Information Systems for the Outcomes Movement

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Outcomes research, measurement, and management have become hot topics well beyond the realm of the academic medical research community that first popularized the concept. Since the 1989 legislation that created the Agency for Healthcare Policy and Research and that resulted in initial congressional funding of the Patient Outcomes Research Team (PORT) studies, the so-called outcomes movement has moved into the mainstream. Everyone from federal and local governments, to payers, to accrediting bodies is jumping on the outcomes bandwagon. Specialized periodicals have sprung up on the subject of outcomes, while nearly every issue of more generalized health care publications has one or more articles on the topic. Meanwhile, patients, payers, and providers are clamoring for objective information about what really works in health care.

At the 1995 HIMSS Annual Conference and Exhibition, 58 percent of some 1,000 attendees completing the HIMSS/HP Leadership Survey indicated that the need for comparative outcomes data was among the three most important forces driving increased computerization in health care.¹ For many organizations, outcomes data is literally becoming essential to survival. As an example, in the summer of 1995, the Blue Cross affiliate CaliforniaCare Health Plans demanded outcomes data for at least 15 diagnoses from virtually every hospital in California. The hospitals were given only a few weeks to respond to a 45-page request for proposals. The information was to be used to categorize providers as preferred and secondary and may ultimately be used to eliminate them from provider panels.²

Given the level of interest, it might be assumed that the tools and technologies of the outcomes movement would be sophisticated and data readily available. Such is far from the case. The reality is that the necessary information systems and data sets are fragmented, proprietary, often difficult to use, and in many cases, still in paper format. Providers are frightened at their seeming inability to meet the demands they see placed on them and are in search of a comprehensive outcomes information system. There is good news on several fronts. On the one hand, forces within both the health care
and information systems industries are combining to support the outcomes movement. On the other hand, there is value to be gained from what already exists. While the ultimate outcomes information system will be some time in coming, it is nevertheless possible to foresee the day when patients, providers, and payers can finally answer the questions: What are our health care options? What are their results? How can we do better?

Outcomes Research, Measurement, and Management

As used here, the term outcome refers to an indicator of the results of a process. While that process may be of almost any type, typically it is related to the content and delivery of health care. The outcomes movement is comprised of research, measurement, and management initiatives. Outcomes research is aimed at determining the short- and long-term results of one or more treatment approaches in an effort to determine the “best” approach to care. Best is dependent on one’s goals, but is usually an attempt to balance quality and cost considerations in some measure. In contrast, most outcomes measurement initiatives have as their focus not so much the assessment of best process as the comparison and evaluation of health care providers. The two efforts—research and measurement—are closely linked in outcomes management, which attempts to operationalize the findings of research and measurement within health care practice. The PORT studies are examples of outcomes research; the Health Plan Employer Data Set (HEDIS) initiative of the National Committee for Quality Assurance (NCQA) is an example of measurement. Guidelines and continuous quality improvement programs are examples of outcomes management.

Those who work with outcomes data generally fall into one of three categories:

Academic, interorganizational teams looking at care across provider organizations and geographic locations
Proprietary, intra-organizational teams looking at care within a health care enterprise
Organizations with some data ownership examining outcomes across multiple providers.

The first group, including such well-known pioneers as Wennberg at Dartmouth and Brook at the Rand Corporation, generally sets out to study alternative approaches to treatment for a specific condition. Researchers obtain access to large sets of claims data, sometimes supplemented with paper medical records. Claims data includes data from insurers, HCFAs MEDPAR and other databases, and regional data sets. Claims data contains some limited number of coded data elements representing clinical condition, procedures or treatments, discharge disposition, and possibly some other
indicator of how the case was resolved. This information source represents a large, fairly uniform set of data that is readily available in coded form, online and theoretically ready for use. Unfortunately, it tends to provide a limited clinical picture, is often fragmented, and usually contains inaccuracies such as mismatched patient identification numbers. It may also have been distorted due to coding practices that are driven more by reimbursement requirements than by a concern for clinical accuracy. One study found that claims data failed to identify as many as half of the prognostically important clinical conditions found in a clinical information system. The use of supplementary paper or on-line patient charts can overcome some of the deficiencies of the data set, but is labor intensive and may not be possible on a large scale project.

