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BC Patient Safety & Quality Council provides system-wide leadership that brings a provincial perspective to patient safety and quality improvement activities. Through collaborative partnerships with health authorities and other healthcare providers, BCPSQC promotes and informs a provincially coordinated, patient-centred approach to patient safety and quality improvement.

Recommended Citation Format
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**Introduction**

Measurement is fundamental in order to understand and improve quality of care. Healthcare organizations already collect a plethora of information on performance and quality. Transformative advances in healthcare will require a greater understanding of how to use the information in a systematic, robust manner to inform and improve quality.

The purpose of this report is to provide a summary of how measurement systems are designed and used to advance the quality of healthcare. The information is intended to be used by those working within the health system to help inform their own quality measurement systems. Information includes best practices for selection of indicators, displaying and analyzing data, and using data to drive improvement at different levels of an organization.

This report is based upon a review of quality improvement literature, an examination of measurement practices utilized by high performing organizations, and consultation with experts in healthcare measurement.
Indicators and Measures:
The terms indicators, measures, and performance measures are often used interchangeably, although some have suggested more precise meanings for each.

Quality indicators and quality measures both refer to quantitative measures used to describe a particular healthcare process or outcome; or structures that impact patient outcomes.1 In this definition, indicators and measures are used to assess the quality of care, as described in the Donabedian’s classic paradigm2 and are used interchangeably. This is the terminology followed throughout this report.

Indicators can also be thought of as tools, screens, or flags that describe quality of care and indicate areas where further attention to quality improvement or measurement may be warranted.3,4 Using this terminology, an indicator may be a proxy for a measure if a precise quantification of the underlying concept is not possible.

Performance measures are described as measures of healthcare processes, patient outcomes, patient perceptions of care, and organization systems and structures associated with the ability to provide high quality care. Performance measures encompass those measures used for public reporting, monitoring and improving quality, and pay for performance strategies.5 In all these contexts, the use of the term performance measure implies that measures are being assessed against some standard, criteria or objective (for example, to assess how well an organization is meeting objectives).

Standardized performance measures have detailed definitions and sampling strategies and allow for valid comparisons across groups, sometimes requiring use of risk adjustment.5

Report Card:
A summary to evaluate healthcare services on a number of key indicators, often produced by a group external to the organization. Report cards often use signals (e.g. red, yellow, green) to display performance. Typically refers to hospital report cards, with comparisons between hospitals, intended for decision-makers and the public.6

Balanced Scorecard:
A single management report bringing together elements of an organization’s strategic agenda, focusing on a small number of indicators that indicate progress towards goals or overall performance of the organization.7

Benchmark:
The best result previously achieved (by an organization, department, provider group, etc.).8 A benchmark can be used, along with other comparative data, to help interpret performance and set improvement goals. One or more benchmarks can be identified and used to set targets for performance in an organization or system.
Dashboard:
A performance measurement system using real-time data to enable decision making. A dashboard is more dynamic than a traditional scorecard which is fixed in time.9

Real-time Data:
Denotes information that is used to continuously monitor quality by displaying and analyzing measures as events occur. There is no delay in the timeliness of the information provided.9

Whole System Measures:
A balanced set of system measures (not disease or condition specific) to evaluate performance on quality and value, and serve as inputs to strategic quality improvement planning.10 (See page 12 for more information.)

Composite Index:
A mathematical combination of several indicators to form a single number.11 The term composite index is used throughout this paper instead of composite indicator or measure which can be taken to mean an all-or-none measurement strategy (for example, a composite measure for VTE prophylaxis is often defined as the percent of patients who received all known best practice elements for VTE prophylaxis). (See page 9.)

Macro, Meso, Micro Levels:
Several measurement frameworks refer to these three levels in a healthcare system.9 The micro-level refers to the point where the system interacts with the patient, i.e. the unit or practice that provides care. The meso-level of an organization is responsible for cross-cutting units and departments providing care for a similar group of patients. For example, the Department of Surgery would be considered a meso-level. A macro-level is the highest level of the system, an umbrella where all intersecting units, departments, providers and staff fit under. In the BC healthcare system, an organization or the health authority can both be thought of as macro-levels.

Statistical Process Control (SPC):
SPC is both a strategy and a collection of methods, based on theories of variation, designed for improvement of systems, processes and outcomes.12 Run charts and control charts (also called Shewhart charts) are two tools used in SPC to understand variation in data and to analyze improvement and performance.
There have been many developments in the measurement of the quality of healthcare over the last two decades. Most healthcare systems now organize their performance metrics under the framework of a balanced scorecard, an approach advocating the inclusion of quality and organizational indicators alongside financial indicators to understand the performance of an organization.7 Typical categories for organizing healthcare scorecards are: financial performance; operational efficiency; quality measures; and satisfaction measures.13 A key aspect of the balanced scorecard is that it should allow a leader, at any point in time, to understand the organization’s progress towards strategic goals, and whether new processes or changes are resulting in improvement.

