

**Evaluation of solid waste management at *El Buen Samaritano* first- level
Hospital in Bagua Grande – Amazonas, 2014.**

Evaluación del manejo de los residuos sólidos en el Hospital I El Buen Samaritano de Bagua Grande -
Amazonas, 2014

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Abstract

This research aims to describe the production and management of solid waste at El Buen Samaritano first-level Hospital of Bagua Grande, the knowledge of the hospital personnel and the environmental impact; all of them observed between July and December of 2014. This is a descriptive, cross-sectional and observational research. The hospital personnel were considered as the population. As instruments, a characterization chart and checklist described in the Peruvian Technical Standards of the Ministry of Health were used, as well as a questionnaire of biosafety awareness elaborated by the author and validated by experts, Cronbach's alpha tests and a Leopold matrix were used to the environmental impact evaluation. We discovered a 2.56 Kg per day rate with regard to solid waste creation; the solid waste management was efficient; the awareness level about biosafety was from regular to excellent in the health care providers, whereas regarding cleaning staff the awareness level was from regular to deficient; the more damaging activities to the environment were toxic waste spill, use of the incinerator, discontinuous trainings and the most affected parameter was occupational safety and health. It was concluded that a bad management of hospital solid waste exists due to the regulation given by the health care waste management is not followed.

Keywords: hospital solid waste; solid waste management; environmental health.

Resumen

Se describe la producción y el manejo de los desechos sólidos en el Hospital El Buen Samaritano de Bagua Grande, así como los conocimientos del personal del hospital, y el impacto ambiental, observados entre julio y diciembre del 2014. Estudio descriptivo, transversal y observacional. La población estuvo conformada por todo el personal del hospital. Se utilizó la ficha de caracterización y la lista de verificación descritas en la Norma Técnica del Ministerio de Salud del Perú, un cuestionario de conocimientos de bioseguridad elaborado por el autor y validado por juicio de expertos y test alfa de cronbach y la matriz de Leopold para evaluación del impacto ambiental. Encontramos que el índice de generación de residuos fue 2.56 Kg/cama/día; el manejo de residuos fue muy deficiente; el nivel de conocimientos sobre bioseguridad fue de regular a excelente en el personal asistencial, mientras que de regular a deficiente en el personal de limpieza; las actividades más nocivas para el ambiente fueron el derrame de residuos infecciosos, empleo del incinerador y capacitaciones discontinuas, y el parámetro ambiental más afectado fue salud y seguridad ocupacional. Se concluye que existe un manejo inadecuado de residuos hospitalarios debido a que no se cumple con la norma que rige la gestión de desechos sanitarios en nuestro país.

Palabras clave: Residuos sólidos hospitalarios; manejo de residuos sólidos; salud ambiental.

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Introduction

Hospital waste is considered dangerous due to potential infectious components which can transmit illnesses to hospital personnel, patients and community (Junco, 2000; Abarca, 2005). That is why the World Health Organization (WHO) stands out the importance and need of a solid waste management in order to protect national and worldwide public health (WHO, 1992).

National and international researches have shown that, despite the existence of regulations, hospital solid waste management is a problem to health institutions, principally because of their low compliance. A research carried out in Julio Criollo Rivas hospital, Venezuela, García and col. (2010) determined that only the 29.2% of the legislation is fulfilled, causing a deficient solid waste management. The same tendency was observed in a research carried out by López (2009) at Hospital Rodríguez IVSS Puerto La Cruz in Venezuela, where only the 40% of the established regulations are fulfilled. These results coincide with researches carried out in Peru: Curro (2007) determined that there is a low quality and deficient hospital solid waste management in three hospitals of the province of Ica: Hospital Regional, Hospital Santa María del Socorro of the Ministry of Health and Hospital III Félix Torrealva Gutiérrez of EsSalud.

In the same way, a research carried out in Hospital Cayetano Heredia by Cifuentes (2008) reported a hospital solid waste mishandling from the source to its disposal. The hospital solid waste management of Level I in EsSalud is unknown, especially in the Amazon region; this is what motivated this research to describe the solid waste management at the El Buen Samaritano

hospital of Bagua Grande, observed in the 2014. Results can contribute to decision-making which will assure the fulfilment of the regulations about solid waste management.

