Radiographic processing effluents management status in healthcare centers*

Situação do gerenciamento de efluentes de processamento radiográfico em serviços de saúde

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Abstract

Objective: The present study was aimed at identifying the status of radiographic processing effluents management in radiodiagnosis centers in regard to handling, packaging, storage, treatment and disposal. **Materials and Methods:** A descriptive-exploratory study was developed in the period from February to May 2009, with interviews based on a script including semistructured questions conducted in 12 radiodiagnosis centers of Ribeirão Preto, SP, Brazil, randomly selected by means of the Statistical Package for Social Sciences, version 10.0. **Results**: According to the respondents, untreated image-processing effluents discharge directly into the public sewage system occurs as follows: developer liquid by 16.66% of the healthcare centers; fixer by 8.33%; and film washing water by 75% of the centers. **Conclusion:** The present study results demonstrate the need for a closer surveillance, control and monitoring by the competent agencies, encouraging the pre-treatment of such effluents in order to minimize their impact on public health and the environment.
Keywords: Management; Effluents; Radiographic.

Resumo

Objetivo: O objetivo deste estudo foi identificar a situação do gerenciamento de efluentes radiográficos em serviços de diagnóstico por imagem, em relação ao manuseio, acondicionamento, armazenamento, tratamento e descarte desses efluentes. **Materiais e Métodos:** Tratou-se de estudo descritivo e exploratório, realizado por meio de entrevistas baseadas em roteiro com perguntas semiestruturadas, realizadas no período de fevereiro a maio de 2009. A investigação foi realizada em 12 serviços de saúde humana e animal de radiodiagnóstico de Ribeirão Preto, SP, Brasil, escolhidos aleatoriamente por sorteio por meio do programa Statistical Package for the Social Sciences, versão 10.0. **Resultados:** De acordo com os entrevistados, 16,66% dos serviços descartavam revelador usado na rede pública de esgoto, sem tratamento prévio, 8,33% descartavam o fixador e 75% descartavam a água de lavagem de filmes diretamente no esgoto, sem tratamento prévio. **Conclusão:** Os resultados deste estudo evidenciam necessidade de maior fiscalização, controle e monitoramento, pela vigilância ambiental e sanitária, para com os efluentes radiográficos, estimulando tratamento antes do descarte, minimizando o impacto à saúde pública e ao ambiente.
Unitermos: Gerenciamento; Efluentes; Radiográfico.

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INTRODUCTION

Radiography is an important complementary tool used for diagnosis in health centers. However, during the radiographic processing, effluents are generated (developer, fixer, and wash water) posing an environmental threat, as such effluents contain organic and inorganic compounds that are toxic to the environment in cases where they are inappropriately disposed of[1].

Investments have been made in training of professionals, in process and equipment improvements in the health sector as a whole and specifically in the field of imaging diagnosis, however little has been done to prevent the occurrence of occupational injuries and disorders and to minimize the environmental impact caused by inappropriate disposal of radiographic effluents[2,3].

According to the Resolution No. 358/05 of Conselho Nacional do Meio Ambiente (Conama) (the Brazilian Environment Council), effluents from radiographic image processing are considered as being "group B effluents" for comprising substances that can pose risks to public health or to the environment, depending upon their flammability, corrosiveness, reactivity and toxicity. According to Article 21 of the mentioned Resolution, group B wastes, with hazardous characteristics, as it is the case with radiographic effluents, when not submitted to processes for reuse, recovery or recycling, must undergo specific treatment and final disposal. Article 22 provides

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that group B wastes in liquid state may be disposed of to streams or public sewer systems provided they comply with, respectively, the guidelines established by the environmental authorities, and competent water and sanitation management agencies[(4)].

However, according to reports in the literature, what actually happens at many health centers is the effluents disposal into streams or into public sewer systems with levels of inorganic compounds such as silver above allowed limits. Additionally, such effluents are discarded with a high chemical oxygen demand (COD) and hydrogenic potential (pH), and color, total dissolved solids concentration, chlorides, sulfates and turbidity over allowed limits[(5)].

The final disposal and treatment of such effluents at most of imaging diagnosis centers, including teaching and research institutions, are not appropriately performed. In most of times, chemical wastes such as developer and fixer solutions are directly discarded without any previous treatment, into the public sewer system[(6)].

