The Measurement of Environmental Performance in Hospitals: A Framework and Process

PASQUALINI BLASS, A. [a,c*], GOUVÊA DA COSTA, S. E. [a,b], PINHEIRO DE LIMA, E. [a,b], BORGES, L. A. [c]

a. Industrial and Systems Engineering - Pontifical Catholic University of Parana – PUCPR, Curitiba, PR, Brazil

b. Federal University of Technology – Parana, Curitiba, PR, Brazil

c. UNIDAVI, Rio do Sul, SC, Brazil

**Corresponding author, apasqualini@unidavi.edu.br*

Abstract

Since the publication of the Brundtland Report (1987), academics and practitioners have raised concerns on the measurement of environmental sustainability performance. In the healthcare sector, especially in hospitals, measuring environmental performance relates to the reduction of environmental impact and continuous improvements in the quality of processes and outcomes. The literature review highlighted concerns on the lack of strategic focus of performance indicators, relevance and robustness of metrics and difficulties for the deployment of measures within different hierarchical levels. New frameworks are necessary to define relevant and meaningful indicators for monitoring and assessing environmental performance if healthcare systems and operations are to be improved. Moreover, field studies conducted with 10 hospitals in the Southern region of Brazil underlined the scarcity of consistent frameworks applied in practice to measure, monitor and improve environmental performance. Considering this context, the study seeks to propose an alternative framework drawn from the review of literature and current legislation. The proposed framework is operationalized through a 'process approach' and evaluated in terms of feasibility (can the process be followed?), usability (is the approach easily followed?), utility (are the results useful for managers?).

Keywords: Healthcare Operations. Environmental Performance. Measurement. Hospitals. Framework

1. Introduction

Organizations have been urged to internalize concerns related to the use of their productive resources and rationalize the impact of their processes on the environment since the publication of the Brundtland Report (Kleindorfer et al., 2005). New regulations have forced hospitals and similar organizations to promote environmental sustainability through a more systematic and selective manner (Tudor et al., 2005). According to Porter (2010), enhanced performance in any sector depends on the existence of a common goal for activities and interests of different stakeholders. In healthcare, this goal is associated with the definition of value represented by the patients' health outcomes by the unit of currency invested in the process. If this value is improved, patients, managers, service providers and suppliers can benefit from it while the sustainability of the healthcare system is also improved.

Meaningful indicators encompass concerns on the quality of healthcare services (Kanji and Moura e Sá, 2003). Quality improvements tend to lead to less waste of resources, improvements in patient satisfaction and medical care effectiveness (Maki et al., 2008). Healthcare indicators are represented by measurable and explicitly defined items related to structures, processes and outcomes of service provision (Campbell et al., 2002). Pressures for cost reduction and quality improvements have been linked with a stricter legal framework. This context has forced healthcare professionals and hospitals to reexamine the way performance is evaluated (Castañeda-Méndez et al., 1998). Although efforts related to improving environmental sustainability performance in healthcare have been put in place, outcomes have been unsatisfactory (Philips et al., 2002). In developing countries such as Brazil, healthcare operations face major challenges including high costs of healthcare services, limited productive resources, inadequate infrastructure and structure (e.g. access to clean water, electricity), lack of public investments and strategically focused governmental policies. These issues emphasize difficulties associated with the measurement of sustainability in healthcare.

Considering this context, the study seeks to develop a meaningful framework that can be used in practice by hospital managers. The paper is divided in five main sections in addition to the Introduction. The research methods used in the study are discussed in the second section. Section 3 summarizes the literature review and the feedback from the field studies. The fourth section describes the proposed framework and process. Final considerations are summarized within the last section.

2. Research methods

Aiming to achieve further insight into the practice of environmental performance measurement, field studies were conducted in 10 hospitals in the Southern region of Brazil. Field studies include one or more visits to the facilities of an organization without involving a lengthier period for interaction (Gupta et al., 2006). The general manager of each hospital was interviewed. The interviewing guide contained the G3 Environmental Dimensions proposed by the Global Reporting Initiative (GRI, 2006). A theoretical framework was developed, using the literature review findings and feedback from the field studies. As the existence of a framework does not guarantee its application (Gouvea da Costa et al., 2006), a three-stage process based on the Cambridge approach (Platts, 1993) was also developed.