Methodology

A descriptive, cross-sectional research was carried out at *El Buen Samaritano* Hospital of Bagua Grande city from July through December of 2014. The establishment is a Base Hospital level I which belongs to an Assistance Network type C of Peruvian Social Health Insurance (EsSalud) and looks after 177166 people. The hospital outsources solid waste management with a contract with SILSA S.A. enterprise, which is in charge of the remodeling, inland transportation and final solid waste storage. The company hires personnel to recollect such solid waste and supplies trash cans and bags for the recollection and storage of solid waste, as well as personal protection equipment. It must be said that hospital personnel execute the segregation in each one of the following areas or services: emergency, hospitalization, operating room, delivery room, obstetric, odontology, pharmacy, laboratory, radiology, physical medicine, modules for children, outpatient department, psychology, telemedicine, triage, kitchen, maintenance, administration, admission, references, insurances, costs and statistics.

Solid waste is generated in different areas or services of the hospital and it is stored temporarily in them; afterwards it is gathered and translated to an area designed to keep it inside the perimeter of the hospital, where then is recollected by the municipality. However, it may exist a possible risk of environmental contamination during this process, either by a deficient segregation, incorrect storage, inappropriate routes and

recollection schedule, poor conditions of storage, shortage of cleaning tools and lack of staff training. With regard to quantity of solid waste, the hospital does not have a register of generated solid waste, that is why the daily production of hospital solid waste is unknown; on the other hand, assessments about environmental impact of solid waste management have not been carried out.

In order to study hospital solid waste management, solid waste was considered as unit of analysis. To knowledge assessment, the unit of analysis was the personnel of the hospital. The population was all the personnel of the hospital and the sample were all the care providers and cleaning staff of the institution, by using the non-probability sampling technique. The personnel who were in holidays and those who manifested their desire to not participate in the research were not included, and the author of the research was not taken into account.

In order to determine the quantity and the kind of solid waste generated at the hospital, the manual of solid waste characterization described in the Technical Standard of the Peruvian Ministry of Health, also known as MINSA (MINSA, 2012). Fourteen evaluations were distributed during morning and afternoon shift in every evaluated service during the sampling period, that means between December 24-30, 2014. A trained member of the cleaning staff weighted the solid waste with the only analytical balance. Class C waste or similar are originated in all areas of the hospital, whereas Class A waste or biocontaminated waste is produced in the operating room, delivery room, emergency, hospitalization, odontology, obstetric, laboratory, radiology and modules for children; Class B waste or specials in laboratories and maintenance. The numbers of beds and its use were also registered.

In order to evaluate the hospital solid waste management, the checklists described in the technical standard elaborated by MINSA (2012) to establish, if in every service complies with: a) remodeling, b) segregation and primary storage, c) inland transportation, d) final storage, e) solid waste treatment and f) external recollection. Photographs of the solid waste disposal at *El Buen Samaritano* hospital were also taken with a digital camera.

In order to evaluate the knowledge of biosecurity standards to have a better solid waste management between care workers and cleaning staff that work at the hospital, a questionnaire was elaborated and used by the researcher. The questionnaire was validated by experts, with the participation of two collaborators, who examined the instrument and its reciprocity with the objectives of the research and Cronbach's alpha test was applied. The questionnaire was divided into two sections, the first one included demographic information of the participants (age, sex, job, service time), and the second one included 10 questions about definitions and biosecurity principles, solid waste classification, stages of the solid waste management, bag colors, personal protective equipment, handwashing and sharp objects management. Questions were in a multiple option format with five options and just one right answer. Two points were given for each right answer and zero points for each wrong answer or answer in blank.

The evaluation of the environmental impact regarding solid waste management was carried out by the researcher, through the Cause and Effect Matrix method, and by using as instrument the Leopold matrix (Ramírez y Fernández, 2008, quoted in Samboni and Espinosa, 2009), which allowed to relate actions that are carried out in solid

waste management with the environmental components that can be modified.

Solid waste creation was rate through a mathematical equation which connects research data (Vergara, 102, p.26). The final indicator calculated the average of the seven days sampling.

In the evaluation of each one of the solid waste management stages through MINSA checklists, the following evaluation criteria was considered: Satisfactory (7 points score), acceptable (equal to or greater than 5.5 or less than 7), deficient (between 3.5 points score and 5) and very deficient (less than 3.5).

In order to determine the level of knowledge of the personnel, in the test of 10 questions the following scale was used: excellent (18-20), good (15-17), regular (12-14) and deficient (< 11). The questionnaire was delivered in working hours in a 2 weeks period in November 2014, to be completed in free moments and at the end of the shift, the questionnaire was collected.

