Using Data to Measure Outcomes

Pam Matthews, RN; Nancy Carter, RN; Kathryn Smith

Outcomes Measurement: Definition and Data Requirements

Why Measure Outcomes? The marketplace is beginning to demand that health care providers develop and provide outcomes data. This is evidenced by managed care companies, JCAHO, business coalitions, and alliances requiring organizations to demonstrate their effectiveness and quality of patient care services. This demand for outcomes measurement is in addition to the internal business requirements of the organization to measure and monitor performance for the purpose of continuous quality and process improvement activities.

Outcomes measurement not only deserves but mandates careful planning. Implementing a process of collecting outcomes data can be very labor intensive. Implementing automated system solutions supporting outcomes data collection can be expensive as well as labor intensive. Part of the planning up front includes defining outcomes, understanding how outcomes are used in analysis and decision making activities as well as identifying who are the players—either the sources of outcomes data or the users of the data.

What Are Outcomes? Outcomes measurement is often very difficult to define because it can relate to any to the following areas:

- Organizational performance
- Clinical effectiveness
- Patient satisfaction
- Service quality
- Appropriateness of care
- Patient responses to treatments
- Cost of services
- Efficiency of services delivered.

Outcomes may be encounter based, span the continuum of care, relate to an individual patient across several encounters, or measure a system.
Outcomes measurement slices through an organization both vertically and horizontally. Also, outcomes measurement is necessary at various levels within a provider organization. For example, macro-indicators are required at the system level to measure and track organizational and system effectiveness while interim process measures track performance at the service-line or unit level. An organization must identify its definition of outcomes and how it will use the outcomes data. This will be driven by the organization’s internal activities as well as its external customers’ data requirements.

**Strategic Planning.** An organization must determine what is strategically important, develop indicators to be measured, identify measurements for the indicators, and then track those significant indicators.

In Emory University Hospital’s strategic planning process, we identify strategies and then develop tactics that support those strategies. For each strategy, macro-indicators are developed, which, when measured, provide a high level assessment of performance on that strategy. Examples of strategies and related macro-indicators include

- Continuously improve patient care (strategy); percent of patients followed on a clinical pathway (indicator)
- Continuously improve patient and family satisfaction (strategy); patient satisfaction (indicator)
- Sustain sound financial position (strategy); cost per discharge; operating margin (indicator).

Together these provide a snapshot of what is important to the success of the organization.

Indicators are also developed for the individual tactics that provide a more detailed picture of performance. Examples of detailed tactics and tactic measures are as follows:

- Reduce waiting times (tactic); waiting time/CQI measurement (tactic measure)
- Use benchmarking process to achieve improvements (tactic); number of projects completed (tactic measure).

**Where Is the Data?** One difficulty with outcomes data is that it resides in many different databases or locations within a single organization.

Measurements are also developed in individual operating units of an organization, particularly in supporting the department’s CQI efforts. These measures are also tied to the organizational strategies and tactics. In this way, outcomes measurements are focused on what is strategically important to the organization.

These databases may not be automated. Figure 1 illustrates examples of the multiple locations for information in organizations. The source of outcome data may be found in medical records systems, case management systems, risks
Data may also be found in departmental QI information or patient satisfaction measurement systems. Systems from different areas have typically been planned independently to meet various functional needs. It is often a labor-intensive process to collect and collate this data for organizationwide reporting.

Currently, we are finding that outcomes measurement efforts focus primarily on claims data. In the future, outcomes measurement will go far beyond what is currently available in the financial systems. Outcomes data will expand to information collected in the clinical areas and departments of the organization. It will also span the continuum of patient care services and link multiple episodes of care. This ability to link episodes of care across the continuum of patient care services will be extremely important.

**Planning Questions.** The following questions should be asked in the development of outcomes data:

What data and information will principal buyers of health care services want now and across the next three to five years?
What measures will a hospital need to explore and implement to further internal process improvements, to reduce cost and improve quality? Can the data in question be tracked so as to produce meaningful results? Do the benefits of tracking the data outweigh the costs of tools to collect and analyze the data?

Addressing these types of issues up front in the planning phase will help the organization to successfully position itself for meeting both internal and external outcomes data requirements.

