Release 0.0: Clinical Information Technology In The Real World

An industry analyst describes the difficult lessons gleaned from the “bleeding edge” of health information technology.

by J.D. Kleinke

PROLOGUE: Participants in the explosion of clinical information technology often refer to being at the “bleeding edge” of technology development—a takeoff on the phrase “leading edge” that graphically evokes the pain that often accompanies the progress. The demand for health care data—on the part of consumers, providers, employers, government, and health plans—is insatiable. Many of the new information technologies coming down the pike demand even more of health plans and physicians, who struggle with the compatibility, transferability, and confidentiality issues that have plagued health data developers and users from the outset. In this paper J.D. Kleinke describes the “numerous and often mind-numbingly complex problems associated with gathering and standardizing information on medical care,” drawing his real-world examples from his tenure as an executive for HCIA, a leading health information technology producer.

The industry’s developmental woes are magnified by its high profile on Wall Street. “In the crucible of American capitalism,” Kleinke writes, “there are few problems that investment money will not try to solve.” Expectations remain high, even as the industry’s fortunes fluctuate with the changing market. More troublesome, however, are Kleinke’s findings that technology’s “ready-made solutions” often fail to live up to these expectations and, in many cases, have not even been tested in the “real world.”

ABSTRACT: The industrialization of medical care delivery, compelled by fifteen years of reimbursement reform, has given rise to a commercial health information technology (HIT) industry. Well financed by Wall Street, the HIT industry offers a variety of ready-made solutions designed to transform a health care organization’s raw data resources into useful clinical information. Many of the resulting clinical decision-support products are encumbered by numerous insurmountable intellectual and technical problems and, as a consequence, meet with cultural resistance from physicians. The long-awaited but costly implementation of electronic medical records (EMRs) will make these pioneering but flawed efforts obsolete, if EMR development successfully exploits recent technological breakthroughs and the ongoing consolidation of health care organizations.

WHEN THE NATION WAS FIRST starting to choke on the details of the Clinton administration’s health system reform plan, health policy guru Lynn Etheredge pointed out that “true health care reform will require a health care information revolution.” This observation flows from the simple fact that the U.S. health care community, despite its 15 percent share of the economy, has been immune to most of the economic and organizational disciplines of other major industries, such as autos and airlines. A key symptom of this absence of industrial rationalization is the absence of uniform quality and cost data.

This absence could readily be chalked up to the numerous and often mind-numbingly complex problems associated with gathering and standardizing information on medical care. But in the crucible of American capitalism, there are few problems that investment money will not try to solve, and the technical and intellectual obstacles to generating meaningful health care information was never one of them. Rather, such information—and the investment capital needed to develop it—was absent throughout the formation of the modern U.S. health care system precisely because economic motives dictated that it be absent. Under cost-plus, fee-for-service medicine, it paid not to know anything about quality or cost: Excessive use of resources generated larger reimbursements, and less efficient care delivery was, perversely, rewarded. Providers were rewarded with larger payments, and payers were rewarded with larger, interest income-generating premiums to pass along to employers. It was not until significant changes in reimbursement were implemented (initially for inpatients under the Medicare hospital prospective payment system and eventually for the whole continuum of care under managed care’s risk-based payment strategies) that there have been any economic incentives to gather information on what is the most cost-effective way to treat a given patient or disease.

Significant and unprecedented economic pressures on health care
providers, introduced by these reimbursement reforms, have compelled the current, historic transformation of the U.S. health care system from cottage industry to full-scale industrial organization. This "industrialization" is defined as the application of traditional operations measurement techniques and tools to the organization and delivery of medical services: statistical process control (for example, total quality management [TQM] and continuous quality improvement [CQI]); operations research and reengineering; line-employee (that is, physician) performance measurement; benchmarking; and outcomes measurement. These initiatives, when pursued earnestly and effectively by providers, require vast quantities of health care data, sophisticated information technologies for manipulating those data, and a wealth of analytical intelligence automated into those technologies.