Intra-organizational outcomes teams use a similar approach to academic researchers, but their data sets are internal and they are more likely to focus on local processes. Their goal tends to be outcomes management. These teams have access to a wider range of data elements and information systems, which may provide a more comprehensive clinical picture. They may also be able to make modifications to the data collection systems to allow them to expand their data sets to reflect specific interests and to address data quality issues. Intra-organizational outcomes teams generally have cleaner, more comprehensive data sets available to them, but the sample size is often too small to be significant. Further, few provider organizations have personnel with the time and training to effectively analyze and interpret outcomes data.

The third group interested in outcomes, those with some right to the data from a large group of organizations, includes insurers or benefits managers, regulatory or watchdog groups, and private health care database developers. These are generally the outcomes measurement people. Like the academic researchers, this group must confine itself to the set of coded data submitted to it, so the scope of its work is limited. However, it is often in a position to specify the content of the data submitted to it, so this group is able to focus on specific areas of interest. For example, the NCQA has defined a set of indicators it will use for HEDIS. This set is limited, and its value has been questioned by some, but it permits comparison across a large, consistent data sample. Likewise, most insurers have available large case samples with common data elements from a diverse group of providers.

Outcomes Information Systems

Despite the drawbacks to these approaches, there have been enough significant successes so far to have generated huge expectations for the outcomes movement. The magnitude of those expectations intensifies the need for better methods and tools to fulfill them. Outcomes information systems have two primary components: the data set and the associated applications. Most existing systems maintain a specific outcomes data set. Yet nearly all health care
information can be considered some component of outcomes data, segmented along the lines of

Administration: Demographics, billing events, cost models, etc.
Patient surveys: Physical health status, mental health status, access, satisfaction, etc.
Clinical operations: Clinical events, conditions, results, etc.

Virtually no system today is truly comprehensive along all three dimensions. An outcomes information system designed to incorporate the entire data model and to support the applications of research, measurement, and management could be represented as shown in figure 1.

There are many reasons why existing outcomes information systems do not yet measure up to the theoretical ideal. Some of these are inherent in the structure of the health care industry, others in the structure of health care information systems, and still others in the structure of the data itself.

**Industry Structure.** The health care industry is still characterized by large numbers of autonomous or semi-autonomous organizations involved in the provision of, administration of, or payment for care. These organizations are linked in an intricate network of relationships, but each has its own data set. The standard concerns of any business regarding proprietary data apply to health care organizations, and are compounded by the uniquely confidential nature of health care data. With the advent of managed care and the horizontal and vertical integration of providers, some of the proprietary boundaries to data sharing have been removed or reduced, but new difficulties have arisen.

**Figure 1. Outcomes Information System**
due to the overlapping relationships entered into by most providers. In an urban area with a well-developed managed care market, these relationships may number in the hundreds for each provider. In such a situation, each provider has its own information system and data set. It may be gathering and assessing its own outcomes data. Each provider affiliation (IPA, PHO, etc.) and managed care organization may also have an information system it would like providers to use, and data it would like providers to share with it. Providers involved with many managed care organizations cannot possibly use all of their information systems, and may not have the resources and expertise necessary to generate each of the data sets requested by the organizations. Even if they can, differing data definitions and the encounter-based orientation of most provider data may seriously limit analysis at the level of the managed care organization.

Information Systems Structure. Until recently, most health care information systems (HIS) were designed and purchased to address administrative requirements such as tracking patient locations, keeping track of charges, and ensuring that employees were paid. While the current emphasis is shifting toward clinical requirements, the bulk of the installed systems base represents administrative systems. While often quite sophisticated, these systems tend to have a limited clinical data set. Existing systems are also heavily weighted toward acute care and inpatient data. With health care migrating outside the acute care setting, much of the information critical to assessing outcomes may be lost or severely limited. Provider organizations vary widely in the type and scope of information systems they have installed. An organization with only rudimentary information systems will have a much more limited set of outcomes information with which to work, even if it has the personnel in place to utilize the data.