This is a worrisome fact when one considers that only 20.2% of Brazilian cities have public sewer collection and treatment systems[(7)]. Additionally, many hazardous chemicals that are present in liquid health services wastes (HSR) are not broken down in wastewater treatment plants in the country, so the disposal of hazardous liquid effluents into the public sewer system, without any previous treatment, is a totally unacceptable practice.

An appropriate solution for the disposal of radiographic effluents would be the substitution of conventional radiography apparatuses by digital radiography apparatuses which do not require chemical solutions for radiographic processing, therefore not generating effluents and avoiding workers to come in contact with chemicals, thus minimizing impacts on occupational health, on the environment and on the public health as a whole.

According to Teschke et al.[(8)], the technological development of digital imaging methods is an available option to eliminate the utilization of developer and fixer solutions in imaging diagnosis centers.

Authors such as Braunschweig et al.[(9)] have stated that after three or four years from the installation of digital systems, such a technology becomes more profitable than the conventional system because of savings on the purchase of radiographic films.

According to Gonzaga Junior and Carvalho[(10)], the technological conversion from conventional into digital radiography is economically feasible. The authors report that after approximately 53 months, a reduction in the cost of the new technology is achieved by the elimination of radiographic film utilization, paying back the initial investment. Additionally, the authors highlight that the digital technology allows the permanent data storage in digital media, reducing required physical storage space and avoiding the disposal of physical radiographic documentation. However, they consider that process safety must be sustained by keeping the capacity of producing images by the conventional method to meet emergency situations caused by technical problems that might occur with the digital environment[(10)].

Other option to solve the problem posed by the disposal of radiographic effluents with environmental optimization is the treatment of such effluents. Although such effluents are highly pollutant, if properly treated they can be turned into useful substances which can generate income and savings for the health centers[(2)].

The treatment of radiographic effluents can be performed *in loco*, at the very health center where they are generated, or outside, by specialized companies.

Such a treatment of radiographic effluents prior to their disposal into the public sewer system would provide for the neutralization, recovery and/or destruction of toxic substances contained in such effluents besides adjusting to established pH and COD parameters for such effluents.

According to Lunar et al.[(11)], different radiographic effluent treatment alternatives have been proposed, as follows: chemical precipitation and sedimentation, chemical oxidation, carbon adsorption, biological oxidation, and reverse osmosis. Some methods combinations have also been utilized, such as chemical-biological, chemical-electrochemical oxidation, and oxidation-separation processes. Besides such processes, recycling of radiographic effluents has also been performed by means of several procedures, such as Cl2-biological treatment, filtration-chelation treatment and adsorption-reverse osmosis.

According to Igarashi-Mafra et al.[(12)], photo-Fenton oxidation is utilized for destruction of organic compounds in water, including those effluents from radiographic processing. The application of the photo-Fenton reaction does not require costly equipment or special abilities and therefore, it might be used *in loco* at small centers whose facilities and reduced waste volumes would not justify the utilization of other processes such as incineration[(13)].

The photo-Fenton technology is a novel alternative that may be adopted by health centers, since it is easily performed. It also meets environmental requirements, utilizing only ultraviolet radiation and components from the environment such as iron and hydrogen peroxide, being considered a “green” technology[(14)].

In addition to organic compounds, radiographic processing effluents are also constituted by inorganic compounds. Among those, the main and also the most hazardous compound is silver, which also must be treated or recovered from the effluents before disposal into the sewer system.

The recovery of silver from radiographic effluents is already feasible and is actually performed by many laboratories. The main techniques for silver recovery include electrolytic recovery, which is more efficient for silver-rich solutions such as fixers, for electrolysis-based solutions, metal displacement solutions (carburizing and metallic exchange), as well as for some that utilize chemical precipitation[(15)].

As it may be observed in the above mentioned literature data, methods for treatment and recovery of radiographic processing effluents have already been developed and are continuously utilized and improved. Such methods are simple and can be utilized in health centers provided there is availability of the necessary infrastructure as well as of technically skilled personnel to perform such an activity.

The treatment of the effluents can also be performed in a remote location. For such a purpose, the effluents must be appropriately packed and stored for later shipment to properly licensed effluent treatment institutions.

The present study was aimed at evaluating the situation of radiographic effluents management in imaging diagnosis centers of Ribeirão Preto, SP, Brazil, with respect to handling, packaging, storage, treatment and disposal of such effluents.

