see an immediate return on their investment in terms of increased income and improved work life -- reduced costs, more billable services, and reduced levels of work effort. With this objective, easing billing transaction costs and increasing accounts receivable is a high priority first step.

Once lower pricing and an attractive ROI have been achieved, our view is that the stage is set for doctors to acquire and use electronic support for information transactions. Early adopters may need payment incentives, but once the majority of doctors use the system, the benefits will be so apparent that momentum will build on its own.

The results should be: continuity of and immediate access to data over time to the same clinician, across visits to different clinicians and hospitals, demographic accuracy, and a consequent reduction in unavailable information and duplication of previously performed tests and treatments. Our estimate was that these steps alone might reduce health care costs by 4-5%.

3.2. Workflow Management

Inefficiency in workflow processes is a major contributor to waste in healthcare. Information technology can substantially reduce inefficiency if deployed properly. Workshop participants identified the following as prime targets for IT development:

- transactional inefficiency;
- clinical process support;
- demographic data accuracy;
- pacing and tracking;
- supply chain management; and
- infrastructure that enables market forces to work effectively.

Transactional inefficiency refers to the waste generated by human operations that could be done partly or completely by machine. Examples include complex billing processes that could be streamlined by shortening the chain from the performance of a service (a visit, test, or procedure) through the accounts receivable and payable process back to reimbursement. A significant part of the almost 20% of administrative overhead of insurers could be reduced, as well as the billing staff that clinicians must support.

Another inefficiency is in the logistics of referral and orders. Referrals are now labor intensive, often requiring time from the most expensive medical professionals. For example, doctors often need to confer with other doctors, but it is notoriously difficult to track doctors down by phone. IT is a far more efficient way to support asynchronous communication, especially if messaging were supported by a built-in prioritizing structure.

Referrals and other medical orders are also fraught with ambiguous administrative information, not just clinical. For example, the transaction generally lacks information such as whether the service is covered by insurance, whether a provider is on a preferred provider list, and when the patient can be scheduled for the service. These actions could be made more efficient by employing technologies already available on commercial web sites to test for eligibility, determine payment sources, and schedule the appointment. Waiting times, out of pocket costs, and convenience could be optimized by direct scheduling support between patient and specialists (not very different than approaches that Orbitz, Expedia, and Travelocity already employ). Further, by directing referrals to preferred providers, an IT supported mechanism could enhance the process of pay-for-performance.

Clinical process support refers here to improvements in the medical processes of care itself. One example is in the complicated teamwork necessary to manage chronic illness. When more than one provider is involved, it is often unclear what the plan is and who should be doing what tasks and when. IT could provide a universally available, constantly updated care plan that would publish the clinical plan for the patient's care, the parties responsible for specific parts of the plan (including the patient), and an up to date score card recording progress so that all parties are able to coordinate care more efficiently and effectively.

Demographic data are frequently inaccurate. Data are often missing or out-of-date. Patients are repeatedly asked for basic demographic and insurance information, sometimes even more than once in the same episode of care. This is a reflection of problems that could be easily corrected in an electronic environment: first, the lack of continuity of the demographic information across the various sites in which patients encounter the care system; second, patients rarely enter and update their own information, a task made easy by the growing access to electronic registration and update in commercial sectors and; third, by linking a patient's record to their insurer, current coverage information would be instantly available.

Pacing and Tracking. Doctors and patients are often unaware of where they stand in the process of diagnosis and treatment. Imagine that both patient and clinician had the ability to track their care in the way a mailing can be traced by FedEx. Not only could such a system inform doctor and patient about the status of their workup, but it could also assure that important benchmarks of care (such as follow-up of key clinical data or repeat tests or procedures that the doctor wished a patient to do) are actually successfully carried out. Much patient dissatisfaction and a considerable number of malpractice actions are generated by loss to follow-up to which the system is now blind.

Pacing and tracking depends on a reliable data stream tracked against performance expectations, with warnings or triggered corrective actions available when expectations are not met. In an integrated electronic data environment, any test, procedure, referral, or treatment can be tracked and reminders and process correction actions generated. In addition, tracking data can be used to create a better reminder system. When the patient has a planned and predictable program - such as medical screening and personal prevention - that has not been carried out, the system can generate further reminders or other remedial actions based on pre-set instructions.

Supply Chain Management is the term that business has coined for the process of optimizing the flow of the building blocks and raw components it needs to make a product or service and deliver it to customers. Because of the waste, inefficiency, poor fit of supply and need, and disruptions in the chain, companies have applied IT to generate savings and quality improvements. The key to supply chain management is bidirectional data flow, from producer to customer and from customer back to producer to generate improvements.