An even greater obstacle to the analyst seeking to understand treatment decisions and outcomes is the fragmented nature of the clinical record. In contrast, the ideal record is a complete, longitudinal picture of all health-related activities from birth to death, including occupational, physical fitness, nutritional, and other relevant lifestyle data. With it, the researcher can look for correlations between treatments, prior conditions, lifestyle, and long-term outcomes. This ideal record is a logical whole, not necessarily a single physical record. It might be stored on many different computers, but is entirely online, and the components can easily be linked together when needed. Unfortunately, today at least, it does not exist.

Actual health care records are discontinuous, incomplete, and often impossible to integrate. Large portions are not online at all. Even within a given health care enterprise, there is no guarantee that computerized data can be linked up into a coherent longitudinal record of care. Many large providers, such as hospitals, have a number of different information systems. These may come under the ownership of individual departments, each with differing priorities and data definitions and often with a profound distrust both of each other and of the central information services team. The systems may or may
not “talk” with each other effectively. In many cases, each system uses its own method of identifying patients and providers, thus making it difficult to link the records of a single patient across systems. Where it is technically possible to link records, software or departmental policies may have been designed to prevent it. This provides a measure of security where more sophisticated security mechanisms are unavailable.

**Data Structure.** Health care information systems cannot fully compensate for the shortcomings of health care data itself. Among these, one of the most critical for the outcomes movement is the lack of well-defined, accepted outcome measures. The concept of health is, by its very nature, subjective and, hence, not easy to quantify. Outcomes are condition or process specific, making it difficult to identify a simple set of outcomes data. Researchers have had success with survey-based health status measures such as the SF-36, but these cover a limited number of conditions and outcomes, and require significant follow-up with patients. Nor are they yet universally accepted. Lacking objective overall health measures, various groups have developed indicators such as blood utilization or maternal deaths to monitor outcomes of specific events. Others have relied on diagnosis and procedure codes, discharge status, length of stay, and proxy measures such as cost. Within a health care organization, researchers can collect data such as unplanned returns to surgery, but they are often limited to data from a single encounter and cannot track long-term outcomes if the patient receives future care outside the organization.

Another long-standing issue has been the lack of a standard taxonomy and coding structure for many health care activities. Nursing is a notable example. Whereas medical diagnoses and treatments are recorded using such standard coding schemes as ICD-9-CM and CPT-4, there are no comparable coding systems for nursing diagnoses and interventions. This is partially related to reimbursement issues. Traditionally medical care has been reimbursed on the basis of a coded description included on a claim, while nursing activities have been reimbursed under the lump payment for inpatient stays or outpatient office visits. Thus there has been considerable incentive for providers to code medical activities, and almost none to code nursing. While a number of coding systems have been developed for nursing, there is to date no standard model. From an outcomes research standpoint, this is disastrous, since a significant component of care is lost to handwritten textual notes or organization-specific or vendor-specific coding schemes. A similar, though even more pronounced, situation holds for other allied health professions. The format of available data is summarized in table 1.

The coding issue is important because uncoded data is almost impossible to analyze in any comprehensive, automated fashion given today’s information systems. Data that is coded using organization-specific coding schemes can be analyzed locally, but, unless it is mapped to some universal scheme or crosswalk, it cannot be analyzed across organizations. Given that a typical acute care hospital has several thousand service codes, this is hardly a trivial task.
Table 1. Representative Coding and Taxonomy

<table>
<thead>
<tr>
<th>General Condition and Treatment (e.g., diagnosis, major surgical procedure)</th>
<th>Specific Condition and Treatment (e.g., drugs, prostheses, results)</th>
<th>Nursing and Allied Health Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT-4</td>
<td>Organization-specific codes</td>
<td>Text</td>
</tr>
<tr>
<td>ICD-9-CM</td>
<td>ICCS and other crosswalks</td>
<td>Organization-specific codes</td>
</tr>
<tr>
<td>Other standard coding schemes</td>
<td>Text</td>
<td>Nonstandard coding schemes</td>
</tr>
</tbody>
</table>

An example of a universal coding scheme is the International Classification of Clinical Services (ICCS), originally developed by the Commission on Professional and Hospital Activities (CPHA) in an attempt to standardize descriptions of treatments. While promising, such crosswalks are of limited value to the outcomes community as a whole unless they become universally adopted.