3. Environmental performance measurement in healthcare organizations

3.1 Healthcare operations and performance measurement

The United Kingdom National Health Service (NHS) produces 600.000 tons of clinical, pharmaceutical, infectious and domestic waste at a cost of 42 million pounds every year (Coote, 2002). Service efficiency and effectiveness have been required from the healthcare sector (Weir et al., 2009). Healthcare is represented by an open system of hospitals, private clinics and consultants, which is subject to several influences such as social, economic, political and technological. In the healthcare sector, the provision of public and private healthcare services coexists.

A significant number of frameworks have tried to overcome the complexity of the performance measurement process. Difficulties associated with the quantification of information and disregard for performance measurement systems already in place have been reported by literature. A multiple stakeholder perspective has been indicated as one of the most important characteristics that contribute to the success of performance evaluation models, considering the complexity of healthcare operations (Tawfik-Shukor et al., 2007). Performance indicators should represent a source for benchmarking and strategic planning. Specific indicators characteristics are required to measure performance efficiently (Feng and Joung, 2011). Such characteristics include:

- Measurability: an indicator should be capable of measuring quantitatively or qualitatively multidimensional perspectives;
- Relevance: indicators should present useful meaning for the evaluation processes;
- Clarity: an indicator should be easily understood by the community, especially those that are not experts;
- Reliability: information proposed by an indicator should be reliable and useful;
- Data accessibility: an indicator should be based on accessible data;

- Opportunity: the measurement of an indicator should happen with the frequency that allows an informed and well-timed decision-making process;
- Long term view: an indicator should be compatible with an open pattern that supports the need for recorded information for future generations.

Metrics are vital elements to measure performance, since potential difficulties can be indicated by the gap metric-standard (Melnyk et al., 2004), especially regarding issues related to sustainability (Gunasekaran et al., 2001). Nonetheless, the existence of a framework that deals with the deployment of measures and metrics in strategic, tactical and operational levels to include tangible, intangible, financial and non-financial aspects is questioned in the literature (Gunasekaran and Spalanzani, 2012). Metrics mentioned by Zhu and Sarkis (2004) include reductions of air emissions and waste of water, increased investments in training and 'green' purchases, and reduced costs with waste treatment and energy consumption.

Hardi and Pinter (1995) argue that indicators that aggregate heterogeneous dimensions are not readily available to be considered in the decision-making process. Often they aggregate dimensions that are not comparable and, when they are, the evaluation based on the perception of stakeholders should be careful. Organizational decision processes guided by a reduced set of indicators may require substantial structural changes. This restrictive process may lead to the selection of indicators related to very specific, less meaningful and non-representative targets. For instance, despite the wide scope of indicators proposed in the applications of the Balanced Scorecard (Kaplan and Norton, 1992) in healthcare organizations, environmental performance indicators are not usually declared. When environmental measures are present, they tend to refer to existing regulations and/or sustainability programs.

3.2 The Brazilian Regulatory Framework for Hospitals and Environment

Nine regulating documents deal directly or indirectly with the hospital waste control and disposal. The evaluation of organizations that provide healthcare services NA2 Rev. 01 of 6 March 2006 is mandatory to acquire Hospital Accreditation with the National Organization for Accreditation (ONA, abbreviation in Brazilian Portuguese). The National Environment Council (CONAMA) and the National Health Surveillance Agency (ANVISA) have specific resolutions. CONAMA Resolution 358 (29 April 2005) approaches the need to treat and dispose of waste from healthcare. ANVISA Resolution 306 (7 December 2004) addresses the management of waste from these services. The Brazilian Technical Standards Association (ABNT) has issued six standards on hospital waste. The ABNT legislates on waste transport (NBR 14652, 11 July 2013); methods for the collection of perforating/cutting materials (NBR 13853, de 30 June 1997); internal and external collection of waste under hygienic and safe conditions (NBR 12810, 1 April 1993); classification of materials and definition of terms (NBR 12808, 1 April 1993, and NBR 12807 of 15 June 2013, respectively); required procedures for the intra-establishment management of healthcare services waste (NBR 12809 of 19 May 2013).