A market need this obvious, compelling, and enormous has not escaped the notice of Wall Street, which has responded by financing the emergence, consolidation, and aggressive marketing of a new health information technology (HIT) industry. In 1997 the HIT industry sold $15 billion worth of products to health care organizations (providers and payers), a figure that Wall Street expects to grow to $25 billion by 2000. Because of this growth rate—and because Wall Street expects profit margins to increase disproportionally faster—publicly traded HIT companies are valued at premium prices relative to the general stock market. As of May 1998 the aggregate price-to-earnings (P/E) ratio for a cross section of HIT companies was 33, compared with a near-record high of 23 for the Standard and Poor's 500 stock index (Exhibit 1). (As a measure of what a company's profits "cost" an investor per share, the P/E ratio is a meaningful way to standardize and compare the prices of individual stocks, similar types of stocks, and the relative value of the stock market as a whole.)

The HIT industry offers a variety of technically and methodologically rich information technology products and services designed to transform a health care organization's existing raw data resources into reliable, clinically robust, credible information. These offerings range from medical business decision-support software, to data warehousing and custom applications development, to clinical expert systems, to enterprisewide electronic medical records (EMRs). Except for the EMRs, these products are built to run "on top of" existing ("legacy") transaction processing systems installed by four core hospital systems vendors (HBO and Company, Cerner Corporation, Shared Medical Systems, and IDX) and a number of fragmented physician office management systems companies; the rest come from an ever expanding and consolidating universe of niche
EXHIBIT 1
Price-To-Earnings (P/E) Ratio Of Health Information Technology Stocks Compared With The Broader Stock Market, 1995–1998

<table>
<thead>
<tr>
<th>Year</th>
<th>Health information technology stocks</th>
<th>Standard and Poor's index</th>
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<tbody>
<tr>
<td>1995</td>
<td>20</td>
<td>10</td>
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<tr>
<td>1996</td>
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<td>20</td>
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<td>1997</td>
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<td>1998</td>
<td>50</td>
<td>40</td>
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NOTES: Stock performance is measured in two-month increments: January, March, May, July, September, and November of each year shown. Values for 1998 are for January and March only.

companies (for example, Oasis, Quadramed, and HCIA) funded by Wall Street or by private investors expecting quick payoffs when the companies go public.

Health care organizations use HIT products and services to reengineer their care processes; reward and penalize physicians; identify cost-savings opportunities; publicize their superior comparative clinical quality; and price and market their services to managed care organizations, employers, and consumers. This paper surveys the interplay between the information needs of health care organizations and the various adequacies and inadequacies of the "solutions" developed and marketed by the HIT industry. It describes the numerous technical, intellectual, and cultural obstacles that have disappointed the purchasers of these products, systems, and services and points to emerging EMR technology as a solution (albeit a conditional one) to many of these problems. Finally, it discusses the impact that investors' expectations had on the faulty positioning and resulting market failures of the HIT sector.

Promises And Realities
Software and other products from the HIT sector reside throughout health care's version of the classic information systems hierarchy, in which tasks range in complexity from the processing of transactions (least complex) to the formulation of clinical expert systems (most complex). The functions mandated by health care industrialization and other symptoms of economically driven self-reform, however, are broadly defined as "clinical decision-support" and "clinical ex-
"This is the Holy Grail of health care industrialization: Every clinical situation, no matter how unique, can be digitized."

pert systems," and as such reside near the top of the hierarchy of complexity. These systems generally consist of static and dynamic modeling routines, driven by normative databases and vast stores of "automated" clinical knowledge; their outputs consist of quantitative comparisons of clinical outcomes associated with alternative medical decisions. This is the Holy Grail of health care industrialization: Every clinical situation, no matter how unique, can be digitized into a set of inputs, quantitative predictors, optimized medical decision making, and maximized results, be they lower costs, improved quality, or some combination of the two.

How we get there from here is a little tricky: Most of these products draw on legacy data systems that were designed to process claims and other transaction data. Operating within these technologies, both provider-specific and normative data streams originate from electronic flows of information originally developed either to track patients around a hospital or to transmit to payers for patient care reimbursement.

