Caught in the Web by the Killer App! An Update

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For the first time in history and only slightly more than a decade ago, protocols, or sets of rules, were established for exchanging information between networks or computer systems. The Internet protocol (IP) and transmission control protocol (TCP) were established to provide the basis for Internet services and resources. Quickly thereafter, Internet-derived protocols, such as the simple mail transfer protocol (SMTP), more commonly known as e-mail, and file transfer protocol (FTP), offered a standard approach for processing, sharing, and exchanging textual information.

Less than a decade ago, another Internet-derived protocol, hypertext transfer protocol (HTTP), provided a standard approach for exchanging multimedia information. This protocol was quickly used by World Wide Web servers and clients to access the graphic as well as textual information included in the collection of different services and resources available on the Internet. Accessible through Web browsers, the Web not only offered a standard approach for processing and exchanging information but also allowed new dimensions of existing applications to be created.

Today the Web is history’s most effective tool for communicating, accessing, and delivering information. There are several reasons for the Web’s effectiveness and success as a widespread information-sharing medium:

- The Web and its browsers did for the Internet’s services and resources what Microsoft’s Windows did for DOS, its original disk operating system—it gave users a graphical interface.
- This interface, using hypertext, is truly user friendly. It is intuitive. It allows users to transfer multimedia-based information between computers within one protocol and request and receive information without the traditional time and space constraints of other media.

Note: As explained in the Editor’s Introduction to this issue of HCIM, this is an update of the original 1997 article: Kohn, D. “Caught in the Web by the Killer App!” Healthcare Information Management, 1997, 11(3), 3–15.
The Web makes information and applications available to authorized users from all stakeholder groups in a very cost-effective manner. Web development tools are designed for incremental growth of systems. Web access assumes the lowest common denominator of computer hardware.

Consequently, in just over two years, the Web and its browsers replaced the Internet's SMTP application as the Internet's most popular derivative and became the Internet's “killer app.” Almost overnight, America Online's (formerly Netscape Communications') Navigator and Microsoft's Internet Explorer Web browsers became ubiquitous and had a greater impact on computing than the introduction of personal computers.

The Healthcare and Information Technology Industries

Because the Web had become the Internet’s most popular place for users to browse and search for information, it offered the healthcare industry’s “Four P’s” (providers, payers, pharmaceuticals, and patients) access to the widest range of healthcare information as well as the ability to disseminate that information.

However, at the same time that the Web was making standard navigation and user interface assumptions possible across many diverse applications, the healthcare industry was undergoing unprecedented change. Today most of those changes continue to challenge the healthcare industry, the nation’s biggest. The changes include, but are not limited to, the flurry of healthcare mergers and acquisitions, the struggle to successfully implement managed care, the rapid growth in the number of the uninsured, and the complexity of managing Medicare reimbursement after the Balanced Budget Act of 1997.

Healthcare was caught in fundamental and irrevocable changes to the way it conducts its business processes. Sadly, information technology (IT), which had always been perceived to produce cost-efficient and cost-effective improvements in productivity and quality of care, was not able to assist the healthcare industry with its changes. To this day healthcare continues to struggle to understand the effective use of IT in managing current and future challenges. Although many attempts to use IT have been conscientious and well designed, more often the implementation of IT in healthcare organizations has neither been effective nor achieved the intended benefits. The one exception is the Web.

Today healthcare IT solution providers are using the Web to improve the development and implementation of healthcare information systems (HISs) and their related software applications. For example, the Web is being used to change the ways in which HISs and components of computer-based patient record (CPR) systems are being created, sent, stored, and retrieved.

In addition, healthcare provider organizations are slowly welcoming the use of the Web to successfully implement IT solutions and realize benefits from
IT investments. For example, systems using Web technologies provide healthcare organizations with sociological leverage. The Web and its derived technologies are familiar, minimizing the opportunity for users to say that they do not understand how to use the systems. Consequently, implementing these systems in healthcare organizations is proving more successful than previous attempts, and these systems are achieving organizational benefits.

**Web-Enabled Versus Web Browser–Based Systems**

During the last decade, most HIS companies were forced to convert their existing systems and products from proprietary, centralized processing–based architectures running on mainframe computers and microcomputers to open, client-server-based architectures. This required a lot of time and money for research and development (R&D). In many cases it involved a total rewrite of systems code. Even HIS companies that had designed their systems based on client-server architectures were required to expend a great deal of time and money on R&D. This was because, typically, these firms had to transition from sixteen–bit to thirty-two–bit hardware and software components, which required a total rewrite of systems code.

