RESEARCH

Revista Brasileira de Enfermagem
REBEn

Evaluation of environmentally sustainable actions in the medication process

Avaliação de ações ecologicamente sustentáveis no processo de medicação

Evaluación de acciones ecológicamente sustentables en el proceso de medicación

Patrícia de Oliveira Furukawa[I], Isabel Cristina Kowal Olm Cunha[I], Mavilde da Luz Gonçalves Pedreira[I]

[I] *Universidade Federal de São Paulo, Nursing Paulista School, Postgraduate Program in Nursing. São Paulo, Brazil.*

How to cite this article:

Furukawa PO, Cunha ICKO, Pedreira MLG. Evaluation of environmentally sustainable actions in the medication process. Rev Bras Enferm [Internet]. 2016;69(1):16-22. DOI: http://dx.doi.org/10.1590/0034-7167.2016690103i

Submission: 12-17-2014 **Approval:** 08-30-2015

ABSTRACT

Objective: to analyze sustainable actions from an environmental point of view in the medication process, from the reception of the prescription of the pharmacy to waste discard by nursing. **Method:** study before and after performed through Lean Six Sigma methodology. The sample consisted of the amount and type of waste resulting from the pharmacy and nursing services of a medical-surgical clinical unit. **Results:** after the intervention was obtained at the pharmacy a reduction of 74.8% of chemical, infectious and sharps waste, an increase of 33.3% of common recyclable and 20% of common non-recyclable. In nursing, there was a reduction of 22.5% of chemical, infectious and sharps waste, an increase of 22.9% of common recyclable and an increase of 20% of common non-recyclable. **Conclusion:** the practice of sustainable actions in the hospital is possible, contributing to the optimization of resources and waste production with benefits to the institution, environment, and health.

Key words: Nursing; Pharmaceutical Preparations; Environment; Sustainable Development; Waste Management.

RESUMO

Objetivo: analisar ações sustentáveis do ponto de vista ambiental no processo de medicação, desde o recebimento da prescrição pela farmácia até o descarte de resíduos pela enfermagem. **Método:** estudo antes e depois realizado por meio da metodologia Lean Seis Sigma. A amostra constitui-se da quantidade e tipo de resíduos resultantes dos serviços de farmácia e de enfermagem de uma unidade clínica médico-cirúrgica. **Resultados:** após intervenção, obteve-se na farmácia uma redução de 74,8% dos resíduos químicos, infectantes e perfurocortantes, com aumento de 33,3% dos comuns recicláveis e de 20% de comuns não recicláveis. Na enfermagem houve uma redução de 22,5% dos resíduos químicos, infectantes e perfurocortantes, um aumento de 22,9% dos comuns recicláveis e um aumento de 20% dos comuns não recicláveis. **Conclusão:** é possível a prática de ações sustentáveis no hospital, contribuindo para a otimização de recursos e geração de resíduos, com benefícios à instituição, ao meio ambiente e à saúde da população.

Descritores: Enfermagem; Preparações Farmacêuticas; Meio Ambiente; Desenvolvimento Sustentável; Gerenciamento de Resíduos.

RESUMEN

Objetivo: analizar las acciones sustentables desde el punto de vista ambiental en el proceso de medicación, desde el recibimiento de la prescripción de la farmacia hasta el descarte de residuos por la enfermería. **Método:** estudio antes y después realizado por medio de la metodología Lean Seis Sigma. La muestra consistió en la cantidad y tipo de residuos resultantes de los servicios de farmacia y enfermería de una unidad clínica médico-quirúrgica. **Resultados:** después de la intervención, se obtuvo una reducción en la farmacia de 74,8% de los residuos químicos, infecciosos y de objetos punzantes, con un aumento de 33,3% de los comunes reciclables y de 20% de comunes no reciclables. En enfermería hubo una reducción de 22,5% de los residuos químicos, infecciosos y de objetos punzantes, un aumento de 22,9% de los comunes reciclables y un aumento del 20% de los comunes no reciclables. **Conclusión:** la práctica de acciones sustentables en el hospital es posible, contribuyendo a la optimización de recursos y la generación de residuos, con beneficios para la institución, al medio ambiente y a la salud de la población.

