

Virtual Reasoning Redefining Healthcare Through Health 3.0

WHITE PAPER 2008

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Enhanced Medical Decisions

INTRODUCTION

The Internet is redefining the healthcare industry. This process is at an early stage, but major transformations can be expected because Internet-based technology will deliver certain healthcare services more effectively and at lower costs. Newly emerging Internet healthcare stakeholders are poised to wrest control from established “brick-and-mortar” entities that have dominated healthcare for decades. For these transformations to occur, a certain progression of events will be required, each of which may cause varying degrees of upheaval in the existing market. The Internet has the potential to become the venue for the delivery of certain medical services, particularly those that are information-based. In the near future, much of the information that is currently imparted to consumers by clinicians will be delivered through and by web-based technology. This information will be distributed by a set of “virtual reasoning” tools that simulate expert decision-making. As these tools become available, they will provide a focal point for information-sharing between consumers and physicians. Virtual reasoning tools that combine the capacity to “think like humans” and to connect consumers and experts through knowledge-supported social media represent the next direction in Internet health or Health 3.0. If the web-based tools that deliver this information mature to the point of becoming reimbursable, beyond their current usefulness as value add-ons, the healthcare industry could experience a shift as dramatic as the one that occurred with the advent of Managed Care.

We are already at the stage when millions (approximately 160 million) of people obtain medical information from the Internet which they previously received only from medical professionals. The search for health information is the number two reason that people use the Internet. Web-based healthcare retail has become a profitable business, with revenues (predicted at \$326 billion in 2008) jumping sharply over the past few years. Along with retail, there has been a concomitant relocation of advertising dollars. From 2006 to 2007, Internet advertising revenues increased 26 percent to 21.2 billion dollars (IAB report), by far outpacing growth in any of the other advertising sectors. With a rapid shift in retail and advertising, entirely new web-based healthcare stakeholders have emerged almost overnight. During the first phase of establishing a foothold in their markets, these new stakeholders face two pressing imperatives: driving traffic to their sites and securing access to consumers’ medical data for targeted advertising.

CONSUMER PROFILING AND PERSONAL HEALTH RECORDS

Access to data is an imperative for a web-based business paradigm because it is needed to drive targeted (or “relevant”) advertising. Approximately, (exact dollar amount) currently flow to Internet companies to advertise healthcare products. The amount of advertising dollars that a service or retail business is prepared to pay per ad is directly based on some measure of relevancy – that is, how likely the web user viewing the ad needs the particular product being presented. More specific profiling results in highly accurate targeting which, in turn, improves the productivity of each advertising dollar. Businesses will pay as much as 7-10 times more for ads that are considered highly targeted to the user. Therefore, the ability to predict ad relevance with precision is essential to Internet companies whose business models are linked to Internet advertising.

The value of highly specific consumer profiling partly explains the tremendous interest that Google and other Internet companies have in personal health records (PHR) – digitized records in which a consumer can maintain his/her highly detailed and comprehensive medical data – equivalent to an electronic medical record for consumers. Two distinctly different types of data are needed to populate the PHR: symptom-related data that can be provided directly by the consumer, and clinical data that the consumer may not have easy access to, such as laboratory and procedure results. Detailed symptom data has never been available anywhere in digitized form; capture of this information has always been considered too labor-intensive, and even electronic medical records rarely capture it adequately. The PHR is an excellent vehicle with which to collect these data directly from the consumer (at little or no cost), if the consumer can be incented to enter it. Clinical data (lab



and diagnostic test results, for example), on the other hand, are currently scattered throughout the healthcare industry as the property of the many brick-and-mortar healthcare companies (managed care, insurance, laboratory, PBM and pharmacy companies, etc) who guard access to it tenaciously. Both types of data, clinical and symptom-related, are important for consumer profiling. Web-based companies have devoted considerable time, money and brain-power to figure out how to access them.

