

EXTENDED ABSTRACT – Strategies for the Animal Health Care Waste Treatment

1- INTRODUCTION

Through the years, papers and studies have been published with the Health Care Waste – HCW, of Human origin, as a theme. In consequence, there are expected values for the production of this kind of waste, function of known productive populations such as sick persons or hospital beds. As to the Animal HCW, not much has been studied despite it is part of the HCW managing system.

Partly this lack of studies is due to the less importance given to the subject. Since many animal epidemic and pandemic (such as mad-cow disease or avian flu) have appeared, representing a threat to human health as well as the survival of modern civilization, where the chain food is based on livestock, it has become vital to change this attitude and develop the treatment of Animal HCW.

This paper summarizes the study of the strategies of Animal HCW treatment, identifying its production universe, the waste generating models and their projections for 2013. It also analyzes scenarios for the development of managing procedures.

2- METHODOLOGY

Noting that few have been done in this matter and that it would be one of the first studies on Animal HCW, the first effort was centred on the search and inventory of bases for the work development. With this in mind, bibliographic, legal, internet and statistics sources were consulted and studied. At the same time, an effort was made to set the study's framework, defining HCW and the Production Universe, composed of populations with known values.

With the objective of finding waste quantifying mathematical models, based on known populations, the work was then driven to the national and European statistical records. At national level the authority of the SIRER (waste electronic registration integrated system) did not allow its lecture. And at European level the data from EUROSTAT – Statistical Office of the European Communities, was limited and inconclusive.

Reaching this stalemate, a national survey of producers and waste was structured, and developed into national inquiries and representative samples. The results were waste quantifying mathematical models, which related known populations to estimated waste weight. From there came the 2013 projections. With the information gathered from authorities and operators involved, it was possible to obtain a description of the HCW market. During the study, nine reference entities and the five HCW operators were contacted, as well as the Animal HCW producers. Based on this information and waste quantities the strategies for the Animal HCW treatment were analysed.

3- DEFINITION OF HCW

Because there are different ways to consider the HCW, the work clarifies one based on the major references. The term Medical Waste was first used by WHO – World Health Organization, on a

publication in 1972. In 1983, on an European report of hospital waste management, appeared the definitions of Hazardous Waste and Infectious Waste. On another publication by WHO, in 1999, PRÜSS, defines the Hazardous Biologic Waste as the one that can infect other living organisms or produce toxins.

TCHOBANOGLIOUS refers only to Hazardous Waste, as the one that, by its nature, can be a threat to human health and the environment. STRAUB, in 1975, presents a first approach to the different groups of HCW: scraps and Biologic Waste. The French authors named it Sanitary Sector Waste, MAYSTRE (1994): “referring together the waste produced by health care establishments”, very broad and including homes for elder people.

In the European Community, the ELW (European List of Wastes) presents a sorted list of codes, which indentify, on detail, every kind of waste. To identify hazardous waste, the code is marked with a “*”. The Chapter or code “18 – Wastes from human or animal health care and/or related research”, is divided in two subchapters: “18 01 – Wastes from natal care, diagnosis, treatment or prevention of disease in humans” (Human HCW), and “18 02 – Wastes from research, diagnosis, treatment or prevention of disease involving animals” (Animal HCW).

The national law is in part at terms with de European law, and in part is ahead of it in concepts and politics, with practical solutions for the present needs. The law: Despacho 242/96, of 1996, regulates the HCW market, creating four groups of waste, based on its origin, hazard and best treatment. The HCW can be: None Hazardous, not biologic contaminated, divided in Group I (considered as domestic waste) and Group II (non hazardous HCW); and Hazardous, contaminated waste, divided in Group III – G.III (biologic hazardous HCW) and Group IV – G.IV (specific HCW).

