

## Healthcare performance indicators -Preview of frameworks and an approach for healthcare process-development-

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### Abstract

*Compared with many other industrial sectors, healthcare shows a relatively antiquated information system structure. Consequently healthcare requires increased improvement, whereas healthcare processes are often seen as key factor. However, despite the importance of process management for healthcare, currently there are only very few approaches focusing on process-oriented performance indicators. Approaches are developed though often from healthcare experts disregarding information management requirements and information systems architectural options (including healthcare process design). Indeed clarification is needed on how required information should be collected by healthcare care organizations. In order to contribute to this research, this paper presents a preview of healthcare performance indicator frameworks and an approach for healthcare process development. Our results reveal that from a healthcare process centric point of view a new classification of performance indicators is beneficial.*

### 1. Introduction

As one of the largest consumers of public spending, healthcare is increasingly recognized amongst most countries as an important economic sector with rapidly growing expenditure. For instance 14% of the US GDP in 2000 accounted for the healthcare industries [46]. Most countries are facing similar problems and challenges in healthcare: often declining resources, increasing medical complexity with an increasing need for high quality healthcare services, and consequently a high pressure for healthcare providers to increase their productivity and reduce costs. Indeed the healthcare sector shows a relatively underdeveloped information system structure [31]. Recent efforts have been made to increase the effectiveness and efficiency, like concepts to integrate healthcare systems or to implement smart card systems for electronic patient record [29;22]. Nonetheless concepts for the implementation of adequate healthcare information systems, such as integrated Electronic Health Record systems are far from realization in most cases.

In many industries, process management has been proven to be a successful means of reducing costs and increasing productivity and quality [2], and thus attempts have been made to apply process management in the domain of healthcare for many years [10;33; 36]. Such projects aim to streamline healthcare services and processes, thus making it

more cost efficient, while delivering better service quality. In recent years process management projects have achieved real benefits [18]. In the US for example, the length of stay for patients has fallen by 33 % as a result of the introduction of clinical process management [5]. For these reasons, applying know-how from business process management to health process management should be seen as an important strategic task for all healthcare providers to take into consideration.

However, despite the importance of process management in healthcare, currently there are only rare glimpses of research related to performance indicators for improving healthcare processes in hospitals. Most current research related to performance indicators in healthcare, demonstrates interest in creating a large range of healthcare service quality indicators and in evaluating hospital performance using a benchmark approach. Whereas in the USA quality of care research and clinical evaluation have been steadily developing over the past 20 years, there was no large interest in central Europe until recently [24]. Increasing health care costs have stimulated the demand for a more systematic evaluation of health care systems. In this regard, our current research aims to contribute to ongoing research in nursing care, and focuses generally on process optimization through information management in the context of nursing care (for process optimization in general see, e.g. [40]). In particular we address aspects of *on which information* is required, *in which quality* and *how* the required information can be gathered and how its quality can be ensured in order to implement effective and efficient nursing care processes.

This paper explores which information is typically required for healthcare performance measurement and presents an example for classifying healthcare performance indicators from an information management perspective. The paper is structured as follows: Sections two and three describe process and performance management and its application to healthcare. Based on an example of typical performance indicators an approach for structuring performance indicators for healthcare process-development is explored in section four, followed by our conclusions and details of further research aims in section five.

### 2. Process Management in Healthcare

Rising medical costs, industry consolidation, changes in social culture and government legislation are driving the need for changes in the delivery, administration and management of healthcare. Healthcare service providers will find it increasingly

difficult to perform or even compete on a cost / service basis, and satisfy new service demands with often decreasing resources. In order to accomplish and improve healthcare services, providers must integrate, automate and optimize critical functions, information and healthcare processes.