TOOLS

To motivate consumers to spend the time and effort required to populate the PHR with their symptom data, web-based companies realize that consumers must receive something of sufficient value in return. Consumers need a very good reason to be interested in PHR-like vehicles and to use them on a regular basis. We already know that consumers want health information since millions of them flock to the Internet each day to supplement the information they previously requested from physicians. Internet companies have already figured out that giving users access to better information through increasingly advanced software tools is the best way to drive traffic, capture user loyalty, and incent people to enter their healthcare data.

Early stage Health 1.0 information has predominantly been available in the form of an “e-pamphlet” with a one-size-fits-all approach. The subsequent generations of Health 2.0 tools are interactive and deliver personalized, more valuable information that is geared specifically to the user’s input. With the advent of advanced tools, consumers are no longer limited to being passive recipients of pamphlet-style information; in these milieus they interact with each other or with sophisticated software that analyzes cases on an individualized basis. Increased personalization is advantageous to consumers for several reasons: first, it directs them toward relevant information more quickly and decreases the time spent wading through a lot of noise; additionally, the more advanced tools go beyond delivering information - they analyze the user’s information and render the type of feedback that might be expected from a medical professional. Advanced tools are being used by Internet entities as bait both to drive traffic and to capture detailed user profiling data.

Several categories of interactive Health 2.0 tools are available, including advanced search engines that deliver more accurate results; social media sites in which individuals hone their medical knowledge through interactions with each other; and finally, expert systems - sophisticated software programs that analyze a consumer’s profile and, based on the analysis, pinpoint the most relevant educational information necessary to support the consumer’s healthcare decisions. These expert system tools basically simulate human reasoning. They apply algorithms (with branch-chain rules) and complex calculations to more or less simulate expert human data processing. Expert systems are in the early stages of development, but they have the potential to elevate software capabilities close to the level of a human expert and generate a virtual expert opinion. Examples of current expert systems include software that assists with insurance plan selection, treatment optimization, differential diagnosis, medication analysis, etc.

Of the three categories of tools, expert systems (clinical decision-support tools, in particular) stand out as especially well-suited for use in conjunction with a personal health record for several reasons: they collect information that can be re-purposed for populating personal health records with consumer data, and they can make use of data that is already contained within the personal health record, without the need for the consumer to reenter it. In other words, along with giving the consumer a powerful reason to use the PHR, expert system tools act as vehicles for augmenting the richness of the PHR database – at minimal cost. If these tools provide the consumer with information that answers a real need – helping with medical decisions, saving money, averting inappropriate care, or preventing harm-- the consumer will come back regularly, and in the process, he/she will be the passive recipient of a steady flow of targeted subliminal marketing messages.



A growing number of stand-alone Health 2.0 tools have been introduced over the past few years, and these are continually being integrated into broader web-based healthcare venues. Microsoft, Google and other Internet companies have already acquired a number of vertical search and decision-support tools, in many cases for handsome payouts. Google Health has cleverly organized its PHR around decision-support types of expert system tools and is planning to make a large number of them available through open partnership arrangements. The advantage to the consumer of using the tools within a broader context—along the lines of the Google PHR—is that clinical information (such as medications) can automatically be populated into the tool via the PHR database, and the consumer enjoys the convenience of having to enter only minimal data to get results.

DATA OWNERSHIP

Google Health and other Internet companies face bigger challenges in finding ways to access clinical data—laboratory and diagnostic test results, insurance claims information, pharmacy and medication data, health maintenance history—that the consumer doesn't always have. The insurers, managed care organizations, physicians groups, and pharmaceutical companies that control these data recognize their value and historically have limited outside access to them. Because of the tight hold that these entities maintain over their piece of the "data pie", accessing this information will not be easy and may be costly. Web-based companies have been exploring approaches to the clinical data problem. Google and Microsoft are involved in initiatives to find data partners, and they have established several to date. Their goal is to aggregate at least enough patient data to form somewhat comprehensive personal health records, with the consumer stipulating to which Internet company their data can be sent. Maintaining these relationships could conceivably become an expensive proposition if partners start asking for a share of the business that their data is helping to generate.

