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Performance measurement in perioperative environments: Current practice at two large university hospitals

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Abstract
Surgical suites and the perioperative environment of hospitals are resource intensive high cost – high risk areas wherein performance is pivotal for patients' health as well as hospitals' reputation and financial position. Obtaining and staying in a position as a high performing unit in a highly complex organization such as hospitals requires access to and treatment of data that only a well founded performance measurement approach can provide.

We review current performance measurement and management practice in the perioperative domain at two large university hospitals – one Norwegian and one in the USA. We then contrast these practices with how performance measurement systems should be designed according to performance measurement literature. Finally, we discuss how performance measurement can be used to enhance transparency and improve the quality, efficiency and coordination of perioperative work.

Introduction
Florence Nightingale expressed that "*the ultimate goal is to manage quality* (in health care)*. But you cannot manage it until you have a way to measure it, and you cannot measure it until you can monitor it.*" (Quoted by Arah et al., (2003)). Surgical suites and the perioperative environment of hospitals are resource intensive high cost – high risk areas wherein performance is pivotal for patients' health as well as hospitals' reputation and financial position. Perioperative processes are also highly complex as a result of having evolved without direction in response to developments in surgical practices and technology (Sandberg et al., 2003). Obtaining and staying in a position as a high performing operating room suite in large modern hospitals requires access to and treatment of data that only a well-founded performance measurement approach can provide.

The questions "*What for?"* and *"For whom?"* are guiding questions for designing and implementing a performance-based management system (Julnes, 2009). There is a range of possible motives for measuring performance. If your purpose is to report activity to public authorities, your performance measurement system is likely to be designed differently than if your intention is to improve the way your organization operates. Whether performance measurement is directed towards a department, an entire organization or a group of organizations will also influence how the performance measurement system is designed.

In this paper, we review current performance measurement and management practice in the perioperative domain at two large university hospitals – one Norwegian and one in the USA. The prior is public while the latter is part of a non-profit health system. Our purpose is to compare the two hospitals' approaches to perioperative performance measurement and contrast these practices with how performance measurement systems should be designed according to literature. Finally, we then suggest how the hospitals' perioperative performance measuring systems could be developed further.

Performance measurement
Performance measurement has been approached from a wide range of perspectives. Researchers with backgrounds from finance, economics, operations management,

marketing, accounting, psychology and sociology have been active in the field (Neely, 2002). Performance measurement can be defined as *"the process of quantifying the efficiency and effectiveness of past actions."* (Neely et al., 2002:xiii). Efficiency is about productivity, focuses on utilization of resources in terms of time and cost, and is often described in terms of an output/input ratio. Effectiveness is oriented towards the suitability of the output, typically focusing on quality measures.

Alongside accounting, the work of Frederick Taylor can be regarded as the starting point for performance measurement. In Taylor's concept of scientific management (Taylor, 1911) the basis for developing improved work methods was found in analysis of existing work methods based on observation and measurement. Measurement was largely focused on how sub-operations were conducted, not only serving as the foundation for improving specialized work methods, but also as the basis for individually based incentive schemes. With the Human Relations movement the focus of performance measurement shifted from the individual to the work group (Radnor & Barnes, 2007). Competition from the Japanese manufacturing industry in the 1960s and 1970s led to a concern for effectiveness also in the west, with quality as the natural starting point (Radnor & Barnes, 2007). Management theories have continued to shape performance measurement. Business process reengineering (BPR) led to a focus on processes going beyond departmental boundaries, and Total quality management (TQM) contributed to the development of measures from a customer perspective (Radnor & Barnes, 2007).

It is difficult to discuss performance measurement without mentioning the Balanced Scorecard (BSC) introduced by Kaplan & Norton (1992). The core of BSC consists of four perspectives: financial; learning and growth; internal business processes; and customer. The BSC can be said to be balanced not only as it focuses on financial and non-financial perspectives, but also as it includes a time dimension in what Kaplan & Norton (1996) refer to as *leading* and *lagging* indicators. Lagging indicators are metrics presenting information of past events that can no longer be influenced. Leading indicators are metrics from an early stage of a chain of cause-and-effects, enabling a degree of prediction. Similar approaches have, however, existed prior to the introduction of the BSC. Otley (2002) points to a set of balanced performance measures developed by The General Electric Company as early as in the 1950s.

