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A methodology of healthcare quality measurement: a case study

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Abstract. In this paper we present a comprehensive model for quality assessment taking into account structure, process and outcome dimensions introduced in the Donabedian framework. To test our hypothesis a case study based on the Italian healthcare services is reported focusing on the analysis of the hospital bed management and on the phenomenon of both active and passive patient mobility.

1. Introduction

The demand of high quality healthcare services is constantly increasing due to global demographic changes such as higher life expectancy with greater disease complexity. However, the current budget reductions make it necessary to optimize resources, improve organization and procedures, maintaining and/or improving the quality of healthcare service delivery. Additionally the continuous introduction of administrative and legal constraints (although oriented to improve services) further complicates the consolidation of good practices.

In this framework the identification of quality indicators is essential to assess healthcare services identifying strength and weakness, also to improve their efficiency and effectiveness. To perform this task it is necessary to collect data from different sources, classifying them homogeneously and maintaining them over time, thus building a robust model for their acquisition, analysis and presentation. This can help organizations to develop scientific tools, methods and statistics for rapid, accurate and predictive assessment of the efficacy, quality and safety of health. Moreover, this can support the management to improve the results and reduce the time to introduce further innovations (time-to-value). Different kind of indicators have been proposed in the literature [1], generally focused on specific aspects of healthcare delivery (disease-specific, rate-based or sentinel, etc.). In this paper we follow the widely accepted methodology proposed by Donabedian [2, 3] who combines several issues, related to the organizational structure, processes, and outcomes, in a comprehensive model [4]. In particular, the health system is split in four conceptual components: mission, structural capacity, processes and outcomes, all interacting with the macro context [5,6]. This approach has the advantage to measure quality on each dimension of the healthcare system (structure, process and outcome). As a



matter of fact research on a suitable methodology to determine proper indicators and the relationship among them is still in progress.

Thus with the final aim of developing a comprehensive model for quality assessment that takes into account these three dimensions and their dynamic relationship, in this paper we test our hypothesis on a case study based on the Italian healthcare services. In particular we focus on the evaluation of efficacy and performance based on the analysis of the hospital bed management.

2. Methods

As said the Donabedian framework has the advantage to measure quality on each dimension of the healthcare system. However, its application needs not only a homogenous classification of indicators related to the healthcare structure, process and outcome, but also a coherent acquisition of data that are usually collected in different information systems and for various purposes [7]. For instance hospital information systems provide information on the staff employed (number of physicians, nurses, technicians) as well as on facilities available (number of beds, diagnostic equipment, etc.), while information on clinical outcome usually derive from hospital discharge forms.

In this paper the proposed methodology is based on the following steps:

- Analysis of available open data sources provided by national authorities and relevant granularity and consistency of data provided.
- Selection of reliable, coherent and suitable set of data according to the purpose of the study.
- Identification of a sound method(s) suitable to match the data available with the three dimensions identified in the Donabedian framework.
- Definition of a case study to verify the reliability of the proposed approach.

3. Materials

For the purpose of our study it is crucial to identify the information sources and flows to select reliable and consistent data to build indicators of each dimensions of the Donabedian framework.

In Italy the Ministry of Health requires a standard set of data to be sent by the hospital information systems that report data on each intervention of a single patient. The Ministry of Health also collects data describing facilities and staff of the healthcare services. This information has recently become freely available for third users following the open data principles, even if with some delay in publishing them.

In this paper we take into account:

- The database of the national healthcare service, which provides statistical data on the territorial healthcare assistance, the personnel employed as well as the healthcare facilities in each local health unit [8].
- The national database of hospital admissions that stores demographic and clinical information about the admissions recorded in Italy. Data are collected based on the discharge report forms [9].
- The National Program of Outcomes Evaluation provides outcome information on the basis of the previous database [10].

Moreover, the data warehouse published by the ISTAT (National Institute for Statistics) [11] has been analyzed to determine overall indicators such as life styles, health conditions and causes of death as well as the population size.

4. Results

4.1. Hospital bed management

To analyse the interaction between structure and process we identify a set of data that meet the requirements of reliability, coherence and adherence related to the efficiency of health structures aggregated at regional level, focusing in particular on the hospital bed management.

To achieve this aim we adopt the Barber and Johnson method [12] to construct a scatter diagram, where data related to structure (number of beds,) and process (in-patient days, , and patient discharges,) are combined to build the following indicators:

- Beds occupancy rate (BOR): percentage of inpatient beds occupied over a specific temporal reference. , where indicates the number of inpatient days available in the given number of days () ;
- Average length of stay (AvLOS): average number of days that inpatients remained in the hospital. ;
- Turnover interval (TOI): average number of days that an available bed remains empty between the discharge of one inpatient and the admission of the next. ;
- Beds turn over (BTO): average number of patients “passing through” each bed during a period. .