Introducing process management shifts the perspectives from a functional orientation towards a process viewpoint, and thus change the way healthcare service providers operate [21]. Process management has emerged as a catalyst to assist healthcare service providers in increasing efficiency and effectiveness of their services. Implementing and monitoring process management becomes increasingly important in particular. Process management is a way to 'define, manage and optimize the dynamic, expanding, contracting, changing activities of an enterprise'. It constitutes organizations activities and then manages the lifecycle of improvement and optimization in a way that translates directly to operation. Essentially it enables users, to define, manage and optimize the practices of an enterprise. Process management comprises in particular two



Fig 1: Core Processes in healthcare

main activities: *monitoring* and *improving* organizational processes. In essence, process management requires to establish measures for processes in order to analyze activity performances, employee workloads and bottlenecks. Furthermore encompasses comparison of as-is and to-be measures and to analyze causes of discrepancy.

Processes of care are usefully distinguished from organizational processes, rather than being combined with them, because there are many important organizational processes worthy of identification and monitoring that do not involve direct patient care. Following the structure of the SAP business map in healthcare, core-processes in healthcare can be identified as summarized in Figure 1 (according to [35]).

Those processes must be flexible enough to suit real, practical healthcare activities so that the following aims can be achieved:

- Patient focused and transparent care
- High quality of care
- Quality monitoring of each patient's care
- Efficient care services
- Predictability and control of changes
- Measurement of effectiveness and cost-benefit of care
- Benchmarking (nationally and internationally)

Healthcare organizations can benefit from applying the concept of business process management:

- Carefully manage and audit key healthcare processes associated with regulatory compliance and requirements.
- Manage the implementation and maintenance of new healthcare services.
- Integrate operational and patient-related information systems, expediting service responsiveness, and reducing patient waiting times.
- Deliver relevant data and analysis directly to points of decision-making in key healthcare processes (e.g. Nursing care).
- Manage, track and audit relationships within the healthcare network, resulting in improved performance for all participants and service groups (e.g. patients, general practitioners, nurses, ambulance, primary care, government agencies).

In order to achieve these aims the core processes need to be designed and managed through performance indicators, which are explored in the following section. The results present a first approach for structuring healthcare process performance indicators.

### 3. Healthcare Process Performance Measurement

Measuring the performance of healthcare providers has been a recurring theme over the last decade, with an increasing interest for new methodologies in performance measurement (e.g. [17;26]). Indeed, in the current indicator-oriented discussion increasing importance is given to the development of key performance indicators sensitive to nursing care [32]. Generally, research has produced numerous suggestions for performance measures (e.g. [3;13;19;41]). Commonly performance is regarded as a multidimensional concept. Some indications are given by the development of performance indicators in manufacturing and service industries or approaches in other countries.

Over the last decades, research has demonstrated the interest in creating a large range of quality indicators measuring the quality of service, and in evaluating hospital performance using benchmark approaches. In many countries approaches to develop healthcare quality indicators have been proposed, as summarized in [31]. Internationally, the importance

of performance and outcome indicators is underscored by the large amount of effort in developing national performance frameworks:

- In the USA the National Quality Measures Clearinghouse (NQMC) provides public access for evidence-based quality measures and measure sets, which is sponsored by the Agency for Healthcare Research and Quality (AHRQ), U.S Department of Health and Human Services ([www.qualitymeasures.ahrq.gov/](http://www.qualitymeasures.ahrq.gov/) and [www.qualityindicators.ahrq.gov/](http://www.qualityindicators.ahrq.gov/))
- The Australian Council on Health Care standards has developed a system of clinical indicators to monitor quality of care (<http://www.achs.org.au/>).
- In the UK, the National Health Service has developed a performance-rating system which includes structure and process measures covering many aspects of hospital activities, such as waiting list, waiting time, operation cancelled, hospital cleanliness, satisfactory financial position, etc. Several performance measures are also used with clinical, staff and patient oriented indicators (<http://www.healthcarecommission.org.uk/InformationForServiceProviders/PerformanceRatings/fs/en>).
- In Ireland, within the National Health Information Strategy actions are identified to develop patient outcomes and a common set of clinical indicators as an essential requirement for an electronic patient record system [11].
- The Swiss Medical Association is working on developing and implementing various projects to ensure and improve quality of care [24].