Other models used for developing and using a system for performance measurement includes the Performance Prism (Neely et al., 2001) and the EFQM Excellence Model (EFQM, 2003; EFQM 2009). These models are at a relatively high level, largely focusing on providing senior managers with an overall view of the organization (see for instance the critique of The Balanced Scorecard by Ghalayini et al. (1997)). With senior management as the target group and the emphasis on strategy that is found in the BSC and the Performance Prism, the field of performance management has lost some of its contact with the operative spheres of the organization as we saw it under Taylorism and Human Relations. Nevertheless, people concerned with the day-to-day operations of units or processes use performance measurement as a tool in their daily work. It may be time for the field of performance measurement to revisit the more operational sides of organizations.

There are five basic performance objectives of operations: quality, speed, dependability, flexibility and cost (Slack, Chambers and Johnston, 2007). These

objectives can form the basis for performance measurement of operations. Harrington (1991) provides the following advice with regards to performance measurement in the context of the operationally geared field of business process improvement:

- Measurement should be made close to each activity in order to provide relevant feedback to the people performing the activity.
- Measurement should be measured close to the activity in terms of time (as soon as the activity has been completed).
- Focus measurement on the activities that significantly impact total process efficiency and effectiveness (relevance)
- The person performing the activity should carry out the measuring
- Output receivers should provide feedback to the people providing the product/service.

In healthcare, performance is important to the healthcare organizations them selves, their sources of funding, employees, patients and patients' relatives. Consequently, "many countries have been developing conceptual frameworks for monitoring, measuring, and managing the performance of their health systems to ensure effectiveness, equity, efficiency, and quality" Also, Arah, Klazinga, Delnoij, ten Asbroek and Custers (2003). International benchmarking of healthcare systems is perceived to have the potential of globally improving healthcare quality (Mayer et al., 2009), something that is reflected by the World Health Organizations Performance Assessment Tool for Quality Improvement in Hospitals (PATH) project and the OECD health care quality indicators project. Indeed, even seemingly simple performance measurement initiatives may result in significant quality improvements (Kotagal et al., 2009). Nevertheless, although healthcare quality measurement has existed for more than 250 years, there is still little agreement in the philosophy of measurement, on what to measure, how to analyze data and how data should be reported (Loeb, 2004). For instance, although existing performance measurement systems include surgical performance indicators, there is no universally accepted and/or validated system for measuring quality of care in surgery Mayer et al. (2009).

Purbey et al. (2006) proposed a performance measurement framework for the healthcare sector, consisting of the three categories efficiency, effectiveness and flexibility. The efficiency dimension focuses on the relation between resource consumption and output. The sub-indicators mentioned by Purbey et al. (2006) are resource utilization and cost reduction. The effectiveness dimension is related to the impacts, which in a healthcare context would be the extent to which a healthcare intervention leads to health improvements. Examples of effectiveness dimensions are service quality; customer satisfaction; growth; and safety (Purbey et al., 2006). The third dimension, flexibility, is presented as a lead performance measurement category as it can measure the system's ability to respond to change or variation. The framework presented by Purbey et al. (2006) points to professional flexibility; instrument flexibility; process flexibility; volume flexibility; mix flexibility; expansion flexibility; and new service flexibility.

Kollberg et al. (2007) found a simple process model useful for measuring lean initiatives in health care services, as it supported measuring critical success factors such as accessibility, delays, preparation time, quality of medical care, referral management, just in time, booking routines and process control. Measures identifying

for instance patient satisfaction and fulfillment of targets and policies would have to be added to the set of performance measures as the process model did not capture the full width of lean changes (Kollberg et al., 2007).