Palabras clave: Enfermería; Preparos Farmacéuticos; Medio Ambiente; Desarrollo Sustentable; Gestión de Residuos.

CORRESPONDING AUTHOR **Patrícia de Oliveira Furukawa** E-mail: patricia.furukawa@unifesp.br

INTRODUCTION

The theme of environmental sustainability, permeated by great concern with the scarcity of natural resources and the quality of life of all living beings, has been widely discussed nowadays by the scientific community. Presently, there is a worldwide movement in the research development aimed at reducing the environmental impact caused by human action. However, it is noted that these research are more related to other areas of knowledge, pointing up the need for more studies in health area[1-2].

Health services, especially hospitals, have several negative environmental effects that threaten health and human well-being[3]. In addition to the high resources consumption, one of the biggest problems related to this issue refers to waste. According to the National Survey of Basic Sanitation, not all Brazilian municipalities have specific collection services for the waste of health services. Its final destination, in the municipalities that collect and/or receive such waste, 61.1% have the waste in sewers or landfills, together with other waste, while only 24.1% of organizations informed having such waste in specific landfills for special waste[4]. Evidence also shows that climate changes and variations affect population health results[5-6]. Climate changes can have harmful effects on human health, threatening thus, the mission and services of hospitals[3].

One of the main assistance activities of a hospital is the medication process, which consists of various steps, such as prescription, revision, and validation of the prescription, dispensation, preparation, administration and monitoring of the patient to monitor the action or reaction of the medicine. All of these steps are directly interconnected and depend on professionals from different areas of knowledge (doctors, nurses, and pharmacists)[7].

However, health professionals still have not been involved with this cause. Data research shows that workers are unaware the impacts that their improper actions cause at population level, reflecting increased costs and environmental damage[8]. Another study shows that despite high percentages of staff have declared their intention to conserve properly, reuse and discard the materials, the actions were different from the desired behavior[9].

This study aimed to analyze the sustainable actions from an environmental point of view before and after interventions implemented in the medication process, from prescription receipt by the pharmacy to waste discard performed by nurses. For this, it was used the Lean Six Sigma methodology that provided theoretical and practical subsidies for the direction of the study.

The Lean system, whose origins date back to the Toyota Production System, seeks to eliminate waste, that is to exclude what has no value to the customer and print speed and efficiency to the company[10]. The Seis Sigma, developed by Motorola to improve the quality of industrial production in 1980, demonstrates the degree in which any process deviates from the target, that is, the process's ability to generate products within preset specifications[11]. These two methodologies have been implemented in an integrated way under the name Lean Six Sigma, for companies looking for better results regarding productivity and quality of their products or services[12]. The successful application of Lean Six Sigma has also been reported in health area as a method by which hospitals can improve their processes[13-14].

However, investigations in this area are justified by the need of research developing, leading practice sustainable actions from an environmental point of view in health services[1-2], contributing thus to the environment and consequently the health of current and future generations.

METHOD

Before and after study, developed in a large hospital, with 446 beds, located in São Paulo, Brazil. The study, performed between February and September 2010, involved the central pharmacy service and nursing service of a unit of a medical-surgical clinic.

As part of the use of Lean Six Sigma methodology was composed an interdisciplinary team of six professionals from the areas of nursing, pharmacy and environmental management, who participated in all stages of application of the project: definition, measurement, analysis, implementation of improvements and control process.

The independent variable involved strategies for improvement related to the practice of sustainable actions in the medication process relating to resource use and waste management. The dependent variable involved the practice of sustainable actions from an environmental point of view in the medication process. The measurement of the shares considered sustainable was through outcome: kg/type of waste/patient. For this, the sample consisted of the amount and type of medical waste generated in the analyzed units.

As a research tool, an institutional spreadsheet waste collection filled by the cleaning service was used, where was daily recorded the amount of waste generated in pharmacy and the medical-surgical clinical unit as classification: potentially infectious, chemical, common recyclable (paper, plastic, metal, and glass), common non-recyclable and sharps. In this spreadsheet, the potentially infectious, chemical and sharps waste were registered together.