MATERIALS AND METHODS

The present descriptive and exploratory study was developed in the period from February until May 2009 by means of interviews based on a semi-structured questionnaire about handling, packaging, storage, treatment and disposal of radiographic processing effluents (developer and fixer solutions and radiographic film wash water), as per Appendix A.

The investigation was undertaken in 12 radiodiagnosis centers in Ribeirão Preto, including services in universities and hospitals, besides public and private medical, dental and veterinary radiodiagnosis centers that agreed in participating in the study. The services were selected based on the registry of health centers equipped with radiographic apparatuses of the Ribeirão Preto City Department of Health, which is updated on a monthly basis.

At the time of such an investigation, 1,138 health centers equipped with radiographic apparatuses were registered in the city, comprising small, medium and large health centers, universities, associations and other public and private institutions.

A previous selection was made amongst the 1,138 registered services, with the purpose of selecting only those which provided exclusively imaging diagnosis services (49), excluding the remaining 1,089 services which were mostly small sized services providing other types of health services such as dental offices.

The final sample comprised 12 radiodiagnosis centers which were randomly selected among the 49 previously selected services, by the Statistical Package for the Social Sciences, version 10.0, representing 24.5% of the pre-selected services.

After the final selection of the services, professionals were appointed to be interviewed, including owners or workers responsible for the radiology services.

Appendix A

Questionnaire for professionals responsible for health centers on the handling, packaging, storage, treatment and disposal of radiographic processing effluents (developer/fixer solutions and film wash water).

I. IDENTIFICATION .... Interview date: ___/___/2009

1 – General data on the center:
- Name:..
- Sector:..
- Address:..
- Fone number:..

2 – General data on the responder:
- Name:..
- Gender:.. Age:....................................
- Function:..
- Fone number:..

3 – How many X-ray apparatuses are there in this center?
- A – In use:..
- B – Not in use:..
  - B.1 – Reason:
    - Broken:..
    - Maintenance:..
    - Other:..

4 – What type of X-ray apparatuses does the service operate?
- A – Digital X-ray:..
- B – Conventional X-ray:..

II. MANAGEMENT OF DEVELOPER/FIXER SOLUTIONS AND RADIOGRAPHIC FILM WASH WATER

5 – What is the monthly average amount of developer solution used in this center?..........................
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6 – What is the monthly average amount of fixer solution used in this center?..................................
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7 – What is the amount of water used in radiographic processing in this center?...............................
....

8 – How often are developer/fixer solutions and radiographic film wash water changed?........................
....

9 – After utilization, what is done with the developer and fixer solutions and wash water?
- Developer:..
- Fixer:..
- Wash water:..

10 – In case the answer to question 9 is "treatment", what is the responsible company and place where the effluents are sent to?
- Developer:..
- Fixer:..
- Wash water:..

11 – In case there is storage of effluents, where is the storage area?
- Developer:..
- Fixer:..
- Wash water:..

12 – How long are such used solutions and wash water stored?
- Developer:..
- Fixer:..
- Wash water:..

13 – What is the type of container used for the storage of the solutions?
- Developer:..
- Fixer:..
- Wash water:..

The data obtained in the interviews were categorized and entered into Excel worksheets for two times with an interval of five days between the first and second data entries in order to minimize transcription errors. Later, validation of the databank, errors correction, and calculation of the percentages of obtained answers were performed. The project for the present investigation was approved by the Committee for Ethics in Research of the Scholl of Nursing of Ribeirão Preto – University of São Paulo.

RESULTS

The results of the present investigation are presented according to the proposed objective of diagnosing the status of radiographic processing effluents management in the selected radiodiagnosis centers in the city of Ribeirão Preto, Brazil.

The interviews were carried out in 12 services, as follows: two dental radiology services (16.66%), one veterinary radiology service (8.33%), four medical radiology services (33.33%), one university veterinary hospital radiology service (8.33%), one university hospital radiology service (8.33%), one maternity hospital radiology service (8.33%), one specialized hospital radiology service (8.33%) and one philanthropic hospital radiology service (8.33%).

Most of the interviewed professionals were women (66.66%), with ages between 22 and 65 years.

Questions related to the knowledge on laws and radiographic effluent management standards were not asked. The questions were answered immediately after the interviewer asked then, without referring to written documents.