An alternative, if less likely, path that would guarantee free data access would be to take the clinical data out of industry's hands and hand it over to the consumer. This represents a radical change. The high degree of fragmentation within the healthcare industry has often been cited as a root cause of many of the industry's problems. Those who study the industry often refer to industry fragmentation as a major contributor to cost and quality problems, but they insufficiently emphasize the most important effect of fragmentation: the lack of a cohesive body of aggregated healthcare data. Without aggregated data, the industry is unable to address its most pressing cost and quality problems such as inappropriate care, duplication of care, lack of outcomes information and evidence-based medicine guidelines, medical errors, or variations in provider practice patterns.

A transfer of data ownership to consumers would address data fragmentation problems, and represent the best over-all approach from the perspective of consumers, payers and, most importantly, for society at large. Unlike industry stake-holders, consumers would be more likely to share de-identified information that is absolutely critical for important quality and research initiatives. One could imagine a U.S. health data registry much like Iceland's. With better data access we would have more effective means to prevent medical errors and to deliver better care at a lower cost. Consumer-directed data could make data portability a reality and lower the resistance to standardized healthcare nomenclature and electronic medical records initiatives. Many industry analysts speak about the lack of information infrastructure as the impediment to data sharing in healthcare. The truth is just the opposite: it's the unwillingness to share data that drives stonewalling against bringing a 21st century IT infrastructure to the industry. If a struggle for data control culminates in a greater ability to aggregate healthcare data, both the industry and society would be the beneficiaries.

With the influx of new Internet stakeholders into the healthcare market, we may see a quietly fought healthcare "data war" which could result in a much needed change in control over clinical data. Given the power of the brick-and-mortar companies that have grown up around healthcare and the influence of healthcare lobbyists, why is this a good time to shift control of patient medical data?



Google and Microsoft already have the concentrated resources, political clout, and the business imperative to affect major shifts in control over the next few years. Still, orchestrating a change in data ownership would require major surgery and great finesse – that is to say, it would not be easy and would likely be bloody. The risks in this scenario would be great – Microsoft, Google, and other Internet giants would not want to jeopardize core business. Operating autonomously is likely to ensure that the old-guard companies would come after them with negative PR and threats of anti-trust litigation.

Of course, issues of data security will have to be addressed as highly sensitive healthcare data is made available over the Internet. This very important and complex topic won't be covered in this paper, however.

ADVANCED SEARCH AND SOCIAL MEDIA

Since most health information is accessed through search, more accurate search engines in the healthcare vertical are high on the consumer's (and healthcare professional's) priority lists. The most recent batch of Health 2.0 vertical search engines refine search results by cataloging them into specific categories ("for the professional", "for the consumer", "by type of disease or symptom," etc) and asking the end-user to specify their search by category of interest. This approach only improves search results marginally: the number of pages returned may decrease, but not usually enough to make a substantive difference.

Several companies have been working on natural language-based search, an approach that holds tremendous promise for improving search result accuracy. Current search methods look for matching words; natural language search matches "meaning" by analyzing the context within which a word is used. For example, if a user wants to read about the "complication of laser surgery in people with diabetic eye disease", a typical text indexed search returns over 200 pages of results that include matches for "diabetic eye disease" and "complications of diabetes, for example; with the few relevant articles scattered within the 200 pages. A natural language search engine, in contrast, is theoretically built to recognize the relevant combinations of concepts, or in other words, the terms in the search phrase that "go together" (it would understand, for example, that the user is not interested in "complications of diabetes"). The natural language recognition approach is theoretically capable of positioning the relevant information at the top of the search results. Developing natural language search engines has proven extremely challenging, however, and none of them have yet reached a reasonable level of maturity for prime time. At some point in the not-too-distant future, however, vertical natural language search engines should be the norm.