In order to identify environmental impacts, the matrix rated at the top of the cell, the magnitude and at the bottom, the importance, by using a rating tables described by Peralta and Barrios (2003). When all the cells were rated, a summation of every row and column was obtained (Arriagada, 2004, p.20). The summation of rows indicated its fragility and the summation of columns indicated its aggressiveness. The mark with regard to fragility included the following values: low (1-15), regular (16-30), average (31-45), high (46-60) and very high (61-75) and with regard to aggressiveness it was: low (1-20), regular (21-40), average (41-60), high (61-90) and very high (91-110).

The analysis of the information was carried out through the analytical and synthetic

method, also descriptive statistics was useful to the calculation of the measures of central tendency in each one of the variables analysed. To the statistical analysis Microsoft Excel 2010 and SPSS 23.0 programs were used.

Results

The results are based on the objectives of the research:

Analysis of the quantity and solid waste class (kg/day) produced at *El Buen Samaritano* first-level Hospital during the sampling period.

The total quantity of hospital solid waste produced at *El Buen Samaritano* first-level Hospital during the seven days sampling period was 285.61 kg, with a 40.80 kg/day overall average production.

The solid waste production data is presented in Figure 1.

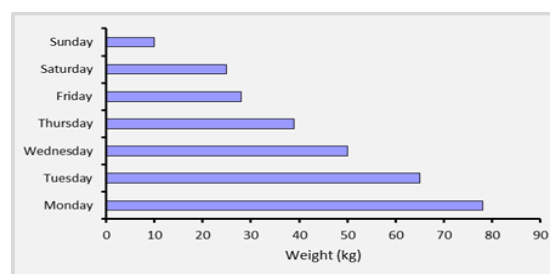


Figure 1. Total quantities (kg/day) of solid waste produced at *El Buen Samaritano* first-level Hospital, November 2014.

The biggest production was biocontaminated solid waste, with a 22.02 kg/day average, in second place, common solid waste represented 17.52 kg/day, whereas special solid waste represented 1.26 kg/day during the seven days sampling period.

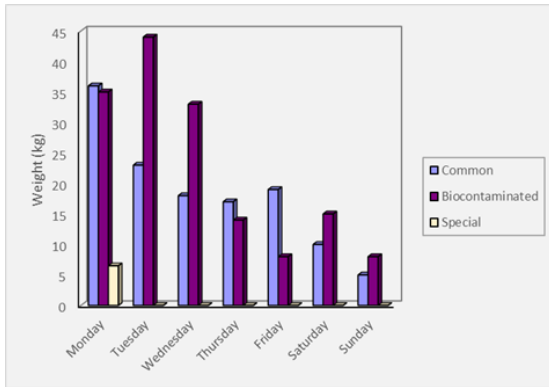


Figure 2. Total quantities (kg/day) of solid waste produced at *El Buen Samaritano* first-level Hospital, November 2014.

The total quantity of sharp objects produced at *El Buen Samaritano* first-level Hospital during the seven days sampling period was 13.30 kg, with a 1.9 kg/day overall average production. Figure 3 shows sharp objects production by services.

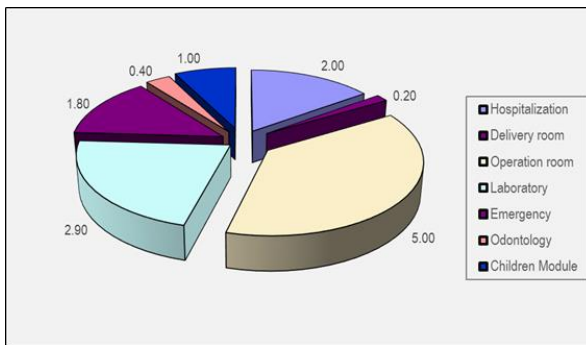


Figure 3. Total quantities (kg/day) of sharp objects production in *El Buen Samaritano* first-level Hospital services, November 2014.

In our research the generation rate found is 2.56 kg/bed/day as it is observed in Table 1.

Table 1

Generation Rate (kg/bed/day) of solid waste produced at *El Buen Samaritano* first-level Hospital, November 2014.