The coding problem is further complicated by the extensive variation in health care terminology. The National Library of Medicine (NLM) is funding a long-term project to create a Unified Medical Language System (UMLS), which uses a metathesaurus to provide a walkway between terms. The UMLS project may eventually make it possible to achieve a universal health care “language” without actually moving to a common set of codes, but this project has already been under way for a decade and will require many more years for completion. Other long-term research projects have focused on the development of a “medical entities dictionary” to allow information systems to recognize coded and uncoded synonyms or instances of a condition or event. While these efforts are certain to be a significant boon to the outcomes movement, their very magnitude illustrates the scope of the challenge.

We can use the functional model as a yardstick for measuring what are used today as outcomes information systems. General health care information systems (HIS) are operational systems that typically work with the transactional data on a single patient at a time. While they may have a comprehensive information set, it is not readily accessible across patients or time. Patient survey data management and analysis products aggregate data across time and patients but tend to lack core operational data necessary to the analysis. Health care decision support packages are also strong in the aggregation and analysis components, but lack the comprehensive data set ultimately desired. Generic analysis and statistical packages such as Microsoft’s Access or SPSS are excellent tools, but lack health care domain knowledge and require the user to build his or her own data set. Given all this, many outcomes professionals find themselves creating specialized computer programs and data sets for each research or measurement application.
Forces for Change

While health care information systems today fall short of what is desired and needed by the outcomes movement, the health care systems of the future should be more than supportive. Developments and pressures within both the health care and information systems industries are rapidly coming together to facilitate outcomes information management.

The Health Care Industry. The very forces leading to demands for outcomes data are also ensuring that such data will become more available and more reliable. Changes in the industry are reshaping provider models, breaking down the proprietary data barriers between organizations, and providing incentives for data sharing. From the standpoint of outcomes, this can only be an improvement on the current state of affairs. For example, the new health care enterprise model will have a population-based focus concerned with overall health, as opposed to encounter-oriented health care. This should increase demands for, and the development of, an integrated longitudinal record. An integrated health care enterprise is a “virtual” distributed organization built around communication, and therefore demanding linked information systems. And it will have a host of new business requirements demanding new software applications, which should, as a by-product, support outcomes management. A number of initiatives within the health care industry are also contributing to changes in data, data availability, and information systems in ways that are supportive of outcomes management:

Quality scorecards. The HEDIS project of the NCQA, an HMO accrediting body, is only the best known of a number of so-called report cards currently being developed and tested by trade groups, managed care organizations, government agencies, and data vendors. These use indicator data such as the presence or absence of prenatal care, vaccination rates, and disease screening rates to help employers evaluate and compare managed care programs. These scorecard projects are currently directing substantial resources into the development of meaningful indicators. Over time, they should generate a wealth of new data to feed into the outcomes assessment process.

Guidelines development. The various initiatives by government, providers, and payers to develop and implement guidelines require outcomes data first to assist in guidelines development and later to assess the impact of implementing them. Payers are also beginning to demand adherence to guidelines in order for care to qualify for reimbursement. This is likely to lead to methods of coding the guidelines themselves and of capturing activities that show compliance. Once again, the result will be an expanded information set available to the outcomes community.

Reengineering health care. Efforts to rethink clinical practice, such as patient-focused care, demand a new kind of clinical record, one that captures the activities of a multidisciplinary care team and is likely to better support outcomes review.
Quality improvement. Underlying many of these other initiatives is the concept of quality improvement. With its emphasis on quantifiable process improvements, this movement requires health care professionals to develop ways to measure what is being done, and the impact of change—again, a demand for outcomes data.

Managed care. The trend towards managed care assumes that we will be able to reduce costs by doing the right thing at the right time, implying a knowledge of what that is, obtained through outcomes studies. Managed care also creates provider networks for data sharing today, and is heavily influencing the move to an integrated health care enterprise.