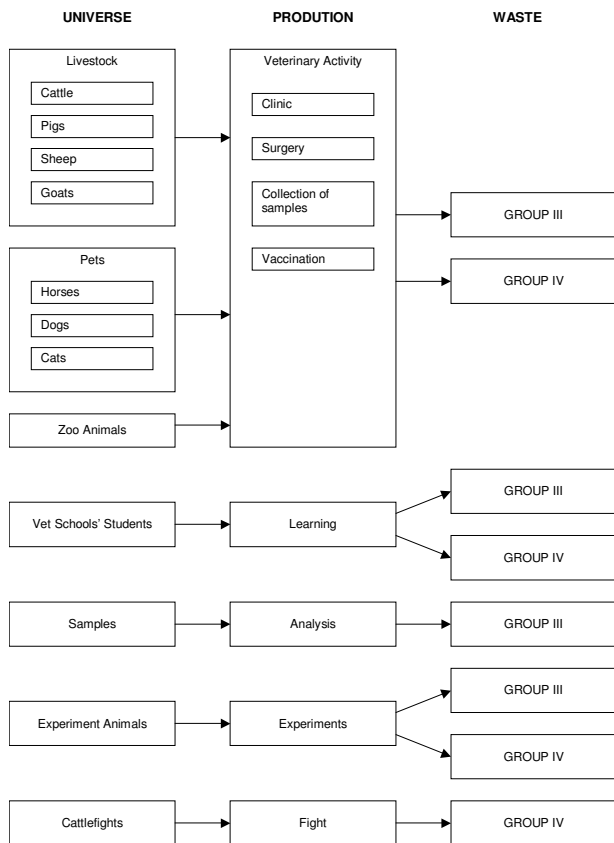
Following it, the law: Decreto-Lei 178/2006, of 2006, defines the HCW as: “the waste produced by medical activity on health care establishments, in prevention activities, diagnose, treatment, rehabilitation and research, related with humans and animals, in pharmacies, in legal-medical activities, in education and in any others which involve invasive procedures such as acupuncture, piercings or tattoos”.

4- PRODUCTION UNIVERSE

In order to calculate the Animal HCW generating models, the production universe was identified. The public health and the risk of infection to the humans and between animals was the major aspect, not including the animal carcasses, considered sub products with different treatment.

Then it was taken into account the name itself: “of animal origin”, meaning every waste said “from health care” made by animals. In that is included the waste from Biotheriums, animal experience laboratories, even the one applied to human health. Last were considered the various definitions and laws on HCW, which, in what matters to piercings, led to the inclusion of Cattlefights’ Waste.

In what concerns to the division of the Animal HCW by origins, there are as many variables as Types of Producers. The Animal HCW system is divided in three stages: the Production Universe (raw material), the Production (transformation) and the Waste (result). The Universe is divided in SEVEN TYPES: Livestock, Pets, Zoo Animals, Veterinary Schools, Veterinary Laboratories, Biotheriums and Cattlefights, considering only the most common species in subgroups, as presented in the figure.



It was considered the division of the Animal HCW, of which only the Hazardous are studied, according to the national law, naming Animal HCW of Group III and Animal HCW of Group IV. At mathematical level, the application universe defines the variables to be considered in order to obtain the generated waste quantities.

The Veterinary HCW is directly related with the veterinary activity on animals, and the variables are the animal headings, with values given by the statistics of the INE (statistics national institute) and EUROSTAT. But the Veterinary HCW is also related with the activities of Veterinary Analysis Laboratories and Veterinary Schools.

The numbers of samples and analysis on livestock are given by the statistics from DGV (veterinary national council). The ones done in pets are considered as part of their own assistance. In the Veterinary Schools there are Medical Veterinary courses and Nursing Veterinary courses. The quantities of HCW produced are different and function of the number of students by course and teaching year, numbers given by DGV (high-studies national council) or by the schools.

In the Biotheriums' HCW, the number and species of animals tested are given by DGV. And in the Cattlefights' HCW, the number and type of shows are known from the statistics of IGAC (cultural activities national regulator).

5- SURVEY

The survey on the seven types of producers was made, in five, by samples and, in two, by universal inquiry. For the sample surveys the choice fell upon producers with management of HCW close to ideal. For the national inquiries every producer of the same type was inquest.

The data received, treated by computer, included the evolution of the production population and HCW in the last five years, the responsible HCW recovery operator and the veterinary assistance type, if it applied. The Zoo Parks' fill form was structure with the contribution of the Lisbon National Zoo.

The survey to Livestock HCW production was made by representative sample, on selected animal producers and agricultures guilds. It was also taken into account the data given by veterinary schools in their field assistance.

The Zoos' HCW production survey was done by universal inquiry to all 19 national parks. The same applied to the Veterinary Schools' HCW, with 12 fill forms being sent to every Veterinary Medical and Nursing School in the country.