Even at a relatively early stage, social media sites have become a valuable asset to people with health concerns, particularly those that are serious or uncommon. The ability to troll through vast amounts of professional-level medical information has created a new class of informed health consumers who, in turn, collaborate with each other through social media networks to further refine their understanding about their conditions. The most sophisticated consumers, in fact, often know more about their health conditions than their general practitioners. The new classes of informed health consumers are providing each other with information that they may not come across by working solo. Not only is information shared in these venues but, through interaction, assessments are refined and erroneous thinking is corrected by peers – in other words, "two heads are better than one". There are even a growing number of social networks for healthcare professionals to exchange information and opinions. One of the major societal benefits of social network tools is that they can function as an advocacy group and as a watchdog against the inappropriate promotion of ineffective or unsafe treatments by special-interest groups. Serious drug side effects, for example, have come to light through consumers sharing their experiences.

Even technically simple social media sites, are tools, in the sense that they are software-based products that enable or enhance information exchange. Social media sites are more useful when they are integrated with other types of advanced tools. The more advanced social media sites currently incorporate ancillary tools that



analyze user-generated input and aggregate it into more useful forms (statistical, graphical, etc). At present, social media users often have a hard time finding relevant comments on these sites unless the comments are direct responses to the user's post. Searching for relevant comments on social media sites, like searching for anything else on the Internet at present, brings up a lot of noise. As search engine accuracy improves in general, so will the ability to pinpoint relevant posts. In addition, the value of the information that users receive on social media will eventually be enhanced by presenting it side-by-side with vetted sources of medical information such as medical guidelines or evidence-based medicine that can be delivered through expert system tools. Users should be able to access formal medical literature and share this information with each other without having to leave the social media site.

VIRTUAL REASONING - A NEW MODEL

Speculation about where Internet healthcare might be taking us can be approached, in part, as a projection of the next generation of the most advanced web-based healthcare tools. If what consumers and payers want out of healthcare is an acceptable cost-quality tradeoff, assurance that care is appropriate for the situation, that the diagnosis is correct, and that errors of commission and omission are kept to a minimum, web-based tools need to move beyond simple search to the level of analytic services – expert systems that are virtually capable of reasoning, rather than merely regurgitating information. For example, if Health 2.0 products bring you cholesterol guidelines, then virtual reasoning tools, in counter-point, should calculate your LDL (bad cholesterol) goal based on your level of risk for heart disease and assess whether or not you are taking the right medicine. Virtual reasoning tools will function more like a human expert and provide the equivalent of an expert-level opinion.

Taking this one step further, virtual reasoning tools could sit “under the hood” of a PHR, continually combing the medical record data for errors and oversights as any new data is entered. They could compare treatment to evidence-based recommendations, follow the response to treatment over time, generate outcomes data, and generally function as an automated quality assurance system. The number of possible applications for expert system tools is mind-boggling. They could even be used to iteratively capture the medical history directly from the patient.

Current web-based business models rely heavily on retail and advertising, but as virtual reasoning tools reach a greater level of maturity, they will cease to function merely as value add-ons. At some point, they will become reimbursable, revenue-realizing businesses in their own right for the services that they provide. When this happens, the impact on healthcare will be profound. These expert system tools could represent cost-effective alternatives to certain face-to-face healthcare services traditionally performed by healthcare professionals. In some circumstances, they will be more cost-effective than the hands-on educational and analytic services now in the purview of healthcare providers. The logical end-point of expert system and decision-support adoption will be a new reimbursable segment of the service industry in which lower cost services are rendered through technology solutions. Tools will never replace the need for physician oversight; but they will become powerful adjuncts to the physician's armamentarium.

In fact, web-based tools will not only benefit the healthcare consumer with just-in-time access to life-enhancing, and in some cases, life-saving information. They will also be equally beneficial to healthcare providers who, without adjunctive information technology, are increasingly unable to assure a level of quality, appropriateness and safety in an age in which medical information is expanding so rapidly that no single clinician can keep track of all the moving parts. Even at this early point in the lifecycle of Internet health products, physicians have flocked to the Internet for information so frequently that Google search has become the number one resource that physicians use to access medical information.