With the exception of administrative simplification, health care reform has shifted from the federal to the state and private sectors. Nevertheless, change is occurring. Almost any move toward reform is likely to generate a number of benefits for the outcomes movement including:

Universal identifiers for patients and providers. These are critical to matching records across information sets in order to assess the long-term outcomes of a course of action. Until the ultimate outcomes information system is available, universal identifiers will help to overcome some of the drawbacks to claims data for outcomes research. They are essential to the development of a single, logical patient record linking together encounters stored across multiple systems.

More uniform coding. Organization-specific coding schemes for health care interventions will almost certainly give way to universal schemes or to a mapping across schemes as legislation or payment requirements demand.

Regional and national data pools. These should provide ready access to comparative data. They will also provide large enough data samples for statistically valid studies.

Standardized baseline functionality in information systems. As variation is reduced in health care provider and payment structures, key functionality within information systems will also become less variable. This will make it more likely that similar data will be available in each organization.

It should be evident, in reviewing this list, that most of these developments are both cause and effect. Providers who wish to compare themselves to other organizations will want to adopt the standard codes used within regional and national data pools and, conversely, the adoption of these codes will make such pools feasible. Such is the case with all of the likely developments.

The Information Systems Industry. One of the only industries more characterized by rapid change than health care is the information systems industry. From the standpoint of outcomes measurement and management, this is all to the good. Some of the most significant changes of benefit to the outcomes movement include:

Standard data definitions and interchange mechanisms for health care data. Standards groups such as the ASTM, HL7, and HISPP break down barriers between information systems caused by differing data definitions. This not only allows the information systems from various newly affiliated health care
organizations to exchange data, but also the often incompatible systems within single organizations.

Open systems, including communications and database standards. These remove the technical barriers to systems integration, just as standard data definitions remove the data barriers. Common database access formats such as structured query language (SQL) mean that data can be retrieved easily from a number of sources and combined to build up a complete picture of conditions, interventions, and outcomes. This approach should allow the merging of local, organizational data with state, regional, and national public databases and with proprietary data sets from specialty companies.

Security. Network-based security standards, such as the distributed computing environment (DCE), provide vehicles for controlling system and data access, while field definitions within databases guard specific data elements from inappropriate usage. Data security and confidentiality is a major concern of health care consumers. The ability to ensure it is critical to the public’s acceptance of outcomes data sharing.

Local and wide area networking. Not only do networks enhance communication; they make it possible for everyone to “work off the same page.” That is, caregivers in many locations can have access to the same applications and information at the same time, thus increasing the uniformity and integrity of the data set. Without networks, each caregiver accesses and enters data on a separate, local computer system, duplicating some, misspelling others, and leaving some out entirely, making it difficult to ever build up a single, comprehensive record of care.

Graphical user interfaces. These make information systems more approachable and easier to use, thereby helping to expand the user community to caregivers and even patients. This in turn should enable the capture of a richer, far more complete information set for outcomes analysis. It should also improve the accuracy of the data, since the closer health care data capture is to the point of care, the more accurate the data.

Text processing. Today, analysis is difficult unless data is coded or text carefully structured, but developments in information retrieval and natural language processing by computer systems will allow the content of a free-form narrative health care record to be analyzed automatically in the future.

High-powered commodity hardware. Inexpensive and interchangeable hardware makes it feasible to collect data at the point of care, wherever that may be. Powerful hardware makes it feasible to work with distributed data, enormous databases, and huge transaction volumes. This supports not only the data collection effort, but the manipulation of large data sets for analysis purposes.

The Shape of Things to Come

There are a number of “outcomes information systems” on the market today. Each claims to address the needs of the health care organization seeking to col-
lect, manage, assess, and report outcomes data. Yet most are highly specialized and work with a narrow, shallow information set. Further, by treating outcomes as a separate issue, they divorce it from the overall information system. It should be evident from the above that such systems can address only a portion of the need. They are piecemeal, temporary solutions to the overall problem. If nothing else, most are simply too small. What is required is a big picture viewpoint, a sweeping gaze across the outcomes landscape. With such a view, outcomes become an integral component of an organization's entire information systems plan.