Ironically, at the same time as thousands of computer components were being “fattened” to thirty-two bits, maintaining “fat” clients and their multitude of corresponding servers became an IT department's worst nightmare. Also at this time, the Web began to be introduced, offering a simpler and more cost-effective alternative to computer system development and maintenance.

Today the mass introduction and acceptance of the Web are once again forcing HIS companies to make a transition—this time to Web browser–based architectures. This is again requiring a large investment in R&D. In all cases it will involve a total rewrite of systems code.

Unfortunately, many HIS companies with legacy or client-server-based systems cannot afford to make the next transition. Consequently, many of these companies are moving to Web browser–based architectures by web-enabling their existing systems and products.

With web enabling, the HIS companies are not rewriting their systems code in the newer, Web-based programming languages, such as Java and its derivatives. Instead, when an authorized user logs onto the system, the user is presented with a web page. From the web page, the company’s systems applications (written in, for example, Microsoft’s thirty-two–bit Visual Basic) are launched.

Web browser–based systems are more complex. These are systems in which companies have either written or rewritten their systems code using one or more of the Web-based programming languages. In Web browser–based systems, the Web browser acts as the primary desktop interface for access to data and document repositories. The Web browser is used to display and query information stored in databases (for example, through drill-down via
hypertext) as quickly as client-server-based systems. In Web browser–based systems, the retrieval application typically resides on the server. (In client-server–based systems, the retrieval application typically is loaded on standard, “fat” clients.) Web browser–based systems accept data inputs from other systems and send them to other databases over the network using plug-ins or display controls, such as ActiveX or CORBA. They are on-line transaction processing systems, not just read-only (content) systems. These systems are proven to reduce network administration and workstation maintenance costs.

Whether the systems are web enabled or Web browser based, the Web’s presence among software applications is rapidly growing. According to a recent survey of chief information officers, management information systems managers, and software developers, more than a third (37.4 percent) of existing software applications have a Web component, and the percentage is expected to continue to grow (41.3 percent of software applications are expected to use Web technologies by 2001).¹

Case Studies: An Update

Hundreds of Web sites for marketing and information distribution purposes signaled the healthcare industry’s first “catch in the Web” by the Internet’s “killer app.” But Web technology continued to mature, from delivering static information via “brochureware” to a platform for the delivery of dynamic information and key business applications. Approximately three years ago, when this article was first written, healthcare organizations such as the Doheny Eye Institute and Hospital in Los Angeles, the Allina Health System in Minneapolis, Columbia-Presbyterian Medical Center in New York, and rural practitioners in Wayne, West Virginia, began to take the Web to the front lines of patient care. These organizations implemented components of the CPR system using Web technologies. These components included access to diagnostic-image databases or nurse’s patient assessment forms using Web browsers and intranets. Another Web technology derivative, an intranet is a private network of web pages with servers located inside a firewall, or security barrier, so that the general Internet public does not have access to the network. Although some of these efforts collapsed during this period, most remain successful and, in fact, continue to add applications.

Today these and other healthcare organizations are investing in “portalware” to manage and deliver their business-critical information. The strategic plans for these organizations are the same—to leverage the benefits of Web technologies to provide immediacy of information, platform independence, and ease of use for all users.

One Midwestern tertiary-care teaching institution capitalized on the familiarity of Web technologies for its clinical information systems (CISs). The systems are so easy to use that most of the institution’s providers of care opt for self-directed training with printed or on-line published materials rather than
formal or informal training sessions provided by IT staff. In addition, the institution’s providers continue to clamor to use it. An astonishing 95 percent of CIS browser users at another, similar institution have never been trained.

The goal of a physician-led intranet at five medical centers in Southern California was to improve the quality of care of patients in the local hospitals who needed attention after physician office hours. Secure Remote Access, as this intranet is called, currently links approximately one hundred physician office and home computers to information on hospitalized patients from a variety of data sources, including lab reports, diagnostic images, and nursing documentation from the five medical centers’ information systems. Initially, there was difficulty bringing up one of the medical center’s information systems inside a Web browser window. However, eventually, the intranet team was able to create the browser interface to all the internal systems through a combination of off-the-shelf software, software created by outside vendors, and “light-duty” internal development using Java.

The goal of the intranet at a large referral center in Wisconsin that serves north and central Wisconsin as well as the Upper Peninsula of Michigan was to improve the organization’s ability to garner even more referrals from its outlying physicians. The medical center reasoned that the organization could add value to its services by providing its referring physicians with information from its internal systems in a more timely way than the competition. OutReach, as this intranet is called, provides the familiar browser interface that is easy to use. And the entire monthly communications cost averages about $20, for the Internet service provider. The system uses the Secure Socket Layer encryption tool as well as an “electronic wallet” for authentication software that must be configured on each user’s computer before that computer can access OutReach.