Table 1 outlines approaches to develop frameworks and measures related to healthcare performance management. Although the table does not intend to provide a thorough review of the plethora of literature that claims to identify healthcare performance indicators, it illustrates the diversity of approaches. However, many experts agree that healthcare lacks of clarity on which information is required and how required information should be collected. This is in part a result of a divergence of views amongst key stakeholders and the diversity of indicators, but it might also result from the predominantly isolated development of performance management concepts (often) with a disregard for information management requirements and information systems architectural options (including healthcare process design).

Traditionally, performance measurement in healthcare organizations has been an administrative function. As such, the systems used have been focused on financial performance. Typical indicators measure the profitability, liquidity, solvency, and asset-employment efficiency of healthcare organizations [41]. An example of a financially oriented performance system is the commonly used diagnosis related groups (DRG)-

based payment system. First introduced in the United States in 1983, the DRG-based payment system was adopted in various forms by many other countries [16;34].

Originally DRGs were developed to provide product definitions for the output of hospitals as classes of patients. Those classes received similar bundles of goods and services to treat the patient's illness. For each defined DRG the hospital receives a certain rate that is considered to be a fair payment to the hospital for the treatment and diagnosis of the given illness. The amount for each DRG is predetermined and calculated from national average costs [14]. This allows management of hospital services by focusing on the final product of the hospital, which is the bundle of goods and services that is provided to patients with a particular illness. In the DRG system all principal diagnoses are organized into major diagnostic categories that are – for the most part – based on organ system involvement. The system allows measuring productivity and costs in hospitals [15]. However, despite the possibilities the DRG-based payment system offered concerning cost control and managing the “products” of hospitals, the DRG system provides “(...) financial incentives to discharge patients from hospitals “quicker” and “sicker” [16].

When measuring performance of a system it is important to consider the complete process involved in turning inputs into outputs and evaluating the outcomes against a defined set of objectives. The difficulty in measuring healthcare outputs and attributing them to system performance is that an outcome may be the result of many factors. Many performance management systems show deficiencies, with separate evaluative processes for service quality, clinical effectiveness, and financial performance in healthcare organizations [45]. Most formal, financially focused performance measurement systems do not allow us to monitor the complete process of patient care [41]. Indeed, using a DRG based financial system aims to measure the costs of similar bundles of goods and services, but it does not allow for measuring the quality of the complete process that the patient and the healthcare organization are involved in. As a consequence of the focus on financial administrative functions and the separation of evaluation processes, current healthcare information systems environments do not allow adequate healthcare performance measurement along the complete healthcare process.