A comprehensive outcomes information system will not be purchased or constructed all at once, but rather assembled piece by piece, somewhat in the manner of a quilt. The overall plan will provide for all of the functionality in the model in figure 1, while the individual components or projects will advance the system toward the ultimate goal. Among the pieces to assemble are the system architecture, the computer-based patient record, and advanced clinical information systems. These are not discrete components, but rather attributes of a comprehensive outcomes information system.

System Architecture. As providers integrate, they confront the almost mind-boggling task of trying to develop a single, integrated information system from the building blocks of their existing individual systems. Since it is seldom feasible to replace everything with a single comprehensive new system, HIS vendors and health care providers alike have sought a strategy to preserve the equity in existing systems while providing a foundation for the future. The model of choice is the information network as shown in figure 2.

The boxes around the circle represent the components of the health care enterprise with their individual information systems. These are often referred to as legacy systems, although in fact they may also be new systems that are highly specialized for a particular application. Each of these systems needs to be able to collect component-level outcomes data applicable to its functions, and to gather patient survey data as appropriate. The circle itself is a local network around which these systems can pass information common to them, e.g., patient name and address or clinical condition. This local network is connected to regional and national networks (the “information superhighway”), to which it can pass information, e.g., the indicators required by accrediting groups, and from which information can be obtained. For the care of an individual patient, the network might be used to gather the records of previous care by another provider. For outcomes management, it might be used to gather together a case sample of similar patients for analysis and comparison.

The information gateway might also be shown as part of the local network. It is a combination of traffic cop, facilitator, universal translator, and general guide for all the bits and pieces of information flowing into and around the network. It knows which systems need what and can properly format and broadcast that information. It also knows what to extract for the repository.
Finally, it includes a component to map everything together using common identifiers so that John Smith in the home health system can be identified as the J. Smith in the physician's office system and as the John J. Smith in the hospital records. This makes possible the linking of disparate components of care into a single, logical, longitudinal record.

The clinical repository provides a unified database on which can be built enterprise-wide applications as the newly integrated health care organization determines its requirements. While it need not be a single, physical database, it does need to be a rationally designed clinical record, providing caregivers with access to immediate, accurate, and comprehensive information. For the outcomes specialist, it represents a data set that is both deep and wide. The data set is deep in that it includes very detailed clinical data, such as all of the tests and treatments received by a patient, their results, dosages, specific brand names, etc. It is wide in that it includes not only a large sample of patients but care provided across the full provider spectrum.

Across the top are shown broad categories of new applications. These can be developed and implemented efficiently when the clinical repository is in place. They, in turn, will enable its expansion by gathering and processing additional information, much of which will help to fill in the picture being studied so intently by outcomes analysts. These new applications should incorporate outcomes data into their core functionality. For example, an enterprise-wide scheduling package might trigger the appropriate patient surveys to be generated in conjunction with new visits. A clinical workstation might prompt the clinician for any required “subjective” outcomes data, and supply a patient's previous health status data at the time of a visit for comparison purposes.

**The Computer-Based Patient Record.** Another component of the outcomes system quilt is the computer-based patient record (CPR). The 1991 Institute of Medicine (IOM) report on the CPR called for an initiative to have the CPR in place throughout the United States by the year 2000. The report acted as a catalyst for the HIS vendor and provider communities. As described by the Institute of Medicine, the CPR is “an electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts, reminders, clinical decision support systems, links to medical knowledge, and other aids.” In other words, it is a data model combined with a model of users and functionality. The study group defining the CPR identified five primary objectives for its development, among them the support of research such as that done within the outcomes movement. On a similar note, the IOM report stated that if users are to derive maximum benefit from the CPR, they (the users) must fulfill four conditions:

- They must have confidence in the data.
- They must use the record actively in the clinical process.
- They must be proficient users of the systems that comprise the CPR.
• They must understand that the record is a resource for use beyond direct patient care, e.g., it is a research tool.5

These conditions are significant to the outcomes movement in that they demand high-quality data entered directly by the caregiver with the understanding that it will drive research.