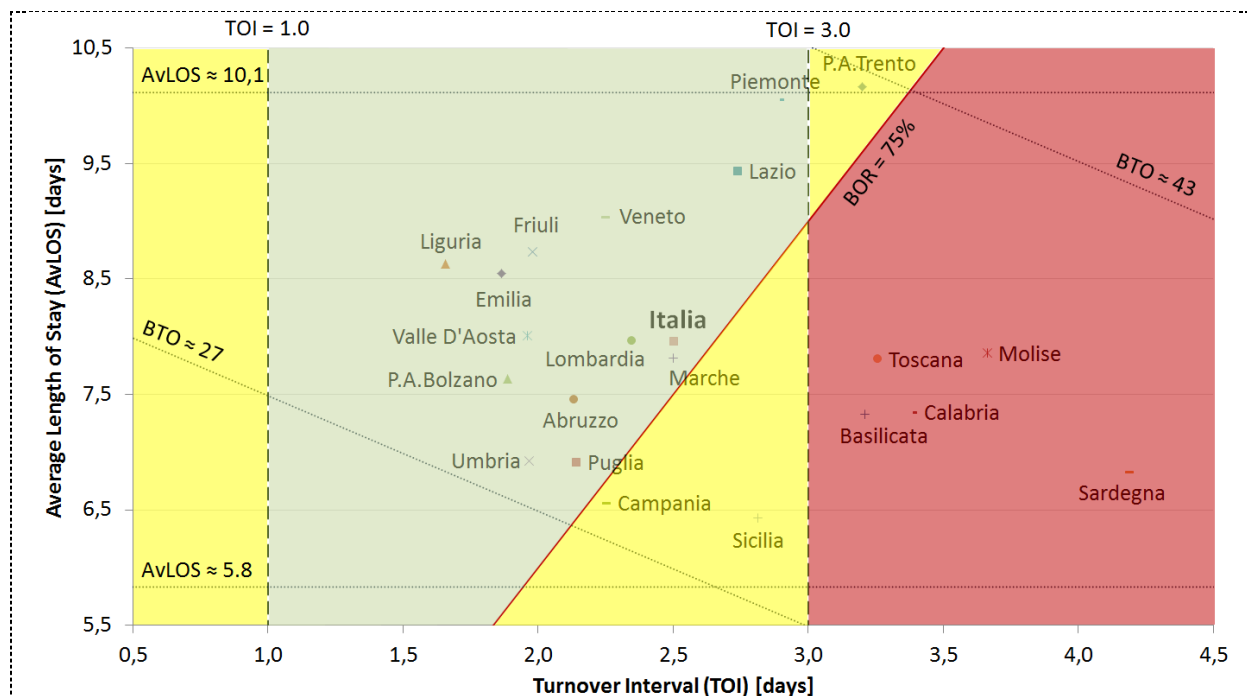


Figure 1. Barber-Johnson diagram of bed level of use distributed by Italian regions. Acceptability area depicted in green is determined considering reference values of turn over interval (TOI = 1.0 and 3.0, green dashed lines) and bed occupancy rate (BOR = 75%, red line) as proposed by national and international guidelines. Moreover, for BTO and AvLOS the average values plus/minus two standard deviations of the overall regions are reported.

Figure 1 shows the hospital bed management distributed by Italian regions, highlighting the reference values of TOI and BOR indicators as proposed by national and international guidelines. Moreover, BTO and AvLOS reference values are also reported considering the average plus/minus two standard deviations of the overall regions, given that these indicators refer to specific hospitalization and diagnosis and do not have general threshold. The reference values of TOI and BTO have been used to identify the following efficiency areas: 1) the red one that identifies regions where both TOI and BOR are outside the reference threshold (e.g. Sardegna); 2) the yellow area that reports regions where either TOI or BOR are outside the threshold (e.g. respectively P.A. Trento and Sicilia) and 3) the green area that identifies regions where both indicators are within the reference thresholds (e.g. Liguria).

4.2. Inter-regional mobility assessment

In order to develop a comprehensive model for quality assessment that takes into account the three dimensions of the proposed framework (i.e. structure, process and outcome dimensions) we further extend the proposed approach integrating the above mentioned indicators with clinical outcome information that take into account the effectiveness of the different healthcare systems in the provision of care services. The analysis of this information has been focused on the 21 regional healthcare systems given that the Italian National Health Service is a regionally decentralized tax-funded system, mainly based on regional budgets thus creating separate and autonomous regional health services.

Thus in the evaluation of singular regional health system a crucial phenomenon is represented by patient mobility that is considered an important marker to assess the supply and demand of services provided. Moreover, this is an appropriate indicator in Italy considering that patients can freely decide the hospital where to be admitted and the choice is essentially determined by distance from home, hospital specialization, waiting lists as well as quality in the supply of care services.

Although it is difficult to classify this indicator in the three pillars proposed in this paper we adopt it to represent the degree of the patient's satisfaction with the specific regional healthcare system focusing the attention on both demand and supply factors in each region and distinguish between pull and push factors. The former describes the ability of a region to attract patients from other regions, whereas the latter describes the ability of a region to restrain the outflows.