In spite of existence of a legal framework, Da Silva et al. (2005) concluded from a study on 91 healthcare facilities in Brazil, including two hospitals, 48 health centers and 22 clinical laboratories that the practice, in most cases, do not comply with current legislation. Existing regulations are yet to produce better environmental performance (Nazar et al., 2005). In addition, the scarcity of regulations that define the consumption of other resources such as water, electricity and fuel in Brazilian hospitals is noteworthy. In recent years, some initiatives have tried to address the disposal of liquid waste with the creation of Eco-centers and Treatment Facilities for Effluents (Vieira et al., 2013). Concerns on measurement environmental performance are regarded as insufficient and limited due to a reduced number of issues (La Forgia and Couttolenc, 2008).

4. Environmental performance measurement frameworks applied in Brazil

The British National Healthcare System (NHS) represents one of the most recognizable performance measurement frameworks described in literature. Potential benefits from waste separation and recycling have been emphasized by hospitals and other institutions within the system. This acknowledgement promoted new initiatives for efficiency and effectiveness improvements (Tudor, 2007). Indicators such as Kilograms per solid waste by patient bed/day or Kilograms of solid waste per

appointment, per day have been suggested (Oliveira, 2003). There is significant consensus in literature a number of indicators are necessary to capture all the important aspects of a particular system. Performance indicators should represent an integrated information network. Performance indicators raise issue awareness and understanding; inform the decision-making process; and measure the achievement of goals (Ventura et al., 2010).

The Syrian Lebanese Hospital (Hospital Sírio Libanes – HSL, in Brazilian Portuguese) is a hospitals philanthropic complex and one of the main medical centers in Brazil and Latin America. HSL adopts an environmental performance measurement framework based on quality programs. The program has generated, since its launching, yearly savings of one million cubic meters of water and 679 tons of paper; 19 tons of glass, 23 tons of aluminum and 101 tons of plastic have been recycled (Bio2 Sustentabilidade, 2012). The environmental management project focuses on two primary objectives: better utilization of input material (e.g. water, electricity and gas) and management of waste and reuse of produced waste. Its indicators focus on waste generation and process inputs consumption.

The 'Global Green and Healthy Hospitals Agenda' is another example of environmental performance framework applied in Brazil. The model was created by the coalition 'Salud Sin Daño' (Health Care Without Harm), an international network of healthcare systems, hospitals, communities, unions and environmental organizations. The framework has 10 main objectives related to leadership, chemicals, waste, energy, water, transportation, food, pharmaceuticals, buildings and purchasing (GGHHA, 2015). The global agenda of the framework presents a comprehensive list of objectives and actions that can be implemented in the search for environmental performance improvements, but does not present guidelines on how to develop specific indicators.

Current legislation has also prompted frameworks to measure healthcare sustainability performance. That is the case with the Manual of Hospital Accreditation (MS, 2002) used in Brazil. Nonetheless, it represents an incipient guide to present meaningful indicators adjusted to the healthcare environment. The existence of indicators is recommended without systematic guidance. Three main aspects are observed: general maintenance, waste and water potability.

ISO 14001, more specifically ISO 14031 for performance evaluation, constitutes another model used in healthcare services in Brazil. It lists principles that are periodically verified and evaluated for re-accreditation. ISO 14001 aims to promote the environmental accreditation of organizations. Dimensions such as pollution of waters, lands and air are verified. Brazilian Hospital Albert Einstein (Hospital Israelita Albert Einstein - HIAE, in Brazilian Portuguese), the most modern private hospital in Latin America with five units located in São Paulo represents a certified organization. Its Environmental Management System has built commitment to environmental issues; a more rational use of water, electricity and resources has been produced (SBIB, 2012).

The Global Reporting Initiative (GRI) methodology is based on a voluntary initiative to standardize sustainability reports. Indicators related to the three dimensions of sustainability are suggested within its guidelines that are also adopted by HIAE. Regarding the environmental dimension, indicators are listed and goals are monitored in terms of (1) materials, (2) energy, (3) water, (4) biodiversity, (5) emissions (6) effluents and waste, (7) products and services, (8) compliance, (9) transport, (10) overall (expenditure and investments in environmental initiatives), (11) supplier environment assessment and (12) environmental grievance mechanisms. The indicators suggested by GRI encompass essential aspects of environmental performance (Morhardt et al., 2002). Moreover, GRI guidelines have been promoted by the United Nations Environment Programme (UNEP). It is regarded as the most prominent reporting guide due to its focus that goes beyond the environment performance measurement to include a balanced approach of financial and social issues leading to sustainability.