To optimize use of the scorecard, it should be disseminated throughout the entire organization. High level indicators seen at the senior executive or governance level should be translated into unit level components that feed the high level measure, so that all units and employees understand how their local results impact the overall measures given to the senior leaders or the public.14

A strategic dashboard is an extension of the balanced scorecard approach. The dashboard approach implies the use of real-time data to understand performance. A dashboard is a way to summarize a complex system into an overall set of indicators. The term strategic dashboard implies that the choice of indicators are mapped to the strategic vision of the organization. What the organization measures, and what the organization is trying to improve, should be aligned.8 A dashboard is especially helpful in complex healthcare systems which integrate many sectors (for example, acute care, primary care, care in the community) as the dashboard can provide a summarized but comprehensive look at the entire system.13

A dashboard should contain the “vital few” measures that the organization regularly relies on for a picture of performance. This is analogous to the dashboard of a car, where the fuel and speed gauges are the measures most used. Each measure should add value. As a general rule, having more than 15 indicators in a “set” may not add valuable information.8,15 A set can be the entire dashboard given to the Board, or can be a set for a specific dimension of quality, i.e. patient safety, reported to leaders specifically interested in safety.

Indicators should show a balanced view of the organization so one can readily determine performance of the system as a whole, and determine if performance in one category occurs at the expense of another. In this way, the dashboard approach is similar to a balanced scorecard.14

Dashboards should reflect real-time data, as opposed to historical performance data often seen in hospital report cards. The data should tell the organization how they are currently performing, in order to prompt decisions and enable actions to address issues as required.8,15

Measures should not be carved in stone. Sets of measures, whether on a dashboard or balanced scorecard, need to be revisited and modified as necessary to reflect current priorities.8 Organizations should revisit measures often and consider dropping those that no longer reflect current priority areas.

Dashboards should present information in a simple graphic display to the top levels of the organization, with the capability to drill down to disaggregated levels of the organization.8

Development of the dashboard should involve multiple levels of the organization, as described in the following framework for a dashboard design team16:

- Governance boards should have input to the design to ensure the organization’s values are represented;
- The CEO may lead the design of the dashboard and ensure the indicators are measuring progress on the organization’s strategic goals;
- The senior administrators’ roles are to ensure the measures chosen reflect the reality of their departments;
- Quality and performance leaders need to ensure the information is reflective of the current performance and trends in the system;
- Medical and clinical leaders should ensure the view given by the dashboard centres around the patient, and that it crosses care boundaries; and
- Ultimately, the leaders of an organization need to use the information to monitor progress toward the strategic plan and need to recognize their accountability for performance.

To optimize use of the scorecard, it should be disseminated throughout the entire organization.
Consensus building and brainstorming techniques, with clinicians and front-line staff can also be helpful in deciding on dashboard indicators.8

SETTING TARGETS
Benchmarking is an important process in using data to set improvement goals or targets. In order for indicator data to be meaningful at senior levels, the data should be used to interpret performance and make comparisons to other organizations. However, benchmarking involves more than just setting a numerical target. A benchmark is the top result from one organization. To truly capitalize on benchmarking, you need to identify and understand the best practices and processes of the organization that enabled them to achieve top results.8

One or more benchmarks can be identified and used to set short- or long-term targets for performance in an organization or system. Targets should be set for performance; however, they need to be based on the organization’s historical data and performance, or based on another organization with similar structure and resources. Setting arbitrary or unachievable targets can be demoralizing to staff.8

DISPLAY OF DATA OVER TIME AND STATISTICAL PROCESS CONTROL (SPC)
The term statistical process control (SPC) refers to a set of methods used to analyze data, based on an understanding of variation. SPC methods have gained acceptance as standard techniques for monitoring healthcare quality, and are widely used by organizations such as the Institute for Healthcare Measurement Strategies for Improving the Quality of Care: A Review of Best Practice | 5

Statistical Process Control: Definition of Terms

**Theory of Variation:** Variation simply means that fluctuation exists in everything that is produced. Using statistics to better understand and explain fluctuations is key to interpreting data, and to understand how to improve it.

**Common Cause Variation:** Random variation that will be inherent in any data that is measured over time. Common cause variation is demonstrated by data points that move up or down within predictable limits, and is not due to any specific cause or change. With common cause variation, there is no evidence that a change has been effective. Without proper analysis, common cause variation is often misinterpreted as being significant in nature.

**Special Cause Variation:** Variation that is the result of a change in the system. During improvement efforts, special cause variation provides evidence that the effort has been effective. Special cause variation can also indicate that performance on the measure is worsening.

**Process Stability and Statistical Control:** A set of data that shows only common cause variation is considered to be stable. Another way to say this is that the process is in statistical control.

**Run Chart:** A run chart is one type of Statistical Process Control tool. It is a running record of measures over time (with units of time along the horizontal ‘x’ axis and units of the measure along the vertical ‘y’ axis). Data is displayed over time and can be analyzed for evidence of change.

**Control Chart:** A control chart is similar to a run chart, however, it is a more complex tool and is better able to show evidence of change in a system. Like a run chart, data is usually displayed over time. The control chart adds an upper and lower line on the chart, called control limits, which aid in analyzing the type of variation in the chart, and determining evidence of change.