**Clinical Pathway Integration**

Clinical pathways are fast becoming a way of life in hospitals across the country. Clinical or critical pathways are generally drafted by multidisciplinary teams who are attempting to lay out an efficient and effective course of treatment for patients with similar diagnoses or procedures. Clinical pathways (and case management) in many organizations are key to the processes of planning, managing, and measuring patient care. At Emory University Hospital, the development of clinical pathways is a key tactic in our strategic planning process and direction. Figure 2 describes “The Learning Process of Care,” which supports the overall development process of our clinical pathways as well as the strategic planning process.

One of the initial tasks of our clinical pathway teams is to decide on the desired outcomes for the patients on their particular pathways. Early in the pathway development process, we set the stage for linking measurements.

**Figure 2. The Learning Process of Care**

<table>
<thead>
<tr>
<th>INPUT</th>
<th>PROCESS</th>
<th>OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards of Care</td>
<td>Patient Care</td>
<td>1. 0-Error Care Yes/No</td>
</tr>
<tr>
<td>Clinical Pathway</td>
<td>Interdependence</td>
<td>2. Valued Care Yes/No</td>
</tr>
<tr>
<td>The Change Process</td>
<td>The Change Process</td>
<td>3. Improvements Yes/No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Customer Satisfaction Yes/No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Interdependence Yes/No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measurement 3, 6, 12 Months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feedback</td>
</tr>
</tbody>
</table>

Consolidation

Meaning and Purpose

Information System Development
“The Learning Process of Care,” shown in figure 2, describes the process by which we attempt to continuously improve the quality and efficiency of patient care. This process is based on the use of the clinical pathways and the standards of care on which the pathways are based. Measurements are made at different frequencies:

- Variances from the path are recorded daily.
- Trends in variances, financial data, length of stay, and other outcomes are measured periodically.
- Staff perceptions regarding interdependence are measured periodically.

Figure 3 illustrates the variance summary report for the medical service of hip replacements. The information feedback loop is depicted in waves.

The first “wave” is comprised of the feedback given to the direct caregivers with a very rapid turnaround time. This is primarily the variance information, which they have been reporting daily. The teams have picked key milestones, which they feel most directly influence the desired outcomes. They need to see the results in a timely manner to determine if the overall process needs modification. Variance reporting and analysis is done based on key milestones along the path and on the desired outcomes at time of discharge.

The second “wave” of feedback is provided on a quarterly basis. This includes trended information comparing the previous three months with prior quarters. Included is the length of stay, patient volume, hospital cost, mortality, complications, and variance from the pathway.

The additional waves of feedback include a broader range of topics, which require longer time delays to obtain. This data includes results from patient satisfaction surveys, physician profiles, quality improvement activities, cost containment efforts and benchmarking data. These higher levels of feedback are provided to a larger audience including the administration, medical staff, marketing, and corporate development.

The review of all feedback provides the impetus for changing the processes, revising the pathways, and fine-tuning the measurement tools.

The level of sophistication we desire in collecting, analyzing, and disseminating this data mandates development of increasingly sophisticated information systems that integrate across the organization both horizontally and vertically.

### Information Systems Support of Outcomes Measurement

**The Complexity of the Situation.** In defining outcome measurements, a natural direction in today's health care environment is to look at how information systems support the process of collecting and collating outcomes data. Once specific outcomes data has been defined, questions like the following must be asked:
## Figure 3. Variance Summary Report Sample