The data referring to the phases before and after the implementation of process improvements were measured, corresponding to waste collected whitin 28 days of February 2010 and 30 days in August 2010.

For the analysis of the medication process, quality tools were used, as: Process Mapping with the identification of problems, Brainstorming, 5 Why's, Impact Effort Matrix and Effect Cause Matrix.

The identification of problems related to the promotion of environmental sustainability was performed in the pre-intervention phase, through the use of tools: Process Mapping, "Brainstorming" and "5 Why's"; each team member can express their knowledge and opinions about the possible root-causes of the problems. As the Lean Six Sigma methodology demand specific goals and deadlines for its

conclusion, it was necessary to prioritize the problems to be solved with the use of tools "Cause Effect Matrix" and "Effort Impact Matrix." Through the first tool, the impact of each problem on the outcome result was analyzed, that is, how much the problem impacted on the amount of waste generated by the service and in the second, the project team evaluated which problems had greater effect on the outcome with less effort related to the implementation of changes, data collection and time for analysis. From this, an action plan was elaborated with the description of the improvements to be implemented based on the root-causes, as the description of those responsible for executing them and deadlines for the conclusion.

After the interventions of the study, the statistical analysis of categorical variables by absolute frequency (N) and relative (%) data was performed.

RESULTS

Process Analysis

Through detailed mapping of the medication process, from prescription receiving by pharmacy service to the discard of waste performed by the nursing staff of the medical-surgical unit, it was identified 16 issues related to the practice of sustainable actions (Figure 1).

In general, the identified problems were related to the irrational use of resources such as labels, paper, packaging and medications, many medications returned and discarded at the pharmacy and incorrect discard of waste.

The main identified problems in order of priority, their root-causes, survey through the use of tools "Brainstorming" and "5 Why 's", as well as their respective improvement actions are presented in Box 1.