The Future of Technologies in Healthcare

In order for the Web and its derived technologies to continue to evolve, the technologies must support a viable business model. In healthcare, that model must result in identifying means of cost savings for healthcare services. Based on this requirement, a few predictions can be made.

Application Service Providers. Application service providers (ASPs) stand a good chance of providing Web-based information systems at a lower cost to healthcare organizations. Some analysts estimate that the total cost of applications can be 25 to 30 percent less if ASPs are used.

In this model a vendor aims to recoup over the life of provider contracts the development and operational costs of running applications on computer servers for many customers from a central geographic location. In other words, using Web technologies, ASPs rent access to, and provide outsourced management or hosting of, application software. This concept is not new (it only has a new name), but the medium—Web technology—is.
For example, ASP proponents cite the following four areas of savings potential of Web-based applications:  

**Capital investment:** mostly limited to personal computers and their connections to the Internet or an intranet, because software licenses and other major expenses are spread over a long-term contract

**Computer infrastructure:** little or no infrastructure necessary, because applications are available through an existing intranet or at any computer with a link to the Internet

**Implementation:** little or no implementation, because a remote Internet server can contain a master application that is delivered to all customers on demand

**Upgrades:** no need to perform computer-by-computer upgrades to new versions of software, because the master application is upgraded for all customers at once

**E-Health Companies.** According to the Health Care Financing Administration (HCFA), it takes about four hours to manually process a physician referral, at a cost of about $20.00. This is due to all the faxing, waiting on hold, and other time delays inherent in a manual system. HCFA estimates that if the process were electronic, the cost would go down to approximately $0.50. Similarly, HCFA estimates that it costs about $5.00 to manually process a claim. If the process were electronic, the cost would go down to approximately $0.22.  

Table 1 gives a comparable summary of costs for manual and electronic processing of eligibility inquiries.

As such, HCFA has estimated that about $250 billion, or around 25 percent, of the approximately $1.2 trillion spent on healthcare is wasted because of inefficient administrative costs. On the other hand, according to a recent study by the investment banking firm Robertson Stephens, the figure for waste is about $399 billion of that $1.2 trillion. The firm broke down the administrative costs for healthcare by segment (Table 2).

<table>
<thead>
<tr>
<th></th>
<th>Manual Inquiry</th>
<th>EDI Inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients per month</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>No. of calls for eligibility</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Average time spent per call (min.)</td>
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<td>20</td>
</tr>
<tr>
<td>Total no. of hours</td>
<td>66</td>
<td>66</td>
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<tr>
<td>Cost per hour</td>
<td>$15</td>
<td>$15</td>
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<tr>
<td>Total cost</td>
<td>$990</td>
<td>$120</td>
</tr>
<tr>
<td>Total cost per year</td>
<td>$11,880</td>
<td>$1,440</td>
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</table>

**Source:** American Medical Association, 1998.

**Notes:** (1) assumes $0.35 per electronic inquiry; (2) includes time plus electronic support.
The following administrative processes performed in physicians’ practices remain manual:

- Precertification
- Eligibility verification
- Referral processing
- Laboratory ordering and billing
- Claims processing
- Pharmacy and formulary verification

E-health companies see tremendous opportunity here. In addition, they see the administrative processes not only as applications but also as services that can be written for the network. They feel that the contemporary concept of an application as a function located on a computer and in constant need of upgrading is a relic of the late twentieth century. Instead, these applications can be written to scalable Internet application programming interfaces (APIs) and delivered by application servers.

**Virtual Patient Records.** Virtual patient records (VPRs) are one of the few applications that are poised to make full use of the Web paradigm. Therefore, they are being explored by a number of healthcare organizations.

VPRs are either web-enabled systems in transition to Web browser–based systems or their architectures are already Web browser–based. VPRs are most often developed in conjunction with a healthcare organization’s intranet. As such, VPRs can be thought of as the Web-compliant components of the CPR. VPRs integrate data from hospitals, clinics, insurers, and ancillary service providers. They are intended to create a single view of patient data from potentially dozens of disparate healthcare sources. They are also intended to gather transactions from the disparate healthcare sources and pass the information to the intranet’s web interface.