### VARIANCE SUMMARY

**HIP REPLACEMENT**  
16-March-94

<table>
<thead>
<tr>
<th>Questions</th>
<th>Reason</th>
<th>Other Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRE-ADMISSION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Was the Physical Therapy consult done?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Yes</td>
<td>5 Consult was not scheduled</td>
<td></td>
</tr>
<tr>
<td>17 No</td>
<td>1 Pt did not show up for appointment</td>
<td></td>
</tr>
<tr>
<td>28 No Response</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |
| | | |
| <strong>POST-OP DAY 1</strong> | | |
| 2. Did pt stand at bedside on POST-OP DAY 1? | | |
| 40 Yes | 3 Pt complaints of pain | HCT Low |
| 16 No | 4 Pt complaints of nausea | Pt to start on 2/19/94 |
| 1 No Response | 1 Pt refusal for other reasons | SPAKA right side |
| | 2 Vital signs unstable | Accomplished 1 day late |
| | 0 Possible hip location | Dizziness |
| | 0 DVT(s) | Vertigo |
| | 0 Pulmonary Embolus | |
| | 6 Other | |</p>
<table>
<thead>
<tr>
<th>Questions</th>
<th>Reason</th>
<th>Other Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POST-OP DAY 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 Yes</td>
<td>0. Post-op ileus</td>
<td>Accomplished 1 day early</td>
</tr>
<tr>
<td>13 No</td>
<td></td>
<td>SPAKA right side</td>
</tr>
<tr>
<td>6 No Response</td>
<td>5. Other</td>
<td>NPO possible ileus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not requiring any analgesic</td>
</tr>
<tr>
<td><strong>POST-OP DAY 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Is put out of bed to bathroom and out of bed in chair for at least one meal on POST OP-DAY 3?</td>
<td>3. Pt complaints of pain</td>
<td>SPAKA right side</td>
</tr>
<tr>
<td>34 Yes</td>
<td>0. Pt complaints of nausea</td>
<td>Severe RA &amp; rec dislocated L THR</td>
</tr>
<tr>
<td>21 No</td>
<td>0. Pt refusal for other reasons</td>
<td>C/O SOB Inc. hip drainage</td>
</tr>
<tr>
<td>2 No Response</td>
<td>1. Orthostatic hypotension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0. Possible hip dislocation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Other</td>
<td></td>
</tr>
</tbody>
</table>
• What are the data elements required?
• Where does this data reside?
• Is the data residing in automated software or is it in hardcopy form?

System support of outcomes data collection and analysis activities can be very complex because the required data typically resides in multiple information systems and in manual systems (or paper format). A “typical” hospital’s information system can be described as twofold. The financial information systems are usually sophisticated and typically more developed along the vendor’s product life cycle. The other side of the house is the clinical information system.

Generally speaking, the truly integrated clinical information system is still under development. Software vendors are at various stages of delivering such a product. Some niche clinical systems are very sophisticated such as lab, radiology, and pharmacy. The integrated patient-oriented systems are still in development or have not achieved full integration with the complete scope of required clinical and financial information systems. Not only are specific feature and functionality requirements important in these systems, but there are other critical issues to address, including system performance, system standards, data integration/integrity, system interfaces, and networking. Many current efforts and new technologies will support the successful integration of clinical information systems. Some examples include open system architecture, data standards (HL7), networking standards, interface engines, inference engines (for enhanced expert systems), multimedia data entry options, fiber and multimedia-supported networks, expanding data storage options, and distributed—but linked—data warehouses, to name a few.

Regardless of current information technology development activity, health care organizations must start providing information required to support their business processes. The true impact of collecting outcomes data is not completely known partly because the field of outcomes measurement is still uncharted territory. We do know that outcomes measurement activities present new and additional data requirements as well as data manipulation and analysis requirements. This development stage of outcomes measurement creates a significant impact from a system perspective. Some data may be available on automated systems; however, in many instances, the data is not available on a system at all. In fact, the data may not be collected at all.

To start addressing the process of collecting outcomes data, organizations are looking to their functional areas or departments as sources of the data. A breakdown of data sources and corresponding system support by functional area can look very disparate. As the following list indicates, there is still disparity of information systems support for outcomes data.

Case management: HIS systems; niche systems; independent database development with manual/paper base forms
QA: HIS systems; niche systems; independent database development with manual/paper process
Infection control: Niche systems; independent database development with manual/paper process
Patient satisfaction: Outsource; niche systems
Patient health outcomes: Niche systems; independent database development with manual/paper process
Financials: HIS systems; niche systems; ESI/DSS systems
Managed care: HIS systems; niche systems; independent database development.

The data source for patient health outcomes surveys is an example of a nontraditional data source requiring data integration and data analysis with other pieces of clinical and financially significant data that have not been present in the past. These nontraditional and new data requirements will support the development of future automated systems by vendors.

Since the complexity of the environment will only increase, information systems must be aligned in a manner to support the institution's efforts in achieving its business strategy and direction. Just as the organization's direction should support outcomes measurement, the organization's information systems business plan should also include a strategy and tactics for supporting outcomes measurement.