The survey of the Veterinary Laboratories' HCW, had meant to be done by national inquiry. Because the list of laboratories was received from the regulator (the LNIV) come too late to be used, so the survey was made by sample. The LNIV (veterinary investigation national laboratory) gave its own production data. The same happened in the Biotheriums' HCW, where the survey was change from universal inquiry to sample as a result of the Biotheriums national list being considered confidential by the regulator, the DGV.

The Cattlefights' HCW were surveyed by sample.

6- QUATIFYING MODELS

QUANTITIES (in kg)		GENERATION FORMULAS		2007		2013 FORECAST		
PRODUCERS	POPULATION	GROUP III	GROUP IV	G. III	G. IV	G. III	G. IV	
LIVESTOCK	Cattle	CTT	0,005 x CTT	0,004 x CTT	43.802	73.456	44.473	74.770
	Pigs	PIG	0,014 x PIG	0,022 x PIG				
	Sheep	SHE	0,001 x SHE	0,004 x SHE				
	Goats	GOA	-	0,004 x GOA				
PETS	Equidae	EGU	0,017 x EGU	0,013 x EGU	65.329	41.608	70.546	44.917
	Dogs	DOG	0,042 x DOG	0,031 x DOG				
	Cats	CAT	0,087 x CAT	0,042 x CAT				
ZOOS	Amphibians	AMP	0,004 x AMP	0,002 x AMP	849	627	975	734
	Birds	BIR	0,075 x BIR	0,007 x BIR				
	Marine Mammals	MMA	0,517 x MMA	0,224 x MMA				
	Big Size Terrestrial Mammals	BTM	1,708 x BTM	1,760 x BTM				
	Other Terrestrial Mammals	OTM	0,683 x OTM	0,704 x OTM				
	Fish	FIS	0,000 x FIS	0,000 x FIS				
	Reptiles	REP	0,123 x REP	0,043 x REP				
MEDICAL VETERINARY SCHOOL	1st Year	MV1	27.976 x MV1	-137.463 x MV1	24.254	53.449	18.187	82.407
	2nd Year	MV2	+ 29.196 x MV2	- 80.225 x MV2				
	3rd Year	MV3	+ 145.289 x MV3	- 114.268 x MV3				
	4th Year	MV4	- 9.512 x MV4	+ 146.820 x MV4				
	5th Year	MV5	- 156.939 x MV5	+ 356.402 x MV5				
NURSING VETERINARY SCHOOL	1st Year	NV1	0,132 x NV1	1,207 x NV1	55	1.573	118	1.439
	2nd Year	NV2	- 0,054 x NV2	- 8.957 x NV2				
	3rd Year	NV3	- 0,412 x NV3	- 3.933 x NV3				
LABORATORIES	LNIV (*)	YEAR	-4.000.000 + 1.904,2 x YEAR	2.000.000 - 1.139,4 x ANO	99.453	11.307	95.437	23.718
	Cattle	CTT	0,012 x (144,98 - 0,071 x YEAR) x CTT	-				
	Pigs	PIG	0,012 x (-0,579 + 0,0003 x YEAR) x PIG	-				
	Sheep	SHE	0,012 x (-40,587 + 0,0207 x YEAR) x SHE	-				
	Goats	GOA	0,012 x (-33,701 + 0,0173 x YEAR) x GOA	-				
BIOTHERIUMS	Amphibians	BAM	0,126 x BAM	0,155 x BAM	257.755	316.084	642.565	787.958
	Cattle	BCT	676,935 x BCT	830,103 x BCT				
	Goats	BGO	17,190 x BGO	21,080 x BGO				
	Guinea Pigs	BGP	0,190 x BGP	0,233 x BGP				
	Rabbits	BRB	4,550 x BRB	5,580 x BRB				
	Equidae	BEQ	440,883 x BEQ	540,640 x BEQ				
	Hamsters	BHM	0,126 x BHM	0,155 x BHM				
	Sheep	BSH	25,786 x BSH	31,620 x BSH				
	Fish	BFI	0,013 x BFI	0,016 x BFI				
	Mices	BMI	0,063 x BMI	0,078 x BMI				
	Rats	BRA	0,190 x BRA	0,233 x BRA				
	Reptiles	BRP	0,379 x BRP	0,465 x BRP				
	Pigs	BPI	168,090 x BPI	203,670 x BPI				
	CATTLEFIGHTS	Bullfights	BUF	-				
Heiferfights		NOV	-	0,791 x HEF				
Mixed Cattlefights		MIF	-	0,803 x MIF				
Popular Heiferfights		PHF	-	0,768 x PHF				
Cattle Varieties		CTV	-	0,088 x CTV				
TOTALS				491.497	498.303	872.301	1.016.106	