**Control Limits:** Control limits are upper and lower lines on a control chart, which are calculated from the data on the chart, and show the range where future data points will lie, if there is no change to the system. The control limits are used in analyzing the control chart. Different types of control limits are calculated, depending on the type of data that is entered into the chart.

**Process Capability:** Process capability refers to the use of control charts to predict what future performance will be, given the past data entered into the control chart.
Measurement Strategies for Improving the Quality of Care: A Review of Best Practice

Improvement (IHI) and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). The use of SPC is preceded by many industries outside of healthcare, such as manufacturing, which have long used SPC methods to improve their processes and to report key measures of performance.12,17

Advantages of SPC

One of the key advantages for using SPC to analyze indicator data is that it provides an accurate understanding of when measures are truly showing improvement, or conversely, showing signs of worsening performance. In many instances, data that is measured over time will show natural fluctuations, in fact, variation theory states that there is always a certain level of fluctuation in any data that is measured over time. Reacting to this variation as a sign of improvement, or a signal that the system if not meeting targets, may be erroneous without applying the appropriate tests of statistical process control. To determine true change based on process improvements, and to determine if the impact is sustained over time, statistical process control (SPC) is the preferred method of analysis.8,12

Statistical Process Control methods produce information about a change in the system that traditional before-and-after statistics (e.g., pre- and post-test) do not. Because improvement data is measured over time, the measure is based on a ‘single stream of data’. The approach to determining significant change is to determine if there is uncharacteristic, or “special cause” variation in the stream. Traditional statistics (for example t-tests) are not appropriate, as they are meant to determine if significant differences exist between two groups or streams.13

An additional benefit is that even small samples of data can produce meaningful information because the amount of data increases over time.17

SPC Tools and Applications

The following are some of the basic SPC tools and applications used in quality improvement in healthcare.

The run chart, the simplest and most intuitive tool of SPC, is a graphical display of several data points plotted in order (usually in the order of time). An annotated run chart provides descriptive information about events that may have occurred, written right on the graph. (Figure 1.)

Through visual inspection, patterns in the data can become apparent, but may not show evidence of true change. Using a set of predefined run chart rules, tests can be applied to analyze the data (for example, to test for evidence of improvement). Run chart analysis applies rules of probability to determine if there is any evidence of improvement. For example, the probability of five points all going up or down in a process that didn’t have any true change is very low (this is one of the run chart rules).17,18

Analysis of run charts requires basic knowledge of how they are constructed and some education about how to apply run chart rules to determine significant change. Basic instruction is provided in various texts on quality improvement and indicators.8,12

Control charts are similar to run charts, but are more sensitive to change and therefore more powerful in detecting evidence of...
improvement. Calculated control limits are used to understand the variation in a process. Control limits provide tests of whether there is special cause variation in the data (perhaps as a result of improvement efforts or alternately a signal that performance is deteriorating). The control chart in Figure 2 shows the upper and lower control lines and shows evidence of special cause variation (in this example, variation is illustrated by: (i) data points outside the lower control limit, and (ii) more than seven data points above the mean). Control limits are similar to confidence intervals in traditional statistics, but are specific to the variability of a process. Analysis of control charts is based on the probability of the data point occurring outside +/- 3 sigma limits (outside the upper or lower control limit), or several data points occurring outside 1 or 2 sigma limits from the mean. Explanation of rules for interpreting control charts can be found in various quality improvement and SPC sources.

Control charts can also be used to test the capability of a process or a system, to help senior leaders determine whether performance targets are being met. Often, summary statistics (such as an average of performance over the last quarter) are reported on dashboards or through other reports to senior leaders; however, this approach does not provide a true picture unless the data is first stable (no special cause variation). Using Figure 3 as an example, the process is stable (no special cause variation) and therefore it is probable that the length of stay will continue to fall somewhere between the upper and lower control limits (between 2 and 12). In this way, leaders can use the data to determine if it meets their performance targets.

More advanced applications of statistical process control enable users to determine and test possible causes of variation in the data. For example, by separating data on the control chart into subgroups such as day and night shift, the data can be analyzed to determine if there are significant differences between the two groups. These analyses are especially helpful in determining areas to target for improvement.

RELATIONSHIP BETWEEN PERFORMANCE MEASUREMENT AND DATA COLLECTED FOR IMPROVEMENT

While performance measures chosen for a dashboard may differ from those measures utilized by front-line teams to improve care, the data sources are often the same and the measures should be related. Measurement has different purposes at different levels and depending on the purpose, may be displayed and analyzed differently. Statistical Process Control (SPC) can aid in understanding the data at every level.

For front-line improvement (micro-level), data can be used for complementary purposes. When working on an improvement effort, data should be used to help identify potential sources of problems and potential solutions. Data can be collected to obtain staff or patient input, for example through a survey, to measure how often a perceived problem is occurring and to determine when and where a problem occurs. Pareto charts are a SPC tool often used to analyze reasons for an occurrence (e.g., causes of readmission). Run charts can also be helpful in looking for emerging patterns in data.