Name of the Hospital	Date	Num ber of beds	In use %	Producti on (kg per day)	Partial rate (kg/bed/day)	Final rate (kg/bed/day)
<i>El Buen Samaritano</i> no first-level Hospital EsSalud	11/24/2014	18	0,85	76,7	5,013	
	11/25/2014	18	0,85	65,7	4,294	2,560
	11/26/2014	18	0,85	50,7	3,314	
	11/27/2014	18	0,85	30,8	2,013	
	11/28/2014	18	0,85	26,8	1,752	
	11/29/2014	18	0,85	23,51	1,537	
	11/30/2014	18	0,85	11,4	0,745	

Solid waste management evaluation at *El Buen Samaritano* first-level Hospital during sampling period.

Pictures show solid waste management at *El Buen Samaritano* first-level Hospital (Figures 4 -9).



Figure 4. Trash can for biocontaminated common solid waste.



Figure 5. Boxes in a waste dump without garbage bags.



Figure 6. Garbage bag with biocontaminated elements placed outside the clinic.



Figure 7. Sharp objects accumulated in vessels without safety standards.



Figure 8. Garbage bags with solid waste which are not placed them in trash cans in the final storage.



Figure 9. Garbage trucks of the city hall transport hospital solid waste to the garbage dump.

The final qualification for the *El Buen Samaritano* Hospital according to the Peruvian Technical Standard (MINSa, 2012) will make it possible to consider the waste management process as very deficient. (Table 2)

Table 2

General Qualification of Solid Waste Management in the *El Buen Samaritano* first-level Hospital of Bagua Grande, November 2014.

Services	E Q	S E	I S	I T	F S	W P	E C	S	A	D	V D
Emergency	V D	V D	V D	D	V D	V D	V D				X
Hospitalization	V D	V D	V D	D	V D	V D	V D				X
Operations room	V D	V D	V D	D	V D	V D	V D				X
Delivery room	V D	V D	V D	D	V D	V D	V D				X
Obstetrics	V D	V D	V D	D	V D	V D	V D				X
Odontology	V D	V D	V D	D	V D	V D	V D				X
Pharmacy	V D	V D	V D	D	V D	V D	V D				X
Laboratory	V D	V D	V D	D	V D	V D	V D				X
Radiology	V D	V D	V D	D	V D	V D	V D				
Physical Medicine	V D	V D	V D	D	V D	V D	V D				
Children module	V D	V D	V D	D	V D	V D	V D				
External Doctor's office	V D	V D	V D	D	V D	V D	V D				
EQ: Equipment SE: Segregation IS: Internal Storage IT: Internal transport				FS: Final Storage WP: Waste Processing EC: External Collection				VD: Very Deficient D: Deficient A: Acceptable S: Satisfactory			

Determination of the level of knowledge of biosafety regulations for the management of solid waste in the assistant and cleaning staff that works in the *El Buen Samaritano* first-level Hospital.

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that works in the *El Buen Samaritano* first-level Hospital.

The total number of assistant and cleaning staff (48 and 9 respectively), 29 assistants and all cleaning staff were interviewed. It was not possible to interview 19 care workers because 3 (16%) were on vacation or free days, 15 (79%) preferred not to participate and 1 (5%) was the author of the study. The predominant age range in the health care was 15 (52%) > 40 years and 5 (56%) cleaning staff from 30 to 39 years old. 18 (62%) people part of the assistant staff were women compared to 6 (67%) men part of the cleaning staff. It was found that workers had a higher average grade of 14.9 (Range: 6-20) compared to cleaning workers grade: 11.1 (Range: 6-18), finding that the highest percentage of correct questions corresponded to: bag color (13%) and hand washing (13%) for the assistant staff; and personal protective equipment (18%), characteristics of the sharps container (16%) and bag color (16%) for the cleaning staff.

On the other hand, the highest frequency of incorrect answers were found in questions about definition of biosafety (22%) and principles of biosafety (20%) for the assistant staff; while for cleaning staff, the incorrect answers corresponded to the definition of biosafety (23%), stages of solid waste hospital management (18%) and sharp objects management (18%). Finally, it was found that the assistant staff had a better performance in the exam: 57% of them passed it, while 23% of the cleaning staff failed the test.

Figure 10 shows the level of knowledge about the biosafety norms for the management of solid waste, both assistant and cleaning staff that work in the hospital are compared.

