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Spie charts, target plots, and radar plots for displaying comparative outcomes of health care

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Abstract

Objective: Comparative evaluations of clinical outcomes (e.g., in-hospital mortality, complications after a surgical procedure) or health care processes involve the definition of several indicators for each study unit. Graphical displays are best suited for highlighting the main patterns in the data. The aim of this study was to compare different graphical techniques, including target plots, radar plots, and ''spie'' charts, for comparing the performances of different health care providers.

Study Design and Setting: Thirteen indicators were calculated and combined in eight composite indices for eight clinical categories of interest. The indices were displayed with target plots, radar plots, and ''spie'' charts.

Results: All the three techniques had an immediate interpretation and were easy to implement. However, target plots failed to highlight small differences between indicators, whereas radar plots were strongly influenced by the order in which the indicators were displayed. Both target and radar plots assumed equal weights for the indicators, and did not allow predetermined judgments on the relative importance of the indicators. ''Spie'' charts overcame the primary limitations of the other two techniques. Furthermore, they are well suited to summarize the overall performance of a health care provider with a single score.

Conclusion: ''Spie'' charts represented the best graphical tool for displaying multivariate health care data in comparative evaluations of clinical outcomes and processes of care among health care providers.

Keywords: Outcome research; Health care data; Graphic display; Multivariate analysis; Radial plots; Performance indicators

1. Introduction

Over the last decade, there has been increasing interest in the development of performance indicators to promote accountability and quality improvement in health care services [1−4]. In its broadest sense, a performance indicator is a quantitative measurement of the ''quality'' of a function provided by health services. These measures evaluate different aspects of the system and reflect different objectives. For example, ''process'' measures are used to assess the delivery of care processes that are recommended in clinical guidelines; such as whether an intervention was performed within 48 hours from a hip fracture. In addition, ''outcome'' measures are used to evaluate the effectiveness of health care processes; such as changes in the 30-day mortality after hospital admission [5,6]. Sometimes, process indicators are used as surrogates of outcome indicators when they are known, a priori, to be strongly associated [7].

Several reports have described outcome and process indicators that evaluate the quality of care for specific conditions (e.g., acute myocardial infarction [AMI]) [8−13]. Health care professionals are generally interested in specific indicators; but providers, policy makers, or citizens may require a synthesis of complex information; for example, the combined results of several indicators for a given condition or for different diseases in a specific clinical category (e.g., cardiovascular category).

Data visualization techniques are very powerful tools for synthesizing information and providing insight into complex data [14]. Different graphical techniques range from simple bar charts and pie charts, which compare values over time or under different conditions, to more complex radial plots that synthesize multivariate health care data. The more complex graphical charts are particularly useful in assessing large numbers of independent variables that may be expressed with different measurement scales [15−17].

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What is new?

1. We illustrated the strengths and weaknesses of frequently used graphical techniques for displaying multivariate health care data in the context of comparative evaluation of clinical outcomes among populations or health care providers.
2. We determined that the ''spie'' chart was able to distinguish data subtleties missed by other graphical techniques, in terms of clarity, intuitiveness, and completeness of the information displayed.
3. We suggest that the ''spie'' chart is the best alternative for graphically presenting clinical outcome indicators for comparative evaluations among health care providers or populations.

A radial plot displays several indicators simultaneously in a circular format. Radial plots compose of radii that project from the center, and length of an individual radius corresponds to the measured value; these values are sometimes connected to form an enclosed shape.

A particular radial plotting technique, called the ''radar plot,'' has been frequently used for graphing multivariate data in the health care field [14,18]. It is easy to implement with the most common software; however, the interpretation of the results strongly depends on the ordering of the indicators being displayed, and the presence of missing information for some indicators is impossible to distinguish from the ''zero'' value for other indicators.

A similar representation, the ''target plot,'' has been used to simultaneously display multiple performance indicators at the level of single services, providers, or populations [19]. In the target plot, indicators of good performance are close to the center, and indicators of poor performance are close to the target periphery. It has an immediate interpretation; however, it becomes obscure when many indicators are displayed at the same time, especially when several have values close to the center of the graph.

A ''spie'' chart is a combination of two superimposed pie charts. One pie chart serves as a base, and its partitions set the angle of each slice. The purpose of this partitioning is to indicate the relative weights (relevance) of the different slices of the pie. The second pie chart is superimposed on the first, with the same angles for the partitions, but the indicator is expressed by changing the length of the radius. This technique overcomes the main limitations of the target and radar plots, and is flexible enough to allow the definition of different weights to the indicators displayed, according to some predetermined judgment of the relevant ''importance'' of the clinical outcomes or process they represent. However, because the interpretation of the results strongly depends on the relative importance of the indicators displayed, the a priori criteria should be carefully defined and clearly stated.

The aim of this article was to investigate the pros and cons of target plots, radar plots, and ''spie'' charts to determine which was best suited to summarize outcomes and processes of health care for comparative evaluations of clinical performance among populations or health care providers.

2. Materials and methods

2.1. Population

The study population on which the three graphical techniques were tested composed of all hospital admissions for specific conditions, within the health care facilities of the Lazio Region, Italy, from 2006 to 2008. All patients were residents of the Lazio Region. The following conditions were investigated, representing eight specific clinical categories:

1. Cardiovascular: AMI;
2. Cardio-surgical: coronary artery by-pass graft (CABG);
3. Cerebrovascular: stroke;
4. Respiratory: chronic obstructive pulmonary disease (COPD);
5. Digestive system surgery: cholecystectomy for cholelithiasis or gallbladder;
6. Scheduled surgery: any surgical procedure;
7. Obstetrics: delivery without previous cesarean sections;
8. Orthopedics: hip fracture.

The clinical categories were classified on the basis of their diagnosis-related groups (DRGs) (codes available on request).

2.2. Outcome and process indicators

The following indicators were defined and calculated for each hospital in the Lazio Region. The *outcome* indicators refer to the endpoint of the hospitalization/procedure, and the *process* indicators relate to institutional adherence to specific clinical guidelines:

1. Cardiovascular:
   - 30-Day mortality after an AMI (outcome indicator);
   - Proportion of AMI cases treated with percutaneous transluminal coronary angioplasty within 48 hours of hospital admission (process indicator);
2. Cardio-surgical: 30-day mortality after a CABG procedure (outcome indicator);
3. Cerebrovascular:
   - 30-Day mortality after a stroke hospitalization (outcome indicator);