An Innovative Contribution to Health Technology Assessment

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Abstract. Healthcare is moving towards increased assistance needs with limited resources, both in economics terms, in personnel or space terms, leading to the usage of specific analysis for the acquisition, evaluation and assessment of medical technologies. The systematic evaluation of properties, effects or other impacts of a medical (or health) technology with a broad multidisciplinary approach is named Health Technology Assessment (HTA).This work presents an approach of a HTA protocol for the classification of hospitals or health facilities equipments, realized by combining the classic HTA concepts with hierarchic clustering techniques in a multidisciplinary analysis of requirements, cost, impact of logistics, technology associated risks.

Keywords: Health, Assessment, Facility, Multi-criteria approach, Decision making.

1 Introduction

The main purpose of HTA is to assist policymaking for technology in health care to achieve the most advantageous resource allocation, evaluating the efficacy and the efficiency of the diagnostic and therapeutic pathways as well as related risks and organizational models.

HTA consists in identifying an analytical methodology that allows the optimization of the product adoption/evaluation process, through a careful study of the effective needs of the users, of the available alternative technologies and the relative operational implications on the setup.

This kind of evaluation requires an interdisciplinary approach of "policy analysis", studying the aspects of safety, cost, benefits, effectiveness, and also include critical evaluations of the actual measures and improving the quality of life.

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HTA methodology implies to recognize the actual healthcare needs and evaluate how technologies may answer to those needs while considering the overall implication of their use including the associated risks.

It may address the direct and intended consequences of technologies as well as their indirect and unintended consequences.

HTA practices have become widespread and are increasingly present in health systems, so that more and more healthcare facilities monitor the global impact of their medical technologies.

The fundamental step of an HTA process can be summarized, as well as in a technology assessment, in some main steps that include:

- the *identification* of the assessment object/topic in order to clarify:
  - the problem addressed by the technology;
  - real clinical needs (needs assessment);
  - requirements or constraints the technology under investigation has to fit.
- the *evaluation* of the technology that for HTAs has to include:
  - the collection of key data in terms of general impact: technical, clinical, social, ethical as well as economical; it involves the comparison of different technologies according to criteria of quality, evaluating the clinical efficacy (benefits), safety, clinical outcomes, costs of the entire life cycle of technology;
  - the analysis of all the collected data and the technology rating;

This process, and its multidisciplinary evaluations, characterize (or it should do) all HTA processes.

- the *synthesis* phase includes:
  - the consolidation and synthesis of all the analysis in order to give a synthetic overview of the assessment results;
  - the production of recommendation on the applicability and adoption of the technology;

However, as in every dynamic process, monitoring the effectiveness of the assessment conclusion helps in refining methodologies and in assuring the correctness of the decision adopted.

2 Literature Review

During past decades, health care systems of industrialized countries have focussed on the problem of assuring health services to all citizens while reducing the allocation of economic resources.

To achieve both the subsistence of the essential health services and the reduction of sanitary costs, almost every state engaged in policies aimed at rationalizing the use of resources by acting on the efficiency of organizations in strengthening service delivery as well as introducing elements of competition between producers or prioritization of health care services to ensure to citizens through public funding. (Sackett, 1980; Battista and Hodge, 1989).

The need to evaluate the effectiveness of different diagnostic and therapeutic protocols and technologies compared to the suffering population and, at the same time, the need to a complete knowledge of the service delivery costs originated a multidisciplinary research area called "Health Technology Assessment". (Battista and Hodge, 1999).

Technical information needed by policymakers is frequently not available, or not in the right form. A policymaker cannot judge the merits or consequences of a technological program within a strictly technical context. He has to consider social, economic, and legal implications of any course of action.

3 Problem Solution

The protocol has been structured following a hierarchical assessment approach, similar to AHP (Saaty, 1980, Saaty, 1982, 1990), based on the definition of the goal to achieve, the criteria and evaluation parameters and their relative and global incidence in the overall decision.