From the statistic treatment of the survey results, were obtained the models of waste quantifying, presented in the table. The values, in kg, are function of the populations of animals, students and cattlefigths shows. The veterinary analysis is also function of the year.

The share of a chosen population on the waste generation takes into account the presence of its variable on the various producers type's formulas. The contribution of Cattle, for instance, has to consider its factors on Livestock and Laboratories. The independent waste generating formulas can be sum to form composed subtotal formulas, by producer type, and national total formulas.

6.1- LIVESTOCK HCW – There were considered four medium and big size species, with individual veterinary assistance opposed to the distribution by water or food used on the smaller species: CATTLE – the animals run free in the field, not including dairy cows and the wild bulls, with particular cares. The G.IV results from vaccination and blood sample, the G.III is smaller and results from cesarean births; PIGS – with the exception of the Alentejano's pigs, the animals stay closed in pigpens, subject to tight sanitary and veterinary control, which is justified by the risk of infection of the entire shed. So the high production values; SHEEP – they move in compact herds, with disease prevention and health care similar to the cattle, so the G.IV is equal, but G.III is smaller as the cesarean lambing is rare; GOATS – is the most laborious and harsh specie. It stays in domestic or communitarian herds in Beira Alta's and Alto Douro's villages. There is no birth assistance, so the G.III is null. On the other hand the vaccines are given with special care, being the G.IV identical to the other species.

6.2- PETS' HCW – These are animals with sentimental or financial value for their owners, so the veterinary assistance is bigger than their survival needs.

The survey was done with six groups/species of pets, but the groups: Birds, Exotics and Other pets, were not considered in the studied as they are not significant. The other three are similar in their veterinary assistance and can be numbered: EQUIDAE – divided by horses, mules and donkeys. The last two are few in number and used for work propose, with a veterinary assistance lower than the horses. The first are leisure and protocol animals, also used as a trading good with possible earns. In the Iberia Peninsula there is a unique horse breeding characteristic: the mare herds, with big groups of mares and their offsprings living free in meadows. Their veterinary assistance is similar to the livestock and their population can not be neglected. The inclusion of these horses, plus the working horses, justifies the fact that the waste production values are close to the livestock animals, and in G.IV smaller than the pigs; DOGS – specie used mostly as company animal with sentimental value. There are still some animals used for work. In some cases, dogs receive more health care assistance than humans, but others, including most work dogs, only get the free rabies vaccine. So the production values, despite double the horses ones, are not very big, staying bellow the 50 g per animal and year; CATS – half-tamed animals, which need some freedom of movements and decisions, that leads to two different characteristics in their relation with men: the alley cat, that lives in outer space, without registration or owner, but keeps a turf in which is fed by humans and the cat with an owner, that likes

to take some “walks” and for that reason is “automatically” sterilized. As the study only considers the owned animals and there are no working cats, the production values are higher than dogs’.

6.3- ZOOS’ HCW – Seven groups were considered: amphibians, birds, marine mammals, big size terrestrial Mammals (>500 kg), Other terrestrial Mammals (=<500 kg), fish and reptiles.

The Fish have null waste production on both categories. It is easy to perceive that fish are not treated individually. The same occurs with the Amphibians in what concerns Zoo’s HCW, with similar values to livestock. Birds and Reptiles waste production amount more or less, to the same quantities as pets. They are considered exotic species, with values that justify a personal care. Higher values are shown by the Mammals, both Marine and Terrestrial, and their productions are closed to the humans’ HCW. Big Size Terrestrial Mammals, because of their size, generate more HCW than the Other Terrestrial Mammals.

It is difficult to quantify the Circus’ HCW. Most of the medical care is done by the local vets where the circus passes by or by the owners themselves. And so their waste is included in the pets’.