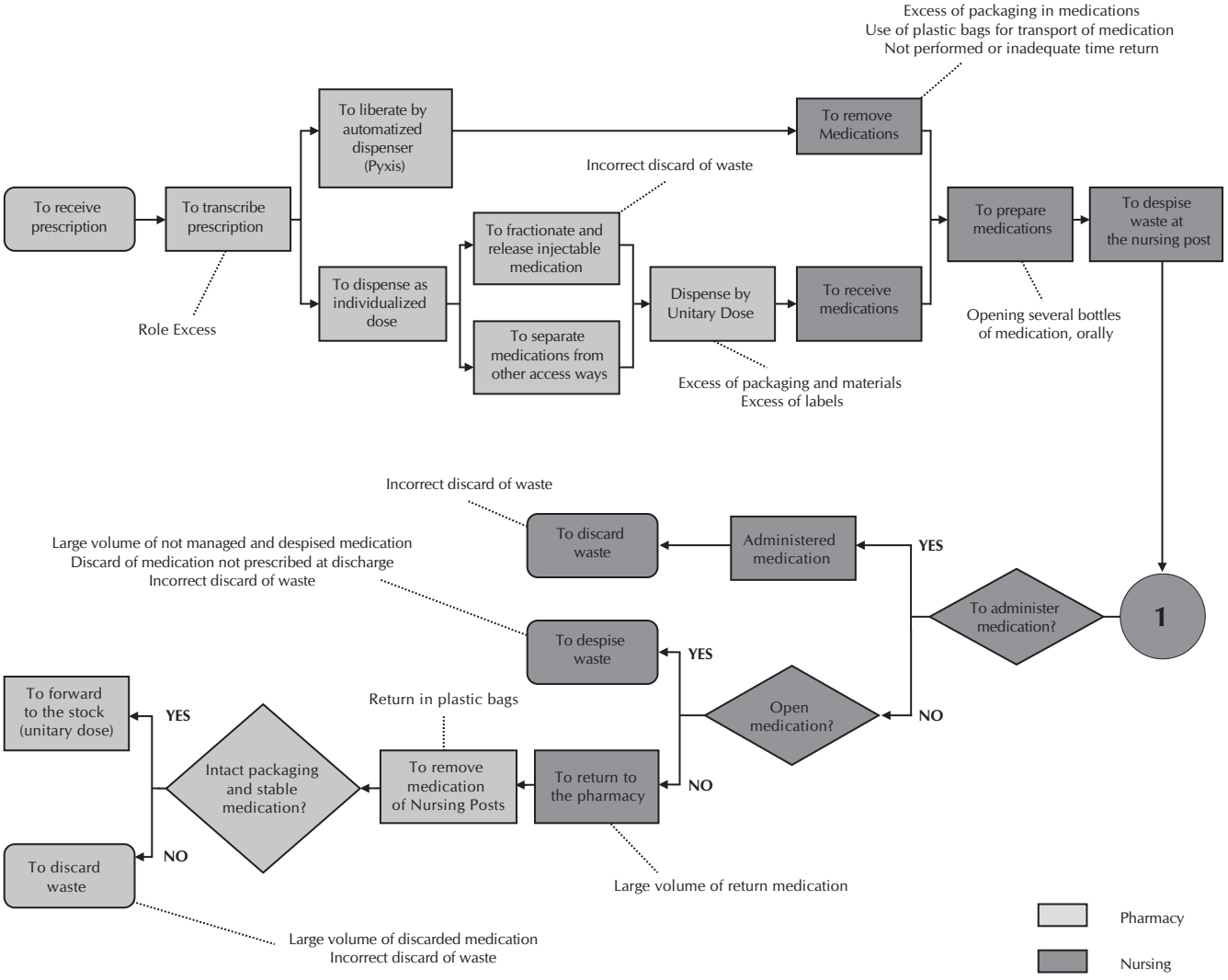

Figure 1 - Detailed map of the medication process with the identification of problems

Box 1 - Action Plan with the Description of the Problems, their Root-Causes and Implemented Improvement Actions in the Process of Medication

Problem Description	Root-Cause	Improvement Action
1. Incorrect discard of waste in handling sector Pharmacy	Few containers because of the risk contamination area and need of high productivity	To examine the available containers and discard in handling area
2. Incorrect discard of waste after administered medication	Lack of awareness and guidance to nursing employee	Online training, in unity and admission
3. Incorrect discard of dangerous chemical waste duos after the return of medications to the Pharmacy	Lack of standardization and acquisition of adequate container by the hospital	Using temporary containers with identification for dangerous chemical waste until the appropriate container be approved by the institution
4. Large quantity of medication returned to Pharmacy	Prescribing information not updated timely to prevent the dispensation of the medication by the pharmacy	Awareness of employees, training in the unit and admission
5. Large volume of medication discarded after returning to the Pharmacy	Medications are discarded because of medication stability and lack of use time control	To act about the discard of this wastes at the moment and verify with the Information Technology sector (IT) ways to control the time between the exit and the return of the medication
7. Packaging excess and materials in dispensing medications	To reduce the risk of loss and errors in the administration of the medication	To reduce excess of packaging without compromising the organization of medications
8. Use of plastic bags to return de medication to pharmacy	Lack of awareness and guidance to nursing employee	Awareness of employees, training in the unit and admission

Outcome Analysis

In pharmacy service, the quantification of residues before the implementation of the improvements was 0.08 kg/patient/day for chemical, infectious and sharps waste; 0.21 kg/patient/day for common recyclable waste and 0.20 kg/patient/day for common not recyclable waste. With the implementation of the improvements, the indicators were: 0.02 kg/patient/day for chemical, infectious and sharps waste; 0.28 kg/patient/day for common recyclable waste and 0.24 kg/patient/day for common not recyclable waste. In total, there were in the pharmacy a reduction of 74.8% of chemical, infectious and sharps waste, an increase of 33.3% in common recyclable waste and an increase of 20% of the common not recyclable waste.