The results from the interviews are presented on Tables 1, 2, and 3.

Table 1 Role of the respondents in the centers, number of X-ray apparatuses and monthly amount of effluents generated by each investigated center.

• Role of the respondents	Number of respondents	%
– Radiology technicians	8	66.66
– Worker responsible of X-ray film development	1	8.33
– Dentists owners of the services	2	16.66
– Veterinarian owner of the service	1	8.33
• Number of X-ray apparatuses	30	
• Types of X-ray apparatuses	Number of services	%
– Conventional	12	100.00
– Conventional and digital	3	25.00
• Effluents	Amount of generated effluents (L/mês)	
– Developer	10 to 240	
– Fixer	7 to 200	
– Wash water	28*	

* The amount of wash water was reported by only one professional (28 L/month). One declared that he did not have such information, and the remaining 10 (83.33%) informed that their centers were equipped with automated film processing apparatuses which utilize a continuous water flow.

Table 2 Frequency of change of effluents, form of packaging and temporary storage of effluents.

• Frequency of effluents change		
– Developer and fixer solutions	Number of services	%
Monthly	2	16.66
Every 15 days	6	50.00
Weekly	2	16.66
Every three or four days	1	8.33
Did not know	1	8.33
– Wash water		
Continuous change	10	83.33
Weekly	1	8.33
Did not know	1	8.33
• Form of effluent packaging		
– Developer		
Not packed*	4	33.33
Containers or buckets	5	41.66
Plastic drum	1	8.33
Tank	1	8.33
Did not reply	1	8.33
– Fixer		
Not packed†	2	16.66
Containers or buckets	7	58.33
Plastic drum	2	16.66
Did not reply	1	8.33
• Form of temporary storage of effluents		
– Developer		
Did not store‡	4	33.33
Dark chamber room	3	25.00
Basement	1	8.33
Laundry, open area, over plastic plates	1	8.33
Closed and roofed room	1	8.33
Masonry external shelter	1	8.33
Did not reply	1	8.33
– Fixer		
Did not store§	2	16.66
Dark chamber room	5	41.66
Covered external area	1	8.33
Laundry, open area, over plastic plates	1	8.33
Closed and roofed room	1	8.33
Outside mansonry shelter	1	8.33
Did not reply	1	8.33

* In one center (8.33%) the effluent was disposed of after being filtered, in another (8.33%) the developer was disposed of into a septic tank and in two others (16.66%) the developer was disposed of from the automatic processing system into the public sewer system.

† In one service (8.33%) the fixer solution was disposed of into a septic tank and in another (8.33%) the effluent was disposed of directly from the automatic processing system into the public sewer system.

‡ Two services (16.66%) disposed of the developer solution directly from the automated processor to the public sewage system, one service (8.33%) disposed of the effluent after filtering it and another (8.33%) disposed of the effluent at the septic tank.

§ In one service (8.33%) the fixer solution was directly disposed of from the automated processing system into the public sewer system and in another (8.33%) the effluent was disposed of into a septic tank.

DISCUSSION

As regards types of radiographic apparatuses found at the investigated radiodiagnosis services, it was observed that some of them (3 services) already utilized digital equipment, reflecting a global trend, constituting an effective solution for the problem of radiographic processing effluents. In Brazil, some specialized and excel-

Table 3 Storage time, treatment and disposal of effluents and companies responsible for collection and treatment of effluents.

	Number of services	%
• Effluents storage time in the service		
15 to 20 days	3	25.00
1 week	2	16.66
1 month	2	16.66
1 year	1	8.33
3 months	1	8.33
Did not know	3	25.00
• Treatment and disposal of effluents		
– Developer		
Storage for later collection by private company	6	50.00
Disposal into the public sewer system, after being filtered in the service	2	16.66
Disposal into the public sewer system, without any previous treatment	2	16.66
Disposal into septic tank and later shipment and treatment in the municipal waste water treatment plant	1	8.33
Did not answer	1	8.33
– Fixer		
Storage for later collection by private company	7	58.33
Disposal into the public sewer system, after being filtered in the service	2	16.66
Disposal into the public sewer system, without any previous treatment	1	8.33
Disposal into a septic tank and later shipment to a municipal waste water treatment plant	1	8.33
Did not answer	1	8.33
– Wash water		
Disposal into the public sewer system, without any previous treatment	9	75.00
Disposal into the public sewer system, after being filtered in the service	1	8.33
Disposal into a septic tank and later shipment to the municipal waste water treatment plant	1	8.33
Did not answer	1	8.33
• Types of companies responsible for the collection and treatment of developer and fixer solution effluents		
– Company licensed by Cetesb, with internet website and phone number for contact	3	25.00
– Without internet website, with phone number for contact registered under the company's name	1	8.33
– With no data on the company	1	8.33