The patient's movement through the process of care seeking, diagnosis, and treatment is, in effect, a clinical supply chain. This process rarely is optimal. IT infrastructure combined with the performance improvement methods used in industry could improve service and clinical quality, as well as reduce cost.

American health care is inching toward a **medical marketplace**. Growing patient responsibility for medical care expenditures (co—payments, health savings accounts, and deductibles) can be linked to best providers who are rewarded through pay-for-performance. An underlying assumption is that consumer power can help optimize the medical care system and enable consumer's to exercise choice to get what they want at a price that they can afford.

Yet, most experts agree that the underlying conditions for an effective market place are missing --- transparency, parity of knowledge between buyer and seller, and measurement of real performance. Without an authentic marketplace that supports both buyer and seller, consumerism is unlikely to be effective at improving medical care.

Information technology is essential to create fair and effective marketplace conditions. IT (especially with some version of the EMR) puts real clinical data into play, so that actual (rather than claims-based) performance can be measured. Accurate, real time, doctor-generated data will also make it possible to perform reliable risk adjustment, so that epidemiologically sound performance data can be used to determine differences in clinical outcomes. Further, IT makes it possible to make the same data available to clinician, patient, and purchaser (transparency). Finally, with real medical data available on process and outcome measures, consumers can approach a position of equivalent knowledge with clinicians.

Achieving this may well require that consumers have what I have termed a "trusted advisor" working to help them to understand performance data and also to determine their own risks and benefits in the context of their personal utilities (including need, resources, and desired outcomes). In a sense, IT makes it possible for consumers to have an unbiased agent working on their behalf in their decision-making, much the way that tax advisors or financial advisors help Americans with needs in either area.

3.3. Clinical Decision Support

Clinical decision support comprises IT functions that assist clinicians in their medical diagnostic and treatment functions. Categories of IT support that were suggested in the workshop include: sorting and display of critical information; diagnostic informational support such as expert guidelines and targeted literature access; and probability determinations

Sorting and Displaying Information: Display of medical information is minimally structured today. The Weed Problem Oriented Record superimposes some architecture on clinical information such as subjective and objective data, as well as diagnosis and plan. Other data needed by clinicians in the management of care (such as most test results and medications) are at best semi-structured, and in some cases abnormal data are highlighted. There are few mechanisms to sort and display information by its medical importance and priority.

Lack of consistent structure in displaying data creates extra work and probably contributes to medical error. Within a given hospital, the record may be more or less standardized in format. But structure and display usually are different in different hospitals and between hospital and office environments where most doctors develop their own methods of recording and displaying data. Thus there is little consistency, making it difficult for caregivers to find and follow vital information in either place, especially if it has been entered by other clinicians.

In addition to standardizing on formats and nomenclature, the IT and EMR fields should agree standards for urgency and importance and formats for displaying such information. By agreeing on the default criteria for importance (while yet allowing some customization by clinicians), designers of electronic records can develop algorithms that sort information by its importance to clinical processes and display it in a clear and consistent way. Were this to be done, any clinician or patient could count on their medical information being readily available in an easily read, consistent, and highly prioritized manner.

Diagnostic Informational Support: Most patients and doctors do not yet find it easy to locate up-to-date, evidence-based information about symptoms, diseases, and treatments. These are available in a variety of forms but often not easy to access at the point of care. To be sure, there are some commercially available products (Up-to-Date, Problem-Knowledge Coupler, WebMD) that can be bought but their use is can be cumbersome and often slows down the processes of clinical care.

Getting this information to the point of care and just-in-time is a key priority. Clinicians need process support that assists them when the work is being done. In our view, the problem can best be solved only by creating an electronic environment that can identify "markers" in real time between a patient's symptoms, potential diagnoses, and diagnostic and treatment considerations and available tools and information. An example is a warning message about a drug-drug interaction as a doctor writes the prescription. The prescription triggers a query of the patient's other medications, activates a review of interactions, selects an appropriate message, and communicates it in real time. The key to providing process support that really works is to make it automatic, by creating triggers that activate a wizard, target an information bank, and then publishes a warning, a reminder, a guideline, or relevant literature.

