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A framework for benchmarking hospital performance: application to surgical site infection

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Abstract

Benchmarking is an approach to quality improvement where practice of leaders are studied to help improve one's own practice. Here, a framework for designing and implementing an information system for benchmarking is proposed. Participating actors are described by Structure, Process, Outcomes and indicators of case mix. The core of the information system consists in a database of actors descriptions, and in an algorithm combining rules and data on Structures, Outcomes and Case mix to identify leaders. Results from the benchmark consist in the Processes of the leaders. An example using data from a surgical site infection surveillance network is provided. Actors were hospital surgical departments, Structure consisted in the type of the hospital, specialty and annual number of interventions. The algorithm for selection of leaders was implemented using a decision tree. Using this framework, benchmarking could be facilitated and more easily accepted by professionals.

Keywords:
Information architecture, Knowledge representation, Quality assessment and improvement

1. Introduction

Accreditation of healthcare organizations by the health authorities is increasingly common in western countries, and has recently been made mandatory in France[1]. A requirement in these accreditation programmes is that healthcare organizations act to improve the quality of care. A widely used approach to quality improvement consists in comparing real practice to *a priori* defined standards. The definition and acceptance of these standards however remain a persistent problem.

Since the pioneering work of Donabedian, the standards used for quality of care assessment rely on three components: Structures, Processes and Outcomes[2]. Structures refer to the medical premises, the medical devices and the human resources. Processes describe the organization adopted to deliver care. Outcomes are the measurable effects of care on the patient's health. These three items are linked by causal links: bad structures lead to bad processes, bad processes lead to bad outcomes. It is often proposed that outcomes should be the primary indicator of the quality of healthcare[3]. For the proponents of this "outcomes movement", individual or hospital wide performance should be compared to standards, poor performance identified and structures or processes improved thereafter. Because this approach often relies on externally defined standards of care, the issue of acceptance of the standards by the professionals must be considered.

"Benchmarking" is a method for quality improvement in which standards are determined by the organization itself, a practical means to bypass the issue of acceptance. In this approach, a first step is to identify "competitors", and especially competitors having better

outcomes (referred to as "leaders"). The second step is to analyze in detail the structures and processes of the leaders to guide improvements. Few examples of this approach have been reported in medicine[4]. A practical obstacle to benchmarking is the lack of publicly available data on competitors. Indeed, quality assurance requires exhaustive, available and reliable information systems[5].

In nosocomial infection surveillance, networks of hospitals have been set up that allow timely collection of standardized information about structures, processes and outcomes [6, 7]. To allow the use of such networks and data for benchmarking, a dedicated information system is required to integrate the data and guide the users for improvement.

Here, we present a framework for the design of such a system. An example is taken from the surveillance of surgical wound nosocomial infection.

2. Data

Surgical site infections (SSI) are nosocomial iatrogenic infections, representing approximately 15% of all nosocomial infections[8]. They are associated with increased length of stay, increased costs, and even death[9]. A portion of these infections could be avoided by prophylactic measures, including cutaneous antisepsis and pre-operative antibiotic treatment [10, 11]. Since 1997, a network of french hospitals has been monitoring SSI incidence[6]. Recommendations for avoiding SSI have been communicated to participants. However, compliance with these is far from perfect, as has been reported in other settings [12, 13].

In 2000, 244 surgical departments have participated in the surveillance network reporting the outcome of 29745 surgical procedures.

3. System Architecture

The information system is structured around the description of actors, who can access the system as contributors during surveillance, and as end users during benchmarking.

Actors

Actors are entities, such as medical departments, participating in the benchmarking process. To parallel the description of quality in healthcare, we adopted a description of actors in terms of Structures, Process and Outcomes. This description was augmented by incorporating indicators of Case Mix.

In the particular setting of SSI, actors are identified with surgical departments. Structures include the status of the hospital (public/ private/ teaching), the surgical specialty, the volume of activity, and the staff count. Processes include the description of the methods for organization of the surgical ward, for cutaneous antisepsis and for antibioprophylaxis. Outcomes include the quality of surveillance, for example the percentage of patients seen one month after intervention, and the rate of SSI, presented according to the NNIS score[14]. Case Mix allows the description of the patients cared for in the surgical ward, and includes risk factors, percentage of emergency procedures and ambulatory procedures.

Information system

The architecture of the information system is presented in Figure 1. During a preliminary surveillance phase, each actor reports its situation using preformatted forms, and the results are stored in a database. As described before, each item belongs to the Structure, Process, Outcomes or Case Mix category.

Competitors

The first step in benchmarking is the identification of competitors. The aim of this step is to restrict the set of entities for comparison to those that provide a fair and meaningful comparison, but not to rank actors.

For a given actor, we thus defined competitors as the set of actors sharing one or several Structure and Case Mix items with the said actor. The determination of competitors is carried out with a set of decision rules organized hierarchically. Items used for the description of structures and case mix have been ranked from most important to less important in establishing a measure of similarity between actors. For example, it was decided that, within the Structure items, the status of a surgical department (either Private / Public / Teaching) was to be considered before the specialty of the surgical department. Decision rules are either based on a perfect match for categorical characteristics or to a difference in proportions or continuous characteristics.