6.4- VETERINARY SCHOOLS’ HCW – There are two courses in the vet schools: medicine and nursery. UNIVERSITIES teach Medicine, and are teaching and investigation orientated. The contribution variations can be justified by different reasons, such as the funds and researches body or the number of students that request the teachers follow-up. POLYTECHNICS have technical nursing courses in strong agriculture areas. The fact that students practice does not include any kind of surgeries, but only injections and sample gatherings, explains the almost lack of G.III waste and the G.IV predominance.

6.5- VETERINARY LABORATORIES’ HCW – There are 25 veterinary analysis laboratories, licensed to do two types of tests: serologic and to the brainstem. The available statistics refer to the four most common livestock species: CATTLE – the waste quantity produced tends to decrease as the ratio gets closer to two analyses per animal each year. This factor is due to the decrease of diseases on the specie; PIGS – the HCW produced are nearly null, and a ratio of one analysis for 100 animals predicting a decrease to one in 200. The reasons for these are the breeding conditions in closed space and the tight veterinary assistance; SHEEP – there is a head control, with the ratio of one analysis per animal, which is justified by the way the herd stays in open field, more subject to diseases; GOATS – the way that the herd is tend is the same as in the sheep, as it is the risk of diseases, so the ratio is the same.

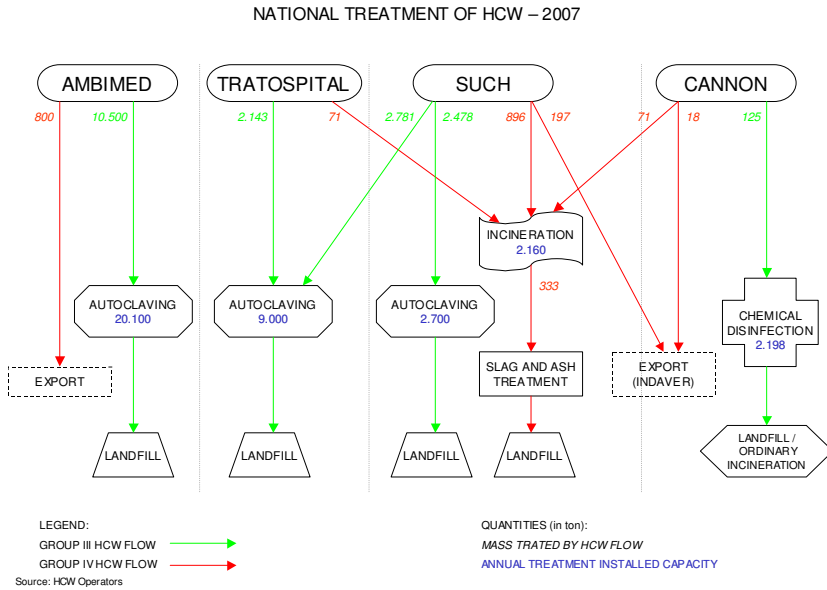
LNIV – This organization is responsible for a great variety of analysis, as autopsies, and its waste production can not be neglected. It is noted a tendency for the increase of the G.III and a decrease of G.IV.

6.6- BOTHERIUMS' HCW – Differing from the rest, the waste production includes the experimented animal carcasses, which means that the G.IV produced is conditioned by the weight of the animals. From the survey sample were obtained the converting factors of their weight in to G.III and G.IV.

6.7- CATTLEFIGHTS' HCW – Waste made off spearheads used on the fights and included in G.IV. There are two types of spearheads based on the type of fight: on horse or on foot, being the second smaller. Usually a Cattlefight has six animal fights. There are five types of shows, being used seven spearheads, except in the last where the average is two: BULLFIGHTS – with the largest wild bulls and professional fighters; HEIFERFIGHTS – with heifers and horse back fighters, heifer fighters and trainees; MIXED CATTLEFIGHTS – with bulls and heifers and with professional and trainee fighters. The waste produce rate is found between the values of the two before; POPULAR HEIFERFIGHTS – with trainees and amateurs fighters; CATTLE VARIETIES – with various cattle, from heifers to cows, and trainees fighters, comic toreadors and popular. It includes the bull runs through the streets.

7- NATIONAL NUMBERS

The study takes in account the numbers of waste produced in 2007 and the previsions for 2013, as in the table already presented. Looking at the percentages (in rate terms), Cattlefights, Zoos and Nursing courses produced waste are null in both groups, while Biotheriums has the majority of the production. Taking in account the forecast for the next 5 years, it is estimated a substantial growth of the Animal HCW in both groups differently.