5. The proposed framework and process

5.1 The developed framework

Indicators should satisfy one or more stakeholder groups (McGlynn, 1997). Scientific soundness and applicability should be achieved. Three aspects are known to address scientific soundness: reliability, validity and adjustability. Reliability relates to the replication of the measurement producing similar

results. Validity refers to the measurement of quality related to healthcare. Adjustability involves the use of other factors apart from quality that will influence the measurement of results. Applicability entails a consistent choice by managers, covering a number of areas and services. It involves parsimony and comprehensiveness (Wilcock and Campion-Smith, 1998).

Although a number of models and indicators to measure environmental performance have been proposed in literature, initiatives related to the environmental sustainability tend to lack strategic focus. The main purpose behind these initiatives has been connected with regulations, accreditation requirements and elements pertaining to quality programs. The deployment of measures in different hierarchical levels has become troublesome due to lack of strategic focus (Fiksel et al., 1999). Furthermore, existing challenges related to the measurement of environmental performance in hospitals are emphasized in developing countries such as Brazil. The field studies conducted in Brazilian hospitals as part of the study emphasized the scarcity of consistent frameworks to measure environmental performance. The feedback points raised in the interviews with General Managers and the literature review findings were used to develop the framework. These points became 'content guidelines' for the framework and associated process. Table 1 lists these guidelines, their implications for the framework and supporting references.

Tab. 1. Framework content guidelines

Content Guidelines	Implications	Supporting References
Performance measurement systems should be developed, implemented and evaluated.	The framework should be developed considering three phases: conception, implementation and analysis.	Bititci et al. (1997); Bourne et al. (2000); Neely (2005).
Performance measurement should be connected with organizational goals.	The environmental performance measurement system should be linked to the strategic focus of the organization.	Bititci et al. (1997); Otley (1999); Fiksel et al. (1999); Kaplan and Norton (2001); Bourne et al. (2000); Wongrassamee et al. (2003); GRI (2006).
The performance measures should be deployed in three organizational levels**:** strategic, tactical and operational.	The environmental performance measurement system should encompass different organizational levels.	Platts (1993); Gunasekaran and Spalanzani (2012); Weir et al. (2009); Feedback from field studies.
Legal Requirements	The field research and literature review indicate the need to fulfil environmental regulations.	McGlynn (1997); Townend and Cheeseman (2005); Veleva et al. (2009); Townend et al. (2009); Yang et al. (2009); Feedback from field studies.
Performance indicators should be developed based on criteria such as measurability, validity and controllability.	Measures should be reliable in order to characterize the environmental performance of hospitals.	Neely et al. (2002); Tawfik-Shukor et al. (2007); Van De Geer et al. (2009); Feng and Joung (2011).
Evaluation of indicators	Performance indicators should be evaluated in terms of the purpose for their conception.	Becker (1997); Bossel (1999); Bourne et al. (2000); Neely (2005).
Monitoring of strategic goals	Collected data should be analyzed to evaluate the achievement of strategic goals.	Bititci et al. (1997); Bourne et al. (2000); Neely (2005).
Environmental reporting	Through performance evaluation reports, it is possible to characterize the environmental performance of hospitals.	Bourne et al. (2000); Neely (2005); Montabon et al. (2007).

The framework is composed by a three-phase process: (1) Conception; (2) Implementation and (3) Analysis. As previously mentioned, the Cambridge approach was adopted to develop the process. The approach is defined by 5Ps (Platts et al., 1998): Purpose, Procedure, Project Management, Participation, and Point of Entry. Apart from these elements, the 'process approach' encompasses strategies used in the manufacturing audit. Activities prescribed in the process are performed during workshops (WH) using a seminar format and worksheets (WS) to record the collected information. Interviews with key actors are also employed in the data gathering. The process is evaluated by participants after each stage in terms of feasibility, usability and utility. Figure 1 represents the developed framework.