The report concluded that, while the necessary technologies for developing a computer-based patient record are already available, no existing clinical information system is capable of supporting the complete CPR definition. Rather, current systems represent a blend of functionality and technology that in some cases approaches, but does not reach, the defined goal. The architecture shown in figure 2 is intended to support a CPR; however, it is possible to have this architecture in place and still not have an effective CPR. The computer-based patient record is dependent not only on the data set but on the applications, hence the need for well-designed advanced clinical systems. The CPR by definition includes tools for data aggregation and analysis. These will, when combined with local, regional, national, and international data, provide a robust outcomes information system. The drawback to the CPR as a source of outcomes information is that one cannot simply buy and install one. A true CPR is a matter of infrastructure, data, software applications, and data definitions. It will evolve and grow, not simply happen. As it does, outcomes information management will also grow and evolve.

**Advanced Clinical Systems.** Most HIS vendors are investing significant research and development dollars in advanced clinical systems typified by intelligent clinical workstations. These are graphical workstations designed to be used by caregivers at the point of care, be that the clinic, the bedside, the emergency room, or the patient's home. The major factor distinguishing these systems from previous generations of systems is that they are intended to support the thought process and work style of both individual caregivers and of categories of caregivers, e.g., doctors and nurses. Previous systems supported clerical personnel.

Clinical workstations are an integral part of the CPR, and play several roles in the outcomes movement. One role is that of data collection. Another role might be termed “micro analysis.” Workstations should enable individual caregivers to review their own outcomes data relative to peers and to analyze that data themselves using simple data manipulation and analysis tools. The workstation should provide access to aggregate data as easily as individual case data. Another role of the workstation is information dissemination. The results of outcomes research should be available to caregivers in a variety of forms: through on-line bibliographic tools, through guidelines lookups, and through the clinical decision support functions provided within the workstation. This last will include reminders, alerts, and order sets reflecting
the results of outcomes research, and detailed analytical tools for the caregiver who is also a researcher.

**Getting There**

Just as the assembly of a quilt is a slow, painstaking process, so is the assembly of a comprehensive outcomes information system. This partially explains the fear and helplessness many health care professionals feel when the issue of outcomes is discussed. It is therefore important to realize that if health care information systems are still embryonic, the outcomes movement itself is still in its infancy. There is significant value to be gained from what exists today. The answer is to use what is available in existing systems, and to use the results of the initial analysis to improve those existing systems. This approach, in conjunction with a careful information systems strategic plan, will support both immediate and long-term needs.

Consider a brief example. Most acute care hospitals have some type of case mix analysis capability. Even a fairly simple system should permit a general analysis of such proxy outcome measures as length of stay and discharge status by type of case. This information can be used to develop guidelines, critical pathways, or other process improvement approaches. For example, you might look at reducing the length of stay (LOS) for total hip replacement cases. Using the case mix system, you can examine the characteristics of cases with differing outcomes—in this example, LOS—and develop a plan to adopt a similar pattern of care based on the characteristics of the cases with the lower LOS. This plan can be loaded into your existing clinical systems, to the extent those systems can support it. For example, if you have nursing care plans online, the new plan can be incorporated in those. If you have an order entry system with standard order sets, the new plan can be set up as a standard order. As you begin to collect data on patients treated under the new plan, you will be going back to your case mix system to assess the impact of the change and possibly to fine-tune it.

Simultaneous with the change in clinical process, you will want to consider how to enhance your existing systems to further support this change. You might want to add additional data elements to better measure outcomes within your case mix system. You may want to implement system modules you have purchased but not yet installed. You may want to purchase additional modules for systems you already have, such as advanced nursing functions. Or it may be time to begin moving forward with major new components of your long-term information systems strategy and architecture. Both sides of the process—the analysis and systems implementation—and the modification of clinical processes and ways of thinking are iterative. The goal is to discover how much outcomes data is already available to you and how best to use it while moving forward with your long-term plan. As new system
components and data elements are put in place, the outcomes information and functionality available to you will expand, enabling you to reap the benefits of the outcomes movement.

References
5. Dick and Steen, p. 3.

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