At the nursing service, the first analysis showed a total of 1.16 kg/patient/day for chemical, infectious and sharps waste; 1.22 kg/patient/day for common recyclable waste and 1.46 kg/patient/day for common not recyclable waste. After the implementation of the improvements, chemical, infectious and sharps waste were 0.9 kg/patient/day, common recyclable waste 1.5 kg/patient/day and common non-recyclable waste were 1.75 kg/patient/day. In total, there were in the medical-surgical clinical unit a reduction of 22.5% of chemical, infectious and sharps waste; an increase of 22.9% in common recyclable waste; and an increase of 20% of the common not recyclable waste. Comparisons of indicators before and after the improvements implemented in the pharmacy and nursing services are represented through Figures 2 and 3.

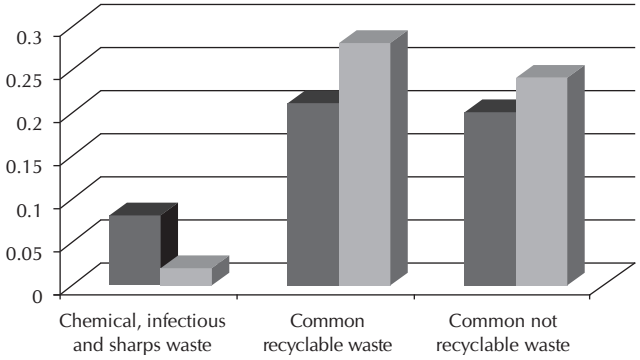

Figure 2 - Comparison of the indicators according to type of waste before and after implementation of improvements in pharmacy service

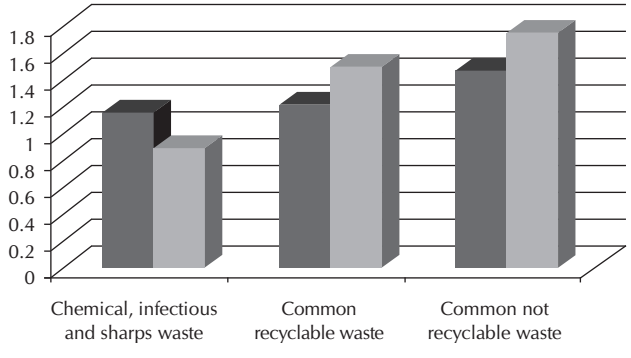

Figure 3 - Comparison of the indicators according to type of waste before and after implementation of improvements in nursing service in the medical-surgical clinical unit

DISCUSSION

Although the improvements implemented can be considered as simple for its applicability and resolution, they had positive effects on outcome results.

The difference of the results, which occurred mainly in the pharmacy service, is due to the fact that the analyzed nursing service of the medical-surgical clinical unit, had participated in another project related to segregation and discard of waste, indicating that changes in attitudes and behaviors have great importance in environmental sustainability in organizations, including health[2].

The problems identified in the practice of sustainable actions in the medication process as an irrational use of labels, paper, packaging, and medications confirm there are materials resources wastes in hospitals. This corroborates other research where the materials are the most cited as a source of waste, the main item medications, followed by paper used in printed[15-16].

The fight against waste beyond to contribute reducing the generation of waste also contributes to the reduction of institutions of material costs. To actively participate in sustainable development, such as reducing resources, can obtain direct economic benefits because such changes translate into cost savings for the hospital management, which can be used to improve the provided services[3].

In this study, the actions included not only the awareness and training of employees, but also corrections related to technology information and reduction in the excess of packaging involving medications. Before the implementation of the improvements, was often professionals put in action the incorrect printer to send the prescription to the patient to the pharmacy, thus being printed in another unit. This problem occasioned not only waste of paper, since it was necessary to reprint the prescription in the pharmacy, but also involved rework and delayed the liberation of medications. Also, configuration errors generated waste of blank paper and unused at the end of each prescription. Conserning packaging, the justification of separate and organize medications, there was a plastic exaggeration involving each drug, even if it were only related to one pill.