Improvement experts have found that when a system is not stable, it is very difficult to improve. Data can show whether or not a system is stable. As an example, if emergency wait times were measured and showed great fluctuation of the data, with

**Figure 2. Example of a Control Chart**

![Figure 2. Example of a Control Chart](image)

Numerous special causes are present


**Figure 3. Stable Process (no special cause variation)**

![Figure 3. Stable Process (no special cause variation)](image)
no predictable pattern, it will be difficult for improvement efforts to succeed. Analyzing the data with a run chart or control chart will help determine whether the process is stable. In this example, improvement teams can work to reduce the fluctuations first, and then focus on reducing the wait times.

A key part of the improvement process is using data to monitor whether an improvement effort is affecting performance and whether a change is being sustained. When analyzing data to determine whether an improvement effort has resulted in a significant change, run charts or control charts should be used.

Similar measures and methods can also be used at the meso level (mid-level leadership crossing departments or units) to monitor effects of improvement strategies. Some of the key measures identified by local improvement teams may be used for monitoring; however, data may not be collected or reported as frequently as during the improvement phase. SPC methods can provide evidence of whether performance measures are improving, or whether new initiatives should be implemented.

At a senior leader or governance level, measures are usually produced for accountability purposes and data is often compared to a performance target. Displaying data over time produces a comprehensive and accurate picture of the performance and how it compares to a target. Capability analysis (as described on page 7) uses upper and lower limits on a control chart to show the range of where future performance is likely to be. The limits are calculated from the past and current data on the control chart, and help leaders understand where the data is likely to be in the future. In this way, leaders can accurately say that their system is, or is not, at an acceptable level of performance.

The macro level indicators on a senior leader dashboard are often referred to as “big dots”. These indicators are impacted by other measures or driving factors (micro and meso level indicators). Ideally, within a healthcare organization, measures from each level should be linked to enable front-line staff to understand how the indicators they report impact the macro level indicators that are reviewed by senior leaders and governance. The approach to outlining these relationships is known as a cascade of measures. An example of cascading measures is provided in Figure 4.

**VISUAL DISPLAY**

With a large number of measures, the display of the information becomes very important. Summary information provided on one page is a good way to get a visual understanding of the performance of several related indicators.

Use of “traffic light” or other visual information may be useful for board reports, but drill down capability is important. The user should be able to drill down to see the underlying chart or numbers. This is the approach used by Kaiser Permanente (KP) in their “Big Q” measurement system, an online and interactive tool.

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**Figure 4. Cascade of Measures Example**

| % of patients with antibiotics received 1 hour before surgery (MICRO) |
| % of surgical teams using the surgical checklist (MESO) |
| SSI Infection Rate (MACRO) |
| Complication Rate (MACRO) |
that allows providers at all levels of the organization to drill down from the big dots, compare by geographical or other comparison areas, and assess against benchmarks and targets. KP uses composite indices, with the ability to drill down and display subscales.\textsuperscript{19}

Small multiples or multi-charting shows small versions of related run charts on a single page to provide a summary glance of information.\textsuperscript{18,20} Figures 5 and 6 provide examples on how to display comprehensive information on a project or on related dashboard indicators.

Sparklines show the run chart, direction of trend, last value and minimum and maximum values all on one chart. They are useful to produce an abundance of information on a single page (Figure 7).

Another one page template is shown in Figure 8 depicting a dashboard report, with 16 indicators reflecting the organization's six strategic objectives, all on a single page.

**COMPOSITE INDICES**

Composite indices are appealing at a senior leadership level as they provide a quick summary glance of the overall performance of a healthcare system; however, there are complexities and limitations to note.

The Manitoba Centre for Health Policy undertook a literature review and investigation of the potential use of composite indices for Manitoba's health system.\textsuperscript{11} Composite indices were developed in four areas: prevention and screening, healthy behaviours, surgical wait times, and health status. They attempted to create quality of care composites to measure the

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**Figure 5. Small multiples: multiple run charts showing progress on four priority areas**

This is an example of a balanced set of measures, based on the BC Health Quality Matrix.\textsuperscript{21} These four measures contribute to an assessment of Accessibility, one of the Dimensions of Quality, and reflect each Area of Care, as outlined in the Matrix.

**STRATEGIC DASHBOARD**

<table>
<thead>
<tr>
<th>Priority Areas for Accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staying Healthy</strong></td>
</tr>
<tr>
<td>Median Wait Time for Routine Appointment with Family Physician (Days)</td>
</tr>
<tr>
<td>Living with Illness or Disability</td>
</tr>
</tbody>
</table>

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Surgical Site Infection: Process and Outcome Measures for Surgical Site Infection

Outcome: Clean Surgery Patients with Surgical Infection

Maximizing the amount of information with “Sparklines”