Before tools replace traditional face-to-face services they have to be integrated into the clinician's normal workflow and medical records system. EMR companies will first incorporate expert system tools for much the



same reasons as the PHR initiatives do – for the value-added benefits they offer to the customer base. In a futuristic model, fully integrated tools might function in the following ways: during the visit or pre-visit - they could be used to collect the “history of present illness” (the original notes that clinicians use to document a new problem); they could provide an initial analysis including a differential diagnosis; generate order forms for prescribed tests or treatments; analyze prescribed treatments and tests for appropriateness and duplication; flag potential problems such as medication allergies or side effects. Post-visit, expert tools could be used as a source of supplemental education to augment the physician’s instructions and to follow response to treatment. At each juncture, expert system tools would generate documentation for the patient’s medical record that could be reviewed by the clinician for accuracy.

To incent physicians to use these tools, they will have to be compensated for offering them, and for the time they spend monitoring their patients through them. Early pilots in which physicians are reimbursed for extended Internet-based care will probably be initiated by payers (large, self-insured employers) who believe that improved care and an increased level of appropriateness will result in an attractive cost-benefit ratio. Insurance intermediaries will likely be asked to administer the pilot programs. Every interested party would have a role to play and would benefit. Most important, when physicians are reimbursed to use expert system technology, they will have sufficient incentive to do so and to adopt electronic medical records as well.

Although many physicians still cringe at the role that the Internet is playing in their patients’ lives, most will ultimately embrace information technology just as have leaders in almost all other industries. To do their job well, physicians will ultimately rely on technology to deliver much of the same information to them that it will deliver to their patients. Technology adjuncts will free healthcare professional from the more mundane functions of data gathering, recording, and administering; they will enable physicians to focus on the more rewarding cognitive aspects of medical practice. With more free time, physicians can move more fully into a consultancy role in which they act as experts that help their patients assimilate and analyze increasingly complex choices. Physicians can direct their patients to favored web-base sources for basic educational information about their medical conditions. The dispersal of information is an important therapeutic activity that physicians do not currently have the time to do thoroughly. The result will be a well-informed patient who is better equipped to collaborate in the healthcare decision-making process. Finally, bringing everything full-circle, virtual reasoning tools will eventually be integrated with electronic medical records, where they further facilitate widespread EMR adoption among physicians in much the same way that they are being employed to drive the use of the PHR among consumers.

CONCLUSION

The extent to which the Internet transforms healthcare may take us by surprise. The technology is too compelling to ignore and has the potential to overcome even the most powerful and entrenched lobbying for the status quo. In summary, the sequence of events in an Internet-sparked industry transformation starts with a business imperative – with consumers validating that sophisticated online medical information is highly valuable; with a business model that transforms the traffic into retail revenues; and with advertising dollars that follow the retail. It’s the data imperative, however, that is the lynch-pin in the story - if data for profiling was not key to the business model, then tools would not be worth developing at this point in time. The pay-out would be too far in the future. Once tools near maturity, however, they will take on a life of their own. They will be incorporated into electronic medical records first as quality assurance features and then as methods to deliver healthcare services. As tools become more central to the business of healthcare, they will spur the development of long-overdue infrastructure improvements in the healthcare industry such as semantic interoperability and EMR adoption. In other words, we should see a cascade of events in which the need for these software tools provides the impetus to finally create the IT infrastructure required to enable them.



Significant activity around tool adoption is already underway: Microsoft, Google and other Internet companies have already been acquiring advanced search and expert system tools-- programs in which web-based service delivery is reimbursed are being piloted-- and Google Health has taken the first steps to make a large number of tools available on their platform. How quickly the process eventually unfolds depends on a number of factors that mostly revolve around any upcoming changes in healthcare financing and in the political climate. No matter how healthcare financing is structured, however, the need for tools that enhance healthcare quality and efficiency still apply. Of particular importance will be the unfolding of the data ownership issue and physician reimbursement for tool adoption. We are in a reasonable position, for the first time in U.S. history, to have fully digitized, transportable and intelligent medical records. Hopefully, the sheer size of the new Internet giants, the value proposition of web-based products, and the natural migration of consumers to these venues will create an environment that strengthens the political will to orchestrate data aggregation and other long-overdue overhauls needed to reshape the healthcare industry into its next, hopefully better, version.