As for medications, as in the research institution, the majority is prepared in a central pharmacy inside the chapel of laminar flow and dismissed for the nursing service in unit doses; the returned medicines were discarded and not reused. Although the unit dose for distribution system presents greater advantages than other traditional systems – among them, the reduction of medication loss – it is observed that there is still much medication discard in the hospital area[17-18]. In this case, the root-cause analysis identified that the lack of control of the time between the exit and the return of the medicament to the pharmacy committed the guarantee of the medicament stability, having to be despised.

As it involved a wider improvement process, which could not be completed within the stipulated period for this project, following the *Lean Six Sigma* methodology, it was opted at first to act in the awareness and training of employees, in order to inform the changes in patients prescriptions as quickly as possible, avoiding the dispensation of medications by the pharmacy. Another action involved the discard of these returned medications until the pharmacy services and information technology seeks ways to control the time between the egress and the return of medications. It is agreed that, when to exist the opportunity for strategies of knowledge gaining about environmental problems or to minimize its impact, people have higher subsidies to reflect on their behavior, motivating them to build responsible actions for the environment[8].

Incorrect discard of waste observed in the study is a serious problem in Brazil and worldwide. Incorrect discard of infectious, chemical and sharps waste from health services represent contamination risks to workers and the community. It gets worse when it comes to medications that are considered dangerous chemical waste because of its active ingredient. Studies have detected the presence of drugs and sub-products in surface water, groundwater, drinking water and even inland subjected to the application of sewage mud, becoming important pollutants[19].

The lack of specific container for dangerous chemicals in the institution, by the requirements of the legislation in force in the country, raised difficulties all other management steps of this wastes, such as segregation, packaging, identification, transportation, storage, collection, and treatment[20-22]. Among medications residues considered dangerous under Brazilian law, can be cited: hormonal products; antimicrobials; cytostatics; antineoplastic; immunosuppressants; digitalis; immunomodulatory and antiretrovirals. When discarded improperly, they can be directly sent to the sanitary landfill, exposing urban sanitation workers and recyclers to direct contact with toxic agents, and facilitates environmental contamination. In other cases, dangerous chemical medications, when segregated as infectious and sent to heat treatment, besides not contributing to the reduction of chemical risk, promotes the liberation of toxic gasses and vapors[22]. So it was chosen to, as soon as, to identify provisionally containers for dangerous chemical waste until a suitable legislation container were subjected to testing, approved and ratified by the hospital.

On the other hand, something that is still observed in some hospitals is the paradigm that all waste from areas related to care is infectious or chemical, when in fact, there is much waste that can be discarded as ordinary waste or be reused and recycled for not presenting a risk to the environment and human health. Examples contained in this study are related to the pharmacy handling sector and the nursing service in the medical-surgical clinical unit, where large amount of paper and plastic that had no contact with the patient was discarded as infectious waste, generating higher costs to institution and impact on the environment due to the specific treatment it must be submitted. Aiming to waste properly discard, reducing the infectious waste, the containers were reviewed in these areas, providing locals for discard of common non-recyclable and recyclable waste, as well as educate and train employees.

In general, the problems of environmental sustainability identified in the medication administration process and the implemented improvement actions refer to the principles of the 3 R's (reduce, recycle and reuse) of the sustainable management of solid waste. Contained in 21 Agenda (global plan of action for achieving sustainable development) of the United

Nations[23]. The principles of the 3 R's following a hierarchy, to understand that causes less impact to avoid the generation of waste than recycling the materials after discard. So while the issue of medical waste management is extremely important, the environmental management of health services should involve and give priority also to other concrete actions of sustainable practices aimed at reducing waste generation and increasing the reuse of resources.

This study has some limitations. It is restricted to a geographical area and performed in a hospital engaged in issues related to environmental sustainability. As a reminder to health institutions, although it may serve as a reference, each institution should map and analyze their medication processes to identify opportunities for improvement. This study points to a direction in the search for best practices in the hospital, involving sustainable activities from an environmental point of view, with quality and safety in Nursing. There is still the need for more studies on the practice of sustainable actions developed by the Nursing team and the development of studies to evaluate the efficiency and effectiveness of interventions that contribute to the environmental sustainability of health services.