<table>
<thead>
<tr>
<th>Perinatal Measures</th>
<th>Site A</th>
<th>Site B</th>
<th>Site C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant women in last 12 months with comprehensive dentist exam completed while pregnant</td>
<td>97 [89</td>
<td>98]</td>
<td>56 [0</td>
</tr>
<tr>
<td>Pregnant women in registry in last 12 months</td>
<td>85 [18</td>
<td>85]</td>
<td>90 [26</td>
</tr>
<tr>
<td>Pregnant women with completed Phase 1 dental treatment plan within 6 months of exam (12 months)</td>
<td>93 [70</td>
<td>93]</td>
<td>32 [11</td>
</tr>
<tr>
<td>Pregnant women with comprehensive oral health exam while pregnant (12 months)</td>
<td>111 [12</td>
<td>111]</td>
<td>50 [7</td>
</tr>
<tr>
<td>Pregnant women with SMGS in last 12 months</td>
<td>nt92 [92</td>
<td>99]</td>
<td>47 [0</td>
</tr>
<tr>
<td>Pregnant women in registry (12 months)</td>
<td>85 [18</td>
<td>85]</td>
<td>90 [26</td>
</tr>
</tbody>
</table>

Run chart of series values

Name of the measure

Upward trend

Last value

implementation of best practice; however, the attempts were not successful as the concepts did not statistically perform as an index. They identified numerous concerns in the composite index approach including: feasibility in using the indices over time; the inability to determine which areas of the composite may need improvement; and the lack of understanding of composites by end-users. They conclude that the effort to construct and validate composite indices is not worth the value, given these limitations.

Indices are common in other industries (e.g., financial markets); however, the difference in healthcare is that quality measures do not use a common unit of measurement, and therefore construction of the index can be complex. Statistically, the variation that is seen in the drill-down measures often gets hidden in the composite (regression to the mean), and therefore it is likely that improvement at the level of individual measures may get masked in the composite index.20

<table>
<thead>
<tr>
<th>Indicator Sets</th>
<th>Baseline Period</th>
<th>Baseline Data</th>
<th>Current Period</th>
<th>Current Data</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Health</strong></td>
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<td>Spiritual Care</td>
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<td>Community Benefit Ratio</td>
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<tr>
<td>Clinical Integration (out-of-network referrals)</td>
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<td>Operating Margin</td>
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<td>Debt/Capitalization Ratio</td>
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<td><strong>Service Breakthrough</strong></td>
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<td>Overall Patient Satisfaction Percentile</td>
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<td>Willing to Recommend Percentile</td>
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<td><strong>Work Life Quality</strong></td>
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<td>Associate Satisfaction Percentile</td>
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<td><strong>Clinical Excellence</strong></td>
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<td>Clinical Quality Index</td>
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<td>Research and CME Performance</td>
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<td>Graduate Medical Education Performance</td>
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<td>Cost Per Adjusted Discharge</td>
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<td><strong>Technology Leadership</strong></td>
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<td>% Aligned Physicians Electronically Linked to Advocate</td>
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<td><strong>Innovative Growth</strong></td>
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<td>Net Ambulatory Revenue as % of Total Net Revenue</td>
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<tr>
<td>Inpatient Market Share</td>
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<tr>
<td>Covered Lives Market Share</td>
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</table>

Source: Adapted from Lloyd R, 2009. Used with permission.
The use of quality indicators in healthcare is an expanding and evolving area. The Institute of Medicine and the Institute for Healthcare Improvement are two organizations that have advanced the body of knowledge, by describing measurement frameworks that capture a comprehensive view of the system.

**Institute of Medicine:** The IOM, in its seminal report, “Performance Measurement: Accelerating Improvement,” advocates for a national system for reporting on the performance of the healthcare system. The committee made the following recommendations to improve upon measurement systems:

- The need for indicators reflecting domains of efficiency, equity and patient-centred care and a broadening of the scope of current indicator sets to include these areas.
- The need for measures to assess care provided over a longer time frame and across providers and settings. For example, measures of the quality of transitions from one setting to another, and measures of patients’ outcomes over time.
- A move towards system-level measures that assess the overall performance of an organization across conditions or service lines.
- Addressing the nature of shared accountability. Currently, measures tend to focus on areas where one provider or organization can be held accountable, ignoring the complexity of many types of care (e.g. treatment of chronic conditions). Measures in such areas still need to be collected and reported, even when there is no one obvious point of action, because if they are unmeasured, the quality will never be addressed.

**Institute for Healthcare Improvement:** The IHI has developed a set of core measures to be used, or adapted, by healthcare systems to reflect the performance of care provided in different sites and across the continuum of care. These Whole System Measures are meant to contribute to an organization’s balanced scorecard or dashboard. Measures at this level are considered “big dots” and as such, should be fewest in number compared to other levels of the organization, and should be the set reviewed at the highest level of the organization. The IHI emphasizes four central premises for the design of system measures:

- show performance over time;
- allow the organization to track performance relative to its strategic plans for improvement;
- allow comparisons to similar organizations; and
- serve as inputs for strategic quality improvement planning.

The Whole System Measures are aligned with the six dimensions of quality identified by the Institute of Medicine, and reflect a continuum of care (Figure 9).