To examine the patient flows of each region the mobility index (M) has been assessed as follows, where:

- I , the inflow rate is the percentage ratio between non-enrolees admitted and the total number of admissions in a given region and
- O , the outflow rate is the percentage ratio between enrolees of a given region admitted in other regions and the total number of admissions of enrolees of the region).

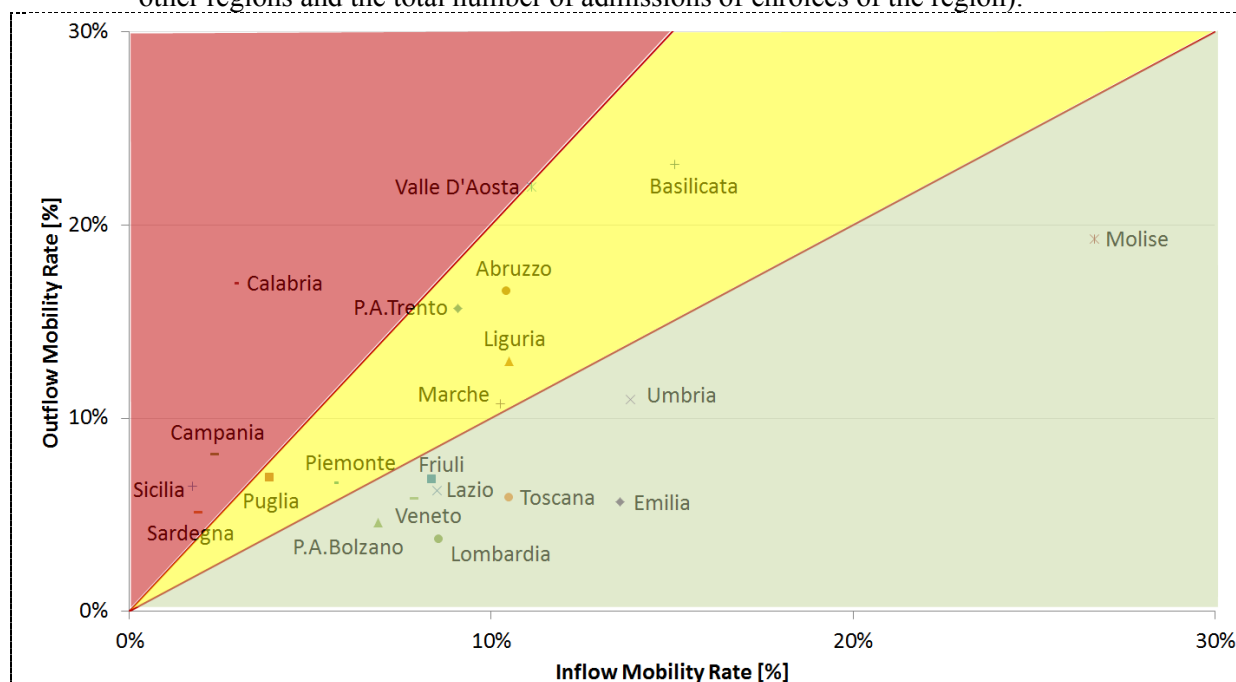


Figure 2. Scattered diagram showing both inflow (abscissa) and outflow (ordinate) mobility rates. Acceptability area depicted in green identifies regions where the inflow mobility rate is higher than the outflow one thus specifying where the mobility index is higher than 1.

Figure 2 shows the distribution of Italian regions considering both inflow and outflow rates. As already reported in the Barber-Johnson diagram, each region has been classified in the following areas: 1) the red one identifies regions where the mobility index is lower than 50% (e.g. Calabria); 2)

the yellow area reports regions where the mobility index is higher than 50% but lower than 100% (e.g. Abruzzo) and 3) the green area identifies regions where the mobility index is higher than 100% (e.g. Toscana). In particular regions classified in the green area are “net importers” of patients from other regions, thus being able to offset the outflows with larger inflows.

5. Conclusions

In this paper we propose a methodology based on a comprehensive model for quality assessment integrating structure and process indicators. In particular, for the analysis of healthcare organizational structure we focused on hospital bed management using Barber and Johnson method, while for the analysis of processes we considered the phenomenon of both active and passive patient mobility. The integration of these aspects referred to the 21 Italian regions allows a more detailed analysis of supply and demand of healthcare services, providing on the one hand a comparative analysis of the regional systems and on the other highlighting some important aspects that could help managers to introduce changes and improvements in the organisation of hospital services.

In the future we intend to extend our analysis integrating other outcome indicators to capture the impact of healthcare service provision on health and wellbeing of patients and population. Moreover, we plan to use other information, such as demographic and geo-referenced data to investigate patient mobility also considering the speciality healthcare services, such as cardiology and gynaecology.

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