Probability Determinations: Beyesian determinations of utility are one type of clinical decision support that deserves special mention. The value of any diagnostic intervention (a test, a physical finding, a treatment) is based on a probability calculation determined by the test's sensitivity and specificity as applied to the prior probability of the condition in the patient at hand. The resulting posterior probability (as influenced by the test) is a critical measure of the efficacy of the additional information generated by the planned maneuver.

Bayesian reasoning is rarely applied today in diagnostic decision-making. Lung scanning for pulmonary emboli is one example where this reasoning is routinely included in the testing. Most doctors don't know how to do Beyesian calculations, and there is little information available to guide clinicians in estimating prior probability or likelihood of the condition that they are proposing to rule in or rule out.

Electronic support could change that and make Beyesian calculations a routine part of diagnostic decision making. The result would be significant improvements in diagnostic accuracy and lowered costs, by eliminating testing of marginal utility. Electronic data banks could link symptoms with diagnostic outcomes to create data bases of prior probability that could be searched based on the characteristics of the patient at hand (think of a Google-type search based on symptoms, prior tests, age, sex, etc). Once prior probability is estimated, the proposed test's sensitivity and specificity could be applied through a wizard to generate a predictive value positive likely outcome. The clinician could be informed of the result prior to finalizing the order. From the clinician's or patient's point of view, advice about the utility of a test and comparison to its financial and personal cost would be available to guide decisions about whether to do a test or not.

3.4. Patient Computing

The working group identified three areas in which IT could reduce a patient's cost and enhance their quality of care: self management of chronic illness; access to their own record any time and any place; and control of the logistics of their care.

First, IT could vastly increase the potential for patient's **self management** of their chronic disease. Recent advances in remote monitoring are already providing vital clinical data that might otherwise require doctor visits to measure. But these patients still need interpretation of these data and directions about modifications in their treatment.

Many of the elements of self care could be easily managed if some simple electronic assistance were available to patients. These include: interpreting remote monitoring of key diagnostic and treatment measures; giving step-by-step instructions and informational support for the actions they need to take to manage their condition, linked to their own tasks and interests; providing algorithms (linked to lab testing or monitoring results) for treatment adjustments such as insulin or inhaler dosing amounts and frequency; emailing advice from clinician experts as needed by the patient; with hot line backup if patients requested help. In addition, IT could improve the logistics of self care by such activities such as reminding patients of actions that are elements of their care plan and enabling patients to obtain results of their own lab tests.

Many of these services are provided today by clinicians. If these services could be delivered electronically in interactive, personalized, and convenient form, many patients might find them affordable and attractive to use.

Second, patients could own their own clinical data and control their medical record. This would enable them to access their medical history when needed and, especially, to make it available wherever they were in the world (via a password) to any provider of care.

Third, patients could manage much of the logistics of their own care. They could be guided to enter their current illness information, their past medical history, family history, medications, and their preferences for care. They could make their own appointments and be given reminders via phone or email, refill their own prescriptions automatically, and access their own lab results. While some of these functions are currently available through some hospitals, health plans, and insurers, few patients have a portfolio of logistical management tools that provides comprehensive support.

3.3. System Improvement

Process measurement is the foundation of improving system performance. Without real data, it will be difficult to improve our health care system through management interventions, consumer empowerment, or research

In today's health care system, patient data are difficult to aggregate, retrieve, and use in research, patient care management, and system improvement. First, most data now available are secondary, not primary from the doctor; these mostly comprise claims data. This database is at best indirect, and often unreliable, information about what is happening clinically behind the exam room door. Thus, we are missing the critical clinical data that might allow a system to document the actual elements and processes of care to buttress malpractice defense, measure and reward clinical performance, and support clinical research and management information.

To create such a database will require satisfactory resolution of many issues such as patient privacy, doctor's acceptance, ease and cost of collection, and ownership of the database. Nevertheless, given the creation of the electronic backbone and its presumed use, the collection of such data is technically feasible now, in real time.

Privacy of patient data must be protected. There are many methods, however, that already exist for either stripping such data of identifying information or creating a statistical method of de-identification for specific uses. These technologies could be applied automatically to patient-specific data entering the database or before its outputs as specific uses.

Doctor resistance can be anticipated to be a stumbling block. However, once these data require no additional effort for the doctor to produce and privacy is protected, they may find it difficult to put forth a rationale for resisting. Doctors could, of course, choose not to use the electronic backbone for their ordering, receiving, and communication of clinical information. But there are significant inducements to both collecting and using the data, which could make it difficult for them to not participate. First, use could be mandated or rewarded by insurers (Medicare, Medicaid, and commercial). Bill payment could be expedited for participants. Malpractice rates could be reduced (because using the system described earlier should reduce errors, document steps taken, and improve patient satisfaction – the three major causes of medical liability). Finally, patient quality could be improved by their doctor's participation, surely a pressure to participate.