IHI stresses that this initial set should be modified to reflect one’s own strategic goals, and should be dynamic, that is, indicators should be added and removed as an organization’s strategic plan evolves. Further, the system measures should complement more specific measures that are being captured at different levels of the organization, so that “small” dots measured at the micro- or meso-system flow from the big dots. (Refer back to page 3 for an explanation of micro-, meso-, macro-systems). If best results are not achieved on system-level measures, it is a signal to drill down to the results of the corresponding micro-level and meso-level indicators.

For targets, IHI set performance goals for each of the Whole System Measures, meant to be ambitious goals that would represent breakthrough performance. The goals were based on best known performers, top decile performers from national datasets or, where applicable, best practices seen in other industries.
Figure 9. View of a Health System Using Whole System Measures from IHI

Examination of the Role of Measurement in Quality Improvement and System Transformation

One of the core components of a high-performing healthcare organization is the use of a comprehensive measurement system to drive change. In this section, the measurement philosophies and structures of several organizations are explored.

Intermountain Healthcare, Utah

The design of Intermountain Healthcare’s data system is integral to their quality improvement and management approach. As a foundation to the system, Intermountain staff and clinicians give considerable attention to outlining an explicit conceptual model for their work processes. The conceptual model has two components, both of which are used in the subsequent development of measures to be tracked over time.

This first is a conceptual flow diagram, based on the best and most current understanding of the clinical condition and delivery of care for the specific process being examined. The model outlines how clinicians and staff see and organize their work, and helps to outline how work processes fit together. The flow diagram starts with a simple flowchart or process map, and is iteratively expanded in detail until it reaches the level of a decision flowsheet (Figure 10).

From the conceptual flow diagram, key process factors are identified and used to measure variation in care processes (i.e. for any given care process, a process defect can be calculated, defined as the percent of patients for whom an evidence-based key process was not performed). Key process factors are those that determine patient outcomes.

The second component is an outcomes chain that is identified for each process, similar to a cascade of measures used by other organizations. The outcomes chain is a hierarchical structure starting with a final outcome, impacted by a series of intermediate outcomes or process steps, and finally down the front-line level, where decisions are made. This level represents areas where change is possible, as illustrated in Figure 11.

An outcome tracking system is developed from the outcomes chain – a set of outcomes and process steps that are tracked at regular intervals (e.g. monthly or quarterly) over time.

Outcomes are classified along the following dimensions (similar to the quality dimensions in the BC Health Quality Matrix):21

- **Medical Outcomes:**
  - Complications (process failures or defects)
  - Therapeutic goals and biologic function
  - Patient’s ability to function, as reported by the patient

- **Service Outcomes**
  - Clinical-patient relationship (e.g. attentiveness, shared decision making, respect, information transfer)
  - Convenience (e.g. scheduling, wait times)

- **Cost Outcomes**
  - Expenditures associated with the care process

Appropriateness is also measured as an outcome, with referral and treatment indications being tracked to determine the appropriateness of an intervention with respect to adherence to evidence based or professional consensus indications.

Measures from the outcome tracking system are routinely monitored for several purposes:
- to identify improvement priorities;
- to monitor trends;
- to understand standings compared to peers and other standards; and
- to track the overall success of improvement projects.

In comparison, improvement teams identify and investigate an extended set of detailed process and outcome data, during specific time intervals, for improvement purposes.

The method of outlining the conceptual flow and outcomes model ensures that any data that is collected is actually used for monitoring and improvement. Only data elements that can be linked to useful reports and measures are collected.

Data Collection

Another key feature of Intermountain’s work is that for each process being reviewed, the data collection method is developed with involvement from front-line workers. Ideally, data is only collected once, at the patient level and then is used for multiple purposes. This same data is used at the front-line for decision making and local improvement efforts, and is rolled up for reporting and accountability purposes. In many other systems, data needs to be collected retrospectively or gleaned from secondary sources. The burden of data collection is minimized and the data captured at the primary source tend to be more accurate.
Outcomes Chain: CABG Mortality

CABG death

Low cardiac output failure (about 85% of deaths)

Return to pump

dry anastomoses
adequate pump volume

Myocardial protection

cardiac rest times
pressors

anesthesiologically stable
temperature control

Dr. William Nugent, Darmouth, Mary Hitchcock Medical Center


Figure 10. Example of a Conceptual Flow Diagram as used by Intermountain Healthcare

Figure 11. Example of an Outcomes Chain Diagram as used by Intermountain Healthcare
and complete than secondary data. Front-line staff and clinicians are also integrally involved in the way the data is collected so that it fits within their workflow. When data are to be used to make comparisons across groups, the analysis requires adjustment for severity of illness, and risk-adjusted variables are defined and collected at the same time.

Intermountain’s data relies heavily on their extensive automated and electronic data system, but similar systems can be envisioned with less advanced technology. The key components needed to replicate their data design are the careful identification of work flow and outcomes for every process improvement that is undertaken. Involvement of front-line staff is essential to understand the processes, identify the data that will be useful and to incorporate data collection into the process.

Front-line staff and clinicians are also integrally involved in the way the data is collected so that it fits within their workflow.

eight pathways of care. Nationally, or at a macro-level, there are a small set of core metrics which allow for international comparisons and measure progress against national strategic priorities.