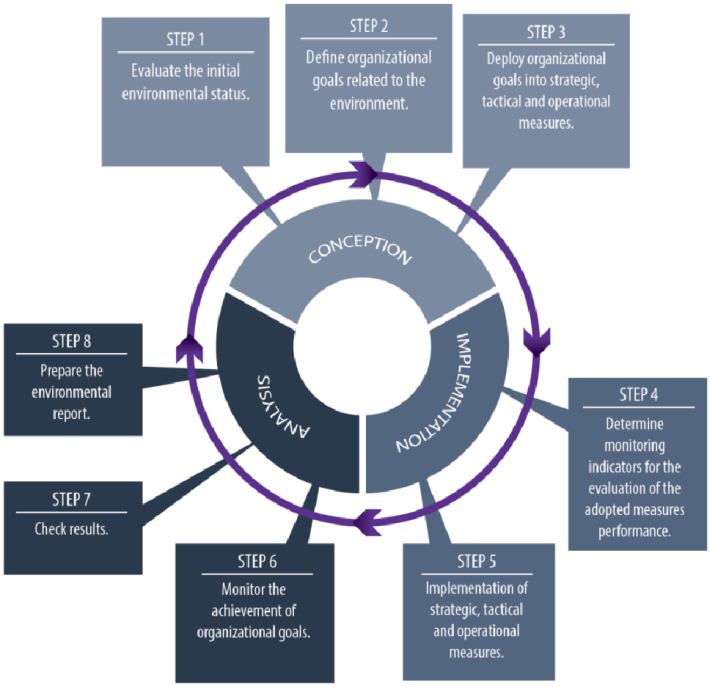

Fig. 1. The proposed framework

5.2 The process

In each stage of the process, worksheets are used to record performed tasks. The process comprises three phases, eight steps and 15 worksheets. Every worksheet is related to a purpose and represents input for the next stage.

Step 1: Evaluate the initial environmental status.

In order to elaborate organizational goals, an initial evaluation of the hospital environmental current status is necessary. The environmental dimensions indicated by the G4 Global Reporting Initiative Guidelines (2014) are used to address significant aspects of environmental performance: (1) Materials; (2) Energy; (3) Water; (4) Biodiversity; (5) Emissions, Effluents and Waste; (6) Products and Services; (7) Compliance; (8) Transport; (9) Overall; (10) Supplier Environmental Assessment; (11) Environmental Grievance Mechanisms. The fulfilment of the Brazilian legal requirements is also verified. Successful experiences reported in literature are used to evaluate the initial status of the hospital operations as best practices also impact on performance and tend to guide learning and corrective feedback (Rosen et al., 2008). The existence of a formalized hospital environmental strategy is examined.

Step 2: Define organizational goals related to the environment.

To establish a consistent strategic focus, the hospital environment strategy (when existent and formalized) is used to define organizational goals. In the absence of such strategy, organizational goals are determined from the list of crucial aspects to be observed.

Step 3: Deploy organizational goals into strategic, tactical and operational measures.

These measures are related to tasks that should be performed in order to achieve organizational goals. Actions are deployed into the strategic (high administration), tactical (managerial) and operational (staff in general) levels to attain goals.

Step 4: Determine monitoring indicators for the evaluation of the adopted measures performance.

Monitoring indicators to evaluate the achievement of goals are proposed for each measure/task. The definition of indicators is based on the following principles: measurability, validity and controllability.

Step 5: Implement strategic, tactical and operational measures.

After determining monitoring indicators and existing information sources for the performance measurement, measures are communicated to the responsible areas so that necessary action is taken.

Step 6: Monitor the achievement of organizational goals.

The measurement includes timely performance evaluations. Monitoring actions allow the reflection on the development of organizational goals and successful implementation of strategies.

Step 7: Check results.

The analysis of organizational performance is performed within this step. It is possible to consider reviewing organizational goals and/or identify the reasons why goals were not achieved.

Step 8: Prepare the environmental report.

Data is compiled and presented to the high administration. The report is then communicated to remaining stakeholders.

6. Final considerations

Literature and practice has shown that the formalization of performance measures across organizations is still scarce. Systems already in place are often overlooked when new metrics are established. Regarding performance measurement frameworks, the lack of guidelines on the development and selection of performance indicators was also identified in the study. The external public has been focused while internally sustainability indicators are composed by dimensions that are not comparable, restrict, and even insignificant. In consequence, the application of frameworks for the environmental performance measurement has been far from satisfactory. In light of the importance of performance measurement for the healthcare sector, especially in hospitals, more robust frameworks are required. Measures that can raise awareness, continuous improvement and innovation in organizational processes are necessary. The study represents a starting point in proposing a meaningful framework to measure environmental sustainability in hospitals within the Brazilian setting. The process will be applied in six hospitals in the Southern region of Brazil and evaluated in terms of its feasibility, usability and utility for managers.