Note: Only six centers (50%) had their radiographic processing effluents collected and treated by five private companies, with two services hiring a same company. According to the respondents, one of the companies responsible for the collection and treatment of effluents charged for the service, while the other companies bought the fixer solution from the health services for a price that ranged from R$ 22.00 per 20 L container to R$ 2.00 or R$ 3.00/L.

lence centers already utilize digital systems, but such systems involve additional costs for small sized centers because of the high initial acquisition cost. Authors such as Braunschweig et al.[9] and Gonzaga Junior and Carvalho[10] have reported that after a period between 36 and 53 months from the installation of the digital system, it becomes economically viable since it is not necessary to buy radiographic films and developer solutions.

As regards the amount of developer and fixer solutions and radiographic film wash water utilized by each one of the investigated services, according to the respondents, the amount of developer solution ranged between 10 and 240 l/month and that of fixer solution, between 7 and 200 l/month, which demonstrates a high consumption and, consequently, the generation of a great effluent amount, corroborating the findings reported by Carlson[16], who have found, in a case study, that the radiology service of a hospital generated 15 containers filled with 20 l of developer and fixer solutions effluents every week, or approximately 15,000 l/year of liquid chemical waste, containing 16 kg of silver in its composition besides other chemical substances.

The amount of developer and fixer solutions utilized in radiological centers varies according to the size of the health service and to the number of acquired images. Generally, large health care centers such as hospitals receive a large flow of patients and consequently utilize a great amount of developer and fixer solutions, consequently generating a greater volume of radiographic processing effluents.

On the other hand, small health centers such as orthopedic, dental and veterinary clinics perform a lower number of examinations, using a smaller amount of developer and fixer solutions, consequently generating lower amounts of radiographic processing effluents. However, as at such small services the generated effluent amount is usually small, many times it is disposed of directly into sinks, thus reaching the sewer system without any previous treatment.

As regards packaging of effluents, according to the respondents the effluents were stored in containers, buckets, plastic drums or even in septic tanks, with the containers or plastic drums being the same containers in which the solutions came in when they were purchased.

Packaging radiographic processing effluents is the act of placing such segregated effluents in bags or containers that do not leak and that are puncture and rupture resistant. According to Resolution RDC No. 306/2004 of Agência Nacional de Vigilância Sanitária (Anvisa) (National Agency for Health Surveillance), the liquid wastes must be packed in containers made from materials compatible with the liquid to be contained, and must be strong, rigid, watertight and fitted with a screwed on and sealing lid[17]. Furthermore, according to the Technical Standard P4.262/2007 of Companhia Ambiental do Estado de São Paulo (Cetesb) (São Paulo State Environmental Agency), hazardous chemical wastes must be stored in plastic drums, glass jars or drums made from materials that are compatible with the effluent to be stored, and such containers must be properly identified, labeled and sealed in order to avoid leakage[18].

In the present study, in some cases the containers were not sealed, and sometimes the compatibility of the container material with the contents was not observed, thus posing the risk of corrosion and spillage of the liquid in the environment.

In a study developed by Sales et al.[19] in Marituba, in the state of Pará, Brazil, it was also observed that in all of the investigated centers, group B wastes were packed without proper attention to container material and contents compatibility, a fact which corroborates the findings of the present study.

As regards temporary storage, the respondents revealed that in their services such storage was not appropriately done, as the storage area was not ventilated and it was not a dedicated area, thus not complying with legal requirements, a fact that reveals lack of proper knowledge or neglect by waste generators.

According to Sales et al.[19], less than one half of the investigated institutions stored HSR, and among those which did it, the wastes storage was inappropriate, particularly in what regards the storage areas.