As indicators continue to evolve, the NHS recognizes the benefit of involving clinicians in the process of developing indicators and also plans to include public and patient viewpoints.

The Quality Improvement Indicators are separate from other sets of measures, such as:
- comparative data on activity and costs;
- patient reported outcome measures (PROMS) used for hip replacements, knee replacements, hernia and varicose veins;
- national data sets used for planning; and
- the Quality Outcomes Framework, the annual reward and incentives program for general practitioners.

To further the work in measurement for quality, the NHS Institute for Innovation and Improvement was given the task of developing a set of indicators to explore quality care in relation to efficiency (i.e. to ensure the best quality care is delivered in the most efficient and cost effective way). This “Better Care, Better Value” indicator set currently comprises four areas: finance, clinical productivity, workforce, and procurement. There are specific indicators for acute care and primary care. Each NHS trust is provided with their indicator results, on a scorecard, each quarter (Figure 12). For each indicator, a table shows the indicator score for the trust, along with the national position (i.e. where the organization ranks out of all trusts), and the percent change from the last reporting period. In the final column, the NHS calculates the potential savings in currency if the indicator result was improved.

Jönköping County, Sweden

Jönköping is a county in Sweden internationally recognized as a leader in healthcare quality. Measurement has played an integral role in the transformation of their system. Jönköping has adopted the system of Quality as a Business Strategy (QBS) in which a balanced set of measures are designed to align with the goals of the organization or system. QBS also emphasizes the need to look at measures over time and analyze improvement or performance in terms of variation (using statistical process control).

Jönköping has developed a balanced scorecard that is used at all levels throughout their system. They use the scorecard as a tool for providing data, at all different levels, for planning and improvement. The Quality Improvement Indicators, an initial and evolving set of 200 indicators is one key piece of their measurement structure.

These indicators are organized around a broad spectrum of pathways: acute care, primary care, end of life, cancer care, long term care, mental health and maternal and newborn care. The indicator set also reflects the three dimensions of quality identified by the NHS: care that is effective, safe, and provides a positive patient experience. The Centre is working to refine and develop the indicator set as some areas of quality are underrepresented and they are continually working to make the indicators meaningful to professionals.

The development of this measurement system plays a key role in the NHS’s vision to make quality improvement an organizing principle for the NHS, embedded in all they do. The NHS envisions incorporation of measurement so that providers and teams consistently measure what they do, using the information to improve care and to compare themselves with other teams. Further, patients should be able to use the same information to support their treatment decisions.

The measurement philosophy has applicability at all levels of care – similar to the micro, meso and macro applications seen elsewhere. The indicator set can be seen as a menu of existing measures. At the local level, care teams choose measures from the larger set of indicators to use internally. The main purpose of the measures at this level is to support improvement. At a regional, or meso-level, regions measure overall improvement on key measures related to their vision and demonstrate accountability for the quality of care delivered through these key measures. The set of measures will be smaller but reflect the
The NHS envisions incorporation of measurement so that providers and teams consistently measure what they do, using the information to improve care and to compare themselves with other teams.

In addition to the Balanced Scorecard, Jönköping worked with the Institute of Healthcare Improvement (IHI) to develop a set of System Measures. Jönköping uses a set of 15 measures, based on the six areas for quality set out by the Swedish National Board of Health and Welfare: care that is knowledge-based and efficient, timely, safe, patient-centred and equitable, and effective. Jönköping also developed the measures with the intent that if other organizations adopted some or all of the measures, they could compare themselves with their peers.

Two criteria for their system measures are: (1) to use existing data wherever possible; and (2) to display monthly results where possible. The System Measures currently used by Jönköping County are:

**Knowledge-based/Effectiveness**
- Percent of patients 65 and older who die in hospital
- Unadjusted mortality
- Hospital Standardized Mortality Ratio (HSMR)

**Timeliness**
- Percent of units and receptions who have achieved Advanced Access (3 days in Primary Care; 14 days to a Specialist)

**Safety**
- Adverse drug events
- Reports from patients sent to insurance company
- Percentage of reports to insurance company resulting in compensation

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**Figure 12. Example of Results from the NHS Better Care, Better Value Indicator Set**