References

Bio2 Sustentabilidade. 2012. Projeto de Gestão Ambiental - Hospital Sírio Libanês. Available at http://www.agendasustentavel.com.br/Case.aspx?id=555 (accessed date March 1, 2012).

Bititci, U. S., A. S. Carrie, L. McDevitt. 1997. Integrated performance measurement systems: a development guide. International Journal of Operations & Production Management, 17(5), 522-534.

Bossel, H. 1999. Indicators for sustainable development: theory, method, applications. Winnipeg: International Institute for Sustainable Developmen.

Bourne, M., Mills, J., Wilcox, M., Neely, A., Platts, K. 2000. Designing, implementing and updating performance measurement systems. International Journal of Operations & Production Management, 20(7), 754-771.

Campbell, B., Sayer, J. A., Frost, P., Vermeulen, S., Ruiz-Pérez, M., Cunningham, A., Prabhu, R. 2002. Assessing the performance of natural resource systems. Conservation Ecology, 5(2), 22.

Castañeda-Méndez, K., Mangan, K., Lavery, A.M. 1998. The role and application of the balanced scorecard in healthcare quality management. Journal for Healthcare Quality 20(1), 10-13.

Coote, A. (Ed.). 2002. Claiming the health dividend: unlocking the benefits of NHS spending. King's Fund.

Da Silva, C. E., Hoppe, A. E, Ravanello, M.M., Mello, N. 2005. Medical wastes management in the south of Brazil. Waste Mnagement, 25(6), 600-605.

Feng, S. C., Joung, C.B. 2011. A measurement infrastructure for sustainable manufacturing. International Journal of Sustainable Manufacturing 2(2), 204-221.

Fiksel, J., McDaniel, J., Mendenhall, C. 1999. Measuring progress towards sustainability principles, process, and best practices. In Greening of Industry Network Conference Best Practice Proceedings, Available at http://www. economics. com/images/Sustainability Measurement GIN. Pdf (accessed date June 1, 2012).

GGHHA. 2015. Global Green and Healthy Hospitals Agenda. Available at http://hospitalesporlasaludambiental.net/ (accessed date January 10, 2015).

Global Reporting Initiative. Sustainability Reporting Guidelines, Version 3.0, GRI. 2006. Available at http://www.globalreporting.org (accessed date July 1, 2012).

Gouvêa Da Costa, S. E., Platts, K. W., Fleury, A. 2006. Strategic selection of advanced manufacturing technologies (AMT), based on the manufacturing vision. International Journal of Computer Applications in Technology 27(1), 12-23.

Gunasekaran, A., Spalanzani, A. 2012. Sustainability of manufacturing and services: Investigations for research and applications. International Journal of Production Economics 140(1), 35-47.

Gupta, S., Verma, R., Victorino, L. 2006. Empirical research published in production and operations management (1992–2005): trends and future research directions. Production and Operations Management 15(3), 432-448.

Kanji, G., Moura e Sá, P. 2003. Sustaining healthcare excellence through performance measurement. Total Quality Management and Business Excellence 14(3), 269-289.

Kaplan, R. S., Norton, D.P. 1992. The balanced scorecard – measures that drive performance. Harvard Business Review 70(1): 71-79.

Kaplan, R.S., Norton, D.P. 2001. Transforming the balanced scorecard from performance measurement to strategic management: Part I. Accounting Horizons 15(1), 87-104.

Kleindorfer, P. R., Singhal, K., Wassenhove, L. N. 2005. Sustainable operations management. Production and Operations Management 14(4), 482-492.

La Forgia, G. M., Couttolenc, B. 2008. Hospital performance in Brazil: the search for excellence. World

Bank Publications.

Maki, J., Qualls, M., White, B., Kleefield, S., Crone, R. 2008. Health impact assessment and short-term medical missions: A methods study to evaluate quality of care. BMC Health Service Research 8, 121-128.

McGlynn, E. A. 1997. Six challenges in measuring the quality of health care. Health Affairs 16(3), 7-21.

Montabon, F., Sroufe, R., Narasimhan, R.. 2007. An examination of corporate reporting, environmental management practices and firm performance. Journal of Operations Management 25 (5), 998-1014.

Morhardt, J. E., Baird, S., Freeman, K. 2002. Scoring corporate environmental and sustainability reports using GRI 2000, ISO 14031 and other criteria. Corporate Social Responsibility and Environmental Management 9(4), 215-233.