Table 1: Performance Measurement in Healthcare Organizations

Author(s)	Performance Measurement
[38]	<p>Describes a conceptual framework for performance assessment in primary health care, which includes indicators for</p> <ul style="list-style-type: none"> <li>• Intermediate health outcomes for consumers</li> <li>• Sub-objectives specified for stewardship, organizational structures and processes, and processes of care and intermediate outcomes</li> <li>• Qualitatively or quantitatively assessed</li> </ul> <p>Example of indicators are given in a hypothetical framework relating to diabetes.</p>
[39]	<p>Evidence-based performance measures (e.g. death among surgical inpatients with treatable serious complications (failure to rescue), nursing care hours per patient day) are used for evaluating the quality of nursing care.</p>
[47]	<p>Provides an overview of usings scorecards, dashboards, and key performance indicators in healthcare. In particular he states that the balanced scorecard for healthcare organizations also need to address issues such as surgical utilization, material management, integration of clinical and financial operations, and patient satisfaction. Key performance indicators include: average length of stay, maintained bed occupancy, FTEs per adjusted occupied bed, case-mix index, monthly surgical cases (outpatient and inpatient), inpatient and outpatient revenues, cost per adjusted patient day, percentage of revenue from charitable sources, revenue and expense per physician, margin per department, admitting-process-performance.</p>
[1]	<p>The East Alabama Medical Center (EAMC) uses non-financial performance measures to improve and maintain high level of customer service, operational and financial success. The aim is, (1) to maintain and improve the quality of clinical services, (2) to improve patient services, (3) to enhance employee recruitment and retention and (4) to maintain accreditation. Examples of the measures used for patient service improvements are numbers of patient complaints, percentage of patients visited by senior nurses.</p>
[25]	<p>Examines the applicability of clinical care indicators, and provides a description of the processes underlying the development of a range of quality indicators relevant to general practice.</p>
[37]	<p>Produced by the National institute of Clinical Excellence, Commission for Health Improvement, University of Leicester and Royal College of Nursing. It aims to support NHS staff by detailing the methods, tools, techniques and activities related to each stage of clinical audit. It includes sections for preparing for audit, selecting criteria, measuring levels of performance, making improvements, and sustaining improvements.</p>
[7]	<p>Presents a partial example using one hospital's joint commission on accreditation of healthcare organisations' ORYX measures. They address questions of "how regular key quality indicator reports can be developed?" and "how regular key quality indicator reports look like?". Examples of the use of different types of control charts and different clinical conditions are presented. Example indicators include: High volume diagnosis-related groups, accreditation requirements, patient satisfaction, agreement between preoperative diagnosis and pathologic diagnosis, x-ray retakes, cross-match to transfusion ratio, c-section rate, patient leaving the emergency department without being seen, medication errors, adverse drug reactions, patient falls, needle-stick injuries, returns to intensive care unit within 24 hours of discharge, unplanned day surgery, discharges against medical advice, 14-day readmission rate, neonatal death rate, low birth weight newborns, average wait time in the family medicine clinic, average wait time for surgery clinic, patient days, patient satisfaction measures.</p>
[44]	<p>Use of the Balanced Scorecard (BSC) to measure the performance of Not-for-Profit (Healthcare) Organizations. The four key perspectives of the BSC used in Healthcare Organizations are: financial performance, patient satisfaction, clinical utilization and outcomes and system integration and change.</p>
[30]	<p>The purpose of this report is to describe and illustrate a national health performance framework that has been developed by the National Health Performance Committee Australia. The goal is to extend the national performance indicator framework for services other than acute inpatient services. In particular the healthcare system performance should be measured by:</p> <ul style="list-style-type: none"> <li>• The monitoring of inputs to the health system such as human resources, capital, facilities, equipment and information systems</li> <li>• The measurement of outputs such as hospital separations, number of consultations with service providers, the provision of medication and diagnostic services, preventative actions, and rehabilitation services</li> <li>• The monitoring of outcomes through changes of health status of individuals, groups and communities</li> </ul>

[6]	Proposes a framework for assessing quality of primary care that is based on Donabedian's classic healthcare quality triad related to structure, process, and outcome [12].
[8]	Using the Essential Public Health Services (three core functions of public health: assessment, policy deployment, assurance) as a framework for identifying, analysing and evaluating public health activities. This approach focuses on public health and not on how to improve the performance of healthcare organizations.
[43]	Proposes an action-oriented framework that focuses on intermediate variables that directly affect health status, and can also be influenced by primary care interventions. The key characteristic of the framework is a set of intermediate variables that link the social and biological systems.
[27]	Describes an evidence-based approach for developing performance indicators for primary care groups. Identified two key domains of performance broadly related to access and effectiveness.

In essence, the variety of theories and approaches in literature contribute to a good understanding of what constitute appropriate healthcare performance indicators (predominantly developed from healthcare domain experts). In general there is agreement that measures and standards should focus on three aspects of performance – effectiveness, efficiency and quality [41]. However, there is actually still little consensus on which information is required [9]. Indeed, there is very little research that evaluates different approaches in the context of information management, thereby analysing different concepts of performance management, the related information system architectural choices and the resulting quality of services and health outcomes. This is the context in which the following approach for classifying healthcare performance indicators is intended.

#### 4. An approach for classifying performance indicators and healthcare process-development

Luthi *et al.* summarize some typical quality indicators that have been identified for a quality healthcare surveillance system in Valais, Switzerland [24]. Following Donabedian's healthcare quality elements [12], the quality indicators are categorized into structure, process

and outcome indicators. Structure indicators are primarily gathered through administrative data, such as the number of beds, counts of hospital stays, or the number of operating rooms. Several process indicators have been proposed such as the use of broad-spectrum antibiotics and vaccination coverage of staff for hepatitis B and influenza. Examples of outcome indicators are listed such as in-hospital mortality, readmission, length of stay and complications.