Carlson[16], in a case study developed in a hospital, has also observed that chemical residues such as developer, fixer solutions and xylene leftovers were inappropriately stored in the place where they were generated and were later taken into the basement of the building, where they were left under unsafe conditions, in an unventilated area, without containment means and over permeable floor.

As regards storage time elapsed before the developer and fixer solution wastes were sent for treatment, the respondents revealed that such elapsed time ranged from one week to one year, which is considered a long period as such solutions must be stored for the shortest possible time avoiding accumulation.

As regards radiographic processing effluents treatment and disposal, it was observed that direct disposal of radiographic processing effluents into the public sewer system, without any kind of previous treatment was done by two services (16.66%) for developer, by one service (8.33%) for fixer solution, and by nine other services (75%) for film wash water. Such findings are very worrisome and corroborate the findings reported by Fernandes et al.[2] and Bortoletto et al.[20], where film wash water effluents were directly disposed of into the public sewer system without any previous treatment.

Such behavior was already expected, as in spite of the fact that Anvisa RDC No. 306/2004 establishes guidelines for the management of radiographic processing effluents no mention is made regarding the obligation of pretreatment of film wash water before it is disposed of into the public sewer system. Furthermore, Anvisa RDC No. 306/2004 establishes that developer solutions may be neutralized in order to reach a pH between 7 and 9 for later disposal into public sewer systems or streams, provided such effluents comply with guidelines established by environmental agencies and competent water management and sanitation bodies[17].

However, some substances that are present in both wash water and used developer solution are not degraded only by means of neutralization or in the public sewer system which relies only upon biological treatments, a fact that makes the disposal of such effluents without pretreatment into the public sewer system or streams utterly inadmissible, because of inherent risks[21].

As regards the types of companies responsible for effluents collection and treatment, the respondents reported that six services (50%) had their effluents collected and treated by five private companies of which three were licensed by Cetesb, had websites on the internet and phone numbers for contact. One of the companies did not have a website, but had a phone number for contact registered under the company's name. For only one of the five mentioned companies data could not be obtained as the respondent could not tell the exact name of the company. Such companies were located in five different cities in the state of São Paulo, as follows: Barretos, Diadema, Campinas, Franco da Rocha and São Paulo.

Considering the relevance of the treatment of such effluents to minimize environmental hazards and risks to public health it is necessary to highlight the need for greater involvement and knowledge on the part of the hazardous effluent generators with respect to technical capacity, qualification and competence of the companies which treat their wastes, in the case of radiographic processing effluents, as the legal responsibility for the management of HSR lies with the generator. The company which performs the treatment must be duly licensed by the environmental agency and must appropriately treat and dispose of the effluents.

Also, it is also necessary to review the Brazilian resolutions with a view on a more careful approach to radiographic processing effluents treatment, including film wash water, before their final disposal into the public sewer system in order to minimize the possible impact on the public health and the environment. Such a proposition is also justified considering the inappropriate management of radiographic processing effluents, and that only 20.2% of Brazilian cities have public sewer collection and treatment systems[7].

It is also extremely necessary to improve the knowledge on specific regulations among professionals involved in health services which generate radiographic processing effluents and other HSRs. Furthermore, health and environmental agencies should provide more training courses on HSR management with basis on the Brazilian regulations, for different institutions, increasing awareness and providing guidance, thus allowing a better response to issues pointed out during future inspections.

CONCLUSIONS

The present study identified the status of radiographic processing effluents management status in imaging diagnosis centers in the city of Ribeirão Preto, SP, Brazil.

The results demonstrate that:

a) Among the investigated services, three already operated digital equipment;

b) The amount of radiographic processing effluents ranged from 7 to 240 l/month, according to the service size;

c) The frequency of change of the developer and fixer solutions varied between every three to four days to every month in some services;

d) Most of the investigated services (10) were equipped with automated film processing systems, with continuous exchange of wash water;

e) Most of the investigated services stored their effluents in plastic containers/buckets, generally the same containers in which the solutions were packed when they were purchased from the suppliers. However in some cases such containers were stored in inappropriate places;

f) The temporary effluents storage time varied significantly among the services, from 15 - 20 days in some of them and reaching 12 months in others;

g) As regards the disposal of radiographic processing effluents, two services disposed of the effluents directly into the public sewer system without any pretreatment, one service disposed of the fixer solution, also without any pretreatment and nine services disposed of the film wash water directly into the public sewer system without any pretreatment.

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