There are significant and perhaps insurmountable difficulties associated with adapting claims and other transaction data sources for clinical decision-support purposes. Each transaction-derived data set has an inherent bias: Regardless of its intended format (that is, the number or variety of its elements), the actual data set is only as specific or as reliable as is minimally necessary to track a patient's movement through the hospital or to generate reimbursement. There are no direct, immediate economic incentives to invest in thorough and consistent data capture beyond this baseline. This phenomenon is manifest across the health care industry in two critical areas: the "upcoding" of reimbursement records for Medicare inpatients and the "downcoding" of records for commercial and Medicare outpatients in capitated reimbursement systems. Here I describe these and other problem areas.

- **Upcoding.** In the case of inpatient upcoding, hospitals have incentives to capture as many codes as possible for Medicare patients: More complex codes lead to higher diagnosis-related group (DRG) assignments, which in turn lead to greater revenue per patient. Under competitive pressures to maximize profits, upcoding has evolved from informal practice to cultural fact to HIT product opportunity, spawning in the process an entire "optimization" software market. The proliferation of upcoding and the widespread
adoption of optimization software help to explain why the illness severity of the inpatient population in U.S. hospitals is found to increase every year. Such studies almost always rely on Medicare claims data and can be summarized by the increase in case-mix index for the median U.S. acute care hospital, which rose from 1.217 in 1989 to 1.258 in 1996. The same Medicare data set used to calculate this figure (the Medicare Provider Analysis and Review, or MedPAR, file) drives the bulk of HIT products dedicated to “hospital profiling”; such products represent a significant segment of the industry’s clinical decision-support product revenue.

- **Downcoding.** In the case of outpatient downcoding, physicians and others who deliver ambulatory services under capitation arrangements with health maintenance organizations (HMOs) have no incentives to capture patient transaction data. The absence of patient encounter detail under risk-based contracts is especially problematic as more services and their associated costs migrate toward outpatient care settings. Without this detail, a comprehensive (or even a fair comparative) understanding of patients’ illness burden, population risk, providers’ performance, or episode- and population-wide costs slips out of reach, at precisely the moment in the health care system’s history when such understanding is most needed.

- **Encounter/admission fragmentation.** Yet another problem is associated with adapting claims data for clinical analysis: Claims tend to represent isolated “line items” of clinical services rather than coherent, unified medical events. An outpatient medical encounter can generate up to five different claims: one for physician services, one for lab tests, another for diagnostic imaging, still another for the resulting prescription, and so on. This phenomenon similarly affects inpatient clinical information: An inpatient claim is not synonymous with an inpatient admission; it involves often myriad hospital clinical services, many of which are billed separately (such as operating and recovery room services, pharmacy, laboratory, blood bank, and rehabilitation). All of these are generally captured and billed as distinct from the services of the typically large number of physicians who diagnose, treat, or consult on a patient during an admission. HIT solutions are emerging to correct this situation, but it is just as quickly exacerbated by continued cost pressures that compel hospitals to outsource increasing numbers of services and departments to separate entities that also bill patients and payers separately.

This fragmentation would not be a problem if the data streams from the various care providers and facilities were all captured by the same software system or patched seamlessly together within a reliable, shared infrastructure. But such systems are almost never integrated operationally, nor do they provide easy portability after
the initial data capture. In fact, the historical fragmentation and
competitive nature of pharmacies, diagnostic imaging centers, lab
services, and physician practices have created legacy systems that
specifically preclude such interoperability. The end result is a data
chaos that makes uniform “encounter building”—a necessary data-
preparation step upstream of any clinical information develop-
ment—highly problematic. For example, if one pharmacy system
provides selectively incomplete data “upstream,” then the incidence
of comorbid conditions such as asthma will go understated for entire
populations in clinical HIT systems “downstream,” leading system
users to entirely wrong (and potentially dangerous) conclusions.