Performance measurement easily turns into a tool for what can readily be counted, such as number of patients, operating room utilization or delays. Botti et al. (2009) argue that previous research has paid little attention to the complex influences of cultural, behavioural and environmental factors related to team performance on clinical handover. In their study of performance among pay-for-performance hospitals Vina et al. (2009) identified several organizational factors for improved performance. Data feedback through quality performance reports did not differ between high and low performing hospitals, pointing to a potential bottleneck in quality improvement if the improvement process stops at the step of reporting data or differences in how performance data is converted into improvement actions (Vina et al., 2009). Implementing a performance measurement system is not only about a set of measures. It is also about the mindset forming the basis for managing health care (Sheldon, 1998; Kollberg et al., 2007).

Performance measurement in the perioperative domain of two hospitals
We now review current performance measurement and management practice in the perioperative domain at two large university hospitals – one Norwegian and one in the USA. The presented performance measures are collected on a regular basis by the surgical department of the Norwegian hospital and by the operating room environment of the US hospital. Each of the hospitals may from time to time use other performance measures to investigating specific areas of interest in the perioperative environment, but such measures are not reviewed in this paper.

The Norwegian hospital
The surgical department reviews performance in monthly meetings in each of five units. Performance is compared to set targets. Deviations from target are investigated and actions are identified and taken to improve performance.

Operating in a public healthcare system, the Norwegian hospital has to adhere to national service guarantees. When a patient is referred to the hospital for possible surgery, it has to set a waiting time guarantee. The length of this guarantee is based on the patient's type of illness and cannot exceed one year. If this guarantee is broken, patients can choose to have treatment at a different hospital and the bill for this will be sent to the hospital that broke the waiting list guarantee. In short, waiting lists are important for the hospital to monitor with respect to both quality and costs.

Surgical workload and productivity is monitored by measures of the sum of operative times (from incision to end of surgery) and total patient-in-room time for the given period.

Cancellation rates – the fraction of scheduled operations that are cancelled on the day of surgery – are a national quality indicator measured by all Norwegian hospitals. Cancellations may be considered symptoms of system problems (Seim, 2009), and the national target is to have cancellation rates below 5 %. The hospital has been working actively to reduce cancellation rates since 2006/2007.

The time from hospital discharge to the sending of a discharge letter to the patient's primary physician is another national quality indicator. The set target is for 80 % of such letters to be sent less than a week after the patient is discharged from the hospital.

Costs and the department budget are also performance measures that are reviewed in the monthly unit meetings.

The hospital is currently developing several new performance measures for the perioperative environment. These include the measurement of delays as compared with a start time matrix and causes of these delays; the degree to which different units utilize their allotted operating room capacity; overutilization and underutilization of operating room team. The hospital is also looking to use statistical process control techniques in performance monitoring and to introduce weekly performance evaluation meetings within each unit.

The US hospital
Operating room performance assessment uses a global examination of budget, case volume, and operational performance measures. These are reported in aggregate for the entire operating room enterprise, and subdivided along operational units, and the service lines. There are three distinct operational units, and roughly 15 service lines, although not all service lines use all of the operational units.

Comprehensive reports are produced monthly, with a performance report for the month, as well as a cumulative fiscal year to date report.

Budget targets for case volume are developed annually, by service line, based on historical case volume and estimates of expected growth throughout the forecast year. Actual case volume is compared to budget volume, by service line and operational unit.

Case volumes and utilization are also reported, again for the month in question and as a cumulative year-to-date report. For comparison equivalent data from the prior year are also presented. The hospital uses a block booking system, wherein a surgeon and or service is assigned to a specific operating room for each operating day. Block hour utilization is reported by service line and functional unit. Utilization of assigned blocks as well as utilization of time outside regular block hours are both recorded. Finally, a six-month trend of utilization of assigned blocks is also reported.

Adjustments in the quantity of assigned block hours can be made based on patterns of underutilization or excessive utilization of block hours beyond the assigned allocation.