Systems support of outcomes measurement. The information systems business strategy must address supporting outcomes measurement since this activity is a business objective of the organization and cuts both horizontally and vertically within the organization. This strategy should clearly demonstrate the process for defining how outcomes measurement activity is supported.

There is not one perfect solution for defining system support of an organization's business objective, but there are effective steps that can be taken that will reach a successful end result. This process requires setting up relationships and trust between areas that may have been at odds with each other in the past. The partnership's goal should be based on the common goal of finding system solutions that are based on the organization's and functional area's business requirements. Out of this process, both short-term tactical activities and long-term solutions can be identified that maximize information systems support and effectiveness.

A process for identifying systems requirements includes the following steps:

Evaluate the institution's mission, vision, business objectives, strategic goals and tactics
Identify data requirements that support the institution's directions
Identify current sources of information: software applications, manual process with paper
Evaluate information systems' current status in terms of source systems, report generation tools, data integration, network/hardware, user accessibility, user
friendliness, user acceptability/perceived benefits, security
Link information systems plans to the business plans and strategic goals and tactics
Identify gaps between current information systems and information systems required to support business plans.

This type of process avoids placing the organization or the Information Systems Department in precarious situations. It supports the development of a partnership situation with the goal of finding solutions based on the organization's business requirements. The first systemwide analysis of information can be alarming, however. Following are some examples that we first found in our organization:

Automated information access limited to department “islands”; little to no cross-functional view of patient information
Enterprisewide information access untimely
Unnecessary data redundancy leading to inconsistencies between patient care information systems and paper hard copies.

From the process outlined above for identifying systems requirements, both short-term tactics and long-term goals for information systems can be identified that support the organization's overall business objectives. These tactics and goals are specific to the organization and the business objectives.

**Long-Term Objectives and Short-Term Tactics.** Utilizing a combination of options supports the organization's achievement of its objectives and does not put information systems in a precarious situation. Again, the business requirements should be the driving force in these types of decision. Sometimes the actual deliverables agreed upon to support the short-term tactics and long-term goals may be a direct reflection of the software vendor market. For example, it may be a business decision to opt for a short-term solution of developing a stand-alone small database and wait until vendors release a product that supports the particular need. This economic solution may also prove to help the end users discover more about the type of automation that best suits their requirements. What is learned from the tactical activity can be used when defining system requirements for future system selections.

Examples of both long-term objectives and short-term tactical activities that can be selected for implementation include

Long-term objective activities: source systems new installations; source system replacements; new technology implementation; technology upgrade; data repositories; data warehouses
Short-term tactics and activities: database development; pilot “self developed” applications; pilot PC solution applications.
At Emory University Hospital, we are using a combination of options with the goal of supporting the organization's strategic business objectives and end user requirements. The current clinical information systems are under evaluation for replacement needs. Some clinical systems, such as critical care, lab, and radiology, are relatively current systems while others are older. Also, there are many clinical areas without automation. A combined administrative and clinical team is supporting efforts in identifying functional area system needs and prioritization of these needs based on the organization's business objectives. These results will be used in the annual budgetary process.

Case management is an example of opting for the development of a stand-alone database as a short-term solution in providing clinical information that supports continued development of the case management process and outcomes measurement. This database is used for collecting the actual variance information, evaluating patient outcomes, and reviewing the effectiveness of the treatment protocols and clinical pathways.

Another example of a small database project is a quality database that is currently under consideration. This would be a short-term tactical business decision supporting a relatively small database repository for quality assurance, utilization review, and infection control requirements. The key aspect of this tactic is to ensure that the data collected will be “open” in order to combine with other data sources for cross-functional data analysis as well as merge with a long-term system solution in the future.

An example of a data repository at Emory is the Clinical Data Repository (CDR). The CDR actually spans across two hospitals and multiple outpatient clinics. A major goal is to provide data and corresponding presentation views that support clinical decision making, thereby exerting an immediate impact on patient outcomes. Functionality of this application must provide views that make “clinical sense” and support the decision-making process at the time of patient treatment. This is a long-term project, which is very dynamic in development.

The CDR supports

- On-line/real time clinical data from a variety of source systems
- Aggregate and longitudinal data views
- Presentation views that make “clinical sense.”