<table>
<thead>
<tr>
<th>Overall scorecard results for Manchester PCT</th>
<th>The table below shows how your trust scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Your opportunity to increase productivity:</strong></td>
<td><strong>National position</strong></td>
</tr>
<tr>
<td><strong>2 Clinical productivity:</strong></td>
<td><strong>(out of 152)</strong></td>
</tr>
<tr>
<td>2.1 Managing variation in surgical thresholds</td>
<td>99</td>
</tr>
<tr>
<td>Relative level of surgery for five procedures</td>
<td></td>
</tr>
<tr>
<td>2.2 Managing variation in emergency admissions</td>
<td>150</td>
</tr>
<tr>
<td>Emergency admissions for 19 conditions</td>
<td></td>
</tr>
<tr>
<td>2.3 Managing variation in outpatient appointments</td>
<td>N/A</td>
</tr>
<tr>
<td>Relative level of outpatient referrals</td>
<td></td>
</tr>
<tr>
<td>2.4 Managing variation in outpatient referrals</td>
<td>122</td>
</tr>
<tr>
<td>Relative level of surgery for five procedures</td>
<td></td>
</tr>
<tr>
<td><strong>3 Workforce:</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Staff Turnover</td>
<td>103</td>
</tr>
<tr>
<td>Full time equivalent</td>
<td></td>
</tr>
<tr>
<td>leavers as a percentage of staff</td>
<td></td>
</tr>
<tr>
<td>3.2 Sickness Absence</td>
<td>128</td>
</tr>
<tr>
<td>Percentage of time</td>
<td></td>
</tr>
<tr>
<td>lost due to sickness absence</td>
<td></td>
</tr>
<tr>
<td>3.3 Agency Costs</td>
<td>N/A</td>
</tr>
<tr>
<td>Percentage of paybill</td>
<td></td>
</tr>
<tr>
<td>spent on agency staff</td>
<td></td>
</tr>
<tr>
<td><strong>4 Prescribing:</strong></td>
<td></td>
</tr>
<tr>
<td>4.1 Increasing low cost statin prescribing</td>
<td>N/A</td>
</tr>
<tr>
<td>Percentage of low cost statins</td>
<td></td>
</tr>
<tr>
<td>4.3 Lipid modifications</td>
<td>145</td>
</tr>
<tr>
<td>Percentage of low cost medications</td>
<td></td>
</tr>
<tr>
<td>4.6 Proton Pump Inhibitors</td>
<td>104</td>
</tr>
<tr>
<td>Percentage of low cost PPIs</td>
<td></td>
</tr>
<tr>
<td>4.1 Renin-angiotensin Drugs</td>
<td>104</td>
</tr>
<tr>
<td>Percentage of low cost ACEI</td>
<td></td>
</tr>
</tbody>
</table>

Patient Centredness and Equity
- Quality of life – inpatients
- Patient satisfaction index – inpatients
- Percent of palliative patients who want to die in hospital that die in hospital

Efficiency
- Healthcare cost per capita
- Healthcare cost per discharge
- Sick leaves longer than 20 days
- Number of employees
- Staff turnover

New measures
- Re-admission to hospital within 30 days
- Number of days spent in hospital in the last six months of life

The Balanced Scorecard and System Measures complement each other
The scorecard is used to determine how the system is working and to facilitate operations and decision making.

The System Measures track progress on how well the system as a whole is moving towards its vision and goals that have been set nationally.

Queensland, Australia
In Australia, the state of Queensland has instituted a monitoring tool which uses data to improve clinical processes, in a systematic and pre-defined way. They analyze more than 25 indicators using a system called variable adjusted life display (VLAD), a type of statistical process control analysis, which risk adjusts the result for age, sex and co-morbidities. The calculation shows trends in a hospital over time and allows meaningful comparison to the state average.

Key to this system is the review process that monitors and takes action to improve results. Each indicator is updated on a monthly basis. Indicators are flagged as warranting further investigation if they touch upon the control limits set in the analysis, meaning that they may be significantly different than the state average. If an indicator is flagged, an investigation process begins and a report must be completed within 30 days. In those cases where it is certain that the result is significantly below the state average, the hospital produces a response to the issue, outlining their improvement plans, which is then reported to the public in the hospital's annual report.
Summary of Best Practices for Quality Measurement

1. **Measures Reflect the Current System**
   Measurement within a healthcare system or organization should use a framework, such as a dashboard or balanced scorecard, to reflect multiple dimensions of quality and a comprehensive view of the system. All indicators on a dashboard should reflect current strategic objectives or priority areas for the organization.

2. **Measurement Throughout the Organization**
   The identification of indicators should involve multiple levels of the organization, with senior leaders ensuring that indicators reflect the strategic goals set out by the organization, and front-line clinicians and staff ensure the measures are workable and reflective of their environment.

3. **Cascade of Measures**
   A cascade or roll-up of indicators is encouraged so that measures collected at front-lines (micro level) are related to those indicators that are reviewed and reported to senior leaders (macro level). This approach reduces the burden of data collection; only measures that are meaningful for decision making, or are directly related to priority areas for improvement, are collected. System measures, that span time frames and specific sectors of care or service lines, should be provided for senior leaders.

4. **Use of Real Time Data to Drive Improvement**
   Indicators should use real-time data wherever possible to ensure that priorities and decisions are based on the current performance. Indicator results should also be communicated throughout all levels of the organization, along with opportunities for dialogue on the results.

5. **Appropriate Data Display**
   Displaying data over time, and analyzing the data using statistical process control methods, are the preferred methods for understanding data and performance. Senior leaders should be given information through data display techniques, analysis, or comparative targets and benchmarks, to understand the performance of their organization.

6. **Plan of Action**
   Measuring and reporting is only one part of a system designed to use data for improvement. Managers and leaders also need a routine set of practices to ensure they act on data that is provided. Leaders are accountable to implement rapid “course corrections” when the data indicates a need to do so, and are responsible for setting priorities for improved performance when indicator results fall short of targets.
References