To whom should the database belong? Its uses include scientific study to improve care, management information to facilitate competitive advantage (which presumably redounds to the patients benefit by offering new products, better service, and improved results), or even the early detection of epidemics or bio-terrorism. Should a patient be asked to give permission to include their data or should this be treated like vaccination? – which is mandatory because of the benefits that it confirms on the public's health. Note that the question of who "owns" the genome raises some similar issues. I raise this issue not to provide an answer, but to put this on the table for discussion.

4. The Impact of IT on the Primary Care Functions

What does realizing these IT functionalities mean for the re-structuring of primary care functions? Of Bodenheimer's eight functions, much of the first four could be transferred to patients if advanced IT support were available. These are: uncomplicated acute care for simple and well-known problems (e.g.colds, cystitis, etc); preventive care; care of patients with stable chronic conditions, and; patient education/self management support for all patients with chronic conditions or risk factors for chronic disease.

Uncomplicated acute care (and the worried well) could largely be self managed with easy access to programs that link symptoms with most likely clinical diagnoses and thence to algorithmically directed medical advice, and warnings about when to seek care. Telephone or email advice could serve as a strong backup when patients remain concerned and need reassurance.

Preventive care could easily be self-managed. The schedules are determined by age, gender, and underlying individual risk factors. These are easily programmable and could be made available to patients to trigger the appropriate actions at the right times. Most of these preventive activities do not require a doctor. The growing market of pharmacy-based nursing services could provide virtually all of the currently recommended American Preventive Medicine at a lower price than most Americans pay now for doctors to deliver such preventive services.

Personalized patient support through IT means a higher proportion will be competent and confident in self management of their stable chronic disease, such as diabetes, arthritis, CHF, asthma, high blood pressure. With technical IT support, patients could monitor their own condition, make adjustments in management based on treatment algorithms, and find and maintain family and community supports for their illness. Many mid-level practitioner functions could be shifted to patients, who could operate in a supportive environment in which they could be more self-sufficient. When changes from their steady-state exceeded pre-set targets that required reassessment and higher level medical decision-making, the patient could be automatically referred to their nurse or doctor.

Patient education, like that of the clinicians, can be enhanced through IT. Using data-based triggers, an IT system can provide customized, layered education and advice to patients in real time. Reminders, guidelines, illustrations, video advice, and Q and A are some of the functionalities that could be built into an individual patient's support system.

Improvements in clinical management processes translate into higher quality, better service, and increased efficiency in all eight Bodenheimer categories. By linking care pathways through multiple caregivers from the patient themselves to their primary care and specialist doctors, an IT infrastructure can streamline information flow, make it more legible, reduce lost or duplicative data, and warn about interactions that are not within predicted parameters. Compared to the current primary care system, an IT supported infrastructure could significantly enhance quality, safety, and reliability and reduce inappropriate care and errors.

Service for both providers and patients will also improve, Providers will benefit from easier (as well as less costly) transactional processes and by process improvements that will make their work easier and allow them to accomplish more in less time. They will worry less because IT will track their patients' care and assure that it is happening according to expectations.

Patients will gain control over aspects of care that are now irritating and dissatisfying. These will include making appointments, receiving reminders about care, billing and other payment logistics, and getting hold of clinicians when they need help.

Efficiency should rise. Regardless of the personnel involved in delivering care (the patient, a nurse practitioner or Physicians Assistant, or a primary care doctor), their work should be easier, faster, and more reliable.
Work effort should go down. From improved scheduling that smooths work flow to removing waste in the billing process, transactional costs should go down. Ultimately, these economies should translate into savings for the purchasers and/or profit for the providers.

The clinician and patient relationship should improve. The twinned foundations of relationship are continuity and trust. IT will greatly improve informational continuity, a key element in building a relationship between clinician and patient. Without it, clinicians risk losing the building blocks upon which knowledge of the patient is built. Having this rich history readily available means that a clinician is supported in the technical aspects of care and is thus freed to develop better the personal relationship.

Trust is also enhanced by IT. Trust occurs when clinical care is more reliable, predictable, and readily available. IT should reduce lost and thus repeated testing. IT should enhance follow-up and decrease the likelihood that a patient and their care processes are dropped or fragmented. Finally, the increased use of IT to support best evidence-based practices and the possibility that patients thus could be brought into the plan, will improve communication and expectations. If both patient and clinician are working off the same plan, they will both be in a better position to know how it is working and whether the plan needs to be modified. They have a basis for discussion and a common set of expectations.