Each user of the VPR has a customized, or filtered, view of the data, depending on the user’s needs. For example, the VPR allows physicians to determine if their patients have followed instructions and are compliant about

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### Table 2. Costs of Administrative Inefficiency by Segment of Healthcare Industry

<table>
<thead>
<tr>
<th>Segment of Healthcare Industry</th>
<th>Administrative Revenue</th>
<th>Administrative Costs</th>
<th>Percentage of Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals</td>
<td>$500</td>
<td>$110</td>
<td>22</td>
</tr>
<tr>
<td>Physicians</td>
<td>230</td>
<td>138</td>
<td>60</td>
</tr>
<tr>
<td>Health insurance</td>
<td>510</td>
<td>82</td>
<td>16</td>
</tr>
<tr>
<td>Medicare/Medicaid</td>
<td>345</td>
<td>69</td>
<td>20</td>
</tr>
<tr>
<td>Total estimated administrative costs</td>
<td>399</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


*Note: estimated costs in billions of dollars.*
prescriptions, based on pharmaceutical records in the VPR. The VPR allows
administrators to view reimbursement rates and gather data for cost analysis.

It is no easy or inexpensive task to integrate patient data from multiple
systems in or between organizations. The most common approaches
used, such as eliminating all or most of an organization’s existing health infor-
mation systems, standardizing on one vendor’s suite of products, or attempt-
ing to connect many diverse systems, are cost prohibitive and practically
unattainable. In addition, the uncertainties about the future state of the health-
care industry preclude any and all such ambitious projects.

On the other hand, by creating an intranet-based architecture, implement-
ing application servers to take basic information from each of an organization’s
disparate systems, and passing the data into a browser window (that is, creating
a VPR), an entire new set of applications can be created without altering exist-
ing systems. This has proved to be a cost-efficient and effective IT alternative.

Capitalizing on Web-derived technologies, an East Coast integrated deliv-
ery network (IDN) integrated its data for a VPR without eliminating or inte-
grating its systems. Instead, this IDN consolidates data from its diverse systems
using Web technologies.  

Prior to the installation of a Web-based CIS at another IDN, providers of
care had to access up to ten different systems to retrieve the information they
needed to take care of patients. Even though end users could point and click
between the disparate systems, they still had to enter the same patient data into
each of the systems. By providing its end users a VPR with a Web-based single
point of entry to multiple information systems, end users simply click on icons
to get information from each of the organization’s individual systems.

The initial purpose of the CIS launched in 1998 at the large tertiary-
care teaching center in the Midwest was to provide an integrated viewer for
patient scheduling information from two separate systems—one an older
homegrown scheduling system, the second a new client-server commercial
product. However, as development of the CIS moved forward, it became obvi-
ous that the same VPR strategies that were being used to integrate the two
scheduling systems could likewise be applied to integrating information from
other sources in the institution.

**Extensible Markup Language.** Web technology can help to solve many
of the healthcare industry’s stubborn information management problems. How-
ever, in order for transactions to be processed for decision support and other
data manipulation purposes, there are still challenges for the future.

Structured data that originate from a plethora of incompatible systems can
be viewed using the Web and its derived technologies. But structured data that
can be identified, aggregated, and manipulated by clinicians and managers
must still be standardized. For this to be accomplished, both the healthcare
and IT industries must organize. There are many ad hoc committees and stan-
dards organizations attempting to do this. However, unfortunately, it is not easy.

A data management scheme developed by Sequoia Software of Columbia,
Maryland, is proving successful in this regard. In a prototype at a large
Southwestern healthcare system, an advanced Internet protocol, extensible markup language (XML), is being used to manage the healthcare organization's Web content. XML is being used for extracting and then standardizing specific data elements in the healthcare system's existing, incompatible information systems.

In short, XML reads the Web-based content and decides how to route and index the data. As a result, the healthcare system's clinicians can interact with the information on the screen (for instance, revising a transcription report or ordering a new lab test from different information systems) without training in the application from which the data originates. Because the computer scheme is based on an Internet-derived protocol, it can manage data and applications from internal and external sources consistently.

XML has been supported as a standard by the likes of Microsoft and the World Wide Web Consortium (W3C). However, such endorsements do not guarantee that XML will be formally defined as the data standard of the future. This is because there are definitions that have yet to be worked out. Thus, there is still a long way to go before an open XML will emerge.

**Conclusion**

It is beyond dispute that XML represents the most promising development yet for achieving a universal standard for Web-based applications. The problem, however, remains arriving at agreement on the universality of the standard and, at the same time, guarding the individuality of those competing for the edge in tomorrow's IT- and e-commerce-dominated organizations.

Therefore, at least for several years, healthcare and IT organizations will remain “caught in the Web.” As this article has attempted to show, this is not a bad place to be—at least until the Internet’s next killer app makes its appearance!

**References**

6. Health Care Financing Administration, GAO report.

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