**Episode fragmentation.** The most significant information
management challenge posed by claims data is the fragmentation of
patient information over time and geographic space as patients
move through a fragmented treatment system. Despite the indus-
try’s belated compulsion toward horizontal and vertical integration,
most patients still receive their care across myriad settings and sites.
Grouping the care delivered in these sites into clinically relevant
units of analysis (a requirement for any clinically based HIT product
to work) is highly complex and rife with potential for error.

Take, for example, the data associated with a complicated cancer
case. Relevant data from several outpatient facilities that provided
various cycles of chemotherapy and radiation treatment, from two
different hospitals that provided inpatient surgical procedures, and
from several pharmacies that dispensed prescriptions will need spe-
cifically to be gathered into an appropriate episode of cancer care.
Data related to a leg fracture that the patient sustained in a car
accident in the middle of the cancer treatment period will need to be
excluded from the episode. But what about the data for a prescrip-
tion for an antidepressant medication filled during the treatment
period? If the patient had a treatment history for the disease (im-
puted from still more data, generated before the cancer diagnosis),
then the prescription should not be included as part of the cancer
episode. If the patient had no history of depression prior to cancer
diagnosis, then the data should be included. This is one small ex-
ample of the unimaginable volume of clinical rules necessary to develop
coherent “episodes of care,” a mind-bending data-handling task that
must be completed before any meaningful clinical information can
be developed and used.

**Classification problems.** As the modern health care system
has evolved into an archipelago of “dis-integrated” providers, there
have evolved in parallel significant problems with regard to patient
illness and procedure classifications. Although the grist for every
HIT product is raw patient data, the simplest classification efforts
are hampered by conflicts among legacy, redundant classification systems. To date there exists no commonly accepted system for grouping a patient’s condition-related records over time into a clinically coherent diagnostic group, despite multiple generations of systems for describing surgeries, grouping inpatients, classifying outpatient procedures, and recording physician visits and other ambulatory services. For example, there are International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes that describe surgeries as performed at a hospital and Current Procedural Terminology, Fourth Edition (CPT-4) codes that describe those same surgeries as performed by physicians at that hospital, and the design of the codes for entire classes of these surgeries almost never matches. This underscores a central defect of the U.S. health care system: It evolved less to treat people than to deliver line-item, billable medical services to patients.

Conflicting classification systems mean significant potential conflicts in how medical care is described in digital form, thus precluding the ability to draw any reliable clinical conclusions from the information. For example, psychiatric illness can be classified using either ICD or Diagnostic and Statistical Manual of Mental Disorders (DSM) diagnosis codes. A New England Journal of Medicine study found that for the same population of patients, using ICD-10 criteria, 3.1 percent suffered from dementia; using DSM-III criteria, 29.1 percent suffered from the same disorder. This is not a trivial difference. As the journal pointed out, this tenfold discrepancy “has serious implications for research and treatment.” It also fully makes suspect all attempts to analyze the treatment or outcomes of populations with dementia as a comorbidity using any HIT product or system, such as in the cancer case described in the previous example. Such populations include, most obviously, broad segments of the frail elderly, the most expensive subpopulation in our health care system.

- **Severity.** The sum total of these problems is embodied in the Herculean task of fairly adjusting for patients’ illness severity and underlying medical risk. Two patients who have precisely the same illness burden but who are treated by two different “integrated delivery systems,” with divergent reimbursement arrangements and data-handling sophistication, will appear within the same clinical HIT product as vastly, clinically different. For example, the absence of reliable outpatient data in one system would miss obvious diagnostic data that would classify a given pregnancy as high risk; poor integration of pharmacy data would miss resource-consumption facts that would easily classify a heart patient as also being diabetic. Both of these situations represent significant comorbidities with serious consequences for risk adjustment, economic forecasting, and

**But how?**

Given the intense pressures of rapidly escalating medical costs and the intense fiercely competitive pressures of the health care industry and ultimately the HIT expenditures, it is in the financial interest of all parties to lowball the health care system’s ability to deliver truly meaningful, clinically valuable data to stakeholders in a “digitized” form.