Data warehouses, and linking them, may prove to be the alternative that makes business sense to support outcomes analysis. Potential ways that warehouses can support outcomes measurements include the following:

- Analysis across all defined outcome types
- Clinical trials and research trials
- Evaluation for effectiveness of treatment protocols, best of practice, and care maps against actual patient care activities and outcomes
• Evaluation for effectiveness of service delivery processes such as TQM/CQI activities
• Support for research in wellness and prevention
• Longitudinal view of data across all episodes of care supporting the continuum of all patient care services.

The warehouse concept is implemented as a repository of data from specifically identified source systems. A report writer tool is overlaid on the warehouse so that end users can access the warehouse for decision support type of retrospective reporting and data analysis activities.

With “data warehouses” becoming another buzz word, there are debates in some circles as to whether the warehouses are more of a trendy fad than a real solution option. The effort of implementing a data warehouse should not be taken lightly. A number of issues must be addressed to ensure success of an implementation. The following were identified when implementing a data warehouse at Emory:

• The warehouse should be business driven, that is, it should contain logical groups of data and make business sense.
• Data collection/source systems must be addressed.
• Data security must be addressed.
• Architectural issues include open systems and relational database.
• Data elements defined in terms of uniformity/integrity.
• Queries and tools: on-line and reporting.
• Export capabilities.
• Linking data from multiple databases.
• Data accessibility.
• User friendly/demonstrated benefits.

We learned that there cannot be any short cuts taken to reach a successful implementation. A data warehouse should be business driven; i.e., it should contain logical groupings of data that make “business sense” or the users may not find it supporting their requirements and will not fully utilize the warehouse. Also, the ability to link the disparate databases will be essential. Examples of warehouses may include

• Financial
• Clinical
• Patient surveys (health status, satisfaction, etc.)
• Marketing
• Managed care related.

Data source systems. The data source systems must be clearly defined as should the process for populating the warehouse. The process should be frequently reviewed for efficiency and effectiveness.
Security. With multiple users having access to data on a large scale, the security process is key. A process must be identified, implemented, and maintained to ensure proper security of the data.

Data elements. The individual data elements populating the warehouse must be clearly defined and steps taken to ensure ongoing data consistency, data uniformity, and data integrity.

Support. Research must be conducted to identify the most appropriate system technology and system tools. This is especially important when evaluating long-term support issues. Consideration is essential in looking at open system architecture and relational database technology.

Query tools. The tools selected for the user to query against the warehouse must be user friendly and intuitive. Training issues must be considered as a cost of implementing the query tool. If it is not simple and friendly, the query tool will not be used.

**Future Directions**

Future direction in the development of information systems must support efforts such as the following:

Support outcomes measurement by “covered lives” based on managed care contracts
Support outcomes measurement across the continuum of all types of patient care services
Support the coordination of services across the continuum of patient care under the direction and guidance of managed care contracts and business partners
Support data comparison between providers, including hospitals, hospital systems, as well as physicians and other clinicians
Support data on an enterprise-wide level as well as from the level of a community health information network.

**Update of Activities**

Since the first draft of this paper, several activities have been initiated that are noteworthy.

A Patient Documentation Committee has been established with the purpose of developing a plan to migrate to “charting by exception” with integration of the clinical pathways. The committee is multidisciplinary, representing clinicians, physicians, as well as medical records. A key charge of this committee is the design and integration of a collection process incorporating outcomes data with the patient documentation system.

A Clinical Pathways Outcomes Team has been formed with the following charge:

Define the outcomes to monitor in conjunction with clinical pathways.
Design a plan for monitoring these outcomes based on prioritization of need. Develop a reporting mechanism or processes for providing expeditious feedback to the appropriate groups.

The committee members represent a wide variety of areas, including clinical pathways, medical records, radiology, quality and performance improvement, utilization management, management systems, pharmacy, information services, and infection control.

These type of activities support the hospital in defining how outcomes data will be integrated in the future activities of patient care delivery.

**About the Authors**

Pam Matthews, RN, is director of clinical services, Piedmont Medical Care Foundation, Atlanta, GA. She was previously senior clinical business analyst, information systems, Emory University System of Health Care, Atlanta.

Nancy Carter, RN, is director of utilization management, Emory University Hospital, Atlanta.

Kathryn Smith is director of management systems, Emory University Hospital, Atlanta.