In order to develop a process-centric approach for structuring healthcare indicators, we adopt a structure proposed by Luehman who differentiate between measures for three activities [23]: Operations, Current Strategies and Opportunities.

- *Operations*: measures the value of the current process performance.
- *Current Strategies*: understanding and evaluation of how the process implementation is aligned and contributes to current strategies.
- *Opportunities*: determine the potential future value of the existing process structure.

McKeen & Smith propose a matrix of measures - originally proposed for the context of IT - by structuring the measures along questions that are typically important for enterprises [28]. Based on this matrix performance indicators could be explored in the context of healthcare process management (see Table 3).

Table 3: An example for classifying performance indicators

		Processes		
		How well are we doing now?	Are we doing the right things?	How well are we positioning us for the future?
Activities	<b>Operations</b>	Effectiveness like length of stay, unplanned readmissions	Patient satisfactory, Surgical site infections, Patient security, Decreased variation in patient care.	External benchmarks (hospitals / countries) quality of coding, Structure indicators like number of stays, operating rooms,
	<b>Strategies</b>	Impact in financial terms such as cost reduction and improved productivity	Balanced scorecard approach in order to assess strategy from: financial, customer, process and learning & growth perspective	Patient relationship Hospital image and reputation
	<b>Opportunities</b>	Flexibility or responsiveness to change  Amount and quality of Nursing and medical data	Staff satisfactory, status of employee's illness	Staff capabilities and competencies

Table 3 includes three levels of performance indicators, structured by increasing difficulty of actual measurement and availability of information. However, most current research (and systems) focuses on operational performance indicators in the first cell (operations in relation to “How well are we doing now?”). For these indicators current technical solutions are sufficient in principal (e.g. data warehouse solutions [4]; Integrated E-Business solution [20]). Nonetheless, in order to improve healthcare services other indicators for measuring strategies and opportunities are even more important. Consider for example a sub-process “patient reception” as a sub-process of the core-process “patient management”. In our simplified example, we assume that the process “patient reception” focuses on improved patient’s satisfaction. Thus one respected performance indicator (according to Table 3) could be patient satisfaction, representing the quality of the service of this process. In short, the activities within the process are aiming to fulfil the objectives of the selected performance indicator. Any inefficiencies (e.g. long waiting period at the reception or unfriendly staff members) would result in a reduced “patient satisfaction” indicator value. However, which information is and can be made available, and how it should be captured is difficult to evaluate. Indeed, experiences in hospitals in Ireland show that most current information system architectures (characterised by large technical diversity and large data redundancy) are often not

appropriate to provide the required information of high quality. Appropriate information systems should allow further sharing (or integration) of all required information (see for example [47] in the context of balanced scorecards). Such an architectural design and the evaluation of information system’s architectural choices is a subject of our ongoing research.

**5. Conclusion and further research**

Indicators are vital to measure the performance and quality of processes and their contribution to strategies and opportunities. Our article provides an exploration of some typical performance indicators for healthcare processes. We also presented an example for classifying these indicators based on increasing difficulty of actual measurement and availability of information. Even if the presented performance indicators for healthcare processes will not be generally applicable, it is important to pursue and develop this research further. The provided approach will be explored in detail, the indicator set will be extended and further validated (based on a thorough literature review and expert interviews). As our analysis reveals many of the current implemented performance indicators focus the financial aspects of healthcare processes (e.g. DRG based performance indicator systems). However, corporate information management is seen as crucial but is often afforded little regard – in particular in not-for-profit organizations. Our article argues that an integrated

performance measurement approach for service quality, clinical effectiveness and financial sustainability requires appropriate information system architectures. Indeed, the presented example for classifying healthcare performance indicators shows that not only “what constitute appropriate healthcare indicators”, but also *which information* is required, of *what information quality*, and *how* required information can be gathered needs to be evaluated. Further research will particular focus on appropriate information system architectures (including processes and organizational structures), information quality management and the evaluation of information system’s architectural choices.

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