There are five HCW licence Operators, and only one: Ambitral, did not respond to the studied. The figure shows the 2007 national HCW flows.

The Human HCW remain constant as the population growth rate stays almost null. In 2007 the Animal HCW is insignificant in comparison with the Human

HCW: 2% in G.III and 16% in G.IV. But this numbers double in 2013 to 4% in G.III and 33% in G.IV.

From the comparison between the numbers obtained in the study with the numbers given by the operators, the total of Animal HCW was gauged in weight. The statistic knowledge of the national potential producer population and of the operators' client numbers, leads to the percentage of served producers. From this is observed that only one third of the potential waste producers is served.

Knowing the installed capacity of the national treatment units, it was possible to compare the quantities of waste produced and treated in 2007. In G.III the installed capacity is about double the produced HCW, but in G.IV that capacity has been reached. In 2013 the forecast is that the G.IV capacity will be exceeded in 37% of waste.

8- NATIONAL MARKET

The costs of the three types of HCW national treatments are presented at the table, divided by nine possible activities.

VALUES (€)	TREATMENT TYPE		
	GIII AUTOCLAVING	GIII CHEMICAL DISINFECTION	GIV INCINERATION
Removal & Transport	0,50 - 0,65		
Autoclaving	0,60 - 0,80		
Chemical Disinfection	0,70 - 0,80		
Cold Storage	0,09 - 0,12		
Incineration	0,70 - 0,90		
Operation & Control	0,60 - 1,75		
Landfill/Ordinary Incineration	0,25 - 0,60		
Slag & Ash Treatment (a)	0,07 - 0,08		
Slag & Ash Landfill Discharge (a)	0,25 - 0,30		
TOTAL MEANS - 2007	2,88	2,93	2,75
VALUES - 2013 (b)	3,35	3,41	3,21

Notes: (a) by operator's data, waste to slag & ash Conversion rate: 27%; (b) assuming a constant inflation tax of 2,6%.

possible activities.

The Incineration value can be divided in two different values, one related to the costs for the operator for the slag & ash treatment.

The value of the HCW market in 2007 is 60.235.516 €, 11% G.IV and 89% G.III, with 95% Human HCW market and 5% Animal HCW. The value of the Animal HCW market is 2.793.151 €, with 49% G.IV and 51% G.III. In 2013 it is forecast an Animal HCW market of 5.322.292 €, in which 52% is of G.IV and 48% of G.III, and the HCW market of 62.764.657 €, with 13% G.IV and 87% G.III.

9- CONCLUSIONS

The Zoo waste production can be included in the Pets waste production, while the Nursing Course production can be part of the Medical Course production. The Cattlefights' HCW is a pure academic study and should not be considered, as it presents a very small risk of contamination. The Biotheriums waste shows a strong tendency to grow, the numbers for 2013 pointing out between 74% and 79%.

Almost every biotheriums, the biggest laboratories and the little veterinaries, zoo parks and vet schools do not send their Animal HCW for treatment. This fact strikes out particularly in the biotheriums for it is the most waste productive type, by the study. Kipping the growth tendency of the operators service, it is forecast that in 2013 every livestock, vet pets and vet school HCW producer will be served by an operator. The remaining will stand far from total service, being needed an extra effort from the operators' part.

After the costs appreciation here-by presented, it is easily understood why the incineration is considered by some people as the only true method of HCW treatment. This method is the only one that assures the complete inoculation and its medium cost to the producer is significantly lower then others.

The study of International sources was left out of this document, partly because during the research only a South African article was found and partly because the lack of time did not allow direct contact with the international research centers.

It would be interesting to broaden the animal universe and include the small livestock species such as: rodents or poultry, or aquaculture and hunting breeding. It would also be important the complete access to SIRER, as well as the development of national inquiries to the veterinary laboratories and biotheriums, that would permit to understand the true significance of the values now obtain.

It would be, also, interest to study the existing HCW treatment technologies and their financial costs, finding better solutions for the integrated managing of the Animal HCW, seen part of the system that treats the Human HCW or, as someone defends, with independent treatment structures, defining in so the Strategies for the treatment of Animal HCW.