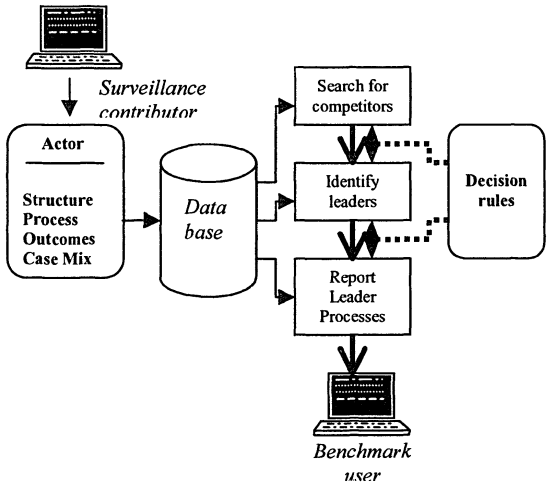

Figure 1 : Architecture of the information system for benchmarking.

The set of actors is progressively reduced by the hierarchical application of the set of decision rules, till all remaining actors are comparable to the candidate, or no actor matches the candidate. In the latter case, competitors are defined as the set of actors matching the more characteristics of the candidate.

Figure 2 exemplifies the approach with 3 items selected in Structure and 1 items selected in Case Mix (Emergence activity) for surgical site infection. Organizing the items for hierarchical comparison puts more weight on the first items.

Leaders

The second step in benchmarking is the identification of leaders. We defined a leader as the competitor with the best outcomes. In the case of SSI, we defined an aggregate measure of Outcomes, taking into account the rate of SSI, the percentage of patients seen one month after intervention and the severity of SSI.

Results of leader research

The Table 1 shows the result of the identification of a leader for a department X entering the benchmark process.

In the last step, the description of the processes used by the Leader are queried for information to Dep. X. Corrective steps and reengineering may be adopted in the view of these processes and lead to improvement of Dep. X.

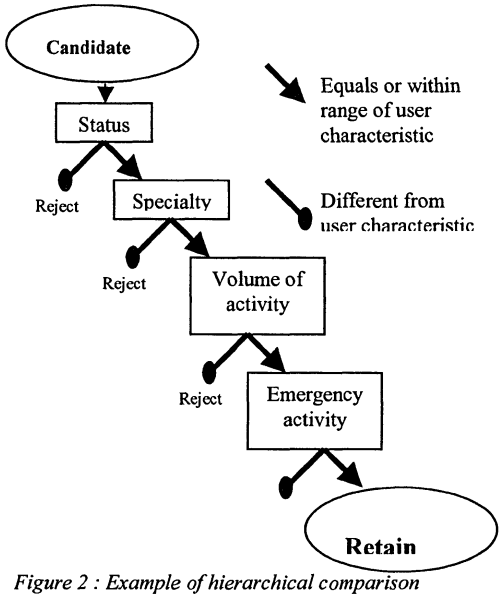

Figure 2 : Example of hierarchical comparison procedure for competitors determination.

4. Discussion

We have described the architecture for an information system dedicated to benchmarking, and given an example with application to surgical site infection.

In this approach, we used the traditional description used in quality assurance since Donabedian's seminal work : Structure, Process and Outcomes[2]. This description encompasses most quality related aspects, but does not explicitly take into account variation in patient recruitment. Indicators of Case Mix, considered in the description of actors is therefore warranted to allow fair comparison of outcomes between healthcare organizations.

While there is good agreement that all the components of the quality of care are addressed in Donabedian's definition, how to best define standards is still debated[15]. Carefully choosing standards is however critical, since conclusions from the comparison of professional performance to these standards, may only have an impact if the standards are accepted. Benchmarking solves this problem by allowing each participant to define its own set of standards, by comparison with leaders.

While the selection of competitors and leaders appears unsupervised, it must be recalled that the definition of competitors, and then leaders, is the result of applying externally defined rules to the data provided by all participants. This assures that the selection of leaders would be consistent for two participants with the same characteristics. In the selection of competitors, the statistical significance of differences in similarity measures is not considered. This issue is clearly important, as it would limit the identification of "leaders by chance". However, in benchmarking, processes of the leaders are not to be merely transposed, but rather adapted to fit in one's setting. Last, the set of rules may be altered if it is found that the selection procedure is not working appropriately.

We chose to report one leader among all competitors. The definition of leaders could however be broadened, to include several competitors performing better than the user. This

would allow proposing several ways to improve performance, corresponding to the processes reported in the group of leaders.

In the framework described, actors are expected to enter benchmarking on a voluntary basis. While a fair description of one's structures, processes, outcomes and case-mix is expected, the simplicity of the reported items should also limit subjective bias. Indeed, it is now regulatory in France to report SSI; the NNIS score is calculated using the type of surgery (clean/contaminated), the ASA score and the duration of the intervention, and is therefore unlikely to be observer dependent; and selective reporting of patients would be identified by low percentage of patients seen one month after the intervention.

Table1: Characteristics of a surgical department X used in the benchmark process and of the Leader identified from the set of its competitors.

Item	Dep. X	Leader
Structure		
Status	Universitary	Universitary
Specialty	Digestive	Digestive
Activity (# interventions / month)	65.3	80.7
Case-Mix		
Emergence (%)	23.3	32.9
Ambulatory (%)	0.0	1.8
Outcomes		
% patients seen after 1 month	31.6	69.5
SSI rate	7.6	2.4
Severe SSI (%)	30.8	25

Quality assurance is a continuous process. Within the framework described here, incremental changes may be brought to the processes in one department, leading to improved outcomes. The surgical department would then enter a new phase of surveillance, during which its performance would be registered in the database. This dynamic change in the database would allow the department to renew its benchmarking procedure with the identification of new leaders.

5. References

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