5. The Effect of IT on Primary Care Manpower

IT could lead to significant restructuring of those providing primary care and the task functions that they carry out. One major impact of IT is to shift patient care responsibility progressively towards the patient, from higher skilled to less skilled providers. In this model, patients would do more of their own acute simple care, prevention, and chronic illness management. Primary care nurses and PA's, whose major function today is in these areas, would do less but would be more actively engaged in the medical logistics of preventive care – from carrying out the testing to giving preventive and life style advice.

Nurse practitioner functions will take over from primary care doctors much of what remains of the first four Bodenheimer categories. The effect of this will be to create spare capacity at the level of physicians.

This shift in responsibility creates an opportunity for primary care doctors. The impact of IT on primary care doctors will be to enable them to move to a higher value-added set of functions. More will be done by patients themselves and nurses will take over a large portion of what remains. Doctors will not be needed for simple acute care, routine and stable management of chronic illness, and for routine prevention.

Doctors will still be needed to manage complex chronic illness, acute on chronic, and new acute illness of a more serious nature. IT will make this work more effective and efficient. Moreover, primary care doctors may retain the triage function for referral of patients to specialists. However, this is by no means a certainty.

IT will make it easier for a patient and possibly a nurse to determine what specialist care is needed. Might this disintermediation of the triage function of primary care doctors and enable patients to directly refer themselves to specialists? This is certainly a possibility. Countering the possibility of over-use of referral specialists is the increasing financial responsibility that patients will bear for care.

With much skin in the game, patients may need trusted advice about what they need and to whom they should go to get it. IT will provide data and decision support tools that primary care doctors may be uniquely skilled to use as the basis of advice to patients about their choices. Who else would be in a better position to integrate evidence based research and a patient's financial and clinical preferences with knowledge of the best specialists and hospitals. Especially when the decision involves a value tradeoff (there may be less expensive hospitals and specialists but just how good are they and what represents the best value proposition for the patient?), primary care doctors have a possible new role as managers of the system and advisors to their patients.

Freed from the need to care for uncomplicated problems and preventive care, primary care doctors can concentrate on higher level functions that add value. There are two that could substantially improve health care for patients and provide ample funding for primary care doctors. These are: caring for the four more complex functions cited by Bodenheimer and making a market-place system work.

Primary care doctors could provide specialist-level care for the common, complex problems. This care must equal or exceed that delivered by the specialists that many of these patients now seek. IT support can make this possible by providing care guidelines, improved logistics, just-in-time expert literature, and targeted clinical advice from specialist experts. Such care should, on average, be better and less expensive than that provided in the average specialist-based system. Primary care doctors should be better able to provide excellent care across multiple problems and over the life history of a patient; patients who are cared for by multiple diverse specialists often fall between the cracks.

By providing more of the direct care in the four more complex Bodenheimer categories, primary care clinicians would be reducing the expenses of specialist care and freeing up financial resources that could uplift primary care doctor compensation. In a medical care system in which patients are struggling with high costs, it is unrealistic to expect that new funding will be found to support enhanced primary care medical activities. But money created by reducing specialist costs could increase primary care compensation and make the field more attractive to medical school graduates.

The second, and new, value adding activity for primary care doctors is serving as the trusted advisor to patients as they make medical choices in a market-based system. In such a system, patients will have a financial stake in the decisions they make regarding recommendations made by specialists. Patients will need assistance (even with the IT-based system that provides objective evidence for decision-making) about the benefits and risks, and help in finding the best value providers to deliver the service. Advising patients about and managing these specialist services is a valuable function that should have little difficulty attracting revenues The revenues should either come from the patient, or the patient's proxy (the insurer or the purchaser), so that it is clear that the primary care doctor is not financially dependent on the patient's decision.

In summary, IT can support or actually deliver many of the functions of primary care. Responsibility can shift from higher skilled and more expensive providers, towards less costly methods of delivering care, including self care. Primary care doctors have important new management functions needed in an expensive and inefficient medical system in which patients are more financially at risk than now. Such a model has worked well in industry to assure that consumers receive the best value for money. If such management is focused on getting the most from specialists, expensive therapies, and advanced technology, wasteful and unnecessary costs should be stripped from the system, and both patients and the primary care sector should benefit.

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