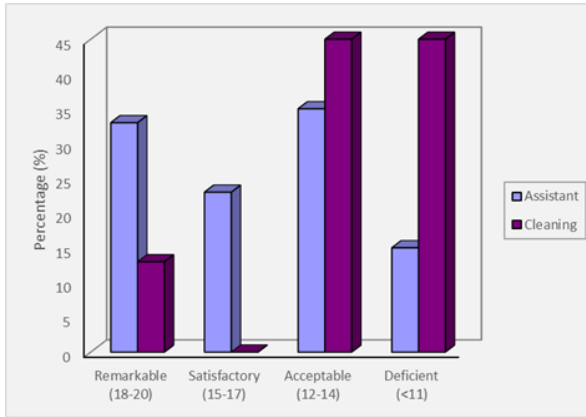


Figure 10. Level of knowledge presented by the assistant and cleaning staff of Hospital I “*El Buen Samaritano*”, about biosafety regulations for the management of hospital solid waste. November 2014.

Evaluation of the environmental impacts of solid waste management in *El Buen Samaritano* first-level Hospital.

The most affected environmental value was occupational health and safety, mainly due to the accidental spill of biocontaminated waste, accidents caused by sharp objects and the lack of supply of personal protective equipment. It was not possible to quantify the accidents that occurred in this hospital because the information records were not available. Table 3 shows Leopold matrix with the rating of the impacts of the environmental components evaluated.

Table 3
Environmental Impact Matrix of Solid Waste Management in *El Buen Samaritano* first-level Hospital EsSalud - Bagua Grande.

SYSTEM	SUBSYSTEM	ENVIRONMENTAL COMPONENTS	ENVIRONMENTAL PARAMETERS	ACTIONS							TOTAL PER ENVIRONMENTAL COMPONENT		
				INFECTIOUS WASTE-CORRECTLY CLASSIFIED	INFECTIOUS WASTE STORAGE	ACCIDENTAL SPILL OF CONTAMINATED WASTE	PERSONAL PROTECTION EQUIPMENT SUPPLY	SHARP OBJECTS ACCIDENTS	INFECTIOUS WASTE TRANSPORT	USE OF INCINERATOR TO INFECTIOUS WASTE TREATMENT		DISCONTINUOUS CAPACITATION	
PHYSICAL COMPONENT	ABIOTIC COMPONENT	AIR	AIR QUALITY	-1 +1	-3 +1	-8 +4			-1 +1	-9 +7	-6 +6	-28	
		SOIL	SOIL QUALITY	-1 +1	-1 +1	-6 +1			-1 +1	-4 +6	-6 +6	-19	
		WATER	WATER QUALITY	-1 +1	-1 +1	-2 +1			-1 +1	-1 +1	-6 +6	-12	
	BIOTIC COMPONENT	FLORA	TREES		-1 +1	-1 +1	-1 +1		-1 +1	-1 +1	-6 +6	-6 +6	-21
			SHRUBS		-1 +1	-1 +1	-6 +4		-1 +1	-1 +1	-6 +6	-6 +6	-21
			HERBS		-1 +1	-1 +1	-6 +4		-1 +1	-1 +1	-6 +6	-6 +6	-21
		FAUNA	BIRDS		-1 +1	-1 +1	-6 +6		-1 +1	-1 +1	-5 +5	-6 +6	-21
			MAMMALS		-1 +1	-1 +1	-6 +6		-1 +1	-1 +1	-5 +5	-6 +6	-21
			INSECTS		-1 +1	-1 +1	-6 +4		-1 +1	-1 +1	-5 +5	-6 +6	-21
			REPTILES		-1 +1	-1 +1	-6 +4		-1 +1	-1 +1	-5 +5	-6 +6	-21
			AMPHIBIOUS		-1 +1	-1 +1	-6 +4		-1 +1	-1 +1	-5 +5	-6 +6	-21
	PERCEPTUAL COMPONENT	CONCEPTUAL FRAMEWORK	LANDSCAPE ELEMENT		-1 +1	-6 +1	-8 +7	-1 +1	-1 +1	-1 +1	-6 +6	-6 +6	-21
			PANORAMIC VIEW		-1 +1	-6 +1	-1 +1	-1 +1	-1 +1	-1 +1	-6 +6	-6 +6	-30
SOCIO-ECONOMICAL-CULTURAL COMPONENT	SOCIOCULTURAL COMPONENT	INFRASTRUCTURE	FACILITIES AND SERVICES	-1 +1	-2 +2	-5 +5	-1 +1	-1 +1	-1 +1	-6 +6		-17	
		HUMAN DIMENSIONS	OCCUPATIONAL SAFETY AND HEALTH	-8 +8	-8 +8	-9 +9	-9 +9	-9 +9	-6 +6	-6 +6	-6 +6	-61	
	ECONOMICAL COMPONENT	ECONOMY	DIRECT EMPLOYMENT	-1 +1	-1 +1	-1 +1	-6 +6	-6 +6	-6 +6	-6 +6	-6 +6	-33	
TOTAL PER ACTIVITY				+23	+24	+67	+18	+23	+26	+87	+90	-398 +358	