A comparison of actual rooms running to staffed rooms available is reported hourly in graphic form by day of week. Because of turnovers, cancellations, and unavoidable gaps between cases, the number of rooms running on weekdays never exceeds the number of available staffed rooms. However, examination of these graphics allows one to identify a mismatch towards the end of the operating room day when demand begins to tail off. Specifically, in late afternoon the number of running operating rooms begins to decline, although staffing remains constant and begins to exceed

demand. Then, at the designated end of the workday, and the number of operating rooms running regularly exceeds the planned staffing level. This is accommodated by using planned overtime, which is handled as a budgeted, but variable cost.

Operational performance metrics include a fraction of the first cases of the day that start on time, again broken out by functional unit and service line.

A case is considered to have started on time if the patient is logged to be in the operating room by the planned time posted in the schedule. If the patient enters the operating room more than one minute after the planned case start time the case is considered to have a delay. The magnitude of the delays (grouped into 10 minute intervals) is reported.

Turnover time, defined as the time from patient out of OR to next patient into OR is shown by service line and functional unit, with comparison to previously agreed targets. Turnover times of greater than two hours are considered to be planned gaps between cases and are not counted. Again, a six-month trend for turnover time is presented.

Discussion

The two hospitals we studied operate in healthcare systems with different funding structures. While Norwegian healthcare is a public service funded through taxes, the US system is much more privatized and is largely financed through individuals' healthcare insurance. Specifics of each healthcare system are a possible cause of differences in the hospitals' approach to perioperative performance measurement.

Indeed, some of the indicators and measures our Norwegian surgical department focuses on are ether national indicators or of importance due to structures of the healthcare system it operates in. Cancellation rates and the time from hospital discharge to the sending of a discharge letter to the patient's primary physician are such national quality indicators that are monitored actively by the department. Similarly, waiting lists and waiting list guarantees are important because of rules in the healthcare system. The other performance measures used by the department largely focus on productivity and financial performance.

The US hospital's monthly operating room performance assessment also focuses on measures of productivity and financial issues. However, some of the measures used are of higher granularity than those currently used by the Norwegian surgical department. For instance, the graphical depiction of hourly operating room utilization may be better suited for diagnosing a problem then the raw utilization fraction. The monitoring of delays is another example of higher granularity in the US measures (the Norwegian surgical department is, however, currently piloting similar measures). Measures of higher granularity may be better suited for identifying problems and as a basis for taking action. Nevertheless, it may be necessary to go "behind the numbers" to identify root causes of the symptoms of imperfect practice identified with the performance measures. Both hospitals analyze causes of deviations from the expected/budgeted in performance measures.

Performance measures related to "softer" issues (e.g. patient or employee satisfaction) are not part of the hospitals' monthly perioperative performance monitoring routine.

Both hospitals do measure such parameters of performance, but this is done in a different context and at different intervals.

Several of the indicators used by the two hospitals can be both leading and lagging. For instance, monitoring of waiting lists can be a leading indicator of the breaking of waiting list guarantees. It can also be a lagging measure of how many guarantees were broken in a given month. Nevertheless, a monthly reporting structure is primarily lagging in nature. It is an instance of looking back the performance for a month and asking if there is any need for specific action to be taken in order to achieve yearly performance targets. The monthly reports provide information of past events that can no longer be influenced.

In its current form performance measurement in the two hospitals is primarily designed for management's regular monitoring of operations. This is an important function. However, the effectiveness of the performance measurement system could be enhanced by adapting it to provide transparency and coordination support in day-to day operations. Statistical process control could be used to quickly detect systematic shifts in performance (Seim, 2006). Real-time data on a level of detail that is close to each activity could facilitate better performance understanding, feedback, and learning for actors throughout the perioperative environment.

Conclusion

The two hospitals' approach to perioperative performance measurement is partially formed by their respective healthcare systems and mainly focuses on productivity and financial measures. Performance measures related to "softer" issues (e.g. patient or employee satisfaction) are not part of the hospitals' monthly perioperative performance monitoring routine. Developing the hospitals' performance measurement approaches so that it provides transparency in day-to-day operations seems could further improve daily operations and performance.

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