A hierarchical breakdown of the problem in N different criteria (or cluster), which groups properties and attributes of alternatives, helps in a better evaluation of the problem itself.

For each cluster are then recognized properties or attributes (or cluster elements) in a variable number. It is worth mentioning that, in health environments, these properties and attributes are not always directly and objectively measurable (i.e. revenues versus degree of patient technology acceptance) and, in order to obtain a comprehensive and concise assessment reducing subjective bias, these are aggregated together in clusters.

The non-objective measurable parameters/attributes can also be quantified and then made comparable by using expert opinions expressed in linguistic variables and converted into numerical values (usually using the ordinal scale used in AHP and a pairwise comparison procedure with the aim of producing a square matrix, whose element aij indicates the relative importance of the element with respect to criteria A_j).

Synthetic assessment of the degree of importance of the single A_j with respect to the others (weights) are calculated by normalizing the global importance of individual factors, i.e. the sum of each element of a row, with respect to the sum; it keeps unchanged the relationships between the factors and makes the sum of all weight obtained equal to 1, which is mathematically convenient in weighted sums.

Assuming gather experts evaluations so that $a_{ik} = a_{ij} * a_{jk}$ (i. e. assuming to know n-1 matrix elements and obtaining the remaining matrix elements from the properties of consistency and reciprocity) is not necessary to evaluate the AHP technique Consistency Index C.I. (CI) as it has supposed a perfect consistency in judgments (C.I. = 0).

Weights obtained are aggregated together with the hierarchical Saaty's composition principle, which allows a priority listing of alternatives to the goal.

In our case the final equipment classification is obtained by scoring the equipment based on the evaluated importance of the criteria and their properties which helps in correctly combining the specific characteristics/condition of the equipment under investigation.

Based on this principle, the overall score of the generic alternative A with respect to the goal may be expressed as:

$$C = \frac{\sum_{i=1}^{k} P_i \cdot V_i}{\sum_{i=1}^{k} P_i} \tag{1}$$

where:

k is the cluster numbers
P_i is the weight of cluster
V_i is the total score of equipment with respect to i-cluster
C is the total score of equipment

$$V_j = \frac{\sum_{j=1}^{n} p_j \cdot v_j}{\sum_{j=1}^{n} p_j} \tag{2}$$

where:

n is the element numbers
p_j is the weight of element j with respect to cluster
v_j is the score of element j
V_j is the total score of equipment for that criteria

Finally, the process ends with a classification of the equipment based on its specific score; in particular, since we hypothesized four different alternatives, classification is achieved choosing three different thresholds and comparing the obtained equipment score with those values. In case of partial evaluation (that is the evaluation based only on some cluster) the sum will include only the aspect under investigation.

4 Conclusions

Technology assessment cannot replace the clinical governance decision makers as these topics are often related to variables dependent on their sensitivity; however, HTA certainly improve management processes through a more effective use of information and knowledge available.

HTA leads to a wider risk analysis and a better health needs assessment, it makes possible an extensive knowledge of the technology characteristics, its effects on individuals health, its economic and/or organizational impact and may allow:

- improved selection processes: for the selection of technologies to adopt through an explicit comparison between the “needs” (health needs, resources available);
- efficient management of procurement processes, since a better understanding of the overall characteristics of the technology can enhance negotiation skills in dealing with suppliers;

– the preparation of all the organizational, professional and financial resources necessary for effective and efficient use of technology in order to increase the level of performance provided.

Generally, HTAs are mainly related to technology or equipment purchase; results are presented in the form of reports or indicators to help decision makers in their conclusions.

However, in our knowledge few of them have been dedicated to a classification of the overall state of hospital equipments especially with relocation/donation purposes.

The proposed methodology, based on the requirements and constraints often suggested by decision makers themselves, provides an indicator (a numerical value) through which the equipment may be classified; using the algorithm all the information associated with the assessment are synthesized to allow managers in easily getting an overall picture of capital equipment state and usage implications in the hospital facility.

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