MS - Ministério da Saúde. 2002. Manual Brasileiro de Acreditação Hospitalar. Brazilian Manual of Hospital Accreditation, Series A, Standards and Technical Manuals 117, 3rd Edition, Reviewed and Updated, 109p.

Nazar, M. W., Pordeus, I.A., Werneck, M.A.F. 2005. Gerenciamento de resíduos sólidos de odontologia em postos de saúde da rede municipal de Belo Horizonte, Brasil. Revista Panamericana Salud Publica 17(4), 237-242.

Neely, A. 2005. The evolution of performance measurement research: developments in the last decade and a research agenda for the next. International Journal of Operations & Production Management 25(12), 1264-1277.

Oliveira, J. M. 2003. A questão dos resíduos de serviços de saúde na administração hospitalar. EnANPAD 27, Atibaia/SP, Proceedings.

Otley, D. 1999. Performance management: a framework for management control systems research. Management Accounting Research 10(4), 363-382.

Phillips, P. S., Holley, K., Bates, M.P., Freestone, N.P. 2002. Corby Waste Not: an appraisal of the UK's largest holistic waste minimisation project. Resources, Conservation and Recycling 36(1), 1-31.

Platts, K. W. 1993. A process approach to researching manufacturing strategy. International Journal of Operations & Production Management 13(8), 4-17.

Platts, K. W., Mills, J. F., Bourne, M.C., Neely, A.D., Richards, A.H., Gregory, M.J. 1998. Testing manufacturing strategy formulation processes. International Journal of Production Economics 56, 517-523.

Porter, M. E. 2010. What is value in health care? New England Journal of Medicine 363(26), 2477-2481.

SBIB - Sociedade Beneficente Israelita Brasileira. 2012. Programa Einstein de Sustentabilidade, Einstein Sustainability Program. Available at http://www.einstein.br/sobre-a-sociedade/sustentabilidade/Paginas/programa-de-sustentabilidade.aspx (accessed date June 3, 2012).

Tawfik-Shukor A. R., Klazinga, N.S., Arah, O.A. 2007. Comparing health system performance assessment and management approaches in the Netherlands and Ontario, Canada. BMC Health Services Research 7, 25-37.

Townend, W. K., Cheeseman, C., Edgar, J., Tudor, T. 2009. Factors driving the development of healthcare waste management in the United Kingdom over the past 60 years. Waste Management & Research 27(4), 362-373.

Tudor, T. L. 2007. Towards the development of a standardised measurement unit for healthcare waste generation. Resources, Conservation and Recycling 50(3), 319-333.

Tudor, T. L., Noonan, C. L., Jenkin L.E.T. 2005. Healthcare waste management: a case study from the National Health Service in Cornwall, United Kingdom. Waste Management 25(6), 606-615.

Van der Geer, E., Van Tuijl, H. F., Rutte, C.G. 2009. Performance management in healthcare: performance indicator development, task uncertainty, and types of performance indicators. Social Science & Medicine 69(10), 1523-1530.

Ventura, K. S., Reis, L. F. R., Takayanagui, A. M. M. 2010. Avaliação do gerenciamento de resíduos de serviços. Engenharia Sanitária e Ambiental 15(2), 167-176.

Vieira, D. S., Rodrigues, S. S., Picoli, R. L. 2013. Gestão Ambiental e Resíduos Hospitalares: Uma análise sobre a legislação vigente e a viabilidade de implantação dos Econcentros e ECTE no Distrito Federal. In IV Congresso Brasileiro de Gestão Ambiental, Salvador/BA, 25-28 November 2013.

Weir, E., d'Entremont, N., Stalker, S., Kurji, K., Robinson, V. 2009. Applying the balanced scorecard to local public health performance measurement: deliberations and decisions. BMC Public Health 9(1), 127.

Wilcock, P. M., Campion-Smith, C. 1998. Never mind the quality: feel the improvement. Quality in Health Care: QHC 7(4), 181.

Wongrassamee, S., Simmons, J.E.L., Gardiner, P.D. 2003. Performance measurement tools: the Balanced Scorecard and the EFQM Excellence Model. Measuring Business Excellence 7(1), 14-29.

Zhu, Q., Sarkis, J. 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operations Management 22(3), 265-289.