CONCLUSION

The significant results achieved in this study, from interventions in the medication process, allowed to conclude that the development of sustainable actions in the hospital is possible, thus contributing to the reduction of resources and the volume of generated waste, with benefits to the environment and human health and can also generate savings for the institution. For this, it is necessary to review and analyze the processes also from the point of view of environmental sustainability. The Lean Six Sigma methodology has proven to be an efficient method of management and process improvements, including in the matters related to this subject.

Nurses have an important role, as a disseminator of sustainable practices for their team, promoting the development of actions to reduce the impact on the environment in all nursing activities.

REFERÊNCIAS

1. Camponogara S, Kirchhof AL, Ramos FR. [A systematic review about the scientific production with focus on the relation between health and environment]. Ciênc Saúde Coletiva [Internet]. 2008[cited 2014 Nov 10];13(2):427-39 Available from: http://www.scielosp.org/pdf/csc/v13n2/a18v13n2.pdf Portuguese.
2. Camponogara S, Kirchhof AL, Ramos FR. A relação enfermagem e ecologia: abordagens e perspectivas. Rev Enferm UERJ [Internet]. 2006[cited 2014 Nov 10];14(3):398-404. Available from: http://www.facenf.uerj.br/v14n3/v14n3a11.pdf
3. Ulhoi JP, Ulhoi BP. Beyond climate focus and disciplinary myopia: the roles and responsibilities of hospitals and healthcare professionals. Int J Environ Res Public Health [Internet]. 2009[cited 2014 Nov 10];6(3):1204-14. Available from: http://www.mdpi.com/1660-4601/6/3/1204/htm
4. Brasil. Ministério do Planejamento, Orçamento e Gestão. Pesquisa Nacional de Saneamento Básico [Internet]. 2008[cited 2014 Nov 10]; Rio de Janeiro: IBGE, 2010. Available from: http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb2008/PNSB_2008.pdf
5. McMichael AJ, Woodruff RE, Hales S. Climate change and human health: present and future risks. The Lancet [Internet]. 2006[cited 2014 Nov 10];367(9513):859-69. Available from: http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(06)68079-3.pdf
6. Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of regional climate change on human health. Nature [Internet]. 2005[cited 2014 Nov 10];438(7066):310-7. Available from: http://www.nature.com/nature/journal/v438/n7066/pdf/nature04188.pdf
7. Cassiani SHB, et al. O sistema de medicação nos hospitais e sua avaliação por um grupo de profissionais. Rev Esc Enferm USP [Internet]. 2005[cited 2014 Nov 10];39(3):280-7. Available from: http://www.scielo.br/pdf/reeusp/v39n3/05.pdf
8. Camponogara S, Ramos FRS, Kirchhof ALC. Reflexivity, knowledge and ecological awareness: premises for responsible action in the hospital work environment. Rev Latino-Am Enfermagem [Internet]. 2009[cited 2014 Nov 10];17(6):1030-6. Available from: http://www.scielo.br/pdf/rlae/v17n6/16.pdf
9. Tudor TL, Barr SW, Gilg AW. Linking intended behaviour and actions: a case study of healthcare waste management in the Cornwall NHS. Resources, Conservation and Recycling [Internet]. 2007[cited 2014 Nov 10];51(1):1-23 Available from: http://www.sciencedirect.com/science/article/pii/S092134490600156X
10. Berlitz FA, Haussen ML. Seis Sigma no laboratório clínico: impacto na gestão de performance analítica dos processos técnicos. J Bras Patol Med Lab [Internet]; 2005[cited 2014 Nov 10];41(5):301-12. Available from: http://www.scielo.br/pdf/jbpml/v41n5/a04v41n5.pdf
11. Santos AB, Martins MF. Modelo de referência para estruturar o Seis Sigma nas organizações. Gest Prod [Internet]. 2008 [cited 2014 Nov 10];15(1):43-56. Available from: http://www.scielo.br/pdf/gp/v15n1/a06v15n1
12. Silva IB, Miyake DI, Batocchio A, Agostinho OL. [Integrating the promotion of Lean Manufacturing and Six Sigma methodologies in search of productivity and quality in an auto parts manufacturer]. Gest Prod [Internet]. 2011[cited 2014 Nov 10];18(4):687-704. Available from: http://www.scielo.br/pdf/gp/v18n4/a02v18n4.pdf Portuguese.
13. Koning H, Verver JP, Van Den Heuvel J, Bisgaard S, Does RJ. Lean six sigma in healthcare. J Healthc Qual [Internet]. 2006[cited 2014 Nov 10];28(2):4-11. Available from: http://www.researchgate.net/profile/Ronald_Does/publication/7034272_Lean_Six_Sigma_in_Healthcare/links/0046352284798852c5000000.pdf