Discussion

It was found a production of solid waste within the expected ranges, a very poor management of solid residue; the knowledge about biosafety rules for solid waste management was very deficient in the assistant staff and deficient in the cleaning staff; and it was also found that solid waste has an average-low environmental impact.

The figure found in the solid waste production index, 2.56 kg /bed per day, is within the range of the recorded by the Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS), which fluctuates between 1 and 4.5 kg/bed per day. Also, Pan American Health Organization (PAHO) (1991) cited in Monge (1997), estimates that 10 to 40% of hospital wastes in Latin America can be classified as hazardous due to its pathogenic nature. In the study carried out, the wastes classified as bio contaminated were estimated at 56.02%, surpassing these values. It is important to remark that, given that there is no adequate segregation in services, it is expected that the generation of this waste may increase. With regard to the production of special waste, it is relatively low compared to sharp objects waste, the WHO⁷ (2007) cited in Marmolejo et al. (2010) indicates that it represents around 1% of the total hospital solid waste. In the study carried out, it reached 4.45%, surpassing this value.

Currently, according to assessment criteria of the technical norm of MINSa (2012), solid waste management at *El Buen Samaritano* First-level Hospital was rated as “very deficient”. These results are like those determined by Carril (2013), who reported similar figures and qualifiers at *José Antonio*

Mendoza Olavarría Hospital, located in Tumbes and medical micro-systems in Zorritos and Zarumilla they belong to the Ministry of Health.

The assistant staff was found to have an average-high level of knowledge about biosafety measures and solid hospital waste management. These results agree with a research carried out at *Almanzor Aguinaga Asenjo* National Hospital - EsSalud in Chiclayo, where the professional and nursing staff had a considerable degree of knowledge of the biosafety norms. (Soto and Olano, 2004).

In the same way, a study at the Distrital Hospital of Bejuma, Venezuela, showed that 67% of the nursing staff had an adequate level of knowledge about hospital waste safe management (Pinto, Ojeda y Pinto, 2007). Also, it was shown that the cleaning staff present an average- deficient knowledge, similar to what was found at a fourth-level university Hospital in Bogota, where the cleaning staff has deficient knowledge about biosafety at work (Ávila y Silva, 2013). Moreover, a research at *Dr. Luis Razetti* University Hospital in Barcelona, determined that the sanitary staff do not have the knowledge they are expected to possess about hygiene and hospital cleaning standards (Marín y Morales,2010).

The analysis of impacts was done with the Leopold matrix by the simplicity of its use (Ramírez and Fernández, 2008, cited in Samboni and Espinoza, 2009). The result showed that most of the environmental impacts evaluated are within the scale of average to low significance. As a fact, a study conducted in Ecuador by Logroño at Sangolqui Hospital and nine sub-centres of Rumiñahui canton in 2013; reported that of the total impacts, 17% are moderated and

⁷WHO (World Health Organization)

50% are minor impacts to the quality of the water and soil. On the other hand, this study also demonstrated that the most affected environmental parameter is the occupational safety and health. As a matter of fact, these results should be taken into consideration to implement a series of measures aiming to minimize the negative effect or adverse clinical waste, and above all, to look after health and well-being of the patients and workers in hospitals.

Conclusions

It was determined that there is an inadequate management of hospital waste, owing to the failure to comply with the standard that is in force for the management of health-care waste in our country.

Recommendations

To include the conditioning, treatment and external transport of solid waste in the Operating Plan and Institutional, to ensure that they are provided with EsSalud budgetary allocation.

The Solid Waste Management and Handling Committee of *El Buen Samaritano* Hospital must supervise the cleaning staff of the contractor and assistant workers to ensure the compliance with the standards that are in force for the management of health-care waste.

To train the staffs, especially the cleaning staff, in handling solid waste with systematic trainings and regular updates.

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