14. Egan S. et al. Using Six Sigma to improve once daily gentamicin dosing and therapeutic drug monitoring performance. BMJ Qual Saf [Internet]. 2012[cited 2014 Nov 10];21(12):1042-51. Available from: http://qualitysafety.bmj.com/content/21/12/1042.long

15. Aranha GTC, Vieira RW. [Study of an indicative dos of the cost of the quality: the waste]. Rev Adm Saúde [Internet]. 2004[cited 2014 Nov 10];23(6):43-55. Available from: http://www.ufjf.br/oliveira_junior/files/2011/08/ARANHA-e-VIEIRA_2004.pdf Portuguese.

16. Castilho V, Castro LC, Couto AT, Maia FOM, Sasaki NY, Nomura FH, et al. Survey of the major sources of waste in the health care units of a teaching hospital. Rev Esc Enferm USP [Internet]. 2011[cited 2014 Nov 10];45(Esp):1613-20. Available from: http://www.scielo.br/pdf/reeusp/v45nspe/en_v45nspea12.pdf

17. Araújo SAN, Sabates AL. Aspectos facilitadores do Sistema de Distribuição de Medicamentos por Dose Unitária para a Enfermagem. ConScientiae Saúde [Internet]. 2010[cited 2014 Nov 10];9(1):47-58. Available from: http://www.redalyc.org/articulo.oa?id=92915037007

18. Lobo BL. Pharmacoeconomic considerations. Am J Health Syst Pharm [Internet]. 2003[cited 2014 Nov 10];60 (Suppl 7):511-4. Available from: http://www.ajhp.org/content/60/suppl_7/S11.long

19. McClellan K, Halden RU. Pharmaceuticals and personal care products in archived U.S. biosolids from the 2001 EPA national sewage sludge survey. Water Res [Internet]. 2010[cited 2014 Nov 10];44(2):658-68. http://www.sciencedirect.com/science/article/pii/S0043135409008446

20. Brasil. Ministério do Meio Ambiente. Conselho Nacional do Meio Ambiente - CONAMA. Resolução nº 358, de 29 de abril de 2005. Dispõe sobre o tratamento e a disposição final dos resíduos dos serviços de saúde e dá outras providências. Diário Oficial da União; Poder Executivo, de 04 de maio de 2005.

21. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária - ANVISA. Resolução da Diretoria Colegiada - RDC nº 306, de 7 de dezembro de 2004. Dispõe sobre o Regulamento Técnico para o gerenciamento de resíduos de serviços de saúde. Diário Oficial da União; Poder Executivo, Brasília, DF, de 10 de dezembro de 2004.

22. Brasil. Estado de São Paulo. Centro de Vigilância Sanitária. Divisão Técnica de Ações sobre Meio Ambiente. Portaria CVS nº 21, de 10/09/2008. Aprova a "Norma Técnica sobre Gerenciamento de Resíduos Perigosos de Medicamentos em Serviços de Saúde". Diário Oficial do Estado; Poder Executivo, São Paulo, SP, de 11 set. 2008.

23. Agenda 21. United Nations. Sustainable Development. United Nations Conference on Environment & Development [Internet]. Rio de Janeiro, Brazil, 3 to 14 June 1992 [cited 2012 Nov 12]; Available from: https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf