NATIONAL INSTITUTE OF TOXICOLOGY
AND FORENSIC SCIENCES

GOBIERNO DE ESPAÑA
MINISTERIO DE JUSTICIA

INT CIENCIAS FORENSES

NATIONAL INSTITUTE OF TOXICOLOGY AND FORENSIC SCIENCES

MADRID
BARCELONA
SEVILLA
TENERIFE

Report 2020

National Institute of Toxicology and Forensic Sciences

Report 2020

Recommended citation: *National Institute of Toxicology and Forensic Sciences. Report 2020.* National Institute of Toxicology and Forensic Sciences. Ministry of Justice.

National Institute of Toxicology and Forensic Sciences
José Echegaray, 4. 28232 Las Rozas. Madrid.

Website:
https://www.mjusticia.gob.es/es/ministerio/organismos-entidades/instituto-nacional

National Institute of Toxicology and Forensic Sciences

Report 2020

GOBIERNO DE ESPAÑA | MINISTERIO DE JUSTICIA

Madrid, 2021

Report presented by Antonio Alonso Alonso
Director of the National Institute of Toxicology and Forensic Sciences

Published by:
Ministry of Justice.
General Technical Secretariat

NIPO (pdf): 051-20-013-6
ISSN: 2792-4866

Catalogue of publications of the General State Administration: https://cpage.mpr.gob.es

Index

1. 2020 Balance Sheet: Effects and lessons learned from the pandemic

No one could have suspected at the beginning of 2020 that the pandemic produced by the SARS-CoV-2 would have such a global impact on our lives and in our professions, confronting us with unimaginable challenges of sustainability and resilience. In the balance of the activity of the National Institute of Toxicology and Forensic Sciences (INTCF) during 2020 is a reference to the effects and lessons learned from the SARS-CoV-2 pandemic that could not be missing.

The confinement produced a huge reduction in the INTCF activity and the Legal Medicine and Forensic Sciences Institutes (IMLCF) in all the Spanish territory during March and June. During those four months, the INTCF maintained an admission system and sample suitability. In May, most of the analytical services were closed until the de-escalation and the return of activity. Then all the staff reincorporated in June.

One of the objectives from the very beginning was the implementation of adequate safety and health protection measures that we set out to accomplish, allowing the return of staff to their workplace. The SEJ RESOLUTION - IMLs-INTCF OCCUPATIONAL SAFETY SCHEME COVID-19 was produced in a record time. Personal protective equipment (PPE) and means of protection were provided for all the staff of the INTCF. Standards and videos were produced and disseminated about the general preventive measures and INTCF specific scientific activity facing the SARS-Cov-2 pandemic. The establishment of morning and evening shifts in the laboratories and a time card control system were other security measures. Likewise, in 2020 the Biology Service of the Department of Madrid validated and implemented the technical PCR procedure for the detection of SARS-CoV-2, and its forensic validation as a sample collection kit was distributed to the IMLCF for the detection of SARS-CoV-2 from post-mortem samples.

The teleworking implementation has been one of the other purposes from the beginning of the confinement. In 2020, 262 teleworking jobs were available, which made possible a 100% attention through teleworking in the 24-hour telephone helpline service of the Toxicology Information Service. The teleworking jobs have been used by the majority of the facultative of the analytical services to elaborate forensic reports and access the LIMS INTCF system of laboratory information management and other INTCF databases. The development and the installation of communication systems through video conferences has been another fundamental progress element. It has helped work meetings, in the virtual attendance to scientific meetings, and to continue the training of our staff. During 2020, and inside the continuous training program of the Center for Legal Studies (Spanish initials, CEJ), 10 online courses with more than 650 student places have been developed, allowing the INTCF staff access to training considerably compared to 2019.

Without a doubt, the digital transformation that we have activated during 2020 to face the challenge of lack of mobility that originated during the pandemic cannot turn back. It must continue developing and implanting itself to its full extent and with all the guarantees because it offers efficient, sustainable, and secure solutions facing the possible

challenges of the future and the new normalities. A large share of the INTCF projects already being implemented during 2020 are also digital transformation projects, such us the European harmonization project for the notification of chemical substances through the European Chemicals Agency (ECHA) or the digital signature project of the forensic reports produced by the INTCF LIMS System.

The analytical services were being reactivated gradually from May, despite the drastic reduction in the INTCF activity during the confinement. The reactivation of the INTCF expert activity in the second half of 2020 is contained in the expert activity statistical data by departments and services presented in this report. Concerning 2019, despite registering in 2020 a decrease of 8,415 cases, a total of 30,908 expert reports (after the realization of 349,072 analyses from a total of 135,528 samples) have been issued, with a descent of only 2,426 reports compared to the total number of emitted reports (33,334) in 2019. Definitions about these parameters and the methodology for the obtention of statistical data are presented in Annex I.

The budgetary expenditure made by the INTCF during 2020 in personnel, analytical instruments, reagents and medical supplies, maintenance services, digital transformation and continuous training was approximately 29 million euros, as shown in section 2.4. During 2020, a significant investment (close to 4 million euros) was produced in equipment and analytical instruments of the different departments and analytical services of the INTCF, thus complementing the technological renovation undertaken in 2019.

One of the INTCF action and research plan objectives includes the modernization of the INTCF of Seville, Barcelona, and La Laguna headquarters. In 2020, the transfer of a plot of land was consolidated by part of the Universidad Pablo de Olavide to construct a new headquarter of the INTCF in Seville. The project drafting and direction of the work of the new headquarter has been programmed for 2021.

About other data of the 2020 balance, we refer to the reader the document ACTIVITY BALANCE DEVELOPED BY THE INTCF DURING 2020, where they can find the initiatives in detail developed during 2020 concerning the fundamental axes of the INTCF activity: expert activity, quality assurance, digital transformation projects, collaboration agreements, training, and education programs. Furthermore, the Annex II of the report collects the legal regulations applicable to the INTCF, where they further define the structure and the functions of the INTCF.

In this INTCF 2020 report edition, we maintain the structure initiated in 2019 to give greater importance to the seven scientific INTCF services that submit their statistical data classified by research type. The repertory of interesting forensic cases has been expanded to continue disseminating the wide range of interdisciplinary scientific areas which make up the forensic sciences. The readers can access the most significant INTCF forensic cases in 2020 collected in this report through the Twitter INTCF official account (@INTCFjusticia) under the hashtag *#casosforensesINTCF2020*. Apart from the

expert activity, the INTCF also investigates and collaborates with other institutions. It also presents the teaching and training activities carried out during 2020. This year it is also included a section describing the work done by the diverse INTCF entities (Sample and Waste Management Area, Library, Supply Management Unit, Occupational Risk Prevention Service, Secretarial Team, and IT Systems Section) that realize diverse support functions to the INTCF expert Services and whose work is essential for the functioning of the different INTCF Departments.

I would like to end by highlighting that despite the great challenges that we had to face, a consequence of the sanitary emergency produced by the coronavirus pandemic, the INTCF has continued progressing and improving thanks to the effort and scientific and human quality of all the staff. It is precisely another of the lessons learned during the pandemic. Without the solidarity, cohesion, and compromise of all the INTCF staff and those from the Ministry of Justice that collaborates closely with the INTCF in the regulation development, the administrative management, the fast recovery of the INTCF professional activity would not have been possible. I would like to express my sincere appreciation for the work done by all the professionals of the INTCF and the Department of Justice.

I greatly appreciate, and specifically, the dedication and compromise effort of the Directors of the Department and from the INTCF Delegation, the dedication and professionalism of the Heads of Service and all the specialist teams as (doctors, specialist technicians, and laboratory assistants), and of the bodies of the Administration of Justice assigned to the INTCF. I must also extend my deepest thanks to the cleaning services, an often forgotten group, for their vital work in the INTCF working on the front line of the battle against this pandemic and protecting the rest of us.

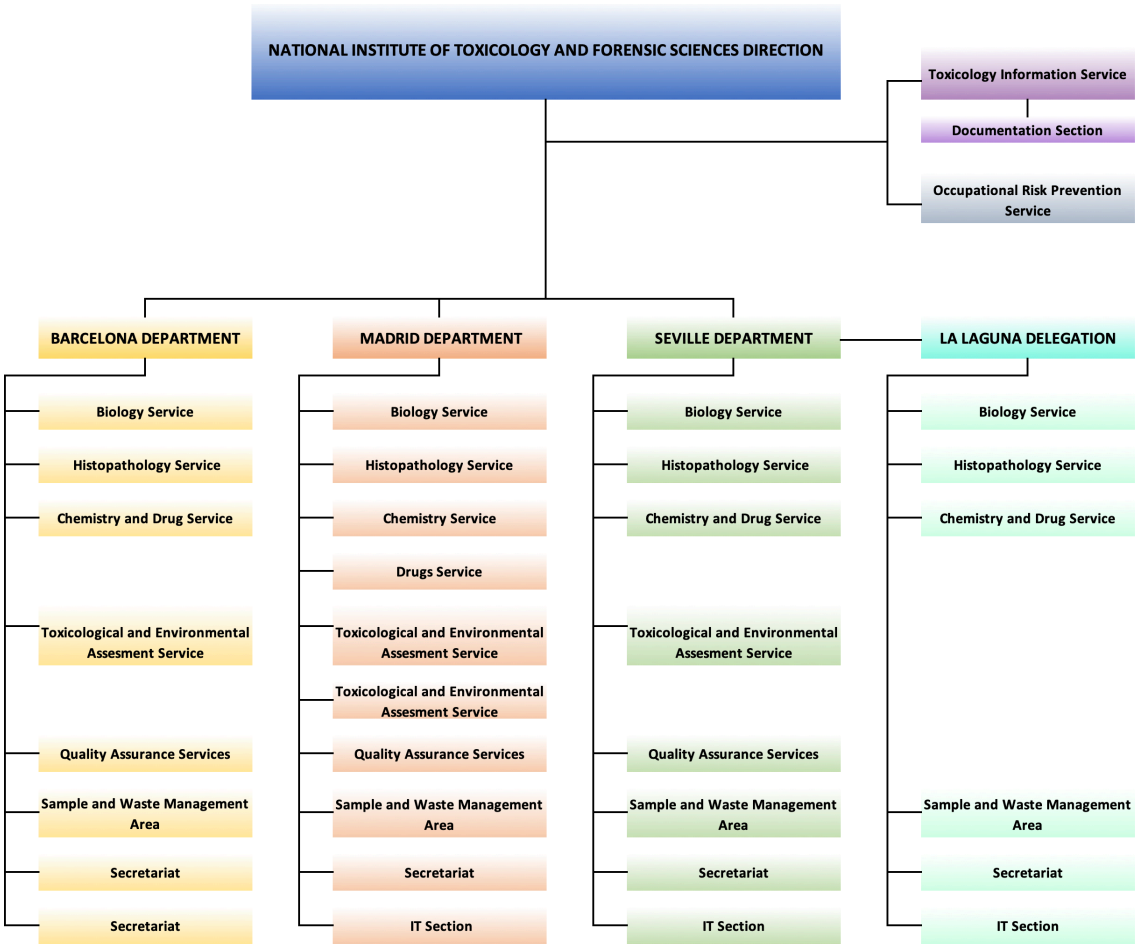
I would also like to take this opportunity to thank all institutions, universities, national and international bodies, which in 2020 have collaborated with the INTCF, with special mention going to the Legal Medicine and Forensic Sciences Institutes. The INTCF maintains a very close collaboration in our common task of giving technical-scientific advice at the service to courts and the Public Prosecutor's Office.

Antonio Alonso Alonso.
Director of the National Institute
of Toxicology and Forensic Sciences

2. The organization at a glance

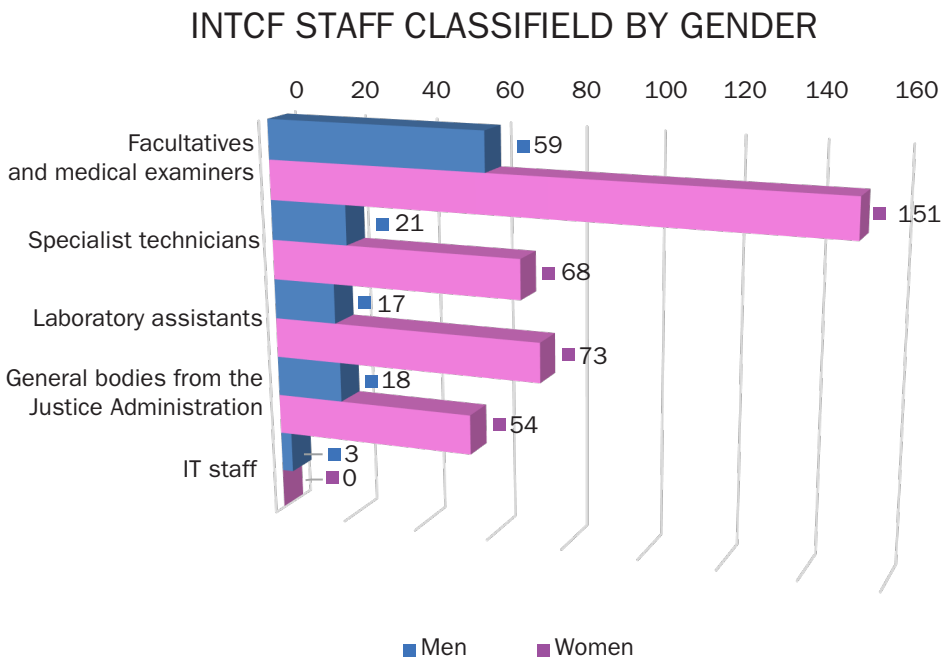
The following graphs show the INTCF chart organization, the territorial scope of action of the four headquarters, the staff distribution by gender and according to the different professional bodies, the budget expenditure, the overall statistical data of the expert activity, the telephone inquiries attended by the SIT, the distribution of the registered cases, and the distribution of the cases registered by each region of the country during 2020.

2.1. INTCF Chart

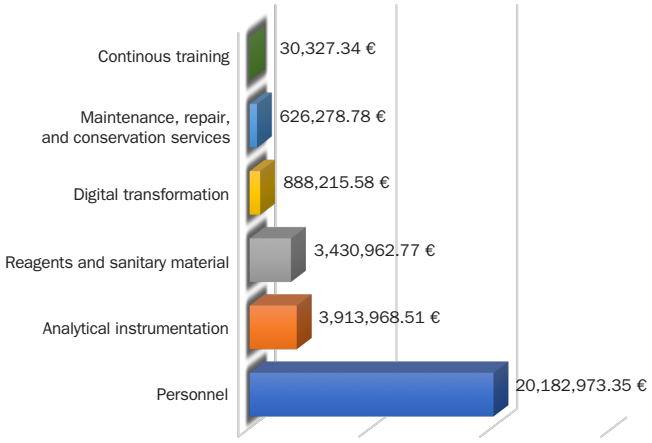


2.2. Scope of action of the various INTCF sites

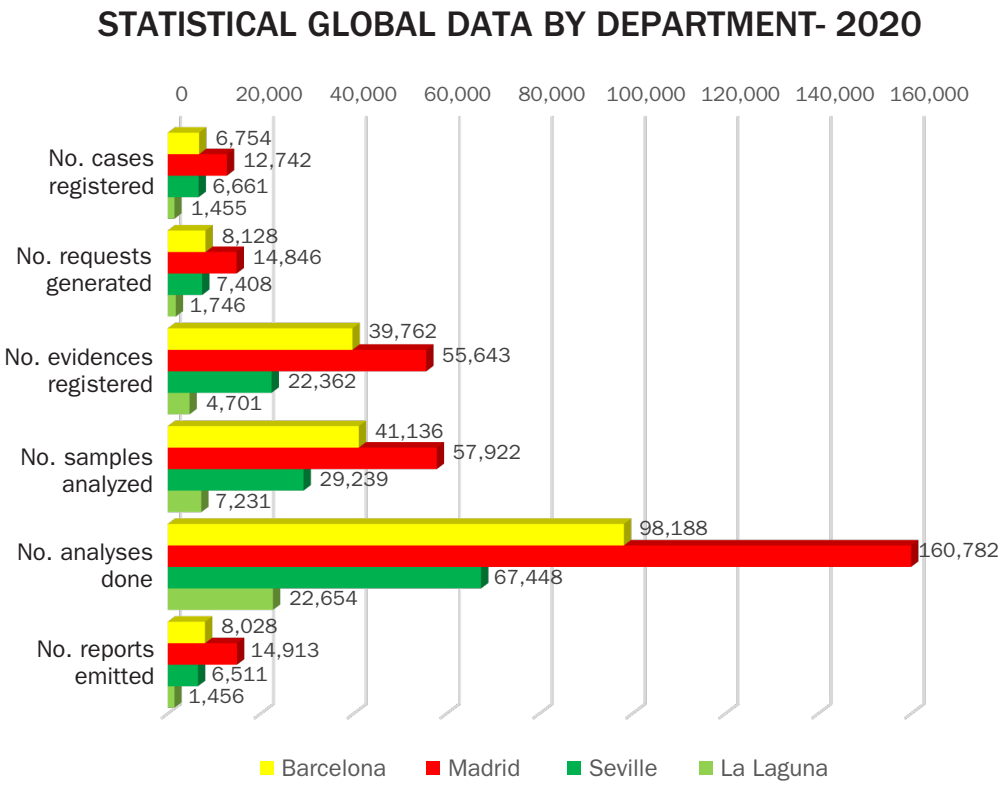
2.3. INTCF staff



2.4. Expenses incurred by the INTCF in the financial year 2020

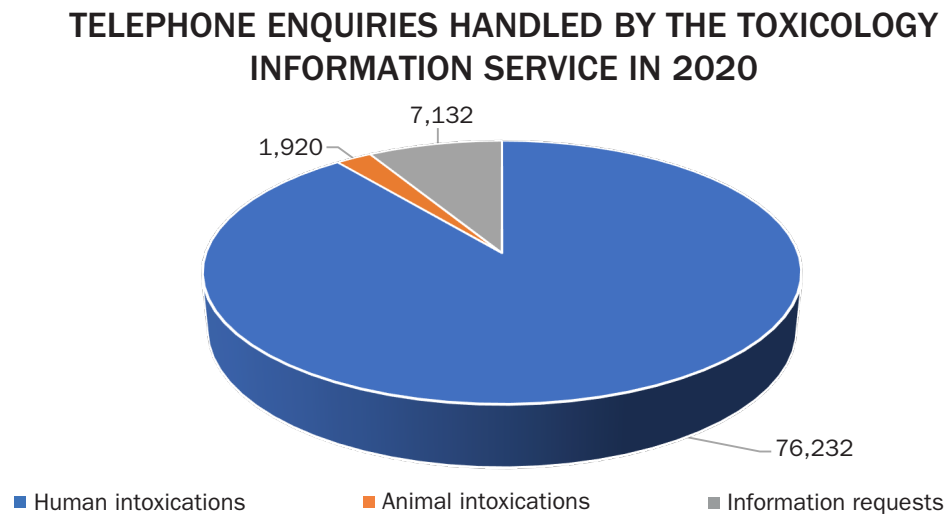


2.5. Summary of the Scientific-Expert Activity

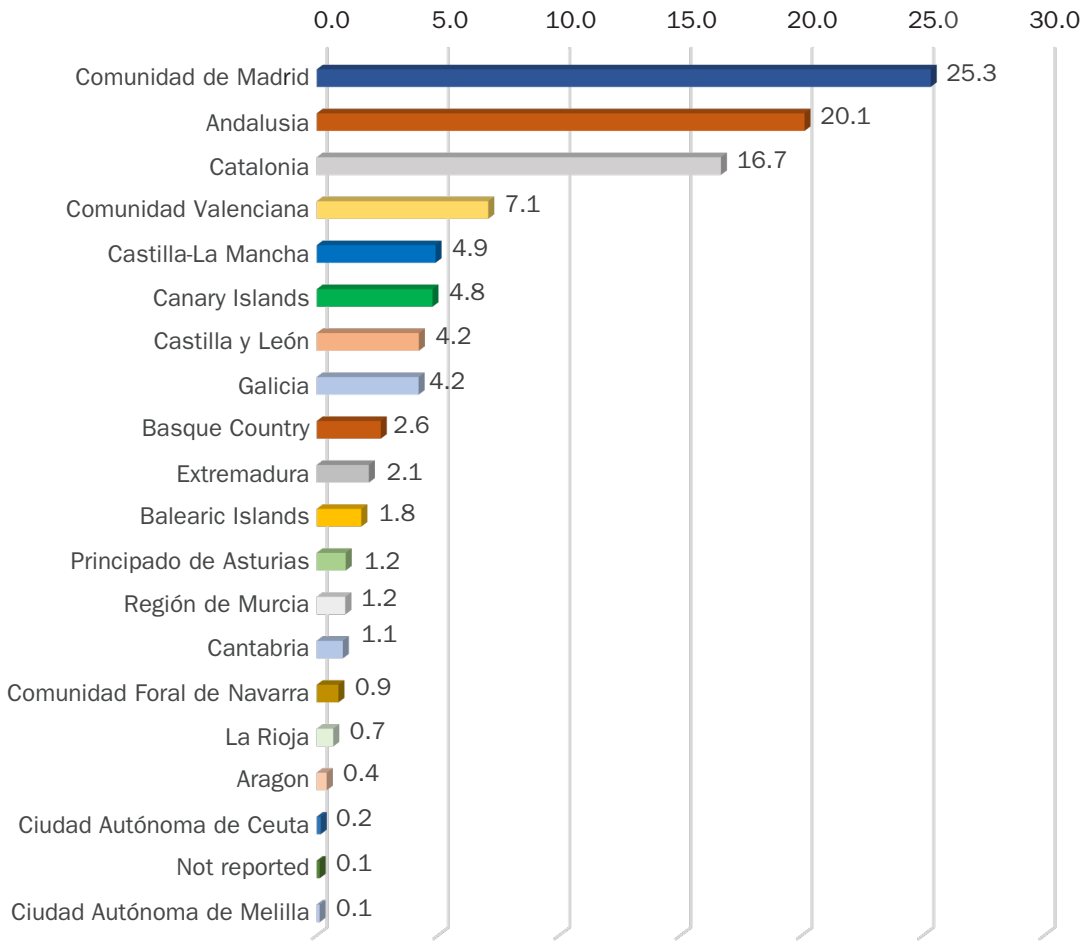


2020	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reportss emitted
Barcelona	6,754	8,128	39,762	41,136	98,188	8,028
Madrid	12,742	14,846	55,643	57,922	160,782	14,913
Seville	6,661	7,408	22,362	29,239	67,448	6,511
La Laguna	1,455	1,746	4,701	7,231	22,654	1,456
Total	**27,612**	**32,128**	**122,468**	**135,528**	**349,072**	**30,908**

2.6. Telephone enquiries handled by the Toxicology Information Service in 2020



2.7. Distribution of registered cases by Autonomous Communities



3. Chemistry and Drugs Services

Each department counts with a Chemistry and Drugs Service except for the Madrid Department, which has a Chemistry Service and a Drugs Service. Finally, the Delegation of La Laguna counts with a section of Chemistry and Drugs.

The Chemistry and Drugs Services carries out mainly expert activities in compliance with the functions entrusted to them, but also carries out teaching and research functions. Its expert work includes the following types of investigations:

Post-mortem Toxicological Investigation:

- *Deaths by homicide*
- *Deaths by suicide*
- *Deaths by an adverse reaction to psychoactive substances*
- *Deaths by car accidents*
- *Deaths by a work accident*
- *Deaths related to sport*
- *Deaths by drowning*
- *Deaths by fire*
- *Deaths by malpractice*
- *Deaths of unknown etiology suspected of criminality*
- *Death data (from ions in vitreous humor)*
- *Deaths of unclear etiology (sudden adult death, sudden infant death, sudden infant death, sudden death associated with sport, and others)*

Toxicological Investigation in Live Subjects:

- *Offenses against traffic safety*
- *Crimes against sexual liberty and chemical submission*
- *Crimes against public health*
- *Other types of offenses*
- *Recent use of alcohol, drugs and psychotropic drugs*
- *Chronic use of alcohol, drugs and psychotropic drugs*
- *Clinical samples*
- *Suspect of poisoning*

Chemistry toxicological analysis of non-biological samples from drug seizures (caches)

To unify criteria in the different Chemistry and Drugs Services when cataloging the different types of post-mortem and live subject toxicological research issues, and to facilitate a detailed classification of the cases received, the sub-types of reports were implemented in 2020 shown in Table 3.1. This classification allows identifying the typology of each case which no longer falls under a common denominator such as “General Toxics”.

Table 3.1. Types and sub-types of Chemistry and Drugs Services

Type of report	Subtype of report
Post-mortem toxicological information	
General Toxics	Natural
	Death due to an adverse reaction to psychoactive substances
	Suicide (hanging, precipitation, intoxication, stabbing weapon, firearm, Drowning, other)
	Accidental (asphyxia, trauma, others)
	Undefined
Death in custody	Natural
	Death due to an adverse reaction to psychoactive substances
	Suicide (hanging, precipitation, intoxication, stabbing weapon, firearm, Drowning, other)
	Homicide (stabbing weapon, firearm, trauma, gender-based violence, other)
	Accidental (asphyxia, trauma, others)
Death suspected of criminality	Homicide (stabbing weapon, firearm, trauma, gender-based violence, other)
Traffic accident	Accidental (asphyxia, trauma, other)
Workplace accident	Accidental (asphyxia, traumatismo, others)
Drowning	Accidental: asphyxia
Fires	Accidental: others
Adult sudden death	Natural
Infant sudden death	Natural
Children sudden death	Natural
Sudden death related to sport	Natural
Toxicological investigation in live subjects	
Drugs in hair	Chronic consumption
	Chemical submission
	Sexual assault due to chemical submission
Sexual assault	Sexual assault due to chemical submission
	Does not apply
General Toxics	Chemical submission
	Hospital: adults
	Hospital: children
	Hospital: neonates
Alcohol in live subjects	Does not apply
Alcoholemia + drugs in traffic	Does not apply
Oral fluid	Does not apply
Drugs or alcohol in biological samples	Does not apply

The staff of the Chemistry and Drugs Services who have carried out this type of research during 2020 are shown in Table 3.2.

Table 3.2. Staff of the Chemistry and Drugs Services of the different Departments

	INTCF-MADRID (Chemistry Service)	INTCF-MADRID (Drugs Service)	INTCF-BARCELONA	INTCF-SEVILLA	INTCF-LA LAGUNA
Head of the Department	1	1	1	1	0*
Facultatives	14	10	17	17	4
Specialist technicians	10	5	9	6	3
Laboratory assistants	6	12	6	7	1
Administratives	1	2	2	2	–

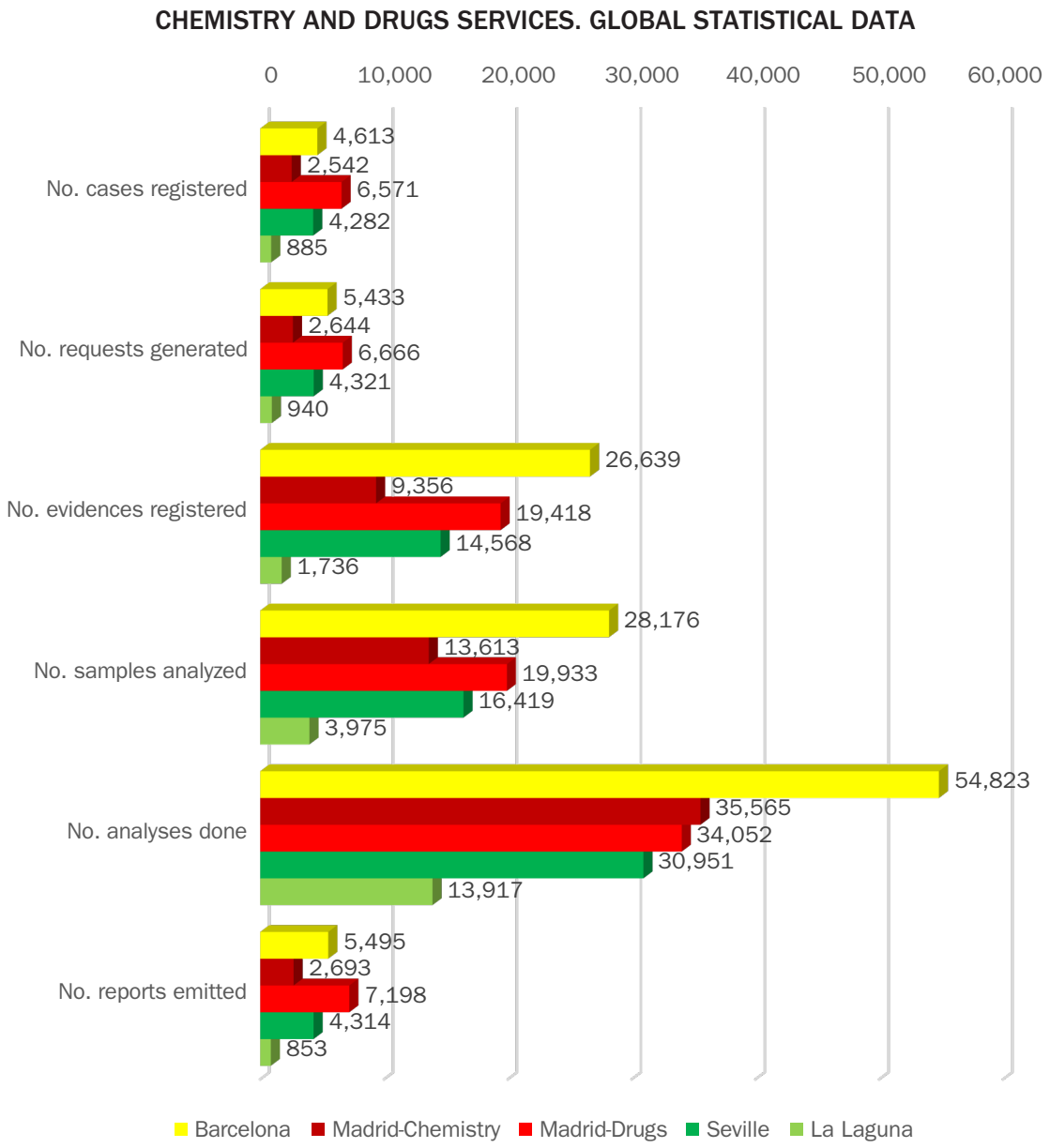
* There is no head of service and instead there is a coordinator who rotates among the doctors who make up the section

Covid-19 has affected our daily life and its singularity in 2020. It has been reflected in the number of cases registered in the Chemistry and Drugs Services during this period. During 2020, 18,893 expert cases were received, which supposes 21.5% fewer cases than in 2019. Furthermore, the total of evidence registered was 71,717, similar to the previous year. Concerning expert reports, 20,553 were emitted in 2020, an 11.8% less than in 2019. In total, there were 82,116 samples analyzed. The global analysis was 169,308; which supposes 14.1% fewer analyzed samples and 31.2% fewer analyses carried out compared to 2019. All these data are shown in Figure 3.1.

Since 1996, the INTCF has been drafting a monographic report (*Toxicological Findings in Road Traffic Fatalities*) analyzing in detail the influence of ethyl alcohol consumption, drugs, and psychopharmaceuticals has resulted in this type of death. In 2020, apart from the annual report of fatal victims in traffic accidents, a monographic report on suicide deaths in 2019 was elaborated (*Epidemiology and Toxicology of Suicide Deaths in Spain*). This report, to be continued in the coming years, has the main objective to alert about the problem of suicide in Spain through the INTCF casework.

The Chemistry and Drugs Services has also acted as a reference centre in matters within its field of activity. Apart from the expert activity, it has participated in teaching and training activities collaborating with legal medicine institutes and university centers in protocols for action with medical-legal repercussions, making validation studies and technological evaluations. It acted as a reference centre of the Society of Hair Testing to analyze drugs in the hair.

Figure 3.1. Overall data of the INTCF Chemistry and Drugs Services' Expert Activity in 2020



	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Barcelona	4,613	5,433	26,639	28,176	54,823	5,495
Madrid-Chemistry	2,542	2,644	9,356	13,613	35,565	2,693
Madrid-Drugs	6,571	6,666	19,418	19,933	34,052	7,198
Seville	4,282	4,321	14,568	16,419	30,951	4,314
La Laguna	885	940	1,736	3,975	13,917	853
Total	**18,893**	**20,004**	**71,717**	**82,116**	**169,308**	**20,553**

Hereunder, the Chemistry and Drugs Services from the different Departments collect the expert and scientific activity and the teaching activities during 2019. A description of a relevant forensic case is also included in each Service to publicize it.

3.1. Madrid Department Chemistry Service

During 2020 the Chemistry Service expert activity had 2,644 requests, and 13,613 samples were analyzed with a total of 35,565 analysis, issuing a total of 2,693 expert reports.

As seen in Figure 3.1.1, the majority request for analysis corresponds with a **general toxic study** (1,530 requests with 8,172 samples analyzed) in dead persons, without a death confirmed. Analytical systematics was applied to this group aimed at the identification and quantification if proceeds from samples received to clarify the cause of death employing a different technology to cover the largest number of investigated substances (> 400 substances) in different matrixes.

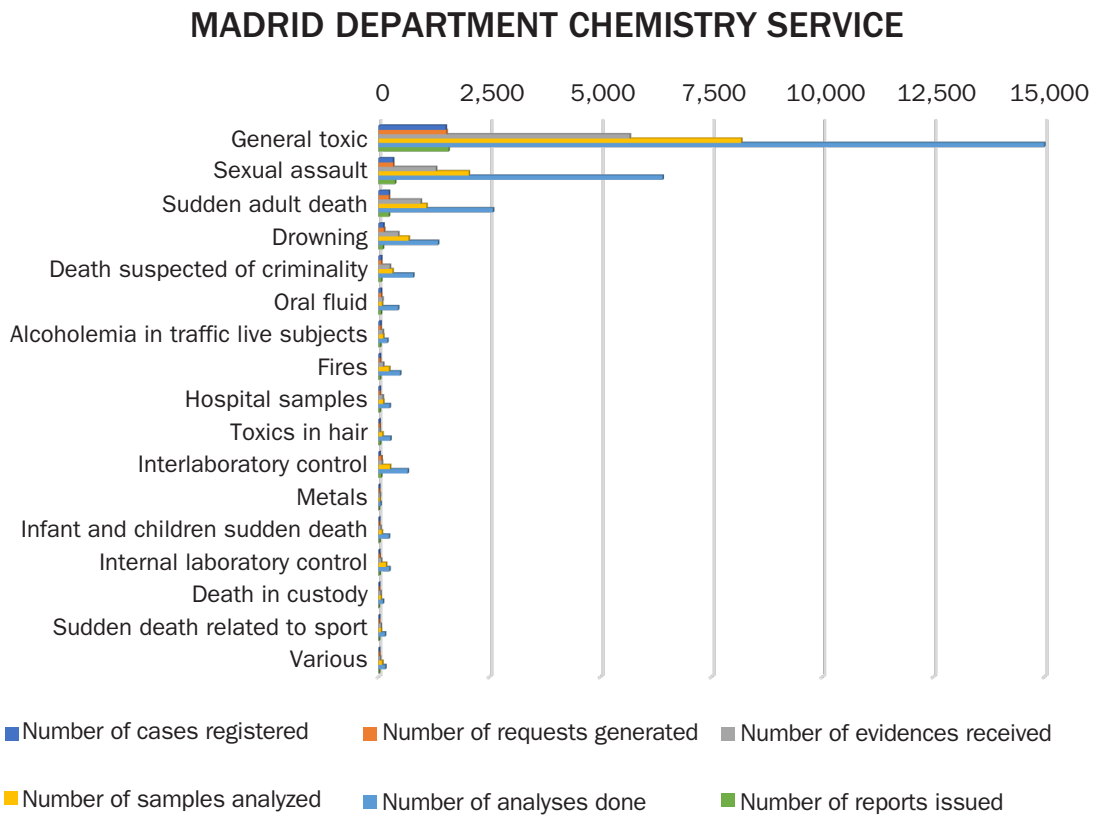
The second most numerous analysis requests corresponds to **crimes against sexual liberty** (331 requests with 2,034 samples analyzed). Systematic analysis to identify the possible employment of substances capable of producing chemical submission leads to different analytical techniques and maximum resolution detectors to investigate detection limits.

In third place, several applications were received, toxicological investigations of the **sudden deaths** (**adult, children, and infant**) (249 requests with 1,154 samples analyzed). On these matters, the toxicological investigation will be oriented on determining the presence of any substance that could cause or contribute to the death.

Another group with big requests is **drowning deaths** (124 requests with 679 samples analyzed). In these cases, apart from realizing a general toxicological study, a hydremia study is performed (strontium and manganese levels in blood samples from ventricles).

Other investigations were done in 2020 by the Madrid Chemistry Department, with a smaller number of requests, that are: **toxicology investigation in fires, study hair detection drugs, investigation on hospital samples to identify the substance that has produced the clinical picture/intoxication, the study of metal intoxication, or chemical-environmental studies.**

Figure 3.1.1. Casework of the Madrid Department Chemistry Service during 2020 according to the type of report



Type of report	Number of cases registered	Number of requests generated	Number of evidence recorded	Number of samples analyzed	Number of analyses done	Number of reports emitted
General toxic	1,514	1,530	5,660	8,172	21,230	1,578
Sexual assault	325	331	1,296	2,034	6,402	371
Adult sudden death	234	234	951	1,080	2,578	234
Drowning	109	124	445	679	1,341	100
Death suspected of criminality	61	61	254	315	782	61
Oral fluid: Confirmatory analysis of drugs in oral fluid	57	58	88	77	440	57
Traffic alcoholemia in live subjects	47	47	94	106	200	40
Fires	32	35	103	239	487	36
Hospital samples	30	30	93	105	251	30
Drugs in hair	22	26	28	88	268	35
Interlaboratory control	22	66	75	259	659	60
Metals	16	16	32	26	48	10

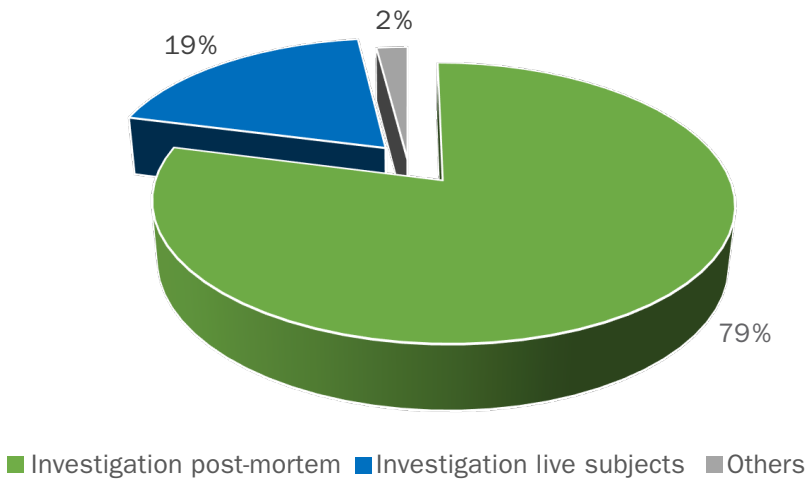
Type of report (cont.)	Number of cases registered	Number of requests generated	Number of evidence recorded	Number of samples analyzed	Number of analyses done	Number of reports emitted
Sudden children and infant death	16	15	45	74	234	22
Internal interlaboratory control	15	25	59	170	246	25
Death in custody	14	14	46	52	100	7
Sudden death at sport	14	14	54	55	146	13
Various	**14**	**18**	**33**	**82**	**153**	**14**
Total	**2,542**	**2,644**	**9,356**	**13,613**	**35,565**	**2,693**

The Madrid Department Chemistry Service analyses to answer the requests received, but to determine alcohol and other volatiles (1,224 analyses). It also carries out the screening through enzyme immunoassay (2,435 analyses) of the requests of the Madrid Drug Service.

The number of requests received in the Service during 2020 decreased 27.8% compared to 2019. The decrease can be attributable to the global pandemic situation caused by the coronavirus. This distortion does not only affect the number of cases received but also the type of casework. We, therefore, proceed to analyze it more specifically both in terms of the cases received and their etiology.

In Figure 3.1.2, the expert investigations carried out are focused on **post-mortem cases (79%)**.

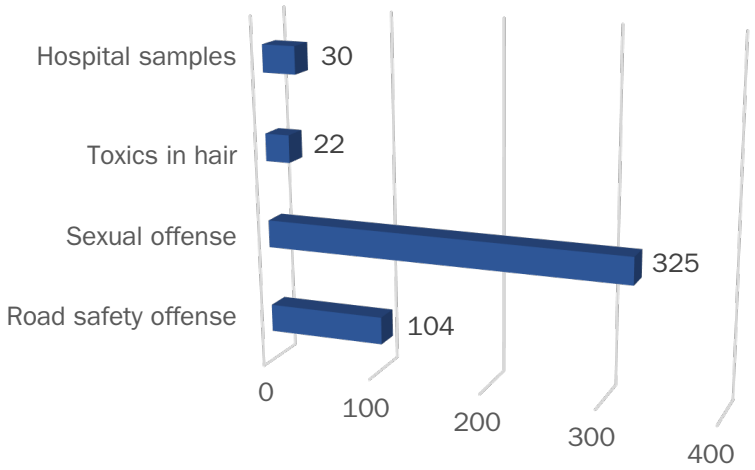
Figure 3.1.2. Classification according to type of investigation



The investigations in living subjects are grouped in four fields (Figure 3.1.3); the majority (**67.5%**) is the investigation of substances in **crimes against sexual liberty** followed by the confirmation of alcohol or drugs in biological samples in road safety offenses (21.6%). To

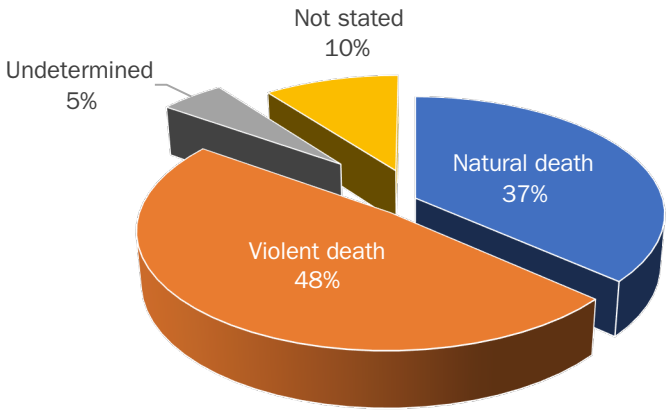
a lesser extent and with similar percentages are investigations of substances in hair samples (4.7%) and substance investigations causing a clinical condition or intoxication that the hospital cannot investigate (6.2%).

Figure 3.1.3. Types of research on living subjects



As we have already explained before, 79% of the investigations are based on samples of deceased persons. The violent etiology represents almost half of the cases analyzing the etiology of the requests received (Figure 3.1.4). Although, in 10% of the cases, the expert reflects neither the etiology nor any information concerning the cause of death.

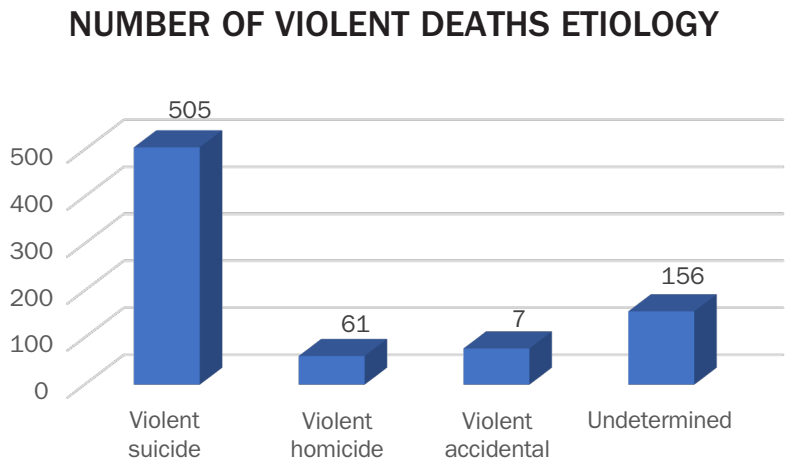
Figure 3.1.4. Type of etiology of post-mortem investigations carried out



Inside the group of violent etiology it draws attention that the predominant group (**50%**) was **violent suicide** (505 cases; Figure 3.1.5). In 2019, 570 cases of deceased of suicide

violent etiology were received. It represented 16.2% of the cases. In 2020 this type of casework increased to 19% of the total number of the received cases.

Figure 3.1.5. Classification of cases according to the type of violent etiology



As the suicidal etiology cases are the main type of cases investigated by the Service, one of them has been chosen to be described as a case of interest.

3.1.1. Interesting forensic case: Death by sodium nitrite intoxication

Hereafter, a case received in the Chemistry Service during 2020 is exposed. The interest lies both in the age of the person deceased (a minor, 16 years) and in the substance employed for the autolytic purpose (sodium nitrite).

Data

On the arrival of the emergency services at 09:29h at the domicile, they found the victim alive, referring to having ingested 20 grams of NaNO2. It is about a 16 years old male that presents paleness, sweating, stupor, foaming at the mouth, and a TA of 77/35.

The victim's background was a mixed depressive-anxiety disorder diagnosis and a dependence on cannabis suffering an intoxication with delirium symptoms two months before its death. He spent three months at the hospital before for the study by solitary confinement, abuse of benzodiazepines, and intoxicants (Cannabis, MDMA, and Methylphenidate). The patient was under treatment with antidepressants (Fluoxetine), antipsychotics (Risperidone), and ferrous sulfate.

Due to the worsening, the patient receives mechanical ventilation support and advanced CPR. The blood collection was at 10:40h at the hospital. The administration of methylene blue (antidote) is approximately at 10:45h. At 10:56, CPR maneuvers were suspended due to the absence of a pulse.

Expert investigation

The forensic requires the histopathological, microbiological, and toxicological study by part of the INTCF.

In the **Histopathology Service**, they receive samples of the heart and the lungs. They do not observe any acute pathology that can explain the cause of death

They receive in the **Chemistry Service**:

- Vitreous body sample.
- Subclavian blood samples (post-mortem).
- Blood samples from the hospital (antemortem).
- Gastric content sample.
- Powder canister with identification label with sodium nitrite.

They proceeded to realize the following analyses:

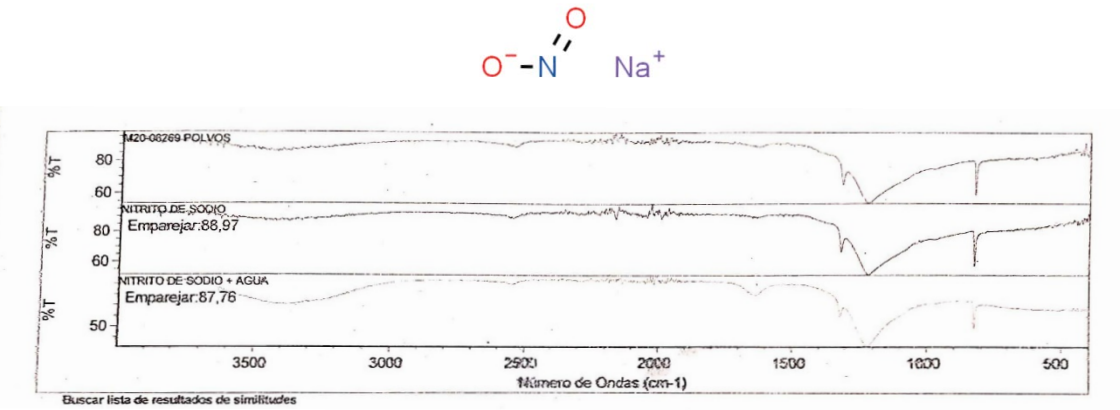
- About the powder sample contained in the canister, they realized afterward an analysis to identify its composition by infrared spectrometry (FT-IR) and the determination of cyanide by UV-VIS spectrophotometry.
- About the blood samples realized:
  - Analysis of ethyl alcohol and other volatiles (methyl alcohol, acetone, and isopropanol) by headspace gas chromatography.
  - Determination of methemoglobin and carboxyhemoglobin by ultraviolet-visible spectrophotometry.
- About the blood, vitreous body, and gastric content they realized:
  - General organic toxicological research aimed at the detection of drugs of abuse, psychotropic drugs, and frequently used drugs among others by GC-MS and HPLC.
- Nitrite determination by ultraviolet-visible spectrophotometry was performed on the serum sample and gastric contents.

Results

	Ante-mortem blood		Post-mortem blood	
Methaemoglobin	17 %		< 5 %	
	Ante-mortem Serum		Gastric content	
Nitrites	>60 g/l		14 g/l	
	Ante-mortem blood	**Post-mortem blood**	**Gastric content**	**Vitreous body**
Paracetamol	< 15 mg/l	< 15 mg/l	Positive	Positive
Methylene blue	Not detected	Positive	Not detected	Not detected

The weight of the canister content was 193.35 grams and the powder was identified as sodium nitrite.

Figure 3.1.1.1. Chemical structure of solid nitrite and infrared spectrum of canister contents and comparison with a sodium nitrite standard.



Evaluation of the results

According to the consulted bibliography[1], physiological methemoglobin concentration is < 2%, cyanosis-producing levels are between 10%-20%, and the lethal methemoglobin levels > 70%. Although, lethal cases are recently being reported with lower methemoglobin concentrations[2].

About the detected concentrations of nitrites, according to the bibliography[3, 4], would be compatible with sodium nitrite intoxication.

Considerations

Methemoglobin results in post-mortem blood samples were within the normal range (< 5%). It is explained by the hospital treatment administered with methylene blue, which is detected in post-mortem blood, which has a short response time[5].

The determination of nitrites in biological matrices (serum and gastric contents) made it possible to complement the results of methemoglobin determination, which are

---

1 Katabami K, Hayakawa M., Gando S. Severe Methemoglobinemia due to Sodium Nitrite Poisoning. Hindawi Publishing Corporation. *Case Rep Emerg Med*. Volume 2016, Article ID 9013816

2 Dean DE, Looman KB, Topmiller RG. Fatal methemoglobinemia in three suicidal sodium nitrite poisonings. *J Forensic Sci*. 2021 Feb 17.

3 Durão C, Pedrosa F, Dinis-Oliveira RJ. Another suicide by sodium nitrite and multiple drugs: an alarming trend for "exit"? *Forensic Sci Med Pathol.* 2021 jun; 17(2):362-366).

4 Durão C, Pedrosa F, Dinis-Oliveira RJ. A fatal case by a suicide kit containing sodium nitrite ordered on the internet. *J Forensic Leg Med.* 2020 Jul; 73:101989).

5 Methylene blue: a treatment for severe methaemoglobinaemia secondary to misuse of amyl Nitrite B Modarai, Y K Kapadia, M Kerins, J Terris. (pag. 270).

often altered by the easy oxidation of Fe2+ in stored samples and are therefore inconclusive.

This case shows the importance of the analysis of hospital samples (ante-mortem) which allowed confirmation of lethal nitrite intoxication.

3.1.2. Scientific and teaching activity

3.1.2.1. Participation in investigation projects

Bravo Serrano B. Collaborator in the Project: "Service-learning on the problem of chemical submission: interdisciplinary collaborative action with horizontal and vertical coordination in several grades". University of Alcalá. Courses 2019-20.

Bravo Serrano B. Short-term expert appointment within the European Project: "Cooperation in criminal investigation in Central America to combat crime and drug trafficking at international level". ICRIME-LA/2017/39066.

Bravo Serrano B, Quintela Jorge O. Research Project: "Evaluation and educational intervention to prevent drug use and sexual violence in youth leisure contexts. Epidemiological area". Department of Health, Social Services, and Equality. University of Alcalá de Henares and National Institute of Toxicology and Forensic Sciences. From 11/12/2018 to 31/12/2021.

3.1.2.2. Contribution to scientific congresses

Bravo Serrano B. "Repository of actions as a basic tool to advance in a long-term APS project". Oral communication. XII Meeting on innovation in university teaching: Teaching resources for blended learning. 14-15 October 2020.

Zaballos M, Rodríguez L, Fernández López I, García S, Melone A, Quintela O, Anadón MJ, Vázquez E, Varela O, Callejo D. Electrophysiologic Reversion of Ropivacaine Induced Cardiotoxicity. Anesthesiology 2020. Octubre 2-5-2020.

Fernández López I, García S, Melone A, Quintela O, Varela O, Zaballos M. Evaluation of the electrophysiological effects of the maximal concentration of ropivacaina after ultrasound-guided serratus intercostal fascial block. Study in a porcine experimental model. Euroanaesthesia 2020. October. Barcelona. España.

3.2.2.3. Scientific publications

Matey JM, García-Ruiz C, Montalvo G, Gómez-Soro JC, Gutiérrez-Delicado D, Rodríguez Gallardo J. et al.: Ultraviolet-visible and high-resolution mass spectrometry for the identification of cyclopropyl-fentanyl in the first fatal case in Spain. *J Anal Toxicol* 2020; 44: 927-935.

Prego-Meleiro P, Montalvo G, Quintela Jorge O, García Ruíz C. Increasing awareness of the severity of female victimization by opportunistic drug-facilitated sexual assault: A new viewpoint. *Forensic Science International*. Volume 315, 2020, 110460.

Prego-Meleiro P, Montalvo G, Quintela Jorge O, García Ruíz C. An ecological working framework as a new model for understanding and preventing the victimization of women by drug-facilitated sexual assault. *Forensic Science International*, Volume 315, 2020, 110438.

Fernández Alonso C, Lázaro del Nogal M, Quintela Jorge O, Santiago Sáez AE. Suspicion of chemical submission in adults looked after in a hospital emergency room. *Revista Española de Geriatría y Gerontología*, Volume 55, Issue 6, 2020, pages 354-357.

3.1.2.4. Relation of teaching and formation activities

Bravo Serrano B. Associate Professor of the Degree in Criminalistics and Forensic Sciences. University of Alcalá. Course 2019/20; 2020/21.

Burgueño Arjona MJ. Associate Professor of the Department of Analytical Chemistry, Faculty of Chemical Sciences, Universidad Complutense de Madrid. Academic year 2019/20; 2020/21.

Del Valle Pérez ME. Honorary teacher of the degree in Criminalistics and Forensic Sciences. University of Alcalá. Academic year 2019/20; 2020/21.

López Uceda EM. Honorary teacher of the degree in Criminalistics and Forensic Sciences. University of Alcalá. Academic year 2019/20; 2020/21.

Quintela Jorge O. Associated teacher in the Department of Toxicology and Health Legislation at the Complutense University of Madrid. Teaching in: Degree in Medicine, Degree in Criminology and Official Master's Degree in Health Expertise. Academic year 2019/2020; 2020/21.

Quintela Jorge O. Associated Professor in the Department of Legal Medicine, Psychiatry and Pathology at the Complutense University of Madrid. Academic year 2019/2020; 2020/21.

Quintela Jorge O. Tutoring of the Final Degree Project of the Degree in Criminology of the Department of Toxicology and Health Legislation of the Faculty of Medicine of the Complutense University of Madrid, with the title "Analysis of hair in cases of chemical submission" to the student María Frías Monterreal. Madrid. Course 2019/20.

Burgueño Arjona MJ. Lecture: "Forensic toxicology. Presentation of real cases before the courts of justice: Cases of gender violence, in the refresher course in forensic chemistry and toxicology. From the laboratory to the courts. Centre for Legal Studies, Department of Justice, Madrid, October 2020.

Pastor López-Davalillo AM. Lecture: "Study of hydremia through the analysis of chemical markers, strontium, and magnesium, in death by drowning" within the course "Multidisciplinary forensic studies in deaths by drowning". Organized by the Centre for Legal Studies. Madrid: 4/11/2020.

Bravo Serrano B. Lecture: “Multidisciplinary investigation of sexual aggressions in forensic laboratories” within the course “Multidisciplinary investigation of sexual aggressions in forensic laboratories”. Organised by the Centre for Legal Studies. From 10 to 13 November 2020.

Bravo Serrano B. Lecture: “The Chemistry and Drugs Services of the INTCF” as part of the course “Introduction to the scientific and forensic activity of the different services of the INTCF”. Organized by the Centre for Legal Studies. From 16 to 18 November 2020.

Velázquez Romanos S. Lecture: “Multidisciplinary introduction to the expert activity of the INTCF” for students of Vocational Training of the Health Branch in the following educational centres of the Community of Madrid: Escuela Técnica de Enseñanzas Especializadas, IES Las Musas, Instituto de FP Claudio Galeno, IES Benjamín Rúa, Instituto Técnico de Estudios Profesionales (ITEP). Course 2019/20.

Burgueño Arjona MJ. Training in “Study of the methodology of comprehensive forensic assessment in gender violence”. Centre for Legal Studies, Department of Justice, Madrid, March 2020.

Del Valle Pérez ME. Training in “Generation of methods with incorporated UV calculations”. Spain PerkinElmer courses. 20 April 2020.

Del Valle Pérez ME. Training in “UV Report Generation”. Spain PerkinElmer courses. 22 April, 2020.

Chemistry Service facultatives. Validation of methods in forensic sciences. Organized by the Centre for Legal Studies, and conducted online from 28 September 2020 to 01 October 2020.

Chemistry Service Faculty. Analysis of pesticides in environmental samples and wildlife poisoning. Organized by the Centre for Legal Studies and carried out online from 5 to 9 October 2020.

Chemistry Service facultatives. Updating in forensic chemistry and toxicology. From the laboratory to the courts. Organized by the Centre for Legal Studies and held online from 19 to 23 October 2020.

Chemistry Service facultative. Multidisciplinary forensic studies in deaths by drowning. Organized by the Centre for Legal Studies and held online from 3 to 5 November 2020.

Chemistry Service facultatives. Multidisciplinary investigation of sexual assaults in forensic laboratories. Organized by the Centre for Legal Studies and held online from 10 to 13 November 2020.

Chemistry Service facultatives. Informative introduction to the scientific and forensic activity of the different services of the INTCF. Organized by the Centre for Legal Studies and held online from 16 to 18 November 2020.

3.2. Madrid Department Drug Service

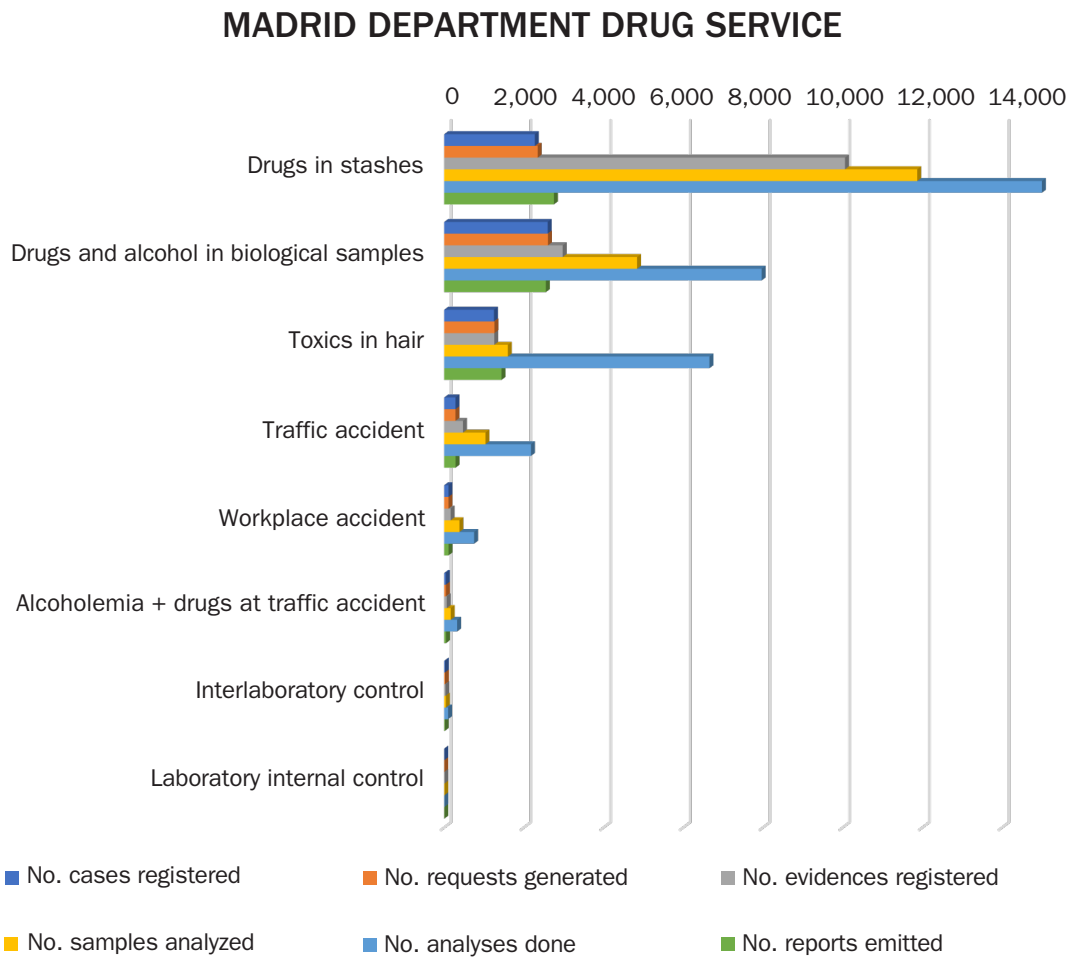
In 2020, the Madrid Drug Service Department received 6,666 requests with 19,418 evidences. 19,933 samples were analyzed through a total of 34,052 analyses, issuing a total of 7,198 expert reports.

In Figure 3.2.1, the predominant requests for analyses correspond to toxicological analyses. Aimed to detect alcohol, drugs of abuse, and psychotropic drugs of **judicial samples from both live subjects and post-mortem studies** (2,604 requests with 3,895 evidences received), followed by the chemistry analysis requests on judicial non biological samples **proceeding from drug confiscation (stash)** (2,347 requests with 12,662 evidences received). Special interest deserves the investigation on emergent drugs, the New Psychoactive Substances (NPS). Unfortunately, many are still unmonitored and remain illegal but constitute a serious health hazard for society. Most of them are sold on the internet, with a false appearance that isn't safe. It is important to highlight the increase of these new drugs (NPS), long overdue to appear on the illegal market, hence the importance of the laboratory role in analyzing these new structures and alerting the Spanish Early Warning System (SEAT) to their existence.

Inside the toxicological study of post-mortem samples, **the toxicological studies related to road traffic fatalities** stand out (282 requests with 976 evidences). The global data of these toxicological studies have been published before in the Report 2020 from the INTCF about *Toxicological Findings in Road Traffic Fatalities*.

Besides that, **the study of chronic drug use in hair** is another of the most important requests that this service attends (1,261 requests with 1,330 evidences). The investigation of chronic drug use and alcohol through the analysis in the hair provides medical-legal assistance in the diagnosis of drug dependence to cases of criminal liability establishing the chronological profile of drug use. These analyses were essential to check the end of drug consumption in judgment cases to award custody in divorce proceedings.

Figure 3.2.1. Casework of the Madrid Department Drug Service during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Stash drugs	2,274	2,347	12,662	11,870	16,074	2,754
Drugs and alcohol in biological samples	2,597	2,604	3,895	4,840	7.967	2,551
Drugs in hair	1,249	1,261	1,330	1,597	6,657	1,438
Traffic accident	282	282	976	1035	2,178	285
Workplace accident	108	108	406	382	751	110
Alcoholemia + drugs at traffic accidents	42	43	97	164	324	45
Interlaboratory control	17	19	48	41	97	14
Internal interlaboratory control	2	2	4	4	4	1
TOTAL	**6,571**	**6,666**	**19,418**	**19,933**	**34,052**	**7,198**

A total renewal of technology has been recently incorporated in the Service laboratories. A series of analytical equipment of the latest generation such as the gas chromatography coupled to tandem mass spectrometry (GC-MSMS), high-performance liquid chromatography coupled to tandem mass spectrometry (UPLC-MSMS), liquid chromatography coupled to high-resolution mass spectrometry-Orbitrap (LC-HRMS-Orbitrap), and high-performance liquid chromatography coupled to high-resolution time-of-flight mass spectrometry (UPLC-QTOF-HRMS). The implementation of such techniques has improved the identification and quantification of all kind of substances, including those new emergent drugs known as New Psychoactive Substances (NPS), whose detection is an analytical challenge.

The Drug Services has undertaken the establishment and validation of the investigation method by GC-MSMS of cannabis (THC and its metabolites: OH-THC, COOH-THC, and companions: CBD and CBN) in blood and has offered such a method to the Chemistry Service for its routinary use.

The implementation of the method for the investigation of drugs of abuse and psychotropic drugs (monitoring of around 350 frequently used substances) using LC-MSMS in the blood and vitreous body and its extension to urine samples (the latter is currently in the implementation phase) has been carried out. All meant a step forward in the modernization of our toxicological analytical methods and strategies in our laboratories, eliminating old classical chromatographic screening methods (GC-MS and HPLC-DAD), which required tedious extraction and derivatization procedures.

3.2.1. Interesting forensic case: Report of a death occurred in a chemsex context. The analytical challenge of the identification of structural isomers of methylmethcathinone: 2-MMC and 3-MMC, mephedrone analogues (4-MMC). The problem of substance control in Spain

Brief introduction and history of the case

As an example of the Drug Service expert activity, a death case has been selected in the context of chemsex. Among other drugs, 3-methylmethcathinone (3-MMC) is detected, an uncontrolled New Psychoactive Substance (NPS).

The investigations undertaken in the Service allowed the clarification of the cause of death of a 41-year-old man. He passed away in Madrid in February 2020. The case was framed in a context of intoxications produced by the practice of chemsex, based on the victim's background, the study of the scene of the events, and the toxicological findings. Sachets of papers filled with drugs and syringes were found next to the putrefied body. For that reason, the forensic doctor could only send to our Institute the urine sample and the sachet for its chemical-toxicological analysis.

Toxicological aspects

The initial chemical analysis of the sent paraphernalia (sachets) allowed the identification of the 3-methylmethcathinone (3-MMC) mephedrone analog. This finding was crucial to focus later on the toxicological investigations on the autopsy samples and thus to establish the death cause. In turn, this allowed an alert from the Institute to the Spanish Early Warning System (SEAT), dependent on the National Plan on Drugs (PNSD). This death occurred in the context of polydrug consumption, finding as a novel the 3-MMC.

Table 3.2.1.1. Toxicological findings from the forensic case

Sample	3-methylmethcathinone (3-MMC)	3-methoxy-phencyclidine (3-MeO-PCP)	GHB	Other psychotropic drugs
Sachet drug paper	Positive	–	–	–
Urine	Positive, nor-methylmethcathinone	Positive	18.4 mg/l	Lorazepam and diazepam and their metabolites: nordiazepam, temazepam, and oxazepam
				Venlafaxine and its metabolites

Regarding the toxicological analysis, a complete screening was carried out mainly aimed at the detection of alcohol, drugs of abuse, and psychotropic drugs. The victim did not consume alcohol. The results revealed consumption of a synthetic cathinone, 3-MCC, belonging to the (NPS) group. In addition, the consumption of two other NPS was detected: 3-methoxy-phencyclidine (3-MeO-PCP) and gamma-hydroxybutyric acid, also commonly known as liquid ecstasy (GHB). All of this was associated with various psychotropic drugs: a selective serotonin reuptake inhibitor antidepressant (SSRI): venlafaxine, two anxiolytics, and benzodiazepines: diazepam and lorazepam.

In conclusion, the victim consumed various drugs of abuse considered as NPS in the previous hours to the death combining psychotropic drugs, whose potentiation of toxic effects could trigger the death. It is, therefore, accidental violent death due to polydrug use (NPS) and psychotropic drugs with accidental etiology.

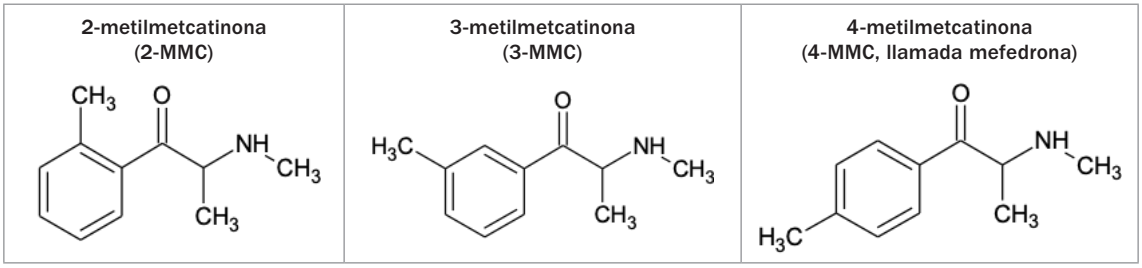
Analytical aspects

The identification of 3-MMC (mephedrone analog) was carried out using high-resolution mass spectrometry-Orbitrap (LC-HRMS-Orbitrap) in combination with the study of its

ultraviolet spectrum obtained by HPLC-DAD. Other instrumentation used was: gas chromatography coupled to tandem mass spectrometry (GC-MSMS) and high-performance liquid chromatography coupled to tandem mass spectrometry (LC-MSMS).

Mephedrone is an isomer for 4-methylmethcathinone (4-MMC). Internationally controlled synthetic cathinone belongs to the group of drugs known as NPSs. Nevertheless, its two structural analogs: 2-methylmethcathinone (2-MMC) and 3-3-methylmethcathinone (3-MMC), unfortunately still not controlled (see Figure 1).

Figure 3.2.1.1. Structural isomers of methylmethcathinone



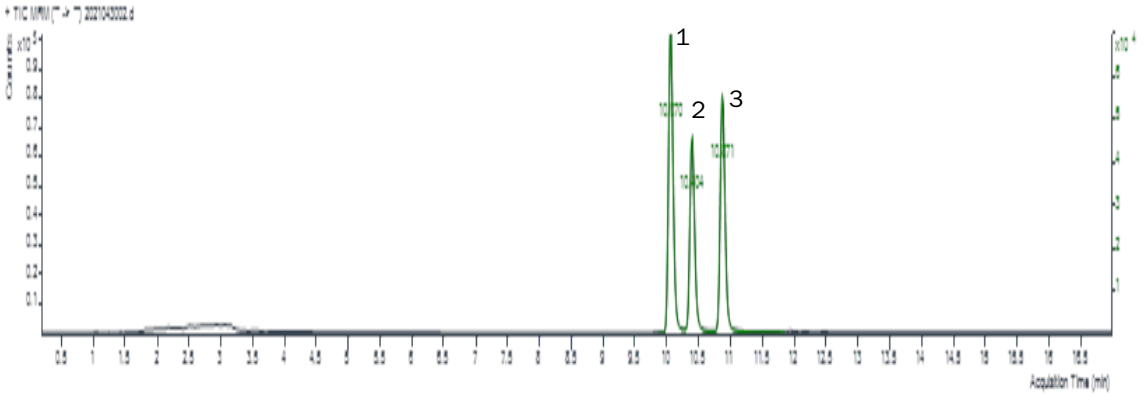
In the purely analytical aspect, it should be noted that these three substances, due to their structural similarity, co-elute in the classical methods based on liquid chromatography commonly used in laboratories.

Added to this previous difficulty, is the fact that it is not possible to make a correct identification by mass spectrometry (MS), neither low nor high resolution (HRMS), as they are isobaric compounds, that is, with the same molecular weight.

However, by using liquid chromatography with ultraviolet-visible spectrophotometry (UV-VIS), their identification can be carried out by presenting different absorbance spectra. The problem is that this strategy cannot be applied to all samples, caused by the limitation of the sensitivity of the technique, because the spectrum is altered when several of these isomers are present together.

A methodological development has been carried out to address this problem in the Drug Service to divide these three structural isomers of methylmethcathinone using a biphenyl stationary phase chromatographic column. It is specific for this purpose. The separative method developed applies both to the analysis of the biological sample and the analysis of non-biological (solid) samples from seized stashes.

Figure 3.2.1.2. Identification by chromatographic separation and mass spectrometric detection (UPLC-MSMS) of the isomers 2-MMC (chromatographic peak no. 1), 3-MMC (chromatographic peak no. 2) and 4-MMC (chromatographic peak no. 3) using a specific column



Aspects relating to the current problem of control of New Psychoactive Substances (NPSs) in Spain

The fact that in Spain 2-MMC and 3-MMC, ortho- and meta-isomers, structurally related to the structure of mephedrone (4-MMC) are not controlled means that they are easy targets for illegal trafficking and recreational use. As such, in our laboratories, as they are illegal they are appearing both in forensic biological samples, from living and dead subjects, and in samples seized by the State Security Forces and Corps (FFCCSE), causing deaths such as the one described here.

From the INTCF Drugs Service, we highlight the urgency for the relevant legislative reforms to be undertaken in our country to speed up all these NPS control processes constantly appearing on the illegal market, based on the similarity of their chemical structure to those already controlled.

3.2.2. Scientific and teaching activity

3.2.2.1. Participation in investigation projects

Gutiérrez D. Participation as Short-Term Training Professor - Expert in the project “Cooperation in criminal investigation in Central America to combat crime and drug trafficking at the international level ICRIME- LA/2017/39066”. Laboratory of the Public Prosecutor’s Office (INACIF) and laboratory of the PNC of the Dominican Republic. Held from 3 to 7 February 2020.

3.2.2.2. Contribution in scientific congresses

Martínez MA and Matey JM. Participation as expert advisors in the Meeting of the Society of Hair Testing (SoHT) for revision of consensus, Seville, 7-8 February 2020.

Matey JM. II workshop Drugs in society 4.0. "New Psychoactive Substances in Society 4.0", organized by the Solindrugs group, University of Valencia, 17-18 December 2020.

Matey JM. VII International Conference on Novel Psychoactive Substances (NPS). Organized by the International Society for the Study of Emerging Drugs, held online, 18-19 November 2020.

Martinez MA and Matey JM. The International Association of Forensic Toxicologists (TIAFT). Online Educational Symposium, 8, 10, 15, 17 December 2020 (10 hours).

3.2.2.3. Scientific publications

Matey JM, García-Ruíz C, Montalvo G, Gómez-Soro JC, Gutiérrez-Delicado D, Rodríguez-Gallardo J, Martínez MA. Ultraviolet-visible and high-resolution mass spectrometry for the Identification of cyclopropyl-fentanyl in the first fatal case in Spain, *J Anal. Toxicol.* 2020 44(8): 927-935.

Matey JM, López-Fernández A, García-Ruiz C, Montalvo G, Moreno MD, Martínez MA. Potential of high-resolution mass spectrometry for the detection of drugs and metabolites in hair: methoxetamine in a real forensic case. *J Anal Toxicol.* 2020 Oct 26: bkaa168

3.2.2.4. Relation of teaching and formation activities

Martínez MA. Tutor responsible for the training in Forensic Toxicology of Teresa Sendino Miguel, 3rd year Resident in Clinical Biochemistry to qualify for the title of Resident Internal Pharmacist (FIR) at the Clinic of the University of Navarra, from 13-01-2020 to 07-02-2020 from 13-01-2020 to 07-02-2020, every working day from 7.30-14.30h.

Martínez MA. Tutor responsible for the training in Forensic Toxicology of Ángel Carretero García, from the Ramón y Cajal Hospital in Madrid for the title of Specialist in Clinical Analysis and Clinical Biochemistry, from 01-01-2020 to 28-02-2020, from 7.30-14.30h every working day.

Martínez MA. Tutor responsible for the training in Forensic Toxicology of Beñat de Alba Iriarte, from the Hospital Universitario Donostia-San Sebastián (Guipuzkoa), to apply for the title of Medical Specialist in Clinical Analysis, from 01-03-2020 to 13-03-2020 during continuous working hours from 7.30-14.30h.

Martínez MA. Tutor responsible for the training in Forensic Toxicology of Blanca Montero San Martín, from the Hospital Universitario La Paz (Madrid), to apply for the title of Specialist in Clinical Biochemistry R4, from 01-03-2020 to 15-03-2020 during continuous working hours from 7.30-14.30h.

Martínez MA. Member of the Tribunal in the presentation of the Final Degree Project "Las Nuevas Sustancias Psicoactivas, Identificación, Fiscalización y Toxicología". Don Rafael Payá López presented at the University Centre of the Guardia Civil in Aranjuez (Madrid), event held online on 18 May 2020.

Martínez MA. Direction of the Master's Thesis "Study of Tattoos in Criminal Gangs'' of the CAC. Ms. Marta Santos Palenzuela presented at the University Centre of the Guardia Civil in Aranjuez (Madrid), an event held online on 17 June 2020.

Martínez MA. Director of the online Course of the Centre for Legal Studies (CEJ) "Update in Forensic Chemistry and Toxicology. From the Laboratory to the courts" (16 hours) and lecturer in the following conferences: "Classical drugs of abuse" (2hr), "New psychoactive substances (NPS)" (1hr), "The epidemic of opioid intoxication" (1hr), "Herbal highs" (30 min), "Alcohol, drugs and driving" (30 min), "Intoxication by opioids" (30 min), "Intoxication by opioids" (1hr), "The epidemic of opioid intoxication" (1hr), "Herbal highs" (30 min), "Alcohol, drugs and driving" (30 min), "Opium intoxications in modern times. Review of cases" (1hr), "The role of samples in toxicological analysis and interpretation of results" (2hr), "Qualitative and quantitative criteria in forensic toxicology" (1hr), "The interpretation of postmortem toxicological results" (1hr). "Round table on forensic toxicology. Part 1. Selection of 19 real cases" (2hr) and "Forensic toxicology round table. Part 2. Presentation of real cases before the courts of justice" (mock trial before the courts) (2hr). Also collaborating lecturers in the round tables were: Almarza E, Matey JM, Moreno MD, Burgueño MJ, Sánchez R (Magistrate-Judge), Hernández J (Prosecutor), Buitrago MJ (Forensic Doctor), and Velázquez R (Lawyer). Held from 19 to 23 October 2020.

Martínez MA. Tutor responsible for the training in Forensic Toxicology of Lieutenant Diego Villegas Vallbona, Pharmacist at the Institute of Toxicology of the Defence (ITOXDEF), Hospital Gómez Ulla (Madrid), from 19-10-2020 to 18-12-2020 during continuous working hours, from 7.30-14.30h.

Martínez MA. Tutor responsible for the training in Forensic Toxicology of Lieutenant Sara Mena Pérez-Montaut, Pharmacist at the Institute of Toxicology of Defence (ITOXDEF), Hospital Gómez Ulla (Madrid), from 19-10-2020 to 18-12-2020 during continuous working hours, from 7.30-14.30h.

3.2.2.5. Other activities

Martínez MA. Reviewer of the following scientific journals: Forensic Science International. Journal Analytical Toxicology. *Journal of Chromatography B, Journal of Chromatography A, Egyptian Journal of Forensic Sciences* (Board Member), *Revista Española de Medicina Legal and Revista de Toxicología.*

Martínez MA. Member of the following societies of forensic toxicologists: Member of the International Association of Forensic Toxicologists (TIAFT) since 2001. Regional Representative of Spain in the International Association of Forensic Toxicologists (TIAFT) since

2018. Member of the American Society of Forensic Toxicologists (SOFT) since 2003. Member of the Society of Hair Testing (SoHT) since 2015. Member of the Spanish Association of Toxicology (AETOX) since 1989. Member of the Spanish Registry of Toxicologists of the AET since 2001. Member of the Register of the European Association of Toxicologists and European Societies of Toxicologists (EUROTOX) since 2003. Member of the University Institute for Research in Police Sciences (IUICP) since 2014.

3.3. Barcelona Department Chemistry Service

The expert activity of the Barcelona Department Chemistry Service has considerably reduced during 2020 as a consequence of the pandemic. Although this labour did not stop during the confinement, it was reduced to minimum services. During this period, only requests about **drugs analyses in the stash** and **drugs in the hair** were received. The requests of other types of analyses at present have reached the usual figures registered into our Service. That is why the number of cases registered in 2020 decreased 10% compared to 2019 and 12% fewer requests were generated. Likewise, the evidences registered were reduced by 9% and 15% fewer samples were analyzed. The biggest difference was the number of analyses done, 22% lower than those carried out in 2019. The figures of the totality of our expert activity through 2020 are shown in Figure 3.3.1.

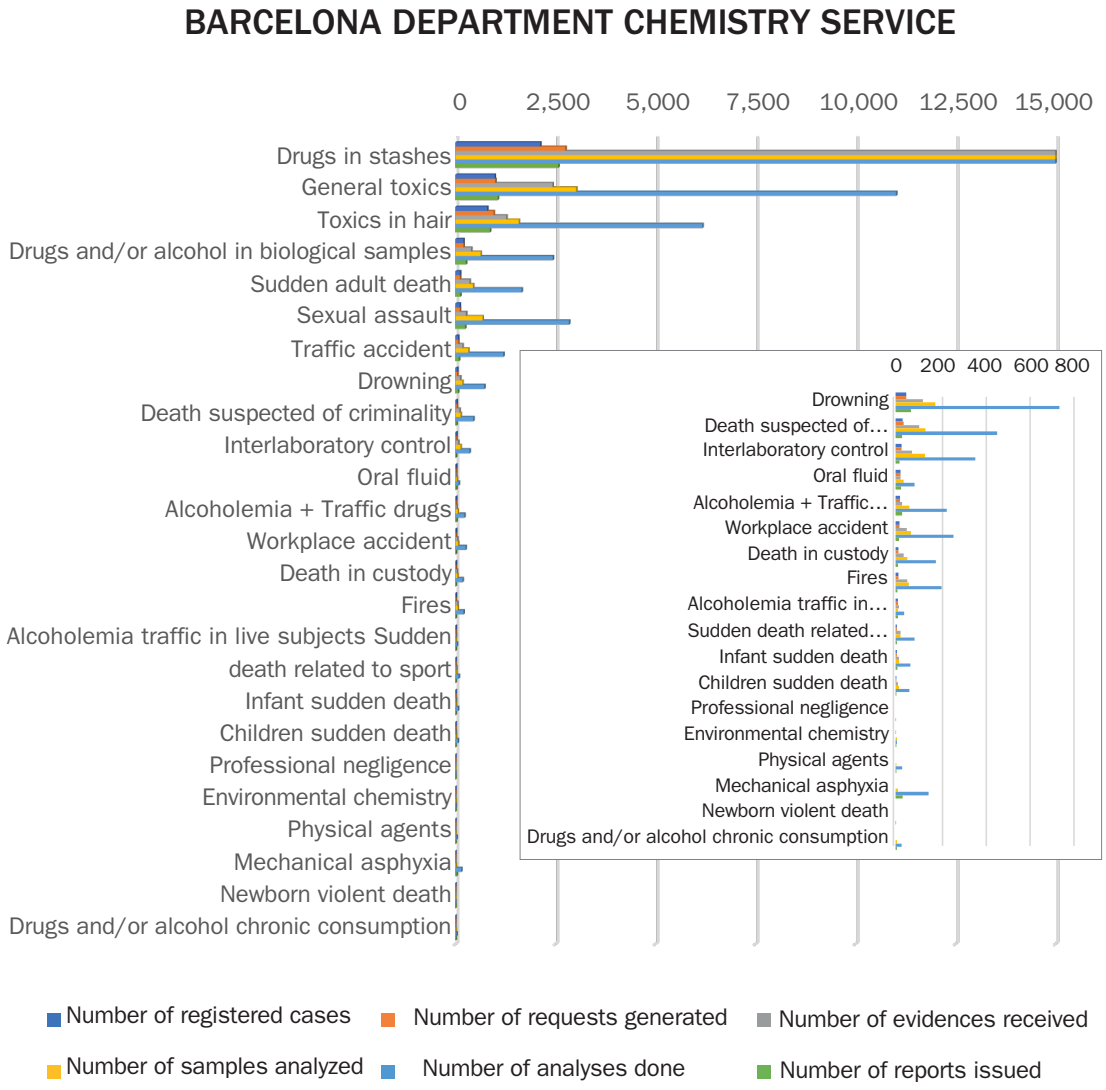
Despite this, it is essential to record the teleworking implementation in our Institute allowing the facultatives of the service to continue their labour uninterruptedly. As a result of this, the pendency of our Service has been reduced by 11% compared to 2019. In the same vein, a great effort has been (and is being) invested in fine-tuning the methods of the new equipment received by the Service. High-performance liquid chromatography coupled to a triple quadrupole mass spectrometer (UPLC-MS tQ) and two gas chromatography coupled to a triple quadrupole mass spectrometer (GC-MS tQ).

Within the singularity that 2020 represented, it is interesting to highlight that the **drug analysis in stashes** (2,752 requests with 21,193 evidences received) is the predominant request for analysis of this Service (49.3% of the requests), did not decrease and maintained in the figures from the previous year. A relevant aspect is that during 2020 we initiated communications to the Spanish Early Earning System (SEAT) through the EDND platform (European Database on New Drugs). Communications were about those new psychoactive substances in the following list provided by the EMCDDA (European Monitoring Centre for Drugs and Drug Addiction) and detected in our Service. A total of 162 early alert communications were done, 11 of them about substances first time identified in Spain and 2 first time in Europe. The Barcelona Department Chemistry Service currently provides a major number of communications to the EDND.

The second most numerous group of analyses of requests corresponds to the **general toxic study** (998 requests with 2,431 evidences received). This group includes deaths of natural etiology (3.9%), violent suicidal deaths (30.6%), accidental deaths (8.9%), and deaths due to an adverse reaction to psychoactive substances (6.2%), among others.

This group has a systematic analysis aimed at the identification and quantification if derived from substances present in the samples received to assist in establishing the cause of death.

Figure 3.3.1. Casework of the Barcelona Department Chemistry Service during 2020 according to the type of report



Type of Report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Stash drugs	2,122	2,752	21,193	20,698	26,565	2,573
General toxics	983	998	2,431	3,019	11,018	1,059
Drugs in hair	797	957	1,274	1,584	6,176	865
Drugs and alcohol in biological samples	201	203	397	631	2,436	264

Type of Report (cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Adult sudden death	117	117	354	440	1,656	123
Sexual assault	109	114	266	680	2,842	244
Traffic accident	70	72	177	324	1,201	89
Drowning	48	48	120	175	723	68
Death suspected of criminality	32	36	104	131	449	29
Interlaboratory control	26	26	72	130	353	17
Oral fluid	21	21	21	35	83	25
Alcoholemia + traffic drugs	20	20	28	60	225	28
Workplace accident	18	18	50	69	255	15
Death in custody	13	13	36	51	179	10
Fires	12	12	52	59	203	9
Alcoholemia traffic in live subjects	10	10	15	10	38	11
Sudden death related to sport	6	6	23	23	83	7
Infant sudden death	5	5	15	15	66	8
Children sudden death	3	3	11	16	62	4
Professional negligence	0	0	0	0	0	1
Environmental chemistry	0	2	0	7	7	3
Physical agents	0	0	0	4	29	4
Mechanical asphyxia	0	0	0	10	147	31
Newborn violent death	0	0	0	0	0	1
Chronic consumption of drugs and alcohol	0	0	0	5	27	7
TOTAL	**4,613**	**5,433**	**26,639**	**28,176**	**54,823**	**5,495**

Our Service also realizes the determination of drugs of abuse and alcohol in hair samples inside the legal research framework of legal investigations or contentious divorces. This study of **toxics in hair** generated 957 requests corresponding to 1,274 evidences received. It is important to highlight the requests received about **drugs or alcohol in biological samples** (203 analysis requests with 397 evidences), **adult sudden death** (117 analysis requests with 354 evidences), **sexual assault** (114 analysis requests with 266 evidences), and **traffic accidents** (72 analysis requests with 177 evidences). However, these figures are significantly lower than those from the previous year. The reason is the epidemiological situation we lived in 2020.

On the other hand, our Service collaborates with the Bellvitge University Hospital. It carries out the quantification of methadone hydrochloride richness in hospital samples.

3.3.1. Interesting forensic case: Investigation of suicide deaths associated with helium and nitrogen inhalation: A new challenge for forensic toxicology

The voluntary inhalation of inert gases and toxics is a method employed to take one's own life. Carbon monoxide and butane are the most used gases for this purpose, because they are easy to have access. From the 1,822 suicide cases registered in our Institute during 2019, carbon monoxide and butane inhalation constitute 2.4%, and 0.4% of the total.

A significant increase in the number of suicides about inhalation of different gases apart from carbon monoxide and butane has been observed. Helium is an inert gas-like small cylinder that is easy to acquire, to blow up balloons at children's parties. Nitrogen is employed in the chemical-medical field to freeze and conserve samples. As it happens with helium, it can be purchased on the internet without a problem. Neither of the two gasses is toxic. Inhaled in excess can displace oxygen leading to death by hypoxia.

The shocking increase in the number of suicides due to inhalation of these gases (in the case of helium inhalation during 2011-2015 an increase of 1.680% has been observed in the UK and a 1.075% in Canada). It was associated with numerous guides and tutorials published on the internet. They try to show in an effective way how a person can commit suicide "without pain" using a gas bottle connected through a simple tube to a plastic bag sealed around the head. Moreover, it is possible to find suicide kits to end one's own life inhaling gases.

Figure 3.3.1.1. The image on the right shows a kit that can be purchased on the internet for suicide purposes. The image on the left is extracted from a Schön CA and Ketterer T article in the *Am J Forensic Med Pathol*

The determination of these gases in forensic samples is a challenge. The fact that helium and nitrogen are found in a gaseous state causes them to dissipate rapidly into the air, making them very difficult to detect in blood or tissue samples. The samples have to be collected in vials with headspace. The election sample is the cardiac blood. In the case of helium, it is enough to produce a qualitative analysis. The blood is found at a trace level. However, nitrogen is present in the atmospheric air. As a consequence, it is present in our blood in an elevated percentage, and so it is necessary a qualitative analysis of the same. It is crucial to carry out comparative controls among collected samples of a deceased person by nitrogen gas on one side, the data collected from persons who have died of other causes, and from living persons on the other to discriminate among normal and elevated percentages of nitrogen in biological samples. (This comparison is carried out in the published articles about helium inhalation suicides). The reviewed articles included not less than 10 persons by the control group. Other studies include the quantification of nitrogen in the air of the crime scene. In all the published studies, the determination of helium and nitrogen is carried out through gas chromatography coupled to mass spectrometry. However, there is no consensus on the optimal method of sampling and analysis.

The determination of the current causes of death is indirectly based on the study of the crime scene and the victim's background (e.g. history of depression). The validated methods or the determination of these gases in biological samples do not exist and that these suicide mechanisms do not produce post-mortem significative changes.

We received for the first time in our Service during 2020 a suicide case by nitrogen inhalation and another with helium. In the case of nitrogen inhalation, the Navarra Legal Medicine Institute (IML) contacted our Service to get advice about how to proceed in the sample taking during the autopsy. The result of such contact was a thorough literature review. We now reflect on this interesting forensic case. As the IML does not have the means to carry out a sample and number of controls like the ones described in the articles published about the matter, we accorded to execute chemical-toxicological analyses that our Service carries out in suicide cases. However, this case allowed us to learn both the Navarra IML and us, which is the correct way to act in case of experiencing such suicide.

Derived from the circumstances described above, our contribution on both cases has been limited to realize a chemical-toxicological study in the biological samples remitted by the correspondent IML (blood and vitreous humor in the helium inhalation suicide case. The nitrogen inhalation case contributed to apportioning the urine sample).

- The determination of ethyl alcohol in the blood and vitreous humor by gas chromatography (GC) - headspace - FID.
- Investigation of the presence of opiates, monoacetylmorphine, cocaine, benzodiazepines, barbiturates, methadone, amphetamines, cannabis, tricyclic antidepressants, propoxyphene, and buprenorphine in blood and urine by homogeneous enzyme immunoassay - Cedia®/DRI®.

– General investigation of drugs of abuse and psychotropic drugs in blood by solid-phase extraction and GC-mass spectrometry (MS) analysis, pre-and post-derivatization.

– General investigation of drugs of abuse and psychotropic drugs in urine by liquid-liquid extraction and GC-MS analysis, pre-and post-derivatization.

In the nitrogen inhalation case, lormetazepam (0.03 mg/l in the blood) was detected in the blood and urine analysis. All analyses were negative in the helium inhalation case.

The analyses executed in our Service of the biological samples referred to together with the autopsy showed no indication that the death cause could be other than the one indicated by the forensic doctor. However, since the crime scene can be manipulated (affected familiars retiring the suicide paraphernalia or aggressors trying to disguise a violent death of a different nature as a suicide) it is urgent to establish analytical methods. It allows the direct death cause determination through a toxicological investigation that identifies helium or nitrogen (or other gases) in the biological samples. It requires the indispensable collaboration of forensic doctors in the realization of adequate sample taking.

Bibliographic references consulted

Austin A *et al.* Recent trends in suicides utilizing helium. *J Forensic Sci* (2011) 56 (3): 649-651.

Byard RW. Changing trends in suicides using helium or nitrogen – A 15-year study. *J Forensic Leg Med* (2018) 58: 6-8.

Byard RW *et al.* Nitrogen inhalation suicide pacts. *Med Sci Law.* (2019) 1: 57-60.

Giorgetti *et al.* Deaths related to nitrogen inhalation: Analytical challenges. *Forensic Sci Int* (2020) 317: 110548

Lo Faro AF *et al.* Fatal inhalation of nitrogen inside a closed environment: Toxicological issues about the cause of death. *Forensic Sci Int* (2019) 302: 109871.

Madentzoglou MS *et al.* Nitrogen-plastic bag suicide. *Am J Forensic Med Pathol* (2013) 34: 311-314.

Smedra A *et al.* Helium suicide – A suffocation or a barotrauma? *J Forensic Leg Med* (2020) 76 102065.

Schön CA and Ketterer T. Asphyxial suicide by inhalation of helium inside a plastic bag. *Am J Forensic Med Pathol* (2011) 32(1): 61-70.

Sinyor M *et al.* Suicide deaths by gas inhalation in Toronto: An observational study of emerging methods of suicide. *J Affect Disord* (2019) 243: 226-231.

Straka L *et al.* Suicidal nitrogen inhalation by use of scuba full-face diving mask. *J Forensic Sci* (2013) 58(5): 1384-1387.

Varlet *et al.* Helium poisoning: new procedure for sampling and analysis. *Int J Legal Med.* (2019) 133(6):1809-1818.

3.3.2. Scientific and teaching activity

3.3.2.1. Participation in investigation projects

Mora Font A. Participation in the FIAPP (Fundación Internacional y para Iberoamérica de Administración y Políticas Públicas) project in Belize. Project for Cooperation in Criminal Investigation in Central America to combat crime and drug trafficking at the international level ICRIME. February 2020.

3.3.2.2. Relation of teaching and formation activities

Mora Font A. Seminar on new psychoactive substances. "II Workshop SolinDrugs Group Drugs in Society". Held via online streaming from 17 to 18 December 2020.

Juan Luis Valverde, director and coordinator of the course "Analysis of pesticides in environmental samples and wildlife poisoning". Organized by the Centre for Legal Studies. Ministry of Justice. Held via online streaming from 5 to 9 October 2020.

Hernando Torrecilla C. "Update on the expert assessment of sexual violence". Organised by the Centre for Legal Studies. Department of Justice. Lecture: "Drugs facilitating sexual aggression". Held via online streaming from 2 to 3 July 2020.

Physicians of the Chemistry Service. Study of the methodology of comprehensive forensic assessment in gender violence. Organized by the Centre for Legal Studies on 5 and 6 March 2020.

Experts from the Chemistry and Drugs Service. Homicide Investigation. Multidisciplinary approach. Organized by the Centre for Legal Studies. From 9 to 10 March 2020. Madrid.

Experts from the Chemistry Service. Validation of methods in forensic sciences. Organised by the Centre for Legal Studies, and held via online streaming from 28 September to 1 October 2020.

Chemistry Service Experts. Update in forensic chemistry and toxicology. From the laboratory to the courts. Organized by the Centre for Legal Studies and held via online streaming from 19 to 23 October 2020.

Chemistry Service Practitioners. Multidisciplinary forensic studies in deaths by drowning. Organized by the Centre for Legal Studies and carried out via online streaming from 3 to 5 November 2020.

Experts from the Chemistry Department. The multidisciplinary investigation of sexual aggressions in forensic laboratories. Organized by the Centre for Legal Studies and held via online streaming from 10 to 13 November 2020.

Experts from the Chemistry and Drugs Service. Informative introduction to the scientific and forensic activity of the different services of the INTCF. Organized by the Centre for Legal Studies and carried out via online streaming from 16 to 18 November 2020.

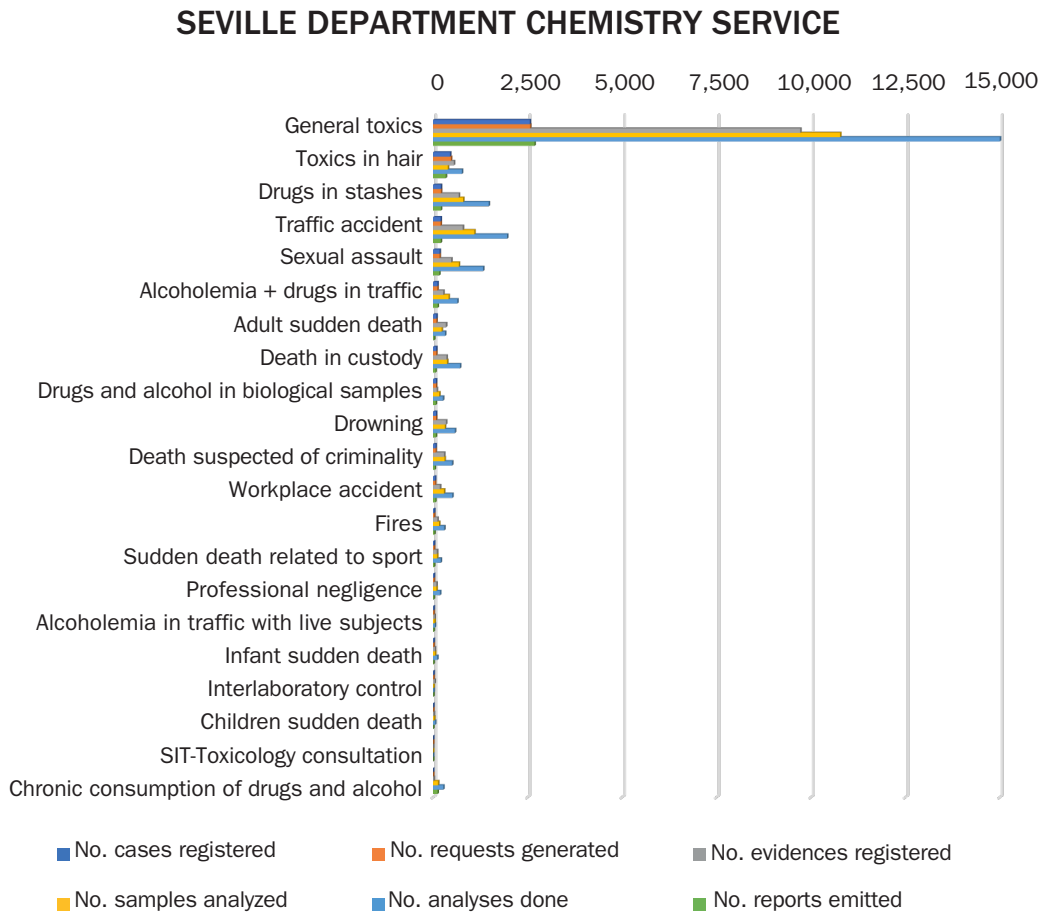
3.4. Seville Department Chemistry Service

Expert activity is the basis of the Seville Department Chemistry and Drug Service. In 2020, they received 4,321 requests and registered 14,568 evidences, all of them arising from judicial cases, and 4,314 reports were emitted.

As it can be seen in Figure 3.4.1, the majority request for analysis corresponds to toxic **general studies**, in post-mortem samples (2,569 requests with 9,719 evidences received). The special circumstances that we have experienced this year due to the pandemic have caused the number of requests to decrease by 17%. We consider it interesting to reflect that there has been a casework variation. An analytical system is applied to this group aimed at the identification, confirmation and quantification, if applicable, of substances present in the samples received in order to help establish the cause of death.

The second most numerous analysis requests groups are drug and alcohol chronic consumption (473 requests with 551 evidences received) and stash drugs (208 requests with 680 evidences), which have experienced a slight increase both in the absolute value and in the percentage compared to 2019, from 3.6% in 2019 to 5% in 2020.

Figure 3.4.1. Casework of the Seville Department Chemistry Service during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
General toxics	2,560	2,569	9,719	10,774	20,741	2,685
Drugs in the hair	449	473	551	389	762	336
Stash drugs	206	208	680	795	1,472	206
Traffic accident	200	201	786	1,092	1,957	204
Sexual assault	172	173	481	681	1,323	164
Alcoholemia + drugs in traffic	116	115	272	410	641	122
Adult sudden death	89	88	340	226	316	29
Death in custody	83	84	356	369	713	66
Drugs and alcohol in biological samples	78	78	96	163	260	73
Drowning	78	79	344	311	576	75
Death suspected of criminality	68	68	291	303	501	46

Type of report (cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Workplace accident	55	55	181	288	509	62
Fires	29	29	116	159	294	35
Sudden death related to sport	26	26	101	107	202	28
Professional negligence	22	22	88	89	185	19
Alcoholemia live subjects	16	16	40	37	48	16
Infant sudden death	15	15	49	53	111	13
Interlaboratory control	13	13	42	13	13	10
Children sudden death	6	6	19	29	56	5
SIT-Toxicological consultation	1	1	1	0	0	1
Chronic consumption of alcohol or drugs	0	2	15	131	271	119
TOTAL	**4,282**	**4,321**	**14,568**	**16,419**	**30,951**	**4,314**

The toxicological studies in **traffic accidents** (201 requests with 786 evidences received) move to fourth place this year and represent 4.65% of the total, facing 5.95% in 2019, probably due to the pandemic restrictions.

In fifth place, we have toxicological investigations of **sexual assaults** due to the number of requests received (173 requests with 481 evidences received). Despite the curfew and other restrictions, this type of investigation has experienced a slight increase, 3.87% in 2019 to 4% in 2020. It is important to remark that the significant increase of requests related to **death in custody** passes to the seventh place (84 requests with 356 evidences received).

The Chemistry and Drugs Service of the Department of Seville, in addition to carrying out the analyzes to respond to the requests it receives, also carries out the determination of the chronic consumption of ethyl alcohol, through the analysis of ethyl-glucuronide in hair samples, in the requests that are received in all departments of the INTCF.

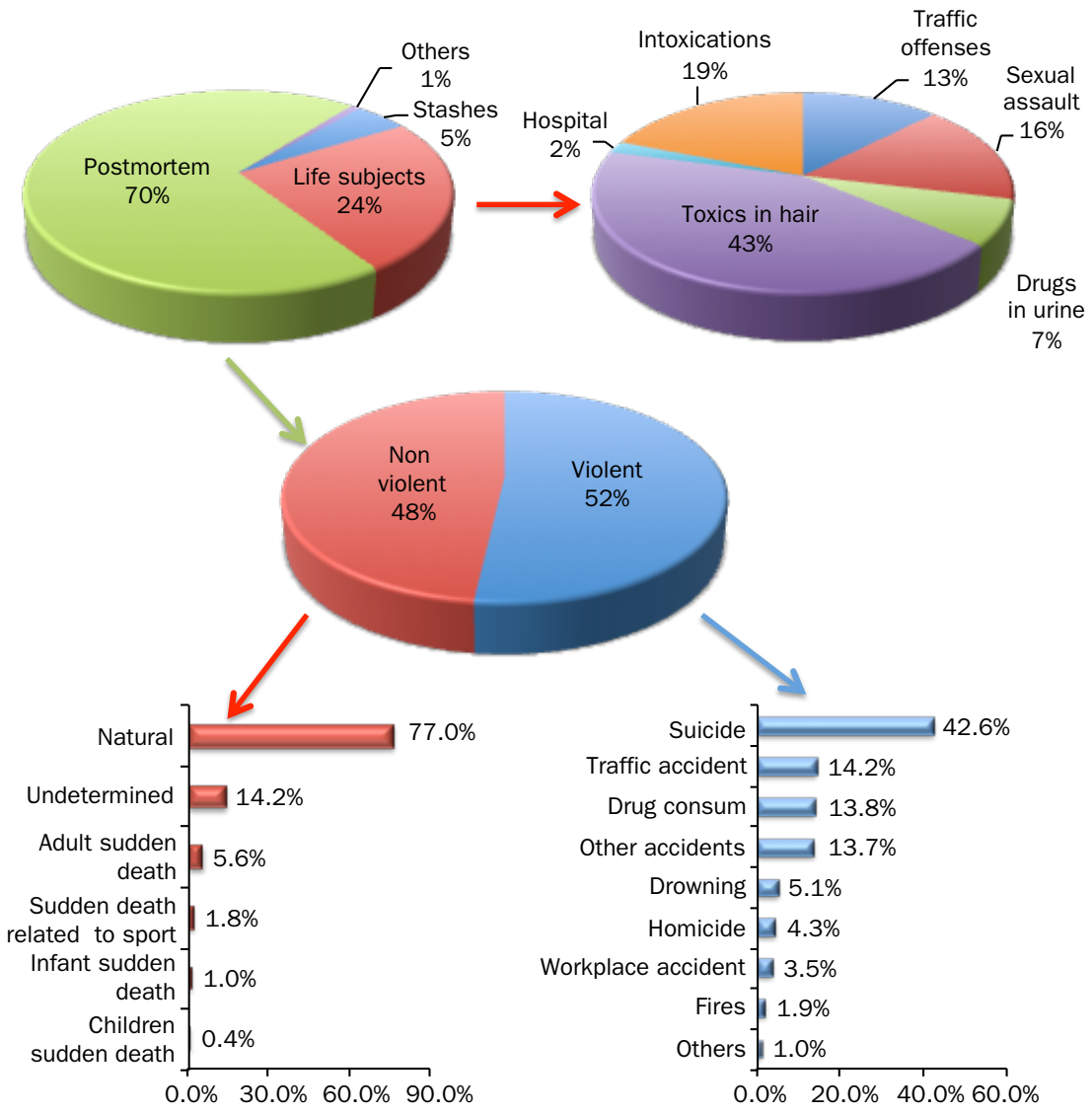
As it is reflected in Figure 3.4.2, the majority of casework corresponds to post-mortem cases (70%), while other cases come from live subjects supposing 24%, and 5% of the cases were related to drug stashes.

As in 2019, it is important to highlight the high suicide incidence, 42% of violent deaths (40% in 2019), more than twice as many as the next most frequent type of death, road traffic accidents (14.2%).

During the first half of 2020, with the purpose of the LIMS register criteria homogenization, the implementation of “Report subtypes” was being developed among all the INTCF

Chemistry services allowing a bigger differentiation in all case types until now, grouped in "General toxics". These subtypes were implemented in July 2020. This Service included "Report Subtypes" in the cases received previous to the date, which allowed to differentiate in Figure 3.4.1 more case types than the year before.

Figure 3.4.2. Classification of the casework of the Seville Department Chemistry Service according to the case type



The Service experienced a crucial improvement in instrumentation. It received two high-resolution types of equipment. A high-performance liquid chromatograph coupled to a triple quadrupole mass spectrometer (UPLC-MS-TQ) and a high-performance liquid chromatograph coupled to a hybrid quadrupole-time-of-flight mass spectrometer (UPLC-MS-QTOF). The equipment will allow not only to actualize the Service routine, but also to

identify and quantificate new substances compounds that only can be analyzed through these instruments. An example will be shown later on in the “Interesting forensic case”.

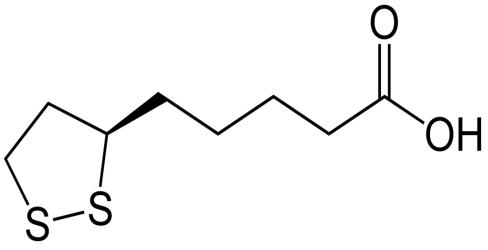
This year’s circumstances due to COVID-19 with the space and capacity limitations that had to be fulfilled resulted in the implementation of the teleworking at the Service, united to work turns established during the state of alarm allowed to accomplish all the restrictions imposed by the government.

One of the Service objectives is expertise quality. In this sense, the Service is internationally recognized. It is one of the three reference centers of a “Proficiency Test” to analyze drugs in hair, organized by the Society of Hair Testing, which has a worldwide scope.

This Chemistry and Drugs Service is characterized by the good relationship and dialogue with forensic doctors and the legal medicine institutes of our scope of action that is not limited to judicial cases we share, but also to collaboration in courses and other activities organized.

3.4.1. Forensic interesting case: Death from lipoic acid intoxication

A case received in the Chemistry and Drug Services has been selected. Its toxicological study allowed to confirm the suspicion of lipoic acid intoxication.



Lipoic acid can be found in the composition of food supplements for their antioxidant properties. It is also used in weight loss diets and as an energy supplement.

It is about a case of a 28 years old female admitted to the hospital with a tonic-clonic seizure secondary to presumed accidental acute lipoic acid intoxication. She passed away 24 hours after being submitted to intensive medical treatment and hemodial-continuous venous perfusion.

Initially, they received in the INTCF blood samples and gastric contents obtained in the autopsy. Subsequently, they could recover serum and urine samples taken at the hospital admission but in a small volume.

The determination of ethyl alcohol was realized in the blood sample with the INTCF usual method (Gas Chromatography - FID-HS), obtaining a negative result. A preliminary test by enzyme immunoassay (CEDIA) specific for amphetamine, barbiturate, benzodiazepine, cannabis, cocaine, opiate, tricyclic antidepressant and methadone compounds was also carried out, obtaining positive results for benzodiazepine compounds.

Subsequently, in the blood and gastric content samples from the autopsy, the usual toxicological analytical systematic in this laboratory was performed, which consists of solid phase extraction and subsequent instrumental analysis that allows the identification and

quantification of the compounds of interest in general toxicology. The employed instrumental techniques in this case were: Gas Chromatography-NPD (GC-NPD), High-Performance Liquid Chromatography-DAD (HPLC-DAD), Gas Chromatography-Mass Spectrometry (GC-MS), and High-Performance Liquid Chromatography-Mass Spectrometry-QTOF (LC-MS-TOF). These samples were also analyzed directly after the LC-MS-TOF ultrafiltration. The serum and urine samples from the hospital were analyzed after the HPLC-DAD and LC-MS-TOF ultrafiltration due to the small volume received.

Table 3.4.1.1. Results obtained in the analyses carried out expressed in mg/l

Sample	Lipoic acid	Midazolam	α-OH-midazolam	Phenytoin	Atracurium metabolite
Samples from the hospital					
Serum	13.65	ND	ND	ND	ND
Urine	166.68	ND	ND	ND	ND
Samples taken in the autopsy					
Blood	0.15	0.10	0.22	0.15	POS
Gastric content	1980.47**	ND	POS	POS	POS

* ND: Not detected; POS: Positive.

** The result is expressed in concentration because the total volume of gastric contents is unknown.

The lipoic acid concentrations in the serum taken at the hospital admission and the blood taken in the autopsy are greater than usual after the dairy recommended dose. The presence of phenytoin, midazolam, and the metabolite of atracurium corresponds to intensivist therapeutic action.

The usage of LC-MS-TOF allowed the identification and quantification of the lipoic acid in the autopsy blood sample, directly after the ultrafiltration and without having to resort to the formation of derivatives. In this case, we had available the gastric content. The serum and urine could be recovered before death. It is not always possible. That is why it is necessary to dispose of sensibility techniques that allow the determination of the compounds in low concentrations that can occur when time passes between ingestion and sampling or after therapeutic interventions.

Figure 3.4.1.1. Chromatograms: (A) autopsy blood sample (Lipoic Ac. 0.15 mg/l); (B) Lipoic Ac. standard (0.10 mg/l)

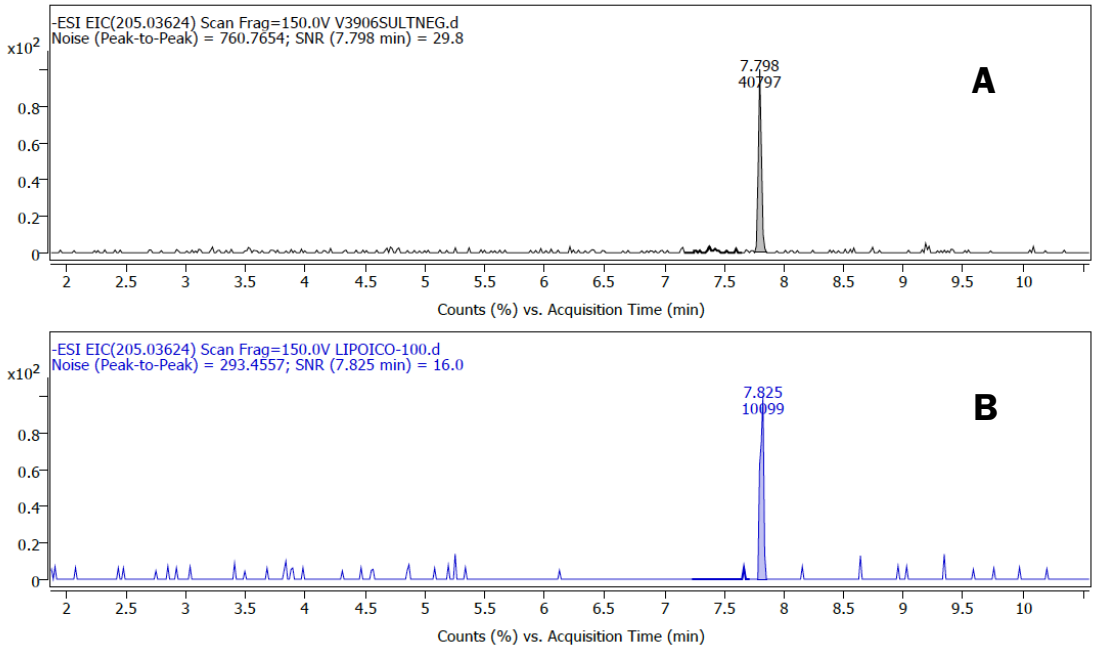
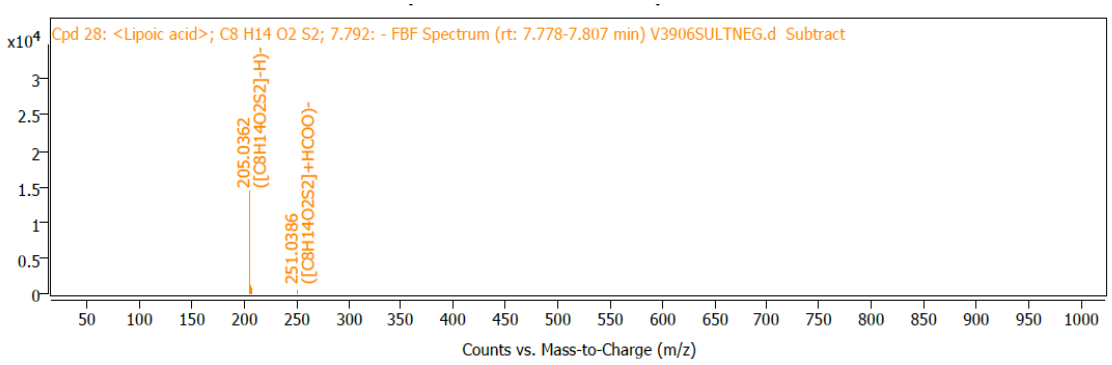


Figure 3.4.1.2. Lipoic acid spectrum



3.4.2. Scientific and teaching activity

3.4.2.1. Participation in investigation projects

Jurado Montoro C. Member of the Scientific Committee of the Andalusian Observatory on Drugs and Addictions (OASDA).

Moreno Bernal E and Soriano Ramón T. Members of the Technical Monitoring Committee of the RASUPSI Mortality Indicator.

González Padrón A. Participation as an expert in Toxicology in the Project “Cooperation in criminal investigation in Central America to combat crime and drug trafficking at the

international level - ICRIME LA/2017/39066". Funded by the European Union, the Spanish Agency for International Development Cooperation (AECID), and the Central American Integration System (SICA). Consultancy implemented in the Laboratory of the Institute of Legal Medicine "Roberto Masferrer" of San Salvador (El Salvador) during 2020.

3.4.2.2. Contribution in scientific congresses

Jurado Montoro C. RASUPSI mortality. National Institute of Toxicology and Forensic Sciences of Seville. Toxicological aspects (Presentation). Rational Use of Psychotropic Substances in Prison. Overdoses and RASUPSI. Can they be prevented? Seville 19 February 2020.

International Meeting of the Society of Hair Testing (SoHT) for the Revision of the Consensus of Drug of Abuse in Hair Analysis. Seville, February 2020.

3.4.2.3. Scientific publications

Huertas T, Jurado C, Salguero M, Soriano T, Gamero J. Stability of cocaine compounds in biological fluids during post-analytical storage. *J. of Anal. Toxicol.* 2020; 44:864-870.

Toxicology in Spain. Chapter 36. Repetto G, del Peso A, Rojas R, Maisanaba S, Repetto M. In Wexler P, Information Resources in Toxicology, 5th Edition, Volume 2: The Global Arena, Elsevier, 2020, 505-523. https://doi.org/10.1016/B978-0-12-821611-8.00036-X

Martín-Macho González MM, Fernando López Hormiga D, Huertas Fernández T. Lethal calcium antagonist poisoning. Medicina Clinica. DOI: 10.1016/j.medcli.2020.05.042.

3.4.2.4. Teaching and formative activities

Jurado Montoro C. The intervention of the National Institute of Toxicology and Forensic Sciences in the investigation of homicides. The Chemistry Laboratory in the investigation of homicides. Course: Homicide investigation. Multidisciplinary approach. Organized by the Centre for Legal Studies (CEJ). Madrid (Spain). 9-10 March 2020.

Soriano Ramón T and Moreno Bernal E. Lecturers on the Master's Degree in Criminology and Forensic Sciences organized by the Pablo de Olavide University of Seville, teaching the module "Toxics and intoxications: the chemical toxicological analysis laboratory". Course 2019/2020.

Del Peso A. Lecturer in the Master's Degree in Criminology and Forensic Sciences organised by the Pablo de Olavide University of Seville, teaching the class "The Laboratory: Chemical-Toxicological Analysis". Pablo de Olavide University of Seville. December 2020.

Bueno J. Lecturer in the Criminalistics Degree. University of Seville, Seminar on Ethyl Alcohol. March 2020.

3.4.2.5. Training activities

Chemistry and Drug Service. Attention to minor victims in the IML. Organized by the Centre for Legal Studies. 2 to 3 March 2020. Madrid.

Chemical and Drug Service Experts. Homicide Investigation. Multidisciplinary approach. Organized by the Centre for Legal Studies. 9-10 March 2020. Madrid.

Experts from the Chemistry and Drugs Service. Validation of methods in forensic sciences. Organized by the Centre for Legal Studies, and held online from 28 September 2020 to 1 October 2020.

Chemistry and Drugs Department. Analysis of pesticides in environmental samples and wildlife poisoning. Organized by the Centre for Legal Studies and carried out online from 5 to 9 October 2020.

Experts from the Chemistry and Drugs Service. Updating in forensic chemistry and toxicology. From the laboratory to the courts. Organised by the Centre for Legal Studies and held online from 19 to 23 October 2020.

Experts from the Chemistry and Drugs Service. Multidisciplinary forensic studies of deaths by drowning. Organized by the Centre for Legal Studies and held online from 3 to 5 November 2020.

Experts from the Chemistry and Drugs Service. ESAR-NET 3 years conference “Estimation of drug abuse and other applications of wastewater analysis for epidemiological purposes”. Organized by the Spanish Network of Wastewater Analysis for Epidemiological Purposes (ESAR-Net) and held online on 4 November 2020.

Experts from the Chemistry and Drugs Service. Multidisciplinary investigation of sexual assaults in forensic laboratories. Organized by the Centre for Legal Studies online from 10 to 13 November 2020.

Experts from the Chemistry and Drugs Service. Informative introduction to the scientific and forensic activity of the different services of the INTCF. Organized by the Centre for Legal Studies online from 16 to 18 November 2020.

Experts from the Chemical and Drugs Service. Contaminated soils and groundwater: update on analytical techniques and ecotoxicity tests. Organized by the Centre of Legal Studies online from 30 November to 3 December 2020.

Experts from the Chemical and Drugs Service. Forensic studies of harmful agents and their effects on soft parts and bones. Organized by the Centre of Legal Studies online from 1 to 3 December 2020.

Soriano T and Hernández N. 2020 TIAFT Educational Symposium online. December 8, 10, 15 and 17, 2020.

3.4.2.6. Other activities

Jurado Montoro C. Consejo Editorial. *Revista Cuadernos de Medicina Forense*.

Jurado Montoro C. International Editorial Board de Toxicologie Analitique & Clinique.

Jurado Montoro C. Revisora. *Revistas Forensic Science Internacional", "Journal of Chromatography B", "International Journal of Legal Medicine*, *Journal of Analytical Toxicology*.

Jurado Montoro C. Miembro. Advisory Board de la Society of Hair Testing (SoHT).

Jurado Montoro C. Secretaria. The International Association of Forensic Toxicologists (TIAFT).

3.5. La Laguna Delegation Chemistry Section

Concerning the expert activity of the Chemistry Section of the La Laguna Delegation, 940 requests were received during 2020 with 1,736 evidences, and 3,975 samples were analyzed through a total of 13,917 analyses, emitting a total of 853 expert reports.

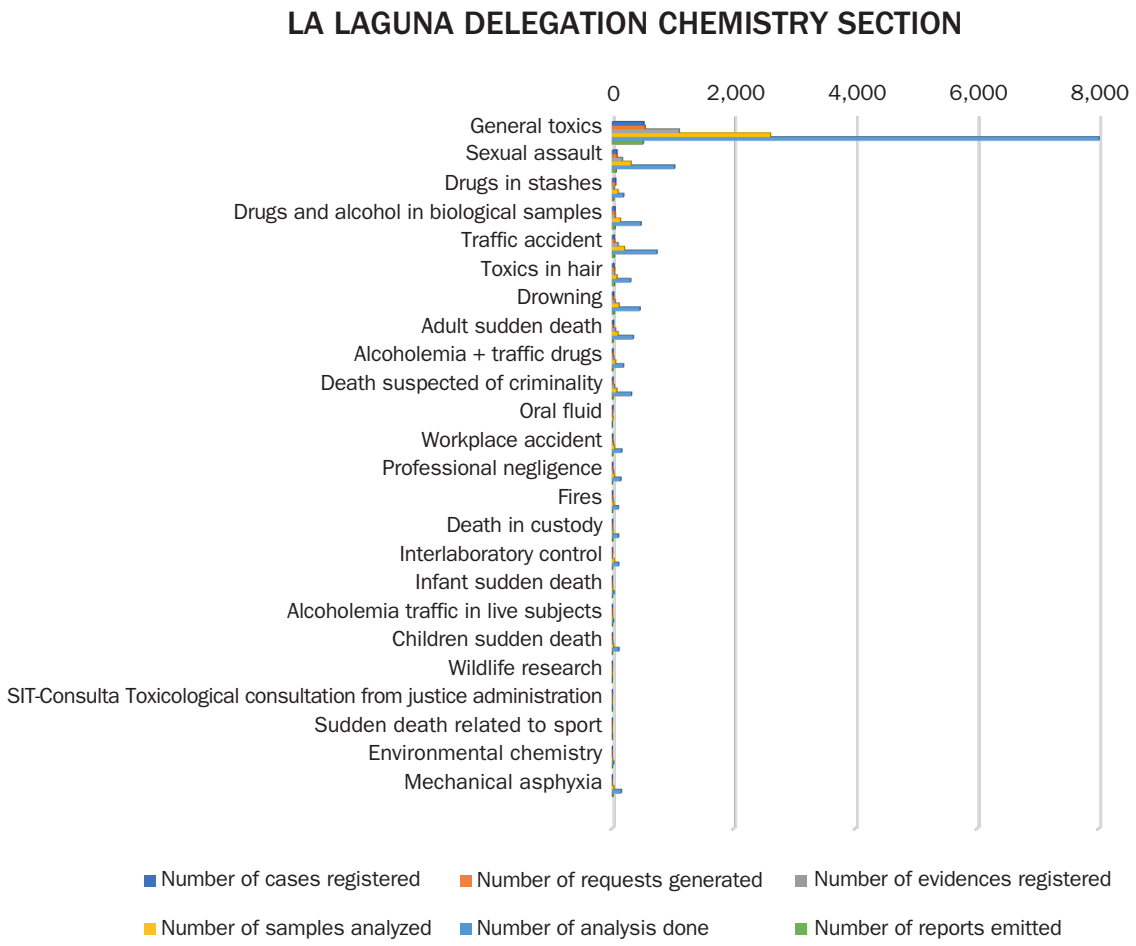
The majority of requests for analysis corresponds to general toxic studies, with 540 requests and 1,101 evidences received (Table 3.5.1). It includes suicidal violent deaths, adverse reactions to psychoactive substances, undetermined deaths (the corpse state makes it impossible sometimes to recognize the cause of death), natural deaths, accidental deaths, etc. An analytical system is applied to this group. It is aimed at the identification and quantification, where appropriate, of substances present in the samples received to help establish the cause of death. This type of study is the one that concentrates 65% of the analyzes carried out and 60% of the expert reports issued. The different studies grouped inside the general toxics report reflected much better the casework received in this service (Table 3.5.1).

The second most numerous group requesting analysis corresponds to crimes against sexual liberty (80 requests with 165 evidences received). In these cases, they applied a systematic analytic to identify possible substances capable of producing chemical submission.

During 2020, there was no decrease in the number of cases of this type in the delegation compared to 2019, despite the epidemiological situation in our country.

In third place, the toxicological studies in drug stashes supposed 56 requests with 30 evidences received. Followed by the type of report of drugs and alcohol in biological samples (48 requests with 51 evidences received), realized mainly in urine samples of live subjects implicated in robberies with violence, drug trafficking, etc. Finally, 42 analysis requests were received in the case of subjects deceased in traffic accidents, corresponding to 97 evidences.

Figure 3.5.1. Casework of the Chemistry Section of La Laguna Delegation during 2020



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
General Toxics						
· Hospital cases	11	11	19	29	136	12
· Adverse reactions to psychotropics	62	62	145	383	1,415	66
· Suicides	156	157	263	676	2,431	135
· Accidental deaths	58	59	78	229	833	58
· Natural deaths investigation	177	177	222	676	2,493	184
· Undetermined deaths	51	52	73	228	931	50
· Others	4	22	301	378	707	5
Sexual assault	78	80	165	310	1,025	64
Traffic accident	35	42	97	200	736	38
Workplace accident	8	10	20	39	156	8

Type of report (cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Drowning	24	25	49	112	455	34
Drugs in hair	29	41	40	75	302	39
Alcoholemia + traffic drugs	13	14	29	52	185	11
Adult sudden death	22	22	52	95	346	14
Oral fluid	12	12	4	14	0	0
Professional negligence	7	7	21	33	142	2
Fires	6	6	14	25	99	5
Stash drugs	56	56	30	95	187	25
Alcoholemia live traffic	3	3	4	8	22	4
Drugs or alcohol in biological samples	45	48	51	134	473	46
Death suspected of criminality	12	14	39	74	316	13
Death in custody	6	6	7	13	103	10
Wildlife research	1	1	1	1	0	0
Sudden death related to sport	0	0	0	0	0	3
Infant sudden death	3	3	4	9	34	2
Children sudden death	2	2	8	21	110	3
Toxicological consultation from justice administration	1	2	0	0	0	2
Interlaboratory controls	3	6	0	35	106	4
Environmental chemistry	0	0	0	6	24	2
Mechanical suffocation	0	0	0	25	150	14
TOTAL	**885**	**940**	**1,736**	**3,975**	**13,917**	**853**

It is worth highlighting the decrease in 2020 of the latter type of requests and of cases of death by drowning, probably due to the lower number of tourists in the autonomous community of the Canary Islands as a consequence of the pandemic. However, an increase in the number of suicides compared to previous years and of other types of studies such as those of drug seizures can be observed.

To ensure the analytical expertise quality carried out in the section, there is participation in the Interlaboratory Exercise on Drugs of Abuse Commonly Found in Drug Seizures, the Blood Alcohol Intercomparison Exercise, and the Forensic Blood Toxicology Proficiency Testing (Quartz).

As shown in Figure 3.5.2, the majority of the casework corresponds to post-mortem cases (69%), while cases from live persons accounted for 22% and seizures of narcotic substances accounted for 6% of the total number of cases recorded.

Regarding the cases classified as post-mortem, approximately 50% of the deaths are classified as violent and 50% as non-violent. En la Figure 3.5.3 shows the incidence of each. As can be seen in the case of violent deaths, suicides again account for almost 50% (49.7%) of them.

Figure 3.5.2. Distribution of the casework in the chemistry section

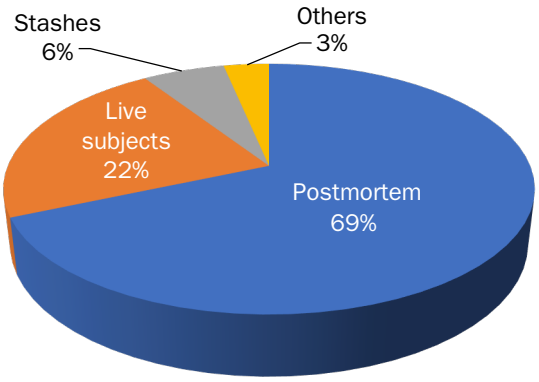
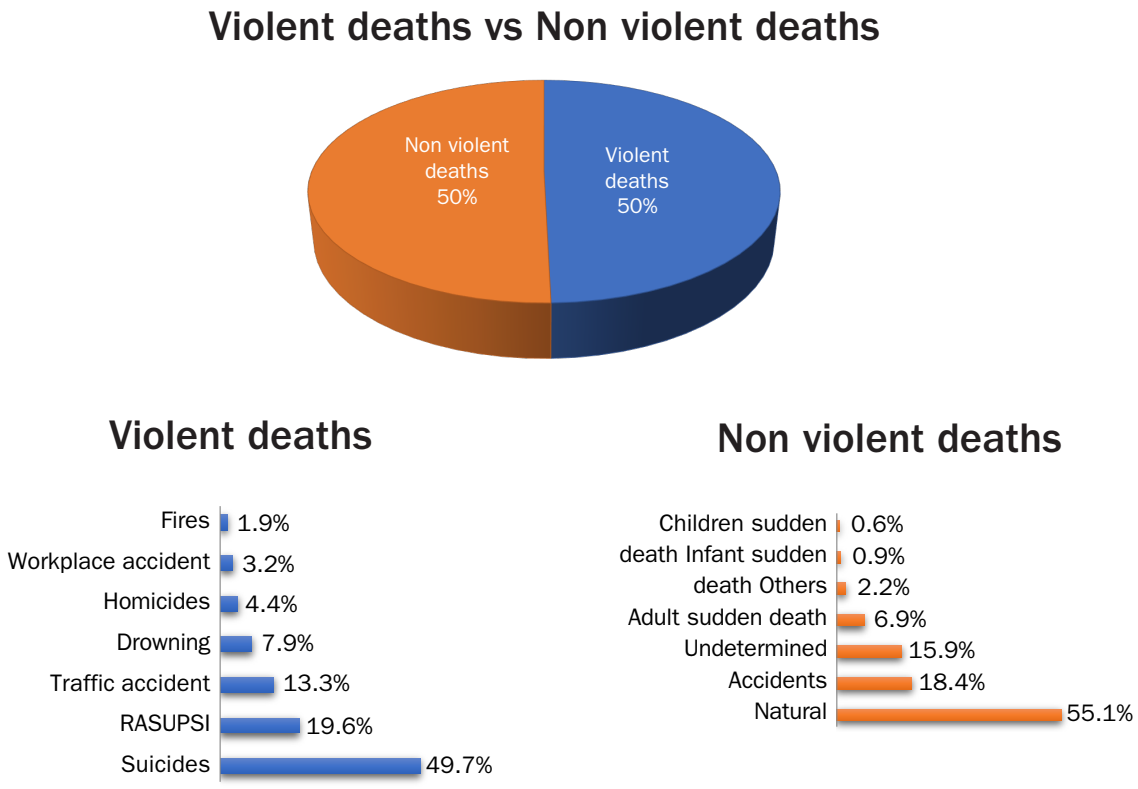
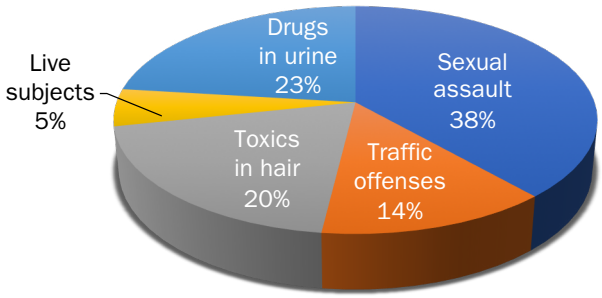


Figure 3.5.3 Distribution in post-mortem cases



Concerning the toxicological studies in live subjects (Figure 3.5.4), it is important to highlight that the majority corresponds to crimes against sexual liberty (38%), followed by drugs of abuse and psychotropic drugs in urine (23%), and chronological studies of toxics consumption in hair (20%).

Figure 3.5.4. Distribution of the casework in live subjects



3.5.1. Forensic interesting case: Toxicological study in a suspected adverse reaction to cocaine in an infant

Intoxication due to drugs of abuse in newborns and neonates has been widely documented in the scientific literature. For the exposure, classical methods have been used routinely, based on the analysis of blood and urine samples from patients showing these clinical manifestations. The documented cases (1-11) demonstrate that acute intoxication by drugs of abuse in children is frequently the first clinical evidence of chronic repeated exposure. Newborns, infants, and young children can be exposed to these substances. For example, through the smoke from their consumption or by hand-and-mouth leading to the ingestion of remains in the home of an active consumer. They can be passively exposed through the placenta, breastfeeding, saliva, or sweat of the consumer. It is important not to forget the possibility of deliberate administration by the adult.

This is the case of a baby of 5 months old who awakes restless, anxious, and without appetite. Sometime later, he began with respiratory distress and died. During the autopsy, a urine toxin screening is carried out. The result is positive for cocaine. A possible cause of death is “suspected cocaine intoxication.”

Samples of blood, vitreous humor and gastric content were sent to analyze them. In addition, blood and urine samples from the mother were sent.

The samples from the baby and the mother, after pretreatment and previous preconcentration, were analyzed by gas chromatography coupled to mass spectrometry (GC/MS), by high-performance liquid chromatography with diode detector (HPLC-DAD), and by liquid chromatography coupled to high-performance mass spectrometry (LC-HRMS). Specifically, the cocaine and metabolites analyses were carried out by gas chromatography coupled

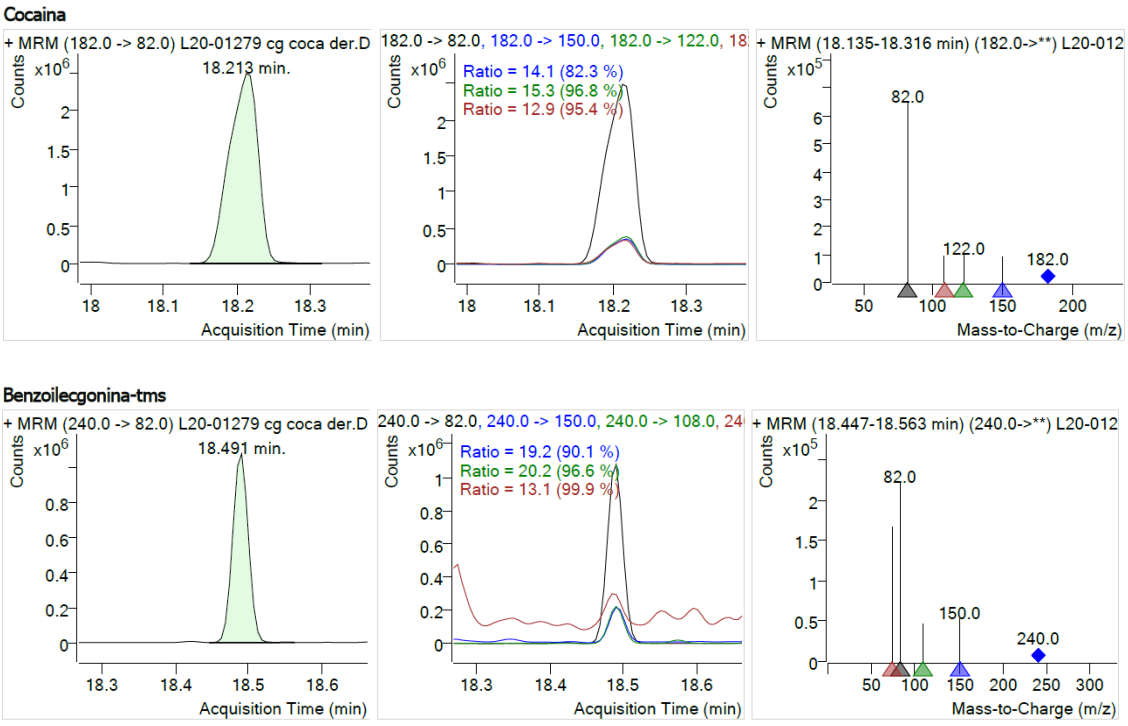
to tandem mass spectrometry (GC-MS/MS) after the derivatization of the extracts with BSTFA. The substances listed in Table 3.5. 1.1 were detected.

Table 3.5.1.1. Results obtained through gas chromatography coupled to tandem mass spectrometry (GC-MS/MS) after derivatization of the extracts with BSTFA

Baby samples			
	Blood (mg/l)	Vitreous humor (mg/l)	Gastric content (mg/l)
Cocaine	0.0020	0.0014	0.0949
Benzoylecgonine	0.0039	0.0016	0.0257

Mother samples		
	Blood (mg/l)	Urine
Cocaine	N.D.	Present
Benzoilecgonina	0.0662	Present
Ecgonine methyl ester	N.D.	Present
Alprazolam	0.0300	Present
N.D.: Not detected.		

Figure 5.3.1.1 Transitions of cocaine and benzoylecgonine-tms by GC-MS/MS, in infant gastric contents sample



Cocaine (benzoylecgonine methyl ester) is a narcotic with stimulating properties, although it also has a marked effect as a local anesthetic. It exerts its stimulating activity blocking the synaptic reuptake of norepinephrine, dopamine, and serotonin. The activation of α and β-adrenergic receptors produces vasoconstriction and an increase in blood pressure. There is a greater likelihood of seizures. The adrenergic activation through diacylglycerol and inositol triphosphate causes a release of intracellular calcium. It causes a heart rate and rhythm increase that can lead to tachycardia and ventricular fibrillation. The vasoconstrictor action of cocaine at the coronary level reduces the supply of oxygen to the heart. Cocaine can also alter the sinoatrial node, leading to arrhythmias. **Benzoylecgonine** is an inactive metabolite of cocaine.

In a clinical study (12) carried out on 36 children whose age varied between 1 and 60 months, 64% of the route of exposure was unknown. They presented various clinical profiles. The most common clinical manifestation was tachycardia. Agitation was observed in 9 patients, and 8 had a low level of consciousness. A reduced group presented gastrointestinal symptoms like nausea, vomiting, diarrhea, and abdominal pain. A minority presented other manifestations such as ataxia, mydriasis, cyanosis, and respiratory depression. There was one rhabdomyolysis case and another cardiac arrest. 3 children did not show any clinical symptoms. As a reference (13), in a study carried out in Philadelphia from 1987 to 1989 in 300 deaths of children aged between 1 week and 24 months, in 16 cases traces of cocaine were found. The deaths were associated with passive exposure to crack smoke in poorly ventilated environments. The mean cocaine concentration obtained in post-mortem blood was 0.076 mg/l, ranging from 0.016 mg/l to 0.03 mg/l. No anatomical alterations were observed in all of them that could explain the cause of death during the autopsy.

It should not be forgotten that normally harmless doses for an adult can cause a severe condition in the child. There may be consumption of different substances simultaneously. On the other hand, chronic intoxications due to continuous exposure to substances of abuse rarely give rise to a specific clinic. They are usually discovered through a toxicological analysis in alternative matrices that accumulate the original substance or its metabolites, such as hair.

To the best of our knowledge, cocaine and benzoylecgonine in the vitreous humor and blood samples prove an exhibition of cocaine. Its presence in the gastric content could aim the ingestion of the same one. The detection of cocaine and benzoylecgonine in the mother's biological samples could point to a possible transfer through breastfeeding. It is a currently unknown factor.

In this case, it is interesting to obtain hair from the mother with a sufficient length to know the possible intrauterine exposure that the baby had during pregnancy, as well as a sample of the baby's hair. In general, hair is proposed as the reference matrix to rule out chronic exposure in children with acute intoxication or those coming from a risky environment.

Bibliographic references

(1) Conway EE, Mezey AP, Powers K. Status epilepticus following the oral ingestion of cocaine in an infant. *Pediatr. Emerg Care*, 6 (1990), pp. 189-190.

(2) Esophagitis, epiglottitis, and cocaine alkaloid ("crack"): "accidental" poisoning or child abuse? *Pediatrics*, 86 (1990), pp. 117-119. (5) Havlik DM, Nolte KB. Fatal "crack" cocaine ingestion in an infant. *Am J Forensic Med Pathol*, 21 (2000), pp. 245-248.

(3) Ottolini MC, Foster KE. Intussusception in association with childhood cocaine intoxication: a case report. *Pediatr Emerg Care* 1994; 10:342-3.

(4) Riggs D, Weibley RE. Acute hemorrhagic diarrhea and cardiovascular collapse in a young child owing to environmentally acquired cocaine. *Pediatr Emerg Care* 1991; 7:154-5.

(5) Pinto JM, Babu K, Jenny C. Cocaine-induced dystonic reaction: an unlikely presentation of child neglect. *Pediatr Emerg Care* 2013;29: 1006-8.

(6) Rivkin M, Gilmore HE. Generalized seizures in an infant due to environmentally acquired cocaine. *Pediatrics* 1989; 84:1100-2.

(7) Conway EE, Mezey AP, Powers K. Status epilepticus following the oral ingestion of cocaine in and infant. *Pediatr Emerg Care* 1990;6: 189-90.

(8) Havlik DM, Nolte KB. Fatal ''crack'' cocaine ingestion in an infant. *Am J Forensic Med Pathol* 2000; 21:245-8.

(9) Bateman DA, Heagarty MC. Passive freebase cocaine ('crack') inhalation by infants and toddlers. *Am J Dis Child* 1989; 143:25-7.

(10) Unintentional pedriatic cocaine exposures result in worseotcomes than other unintentional pediatric poisonings. *The Journal of Emergency Medicine*, Vol 52, N.º 6, pp. 825-832, 2017.

(11) Haresh G. Mirchandani, MD; Ila H. Mirchandani, MD; Frederic Hellman, MD; Rosanne English-Rider; Samuel Rosen, PhD; Elizabeth A. Laposata, MD. Passive inhalation of freebase cocaine (crack) smoke by Infants. *Arch Pathol Lab Med.* 1991 May;115(5):494-8.

(12) Garcia-Algar O, Lopez-Vilchez MA, Pacifici R, Pichini S. Intoxicación aguda y exposición crónica a cocaína en un niño. *Med Clin* (Barc), 125 (2005), pp.436-437.

(13) Ernst AA, Sanders WM. Unexpected cocaine intoxication presenting as seizures in children. *Ann Emerg Med*, 18 (1989), pp. 774-777.

3.5.2. Teaching and scientific activities

3.5.2.1. . Formative and teaching activities

Teaching in the area of Legal and Forensic Medicine at the University of La Laguna, in the degree of medicine in the subject Legal and Forensic Medicine and in the degree of pharmacy in the subject of Drug Addictions.

Training agreement with the Canary Islands Health Service for the rotation of resident pharmacist interns from the University Hospital of the Canary Islands and the Nuestra Señora de La Candelaria University Hospital in the Chemistry Section of the INTCF Delegation.

3.5.2.2. Formative activities

Chemistry and Drug Service Facultatives. Validation of methods in forensic sciences. Organized by the Centre for Legal Studies, and held online from 28 September 2020 to 1 October 2020.

Chemistry and Drugs Facultatives. Analysis of pesticides in environmental samples and wildlife poisoning. Organized by the Centre for Legal Studies and carried out online from 5 to 9 October 2020.

Chemistry and Drugs Service Facultatives. Updating in forensic chemistry and toxicology. From the laboratory to the courts. Organized by the Centre for Legal Studies and held online from 19 to 23 October 2020.

Chemistry and Drugs Service Facultatives. Multidisciplinary forensic studies of deaths by drowning. Organized by the Centre for Legal Studies and held online from 3 to 5 November 2020.

Chemistry and Drugs Service Facultatives. Multidisciplinary investigation of sexual aggressions in forensic laboratories. Organized by the Centre for Legal Studies online from 10 to 13 November 2020.

Chemistry and Drugs Service Facultatives. Polluted soils and groundwater: update on analytical techniques and ecotoxicity tests. Organized by the Centre for Legal Studies online from 30 November to 3 December 2020.

Chemistry and Drugs Service Facultatives. Forensic studies of harmful agents and their effects on soft parts and bones. Organized by the Centre for Legal Studies online from 1 to 3 December 2020.

4. Biology Services

Each Department from the INTCF has a Biology Service, and there is a biology section in the La Laguna Delegation. The Biology Services functions are fundamentally forensic but also teaching and investigating activities. Inside the expertise labour, we include the following principal investigations:

- *Biological research and genetic identification of biological traces of criminal interest in sexual assault, homicides, and other crimes*
- *Genetic identification of missing persons and cadaveric remains*
- *Genetic investigation of kinship relations in parentage proceedings*
- *Genetic identification in irregular adoptions and newborn subtractions*
- *Genetic identification of non-human species*
- *Drowning (diatom studies)*
- *Sudden death (biochemical and microbiology studies, but only in the Madrid Department)*
- *Botanical identification (only in the Madrid Department)*

Personal staff and the Biology Section that have participated in this kind of investigation during 2019 are shown in Table 4.1.

Table 4.1. Different Departments staffs of the Biology Services

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA	INTCF-LA LAGUNA
Head of the Department	1	1	1	1 (*)
Facultatives	21	13	10	1
Specialist technicians	8	5	5	3
Laboratory assistants	10	4	1	1
Administratives	2	–	2	–

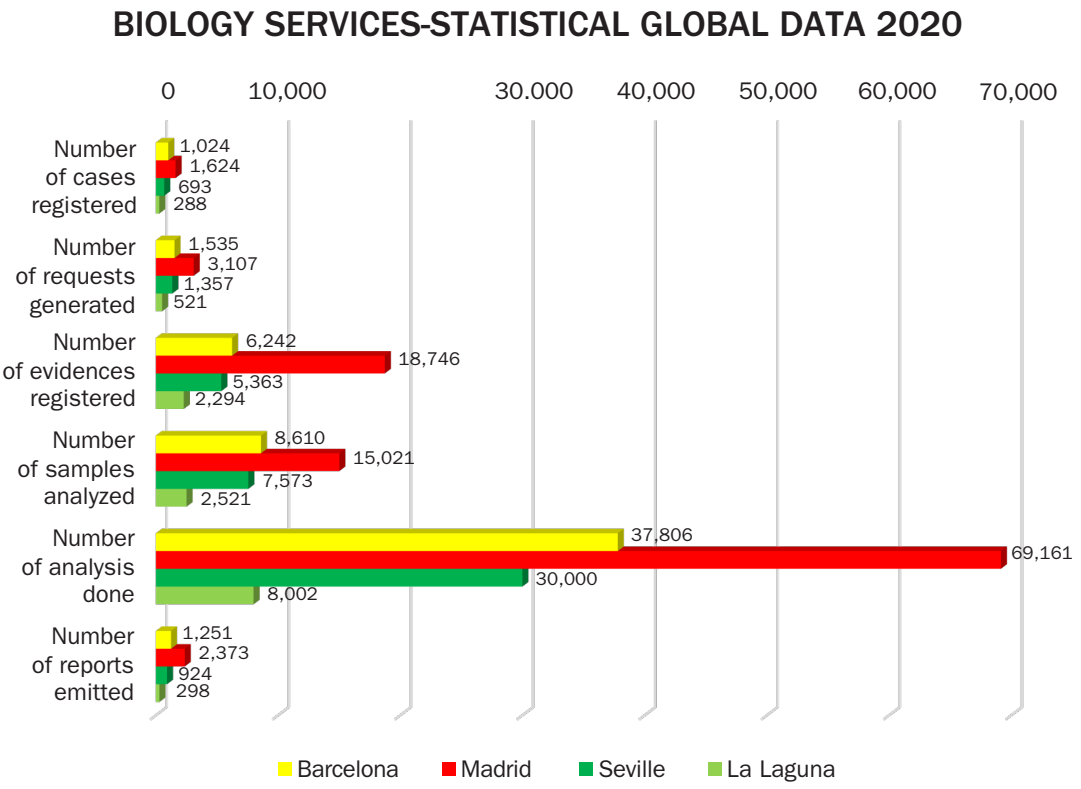
(*) Facultative that also works as the Service coordinator.

The INTCF Biology Services registered in 2020 a total of 3,629 expert cases and a total of 32,645 evidences to analyze, emitting 4,846 expert reports after the analysis of 33,725 samples on which 144,969 analyses were carried out (Figure 4.1).

The data supposes a descent of 6.9% in the number of reports issued compared to 2019 (4,864 reports emitted in 2020, facing 5,227 reports emitted in 2019), despite the state of alarm decreed by the government dated 14/03/2020 (RD 463/2020) related to the contention of the COVID-19 pandemic. The Institute's on-site activity was paralyzed for two months, reduced to essential services. It is thanks to the teleworking habilitation for

the facultative, which was completed between 3-6 weeks after the state of alarm decree, and to the staff effort, that the general production of reports emitted compared to 2019 was less affected than we expected.

Figure 4.1. Overall data on the INTCF Biology Services expert activity during 2020



	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Madrid	1,624	3,107	18,746	15,021	69,161	2,373
Barcelona	1,024	1,535	6,242	8,610	37,806	1,251
Seville	693	1,357	5,363	7,573	30,000	924
La Laguna	288	521	2,294	2,521	8,002	298
Total	**3,629**	**6,520**	**32,645**	**33,725**	**144,969**	**4,864**

Within the expert work of the INTCF Biology Services, the data and results obtained in the different indices of the INTCF DNA databases during the year 2020 are also presented.

Apart from the expert activity, the Biology Service during 2020 has also acted as a reference centre for their specialty. It has collaborated with other institutions in different workgroups (National Technical Commission for Multiple Victim Events, National Commission for the Forensic Use of DNA, Spanish and Portuguese-speaking Group of the International Society for Forensic Genetics [spanish initials, GHEP-ISFG], and the Regulatory and coordination committee for the national identifier obtained through the DNA management system [spanish initials, COMSIGENI]).

The Biology Service facultatives have developed crucial investigative labour validating several application methods in biology and forensic genetics. They manifested with a big number of scientific publications and contributions to national and international forensic congresses, collected in the following sections of the report.

We add the teaching activity developed in collaboration with the IMLCF with different universities and the Centre for Legal Study, apart from the investigative activity. Because of the restrictions imposed to stop COVID-19, it has been impossible to carry out in 2020 external staff on-site activities through supervised internships in the field of educational cooperation with universities and public hospitals.

Hereunder we collect the scientific and expert activities like the teaching and formative activities developed during 2020 for each Biology Services from the different Departments. Each Service includes the description of an interesting forensic case, to publicize the expert activity.

4.1. Madrid Department Biology Service

Concerning the expert activity of the Madrid Department Biology Service, they received 3,107 requests with 18,746 evidences. They analyzed 15,021 samples through a total of 69,161 analyses, emitting a total of 2,373 expert reports in 2020.

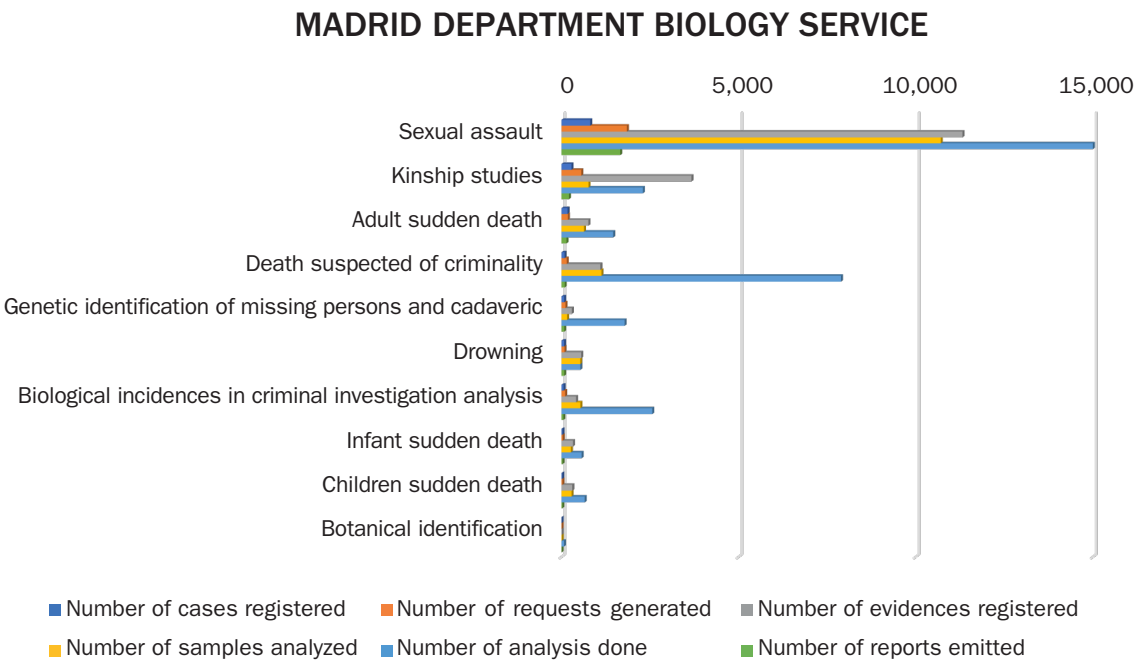
In Figure 4.1.1, the predominant analysis is the investigation of **sexual assault cases** (1,847 requests with 11,320 evidences received). The biological and genetic studies of semen samples are carried out. The DNA profiles are obtained from reference samples of the implied persons in the process (defendants, victims, persons to be discarded).

The second most numerous analyses requests are **kinship biological studies** (559 requests with 3,669 evidences received). Followed by **criminality suspect death studies** (150 requests with 1,097 evidences), **identification of missing persons and cadaveric remains** (113 requests with 292 evidences received), and the **analysis of biological evidence of criminal interest** (104 requests with 412 evidences received).

The third most numerous analysis requests correspond to **microbiology and biochemical studies in the sudden death in adults, children, and infants** (244 requests with 1,391 evidences received) and the **biological analyses of the drowning deaths** (85 requests with 557 evidences received).

As complementary activities to the expert work related to judicial cases, the facultative staff has participated in the validation of a technical PCR procedure for the detection of SARS-CoV-2 in the forensic field, in the implementation and validation of DNA extraction methods by means of an automated station, in internal training programs of five facultatives, one Laboratory technician and five laboratory assistants in various techniques, as well as in the publication of several scientific articles and in teaching courses organized by the Center for Legal Studies, among others.

Figure 4.1.1. Casework of the Madrid Department Biology Service during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Sexual assault	812	1,847	11,320	10,708	51,342	1,658
Kinship studies	283	559	3.669	763	2.298	211
Analysis of biological evidence in criminal investigation	60	104	412	535	2.562	53
Genetic identification of missing persons and cadaveric remains	78	113	292	159	1.781	79
Death suspected of criminality	87	150	1.097	1.129	7.890	91
Adult sudden death (*)	172	182	760	636	1.460	142

Type of report (cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Children sudden death (*)	23	27	305	285	655	25
Infant sudden death (*)	29	35	326	267	569	30
Drowning	75	85	557	532	532	79
Botanical identification	5	5	8	7	72	5
TOTAL	**1,624**	**3,107**	**18,746**	**15,021**	**69,161**	**2,373**
(*) Microbiology and biochemical analyses.						

4.1.2. Interesting forensic case

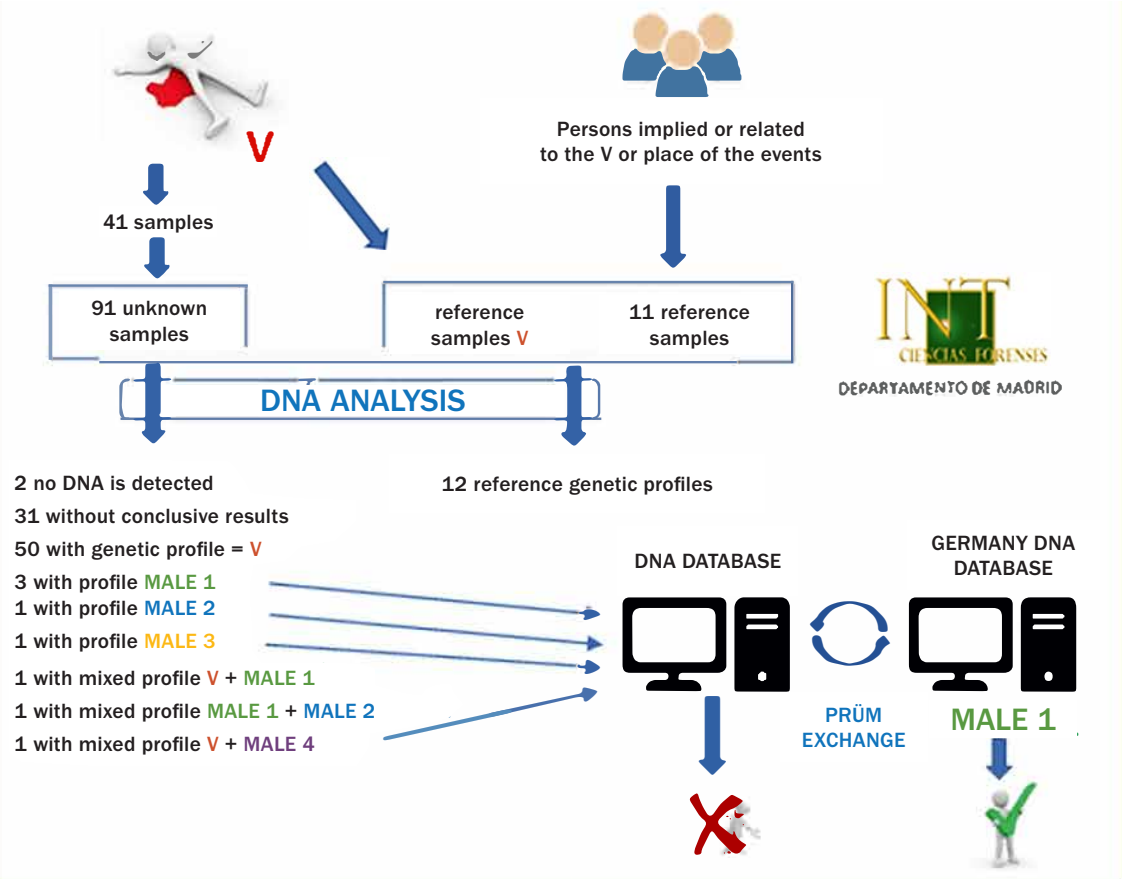
4.1.2.1. DNA database match (under the Prüm Treaty) related to a homicide

It is about a homicide that occurred in January 2019 in a small cheap hotel room in Madrid. The Service of Biology of the Department of Madrid of the INTCF received 41 items gathered during the ocular inspection (corporal samples of the victim's body, clothing, bedclothes, napkin, handkerchief, sealing tape, swabs with samples from the scene of the facts…), as well as an reference sample of the victim and other 11 people related in some way or another to the facts. It is suspected that the perpetrators come from Eastern Europe. In total, 12 reference samples and 91 unknown samples were analyzed. Genetic profiles (23 autosomal STR markers) of 4 males of unknown identity were detected. They were not compatible with any of the genetic profiles obtained from the reference samples analyzed.

After the registration of the 4 men genetic profiles of unknown identity in the national DNA database, no coincidence was detected. After the exchange of information regulated by the Prüm Treaty, a coincidence of one of the unknown profiles was detected (MALE 1) with a reference genetic profile (for 8 autosomal STR markers) registered in the German DNA database. As a general rule, the scientific community recommends a minimum of 10 markers to consider that the detected coincidence is not fortuitous. Germany was asked to expand the markers, as well as the information associated with said profile, not being possible to expand the requested markers, since the usual practice in that country is not to keep the samples from which the genetic profiles registered in the database come.

Once the associated information was received, they check the male of Latvian or Georgian nationality. Six different aliases with diverse nationalities appeared in the documentation with numerous police records. Property crimes, fraud, illegal entry and residence, aggravated bodily injury, and trespassing on private property in Germany between 2007 and 2012, and in Ireland by robbery in 2013.

Figure 4.1.2.1. Results of the genetic analysis and usefulness of the DNA database in a homicide case



Considering that, despite the low number of markers, the detected coincidence can be relevant and based on the result obtained for the Likelihood Ratio (LR): the frequency of this profile in population Spanish was 1 in a trillion, superior to 1 in billion. It is a threshold accepted by the scientific community as sufficient to consider that the detected coincidence is not fortuitous in the case of having less than 10 markers. The coincidence detected and its statistical assessment were made known to the competent judicial authority.

Putting in common the results of the investigations obtained until the moment was realized in court, it is done between the INTCF facultative responsible for the case and the National Police Group of Homicides. After comparing the filiation data and the photographs contributed by Germany, it turned out that the individual at issue was the main suspect of the National Police. The investigating judge agreed to search and capture the investigated to take a new reference sample and proceed to expand the number of autosomal STR markers to assess this coincidence with more guarantees despite the insufficiency in the number of markers available for the reference sample.

This case highlights the importance of collaborating between the different institutions and of evaluating all the results obtained. Although a priori they may seem insufficient, they can be very useful in the course of the investigation to clarify the facts.

4.1.2.2. Genetic identification of bone remains of 1945

Bone remains found by a group of cavers in a pit cave in Bejes (Cantabria) were received in the INTCF Madrid Department. The anthropological study carried out in the Criminalistics Service concluded that the bone remains were of human origin. They represented at least two different individuals: one compatible with an adult male and the other immature. The bone remains for genetic identification were selected. In the case of the adult male, a tooth (molar) and the right humerus. In the case of the immature individual, the left femur diaphysis.

Figure 4.1.2.2. DNA extraction of bones requires prior cleaning, cutting, and pulverization of the selected fragments

The same genetic profile of a male was detected from the tooth, the humerus. From the femur, a genetic profile attributable to a female was detected. The analyses were expanded with specific STR markers of the Y chromosome (in the case of the humerus and tooth), exclusively paternal inherited, and regions of mitochondrial DNA, exclusively maternally inherited (in the humerus, tooth, and femur.) The genetic profiles and haplotypes obtained were registered in the national DNA database without detecting compatibility with any of the genetic profiles registered to date.

The Civil Guard suspected that the remains of the male could belong to a forest guard who disappeared in 1945. The genetic profile (for 17 autosomal STR markers) of his biological daughter was received. It was obtained in 2010 by the IMLCF Forensic Genetics Service Luis Concheiro of Santiago de Compostela. After both profiles comparison, the compatibility was detected for a father-child relationship with a paternity index (PI) of 5,320,683 and a probability of paternity of 99.99998%.

A new reference sample of the daughter was requested to increase the number of comparable markers to a total of 22 to increase the probative force of the results. This time

reaching a PI value of 23,337,322,119, it is equivalent to probability paternity of 99.999999996%.

It was agreed by the judicial authority that all bone remains that could be identified as corresponding to the identified male individual were analyzed to be delivered to the family for burial. Thus, with the new analyses, a left tibia, a right coxal, a left parietal fragment, and another tooth included in an incomplete mandible fragment were also identified.

After a long wait without knowing the whereabouts of their ancestor, finally, all the identified bone remains were returned to the family so that they could be buried.

The woman's genetic profile obtained from the femur of an immature individual remains in the national DNA database so it can be collated successively with the genetic profiles incorporated into it for identification purposes.

4.1.2.3. Forensic Microbiology in 2020

The year 2020 marks a before and an after in the infectious history disease. In the 20th century, clinical microbiology, antibiotic therapy, and preventive medicine development permitted the descent of the incidence of severe infectious diseases that caused deaths. However, the last 20 years have seen the emergence and rapid dispersal of emerging pathogens that have caused outbreaks and epidemics that have sometimes crossed borders. In this century, infectious disease has never turned health systems in check as SARS-CoV-2 has provoked. The joint work of microbiologists and forensic pathologists allows an in-depth understanding of its pathogenetic mechanisms and its various associated conditions.

Although in clinical medicine SARS-CoV-2 has collapsed everything causing other entities to go unnoticed, we have been vigilant to prevent this from happening. An example of this is as follows: A 20-month-old girl with catarrhal symptoms, high fever, and mild respiratory failure was sent to the hospital emergency service. She remains under observation for about 10 hours with physical antipyretic treatment and paracetamol. Although she was discharged with antipyretics, she returned to the hospital with persistent fever and severe respiratory failure after 24 hours. She received assistance in the intensive care unit with mechanical ventilation, antibiotic treatment, and support. Severe respiratory infection was diagnosed in the tests carried out. She evolved unfavorably, suffering shock. She died on 28 Dec 19, about 8 hours after receiving assistance in intensive care.

In the autopsy, made 72 hours later, pulmonary alterations compatible with respiratory infection are confirmed. The forensic doctor asked for the microbiological study making

an exhaustive sampling. It arrived at our laboratory in January of 2020 in addition to the histopathological and chemical studies.

Microbiological analysis showed the majority isolation of *Streptococcus pyogenes* in the five lung lobes and pharyngeal swabs, together with the usual flora of the upper respiratory tract. This strain belonged to the M1 serotype (emm gene) and carried the spe A, B, F, G, J, and Z genes that, as superantigens, are considered virulence factors. By molecular analysis, Metapneumovirus A was detected in the three lobes of the right lung, in the lower lobe of the left lung, in nasal and pharyngeal swabs, and Bocavirus in both swabs.

The histopathological diagnosis (Histopathology Section of the La Laguna Delegation) explained the death. It was a lymphocytic interstitial lung disease of probable viral etiology and bilateral necrotizing pneumonia. It affected all lobes and extended to the pleura.

The microbiological study made it possible to establish the etiology of the two pulmonary entities. The panlobular lymphocytic interstitial pneumonitis is caused by Metapneumovirus A, complicated by panlobular necrotizing pneumonia caused by *S. pyogenes* (bacterial superinfection). Tissue necrosis may be related to the expression of the M1 protein, one of the virulence factors detected. The M1 serotype is the most prevalent among *S. pyogenes* strains isolated in severe and invasive infections in Europe[1]. The presence of Bocavirus suggests a viral co-infection with Metapneumovirus A in the upper respiratory tract.

Metapneumoviruses can cause bronchiolitis, asthma, and pneumonia. Although its course is generally mild, a high viral load in the nasopharynx correlates with lower respiratory tract involvement and hospitalization of children under 5 years. The highest risk of developing severe disease corresponds to infants, the elderly, and immunosuppressed[2]. Co-infection with other respiratory pathogens is common due to its seasonal pattern (winter through early spring). Bocavirus is usually a companion virus. Although it can be pathogenic by itself, causing bronchiolitis and other respiratory infections in young children[3]. Both pathogens are emerging viruses described in the early 21st century. While these analyses were being carried out, a collaborative retrospective study started between the Microbiology Laboratory and the different Histopathology Services of the INTCF. The

---

[1] Luca-Harari B, Darenberg J, Neal S, Siljander T, Strakova L, Tanna A *et al.* Clinical and Microbiological characteristics of severe Streptococcus pyogenes disease in Europe. *J. Clin. Microbiol*. 2009. 47:1155-65, 2009. Doi: 10.1128/JCM.02155-08.

[2] Inostroza E, Pinto R. Nuevos virus respiratorios en pediatría. *Rev Medicina Clínica Las Condes*. 2017. 28;83-9. DOI:10.1016/j.rmclc.2017.01.005.

[3] Von Linstow ML, Hogh M, Hogh B. Clinical and epidiomiologic characteristics of human bocavirus in Danish infants. Rresults from a prospective birth cohort study. *Pediatr Infect Dis J.* 2008; 27: 897-902).

purpose was to assess whether fatal cases associated with COVID-19 had occurred in Spain in the forensic field at the beginning or before the first wave of SARS-CoV-2 infection that would have gone unnoticed. After selecting those deaths with pulmonary pathology presumably compatible with SARS-CoV-2 infection, this virus was investigated in the available samples. A specific qRT-PCR (reverse transcription followed by real-time PCR) was used for this virus. Considering that it was in La Gomera where the first case of SARS-CoV-2 infection was registered in Spain (01/31/20), that the unexpected death of this girl occurred in Lanzarote on 12/28/19 and that her histopathology was compatible, this matter was included in said study. The presence of this virus was not detected in nasal and pharyngeal swabs or paraffin sections of the lung from the most affected areas. It allowed discarding the implication of SARS-CoV-2 in this infant death. It allowed confirming that the detected pulmonary pathology in COVID-19 can also be in infections by another virus emergent like Metapneumovirus A.

As take-home messages, it is crucial to point out the necessary collaboration between microbiologists and forensic pathologists to 1) detect emerging pathogens in fatal cases, 2) detect rare co-infections, and 3) deepen our understanding of lung disease caused by emerging viruses. Some produce pictures similar to those of SARS-CoV-2.

Figure 4.1.2.3.1. Streptococcus pyogenes culture in lungs. Microbiology Laboratory, Biology Service. INTCF Madrid Department

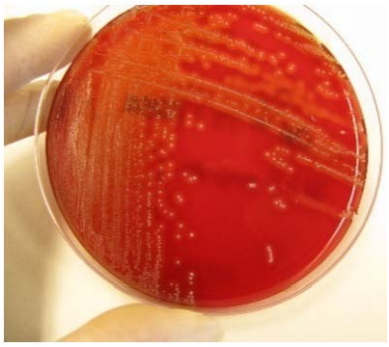


Figure 4.1.2.3.2. Lung with whitish areas in the pleura, that in the microscopic study corresponds to purulent exudate (indicative of bacterial superinfection). Necrosis in the parenchyma extends to the overlying pleura. The region of lung cut for microbiological study (arrow), which requires fresh tissue, can be seen (INTCF La Laguna Delegation Histopathology Section)

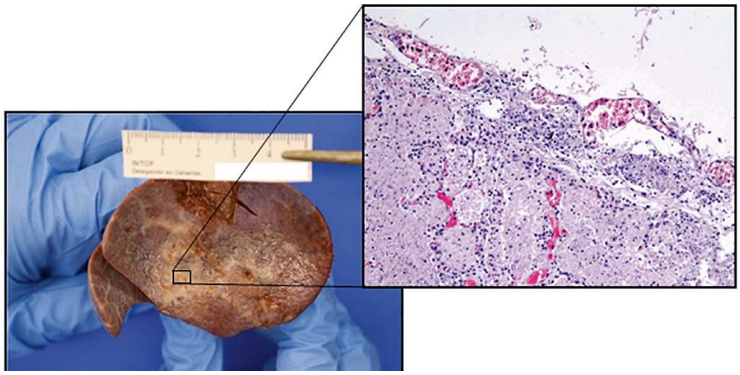
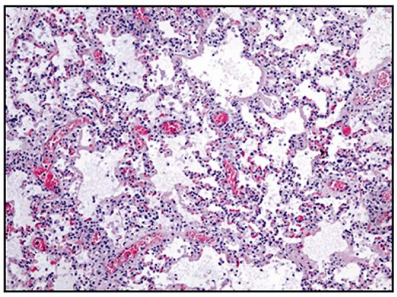


Figure 4.1.2.3.3. Interstitial pneumonitis with diffuse alveolar damage (INTCF La Laguna Delegation Histopathology Section)



4.1.2.4. The genetic identification and the LC-QTOF MS chemical analysis posterior of a (Oenanthe spp.) remaining root demonstrate the undetermined death cause

The current work emphasizes vegetal evidence identification, often underestimated in an undetermined sudden death context (USD)[4]. A 86 years old individual with an umbilical hernia recent surgery history was admitted to the Glasgow 8 Hospital. The possibility of having eaten a non-specific tuber or root, possibly cassava, was reported, and remains were found at the scene (Fig. 1). After the ingestion, the person commenting vomits a descent in the level of conscience. At the emergency room after seizures, they administer him benzodiazepines/haloperidol. He starts with respiratory insufficiency, a new seizure, and a cardiac arrest. They performed cardiopulmonary resuscitation (CPR) and began the treatment. He died hours later. The vegetal evidence and other post-mortem samples were sent from

[4] Martínez P, Quintela O, del Valle E, Pérez-Gómez B. Genetic identification and subsequent LC-QTOF MS analysis of plant remains *(Oenanthe spp.)* could prove the cause of an undetermined sudden death. *International Journal of Legal Medicine.* DOI: 10.1007/s00414-020-02488-6.

the IMELGA to the INTCFM for its biological and toxicological investigation to research the death as natural versus accidental, without signs of intentional intoxication.

In the autopsy, they observed internal organs congestion and a bilateral lung effusion, outbreaks of subarachnoid hemorrhage in the brain; heart with multiple petechiae, and non-specific findings in the spleen, liver, kidneys, and esophagus. The stomach showed greenish alimentary contents with erosive gastritis. The small intestine is compatible with intestinal ischemia and the colon with hemorrhagic debris. The cause of death was determined as multi-organ failure. A priori, we are interested in identifying the plant species and searching for cyanide that could be present in cassava bark.

The root remains couldn't be determined if they belong to *Manihot spp. (Crotonoideae)* genus due to the lack of morphological features proceeding to the genetic identification of the vegetal remains. The nrDNA ITS2 (Internal Transcribed Spacer) fragment was analyzed amplifying with the ITS3/ITS4 par, resulting in more than 30 sequences corresponding to the *Oenanthe spp. genus and the O. crocata* (AY360246, AY360247, JN400254 species, sequences of the *BLASTn search*) (Fig. 2). The sample analyzed was susceptible to containing Oenanthotoxin. It proceeded to its searching in the vegetal remains and the victim sample.

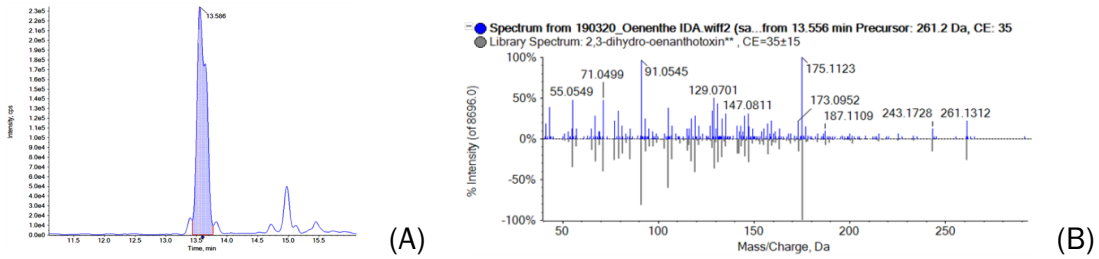
For the detection and identification of oenanthotoxin and polyalkenes related to the Chemistry Department, they applied the LC-QTOF MS high-resolution technique, analyzing the homogenized gastric content and the vegetal evidence extract. The polyacetylenes (enanthotoxin and 2,3-dihydroenanthotoxin) were positive in the plant extract and trace amounts in the gastric contents (Fig. 2. A, B). The identification of the toxin in blood was not possible due to the time elapsed. There was no toxin standard available for Oenanthe. However, the reference standard for the toxicological ingredients could be extrapolated from the root extraction components, from the information provided by the high-resolution mass spectrometry technique used, as well as from the mass spectra reflected in the scientific literature consulted (Fig. 3B).

The result of having found the toxin in the root extract and gastric content could demonstrate the ingestion of the Oenanthe poison hemlock. The *Oenanthe spp.* and *O. crocata species* contain polyin (oenanthotoxin) mainly concentrated in the root and are mistaken for other edible species of the genus. Enanthotoxin is a C17 polyacetylene isomer of cyclotoxin which is also related to carotatoxin. When this toxin is introduced into the organism, it blocks GABAergic responses causing hyperactivity in neurons, which would explain the effect of the convulsions that occurred in the present case. The symptoms of his intoxication resemble those of *Cicuta sp.*, such as nausea, vomiting, diarrhea, tachycardia, convulsions, mydriasis, rhabdomyolysis, renal/respiratory failure, cardiac arrhythmias, coma, and death. It is important to evaluate all the information. Whether accidental, suicidal, or homicidal intoxication by ingestion of plant material has occurred considering these types of judicial investigations when faced with unexplained death.

Figure 4.1.2.4.1. Remaining root/tuber plant from problem sample not taxonomically recognisable due to lack of morphological characters

Figure 4.1.2.4.2. Section of the resulting nrDNA ITS2 electropherogram compatible with Oenanthe spp., Oenanthe crocata or water hemlock (*Apiaceae, Umbelliferae*)

Figure 4.1.2.4.3. Chromatograms of single am/z 261,183 ions extracted from a methanolic extract of gastric contents, showing the retention time for the enanthotoxin peak at 13.586 min. (A). High resolution MS-MS spectra of 2,3-dihydro enanthotoxin, as a mirror image, in gastric contents (top) and in plant material (bottom) (B)



4.1.3. Teaching and scientific activity

4.1.3.1. Participation in investigation projects and collaboration with other institutions

Collaboration with the Spanish and Portuguese Speaking Group of the International Society for Forensic Genetics (GHEP-ISFG) in the coordination of two working committees and in carrying out their collaborative exercises: Working Committee on the "Interpretation of Mixtures of Autosomal STR Profiles" and its collaborative exercise on "Inter-laboratory Validation of the LRmix Studio software (GHEPMIX8)"; Working Committee on the "Forensic Applications of Mass Sequencing", and its collaborative exercise "GHEPMPS02".

Collaboration with the Spanish Agency for Food Safety and Nutrition, Biological Risk Management Area, in the elaboration of the text "Advice for the collection and self-consumption of wild mushrooms."

Collaboration in the development of the protocol for urgent and coordinated health care for women victims of sexual violence in the Community of Madrid (VISEM Code).

4.1.3.2. Contribution in scientific congresses

EXCHANGE Project Symposium "Challenges to criminal justice and police and judicial cooperation: the DNA data exchange within the Prüm System". Online, 22/06/2020.

ESGFOR Annual Business Meeting 2020. ESGFOR (European Study Group of Forensic and Postmortem Microbiology) of the European Society of Clinical Microbiology and Infectious Diseases. Online, 30/06/2020.

Webinar "Preparing for the worst - Rapid DNA as Part of a Comprehensive Disaster Victim ID Plan", organized by Bode Technology. Online, 30/07/2020.

COMSIGENI Meeting. Online, 18-19/11/2020.

11th Meeting of GCLAITH: Latin American Scientific Working Group on Human Identification. Organized by Promega, at the International Symposium on Human Identification ISHI31. Online, 17-18/09/2020.

HIDU Virtual 2020. Forensic Genetics: Latin American Edition. Organized by ThermoFisher Scientific. Online, 21/10/2020.

Meeting of the DNA Working Group of the Spanish Network of Official Forensic Laboratories (RLFOE). Organized by the National Directorate of INTCF, telematic. The paper INTCF-MADRID Biology Service, Approach to borderline profiles was presented. 09/11/2020.

"COVID-19 pathophysiology and target-organ damage". ECCVID 2020-ESCMID Conference on Corona Virus Disease. Online, 23-25/09/2020.

ECCVID 2020 -ESCMID Conference on Corona Virus Disease. Online, 23-25/09/2020.

26th ANNUAL CODIS Conference. FBI. Online, 7-10/12/2020.

13th Meeting of Researchers of the University Institute for Research in Police Sciences (University of Alcalá de Henares). Online, 15-16/12/2020.

15th GHEP-ISFG Forensic Genetics Conference. Online. 14-15/12/2020.

4.1.3.3. Scientific publications

Barrio PA, García O, Phillips C, Prieto L, Gusmão L, Fernández C, Casals F, Freitas JM, González-Albo MC, Martín P, Mosquera A, Navarro-Vera I, Paredes M, Pérez JA, Pinzón A, Rasal R, Ruiz-Ramírez J, Trindade BR, Alonso A. The first GHEP-ISFG collaborative exercise on forensic applications of massively parallel sequencing. Forensic Science International: *Genetics*, 2020; 49:102391.

Carnicero S, Fernández Rodríguez A, Lucena J, Molina P, Morentin B, Muñoz Recommendations for forensic medical action in the recovery of the corpse and medico-legal autopsies in the pandemic situation generated by COVID-19. V. Version 1.1, 01.06.2020.

Delgado A, Fernández-Rodríguez A, Jado I, Ybarra C. The Microbiology laboratory in response to bioterrorism. Procedures in Clinical Microbiology. Cercenado Mansilla E, Cantón Moreno R (editors). Spanish Society of Infectious Diseases and Clinical Microbiology (SEIMC). 2020. ISBN: 978-84-09-22265-0

Fernández-Rodríguez A, Casas I, Culebras E, Morilla E, Cohen MC, Alberola J. COVID-19 and post mortem microbiological studies. *Rev Esp Med Legal.* 2020; 46:127-38.

González-Quero N, Martínez P. Bioactive compounds in some principal mushrooms: An association to adverse effects. *GSC Advanced Research and Reviews* 2020; 5(2): 31-47.

Gregorio I, Zapata F, García Ruiz C, Martínez P. Superabsorbent sanitary pads as evidence in sexual aggression cases. *Int J Forensic Sci.* 2020; 5(4).

Martinez P. Forensic botany. In: Bárbaro A. (Coord.), *Manual de Criminalística y Criminología*, pp. 235-264. Tébar Flores (Eds). Madrid 2020.

Tejedor MA, Vallejo G, Navarro E, Martinez P, Alberti N. Postmortem tryptase cutoff points and main causes of fatal anaphylaxis. *Journal allergy Clinic immunologie Practique*, 2020; 8(2): 761-762.

4.1.3.4. Education and teaching activities

Courses held

Albarrán C. Training action on “Attention to minor victims in the IMLCCFF”, programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ), with the lecture

"The study of DNA in crimes against sexual freedom in minors". In person, CEJ-Madrid, 2 to 3 March 2020.

Albarrán C. Training action on "Multidisciplinary investigation of sexual aggressions in forensic laboratories", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ), with the lecture "Forensic genetic analysis in sexual aggressions: principles and problems". Online modality, from 10 to 13 November 2020.

Barrio PA. Seminar "HIDU Virtual 2020. Forensic Genetics: Latin America Edition", with the paper "Forensic NGS. STR marker studies by MPS for forensic use: Validation of kits and Spanish Population Study". Online modality, 21 October 2020, organized by Thermo Fisher Scientific.

Barrio PA. Training Action on "Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ), with the presentations "Fundamentals for the use of EuroForMix software", "Practical workshop on EuroForMix software and presentation of case studies", and "Presentation of a validation model of a software for use in forensic genetics (LRmix Studio)". Online modality, 23-27 November 2020.

Barrio PA. Training action on "Introduction to mitochondrial DNA analysis", of the online training programme for collaboration in activities to improve Forensic Genetics, within the European project "Cooperation in criminal investigation in Central America to combat crime and drug trafficking at an international level", ICRIME-LA/2017/39066, coordinated by the International and Ibero-American Foundation for Public Administration and Policies F.S.P. (FIIAPP). The lectures given were: "New strategies: Analysis of mitochondrial DNA by Massively Parallel Sequencing (MPS)", "Presentation of practical exercises: Analysis of MPS data (IGV); Use of the EMPOP database", and "Resolution of practical exercises: Analysis of MPS data (IGV); Use of the EMPOP database". Online modality, on 30 November and 2, 4, 8 and 11 December 2020.

Fernández-Rodríguez A. Seminar "Recommendations for the prevention of risks due to biological agents in the laboratory in times of Coronavirus". In person, INTCF-Madrid, 4 March 2020.

Fernández-Rodríguez A. Master in Health Biology, UCM, subject "Public Health". Lecture: "Health contributions of Forensic Biology". Online modality, 20 October 2020.

Fernández-Rodríguez A. Training action on "Multidisciplinary investigation of sexual aggressions in forensic laboratories", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ), as a coordinator of the course and with the lecture "Guidelines for taking samples in sexual aggressions". Online modality, from 10 to 13 November 2020.

Fernández-Rodríguez A. AECID course on Crimes against sexual freedom and indemnity. Problems and forensic action. Contributions of forensic sciences to the approach to sexual violence in the judicial sphere in Latin America and the Caribbean. Participation in practical workshops. Papers presented: "Recommendations for taking samples for biological studies in sexual aggression" and "Sexual violence. Studies in the forensic biology laboratory". Online modality, from 2 to 20 November 2020.

González E. Training action on "Multidisciplinary investigation of sexual aggressions in forensic laboratories", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ), with the lecture "Usefulness of DNA databases in sexual aggressions". Online modality, from 10 to 13 November 2020.

Vallejo G. Training action on "Multidisciplinary forensic studies of deaths by submersion", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ), as a coordinator of the course and with the lecture "Biological examinations of drowning: diatoms and alternative methods". Online modality, from 03 to 06 September 2020.

Espinosa E. Presentation of the work carried out by the Specialist Laboratory Technicians at the INTCF for students of FP Higher Level Health Branch at the Technical School of Specialised Education; IES Las Musas; Instituto FP Claudio Galeno; IES Benjamin Rua; Instituto Técnico de Estudios Profesionales.

Courses received

SEIMC (Spanish Society of Infectious Diseases and Clinical Microbiology) optimization course in microbiological diagnosis. Online modality, from 27 January to 27 March 2020.

Training action on "Study of the methodology of comprehensive forensic assessment in gender violence", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ). On site, CEJ-Madrid, from 5 to 6 March 2020.

Training action on "Investigation of homicides, multidisciplinary approach", programmed within the Continuous Training Plan of the Centre for Legal Studies (CEJ). On site, CEJ-Madrid, from 9 to 10 March 2020.

Training action on "Validation of methods in Forensic Sciences", programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online modality, from 28 September to 1 October 2020.

Training action on "Multidisciplinary investigation of sexual aggressions in forensic laboratories", programmed as part of the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online modality, from 10 to 13 November 2020.

Training action on “Informative introduction to the scientific expert activity of the different INTCF Services”, programmed as part of the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online modality, from 16 to 18 November 2020.

Training action on “Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics”, programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online modality, from 23 to 27 November 2020.

4.2. Barcelona Department Biology Service

Concerning the expert activity of the Barcelona Department Biology Service, during 2020 they received 1,535 requests with 6,242 evidences. They analyzed 8,610 samples through a total of 37,806 analyses, emitting a total of 1,251 expert reports.

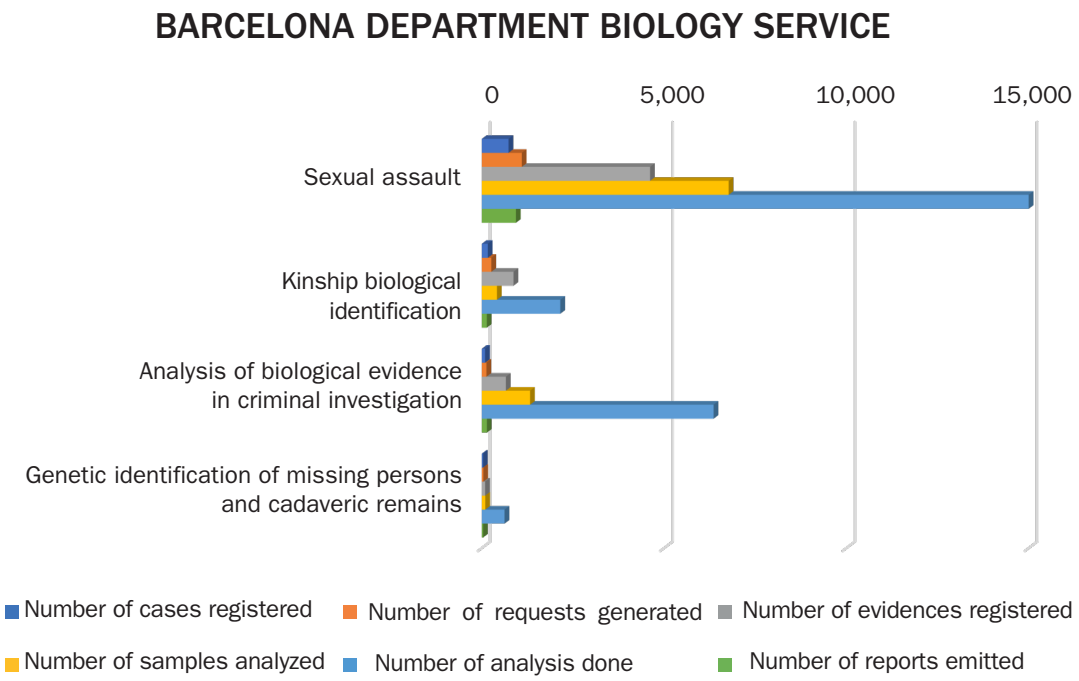
As it can be seen in Figure 4.2.1, the predominant analysis request corresponds to those **sexual assault cases** (1,098 requests with 4,617 evidences received). They do a biological and genetic study looking for semen or other biological vestiges, and DNA profile obtention of the samples of the implied persons in the procedure (defendants, victims…).

The second most numerous group of analysis requests corresponds to **kinship biological studies** (263 requests with 870 evidences received), followed by **analyses of biological evidence of criminal interest** (129 requests with 662 evidences received), and **genetic identification of missing persons and cadaveric remains** (45 requests with 93 evidences received).

During 2020, there has been an important effort in the actualization of the documentation associated with the procedures of work in the Biology Service and to accredit new tests for future implementation.

Likewise, the Biology Service members have participated continuously in some activities aimed to implement and improve new analysis methods in laboratories of diverse Turkish institutions (Gendarmerie and Institute of Forensic Medicine). They were developed in the European Project TR 16 IPA JH 03 18 - Forensic Training Towards Advanced Examination Methods.

Figure 4.2.1. Casework of the Biology Service of the Department of Barcelona during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analysis done	No. reports emitted
Sexual assault	735	1,098	4,617	6,772	28,667	937
Kinship biological investigation	165	263	870	416	2,155	138
Analyses of biological evidence in criminal investigation	91	129	662	1,325	6,359	141
Genetic identification of missing persons and corpse remains	33	45	93	97	625	35
TOTAL	**1,024**	**1,535**	**6,242**	**8,610**	**37,806**	**1,251**

4.2.1. Interesting forensic case

4.2.1.1. Coincidence in the police database with a genetic profile entered 10 years ago

A sexual assault case in 2010 in Orihuela of a 25 years old woman is received. The case describes that the alleged aggressor was a British citizen that the woman met him hours before, but she could not remember his name well. Among all the samples analyzed, the unique male genetic profile is highlighted from a stain and a cigarette butt. Such a profile is registered in the police database without detecting any coincidence nor compatibility

with any genetic profile previously introduced. However, a year after a "match" is obtained with a mixed genetic profile introduced by the Valencia National Police, without having any information about the alleged aggressor's identity. In July 2020, a "match" is detected in Prüm with the United Kingdom, identifying the alleged aggressor.

4.2.2. Teaching and scientific activity

The members of the Biology Service have continuously participated in some training activities aimed at the implementation and improvement of new methods of analysis in laboratories of different Turkish institutions (Gendarmerie and Institute of Forensic Medicine) and which were developed in the context of the European Project TR 16 IPA JH 03 18 - Forensic Training Towards Advanced Examination Methods.

25th GHEP-ISFG Forensic Genetics Conference. Online. 14-15/12/2020.

26th ANNUAL CODIS Conference. Organized by CODIS Unit, FBI Laboratory, FBI. Online, 7-10/12/2020.

4.2.3. Coordinated/taught training activity

Manuel Crespillo, Ángel Serrano and Àlex Pifarré. Participation in the course CRIMINAL AND HUMANITARIAN DNA DATABASEs within the TWINNING PROJECT TR 16 IPA JH 03 18 FORENSIC TRAININGS TOWARDS ADVANCED EXAMINATION METHODS (act 3.6): on line: 6-10 July 2020.

Manuel Crespillo. Coordination and participation in the course "Mitochondrial DNA analysis in forensic applications" within the AC1/ICRIME project. Online: 30 November-4 December and 7-11 December 2020.

Manuel Crespillo. Coordination and participation in the course "Use of specific software for the analysis of mixtures: use of the LRmixStudio software" within the AC1/ICRIME project. Online: 2 to 15 November 2020.

Manuel Crespillo. Conference entitled "Importance of quality in forensic genetics laboratories" within the Master's Degree in Genetics, Chemistry and Toxicology. Rovira i Virgili University. 4th October 2020.

Coordination of the meeting of the DNA Working Group of the Network of Official Forensic Laboratories of Spain (RLFOE). Organized by the National Directorate of INTCF, telematics. The paper "Biology Service INTCF-MADRID, Approach to borderline profiles" was presented. 09/11/2020.

Manuel Crespillo. Lecture entitled "Validation of methods in Forensic Sciences", programmed as part of the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online, from 28 September to 1 October 2020.

Manuel Crespillo. Lecture entitled “Informative introduction to the scientific expert activity of the different INTCF Services”, programmed as part of the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online, from 16 to 18 November 2020.

Manuel Crespillo. Coordination and participation in the CEJ course on “Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics”, scheduled within the Continuing Education Plan of the Centre for Legal Studies (CEJ). Online, from 23 to 27 November 2020.

Manuel Crespillo. Presentation at the GCLAITH meeting: Latin American Scientific Working Group on Human Identification. Organized by Promega, at the International Symposium on Human Identification ISHI31, entitled “La Comisión Nacional para el uso forense del ADN (CNUFADN): una herramienta de coordinación y estandarización entre los laboratorios de genética forense españoles”. Online, 17-18/09/2020.

Manuel Crespillo. Conference entitled “National databases of genetic profiles and the importance of accreditation of forensic genetics laboratories” at the invitation of the national registry of genetic data linked to sexual integrity, belonging to the Department of Justice and Human Rights of the Argentine Republic. Online. 30 October 2021.

Àlex Pifarré. Session entitled “Applications of Genetics in the field of Justice” within the Master’s Degree in Criminal Law and Criminal Sciences, Faculty of Law, Universitat Pompeu Fabra, Barcelona. Online. 19/03/2020.

Training Action on “Study of the methodology of comprehensive forensic assessment in gender violence”, scheduled within the Continuing Education Plan of the Centre for Legal Studies (CEJ), CEJ-Madrid, from 5 to 6 March 2020.

Training on “Investigation of homicides, multidisciplinary approach”, programmed within the Continuing Education Plan of the Centre for Legal Studies (CEJ). CEJ-Madrid, from 9 to 10 March 2020.

4.3. Seville Department Biology Service

Concerning the expert activity of the Seville Department Biology Service, during 2020 they received 1,357 requests with 5,363 evidences and analyzed 7,573 samples through a total of 30,000 analyses, emitting a total of 924 expert reports.

As it can be seen in Figure 4.3.1, the predominant analysis request corresponds to the investigation of **sexual assault cases** (730 requests with 2,913 evidences received), realizing a biological and genetic study of semen or other biological remains, as well as DNA profile obtention of the reference samples implied in the process (defendants, victims…).

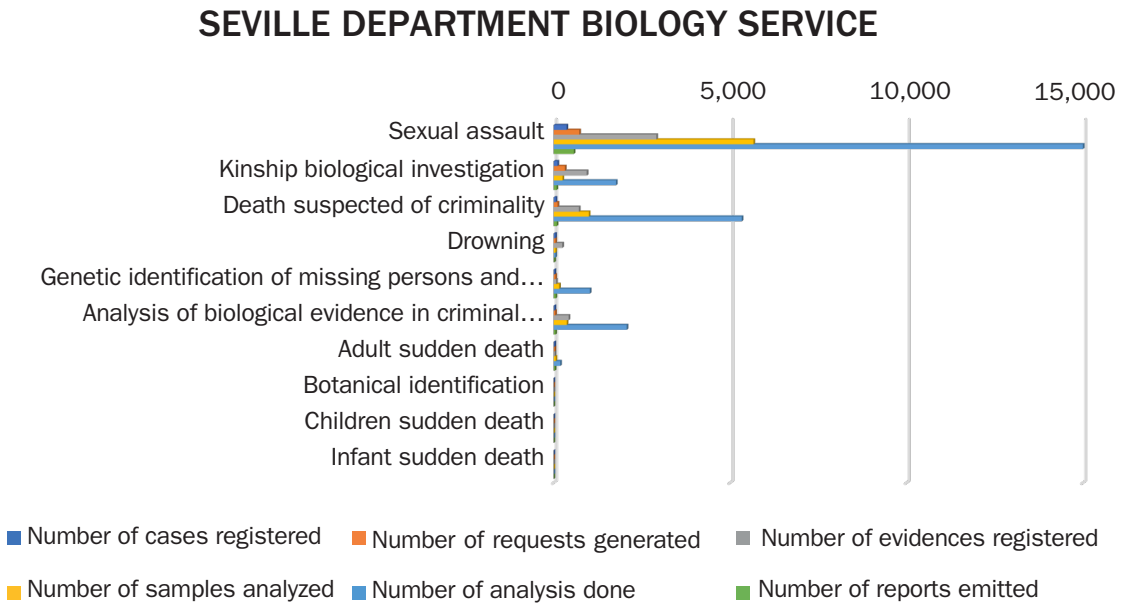
The second most numerous group of analysis corresponds to **kinship biological studies** (323 requests with 939 evidences received), followed by an **analysis of biological evidence of criminal interest** (115 requests with 722 evidences received), and the **genetic**

identification of missing persons and corpse remains (54 requests with 75 evidences received).

Also, it is important to highlight the **biological investigation of drowning deaths** (55 requests with 249 evidences received) and the **sudden adult deaths** (31 requests with 33 evidences received).

The facultative staff of the Service has participated in complementary activities to the resolution of court cases and in the publication of various scientific and educational publications. This has been done in courses organized by the Centre for Legal Studies or in Degrees and Masters of the Universidad Pablo de Olavide, among others.

Figure 4.3.1. Casework of the Biology Service of the Department of Seville during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Sexual assault	370	730	2,913	5,666	19,549	573
Kinship biological investigation	113	323	939	254	1,769	86
Death suspected of criminality	66	115	722	1,001	5,332	91
Drowning	52	55	249	54	54	23
Genetic identification of missing persons and corpse remains	31	54	75	160	1,028	61

Type of report (cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Analysis of biological evidence in criminal investigation	30	48	427	374	2,073	53
Adult sudden death	29	31	33	62	189	35
Botanical identification	1	0	4	0	0	0
Children sudden death	1	1	1	1	3	1
Infant sudden death	0	0	0	1	3	1
TOTAL	**693**	**1,357**	**5,363**	**7,573**	**30,000**	**924**

4.3.1. Interesting forensic case

4.3.1.1. A homicide case and the concurrence effect of the non-criminal biological remains at the crime scene

Background

On 23 March 2020, at the height of the pandemic and with almost the entire Spanish population confined except for the essential services, the lifeless body of a 28-year-old immigrant woman with obvious signs of violence was found in Las Madres, settlement in Moguer (Huelva). The surrounding neighbors informed the security forces of the commission of the crime and, from the first moment, provided data that were outlining the subsequent investigation. Although the facts happened in a relatively small stay, the collection of biological evidence of possible forensic interest were very productive, because of the practice of prostitution in this enclave, the numerous bayonet wounds inflicted on the victim, and the manipulation of her properties that dispersed the rest of the blood by all the stay. Robbery was determined as the motive for the crime.

Evidences

The ocular inspection recorded loads of samples with blood traces (collected from the floor, walls, furniture, and clothes). It also recorded an unusual amount of evidences with traces of semen. There were 26 used condoms and condom wrappers, 27 cleaning wipes with seminal remains, garments of clothing, and other personal belongings with semen stains. The number of biological remains concentrated in a small room was a great background noise when it came to elucidating what remains of interest in the case under investigation. In addition, 21 reference samples were sent for discard. The analyses were urgently requested due to the seriousness of the events. It was a challenge given the circumstances in which the laboratory was at that time.

Results and conclusions

The study started with the samples that would be most relevant in a homicide case. The weapon was allegedly used. Some figurative blood stains (palm prints) were found on the canopy-mosquito net surrounding the victim's bed. The extreme violence with which the victim was stabbed produced the knife blade break. According to the forensic study, the different routes and depth of the stabbing would indicate that the aggressor would have continued to stab the victim with the broken blade. It is a theory supported by male biological remains at the broken end of the blade. It coincided with the one detected in the figurative spots of the mosquito net. Once the samples of reference and discarded genetic profiles that were identified were analyzed, the biological remains of 18 unknown men at the crime scene were reported. A neighbour who, not knowing its origin, bought the victim's mobile phone from the alleged perpetrator and offered a detailed description of it to the investigators was one of the first to be discarded from the scene. The aggressor staged an epic escape by hiding in other Huelva settlements close to Las Madres and committing a new attack. In this second attempted murder case, he was stabbed with several severe injuries. He managed to survive the attack on a neighbour from another settlement. The data provided by the new victim with the description of the buyer of the mobile outlined a complete portrait of the aggressor that led to his arrest in Seville two months later. Once his genetic profile was obtained, the coincidence with the biological remains found on the knife, the mosquito net, and a jacket at the scene was confirmed.

Figure 4.3.1.1.1. Bloodstains on mosquito net and murder weapon

Final considerations

The judicial consent was obtained to register the genetic profiles obtained in the investigation in the DNA Database by sending the corresponding forms to the competent court as it is usual in the INTCF procedure. Once the facts had been elucidated by collecting all the data of the investigation, it was established that there were no other collaborators in the crime. Therefore, there is a lack of connection of the rest of the genetic profiles obtained at the crime scene with the investigated facts. The record is rescinded to the pertinent homicide and robbery profiles.

4.3.2. Teaching and scientific activity

4.3.2.2. Scientific publications

Cláudia Gomes, Gerard Remolins, Ana María López-Parra, Juan F. Gibajad, Maria Fondevila, Flavio De Angelis, Virginia Veltre, M. Eulàlia Subirà, Carlos Baeza-Richer. Paleogenetic evidence of a Pyrenean Neolithic family: Kinship, physical appearance and biogeography multidisciplinary analysis. October 2020. *Journal of Archaeological Science*. DOI: 10.1016/j.jas.2020.105226

Cláudia Gomes, José David Quintero-Brito, Jesús Martínez-Gómez, Rui Pereira, Carlos Baeza-Richer. Spanish allele and haplotype database for 32 X-chromosome Insertion-Deletion polymorphisms. February 2020. *Forensic Science International: Genetics* 46(2):102262. DOI: 10.1016/j.fsigen.2020.102262

4.3.2.3. Education and teaching activities

Baeza Richer, Carlos. Lecture Statistical interpretation of DNA data in paternity and criminalistics. Subject: Information Processing. Scientific Police University Centre of the Guardia Civil (attached to the Carlos III University).

López Soto, Manuel. Associate Professor of the Department of Molecular Biology and Biochemical Engineering (Area of Genetics) of the Pablo de Olavide University. Course 2019-2020 and 2020-2021 with teaching in the Double Degree in Law and Criminology, in the Degree in Criminology and in the Master's Degree in Criminology and Forensic Sciences.

López Soto, Manuel. Lecture "The Intervention of the Institute of Toxicology and Forensic Sciences in the Investigation of Homicides. The Biology Laboratory in Homicide Investigation". Course "Homicide Investigation. Multidisciplinary Approach". Centre for Legal Studies. 9-10 March 2020. Madrid

Prieto Ruiz-Canela, MV. Lecture "Types of studies and samples in the Forensic Biology Laboratory" as part of the Master's Degree in Criminology and Forensic Sciences at the Pablo de Olavide University in Seville. 2 March 2020.

Pardo Arias, Beatriz; Hilillo Maestre, María del Mar, Baeza Richer, Carlos; Plata Alcántara, Ana. Attendance at the course "Homicide Investigation. Multidisciplinary Approach, organized by the Centre for Legal Studies on 9-10 March 2020. Madrid. 10 teaching hours.

Pardo Arias, Beatriz; Hilillo Maestre, María del Mar. Attendance at the course "Study of the methodology in integral forensic valuation in gender violence", organized by CEJ within the program Continuous Training, on 5 and 6 March 2020. Madrid. 10 teaching hours.

Hilillo Maestre, María del Mar; Capilla San Martín, Javier; López Soto, Manuel. Attendance at the course "Multidisciplinary forensic studies of deaths by drowning", organized by the Centre for Legal Studies on 03-05 November 2020.

Hilillo Maestre, María del Mar. Attendance at the course "Multidisciplinary investigation of sexual aggressions in forensic laboratories", organized by the Centre for Legal Studies on 10-13 November 2020.

Hilillo Maestre, María del Mar. Attendance at the course "Forensic studies of injury agents and their effects on soft parts and bones", organized by the Centre for Legal Studies on 1-3 December 2020.

Hilillo Maestre, María del Mar; Flores García, Inmaculada; Capilla San Martín, Javier; Luque Gutiérrez, Juan Antonio; López Soto, Manuel. Attendance at the course "Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics", organized by the Centre of Legal Studies on 23-27 November 2020.

Flores García, Inmaculada. Attendance at the course "Attention to minor victims in IML and CF", organized by the Centre for Legal Studies on 2-3 March 2020.

Domínguez Rodríguez, África. Attendance at the course "Informative introduction to the scientific-pericial activity of the different services of the INTCF", organized by the Centre for Legal Studies on 16-18 November 2020.

Luque Gutiérrez, Juan Antonio. Attendance at the course "The Y Chromosome in the Forensic and Kinship Laboratory: Sexing, Profiling, and Matching Male DNA", organized by Promega on 21 April 2020 (1.5h).

Luque Gutiérrez, Juan Antonio. Lecture: "Fundamentals to use the software Familias" within the course "Herramientas bioinformáticas para la valoración de los cocientes de verosimilitud (LR) en genética forense", organized by the Centre for Legal Studies (1h) 25/11/2020.

Luque Gutiérrez, Juan Antonio. Lecture: "Practical workshop on the software Familias and presentation of practical cases", within the course "Bioinformatics Tools for the Evaluation of Likelihood Ratios (LR) in Forensic Genetics", organized by the Centre for Legal Studies (1h). 25/11/2020.

Luque Gutiérrez, Juan Antonio. Virtual 6th annual HIDS. 24-25 June 2020. Thermo Fisher. Online.

Luque Gutiérrez, Juan Antonio. 26th ANNUAL CODIS CONFERENCE. Organized by CODIS Unit, FBI Laboratory, FBI. Online 7-10/12/2020.

Luque Gutiérrez, Juan Antonio. XXV GHEP-ISFG Forensic Genetics Conference. On line meeting. 14-15/12/2020.

4.4. La Laguna Biology Section

Concerning the expert activity from La Laguna Biology Section, during 2020 they received 521 requests with 2,294 evidences registered and 2,521 samples were analyzed through 8,002 analyses, emitting a total of 298 expert reports.

It is crucial to highlight that during 2020 the Delegation observed an increase compared to the previous year in the number of issues, despite the COVID-19 epidemiological situation in our country. The data supposes an increase of 27.07 % in the number of requests received compared to 2019 (410 requests received).

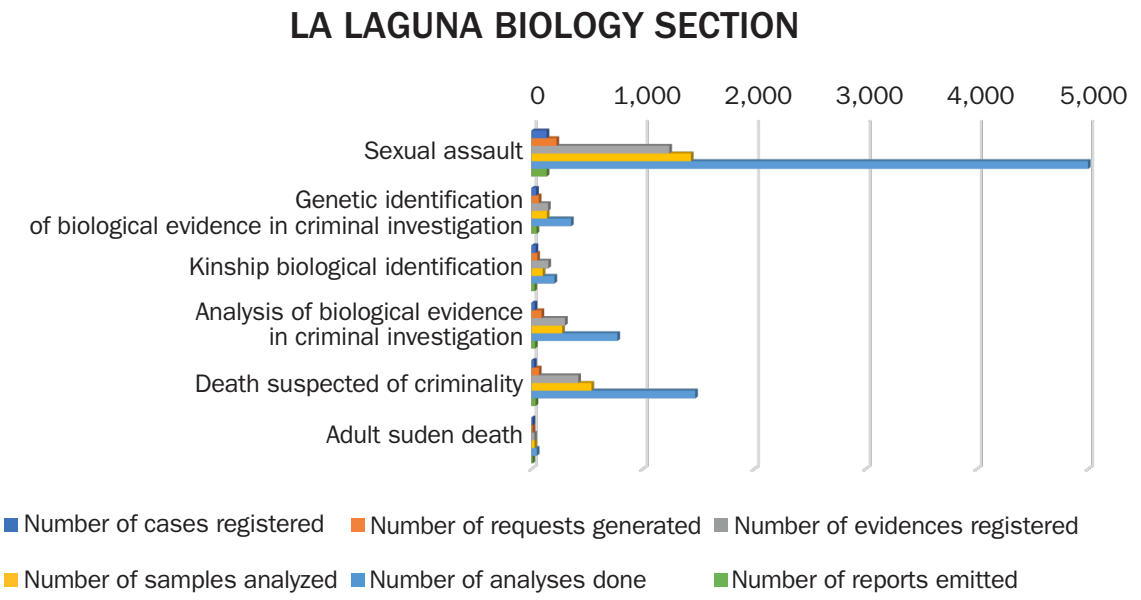
As can be seen in Figure 4.4.1, the predominant analysis request corresponds to the investigation of **sexual assault cases** (226 requests with 1,239 evidences), making a biological and genetic study of semen or other biological incidences as well as the DNA profile obtention from samples of the persons implied in the procedure (defendants, victims, etcetera).

Inside the **genetic analyses**, the second most numerous group of analysis requests corresponds to the **analysis of biological evidence of criminal interests in live subjects** (92 requests with 302 evidences received), followed by an **investigation of deaths suspected of criminality** (69 requests with 422 evidences received), **the genetic identification of missing persons and cadaveric remains** (68 requests with 150 evidences received), and the **kinship biological studies** (54 requests with 153 evidences received).

We must highlight the **adult sudden death** with biochemical analyses (12 requests with 28 evidences received).

These data suppose an increase of 88.88 % in the number of requests about the genetic identification of missing persons and cadaveric remains compared to 2019 (36 requests received in 2019). The reason is that 2020 was the second year of most immigrants coming in small boats or canoes in the Canary Islands from history. The islands received 23,023 irregular migrants by sea, an average of 63 diaries (source: Ministry of the Interior and the Government Delegation).

Figure 4.4.1. Casework of the La Laguna Biology Section during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Sexual assault	137	226	1,239	1,433	5,142	138
Genetic identification of biological evidence in criminal investigation	43	68	150	140	357	47
Kinship biological investigation	39	54	153	102	208	29
Analyses of biological evidence in criminal investigation	31	92	302	277	773	34
Death suspected of criminality	26	69	422	540	1,472	39
Adult sudden death (*)	12	12	28	29	50	11
TOTAL	**288**	**521**	**2,294**	**2,521**	**8,002**	**298**
(*) Biochemical analyses						

4.4.1. Interesting forensic case

4.4.1.1. Identification of biological evidence in the investigation of a theft with violence committed at a bank branch

Coming from the Civil Guard of Puerto de la Cruz (Command of Santa Cruz de Tenerife), samples taken in the ocular technical inspection of different areas of a bank branch are

received in this Delegation of La Laguna of the INTCF on the occasion of the investigation of robbery with violence. In addition, samples taken at the address of an individual are received. A total of 40 evidences were received. They search for biological remains probably left on the surfaces manipulated by the perpetrators of the events.

Due to the development of the investigation, the reference samples of two victims are also received for disposal, who usually carry out their work in the bank office. As well as the reference samples of four investigated as alleged perpetrators of the events.

From the samples sent, the obtention of doubted genetic profiles that may exist are requested, and the comparison with the reference samples of the people received for discard and those investigated.

After having carried out the analysis of 63 unknown samples between evidence and clothing clippings, the results were collected in two reports issued to court with a copy to the Guardia Civil, after having carried out the analysis of 63 unknown samples between evidence and clothing clippings. In them, the coincidences obtained with two of those investigated are reported. In two of the latex gloves analyzed, unique DNA profiles were obtained that matched their reference samples. Likewise, a compatible genetic profile was obtained with a mixture of DNA from at least four people. All the alleles of the two investigated mentioned above were observed.

Once the pertinent studies were completed, at the direct request of the Guardia Civil, the reference genetic profiles of those investigated were registered in the National Database of DNA Profiles of criminal interest. However, after the search, it was observed that the profiles of those investigated were duplicated in the registration by another laboratory of the State Security Forces.

4.4.2. Teaching and scientific activities

4.4.2.1. Participation in investigation projects

Collaboration agreement with the Canary Islands Institute of Bioanthropology, of the Autonomous Body of Museums and Centres of the Island Council of Tenerife, in the field of research and teaching.

4.4.2.2. Contribution in scientific congresses

Attendance at the online course on validation of methods in forensic sciences, scheduled within the Continuing Education Plan of the Centre of Legal Studies (CEJ), held from 28 September 2020 to 1 October 2020.

Attendance at the online course on bioinformatics tools for the assessment of the likelihood ratios (LR) in forensic genetics, programmed as part of the Continuing Education Plan of the Centre for Legal Studies, held from 23 to 27 November 2020.

26th ANNUAL CODIS Conference. Organized by CODIS Unit, FBI Laboratory, FBI. Online, held from 7 to 10 December 2020.

25th GHEP-ISFG Forensic Genetics Conference. Online. 14-15 December 2020.

4.5. The INTCF DNA DATABASES

In 2020 a total of **653 genetic profiles** were identified in different DNA files of the INTCF. In cases of criminal investigation and identification of disappeared, they signed up a total of **622 DNA profiles**. Registered as well in the national DNA database managed by the State Secretariat for Security from the Ministry of Interior. In the case of genetic profiles obtained about Irregular Adoptions and Newborn Subtractions cases, files managed by the Ministry of Justice were a total of **31 DNA profiles**.

In the present report, we analyze the results obtained in the different DNA databases of the INTCF during 2020.

4.5.1. Criminal investigation and identification of disappeared

In 2020, the INTCF (Order JUS/2267/2010, 30 July) is the institution responsible for the two DNA profile files:

- The INTCF-ADNIC file (Criminal Investigation), whose purpose is the genetic comparison of biological traces of unknown origin with each other and with reference samples of individuals investigated in a criminal procedure, to identify coincidences between the DNA profiles, and to provide information in the investigation of offenses without a known perpetrator.
- The INTCF-ADNID file (missing personal investigation), to identify the genetic of disappeared persons and corpses without identification in court proceeding through the comparison of genetic profiles obtained from an unknown human with the DNA profiles obtained from the family samples or of DNA profiles obtained from ante-mortem samples of the missing persons.

Such DNA profiles are compared systematically using the software CODIS (Combined DNA Index System) of the Federal Bureau of Investigation, Dept. of Justice, EEUU). In the local node of the Department of Justice and in the national node of the DNA database managed by the Secretary of State for Security of the Interior Department by the provisions to ORGANIC LAW 10/2007, of 8 October, regulating the police database about DNA based-identifiers. Also, the DNA profiles registered at the national node are regularly compared against the DNA databases of 23 European nations by the Prüm treaty (Instrument of ratification by Spain of the Convention on the stepping up of cross-border cooperation,

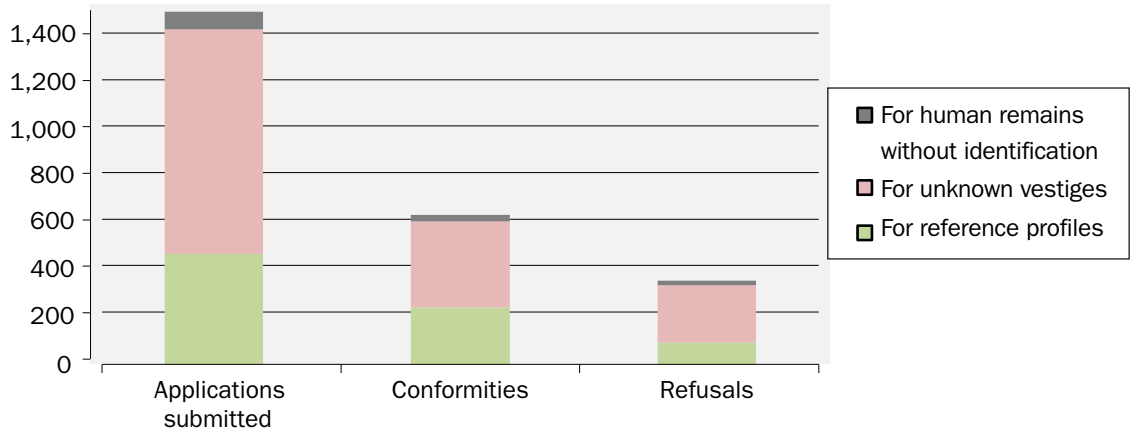
particularly in combating terrorism, cross-border crime, and illegal immigration, done at Prüm the 27 May 2005).

In 2020, a total of **1,469** requests about judicial pronouncements for the genetic profile registers in the DNA databases were sent from the INTCF to court offices (**935** [64%] requests to the register of unknown genetic profiles, **461** [31%] to reference genetic profiles, and **73** [5%] to genetic profiles of unidentified human remains). It is worth mentioning that in the La Laguna Section the data is only referred to the last two months of the year, as no such requests for court rulings were submitted in the previous months.

During 2020 a judicial pronouncement was received by direct request or to a previous request by this institute for the register of 973 profiles, **624** (64%) of them corresponding to judicial conformities and **349** (36%) to judicial denials. This supposes a descent of 22% in respect to 2019 (probably due to the situation derived from the COVID-19 pandemic), although the compliance/denial ratio remains in line with previous years.

From the aforementioned data, it is clear that, by the different Departments, a follow-up is carried out on the requests sent to obtain a judicial ruling on whether, depending on the current state of the procedure, the type of crime, etc. ., genetic profiles are susceptible to being registered in the DNA database, since, following the pattern of previous years, in more than a third of cases, such registration is ultimately not applicable.

Figure 4.5.1.1. Judicial pronouncements for registration in the DNA database (2020)

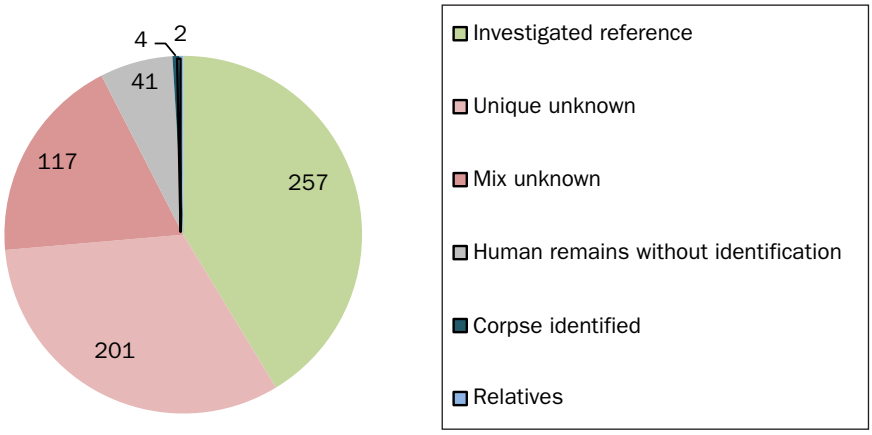


In 2020, there was a register of **622** genetic profiles in the national node of the DNA database from the INTCF, of which **576** profiles (93%) were registered in the INTCF-ADNIC file and **46** profiles (7%) were registered in the INTCF-ADNID file.

In the field of criminal investigation (INTCF-ADNIC file), **318** (55%) unknown DNA profiles were registered (either individual or a mixture of two or three contributors) coming from forensic samples obtained in the crime scene, the body, or clothes from the victim or the condemned, and **257** (45%) DNA reference profiles of persons investigated in a court procedure. The majority of DNA profiles in the file correspond to investigations of crimes against sexual liberty in adults (**65%**), followed to offenses against minor sexual indemnity (**19%**), to homicides (**9%**), burglaries (**4%**), and the rest (**3%**) to other crimes or matters (gender violence, robbery with violence or intimidation, injuries, and others).

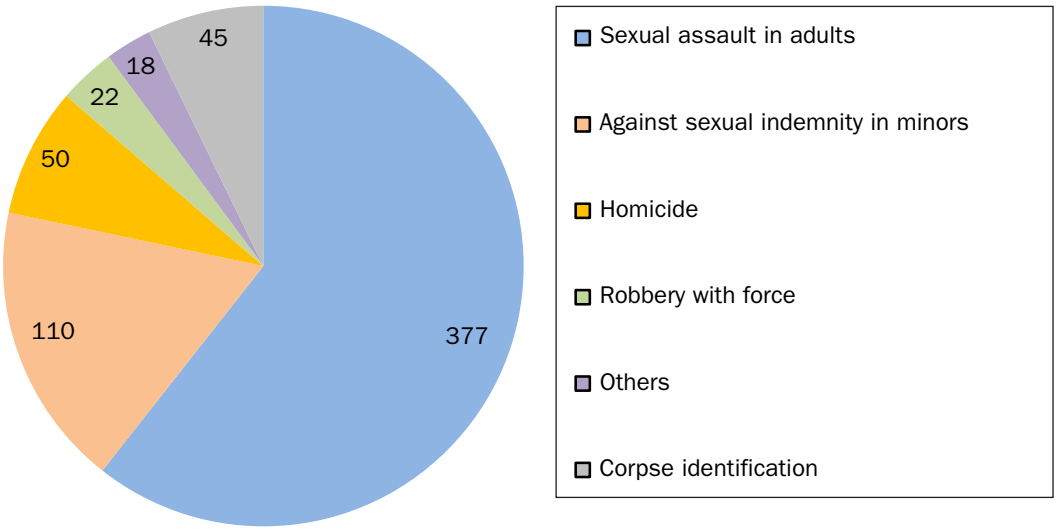
The distribution of DNA profiles registered by the INTCF in the database depending on the type of sample, the number, or the type of coincidence between genetic profiles detected during 2020 are collected in the following figures.

Figure 4.5.1.2. Profiles registered in the INTCF DNA database (2020)



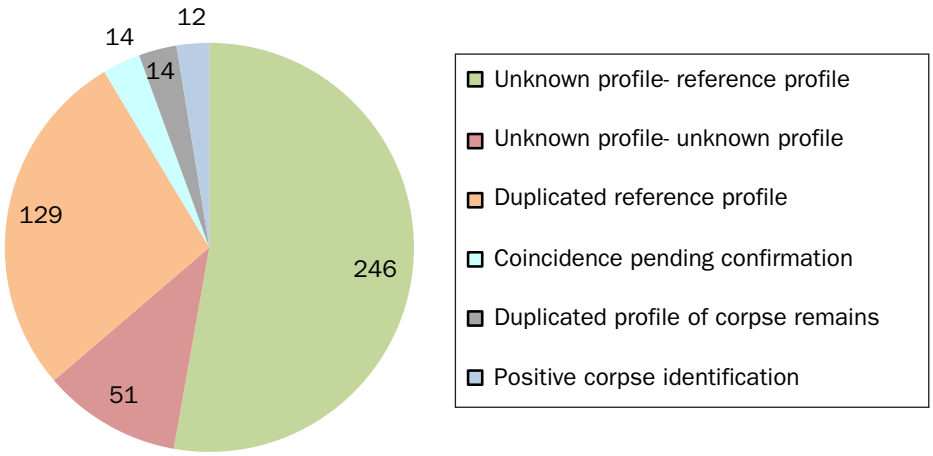
Concerning the number of genetic profile matches detected during 2020 (**466**), we have to highlight that in the criminal investigation field they have registered **430** matches, of which **246** (57%) have been among reference profiles of an investigated person and a unknown sample, which has contributed in the resolution of numerous judicial investigations, and **51** correspond to profile matches among unknown profile matches with each other. They have seen **129** matches (30% of the total) among DNA undoubted reference profiles of the same investigated or condemned due to duplications of the same person in the national database, having been registered by other institutions in addition to the INTCF, either for the same or for a different judicial case.

Figure 4.5.1.3. No. of profiles registered in the INTCF-ADNIC by type of case (2020)



On the other hand, the number of compatibilities detected in 2020 in the field of investigation of missing persons that have helped in corpse identification investigation has been **12**. In this area, it should be noted that 39% of the matches detected (14 of 36) correspond to duplicate profiles from unidentified corpses that have been analyzed by another institution in addition to the INTCF.

Figure 4.5.1.4. No. of matches detected in the DNA database (2020)



4.5.2. Irregular adoptions and newborn abductions

The Order JUS/2146/2012, 1 October established to create the file "DNA profiles from people affected by the newborn abductions" managed by the INTCF to identify possible kinship genetic relations between persons affected by the possible newborn abductions always with their consent.

The file intends to avoid the current dispersion of all the DNA data through the genetic profile centralization (both the generated in private laboratories and the generated in the INTCF in the course of the investigations ordered by magistrates and judges) in a single DNA database to ensure that all cross-referencing between family members of the different indexes is performed and to ensure the highest degree of success in the search.

They included in 2020 **31 DNA profiles** in the register of "DNA profiling of persons affected by the newborn abduction" (obtained by the diverse private DNA laboratories) that come from requests of affected people through the **Information Office for Persons Affected by the Possible Abduction of Newborns**.

The total number of DNA profiles present in that file at the end of 2020 was **621**, with the following distribution according to the type of family member:

FAMILIAR	No. of profiles	%
Biological mothers searching for their children	399	72.3
Biological fathers searching for their children	50	
Sisters that search their biological brothers/sisters	42	11.9
Brothers that search their biological brothers/sisters	32	
Adopted daughters that search for their biological parents	65	15.6
Adopted children that search for their biological parents	32	
Others	1	0.2
Total	**621**	**100**

In the searches carried out during 2020 in this file, all the possible compatibility detected (with none, one or even two genetic inconsistencies) between biological parents who are looking for children and adoptive children who are looking for their Biological parents, as well as between siblings looking for their biological siblings, turned out to be fortuitous matches after joint evaluation of all the available data.

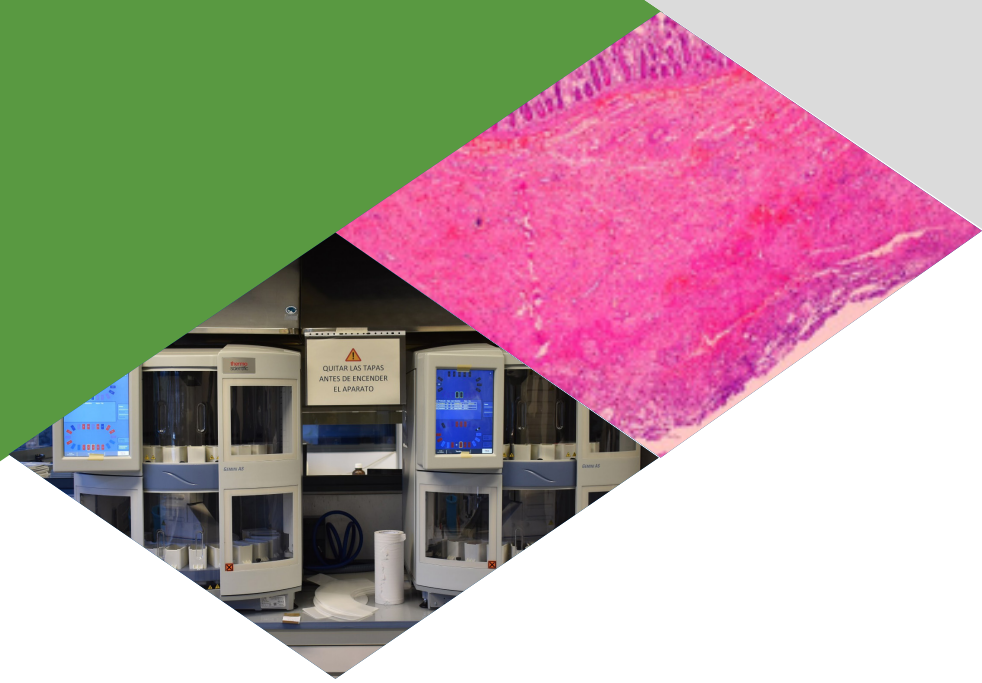
The degree of success in the parentage relation identifications between the affected registered in this DNA file managed by the INTCF will be determined primarily by the degree of involvement of those concerned in this project and only be guaranteed if they consent to the recording of their DNA profile.

REPORT CODIS 2020

		INTCF Department				TOTAL INTCF
		Madrid	Barcelona	Seville	La Laguna	
Requests of judicial pronouncement to register in CODIS remitted in 2020						
	For reference profiless	236	173	42	10	**461**
	For unknown vestiges	368	429	130	8	**935**
	For human remains profiles without identification	26	17	19	11	**73**
	For relative reference profiles	0	0	0	0	**0**
	Total requests sent	**630**	**619**	**191**	**29** *	**1469**
Judicial pronouncement about the register in CODIS received in 2020						
Compliance (expressed or by omission in unknown profiles)	Reference profiles	165	42	27	3	**237**
	Unknown profiles	147	149	57	5	**358**
	Human remains without identification	11	3	14	1	**29**
	Relatives	0	0	0	0	**0**
	Total approvals	323	194	98	9 *	**624**
Refusal (expressly or by dismissal because the offence is not substantiated)	Reference profiles	65	16	10	0	**91**
	Unknown profiles	154	45	41	0	**240**
	Human remains without identification	14	1	3	0	**18**
	Relatives	0	0	0	0	**0**
	Total refusals	**233**	**62**	**54**	**0** *	**349**
Profiles registered in CODIS in 2020						
By profile type	Unique unknown	89	63	27	22	**201**
	Unknown mixture	54	32	26	5	**117**
	Corpse identified	4	0	0	0	**4**
	Reference of condemned	167	48	26	16	**257**
	Human remains without identification	17	9	12	3	**41**
	Relatives	1	0	0	1	**2**
	Total registered profiles	**332**	**152**	**91**	**47**	**622**
By case type	Sexual assault	189	104	58	26	377
	Against the sexual indemnity of minors	75	20	12	3	**110**
	Gender violence	6	0	2	0	**8**
	Homicide	32	9	5	4	**50**
	Robbery with force	7	9	0	6	**22**
	Robbery with intimidationn	0	1	0	2	**3**
	Injuries	0	0	0	2	**2**
	Corpse identification	20	9	12	4	**45**
	Against public health	0	0	0	0	**0**
	Terrorism	0	0	0	0	**0**
	Others	3	0	2	0	**5**
	Total profiles registered	**332**	**152**	**91**	**47**	**622**
Coincidences detected in CODIS in 2020						
	Unknown profile-unknown profile	23	16	9	3	**51**
	Unknown profile-reference profile	110	79	38	19	**246**
	Duplicated reference profile	83	26	13	7	**129**
	Coincidence pending confirmationn	8	4	2	0	**14**
	Duplicated profile of cadaveric remains	1	3	9	1	**14**
	Positive cadaveric identification	6	0	2	4	**12**
	Total coincidences detected	**231**	**128**	**73**	**34**	**466**

* Data correspondent to November and December 2020, as no applications were submitted in previous months.

5. Histopathology Services



Each INTCF Department has a Histopathology Service (Barcelona, Madrid, and Seville), existing a Histopathology Section in the Delegation of La Laguna.

The Histopathology Services complies with their entrusted function, performs expert activities analyzing the samples coming from the Legal Medicine and Forensic Sciences Institutes (IMLCF), and apportions diagnostic elements to solve problems that arise during the judicial investigation. Inherent to its nature, they serve as a reference centre in its matter, sharing experience and knowledge, forming and developing teaching and investigative functions of public interest.

The developed histopathological studies to carry out the expert activity start with the samples register remitted by the IMLCF, which are reviewed, macroscopically studied, photographed and carved. The subsamples obtained are subjected to automated processing by paraffin embedding and / or frozen sections. with cryostat when required. Routine staining techniques, basic histochemical and immunohistochemical techniques, cytocentrifugation in the case of biological fluids, microscopy, and photomicroscopy are used. The electrolysis technique is realized to dissolve metallic elements in hearts with stents implanted in coronary arteries (Madrid Dept.). The correspondent report is emitted and submitted in writing. The principal facts of the case are detailed (investigation objectives), including the type of report, a summary of the information received (according to sample referral form), the study techniques done and their results, comprising macroscopic and microscopic aspects of the samples. Last but not least, the enumeration of the histopathological studies and the conclusion related to the information received. The reports are remitted to court and the Legal Medicine Institutes with an indication of the estimated custody time, depending on the nature of the case, before its destruction.

Within its expert work, the following types of investigation are included:

- *Sudden and unexpected death*
- *Sudden death associated with the sport*
- *Infant sudden death*
- *Perinatal death*
- *Violent newborn death*
- *Pregnancy-abortion diagnosis*
- *Death associated with anaphylaxis*
- *Death investigation due to alleged medical malpractice-iatrogenesis*
- *Traumatisms*
- *Vitality and data study*
- *Asphyxia (hanging, strangulation, confinement, suffocation)*
- *Intoxication death*

- *Death associated with alcohol or drugs*
- *Deaths due to physical agents: freezing, hypothermia, heat burns, heatstroke, electricity, radiation*
- *Death in fires*
- *Deaths at institutions*
- *Other histopathological studies*
- *Cytological study of liquids*

The expert report principal objective is to collaborate in the determination of the death cause and to subminister histomorphological relevant data for the investigation, such as:

- The post-mortem character of injuries means if the subject was alive when the injury or pathology was produced.
- It is of interest to date the time elapsed between the occurrence of an injury and the death of the person. Differentiate between injuries of different dates.
- Diagnose the existence of any disease that can precede or favour a traumatic or violent death (for example a cardiac pathology in traffic accidents or workplace accidents).
- The investigation into the deaths in which a medical malpractice claim has been filed.
- In addition to their expert work, the facultative staff of the Histopathology Departments carry out a research work reflected in scientific publications and the participation of forensic congresses and other medical national and international specialties.
- Teaching activity carried out in collaboration with the Legal Medicine and Forensic Sciences Institutes, various Universities, and the Centre for Legal Studies.

The INTCF Histopathology Services registered during 2020 a total of 3,850 forensic matters and a total of 12,177 evidences for their analysis, emitting 3,926 expert reports after the analyses of 14,505 samples with 14,670 analyses carried out (Figure 5.1). It supposes an increase of 6.45% in the number of reports emitted in respect to 2019 (3,692 reports emitted). Despite the circumstances in which the work has been carried out, due to the Coronavirus pandemic (SARS-COV-2), it has posed a challenge and increased effort for all departments.

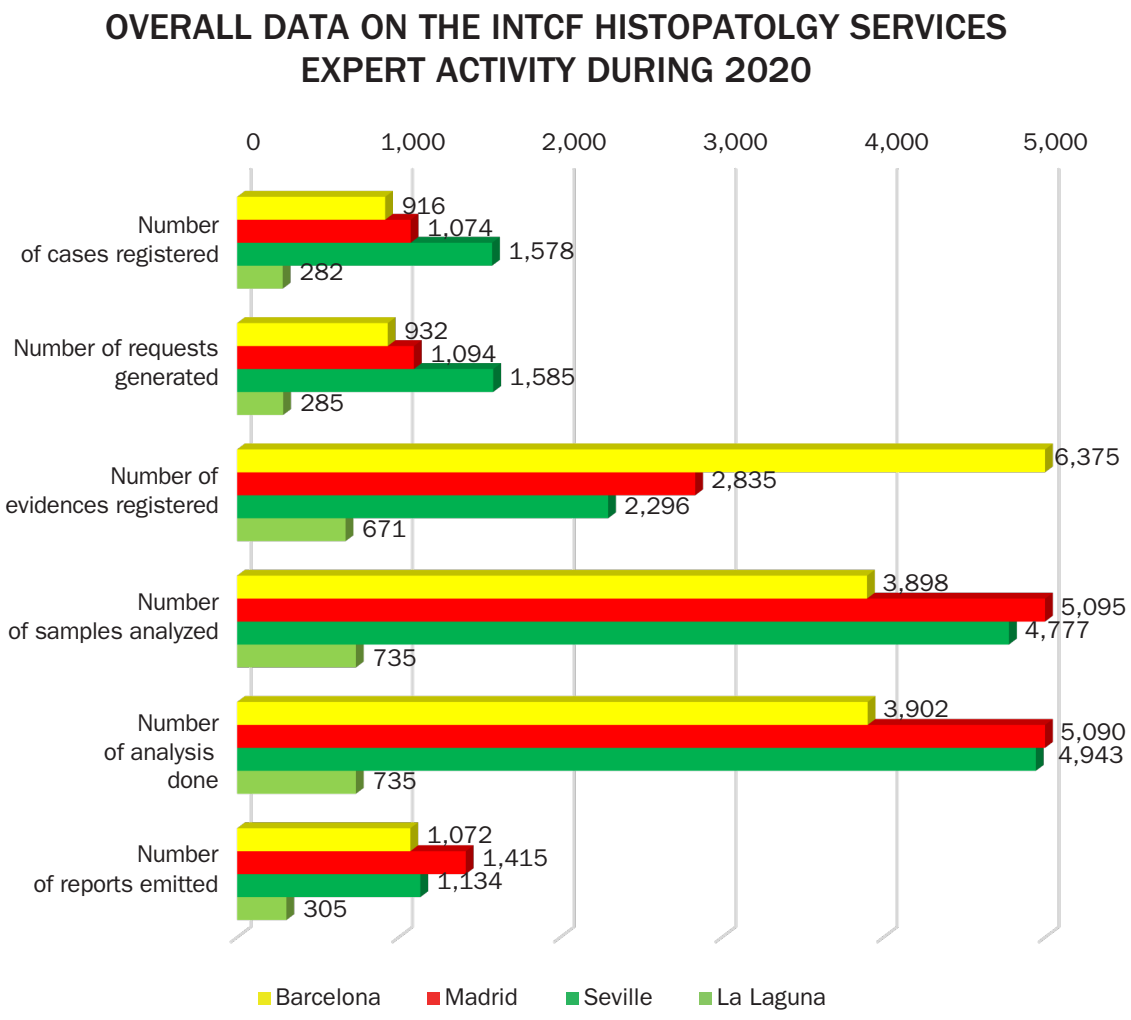
The Histopathology Services staff which have worked in 2020 is shown in the following table.

Table. 5.1. Staff of the Histopathology Services

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA	INTCF-LA LAGUNA
Head of Department	1	1	–	1*
Facultatives	7	4	7	1
Specialist technicians	5	3	6	1
Laboratory assistants	2	5	3	1
Administratives	1	–	1	–

* Facultative who performs the duties of Service Coordinator.

Figure 5.1. Overall data on the INTCF Histopathology Services Expert Activity during 2020



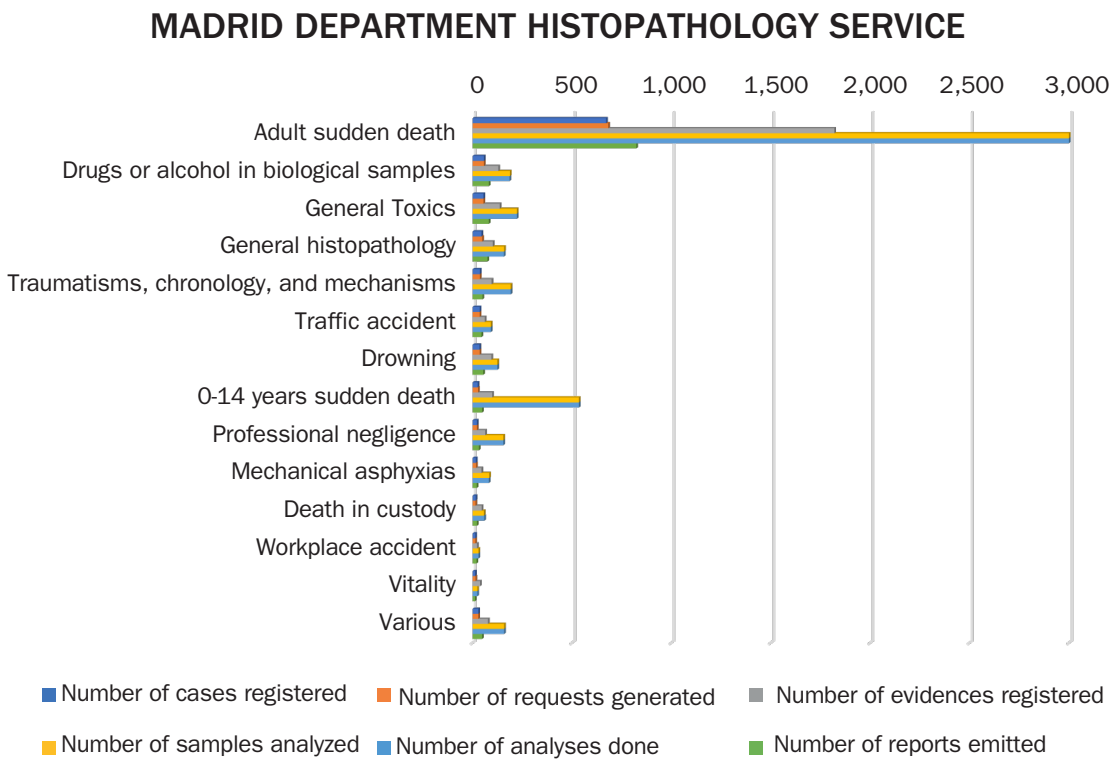
	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Barcelona	916	932	6,375	3,898	3,902	1,072
Madrid	1,074	1,094	2,835	5,095	5,090	1,415
Seville	1,578	1,585	2,296	4,777	4,943	1,134
La Laguna	282	285	671	735	735	305
Total	**3,850**	**3,896**	**12,177**	**14,505**	**14,670**	**3,926**

The expert activity and the teaching activities developed during 2020 are collected from these Histopathology Services from each Department. Each Service includes the description of a forensic case to publicize their expert labour.

5.1. Madrid Department Histopathology Service

The general casework of the service concerning the type of cases in which the histopathological study was requested, the number of samples, the organs analyzed and the emitted reports are reflected in the following figure and the next table.

Figure 5.1.1. Casework of the Histopathology Service of the Madrid Department during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Adult sudden death	672	683	1,820	3,072	3,070	824
Drugs or alcohol in biological samples	57	57	130	188	186	82
General toxics	55	55	137	223	223	82
General histopathology	45	49	102	159	158	75
Traumatisms, chronology, and mechanisms	37	37	96	192	192	50
Traffic accident	36	36	62	92	92	45
Drowning	35	36	95	125	125	54
0-14 years sudden death	26	28	99	535	535	48
Professional negligence	22	22	64	155	155	32
Mechanical asphyxias	17	18	45	84	82	21
Death in custody	16	15	46	57	59	22
Workplace accident	14	14	23	30	30	20
Vitality	13	15	38	24	24	12
Various	29	29	78	159	159	48
TOTAL	**1,074**	**1,094**	**2,835**	**5,095**	**5,090**	**1,415**

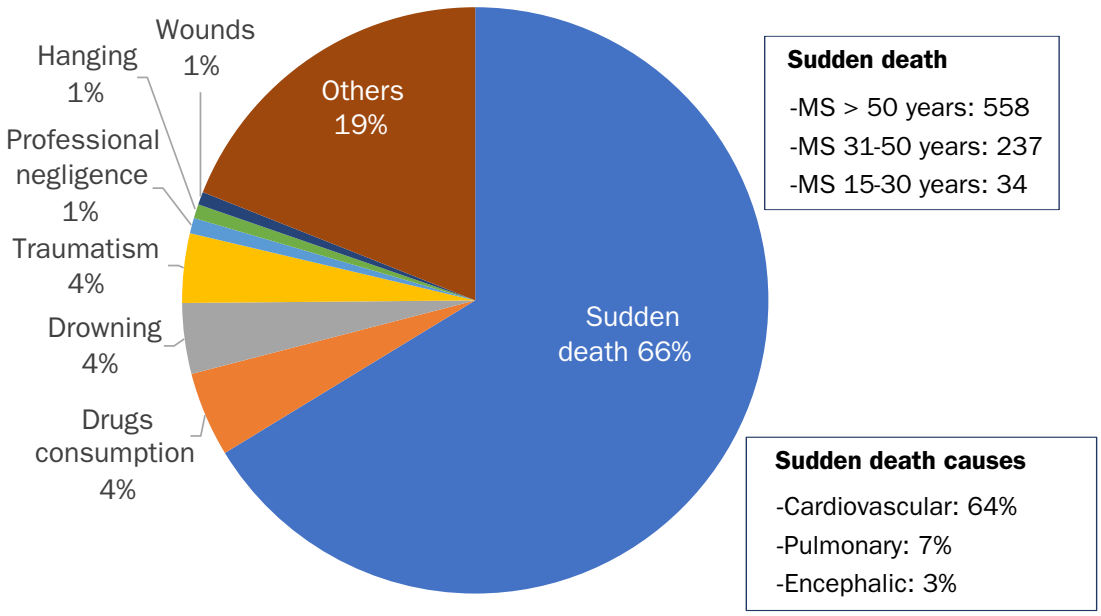
In 2020 the Madrid Histopathology Service emitted **1,415 reports**, more than the year before despite Covid-19. The majority of the studies (66%) were due to **sudden deaths, the** majority in 50 years old, but many occurred to young people, teenagers, and pediatric age (Figure 5.1.2); in 11 deceased were associated with the sports activity. Most of them occurred to men (73%). The most frequent causes were cardiovascular (64%), with deaths due to coronary atheromatous disease (59%) and cardiac hypertrophy (22%). In 115 deceased cardiac findings were suspected of **hereditary cardiomyopathy**. At the request of the families and with the pertinent judicial authorization, blood samples from 22 cases were sent to external laboratories specialized in genetic studies of familial heart disease. The most frequent pulmonary causes were pulmonary embolism and infectious pathology. Inside the encephalic pathology, strokes were the most frequent. In children under one year, the most common were sudden death without findings explaining the death, compatible with sudden **infant death syndrome**.

From the 82 who died due to **drugs of abuse** (demonstrated in the analysis of toxics), the histopathological study found a pathology that could have contributed to death in 44% of cases. Concerning deaths by **drowning** (54 cases), 60% of lungs demonstrated compatible microscopical injuries, and in 6 deceased it was found a cardiac pathology predisposing to death by drowning.

The majority of **traumatisms** were accidental, whether in traffic accidents (22%) or work-place accidents (15%). Eight traumatism cases were homicide. In the deaths related to **traffic or work accidents**, the histopathology study is required on the majority of occasions with the purpose to determine the existence of any previous pathology that could propitiate the accident (**concause**). This investigation was carried out in 38 accidental deaths.

Inside the group of mechanical asphyxia, **hangings** constituted the bigger group with 11 studies. All of them have suicidal etiology. Three of them occurred in penitentiary centres. As it has been commented in the introduction, the determination of the vital or post-mortem character of the injuries is one of the most crucial objectives in histopathological study. It is applicable in deaths by traumatism, asphyxia, but particularly **in the case of knife and firearm injuries**. These investigations were carried out in 9 homicides.

Figure 5.1.2. Reports issued in 2020 by type of death investigated



5.1.1. Interesting forensic case: accidental death by button battery ingestion in a 10 months-old baby

Facts resume: A 10 months-old baby of the female gender accidentally ingests a button battery on 09/10/2020. She was taken to the emergency room. They managed to extract her foreign body through an endoscopy 7 hours later after the ingestion. The extraction was difficult. They observed a burn of 4 cm in length. She was discharged due to her evolution on 19/10/20.

Circumstances of the death: The baby started with respiratory insufficiency and noise the night of 06/11/20 as if she had something inside her throat. The 061 patrol found

the baby girl in cardiorespiratory arrest with blood coming out of her nostrils and oral cavity. As it was a sudden unexpected death, it was the subject of a judicial autopsy.

Autopsy findings: Organs with anemic appearance. Area of necrosis in the middle third of the esophagus measuring 2.4 x 2 cm with fistula to the aortic arch and significant blood in the trachea and bronchi and the stomach (100 ml).

Possible death cause: Hypovolemic shock secondary to aorto-oesophageal fistula.

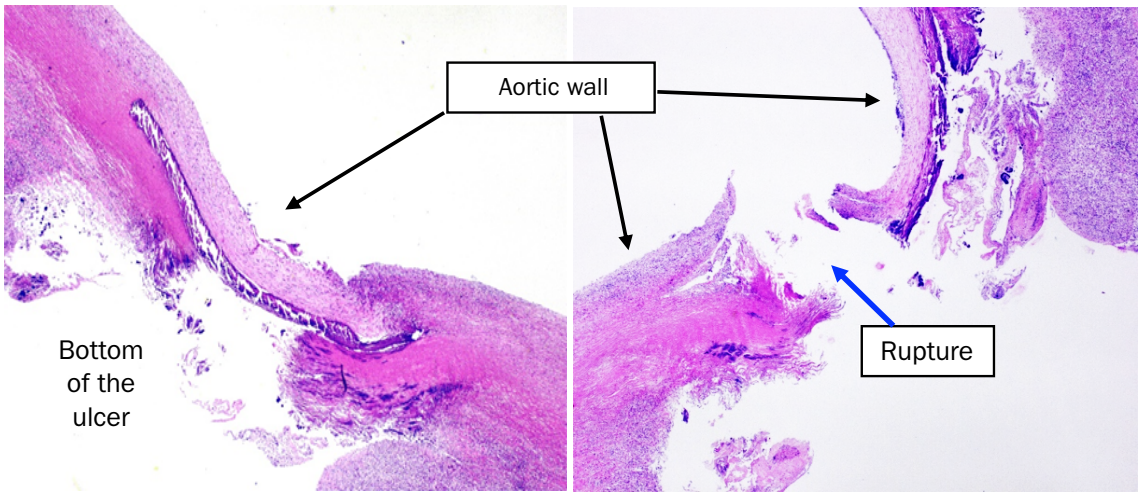
Histopathology study: In the sample of the esophagus and aortic arch fixed in formalin, a 2 x 1.5 cm ulcerated lesion with a communication (fistula) to the aorta was identified. Microscopically, the ulcer involved the entire thickness of the esophageal wall, with only the wall of the aorta with a solution of continuity (rupture) in the area of the fistula being recognizable at the bottom of the ulcer.

Conclusion: Caustic button battery ulcer fistulised to the aorta.

Figure 5.1.1.1. Esophageal ulcer and fistula orifice (arrow)

Figure 5.1.1.2. Fistula between esophagus and aorta

Figure 5.1.1.3. Photomicrographs of the ulcer bed and rupture



5.1.2. Actividad científica y docente

5.1.2.1. Contribution in scientific congresses

Suárez Mier MP. Interactive cases: Sudden avoidable or unavoidable death in familial heart disease. Expert panel. eCongress SEC 2020 Cardiovascular Health. 28-31 October 2020.

5.1.2.2. Scientific publications

Suárez-Mier MP, Hernández-del Rincón JP, Torres-Sánchez C, Sabater-Molina M, Gimeno-Blanes JR. Sudden death in pregnant women due to trophoblastic embolism vs. thyroioditis vs. canalopathy. *Rev Esp Med Legal.* 2020; 46(2):81-84.

Rodriguez Esmores F, Sánchez de León Robles MS, Suárez Mier MP. Sudden death due to delayed rupture of aortic dissection. Boletín Galego de Medicina Legal e Forense. 2020, no. 27 (June).

Bañón-González R, Carnicero-Cáceres S, Suárez-Mier MP, Díaz FJ. Autopsies in suspected cases of SARS-CoV-2. *Rev Esp Med Legal.* 2020; 46(3):93-100. https://doi.org/10.1016/j.reml.2020.05.002

Hall CL, Gurha P, Sabater-Molina M, Asimaki A, Futema M, Lovering RC, Suárez-Mier MP, Aguilera B, Molina P, Zorio E, Coarfa C, Robertson MJ, Cheedipudi SM, Ng KE, Delaney P, Hernández JP, Pastor F, Gimeno JR, McKenna WJ, Marian AJ, Syrris P. RNA sequencing-based cardiac tissue transcriptome profiling implicates novel putative disease mechanisms in FLNC-associated arrhythmogenic cardiomyopathy. *Int J Cardiol.* 2020; 302:124-130. https://doi.org/10.1016/j.ijcard.2019.12.002

Hall CL, Akhtar MM, Sabater-Molina M, Futema M, Asimaki A, Protonotarios A, Dalageorgou C, Pittman AM, Suárez-Mier MP, Aguilera B, Molina P, Zorio E, Hernández JP, Pastor F,

Gimeno JR, Syrris P, McKenna WJ. Filamin C variants are associated with a distinct clinical and immunohistochemical phenotype of arrhythmogenic cardiomyopathy. *Int J Cardiol.* 2020; 307:101-108. https://doi.org/10.1016/j.ijcard.2019.09.048

5.1.2.3. Teaching and scientific activities

Teaching activities

Suárez Mier MP. Associate Professor. University of Alcalá. Faculty of Science. Degree in Criminalistics: Forensic Sciences and Technologies. Subject 2nd four-month period: Histopathology. Course 2019/2020.

López García P. Honorary Professor of Practicum. University of Alcalá. Faculty of Sciences. Degree in Criminalistics: Forensic Sciences and Technologies. Subject 2nd four-month period: Histopathology. Course 2019/2020.

García Pérez JL, Espárrago de Mingo A. Collaborating lecturers. University of Alcalá. Faculty of Sciences. Degree in Criminalistics: Forensic Sciences and Technologies. Subject 2nd four-month period: Histopathology. Course 2019/2020.

Suárez Mier MP, Sánchez de León Robles MS, Chaves Portela S, López Garcia P, García Pérez JL, Espárrago de Mingo A. Trainers in rotations at the Histopathology Service of the INTCF of two Internal Resident Doctors of Pathological Anatomy at the University Hospital of Móstoles (March 2020) and the University Hospital 12 de Octubre (September), respectively.

Sánchez de León Robles MS. "Contributions of histopathological analysis in the study of drowning deaths", within the course: Multidisciplinary forensic studies of drowning deaths. Director: Gloria Vallejo. Continuing Education Plan for 2020 of the Centre for Legal Studies, held online 3-5 November 2020.

Suárez-Mier MP. "The Histopathology Services of the INTCF" in the course: Introduction to the scientific and forensic activity of the different services of the INTCF. Director: Antonio Alonso. Continuing Education Plan for 2020 of the Centre for Legal Studies, held online on 17 November 2020.

Sánchez de León Robles MS. "Contribution of the histopathology service in reports on injury agents", in the course: Forensic studies of injury agents and their effects on soft parts and bones. Director: Margarita Santamaría. Continuing Education Plan for 2020 of the Centre for Legal Studies, held online 1-3 December 2020.

Suárez-Mier MP. "Utility of Forensic Histopathology in violent and suspected criminal deaths". University Master's Degree in Police Sciences. 25 November 2020. University of Alcalá.

Attendance at training activities

García Pérez JL. 43rd Annual Meeting of the Spanish Society of Anatomic Pathology, 6-7 February 2020. Madrid.

García Pérez JL. "Homicide investigation. Multidisciplinary approach". Director-coordinator: Manuel Salguero Villadiego. Continuing Education Plan 2020 of the Centre for Legal Studies, 9-10 March 2020.

Suárez Mier MP. "Online Seminar on University Higher Education". Sessions: 1) Fundaments of Online Education. 2) Efficient Communication: Motivational speaking and Telegenics. 3) Design of Activities and Evaluation: Practical Experiences. 4) Virtual Learning Environments. 5) Online Exams: Final Evaluation. Organized by the International University of La Rioja, 11-12 May 2020.

Chaves Portela S, García Pérez JL, López García P, Espárrago de Mingo A, Suárez Mier MP. "Multidisciplinary forensic studies of death by drowning". Continuing Education Plan 2020 of the Centre for Legal Studies, Online course, 3-5 November 2020.

García Pérez JL and Suárez Mier MP. "Fetal and perinatal autopsy". Organized by the Catalan Society of Pathological Anatomy. Online course. Barcelona, 19 October to 9 November 2020.

Suárez Mier MP, López García P, Chaves Portela S and García Perez JL. "9th Cardiogenetic Workshop". 27 November 2020.

Sánchez de León Robles MS, López García P, Chaves Portela S, Espárrago de Mingo A and García Perez JL. "Informative introduction to the scientific and expert activity of the different Services of the INTCF". Director and coordinator: Mr. Antonio Alonso Alonso. Continuing Education Plan 2020 of the Centre for Legal Studies. Online course, 16-18 November 2020.

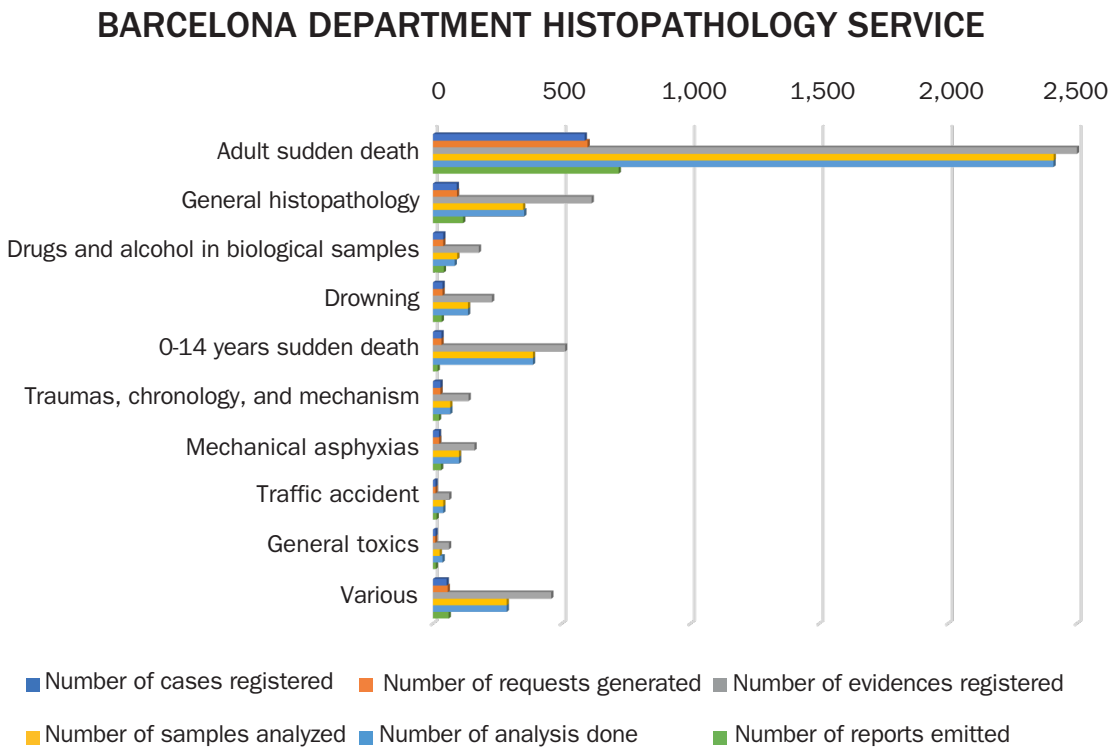
López García P, Chaves Portela S, Espárrago de Mingo A and García Perez JL. "Forensic studies of injurious agents and their effects on soft parts and bones". Director and coordinator: Margarita Santamaría Lozano. Continuing Education Plan 2020 of the Centre for Legal Studies. Online course, 1-3 December 2020.

Espárrago de Mingo A, García Pérez JL. Master in Forensic Medicine (University of Valencia). October 2019-June 2020.

5.2. Barcelona Department Histopathology Service

The year 2020 has characterized the Barcelona Histopathology Service by two particularities. The first one has been SARS-Cov-2, which has affected the whole staff intensively and has been faced with teleworking. The casework impact has been lower than expected. Secondly, the changes due to retirement or secondments of the number of doctors and their experience have been noted, although the Service is reacting by providing sufficient staff to overcome this situation. It is to deal with routine cases more quickly and to progressive historical dependence.

Figure 5.2.1. Casework of the Barcelona Department Histopathology Service during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Adult sudden death	589	600	3,956	2,410	2,409	721
General histopathology	92	93	616	350	354	117
Drugs and alcohol in biological samples	40	40	178	94	84	42
Drowning	37	37	229	136	136	34
0-14 years sudden death	33	33	513	388	388	18
Traumas, chronology, and mechanism	29	29	138	67	67	23
Mechanical asphyxias	23	24	161	101	101	31
Traffic accident	10	10	63	40	40	14
General toxics	10	9	62	26	37	11
Various	53	57	459	286	286	61
TOTAL	**916**	**932**	**6,375**	**3,898**	**3,902**	**1,072**

Concerning the expert activity, the number of cases registered this year has been 916. It has decreased compared to the previous year by approximately 20%. There have been

932 requests generated and 6,375 evidences registered, 3,898 samples analyzed, 3,902 analyses done, and 1,072 reports emitted. This fact is related to the pandemic and the decrease in the number of autopsies carried out. Suspected cases of COVID illness have generally been well documented and there have been no incidents.

As always, the most significant number of cases has been made up of those which, being "suspected of criminality" and therefore creditors of a judicial autopsy, end up showing a pathology or an injury that justifies a natural death. These include cardiovascular deaths due to structural pathology and a lesser degree after genetic study among those who, after an exhaustive study, are considered to have a structurally normal heart with no other particularities in the autopsy study.

However, a group of cases is cataloged as undetermined or uncertain caused by diverse reasons such as shortage of samples, information, or complex diseases. We see ourselves obligated to catalog them generically as “general histopathology study”.

We also reiterate, as in recent years, that prolonged survival, the delay in the onset of pathologies, or their chronicity due to the great progress in epidemiology and clinical medicine give place to anatomopathological backgrounds with variegated pictures with overlapping of acute and chronic pathologies are more difficult to interpret. Cardiopathies, degenerative senile neurological disorders, and traumatism are an example.

Among the causes of death ultimately classified as violent, there is small variation concerning the last years highlighting death in the context of drug dependence, various intoxications, especially by alcohol and medicines. These last are frequently connected to suicide cases and psychiatric pathology. Drowning, mechanical asphyxia, and trauma, especially head injuries, are relevant parts of violent death. The vitality, datation, and filiation of injuries are undervalued by constituting substudies of natural cases or violent etiology. Moreover, we have continued with our routinary training activities. We continued with 2 intercomparison exercises between laboratories and multidisciplinary collaborations, especially genetic cardiopathies. We have had a large proliferation of online attendance at generally free courses, especially among laboratory staff and outside working hours.

5.2.1. Interesting forensic case: Violent infant death secondary to maltreatment with duodenal rupture

Introduction: It is about a two-year-old girl with a history of maltreatment. She passed away in her domicile with external injuries and intern trauma without receiving medical assistance.

The autopsy identifies poly contusions, cephalohematoma on the scalp with the internal expression of subgaleal and subperiosteal hematoma, oedematous brain tissue, pleural and pericardial fluid, a complete section of the duodenum 9 cm from the stomach with hemorrhagic infiltration in both segments of the sectioned area, and purulent peritoneal

fluid (700 cc). The cause of death is secondary to multiple traumatisms and peritonitis, of presumed medico-legal homicidal etiology.

Histopathology: The Histopathology Service receives the entire brain, the cervical anatomical block, both lungs, the heart, the right hepatic lobe with the biliary vesicle, the stomach with the small intestine, and both kidneys.

The principle histopathological findings are: a) a rupture/complete duodenal tear with irregular hemorrhagic edges and transmural fibrinous-purulent exudate with associated acute peritonitis (Figures 1, 2 and 3); b) subacute biventricular mononuclear myocarditis (Figure 4); c) a marked collapsed and congested lung with edema and mild alimentary bronchial aspiration, and d) mild cerebral edema.

Figures 5.2.1.1. Macroscopic photograph of the complete duodenal rupture/tear

Figure 5.2.1.2. Macroscopic image of the rupture/tear area with irregular hemorrhagic borders and transmural fibrinous-purulent exudate

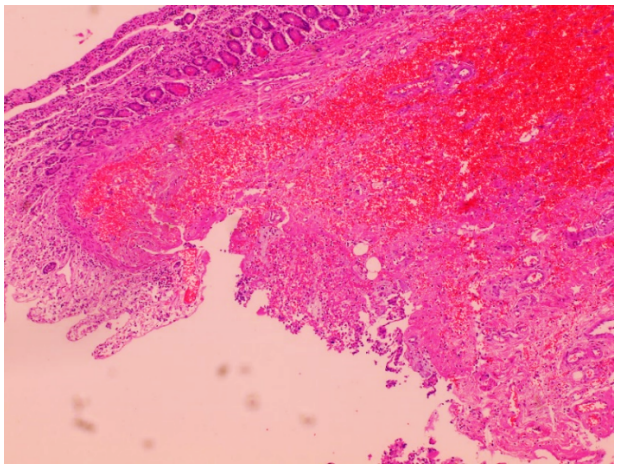


Figure 5.2.1.3. Microscopic image of acute peritonitis

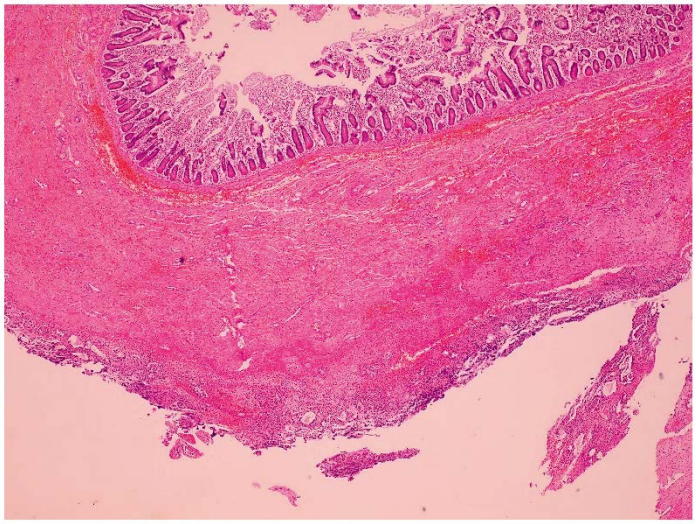
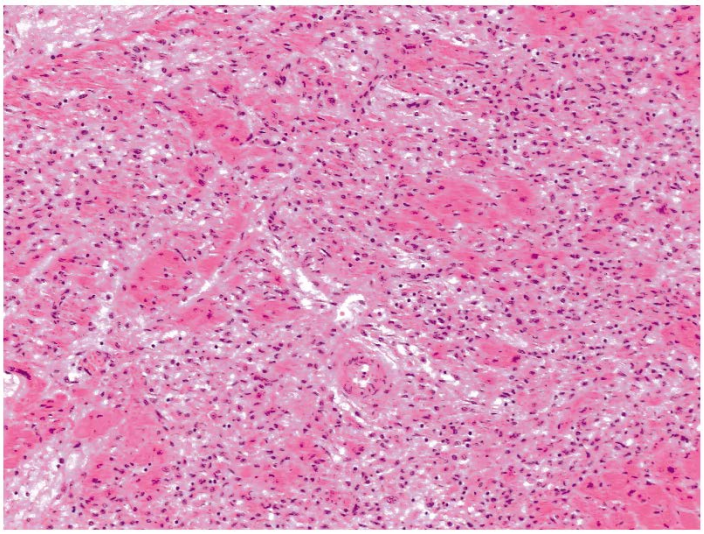


Figure 5.2.1.4. Microscopic image of subacute myocarditis



Results: The majority of cases due to infant maltreatment are produced by blows, shocks, falls, and less frequently by burns or suffocation, being the cause of death a head trauma, followed by rupture of abdominal viscera with hemoperitoneum, and peritonitis. The second duodenal portion is very vulnerable to blows to the central portion of the abdomen because it is trapped between the abdominal wall and the lumbar spine.

In this case, the contribution of the histopathological study is based on determining the existence of injuries in a maltreatment context such as the rupture/complete duodenal tear (together with the rest of the poly contusions evidenced at autopsy). It is also based on their vitality (in the form of irregular and hemorrhagic borders of the lesion with

transmural fibrinopurulent exudate and associated acute peritonitis), and the existence of a previous pathology (evolved myocarditis) that may have influenced the death.

In addition, the blood, vitreous humor, pericardial fluid, gastric contents, bile, peritoneal contents, and hair are sent to the Chemistry and Drug Service. The presence of paracetamol is identified in all of them as cocaine, benzoylecgonine, ecgonine methyl ester, cannabinoids, and cannabinol, with venlafaxine traces (antidepressant), o-desmethylvenlafaxine (its metabolite), and zolpidem (hypnotic/sedative) in the hair, corroborating with these findings the history of maltreatment.

5.2.1. Teaching and scientific activity

5.2.2.1. Contribution in scientific congresses

Multidisciplinary study in the MUSIB study of "sudden death in the Balearic Islands". Three sessions of case closures by videoconference. Collaboration in publications. Collaboration agreement between the Department of Justice, the Health Service of the Balearic Islands and the Cardiology Service of the Son Llàtzer Hospital (Mallorca), signed on 13 March 2018.

Borondo Alcázar JC. Round table: Familial heart disease. As an expert. E SEC 2020 Congress on cardiovascular health. Madrid 31/10/2020.

5.2.2.2. Scientific publications

Ripoll-Vera T, Pérez Luengo C, Borondo Alcázar JC, García Ruiz AB, Sánchez Del Valle N, Barceló Martín B, Poncela García JL, Gutiérrez Buitrago G, Dasi Martínez C, Canós Villena JC, Moyano Corvillo S, Esgueva Pallarés R, Sancho Sancho JR, Guitart Pinedo G, Hernández Marín E, García García E, Vingut López A, Álvarez Rubio J. "Muerte súbita de jóvenes: rendimiento diagnóstico de un programa autonómico de autopsia molecular con secuenciación masiva Sudden cardiac death in persons aged 50 years or younger: diagnostic yield of a regional molecular autopsy program using massive sequencing". *Revista Española de Medicina Legal*. https://doi.org/10.1016/j.recesp.2020.03.001

5.2.2.3. Education and teaching activities

Teaching activities

External rotation tutorials for a fourth-year resident in the speciality of Pathological Anatomy at the Vall d'Hebrón Hospital in Barcelona (January-February).

Collaboration agreement with IES Guineueta (Barcelona). An internship for a student from October to March 2018/2019 academic year (200 h). Tutor: Jordi Castro Pons.

Borondo Alcázar JC. Advisory Board in the *Spanish Journal of Legal Medicine.*

Borondo Alcázar JC. Advisory Board of the *Revista Jurídica de la AMLC.*

Attendance at training activities

Borondo Alcázar JC. E SEC 2020 Congress on cardiovascular health. Madrid, 28/10/2020 - 31/10/2020. 2 credits.

Moyano Corvillo S, Borondo Alcázar JC, Ladino Orjuela D, Montoya Sánchez M, Chávez Calderón J, Sonia Nsang Silebó, Lidia Rodríguez Izquierdo. I National Congress of COVID-19. SEIMC. Online format. September 13 to 19, 2020. 16 teaching hours.

Two (six-monthly) intercomparison exercises in forensic pathology (continuing education) through the College of American Pathology (CAP).

Borondo Alcázar JC. "Update on thoracic and thoracoabdominal aortic aneurysms". Webinar. SOLACI (Latin American Society of Interventional Cardiology). 20 August 2020.

Ladino Orjuela D, Borondo Alcázar JC. Muñoz Montoya M, Chávez Muñoz, Rodríguez Izquierdo L. "Intervencionismo periférico". SOLACI (Latin American Society of Interventional Cardiology). Webinar. 12 September 2020.

Susana Moyano Corvillo, Diana Ladino Orjuela. Forensic studies of injury agents and their effects on soft parts and bones. Organized by the Centre for Legal Studies. Online. From 1 to 3 December 2020. Teaching hours: pending certificate.

Susana Moyano Corvillo, Diana Ladino Orjuela. Multidisciplinary Forensic Study of Deaths by Drowning. Organized by the Centre for Legal Studies. Online. From 3 to 5 November 2020. Teaching hours: 7.

Moyano Corvillo S, Ladino Orjuela D. Course on "Updating fetal and perinatal autopsy". Catalan Society of Pathological Anatomy. Vall d'Hebron Hospital. Barcelona, 19 to 9 November 2020.

Ladino Orjuela D. "Intervention in congenital cardiopathies" (1:30 h). Webinar. SOLACI. Barcelona, 24 October 2020.

Ladino Orjuela D, Díez Espinar R, Nsang Silebó S, Rodríguez Izquierdo L. "Selected topics in haemodynamics II (1h:15m) Webinar. SOLACI. 10 October 2020.

Rodríguez Izquierdo L. Selected topics in haemodynamics III (1h:15m) Webinar. SOLACI. November 2020.

Díez Espinar R, Chavez Calderón J, Muñoz Montoya M, Rodríguez izquierdo L, Nsang Silebó S. "Verification and calibration of pipettes. Mettler Toledo. Online. 1,5 h lectivas. 17 September 2020.

Chávez Calderón J, Muñoz Montoya M, Nsang Silebó S. Course: Good weighing practices. Online. Mettler Toledo. 8 August 2020.

Chávez Calderón J, Muñoz Montoya M, Rodriguez Izquierdo L. Course: Good pipetting practices. Online. Mettler Toledo. 7 November 2020.

Chávez Calderón J, Muñoz Montoya M, Rodríguez Izquierdo L, Nsang Silebó S. Good laboratory practices, spectrophotometry. Metller Toledo. 7 November 2020.

Muñoz Montoya M, Rodríguez Izquierdo L. Presentation of clinical cases. SOLACI. Webinar. 26 September 2020.

Nsang Silebó S. Preparatory meetings for the First National Congress on Science and Justice (health consensus). Online. November 2020.

Nsang Silebó S, Rodríguez Izquierdo L. Cardiac arrhythmias. (SOLACI). Webinar. 26 September 2020.

Nsang Silebó S. New frontiers in haemodynamics wards. Webinar. SOLACI. 28 November 2020.

Nsang Silebó S, Rodríguez Izquierdo L. Biosafety and occupational risk prevention for healthcare personnel (LOGOSS). March/May 2020.

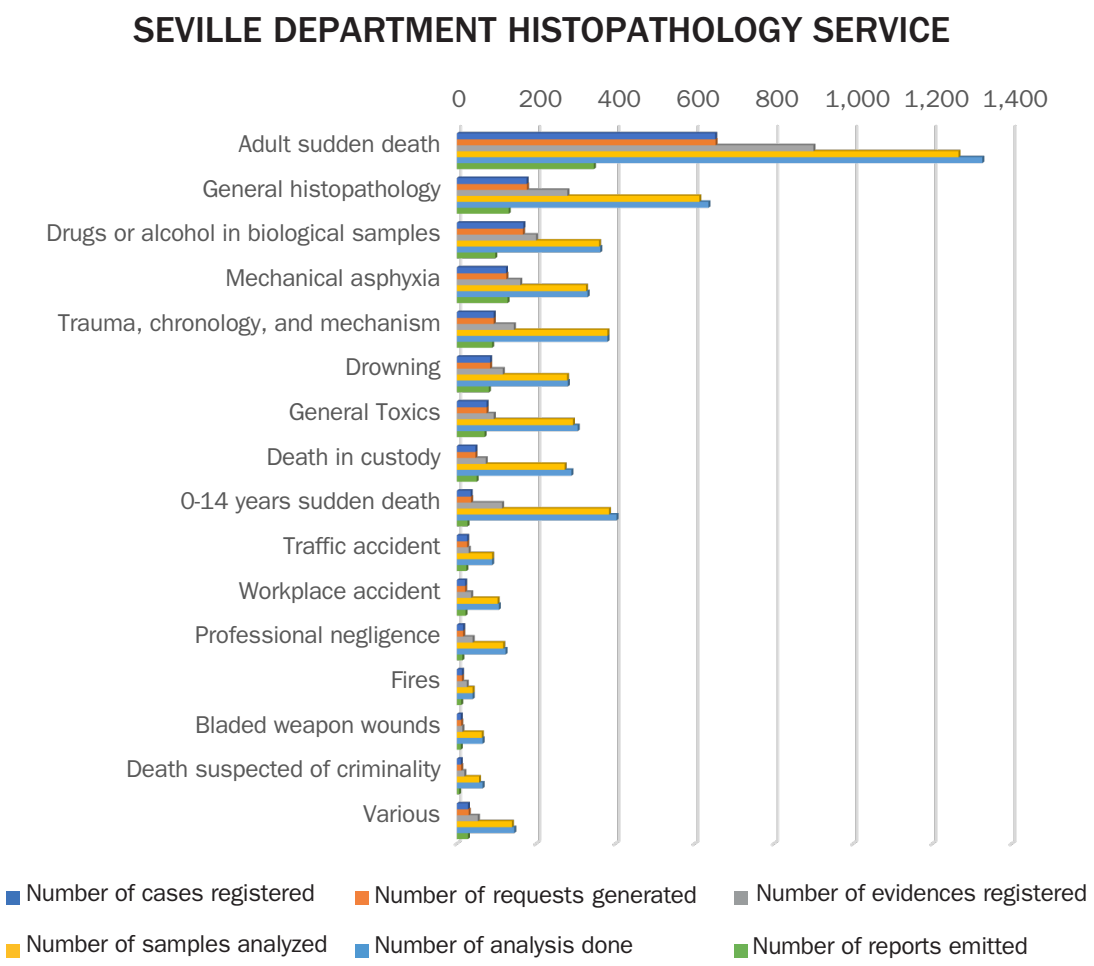
Nsang Silebó S, Rodríguez Izquierdo L. Gynecological laboratory tests and body fluids for the senior technician in the clinical laboratory. (LOGOSS). April/June 2020.

5.3. Seville Department Histopathology Service

Concerning the Seville Department Histopathology Service, during 2020 they received 1,585 requests, registered 2,296 evidences and analyzed 4,777 samples through a total of 4,943 analysis, emitting a total of 1,134 expert reports.

As it can be seen in Figure 5.3.1, the predominant analysis request corresponds to the investigation of **adult sudden death cases** (653 requests with 900 evidences received) followed by **general histopathological studies** (177 requests with 279 evidences received), the study of deaths **related with alcohol and drugs of abuse consumption** (167 requests with 200 evidences received), **general asphyxia studies** (125 requests with 160 evidences received), **the histopathological studies in deaths from toxic origin** (75 requests with 93 evidences received), and **traffic accidents** (26 requests with 30 evidences received).

Figure 5.3.1 Casework of the Seville Department Histopathology Service during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Adult sudden death	652	653	900	1,266	1,326	346
General histopathology	176	177	279	612	635	131
Drugs or alcohol in biological samples	168	167	200	359	362	97
Mechanical asphyxia	124	125	160	326	330	128
Trauma, chronology, and mechanism	93	93	144	380	380	89
Drowning	84	84	116	278	280	81
General toxics	75	75	93	293	305	70
Death in custody	47	47	73	272	289	50
0-14 years sudden death	35	36	114	384	403	27
Traffic accident	26	26	30	89	89	24
Workplace accident	21	21	36	103	106	22
Professional negligence	16	16	40	117	123	14

Type of report (cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Fires	13	13	25	40	40	11
Bladed weapon wounds	10	11	14	63	65	10
Death suspected of criminality	10	11	19	56	65	6
VARIOUS	**28**	**30**	**53**	**139**	**145**	**28**
TOTAL	**1,578**	**1,585**	**2,296**	**4,777**	**4,943**	**1,134**

5.3.1. Interesting forensic case: Investigation of a death associated to the consumption of heroin intravenously

A dead body of a 40 years-old man is found in the bathroom with drugs paraphernalia.

The macroscopic data outlined in the forensic report after the autopsy showed signs of venipuncture in the left groin and a more evident acute lung edema in the lower lobes.

In the microscopic exam, edema lung liquid is observed in the interior of the alveolar spaces. The majority of lung arterioles are partially or totally occluded by emboli of foreign material from the cutting of the drug. The material is phagocytosed by macrophages that undergo a giant cellular transformation, giving a very characteristic macroscopic image (see pictures). We found anthracotic pigment-laden macrophages, preferentially perivascular, and numerous intra-alveolar macrophages.

Histopathological diagnosis: Intravenous drug addiction lung. A lung of a heroin addict. Acute pulmonary edema. Anthracosis.

Chemical-toxicological analysis: We find benzoylecgonine, cocaine, codeine (0.14 mg/l), morphine (16.16 mg/l), and the presence of methadone, EDDP, tramadol, desmethyl tramadol, nordiazepam, oxazepam, ketoprofen, and amitriptyline, and nortriptyline are also found in the urine. Taking into account the relation between the concentrations of codeine and morphine in the urine samples, we can affirm that the detected morphine comes from the consumption of heroin.

Clinical-pathological considerations: The continuous occlusion by microemboli of foreign material in the pulmonary arterioles, due to the repeated venipunctures by the heroin addict, results in an extraordinary increase in resistance to the passage of blood through the pulmonary circulatory tree. This increased resistance in the pulmonary microcirculation leads to right heart failure, accompanied by chronic passive congestion in the liver (nutmeg liver) and right ventricular hypertrophy in the most severe cases.

Heroin is a drug capable of producing acute pulmonary edema not associated with mast cell activation; is not related to histamine. Acute pulmonary edema is one of the biggest causes of death in drug addicts.

Figure 5.3.1.1. Pulmonary arteriole occupied by emboli with foreign material from the substances used to cut heroin. The foreign material embolus has been phagocytized by macrophages, forming giant foreign body-like cells, and in turn has organized and adhered to the wall, leaving a small part of the lumen permeable, on the left of the image

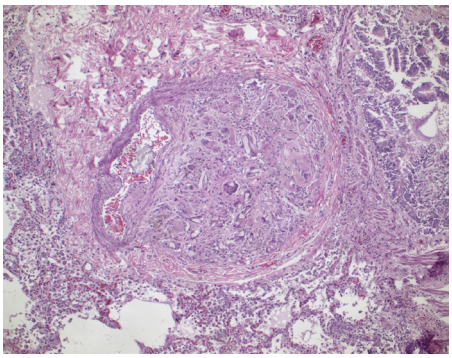


Figure 5.3.1.2. Foreign material still in the bloodstream in the lumen of the arteriole itself, due to the recent intravenous injection of the drug. Note that the characteristics of the foreign material are the same as those found within the giant cells that exist in the embolus

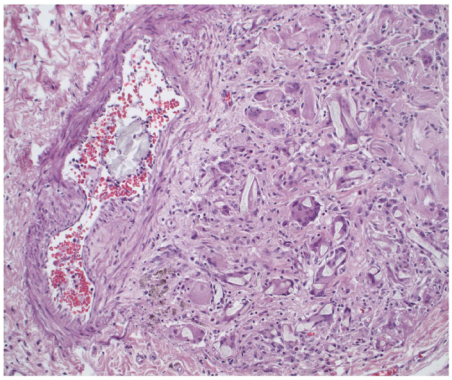
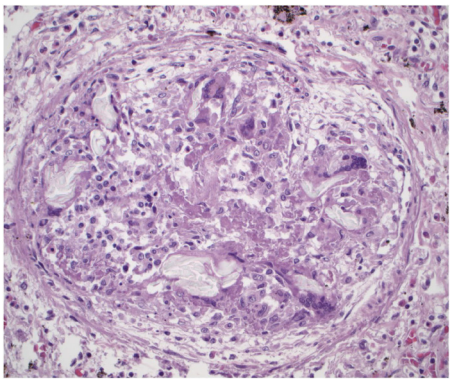


Figure 5.3.1.3. Small arteriole totally occluded by embolus of foreign material



5.3.2. Teaching and scientific activity

5.3.2.1. Teaching and education activities

Attendance to training activities

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Validación de métodos en las ciencias forenses". Plan de Formación Continuada 2020 del Centro de Estudios Jurídicos. Curso *online*. 28 de septiembre-1 de octubre 2020.

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Estudios forenses multidisciplinares de muerte por sumersión". Plan de Formación Continuada 2020 del Centro de Estudios Jurídicos. Curso *online*. 3-5 de noviembre de 2020.

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Validation of methods in forensic sciences". Continuing Training Plan 2020 from the Centre of Legal Studies. Online course. 28 September-1 October 2020.

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Multidisciplinary forensic studies of death by drowning". Continuing Education Plan 2020 of the Centre for Legal Studies. Online course. 3-5 November 2020.

Martínez de Mandojana Pérez, AM; Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio, A. "The multidisciplinary investigation of the sexual aggressions in the forensic laboratories". Continuing Training Plan 2020 from the Centre of Legal Studies. Online course. 9-13 November 2020.

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Informative introduction to the scientific and forensic activity of the different INTCF Services". Director and coordinator: Mr. Antonio Alonso Alonso. Continuing Education Plan 2020 of the Centre for Legal Studies. Online course. 16-18 November, 2020.

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics". Continuing Education Plan 2020 of the Centre of Legal Studies. Online course. 23-27 November 2020.

Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Polluted soils and groundwater: update on analytical techniques and ecotoxicity testing". Continuing Education Plan 2020 of the Centre for Legal Studies. Online course. 30 November, 1-3 December 2020.

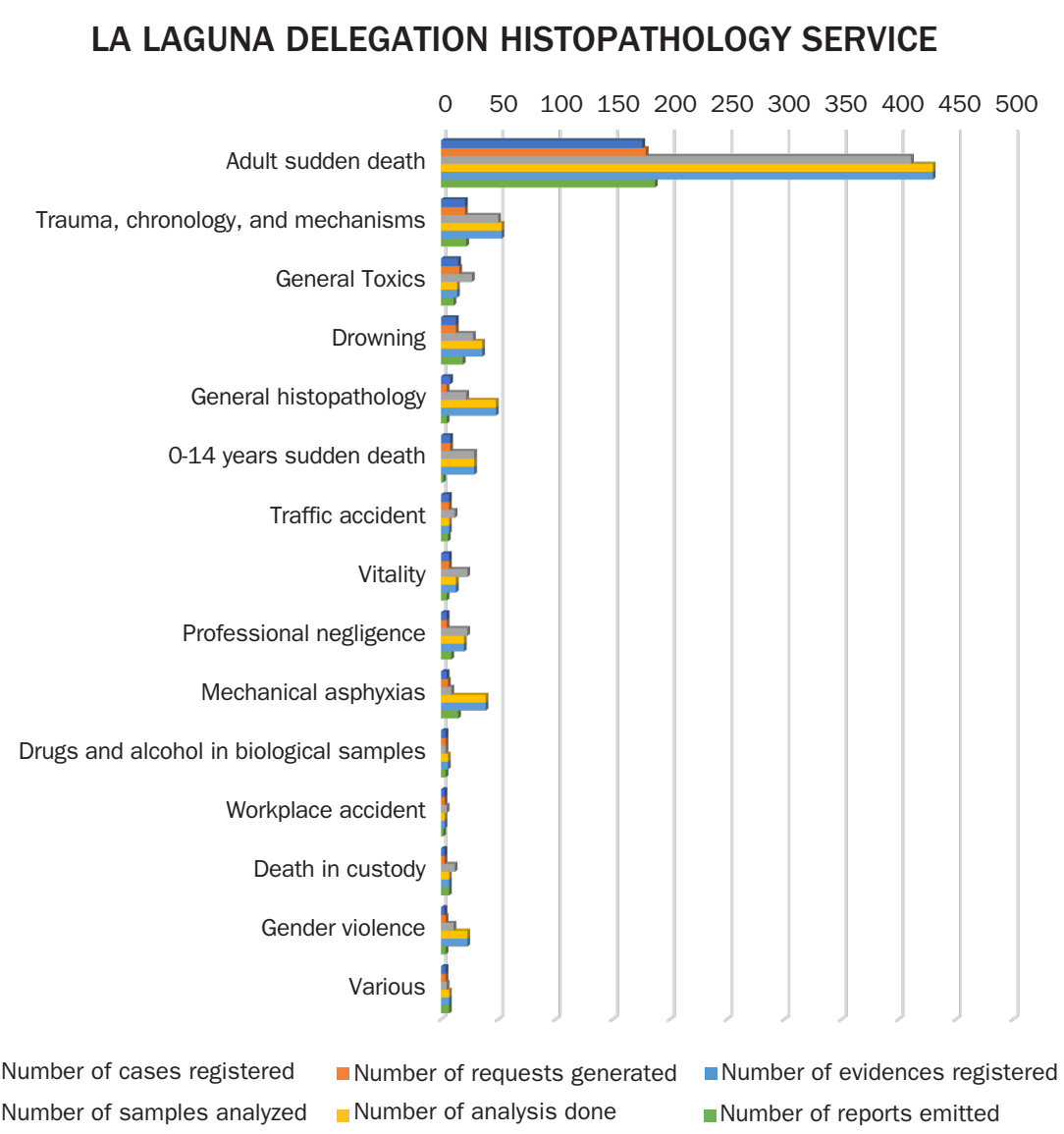
Martínez de Mandojana Pérez AM, Mateo Vico OM, Moro Cárdenas MC, Ronquillo Rubio A. "Injurious agents and their effects on soft parts and bones". Continuing Education Plan 2020 of the Centre for Legal Studies: Online course. 1-3 December 2020.

Moro Cárdenas MCi. "Mindfulness", by the IAPP.

Moro Cárdenas MC. "Prevention of occupational risks before COVID 19", Escuela Sindical Juan Muñiz Zapico. CCOO.

5.4. La Laguna Delegation Histopathology Section

Figure 5.4.1. Casework of the La Laguna Delegation Histopathology Section during 2020 according to the type of report



Type of report	No. of cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Adult sudden death	176	179	411	430	430	187
Trauma, chronology, and mechanisms	21	21	50	53	53	22
General toxics	15	16	27	14	14	11
Drowning	13	13	28	36	36	19
General histopathology	8	5	22	48	48	5
0-14 years sudden death	8	8	29	29	29	2

Type of report (cont.)	No. of cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Traffic accident	7	7	12	7	7	6
Vitality	7	7	23	13	13	5
Professional negligence	5	5	23	20	20	9
Mechanical asphyxias	5	6	9	39	39	15
Drugs and alcohol in biological samples	4	4	4	6	6	4
Workplace accident	3	3	5	3	3	2
Death in custody	3	3	12	7	7	7
Gender violence	3	4	11	23	23	4
Various	4	4	5	7	7	7
TOTAL	**282**	**285**	**671**	**735**	**735**	**305**

In 2020, the Histopathology Section has emitted **305** histopathology reports to collaborate to clarify or confirm the cause of death estimated by the diverse doctors of the Canary Islands Autonomous Community after the 305 autopsies. 187 **sudden death** studies have been carried out (**61.96%**), from which 185 corresponded to adult sudden deaths, 2 of them associated with the sport. The two other studies correspond to pediatric sudden deaths of 1-14 years. The adult sudden deaths were of cardiac origin (**52.43%**). Coronary disease was the most frequent cause (**69.07%**).

Inside the section of sudden cardiac deaths, we have to mention hereditary cardiomyopathies and sudden deaths with the heart with a standard structure. The aortic syndromes affect many more young people (minors of 35 years). Its diagnosis contemplates the follow-up of standardized anatomopathological protocols and multidisciplinary collaboration, with the posterior familiar genetic advice and the following social sanitary transcendence. In these cases, the report states the convenience of a specialized cardiological examination of the next of kin, preferably at the Hereditary Cardiopathies Unit corresponding to their health demarcation. A frozen blood sample has been conserved if necessary for the genetic studies in any specialized laboratory of the health system. In 2020, the blood samples of 12 deceased and 4 genetic studies have been done outside the INTCF.

The **vitality studies** of the injuries acquire relevance in homicidal violent deaths because they help to determine if they were produced alive or not and to establish as possible the approximated date of the injuries to contribute to the chronology facts. The injuries were studied, especially the bladed weapon ones and in fires and those produced in the cervical block (cutaneous, muscular, and fractures of the laryngeal skeleton) in strangulations, the latter being associated with gender violence deaths analyzed in 2020 (4 cases). We

highlight that in these cases the expert report concludes with court assistance with frequency.

Secondly, 15 **deaths related to alcohol and drug abuse were** reported. The complementary histopathology studies were requested to clarify the existence of pathologies of the consumption of substances that could proportionate a sudden death.

The studied deaths by drowning were 19. In these cases, apart from analyzing histopathological findings compatible with the acute entrance in the lung, other pathologies were evaluated, such as cardiac ones, that could have been the predisposing factor of a drowning death.

The **traumatisms** have supposed a 10%, approximately, in the requested studies in 2020. In homicidal and accidental deaths (traffic accidents, workplace, and falls) a brain study was requested to determine the existence of traumatic injuries. Likewise, in traffic accidents and accidents at work and falls, a histopathological study was requested to determine the concurrence of any other illness, like cardiac, that could favour the accidental traumatic death.

The study of deaths with **professional negligence/malpractice** sued by the family was supposed to be 3% of the reports emitted in 2020.

The **deaths in custody** refer to the deceased deprivation of liberty situation, prisoners, detainees, and patients admitted involuntarily in psychiatric centres. Concerning this type of death, 7 reports have been emitted. It has helped to determine the most probable cause of death. In half of the cases they were related to the consumption of medicines. Ischemic heart disease was the second most frequent cause, confirming the natural etiology of the death.

5.4.1. Interesting forensic case: AIDS as the fundamental cause of death in a woman with unknown HIV infection

Background: A 46 years-old woman with a history of headaches, smoking, and chronic alcoholism is admitted to the Hospital Emergency Department with an altered level of consciousness, severe respiratory insufficiency, and signs of malperfusion. Lately, she was sent to the critical care unit, suffering a cardiorespiratory arrest and exitus after the three hours she was admitted. A medical-legal autopsy was done due to the death of an unaffiliated cause.

Removal data: Woman deceased in the hospital centre. The echocardiography study advised the dilatation of the right ventricle. The thoracic radiographic study revealed a bronchial alveolar pattern in the right hemithorax and total occupation of the left hemithorax. Acute phase reactants were increased (CRP: 164.30). Her friends reported that, in the 20 days before death, she had suffered from decreased intake, headache, and high fever episodes.

Relevant findings in the autopsy: White female, 63 kg in weight and 164 cm in height. The HIV screening performed in the autopsy room was positive. The historical clinic did not figure that the deceased was HIV-positive. The heart showed right ventricular dilatation with friable walls and hemorrhages all over the endocardial surface, suggestive of acute cor pulmonale. The lungs were found to be overweight and dense, suggesting a possible acute respiratory distress syndrome. The liver was gaining weight, steatotic, and with a nutmeg image. The spleen weighed 640 grams (normal range: 150-200 grams). The pancreas showed scattered calcifications.

C**omplementary studies requested to the INTCF**: Histopathological and toxicological.

Provisional medical-legal conclusions: 1) The medical-legal death etiology was natural. 2) The cause of death was acute respiratory distress syndrome, the immediate one being right ventricular failure. 3) Once the results of the complementary studies are recieved, the considerations shall be made as appropriate.

Histopathological study: The cardiac viscera and the lung and kidney fragments were studied. In the lung parenchyma, massive round or oval yeast-like structures were observed inside alveoli and capillaries, often agglomerated, with diffuse alveolar damage in the acute phase and intra-alveolar foamy macrophages with yeast inside. These yeasts were also identified in capillaries and myocardial interstitium, as well as in renal tissue, where the involvement was glomerular and interstitial. The yeasts showed positivity for PAS, methylamine silver, and mucicarmine staining, being compatible with Cryptococcus.

The emitted **histopathological diagnostic** was disseminated cryptococcosis with pulmonary, myocardial, and renal involvement.

Conclusions: The presence of this disseminated opportunistic infection in the context of HIV infection is diagnostic of Human Immunodeficiency Syndrome (AIDS). In this case, it was the underlying cause of death; the immediate cause being Acute Respiratory Distress Syndrome (ARDS) - Cor Pulmonale.

The HIV screening is done in the autopsy with the histopathological study of the samples remitted by the forensic doctor to establish the fundamental cause of death. It is crucial to highlight the autopsy study in deaths in unknown etiology fatalities. The epidemiological interest, in this case, is added to the fact that the deceased had an unknown HIV infection.

Figure 5.4.1.1. Haematoxylin-Eosin stain. Lung parenchyma with massive cryptococcal involvement

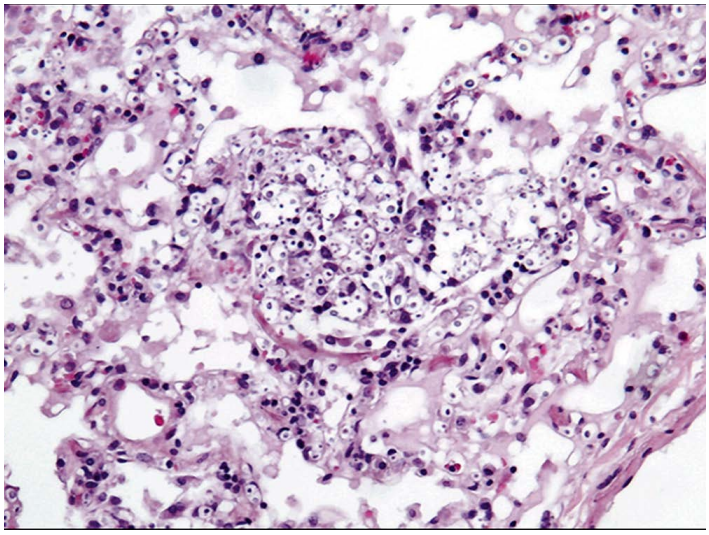


Figure 5.4.1.2. Musicarmine staining. Lung parenchyma with cryptococcal stained red

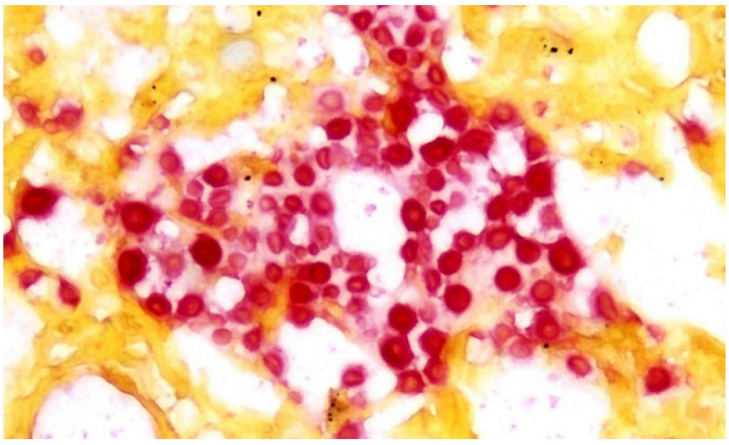


Figure 5.4.1.3. Haematoxylin-Eosin stain. Presence of Cryptococci in myocardium

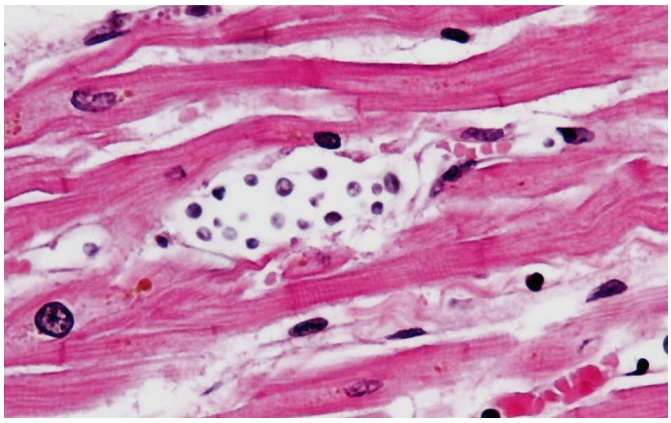
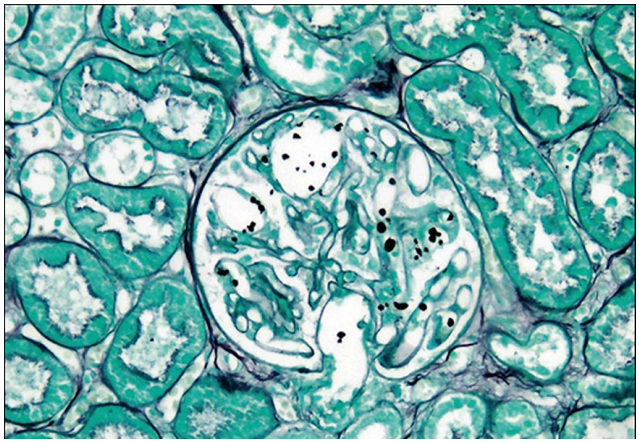


Figure 5.4.1.4. Methylamine silver stain. Presence of black stained Cryptococcus in renal glomerulus



Bibliography

Penmetsa S, Rose TA, Crook ED. Rapid respiratory deterioration and sudden death due to disseminated cryptococcosis in a patient with the acquired immunodeficiency syndrome. South Med J. 1999, Sep; 92(9):927-9. Doi:10.1097/00007611-199909000-00018

Setianingrum F, Rautemaa-Richardson R, Denning DW. Pulmonary cryptococcosis: A review of pathobiology and clinical aspects. Med Mycol. 2019, 1 Feb; 57(2):133-150.PMID: 30329097. https://doi.org/10.1093/mmy/myy086ç

5.4.2. Teaching and scientific activity

5.4.2.1. Scientific publications

Gonzalez-Arnay E, Martin-Olivera R, Quintero-Quintero YC, Hernandez-Guerra AI. Proposal for a harmonized protocol for COVID-19 screening and necropsy in forensic sciences facilities. J Forensic Leg Med. 2020; 76:102067. https://doi.org/10.1016/j.jflm.2020.102067

5.4.2.2. Teaching and training activities

Education activities

Hernández Guerra AI, Quintero Qintero YC. Training in rotation at the Histopathology Section of the INTCF-Delegation in the Canary Islands of an Internal Medical Resident of Anatomical Pathology of the University Hospital of the Canary Islands (March 2020).

Collaboration agreement between the Histopathology Section of La Laguna and the Pathology Department of the University Hospital of the Canary Islands for the training of anatomical pathology residents in foetal pathology and autopsy.

Attendance to training activities

Hernández Guerra AI, Quintero Quintero YC. "Multidisciplinary forensic studies of death by drowning". Continuous Education Plan 2020 of the Centre for Legal Studies, online course. 3-5 November 2020.

Hernández Guerra AI, Quintero Quintero YC. "Informative introduction to the scientific and expert activity of the different INTCF Services". Director and coordinator Mr. Antonio Alonso Alonso. Continuing Education Plan 2020 of the Centre for Legal Studies. Online course. 16-18 November 2020.

Hernández Guerra AI, Quintero Quintero YC. "Forensic studies of injury agents and their effects on soft parts and bones". Director and coordinator: Margarita Santamaría Lozano. Continuing Education Plan 2020 of the Centre for Legal Studies. Online course. 1-3 December, 2020.

Quintero Quintero YC. "Validation of Methods in Forensic Sciences". Continuing Education Plan 2020 of the Centre for Legal Studies. Online course. 28 September to 1 October 2020.

Quintero Quintero YC. Dermatopathology: Adnexal Tumors. The United States and Canadian Academy of Pathology (USCAP). Online modality. February 2020.

Quintero Quintero YC. "SEAP Quality Assurance Module in Surgical Pathology. Edition 2019. Spanish Society of Anatomic Pathology Foundation. Online modality. 27 December 2019 to 17 March 2020.

Quintero Quintero YC. Neuropathology. “Interactive Pathology: case-based update”. The United States and Canadian Academy of Pathology (USCAP). Online modality. 14 April 2020.

Quintero Quintero YC. “Fetal and perinatal autopsy”. Organized by the Catalan Society of Pathological Anatomy. Online course. Barcelona, 19 October to 9 November 2020.

Hernández Guerra AI, Quintero Quintero YC. “Advances in Anatomic Pathology 2020”. Pathological Anatomy Service of the Hospital Universitario de Canarias. January-December 2020.

5.4.2.3. Participation in investigation projects

Pathology associated with Covid-19 infection: results of autopsy series at the IMLCF of Santa Cruz de Tenerife. Raquel Martín-Olivera[1], Emilio González-Arnay[2], Yamilet C. Quintero-Quintero[3], Ana I. Hernández-Guerra[3], Jesús M. Vega-González[4], Eduardo C. Salido-Ruiz[4, 5]. Project approved by the Directorate General for Relations with the Justice Administration of the Government of the Canary Islands on 21 May 2020.

[1] Legal Medicine and Forensic Sciencies of Santa Cruz de Tenerife.
[2] Applied Anatomy Laboratory. Anatomy, Histology, and Neuroscience Department. Universidad Autónoma de Madrid.
[3] Histopathology Section. National Institute of Toxicology and Forensic Sciences. Canary Islands Delegation.
[4] Pathological Anatomy Service. Hospital Universitario de Canarias.
[5] Basic Medical Sciences Department. Universidad de La Laguna.

6. Criminalistics Service

The Criminalistics Service is located in the Madrid Department, attending requests which come from all the national territory.

The required studies fall into the following areas:

- *Injuries study*
- *Traces study*
- *Anthropology study*
- *Forensic entomology study*
- *Documentoscopy and graphs*

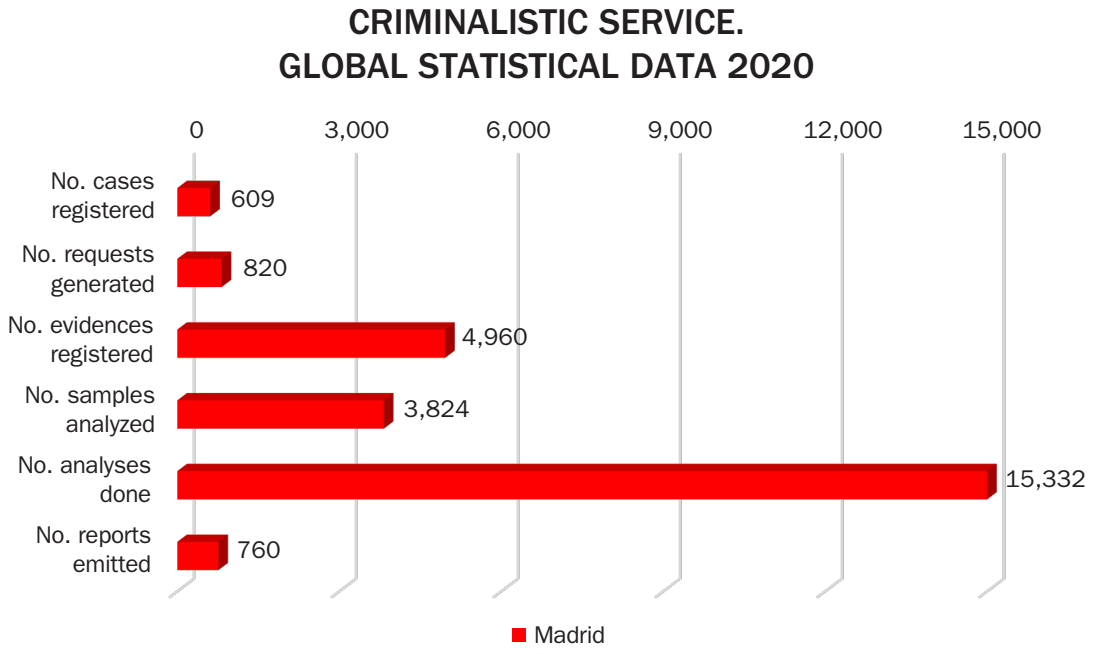
The Criminalistics Service staff that has participated in these type of investigations during 2020 is shown in Table 6.1.

Table 6.1. Madrid Department Criminalistics Service

	INTCF-MADRID Criminalistics Service
Head of the Department	1
Facultatives	11
Specialist technicians	5
Laboratory assistants	3
Administratives	1

During 2020, the INTCF Criminalistics Service has registered 609 cases, generating a total of 820 requests, with 4,960 evidences to analyze, 760 reports emitted, 3,824 samples analyzed, and the realization of 15,332 analyses.

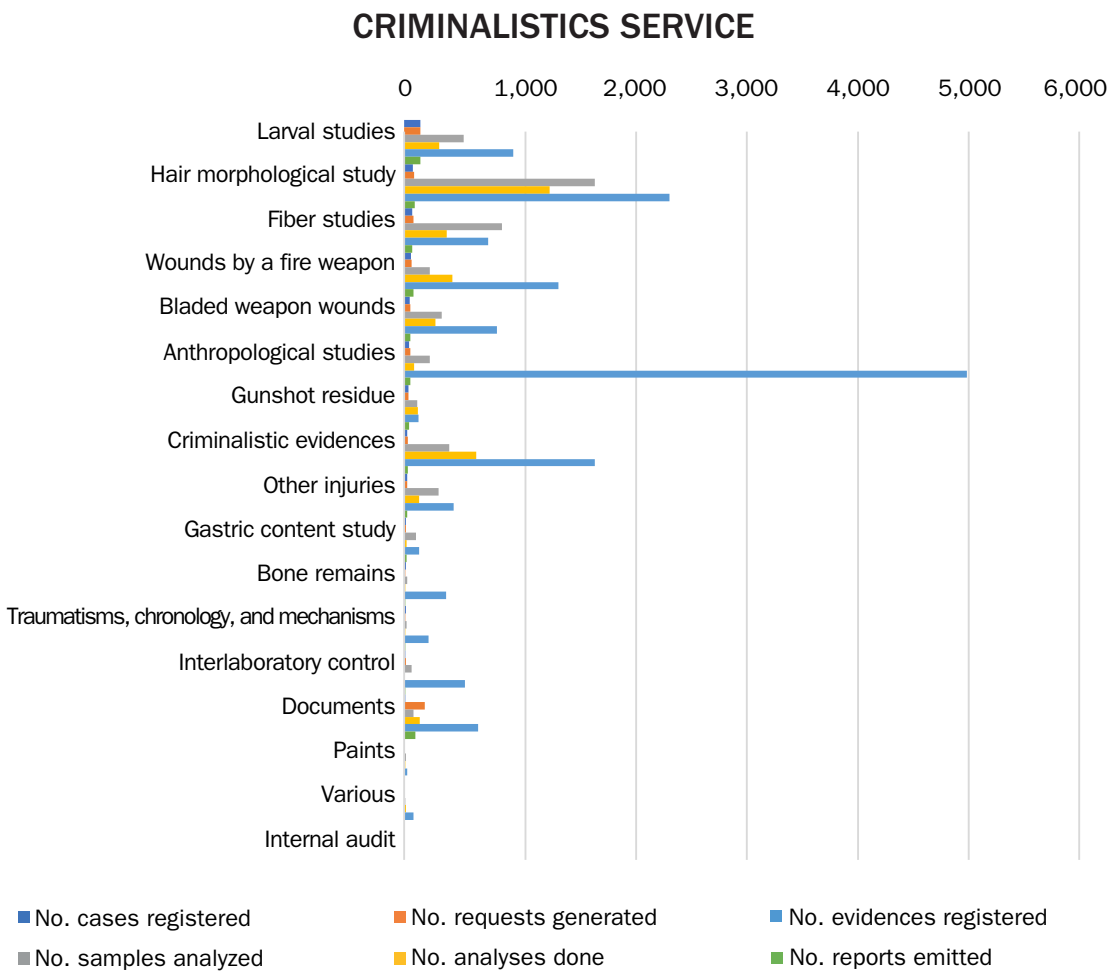
Figure 6.1. Overall data on the INTCF Forensic Service expert activities during 2020



2020	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Madrid	609	820	4,960	3,824	15,332	760
Total	**609**	**820**	**4,960**	**3,824**	**15,332**	**760**

In Figure 6.2, the Madrid Department Criminalistics Service shows the casework during 2020 according to the type of report.

Figure 6.2. Casework of the Madrid Department Criminalistics Service during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Larval studies	140	140	519	305	957	144
Hair morphological study	79	88	1,671	1,272	2,324	91
Fiber studies	71	80	854	372	733	73
Wounds by a fire weapon	60	65	223	421	1.352	83
Bladed weapon wounds	48	56	329	273	812	57
Anthropological studies	42	53	225	85	4.926	52
Gunshot residue	38	38	117	118	126	46
Criminalistic evidences	27	35	395	632	1.668	32
Other injuries	27	29	299	133	433	25
Gastric content study	17	18	104	22	132	21

Type of report (Cont.)	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Bone remains	16	11	28	12	369	12
Traumatisms, chronology, and mechanisms	15	11	24	11	212	11
Interlaboratory control	13	14	63	0	534	12
Documents	12	178	83	137	647	96
Paints	2	2	14	13	25	2
Various	1	1	12	18	82	3
Internal audit	1	1	0	0	0	0
TOTAL	**609**	**820**	**4,960**	**3,824**	**15,332**	**760**

Although it is a multidisciplinary Service, on occasions there is an interconnection of the different areas, that allows elaborating expert reports in a global form to answer the formulated requests by the doctors and judges.

The participation in specialized workgroups, the attendance to courses, the continuous revision of specialized publications, and the personal experience acquired during years of work made the staff of this service acquire knowledge that allows carrying out the expertises required by courts with specialization and experience.

Study of injuries

Include all those that affect the body integrity: gunshot injuries, bladed weapon injuries, and blunt injuries.

In general, the types of sample to be studied are skin flaps or, in other words, skin cuttings. This service is the only forensic laboratory in Spain that carries out this study on body samples.

The study of **gunshot injuries** is focused in determining the inlet and outlet orifice and the estimation of the gunshot distance. It is necessary to count with all the superficies (clothing and skins) that the projectile has traversed and, in function of morphology and the presence of residues, indicate which orifices correspond to incoming projectiles and outgoing projectiles, as well as estimating the distance at which the shot was fired.

In 2020, they received a total of 65 requests of the gunshot injuries study, realizing 83 reports, and 421 samples were analyzed, which supposes 1,352 analyses.

From the 83 expert reports elaborated, 38 gunshots were done through the clothes and other interposed materials, not having received the same in 14 cases, what impedes obtaining the distance from gunshot results in 37% of cases.

Another type of request is the identification of the gunshot author through the analysis of **gunshot residue** in the hands with the SEM-EDX technique. The study is based on the detection of particles with a specific composition coming from the ammunition.

The INTCF Criminalistics Service supplies to all the IMLCF of Spain a gunshot residue collection kit which specifies the protocol to follow for the right sample collection. The kit utilization is to practice the sample taking at the scene to avoid losses of waste in the hands that will end up in false negatives.

In 2020, a total of 38 requests were received and 46 reports were emitted with 118 samples analyzed and 126 analyses realized.

In the study of the **bladed weapon wounds**, it is about to establish the type of injury produced and, in the function of it, which could have been the production mechanism and the characteristics of the causal object, establishing the compatibility or not if the weapon has been referred.

In 2020, 56 such requests were received and 57 reports were issued, corresponding to 273 samples studied, with 812 analyses carried out.

The study of **blunt wounds** includes the ones produced by diverse mechanisms: lacerations of contusive origin produced by the action of a hard object on the body surface, hangings, and strangulations, as well as those produced by other more complex mechanisms such as bites. In these types of wounds, it is particularly important to examine the possible presence of foreign material inside the wounds to determine the type of object causing it or the compatibility with the noose in the case of hangings and strangulations.

The exam of these samples during 2020 generated 29 report requests, emitting 25 reports, with 133 samples studied and 433 analyses realized.

Frequent to the study of stabbing weapon wounds and blunt injuries in skin flaps, a part of the criminalistics study includes the vitality study, having to share the samples with the Histopathology Service.

Inside this area of study there is the violence signs exam in clothes with the purpose to determine if the continuity solutions in a clothing have been realized by a cut or by a tear.

Study of traces

The area of traces includes the fibers, paintings, plastics, ropes, inorganic stains, adhesives, and all those samples of unknown origin, not organic, that may be of interest.

The **hair** exam in the Criminalistics Service refers to the morphological study that allows a previous selection to the genetic study. It saves time and material means. During 2020, a total of 88 requests were received, 91 reports were issued, 1,272 samples were studied and 2,324 analyses were carried out.

Regarding **fibers**, 80 study requests were received and 73 reports were issued, corresponding to 372 samples analyzed, with 733 analyses carried out.

Concerning the **paintings**, the study comprises the active participation of the INTCF Criminalistics Service in the database elaboration of the EUCAP of automotive paints from the Working Group Paint and Glass of ENFSI, the European Network of Forensic Science Institutes providing samples of vehicles manufactured in Spain. However, during 2020, due to the pandemic, no samples were received from car manufacturers in Spain to include them in the database, resulting in only 2 requests, which led to 2 reports being issued, with a total of 13 samples and 25 analyses performed.

The rest of the **traces** in this group were diverse, being samples of unknown origin that were sent to identify small remains found on various supports studied in the Service and which were individualized to identify them and try to determine their origin. A total of 35 requests were made, with 32 reports issued, 632 samples analyzed and 1,668 analyses carried out.

Study of forensic anthropology

Includes the study of total or partially skeletonized and bone remains in which it is requested: bone identification, species determination, the minimum number of individuals, biological profile, injuries study, and estimated death date.

The genetic study is included in a high proportion of these samples, either for the identity confirmation or inclusion in the missing persons databases.

About the **biological profile**, a total of 53 requests were received in 2020, generating 52 reports, and 85 samples were studied, with 4,926 analyses carried out.

The **study of injuries** or **traumatisms** in bone remains includes both the examination of skeletonized remains, soft parts samples in which the study of injuries in skin tissue and bone is requested. A total of 11 requests were made, with 11 reports issued, 11 samples analyzed and 212 analyses carried out.

Data from bone remains accounted for 11 requests, with 12 reports issued, 12 samples analyzed and 369 analyses carried out.

Forensic entomology

These studies try to determine the death date based on the fauna colonizing a corpse, taking into account the circumstances in which the body was found such as in open or closed areas, death cause, environmental conditions (temperature, humidity, season of the year), etc.

It is one of the most requested studies that the Service receives. The majority of them are related to corpses located in closed areas and predominantly by a non-violent death.

In 2020 they received 140 requests, with 144 reports emitted, analyzing 305 samples, which supposes 957 analyses.

Gastric content

The examination of gastric content includes the study of food present in the stomach at the time of autopsy. It takes into account the food ingested and the estimated time from the intake and time of death. The study is based on the food macroscopic identification of food. It tries to identify the animal or vegetal origin and the macroscopic structures that allow knowing what type of food is.

During 2020 a total of 18 analyses requests were received, emitting a total of 21 reports, with 22 samples analyzed and 132 analyses done.

Documents

It includes the exam of manuscripts and printed documents, the identification of the author of a text, the authenticity of a signature, and, in case that it is false, the audit.

During 2020 a total of 178 analysis requests were received with 96 reports emitted, having studied 137 samples and a total of 647 analyses.

Quality controls

Inter-laboratory controls are carried out in virtually all areas of study at the Forensics Science Department. These controls come from international (ENFSI and CTS) and national (RLFOE) bodies. They include the study of fibers, hairs, paints, adhesives, gunshot residues, gunshot distance, bone identification, and handwritten documents. During 2020 we have participated in a total of 13 controls, with 534 analyses performed.

6.1. Interesting forensic cases

6.1.1. Suicide or accident? Two deceased and a single shot

Two elders are found in the bed dressed and with gunshot wounds. The woman is in a supine position with her hands in the chest and the man is from the side turning its back to the woman. On the bedside table, there is a carbine with the walls blood spatter.

When the autopsy is performed on the corpses, the man presents an incoming orifice at the level of the chest and an outgoing orifice at the back with a descendent trajectory.

The woman has an incoming orifice in the chest, and from the interior of the body a deformed semi-armoured caliber projectile of 7.65 is extracted.

There is only one single percussion pod in the place of the scene.

It is suspected that the man fired the gun and that the projectile went through him, and then penetrated the woman.

The gunshot orifices are analyzed, finding that the man's gunshot had contact and that the outgoing orifice edges in the clothes are gunpowder particles.

There is some gunshot particle on the edges of the entry wound of the outermost garment worn by the woman.

The investigation of the gunshot residue on the man's hands is positive, but not on the woman's hands, where no gunshot residue is found.

A study is executed about the clothes that the woman dresses in. In all the clothes, there is blood from a man with a genetic profile compatible with it.

The bullet collected in the woman's body shows the genetic profile of the two dead.

Figure 6.1.1.1. Female entry orifice clothing

Figure 6.1.1.2. Female skin entrance orifice

Figure 6.1.1.3. Inlet orifice man clothing

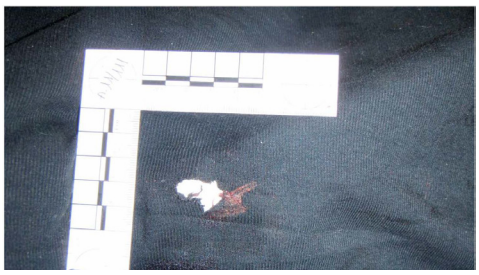


Figure 6.1.1.4. Inlet orifice man skin

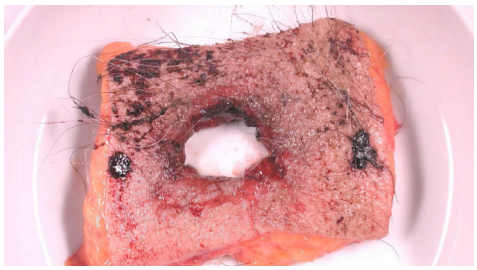
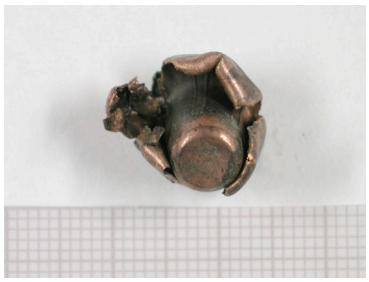


Figure 6.1.1.5. Projectile



6.1.2. Car hit investigation

A 67-year-old woman hitted by a car dies. A fragment of tissue collected by the police from the vehicle involved and the cardigan worn by the victim are submitted.

Figure 6.1.2.1. Fragment collected from the vehicle

Figure 6.1.2.2. Cardigan of the victim

The fibre composition of both samples is analysed and it is found that in both cases they are pink cotton fibres, with the same behavior under fluorescence.

Figure 6.1.2.3. Victim's cardigan fibres

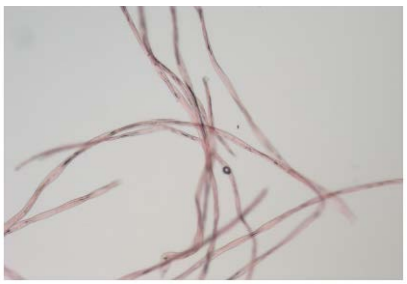
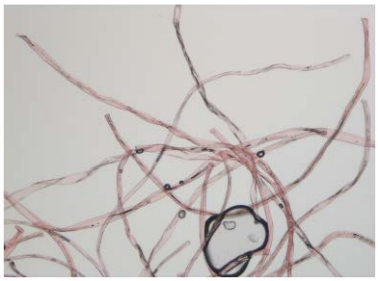


Figure 6.1.2.4. Fibres from the sample collected from the vehicle



The obtained results indicate that it is the same fiber being positive, concluding that there is a compatibility between both. It indicates a probable common origin.

6.1.3. Investigation of a murdered and dismembered woman

In the autumn of 2017, a young woman disappeared. Nobody was worried until one year later, when a familiar tried to contact her, the phone demonstrated that it stopped giving a signal at the end of 2017. The young woman lived in a rented room with her boyfriend. He comments that she left with another man after breaking all contact with him and taking the dog with her.

The victim was found in the interior of a refrigerated chest in a frozen state in the boyfriend's room.

Body fragments from upper and lower limbs, arms, forearms, thighs, and legs were received to study amputation tips, both in soft tissue and bone; skin fragments from the chin and back for the study of wounds; hair collected from the victim's body, as well as hairs from the head and pubis for comparison; textile fibers collected from the surface of the victim's body and the victim's fingernails. A knife and a mattock were also submitted for possible compatibility with the injuries under study.

The study of the amputation edges of the fragments of the upper and lower extremities indicated that the mutilating injuries were inflicted at various times, and the minimum number of impacts could be determined, as well as the direction of the cuts and the inclination with which the object acted. All the cuts were produced by the action of an object with a sharp cutting edge compatible with the knife submitted.

The action of dental arches was observed, and therefore compatible with a bite, in one of the samples from the left forearm.

Figure 6.1.3.1. Bone cuts

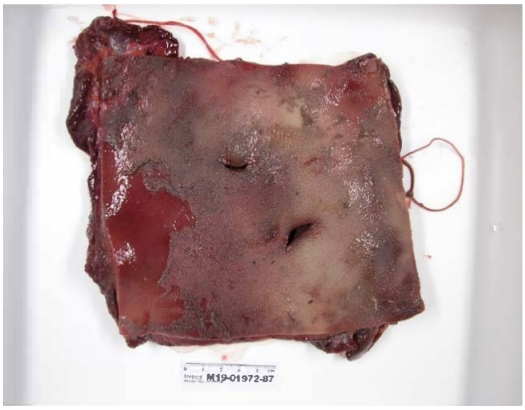
Figure 6.1.3.2. Soft tissue cuts

Figure 6.1.3.3. Suspicious weapons

Figure 6.1.3.4. Bite

The skin fragment from the chin showed the presence of lesions compatible with a blunt force mechanism (hit). The sample from the back shows two wounds produced by a knife with similar characteristics to the one submitted.

Figure 6.1.3.5. Bladed weapon wounds



A total of 69 hairs were studied, of which almost half had the characteristics of animal hairs (dog?), as 2 hairs were different from the victim's own, and the rest were similar to the victim.

The fibers collected from the surface of the victim's body and her fingernails were mostly cotton fibers of different colors. It was not possible to establish their origin.

The suspect was tried by a jury court, charged with gender violence.

6.2. Teaching and scientific activity

6.2.1. Participation in investigation projects and collaboration with other institutions

In collaboration with the ENFSI Working Group Paint and Glass, the maintenance of the EUCAP automotive paint database has been carried out.

In collaboration with the ENFSI Working Group Paint and Glass, participation in the creation of the adhesive tapes database.

Creation of an internal photographic database of microscopic structures from different foods, for application in the study of gastric contents.

Agreement between the Ministry of Justice and the state agency CSIC, M.P. to carry out RAMAN analyses in the Research Group on Optical Spectroscopies in Plasmonic Nanostructures of the Institute for the Structure of Matter.

CSIC Interdisciplinary Platform. Open Heritage Research and Society. Study of pigments.

Collaboration with the Ministry of the Interior for the integration of data at national level on the discovery of unidentified human remains and the identification of missing persons.

6.2.2. Contribution in scientific congresses

"Does osteological age matter? A case of an identification case". Authors: A. Muñoz, M. Benito, T. Cabellos, A. Jiménez, E. Labajo, B. Perea. Presented at the "XII Scientific Meeting of the Spanish Association of Anthropology and Forensic Odontology (AEAOF): Virtual edition. Organized by the AEAOF and the UGR.

6.2.3. Education and training activities

Internship training for a student of the Degree in Criminology at the Complutense University of Madrid.

Amparo Jiménez, Teresa Cabellos. "Forensic Anthropology". Lecturers. Complementary Training Course for the Unification of the scales of officers of the Guardia Civil. University Centre of the Civil Guard, Carlos III University, Aranjuez (Madrid), February 2020.

María Luisa Beringola. "Forensic Entomology". Lecturer. Complementary Training Course for the Unification of the scales of officers of the Guardia Civil. University Centre of the Guardia Civil, Carlos III University. Aranjuez (Madrid). 11 March 2020.

Amparo Jiménez, Teresa Cabellos. "Forensic Anthropology". Lecturers. Complementary Training Course for the Unification of the scales of officers of the Guardia Civil. University Centre of the Guardia Civil, Carlos III University, Aranjuez (Madrid), June 2020.

Amparo Jiménez, Teresa Cabellos. "Forensic Anthropology". Lecturers. Complementary Training Course for the Unification of the scales of officers of the Guardia Civil. University Centre of the Guardia Civil, Carlos III University, Aranjuez (Madrid), November 2020.

María Luisa Beringola. "Forensic Entomology". Lecturer. Complementary Training Course for the Unification of the scales of officers of the Guardia Civil. University Centre of the Guardia Civil. Carlos III University. Aranjuez (Madrid). 6 July 2020.

Ana María Pérez Cao. Speaker in Homicide Investigation. Multidisciplinary approach. Lecture given The intervention of the INTCF in the investigation of homicides. The crime laboratory. 09/03/2020-10/03/2020.

Ana María Pérez Cao: Speaker at the Seminar on reconstructive and forensic ballistics. IUICP. The role of the crime laboratory in the study of firearm injuries. 24 November 2020.

Ana María Pérez Cao. Collaborator with the University of Alcalá in the Criminalistics Degree. (Electron microscopy and energy dispersive X-ray microanalysis).

Teresa Cabellos. Participation in the elaboration of the European Project FEATURE H2020. September 2020.

Amparo Jiménez Sánchez, Mar Nogal Ruiz and Teresa Cabellos Panadés. "XII Scientific Meeting of the Spanish Association of Anthropology and Forensic Odontology (AEAOF): Virtual edition. Organized by the AEAOF and the UGR. November 2020.

Margarita Santamaría Lozano. Director of the Final Degree Project in Public Security Management, University Centre of the Guardia Civil, Carlos III University of Madrid. “Time of permanence of fibres on textile supports”.

Margarita Santamaría. Director of the course “Forensic studies of injury agents and their effects on soft parts and bones”. Centre for Legal Studies. At the INTCF Madrid Department. 1-3 December.

Margarita Santamaría. Speaker at the course “Informative introduction to the scientific and forensic activity of the different INTCF Services. The Criminalistics Service of the National Institute of Toxicology and Forensic Sciences”. 18 November. Centre for Legal Studies. Madrid.

Attendance at the Seminar “Biometric handwritten signature”, 11 February 2020, Mossos d’Esquadra. Sabadell.

Attendance at the course “Homicide investigation. Multidisciplinary approach”. 9 and 10 March 2020. Centre for Legal Studies. Madrid.

Attendance at the course “Violent death, 5th edition”, 21 September to 13 November. Centre for Legal Studies. Madrid.

Attendance at the course “Validation of methods in Forensic Sciences”, 28 September to 1 October. Centre for Legal Studies. Madrid.

Attendance at the course “Multidisciplinary investigation of sexual assaults in forensic laboratories”. Organised by the CEJ, as part of the 2020 Continuing Education Plan, given online from 10 to 13 November.

Attendance at the course “Informative introduction to the scientific and forensic activity of the different INTCF Services”, from 16 to 18 November. Centre for Legal Studies. Madrid.

Attendance at the course “Multidisciplinary forensic studies of deaths by submersion”. Organised by the CEJ, as part of the 2020 Continuing Education Plan, given online from 3 to 5 November.

Attendance at the seminar “Forensic Reconstructive Ballistics”. Organised by the IUICP. Delivered online on 24 November 2020.

Attendance at the course “Forensic studies of injury agents and their effects on soft tissue and bone”, from 1 to 3 December. Centre for Legal Studies. Madrid.

Meeting of the RLFOE Graphistics Group on 29 June 2020.

7. Toxicological Assessment and Environmental Services

The Toxicological Assessment and Environmental Service are one of the Services in Madrid, Barcelona, and Seville Departments. It was created in 1998 due to the expert reports demanded by part of the courts in environmental crime, as it was considered that specialization in this area was necessary to give answers to the analysis request and assessment of results in alleged offenses against the environment.

The Toxicological Assessment and Environmental Service have as objective the emission of reports and dossiers that the Judicial Authorities and the Public Prosecutor's Office request. It also analyses and investigates practices ordered by Judicial Authorities, Governmental Authorities, and the Public Prosecutor Office related to the judicial procedures or in the preliminary proceedings carried out by the Public Prosecutor's Office in fields of the investigation of alleged offenses against the environment and natural resources.

The analyses and test effectuated in our three laboratories and the assessment reports emitted in the Toxicology Assessment and Environmental Service determine the existence or not of a severe risk or damage produced by a concrete activity, a criminal offense set out in the Penal Code, in Chapter III of Title XVI, that regulates the so-called crimes against natural resources and the environment, articles 325 to 331. Chapter IV regulates offenses relating to the protection of flora, fauna, and domestic animals (Organic Law 10/1995, 23 November 1995).

To meet this objective, requests for analyses and tests by the judicial authority are dealt with, apart from collaborating or advising the Judicial Police in the sample taking. In cases considered necessary, and always at the request of the Public Prosecutor Office, studies and fieldwork are realized to complete the expert report. The opinions emitted by the service collect the analysis and tests realized in numerous samples, which require a profound study of the location and the activity. A detailed bibliographic review and of the specific regulation is needed; communitary, statal of the different autonomous community, and municipal (spill, quality of the waters, residues, emissions into the atmosphere, air quality…).

The majority of the cases are related to the following investigations:

- *Environmental impact study of urban or industrial wastewater spills of hydraulic public domain*
- *Environmental impact study of discharges of slurry and sewage sludge*
- *Residues and leachates analyses and environmental impact study*
- *Environmental investigations about polluted soils*
- *Environmental investigation of atmospheric pollution*
- *Environmental investigations about poisoned flora and fauna samples*
- *Environmental investigation in fires*
- *Scientific-technical and regulatory assessment of applicable environmental regulations*

The analysis techniques, studies, and tests carried out for this purpose are:

- Physicochemical Techniques.
- Ecotoxicity bioassays.
- Microbiological Analysis.
- Fieldwork.
- Assessment of environmental reports and documents.
- Bibliographic reviews.
- Study of specific legislation.

Concerning the management of quality about the activity of the laboratories, all the Toxicology Assessment and Environmental Services participate actively in the continuous implementation of the INTCF quality system. It is done through the continuous revision and actualization of internal work procedures and its correspondent validation tests; participation in interlaboratory exercises of the parameters and tests established in each laboratory, and their participation in the correspondent internal and external audits.

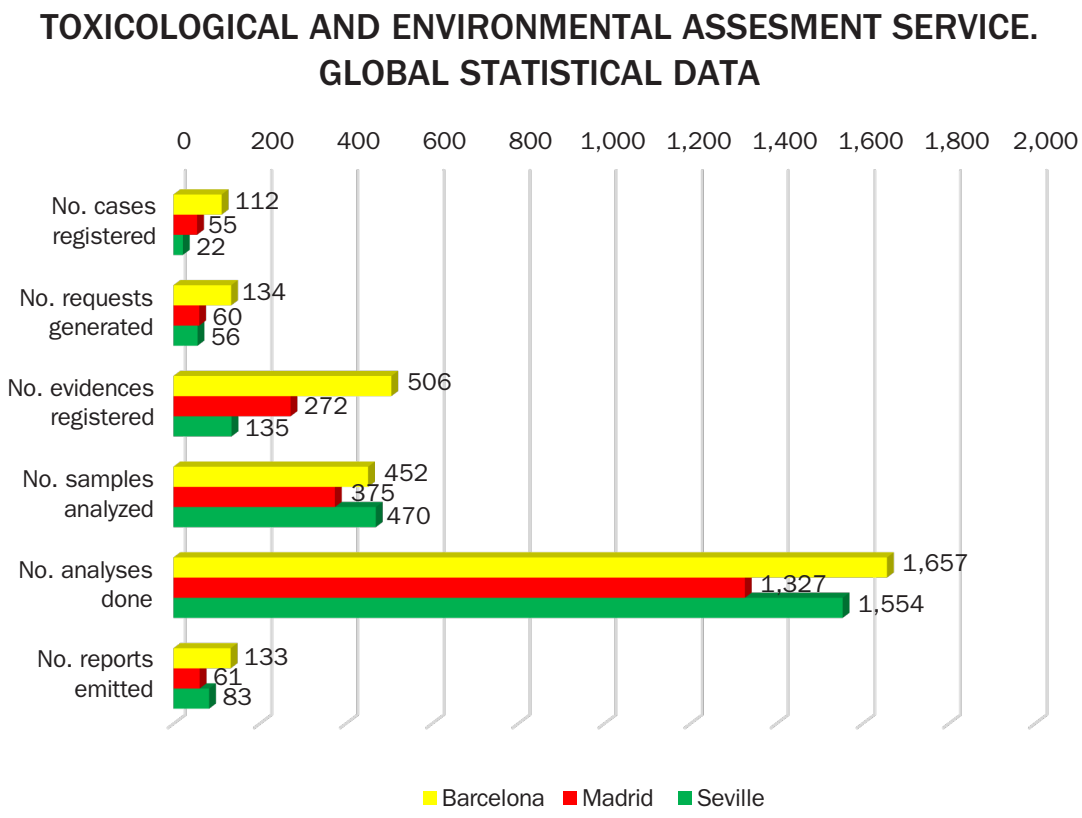
The Environment Service has several of its analysis methods accredited by ENAC under UNE EN ISO/IEC 17025 (a.ccreditation files ENAC: 297/LE639, 297/LE1366, 297/LE2239)

Table 7.1: Staff of the VTMA Services of the different Departments (2020)

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA
Head of the Department	1	1	1
Facultatives	5 (4*)	1 (0*)	2
Specialist technicians	2	2	1
Laboratory assistants	2	–	1
Administratives	–	–	–
(*) INTCF-MADRID: 4 from November 2020 due to retirement. (*) INTCF-BARCELONA: 0 from August 2020 due to relocation.			

The VTMA INTCF Services have registered during 2020 a total of 250 expert reports, emitting 277 reports after the analysis of 1,297 samples.

Figure 7.1. Global data of the expert activity during 2020 in the INTCF's Toxicological and Environmental Assessment Services



2020	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Barcelona	112	134	506	452	1,657	133
Madrid	55	60	272	375	1,327	61
Seville	22	56	135	470	1,554	83
Total	**189**	**250**	**913**	**1,297**	**4,538**	**277**

Hereunder, there is the expert and scientific activity as well as the teaching activities developed during 2020 by each VTMA Services of each Department. Each Service has included a forensic interesting case description to publish the expert labour.

7.1. Toxicological and Environmental Assessment Service of the Madrid Department

During 2020, 60 requests for reports were received, relating to 272 pieces of evidence submitted; 61 reports/expert opinions were issued, 375 samples were investigated and 1,327 analyses were carried out.

A characteristic of the SVTMA of the Madrid Department casework is the variability of the investigations carried out.

During the year covered by this report, the highest number of reports issued and requests registered corresponded to the drafting of opinions and requests for environmental investigations of spills (21 opinions issued).

The reports emitted form part of the investigation of spills mostly (15 reports) were linked to the elaboration of **urban wastewater spills** reports to inland waters (streams, rivers, reservoirs...), but also discharges of urban wastewater spills into the ground (2 reports). These investigations were carried out using physicochemical analysis reports, ecotoxicity test reports, microbiological analysis reports (fecal contamination indicators), scientific-technical assessment reports on the results obtained, and documentation provided during the investigation. An opinion was done related to the investigation of **industrial wastewater spills**. For the investigation of **agricultural and livestock origin residues** (liquid manure), an opinion was emitted linked to the impact of the cause and soil with a physical-chemical and a valuation report. The other four opinions were emitted related to several investigations with diverse causes known as **other spills** (accidental spills result of traffic accidents, accidental spills in cleaning processes, spills of unknown origin affecting the environment).

The reports emitted as a consequence of the **spill's environmental investigation** (7 reports) correspond to environmental impact due to the inadequate residue management (3 of the reported). The rest are abandoned and deposited outdoors and in closed areas. These studies involved the realization of physical-chemical reports, ecotoxicity test reports, and scientific-technical valuation reports related to these opinions.

The **environmental investigation of polluted soils** involved the emission of 6 reports. The pollution comes from agricultural and livestock residues (fertilizers, slurry, etc.), industrial residues, and inadequate waste management. The preparation of physical-chemical analysis reports, ecotoxicity test reports, and scientific-technical assessment reports make up these reports.

The studies of **atmospheric pollution** gave place to 1 scientific-technical valuation reports referring to atmospheric emissions of different compounds and their environmental and health impact.

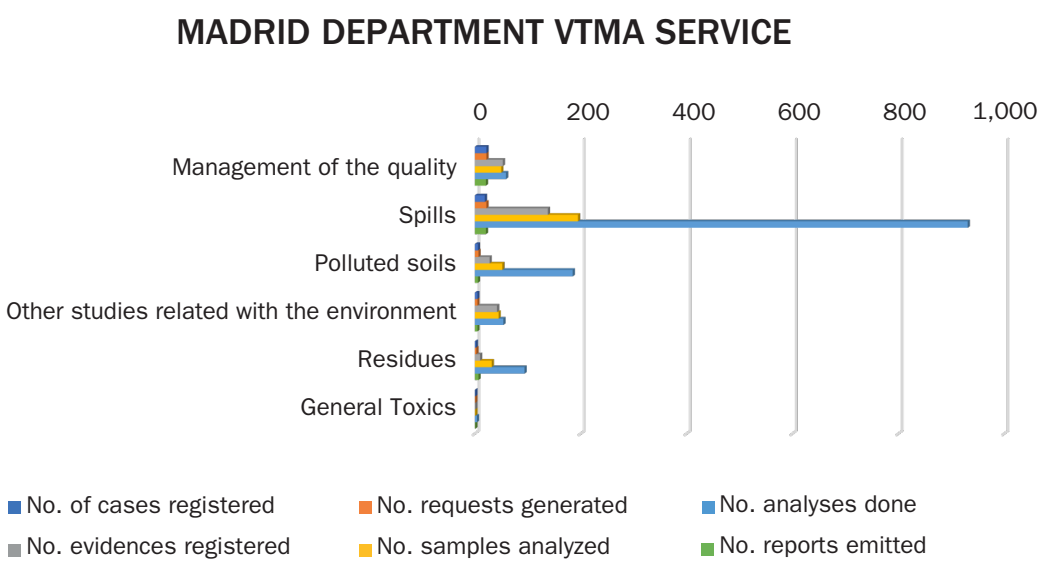
The investigation of heavy metals in samples of illegal medicines resulted in a physical-chemical analysis report and the corresponding reports in the general **investigation of toxic substances**.

Two reports have been issued about scientific-technical assessment **reports** concerning documents forwarded from judicial authorities.

Finally, two reports issued are part of the investigation of offenses against flora and fauna: felling of trees and fish mortality (without apparent cause), that are considered within the miscellaneous of **other studies related to the environment**.

The **proper management of the quality** of the service that ensures the laboratory's activity, the competence, and the ability to generate valid results have involved the issuance of 21 reports related to the continuous implementation of the INTCF quality system.

Figure 7.1.1. Casework of the VTMA Service of the Madrid Department during 2020 according to the type of report



Type of report	No. of cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Management of the quality	22	22	53	50	59	21
Spills	19	22	138	195	931	21
Polluted soils	6	7	28	52	185	6
Other studies related with the environment	5	5	42	45	54	5
Residues	2	3	10	32	94	7
General toxics	1	1	1	1	4	1
TOTAL	**55**	**60**	**272**	**375**	**1,327**	**61**

The number of samples investigated (analyzed and/or studied) based on the evidence received, as well as the number of analyses carried out, corresponds most to reports related to the environmental investigation of spills (with 195 samples analyzed and 931 analyses carried out), followed by reports related to the environmental investigation of polluted soils (with 52 samples analyzed and 185 analyses carried out).

The variety of the typology of the samples analyzed is shown in Table 4. The type of sample most analyzed is related to the nature of the medium affected, with inland water samples being the medium most affected by spills and soil samples in the investigation of polluted soils.

Figure 7.1.2. Types of samples analyzed by the VTMA Service of the Madrid Department

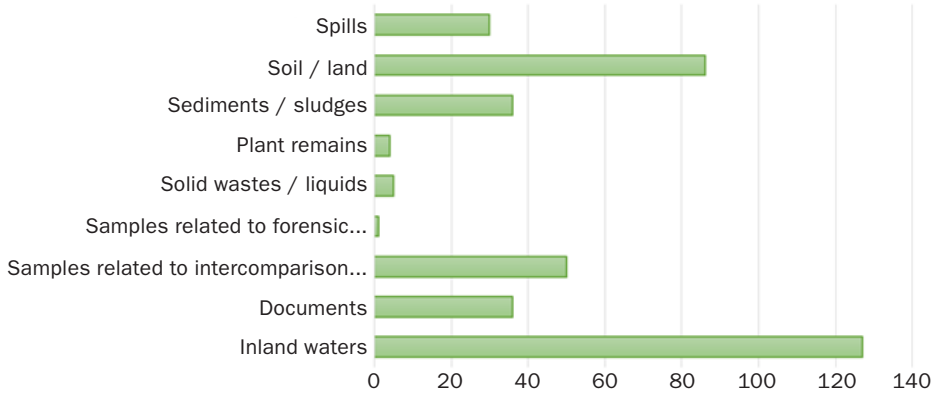


Table 7.1.1. Types of samples analyzed by the SVTMA of the Madrid Department during 2020

	NO. SAMPLES ANALYZED	NO. SAMPLES ANALYZED (%)
Inland waters	127	33.9
Documents	36	9.6
Samples related to intercomparison exercises	50	13.3
Samples related to forensic investigations	1	0.3
Solid wastes/liquids	5	1.3
Plant remains	4	1.1
Sediments/sludges	36	9.6
Soil/land	86	22.9
Spills	30	8.0
TOTAL	**375**	

The types of analysis are related to the different reports that make up the dossiers issued, i.e. physical-chemical analysis reports, microbiological analysis reports, ecotoxicity test reports, and assessment reports, and are listed in Figure 7.1.3 and Table 7.1.2.

Figure 7.1.3. Types of analysis carried out by the VTMA Service of the Madrid Department

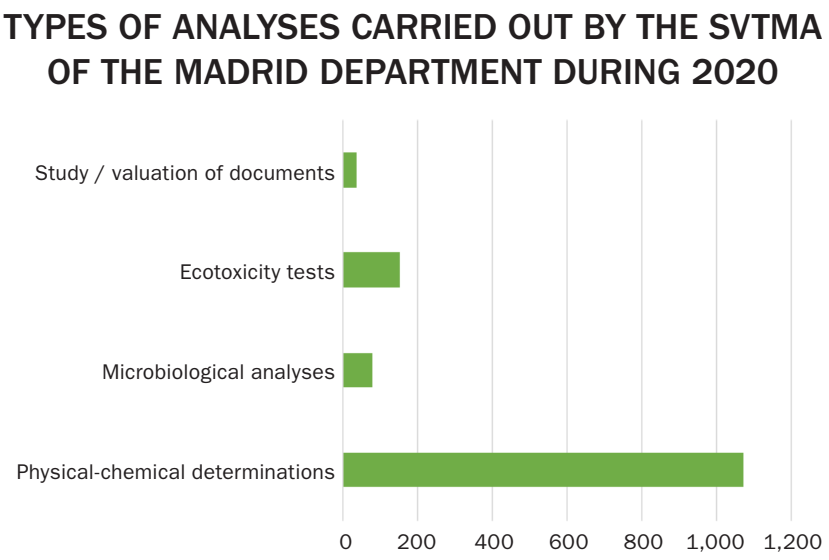


Table 7.1.2. Types of analyses carried out by the SVTMA of the Madrid Department during 2020

	No. of analyses	No. of analyses (%)
Physical-chemical determinations	1,073	80
Microbiological analyses	78	6
Ecotoxicity tests	152	11
Study/valuation of documents	36	3
total	**1,339**	

7.1.1. Interesting case: Investigation of an alleged offence against flora and fauna: felling and poisoning of trees

Background

Member of the Nature Protection Service (in Spanish, Servicio de Protección de la Naturaleza - SEPRONA) of the Guardia Civil contacted the SVTMA of the Madrid Department with the purpose to bring the facts under investigation to the attention of the laboratory

and, before the sampling to be carried out, be advised on the orientation of the analyses to be carried out and the sampling to be performed: type of sampling, samples required and suitable for the investigation and subsequent analysis, sample quantity, as well as the type of containers in which the samples were to be collected.

It was about realizing a sample collection of flora (wood of tree trunks) by supposed hydrocarbon poisoning. Several specimens had been felled (up to 47 according to the inspection executed by SEPRONA). The tree stumps that remained from all of them presented incisions. There was a strong odor of diesel fuel.

The offense was clear, having felled the trees without permission or authorization. They wanted to confirm the presence of "diesel fuel", a product sprayed to the tree stumps after the tree fell to stop them from rebounding.

They planned to perform an aleatory sampling of the cut tree stumps and collect samples of the wood affected by the diesel fuel spill in glass jars (suitable for samples with organic compounds). It was also considered opportune to pick up a land sample of the estate where the felled specimens were found.

Among the species felled, 11 were beech trees (*Myrica faya*) and 3 Canary Island strawberry trees (*Arbutus canariensis*), both included in the provisions for the protection of species of the wild vascular flora of the Autonomous Community of the Canary Islands. (Order of 20 February 1991 of the Regional Ministry of Territorial Policy, on the protection of species of the wild vascular flora of the Autonomous Community of the Canary Islands. http://www.gobiernodecanarias.org/boc/1991/035/002.html). These species were located on land used for rural tourism.

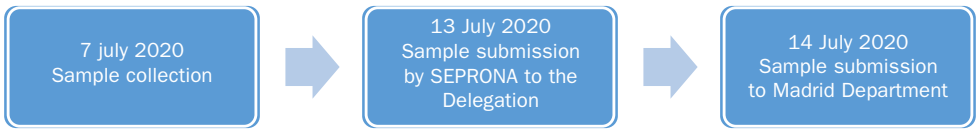
Figure 7.1.1.1. Photographs of the geographical location of the spill

Fuente: https://visor.grafcan.es/visorweb/

Sample collection and submission

The SEPRONA patrol, in virtue of police proceedings and by order of the judicial authority (Juzgado de Primera Instancia e Instrucción, before proceedings) realized the sample taking.

The samples taken together with the documents of the chain of custody were delivered by the SEPRONA at the Canary Islands Delegation of the National Institute of Toxicology and Forensic Sciences. The samples are sent from the Canary Islands Delegation of the National Institute of Toxicology and Forensic Sciences to the Madrid Department. The samples are sent by courier, guaranteeing the chain of custody of the samples sent at all times.



Samples submitted

- 4 wood samples (Known as SH1, SH2, SH3, and SM1):
  - 3 of specimens of beech ("*Myrica Faya*"), taken at random from the eleven felled trees.
  - 1 of specimen of Canary Island strawberry tree (*Arbutus canariensis*).
- 1 surface soil sampling (close to stumps of felled trees and other than those already sampled and called ST1).

All samples were geo-referenced.

Samples were collected in transparent glass jars with metal lids with valve, filled with the wood sample up to ¼ of the volume and up to ¾ of the volume with the soil sample.

Each container/sample is placed individually in a Guardia Civil plastic bag, sealed with plastic flange seals and unique numbering.

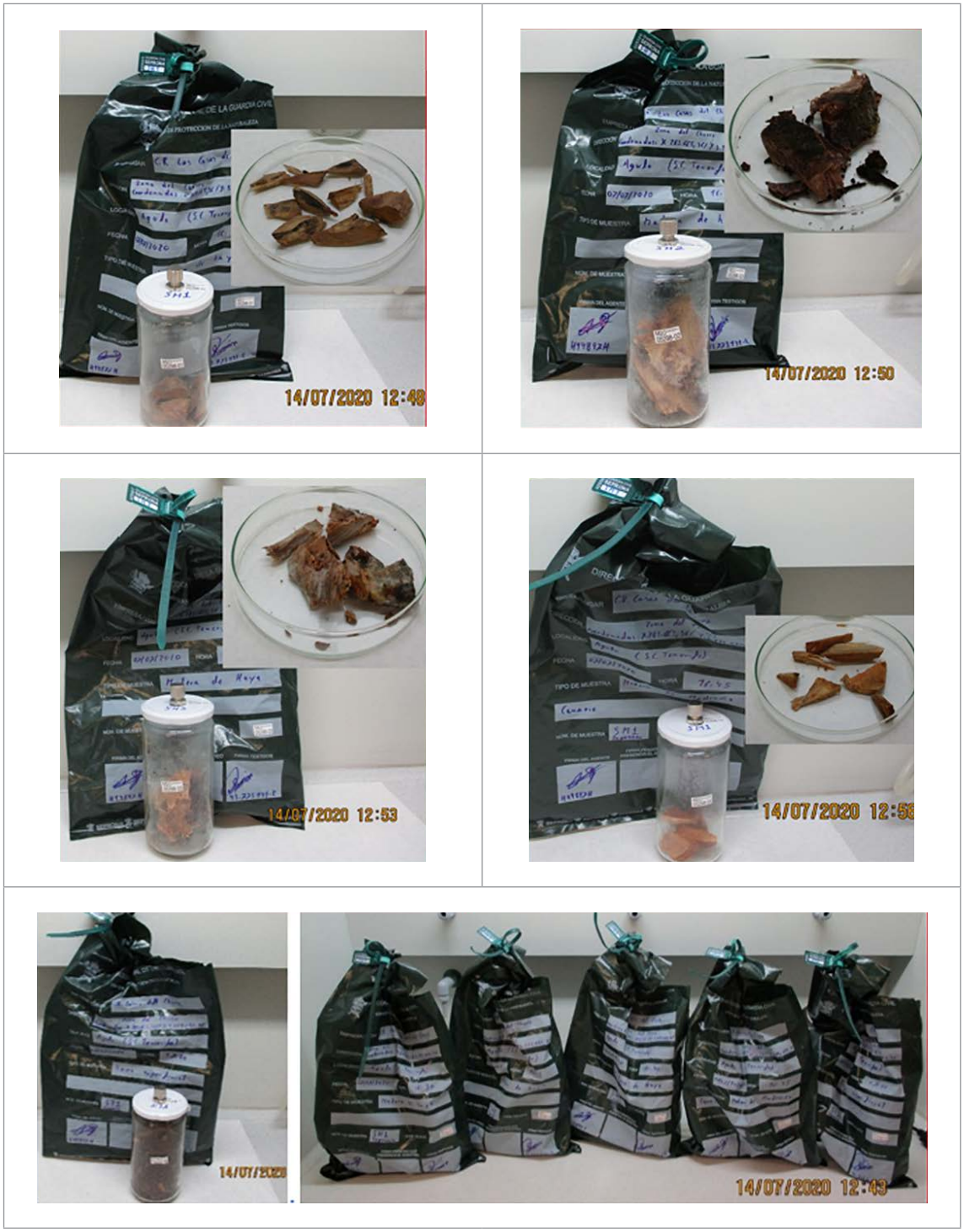
After delivery of the samples to the INTCF, they are assigned a unique numbering both in the Canary Islands Delegation (L20-xxxxx-01, 02, 03, 04 and 05) and in the Madrid Department (M20-xxxxx-01, 02, 03, 04 and 05).

Requested analyses: Investigation of hydrocarbons remains in the wood and superficial land samples collected.

To confirm the presence or absence of hydrocarbons (diesel fuel), they realized the determination of hexane removable material (PNT-V-T054) and total hydrocarbons (adaptation of PNT-V-T061, identification of hydrocarbons by gas chromatography/mass spectrometry), in all samples received.

The presence of diesel fuel was confirmed in all samples by obtaining a chromatographic profile corresponding to the n-alkanes characteristic of heavy petroleum distillate (diesel fuel).

Figure 7.1.1.2. Photographies of the received samples



With this, we answered the analysis request to confirm the use of diesel fuel that sprayed in the tree stumps left after the fell will stop the tree rebound, facilitating the evidence and enabling the offense to be classified as an alleged offense against flora and fauna. The INTCF intervention in the investigation of hydrocarbons (diesel fuel) has established

the existence of direct harmful conduct that goes further more of tree felling, pretending to avoid the rebound of cut species.

Considerations

The facts investigated can be typified inside the offenses against flora and fauna (Chapter IV of Title XVI of Book II. L.O. 15/2003, of 25 November, amending L.O. 10/1995, of 23 November, of the Penal Code. B.O.E., 26 November). Protecting these species due to their natural resource condition, not considering these behaviours as simple administrative offenses. The Penal Code, in its article 332, considers the fell and the destruction of protected species of wild flora as typified behaviours, increasing the penalty to be imposed in the case of species or subspecies listed as endangered.

The species beech (*Myrica faya*) and Canary Island strawberry tree (*Arbutus canariensis*) are included in the provisions for the protection of species of wild vascular flora of the Autonomous Community of the Canary Islands.

Figure 7.1.1.3. Photographs of the protected species of beech and Canary Island strawberry tree

7.1.2. Teaching and training activities

Collaboration with the University of Alcalá de Henares (UAH) in the teaching of the subject "Forensic Instrumental Analysis (652010)" of the Degree in Criminalistics: Forensic

Sciences and Technologies, academic year 2020-2021: Topic 8. Types of atomization sources. Flame atomic absorption spectroscopy. Atomic absorption spectroscopy with graphite chamber. Atomic absorption spectroscopy with hydride generator. Forensic applications: Determination of potassium for establishing date of death, study of hydremia, determination of arsenic. Tpoic 9. Atomic emission spectroscopy. X-ray fluorescence spectroscopy (XRF): fundamentals and instrumentation. Forensic applications. Optical emission spectroscopy with induction coupled plasma (ICP) source: fundamentals and instrumentation. Forensic applications: elemental chemical analysis of ink and glass samples. Environmental crimes. Practical content. Practical 4: Spectroscopic analysis of samples for forensic purposes. Academic year 2019/20, November-December 2020. Pilar García de Yébenes Torres.

“Forensic DNA (Group B-2 Anthropology - DNA) 4th ed.”, CEJ Continuous Training Plan 2020, online, Ministry of Justice. Sergio Sánchez Pérez.

“Analysis of pesticides in environmental samples and wildlife poisoning”, CEJ Continuous Training Plan 2020, online, from 05/10/2020 to 09/10/2020, with a duration of 10 teaching hours. Pilar García de Yébenes Torres, Sergio Sánchez Pérez, Juan José Rivero Herrera, Javier Piga de la Riba, Jorge Muñoz Conejero.

“Refresher course in forensic chemistry and toxicology. From the laboratory to the courts”, CEJ Continuous Training Plan 2020, online, from 19/10/2020 to 23/10/2020, with a duration of 15 teaching hours. Juan José Rivero Herrera.

“Multidisciplinary forensic studies of deaths by drowning”, CEJ Continuous Training Plan 2020, online, from 03/11/2020 to 05/11/2020, with a duration of 6 teaching hours. Pilar García de Yébenes Torres.

“Introduction to the scientific and expert activity of the different services of the INTCF”, CEJ Continuous Training Plan2020, online, from 16/11/2020 to 18/11/2020, with a duration of 7 teaching hours. Juan José Rivero Herrera, Javier Piga de la Riba.

“Homicide investigation. Multidisciplinary approach”, CEJ Continuous Training Plan 2020, classroom-based, from 09/03/2020 to 10/03/2020, with a duration of 12 teaching hours. Juan José Rivero Herrera.

“Polluted soils and groundwater: update of analytical techniques and ecotoxicity tests”, CEJ Continuous Training Plan 2020, online, from 30/11/2020 to 03/12/2020, with a duration of 10 teaching hours. Pilar García de Yébenes Torres, Sergio Sánchez Pérez, Juan José Rivero Herrera. Javier Piga de la Riba, Jorge Muñoz Conejero.

“Methods validation in forensic sciences”, CEJ Continuous Training Plan 2020, online, from 28/09/2020 to 01/10/2020, with a duration of 10 teaching hours. Pilar García de Yébenes Torres, Sergio Sánchez Pérez.

“3 Years of ESAR-NET: Estimation of drug abuse and other applications of wastewater analysis for epidemiological purposes”. Centre for Legal Studies (CEJ), online course, from 4 to 6 November 2020. Javier Piga de la Riba, Jorge Muñoz Conejero.

"Anticoagulation", Grupo Formación EGS Universidad de Nebrija, online course, from 25-01-2020 to 24-02-2020, with a duration of 75 teaching hours. Lara García Mínguez.

"Good Weighing Practices", Mettler Toledo, online course, from 03-12-2020, with a duration of 1 teaching hour. Lara García Mínguez.

"Sanitary residues management", Grupo Formación EGS Universidad de Nebrija, online course, from 25-02-2020 to 24-04-2020, with a duration of 100 teaching hours. Lara García Mínguez.

"Emergency Laboratory", Grupo Formación EGS Universidad de Nebrija, online course, from 25-12-2019 to 24-01-2020, with a duration of 75 teaching hours. Lara García Mínguez.

Agilent Seminar "Tips & Tricks GC and GCMS", 3 March, at San Pablo CEU University of Madrid. 4 teaching hours. Juan José Rivero Herrera.

"Seminar on Purified Water Applications for the laboratory", Merck, classroom course, from 11-02-2020. Lara García Mínguez, Margarita de Pablo López.

"Advanced Mass Hunter software: qualitative and quantitative for GCMS and LCMS". Agilent Technologies. Sergio Sánchez Pérez, Juan José Rivero Herrera.

"Swimming pool water treatment and disinfection: most common mistakes"; 10 June 2020, 1 hour-webinar. HANNA Instruments. Pilar García de Yébenes Torres.

"Verification and calibration of pipettes", Mettler Toledo, online course, 17-09-2020, with a duration of 1 hour. Lara García Mínguez.

Degree in Chemistry. U.N.E.D. June 2020. 240 ECTS credits. Juan José Rivero Herrera

"English B1", Consejería de Hacienda y Función Pública, Comunidad de Madrid, online course, from 17-02-2020 to 31-07-2020, with a duration of 100 teaching hours. Lara García Mínguez.

2020 Online Forensic Symposium: Current Trends in Forensic Toxicology (8-12 June 2020)". Sergio Sánchez Pérez.

7.2. Toxicological and Environmental Assessment Service of the Barcelona Department

Concerning the expert activity from the VTMA Barcelona Department, during 2020, they received 134 requests with 506 evidences. They analyzed 452 samples through a total of 1,657 analyses, emitting a total of 133 expert reports.

Concerning environmental crime investigation, during 2020, our casework increased 14% compared to 2019. The increase is due to a continuous and direct collaboration with Judicial Police. They have strengthened confidence in our expert service as a laboratory and as emissor of valuation reports to the Justice Administration service.

In 2020 casework has considerably increased in several circumstances. On one hand, during the first semester, we have received in the Department all the requests related to the environment corresponding to the Autonomous Community of Valencia that has always been attended by the Valencia Institute of Legal Medicine and Forensic Sciences. On the other hand, the SARS-COV-2 pandemic resulted in an inactive period as the investigation of alleged crimes against the environment and natural resources were not treated, activities considered essential. Finally, in the second semester of the year, this Department got rid of the only service facultative, affecting activity to a large extent.

Concerning the casework related to the environment, the urban and industrial wastewater spills to the hydraulic public domain continue to be the predominant analysis requests received. However, comparing 2020 with the previous year increased other types of requests such as those related to discharges into the marine environment, the investigations related to the management of residues, illegal landfills, abandonment or illegal storage of residues, and the studies related to polluted soil and groundwater. Concerning the organic field of analysis, after the acquisition of the new gas chromatograph-mass spectrometer, we can deal with other investigations related to the environment such as poisoned fauna issues; as well as various reports related to fraud in the qualitative/quantitative composition of phytosanitary products.

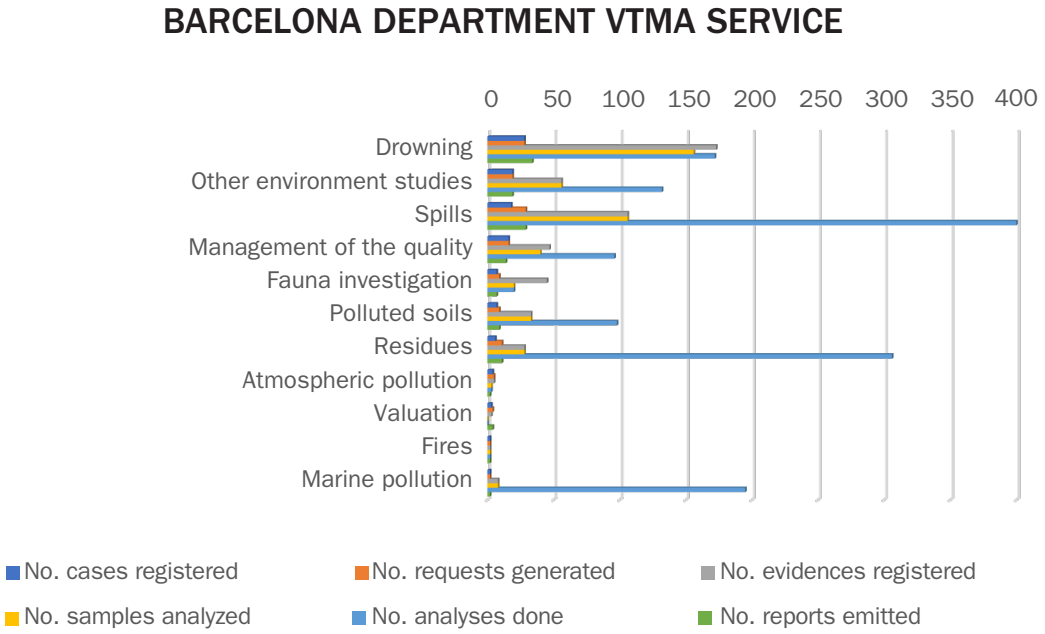
From the Barcelona service, they investigated the drowning cause of death, asphyxia. During 2020 it was reduced by 43%. The reduction is possibly due to the confinement stage, mobility reduction, and tourism reduction.

During 2020 a total of 8 trips to field occurred, obtaining great utility data for the elaboration of environmental valuation reports related to the receptor media, analysis in situ and the data obtained in the visual inspections of the companies under investigation.

The priority was to put all efforts into improving the quality of the enclosed information to the pure analytical data with concrete explanations about each parameter and analyses realized, the interpretation of the analytical results and environmental valuation of all the available data, both of our analyses and other attached reports and our media observations and measurements done “in situ”.

In the same way, to guarantee the quality of our analyses we participate in interlaboratory exercises of several organizations that cover a huge spectrum of determinations that are done in this Service: heavy metals, general pollution parameters, toxicity tests, microbiological tests, and the determination of combustion accelerants in evidence of fires.

Figure 7.2.1. Casework of the VTMA Service of the Barcelona Department during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Drowning	28	28	173	156	172	34
Other environment studies	19	19	56	56	132	19
Spills	18	29	106	106	633	29
Management of the quality	16	16	47	40	96	14
Fauna investigation	7	9	45	20	20	7
Polluted soils	7	9	33	33	98	9
Residues	6	11	28	28	306	11
Atmospheric pollution	4	5	5	3	3	2
Valuation	3	4	3	0	0	4
Fires	2	2	2	2	2	2
Marine pollution	2	2	8	8	195	2
TOTAL	**112**	**134**	**506**	**452**	**1,657**	**133**

7.2.2. Types of samples analysed by the VTMA Service of the Barcelona Department during 2020

The following table shows the number and type of evidence received and analysed in this Service during 2020.

Table 7.2.1. Types of samples analyzed by the SVTMA by the Barcelona Department during 2020

	No. samples analyzed	No. samples analyzed (%)
Spills/inland waters	64	14.2
Groundwater	10	2.2
Drinking waters	16	3.5
Marine waters	23	5.1
Samples related to inter-comparison exercises	39	8.6
Drowning	156	34.5
Solid residues/liquids	39	8.6
Phystosanitary falsification	12	2.7
Poisoned fauna	47	10.4
Soil/land	9	2.0
Fires	2	0.4
Atmospheric pollution	9	2.0
Collaboration Chemistry Service	26	5.8
Total	452	100

7.2.3. Types of analysis realized by the Barcelona Department VTMA Service during 2020

Concerning the analyses and studies that are realized in the Department about the received requests, the following table and graphic shows the distribution sample of the different work realized in the Service.

Figure 7.2.3.1. Types of studies on environmental samples carried out by the VTMA Service from the Barcelona Department

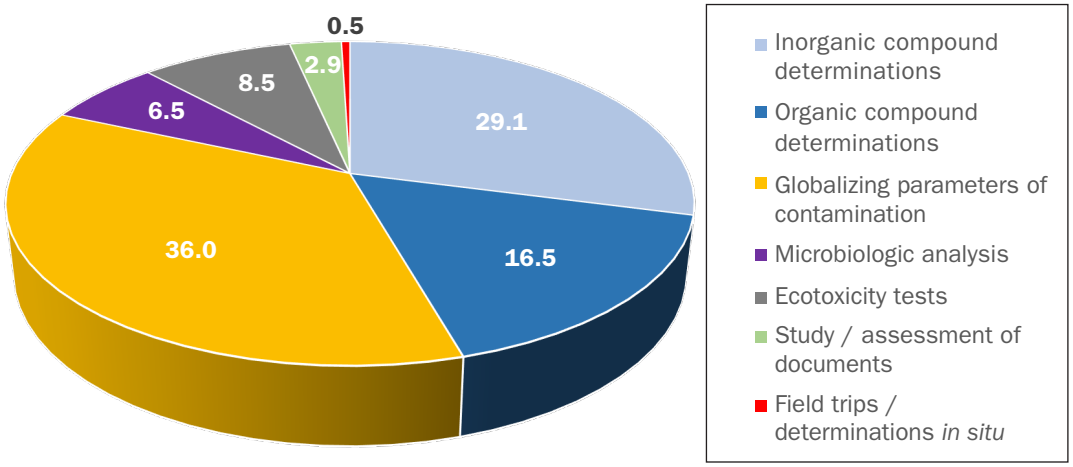


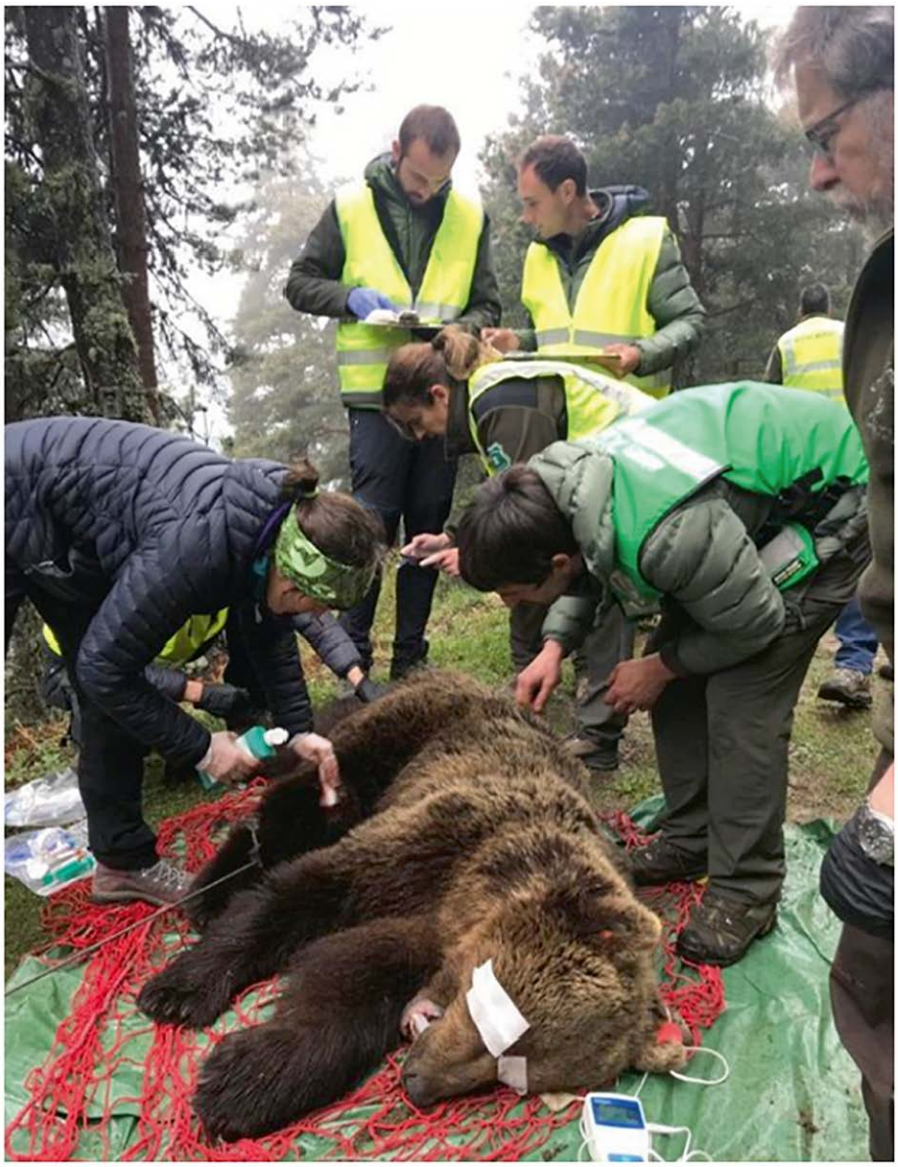
Table 7.2.3.1. Types of studies on environmental samples carried out by the VTMA Service from the Barcelona Department

	No. of analysis	No. of analysis (%)
Determination inorganic compounds	482	29.1
Determination organic compounds	273	16.5
Overarching pollution parameters	597	36.0
Microbiological analysis	108	6.5
Ecotoxicity tests	141	8.5
Study/valuation of documents	48	2.9
Field outings/determinations in situ	8	0.5
TOTAL	**1,657**	**100.0**

7.2.4. Interesting case: Investigation of the cause of death of a brown bear, called Cachou, found dead in the Val d'Aran

The toxicology studies related to the offenses against the environment and natural resources include offenses relative to the protection of flora, fauna, and domestic animals. To investigate alleged offenses against the protected fauna at the request of the Court no. 1 of Vielha and Mijaran, in 2020, a toxicology investigation was carried out in the toxicology valuation and environmental laboratory, in coordination with other institutions to elucidate the cause of death of an animal that enjoys a special degree of protection: a brown bear (Ursus arctos) called Cachou.

Figure 7.2.4.1. The corpse of the bear in a forest of Les (Val d'Aran, Lleida)



The bear corpse was located on April 9th in a forest of Les (Val d'Aran, Lleida). The alert about its death is produced thanks to the signal of his transmitter collar.

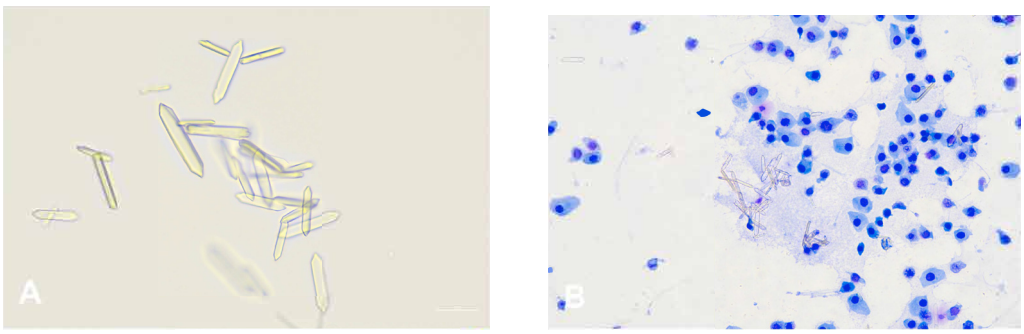
The Mossos d'Esquadra (catalan police) details that the body of the animal was in a location very inclined. In the ocular analysis of the location, it was appreciated that the bear could have fallen from a cliff in an unnatural position. The body was stiff, but it was not swollen or foul-smelling. From observation of the cadaveric fauna, it had not been dead long. From that moment an investigation begins to clarify the causes of death. They move the animal the same day to the Faculty of Veterinary Medicine from the Universidad Autónoma de Barcelona, where they perform the necropsy.

Figure 7.2.4.2. The bear corpse in the Faculty of Veterinary Medicine from the Universidad Autónoma de Barcelona, where they perform the necropsy

The Wildlife Ecopathology Service (SEFAS) performed a preliminary necropsy on the 10th of April, facial injuries compatible with trauma caused by another bear, but of a minor nature and not affecting vital structures, were observed. The cause of death is not evidenced by the necropsy. For the realization of a toxicology and histopathological analysis different biological samples of the corpse are obtained. It is to determine if his death could be related to the ingestion of toxic substances.

The complementary histopathology studies to the necropsy raise suspicions about the possible intoxication of the bear because of criminality. Microscopic analysis of the urine sediment, after centrifugation at 1,500 rpm for 5 minutes, revealed numerous crystals with morphology compatible with crystals of hippuric acid or calcium oxalate monohydrate. They are elongated, transparent, six-sided crystals.

Figure 7.2.4.3. Results of microscopic analysis of urine sediment. A: Direct observation under the microscope. B: Rapid staining with Diff-QuicKTM of the sediment obtained by centrifugation of the urine



The observation of what appear to be calcium oxalate crystals raises the suspicion of a possible poisoning by ethylene glycol or other glycols. Ethylene glycol is a product present, for example, in high concentrations in antifreeze fluids used in cars.

Calcium oxalate crystals are an end product of the metabolism of various types of glycols.

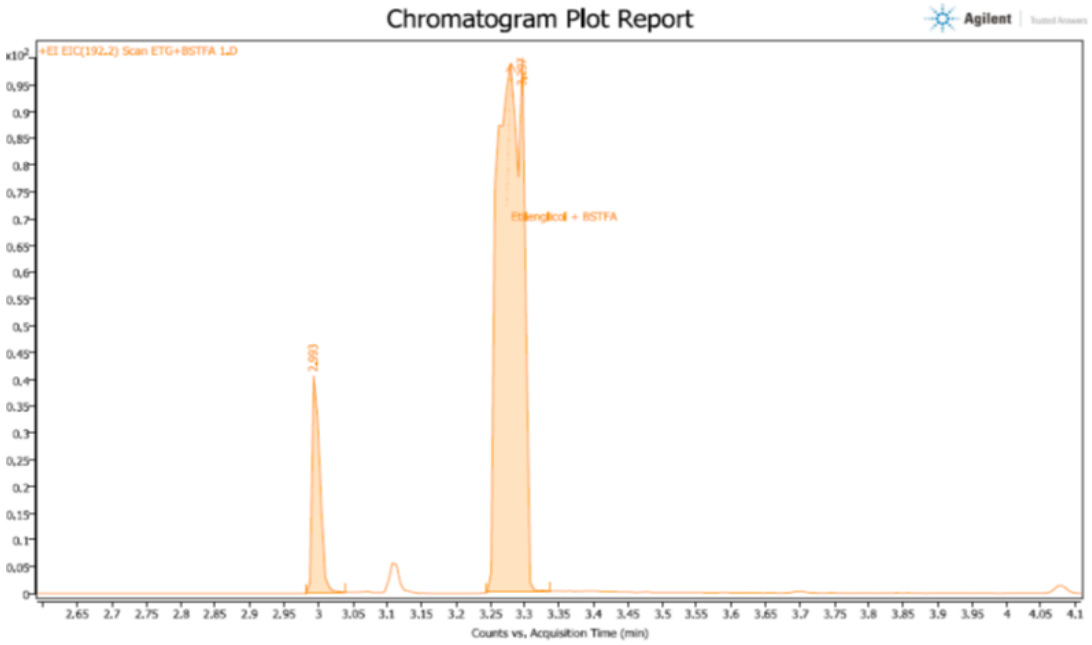
The samples received at the Toxicological and Environmental Assessment Service were sent from the Wildlife Ecopatology Service of the Department of Animal Medicine and Surgery (Universidad Autónoma de Barcelona). These samples were: gastric contents, blood, urine, serum and liver, and kidney.

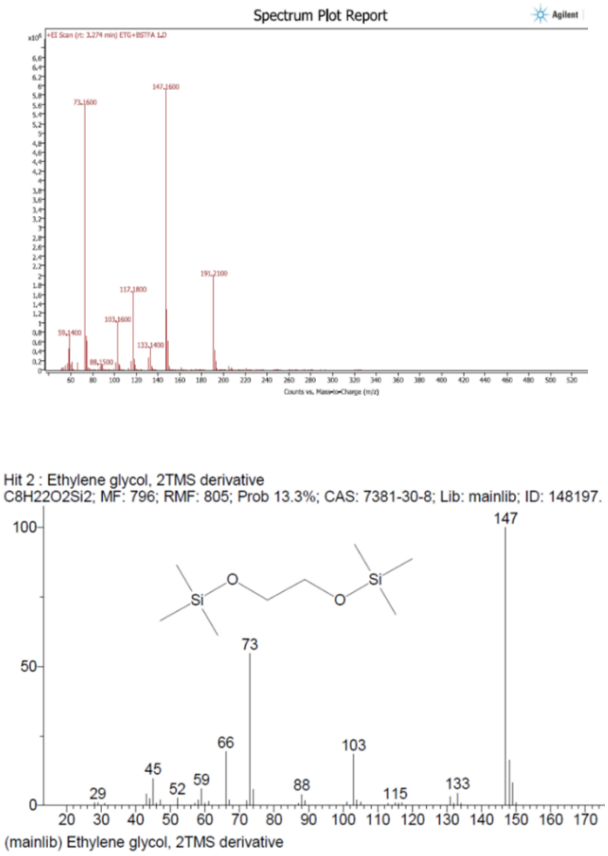
In addition, different samples of feces and evidence related to the case, located in the area where the corpse was discovered, were received later.

The analyses carried out in this service were therefore aimed at the toxicological investigation of ethylene glycol and its metabolic product glycolic acid, as well as other antifreeze agents such as diethylene glycol, using extraction, derivatization, and analysis by gas chromatography-mass spectrometry.

The samples analysed (blood, serum, and gastric contents) showed the presence of high concentrations of ethylene glycol and its initial metabolism product, glycolic acid.

Figure 7.2.4.4. Results of gas chromatography-mass spectrometry analysis





The report carried out by this service of the National Institute of Toxicology determined the presence of ethylene glycol in the samples taken from the bear, a chemical product present in high concentrations (90-95%) in vehicle antifreeze. With all the data analyzed, it was possible to determine that Cachou's death occurred between the 8th and 9th of April and the poisoning between the 26th and 27th March. The investigation is still open to determine the reasons for the death of the animal, taking into account that many people were against the presence of the bear as it had attacked cattle and horses of some herds.

7.2.5. Education and teaching activities

7.2.5.1. Teaching

Luis Burillo Borrego: Lecture on "Forensic Ecotoxicology" as part of the subject Environmental Liability Systems. Master's Degree in Environmental Law and Sustainability (MADAS) University of Alicante. 23 March 2020.

Luis Burillo Borrego: Conference: Peculiar characteristics of environmental expertise. Workshop on Strengthening the determination and prosecution of environmental crimes. Attorney General's Office of Ecuador, Program of Integral and Social Reparation (PRAS),

Environment Department; and Latin American Network of Environmental Public Prosecutors. 22 and 23 June 2020

Luis Burillo Borrego: Conference: Reasonable Fuels. II International Conference on Law and Renewable Energy. 3-4 December 2020. PRODENER Project "The transformation of the Energy Model: proposal for a comprehensive regulatory framework for the development of Renewable Energies" (DER2017-89157-R).

7.2.5.2. Training

Luis Burillo Borrego: Multidisciplinary forensic studies of deaths by drowning. Centre for Legal Studies. 7 hours. 3-11-2020 to 5-11-2020.

Luis Burillo Borrego: Course on polluted soils and groundwater: Updating of Analytical Techniques and Ecotoxicity Tests. Centre for Legal Studies. 10 hours. 30-11-2020 to 3-12-2020.

Herminia Bueno Cavanillas: Polluted soils and groundwater: update on analytical techniques and ecotoxicity tests. From 30 November to 3 December 2020. Centre for Legal Studies. Online Continuing Education. 8 hours.

Herminia Bueno Cavanillas: Analysis of pesticides in environmental samples and wildlife poisoning. From 5 to 9 October 2020. Centre for Legal Studies. Online Continuous Training. 9 hours.

Herminia Bueno Cavanillas: Validation of methods in forensic sciences. From 28th September to 1st October 2020. Centre for Legal Studies. On-line Continuous Training. 7 hours.

7.2.5.3. Publications

Burillo Borrego L, Castaño Martínez E, Environmental risk from alternative and renewable combustibles in Valencia Martín G, Rosa Moreno J, *La Transformación renovable del modelo energético.* Ed. Aranzadi, n.º 29. 2020, pp 256-289.

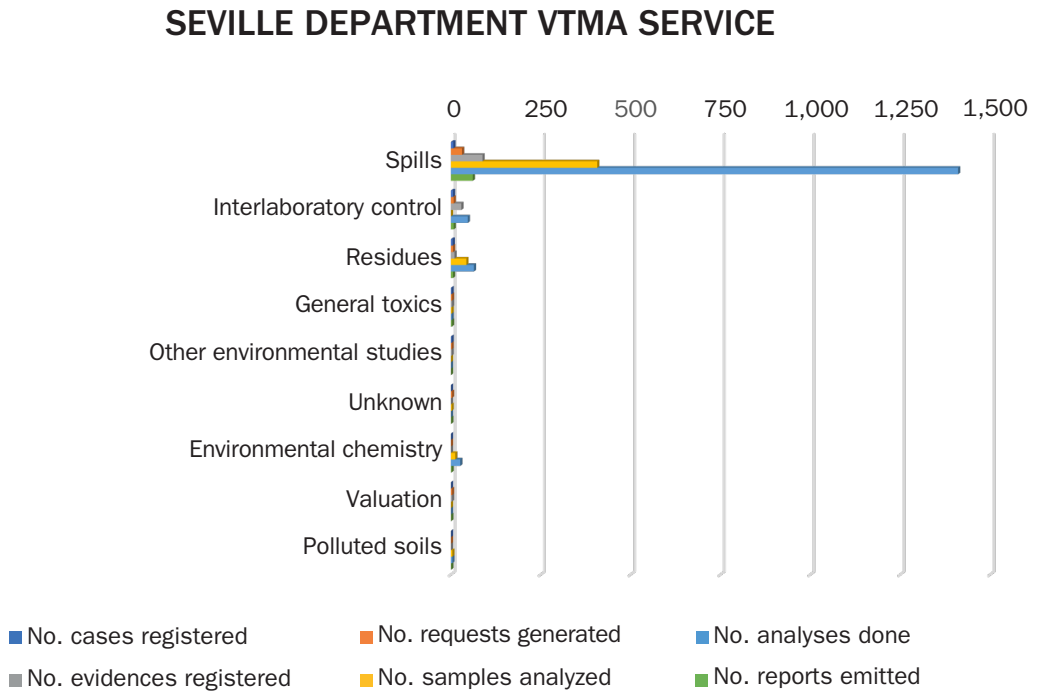
7.3. Toxicological and Environmental Assessment Service of the Seville Department

In 2020, the Service stayed several months practically inactive due to the state of alarm. During the period from 14 March until the end of summer, the environmental investigations were paralyzed because they were not inside the Justice's proprietary attention. During that period, no cases were received. The laboratory worked exclusively for the maintenance, the realization of sample taking, and the elaboration of expert reports mainly by teleworking, the reason why the elaboration of 83 reports is greater than the number of cases and requests received, 22 and 56 respectively, as the 2019 pendency reports have been prepared.

7.3.1. Casework of the SVTMA Service of the Seville Department during 2020 according to the type of report

Among the cases/petitions received this year, the largest number concerned wastewater spills, urban, and discharges that have not undergone any treatment. The rest of the spills are mainly from the olive industry.

Figure 7.3.1. Casework of the VTMA Service of the Seville Department during 2020 according to the type of report



Type of report	No. cases registered	No. requests generated	No. evidences registered	No. samples analyzed	No. analyses done	No. reports emitted
Spills	7	31	88	407	1,411	61
Interlaboratory control	6	8	29	0	47	8
Residues	5	6	10	43	64	6
General toxics	2	3	3	2	2	3
Other environmental studies	2	2	2	0	0	0
Unknown	0	3	0	2	0	1
Environmental chemistry	0	0	0	12	26	2
Valuation	0	3	3	0	0	1
Polluted soils	0	0	0	4	4	1
TOTAL	**22**	**56**	**135**	**470**	**1,554**	**83**

7.3.2. Interesting case: Investigation of the clandestine spills of slurry ponds into a public watercourse in a specially protected site. Arriate, Málaga

In November 2018, the SEPRONA patrol of the Guardia Civil of Ronda became aware of some spills of slurry from the ponds of a pig farm into the Ventilla stream.

The ponds were emptied through illegal hose pipes, which had an organoleptic impact on the quality of the water in the stream.

Figure 7.3.2.1. Photographs of the slurry ponds in Arriate and detail of an illegal emptying hose

On 26/11/2018, the SEPRONA Team of the Civil Guard (Guardia Civil) in Malaga took samples of the slurry from the ponds and sent them to this Institute for analysis and assessment of the damage they could cause to water quality and the balance of natural systems.

The samples analyzed showed characteristics compatible with a slurry spill. This type of spill, due to its polluting nature measured mainly in terms of biochemical oxygen demand, chemical oxygen demand, suspended solids, phosphorus, and nitrogen compounds, will not be authorized under any circumstances.

The values found in the DBO and DQO tests show an excess of organic matter which will lead to a forced depuration environment and a decrease in the oxygen levels of the receiving medium. The most important emissions are those related to nitrogen (N) and phosphorus (P), which contribute especially to eutrophication phenomena.

In the case of direct emissions into the stream, through the drainage hoses of the ponds, they may give rise to an increase in organic matter and nutrients, consuming the oxygen in the recirculation medium and thus creating an anoxic environment in the stream. It will eventually lead to the disappearance of aquatic species, reducing the diversity of the stream. Eutrophication of the water may occur. The excess turbidity will decrease photosynthetic processes favouring anaerobic fermentation conditions.

The Ventilla stream forms part of the basin of the Guadiaro, one of the main rivers of the Mediterranean Hydrographic District. It is a tributary of the Guadalcobacín, which, when

it joins the Guadalevín, gives life to the aforementioned Guadiaro. The gallery forest of the Ventilla stream is the best preserved in the Serranía (mountain range) de Ronda. It forms part of protected natural spaces, recognised in a municipal figure in the town council of Arriate created for the enhancement and knowledge of the Ventilla stream, which is the Riparian Complex of Environmental Interest.

Furthermore, the ponds included in the authorization for the activity are 3 waterproofed ponds. The fourth pond at the farm is not authorized and is built directly on the ground without being waterproof, which could lead to seepage through the ground and affect the groundwater.

The report issued by this Service concludes that the discharge of wastewater or products with the characteristics of the samples analyzed, due to their polluting power, is not authorized and may cause substantial damage to the quality of the La Ventilla stream, which is protected as a Riparian Complex of Environmental Interest. The continuity of the discharge over time could cause severe damage to the balance of the natural systems in the study area.

The case has recently been judged with the result of conformity on the part of the operator of the activity.

7.3.3. Scientific and training activities

7.3.3.1. Contribution in scientific congresses

Lhoëst Mathijsen F. “The Toxicological and Environmental Assessment Services”. Informative introduction to the scientific and expert activity of the different Services of the INTCF. 16-18 October 2020. Centre for Legal Studies. Online Continuing Education.

Cano Rodríguez M.E. “Ecotoxicity tests: forensic application in contaminated soils in the INTCF”. Polluted soils and groundwater Update on analytical techniques and ecotoxicity tests. From 30 November to 3 December 2020. Centre for Legal Studies. On-line Continuing Education.

Cano Rodríguez ME, Gómez Bujedo S. Validation of methods in forensic sciences. 28 September to 1 October 2020. Centre for Legal Studies. Online Continuing Education. 7 hours.

7.3.3.2. Education and training activities

Cano Rodríguez ME, Gómez Bujedo S, Lhoest Mathijsen F. Analysis of pesticides in environmental samples and wildlife poisoning. 5-9 October 2020. Centre for Legal Studies. Online Continuing Education. 9h.

Cano Rodríguez ME, Gómez Bujedo S, Lhoest Mathijsen F. Informative introduction to the scientific-pericial activity of the different INTCF Services. From 16 to 18 October 2020. Centre for Legal Studies. Online Continuing Education. 7 hours.

Cano Rodríguez ME, Gómez Bujedo S. Actualization course in forensic chemistry and toxicology. From the laboratory to the courts. From 19 to 23 October 2020. Centre for Legal Studies. Online Continuing Education. 16 hours.

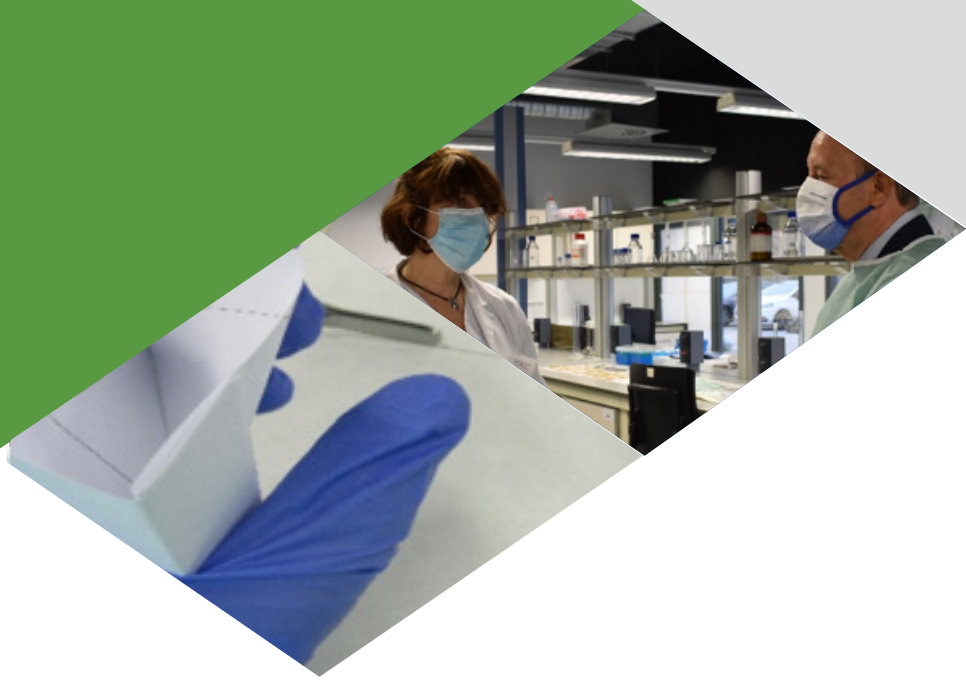
Cano Rodríguez ME, Gómez Bujedo S. The multidisciplinary investigation of sexual aggressions in forensic laboratories. From 9 to 13 November 2020. Centre for Legal Studies. Online Continuing Education. 10 hours.

Cano Rodríguez ME, Gómez Bujedo S, Lhoest Mathijsen F. Polluted soils and groundwater: updating analytical techniques and ecotoxicity tests. 30 November to 3 December 2020. Centre for Legal Studies. Online Continuing Education. 8 hours.

7.3.3.3. Other merits

Credentials awarded to María Elena Cano Rodríguez and Silvia Gómez Bujedo, doctors of the VTMA Service of the Seville Department: Diploma of Congratulations in recognition of their professionalism, dedication, and love for the Service, for their collaboration and full willingness in the development of the VASTUM Operation carried out by the SEPRONA Investigation team. Command of the Guardia Civil of Málaga. 17 March 2020.

8. Quality Assurance Services



Each INTCF Department has a Quality Assurance Service (spanish initials, SGC). There is no Service like this in the La Laguna Delegation, so the functions are performed by a facultative named by the Director.

The Quality Assurance Services ensure two of the INTCF functions defined in article 480 of the Organic Law 6/1985, of 1 July, of the Judiciary Power, which is to "contribute to the scientific criteria unity" and "analytical expert quality", through the management and control of all the aspects related to the quality assurance in the analytical Services of the INTCF according to UNE-EN ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories, as well as through the organization and coordination of interlaboratory exercises both nationally and internationally, as a reference centre in Toxicology and Forensic Sciences.

Concerning the implementation and maintenance of accredited test scopes based on the UNE-EN ISO/IEC 17025 Standard, and in all matters relating to the process and scope of accreditation as test providers based on the UNE-EN ISO/IEC 17043 Standard, the Quality Assurance Services of each Department act as the main interlocutor with the National Accreditation Body (ENAC).

Apart from their role as experts, the Service issues reports related to the quality system and the chain of custody. These reports may be external or internal; the latter is issued to inform the Department's Directors about the implementation and monitoring of the quality system progress.

Although each Quality Assurance Service carries out its functions within its Department/Delegation, during 2020 the following tasks were carried out jointly:

- Fulfilling one of the objectives established for the Quality Assurance Services, in the 2020-2022 Action and Research Plan, the general functions have been reviewed among the Departments and the Delegation, to harmonize their classification and include them in the web portal for their knowledge, with the following being agreed:

  - *Management and control of the quality system documentation*
  - *Elaboration of standard operating procedures related to quality management*
  - *Follow-up and closure of non-conformities, corrective actions, complaints and risk, opportunity management and improvement actions*
  - *Internal audits management*
  - *Development/coordination of the interlaboratory comparisons organized by the INTCF, as a reference centre*
  - *Control and evaluation of the interlaboratory comparison results in which the centre participates*

- *Advice and monitoring of validations*
- *Collaboration with the different INTCF Services in:*
  - *The implementation, maintenance, and improvement of a quality system based in UNE-EN ISO/IEC 17025: General Requirements for the Competence of Testing and Calibration Laboratories*
  - *Management of staff training*
  - *The elaboration and revision of the calibration, verification, and maintenance program equipment*
  - *The elaboration and revision of the Standard Operating Procedures for Technical Work*
  - *Maintenance of accreditations and in the process of new scopes*

- The approval of a new version of the ISO/IEC 17025 standard on 30 November 2017, which cancels and replaces the ISO/IEC 17025:2005 standard, meant that accredited laboratories, such as those of the INTCF, had to adapt their systems to the new requirements established. During 2020, the Quality Assurance Services updated and adapted 5 chapters of the Quality Manual to the new requirements (MC-C1 Organization, MC-C2 Quality System, MC-C3-Personnel, MC-C5 Equipment, and MC-C8 Control of Records, Issuance of Reports and Opinions. The Quality Policy was updated to make clear the Directions's commitment to manage any conflict of interest that could jeopardize impartiality and establish measures to maintain confidentiality.
- Heads of the Quality Assurance Services of the different Departments have actively participated and collaborated within the Quality group of the Network of Official Spanish Forensic Laboratories (RLFOE), with virtual attendance at the annual meeting. At these meetings, new developments in international standards that apply to the forensic field are shared. It serves as a forum to exchange opinions related to the management and implementation of quality with the other quality managers of Spanish forensic laboratories.
- Within the Programmes of the General Framework for Quality Improvement of the AGE D.G. established by the Public Governance S.G. of the General Inspectorate of Services of the AGE, the Quality Assurance Services have carried out the completion of a survey, with the target to reflect the quality activity of the INTCF to the programs of the general framework to improve the quality of the General State Administration (ISAM 2020).

The personnel resources available to the Quality Assurance Services for the development of all the activities carried out during 2020 are as follows in Table 8.1.

Table 8.1. Staff of the Quality Assurance Services of the different Departments

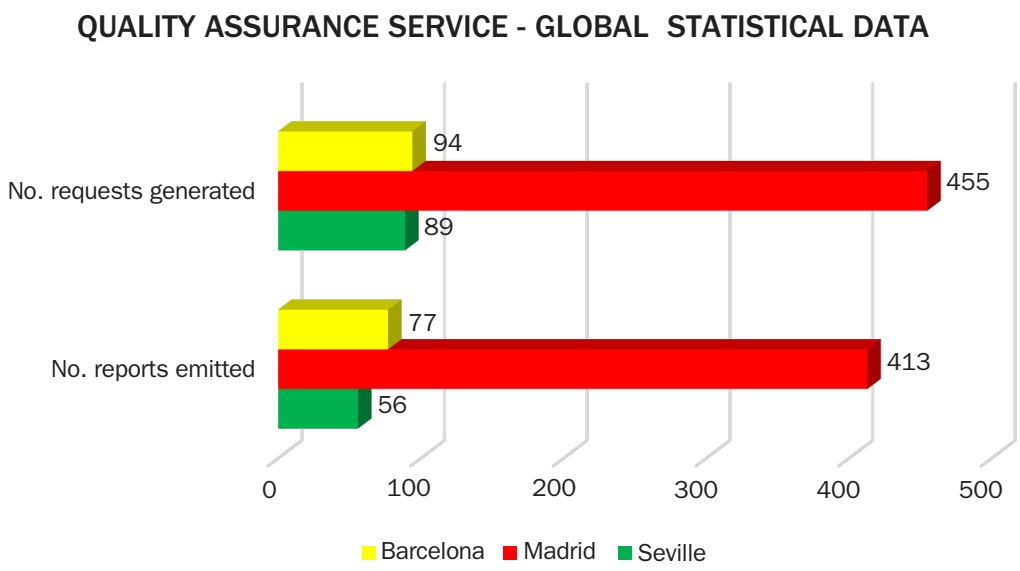
	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA
Head of the Department	1	1	1
Facultatives	2	1 + 1 (*)	2
Specialist technicians	1	1 (**)	–
Laboratory assistants	–	–	–
Administratives	1	–	–

(*) Facultative with partial dedication in the Service.

(**) Specialist technician that does activities related to the management focused on equipment and MRs of the Department

Overall data on the number of requests registered and reports issued by the INTCF Quality Assurance Services during 2020 are collected in Figure 8.1.

Figure 8.1. Overall data of the number of requests registered and reports issued by the INTCF Quality Assurance Services during 2020



	No. requests generated	No. reports emitted
Barcelona	94	77
Madrid	455	413
Seville	89	56
Total	**638**	**546**

Not all the activities carried out by the different Quality Assurance Services are recorded in the LIMS system, so the detailed distribution of the activities carried out by each of the Quality Assurance Services during 2020 is shown in the different tables shown throughout this chapter (Tables 8.1.1, 8.2.1 and 8.3.1).

These activities would be defined as follows.

1 and 2. Management of system documents. Standard Operating Procedures (SOPs) are written documents that describe how an activity included within the Quality System has to be carried out. The annexes are part of the SOPs and include specific information. Due to its importance, constitute an independent document. Data collection sheets are used to record the activity

As the SOPs, the HRDs, and the annexes related to them are the documentary basis of the quality system implemented in the Department. The review of their validity and adaptation to new quality requirements and to the operational changes that need to be implemented is important to ensure the correct functioning of the laboratories. The SGC reviews the technical preparation and the design of all of them before they are put into effect. Once approved, the SGC is in charge of its management and distribution.

3 and 4. Staff training. The training and qualification of the personnel working in the different Services are one of the pillars of the quality of the work carried out in the laboratory. For this reason, the ISO 17025 quality standard establishes as a requirement that the laboratory is sure that all the staff has the necessary competence to carry out the activities for which they are responsible. The training programs and all the registers derived until the obtention of the qualification certificate are supervised by the SGC.

5. Management of internal/external equipment calibrations. The SGC collaborates with the Services in the preparation and review of the equipment calibration, verification, maintenance program, and the management of external and internal calibrations. It also coordinates and manages the inventory of equipment, reference materials, standards, and reference data.

6. Validation studies. The validation of a test method involves working out studies to check that the methods are suitable for their intended purpose. Although the Services are responsible for carrying out the validation studies, the role of SGC is to advise and guide the design (parameters to be studied, the matrices to be tested, the evaluation criteria to be applied to evaluate the results), the development and the evaluation of results.

7-8. Intercomparison exercises in which the INTCF participates. Participation in Quality controls, called Intercomparison Exercises, is one of the most useful tools that laboratories have for their self-assessment and assurance of the validity of the results they issue. The Services of the different Departments/Delegations of the INTCF receive samples similar to those of the casework, analyze them, and evaluate the results obtained against criteria previously established by the suppliers. The SGC manages the reception of the samples from these exercises. In some cases, it is in charge of sending results after their analysis.

Once the provider issues a report, the SGC evaluates the participation result of each Service. Each new supplier is assessed on the basis of a test developed by the Quality Assurance Services to evaluate the suitability of the characteristics and technical aspects of the new testing exercise.

9 and 10. Intercomparison exercises that the INTCF organizes. The INTCF Regulation recognized its role as a reference centre. Among its functions as a reference centre is to organize quality assurance controls that allow self-evaluation of the different laboratories in the methods. In this regard, the INTCF acts as a provider of Intercomparison Exercises organizing three exercises from the Quality System Services. A quality control for forensic and paternity laboratories realized annually by the INTCFM, in collaboration with the Spanish and Portuguese Speaking Group of the ISFG, a four-monthly one organized and carried out by the INTCFS and focused on laboratories performing blood alcohol and volatiles analysis, and an annual one, organized by the INTCFB, which allows laboratories to analyze drugs of abuse commonly found in stashes.

11. Internal audits. The laboratories and the internal audits follow up continuously the Quality System requirements. They are implemented allowing the detection of deviations from the work procedures and established policies. These audits are done in planned intervals as it is established in the Internal Audits Program elaborated by the Quality Assurance Service (spanish initial, SGC). They are approved by the Direction when the circumstances of the moment recommend it (when changes are introduced in the work systematics, it is suspected non-compliance with the established Quality requirements...).

12. Quality system review. This activity, together with the internal audits, is essential to obtain information about the conformity of the activities carried out with the requirements of the implemented Quality System and with the requirements of ISO 17025. The quality system is reviewed periodically in a meeting with the Direction at least once a year. It is to assure its efficiency and if necessary to start with the corrective or improvement actions. The information derived from this review is duly documented in a comprehensive and detailed report drawn up by the Quality Assurance Service. It does not include only the review findings, but also any need for change detected and the proposed actions for improvement.

13 to 15. Non-conforming works, improvement, and corrective actions. When any aspect of the activities carried out under the Quality System does not comply with the established procedures or requirements, a non-conformity or non-conforming work (NC) is opened to study the causes of the deviation, assess the influence it may have had in other areas and the risk that it may pose for the activity of the laboratory. Corrective actions (AC) are needed to correct the causes that have given rise to it and avoid the same situation. The SGC documents all the NCs, evaluates the corrective actions proposed by the Service, and follows them.

16. Actions to address risks and opportunities. The new risk-based approach of the new ISO 17025 quality standard requires laboratories, through the SGC, to identify and assess the risks and opportunities associated with the activities performed.

17. Claims and complaints management. The SGC performs the initial management of the communications (professions, requests, etc.) in which it is suspected that there may be implicitly a claim or that, in the case of not taking the appropriate measures, may generate a claim, as well as the management of user complaints in relation to any activity of the INTCF. It is also responsible for the management when a citizen submits or sends a complaint.

8.1. Madrid Department Quality Assurance Service

Thanks to the reorganization of the staff based on their availability to travel to the INTCFM during the state of alarm and the use of telematic means, it has been possible to continue keeping the management tasks carried out in the SGC active, as well as those carried out in collaboration with the Services.

In 2020, the SGC has supervised the initial training programs that have been carried out for all newly hired personnel, as well as the programs focused on acquiring new qualifications by personnel already qualified in other activities. Likewise, inside the training of the new facultative and assistants, seminars were done in order for all the staff to know the Quality System and work under the guidelines determined by UNE-EN ISO/IEC 17025.

The INTCFM Services' purpose was to use the latest techniques or optimize them to provide increasingly reliable results to users. Several validations have been carried out under the guidance of the SGC. It is to assess the suitability of a method or an analytical improvement before its implementation. One of them was the one realized during the initial months of the pandemic to implement a protocol to extract and detect the genetic material of the virus that caused the SARS-CoV-2, in judicial autopsies in suspect causes of death by this virus agent. The validation studies were focused on the election of methods for the extraction of viral RNA from samples in different matrices (swabs and paraffin blocks) and in the assessment of the efficiency of a qualitative multiplex assay allowing the detection of 3 SARS-CoV-2 virus-specific regions: ORF1ab, protein S and protein N (TaqPath™ COVID- 19 CE-IVD RT-PCR). Such studies were executed in a brief period. These studies resulted in the implementation of two automated extractions of SARS-CoV-2 genetic material. One for swabs and the other one for paraffin blocks , respectively, as well as multiplex real-time qualitative detection of the virus.

Some of the validation studies that have also been developed or completed during 2020 were the extraction of unknown samples in the Biology Service with a robot, and the optimization of already implemented techniques such as new columns in the quantitative determination of heroin or the quantification or confirmation of the method for the quantification of cannabinoids in blood, serum, and plasma by GC-MSMS in the Drugs Service.

Despite the difficulties that the sanitary situation of 2020 has supposed, one more year it has been possible to organize and coordinate the Intercomparison Exercise "Study of

DNA polymorphisms in bloodstains and other biological samples". The study has been reevaluated by the National Accreditation Body (ENAC). This accreditation body has evaluated and approved the maintenance of the accreditation scopes that recognizes the INTCFM as a testing laboratory that works under UNE EN ISO 17025 (LE1367 and LE1366 files). It is a provider of Intercomparison Exercises according to UNE EN ISO 17043 (PPI/016 file).

In 2020, in addition to organizing this exercise, we collaborated with the Spanish and Portuguese Speaking Group in carrying out the second collaborative exercise "Forensic Applications of Massive Sequencing", whose results may help to unify scientific criteria in this novel technique, which is on the rise in the forensic field.

8.1.1. Activities performed by the Service

The activities and functions that the Quality Assurance Service has carried out during 2020 are collected in Table 8.1.1.

Table 8.1.1. Activity data corresponding to 2020

Activities	
1. Development of new Standard Operating Procedures (SOPs) and Data Collection Sheets (HRDs). Modification of versions of procedures and sheets	35 (PNT) 28 (HRD)
2. Elaboration of new annexes and existing ones	43
3. Training programs and qualification certificates of the staff	22
4. Initial and ongoing training of personnel in the Quality System	9
5. Management of external equipment calibrations	2
6. Validation studies of analysis methods	7
7. Evaluation of the participation in intercomparison exercises	102 (107)
8. Conformity assessment of organizers of intercomparison exercises in which the Department participates	—
9. Evaluation of external participant (reports)	3
10. Evaluation of external participant (certificates)	295

Activities (cont.)	
11. Internal audits	9
12. Management review by the Management	2
13. Nonconformities or non-confirming work records	63
14. Corrective action records	19
15. Improvement action records	24
16. Actions to address risks and opportunities	5
17. Claims and complaints management	22

The following is detailed to fully describe the data corresponding to the activities collected in this table.

1 and 2. Management of system documents. From a total of 35 working procedures, 29 already existing versions were modified, both technical and of management, elaborating 6 new technical procedures. From the HRDs put into force, 13 were newly created. The rest were modifications to existing versions. 43 annexes were managed.

3 and 4. Staff training. In 2020, 22 training programs were reviewed and managed with the correspondent registers. 13 of them were training programs to access the centre, and the rest were elaborated for the training of staff into new techniques.

Likewise, as part of the initial training, the SGC gave seminars to raise awareness of the Quality System implemented at the INTCFM. During 2020, training in Quality was given to 9 people (7 assistants, 1 facultative, and 1 specialist laboratory technician). Throughout the year, all the queries made by the Services were answered, especially about incidents or doubts related to the management of samples, technical activities, and the issuing of reports.

5. Management of external equipment calibrations. In 2020 the calibration, verification, and management program of each Service reviewed some incoherence concerning the equipment maintenance. After informing the Service, they were assessed and remedied. Annually, a total of 92 pipettes were externally calibrated by an ISO 17025 accredited company for automatic pipettes with a volume of 10 ml or less once again. The SGC has coordinated with the Services to send them, subsequently supervising the evaluation of the external calibration carried out by them. The incidents detected after calibration and their possible transcendence in the laboratory's analytical work was evaluated. Likewise, the external calibration of 14 masses (12 class E2 and 2 class M1) used by the Services as reference masses for the calibration, verification of grading scales, and analytical balances was managed.

6. Validation studies. In 2020, 6 validations have been initiated, finalizing during the same year 5 of them (see Table 8.1.2), and a validation initiated in the Drug Service in previous years has continued.

Table 8.1.2. Validations in 2020

SERVICE	Test/technique method	State
BIOLOGY	DNA extraction by the total lysis method on biological trace stains of different nature using the Automate ExpressTM automated station, with the Prefiler® Express forensic DNA extraction kit (Life TechnologiesTM).	Finalized
	Automated nucleic acid extraction on the EZ1® ADVANCED XL with EZ1® DPS VIRUS KIT and manually with MAGMAX™ Viral/Pathogen Nucleic Acid Isolation Kit from swabs.	Finalized
	Amplification and detection of SARS-COV-2 virus (COVID-19) genetic material using the commercial TAQPATH™ COVID-19 CE-IVD RT-PCR KIT on the ABI 7500 and the QUANTSTUDIO 5	Finalized
	Automated nucleic acid extraction on the EZ1® ADVANCED XL with EZ1® DPS VIRUS KIT from paraffin sections (FFPE)	Finalized
DRUGS	Confirmation and Quantification by GC-MS-MS in Blood of: 11-Nor-Δ9-Tetrahydrocannabinol-Carboxylic Acid (THC-COOH), Tetrahydrocannbinol (THC), Hydroxy-Tetrahydrocannbinol (THC-OH), Cannabinol (CBN), Cannabidiol (CBD)	In process
	PNT-D-T006: Verification of the Poroshell 120 EC-C18 column and HEROPOROSHELL method for use in the PNT-D-T006 accredited procedure on UPLC 1290 Infinity II (D-192) equipment.	Finalized
TOXICOLOGICAL VALIDATIONS AND ENVIRONMENT	Validation for the detection of Sb by plasma emission spectrometry.	In process

In addition, 4 spreadsheets associated with tests or techniques have been validated.

Table 8.1.3. Spreadsheets validations

SERVICE	Spreadsheets	State
DRUGS	HRD/PNT-D-T006/H/8 Heroin calibration line	Finalized
TOXICOLOGICAL VALIDATIONS AND ENVIRONMENT	HRD/PNT-V-T018/A: Daphnia SP immobilisation test data.	Finalized
	HRD/PNT-V-T018/B: Daphnia SP immobilisation test data collection sheet with positive control. Potassium dichromate.	Finalized
	HRD/PNT-V-T018/D: Data collection sheet for TOC-feeding daphnia population.	Finalized

7 and 8. Intercomparison exercises in which the INTCFM participates. During 2020, we participated in 51 exercises, resulting in 107 evaluation reports from SGC, as some exercises consist of two or more rounds per year.

After the first participation in an Intercomparison Exercise, the laboratory must assess whether the program meets the requirements to be used as quality control. No conformity assessment of exercise organizers has been performed in 2020.

9 and 10. Intercomparison exercises that the INTCFM organizes. One more year INTCFM has organized annually collaborating with the Spanish and Portuguese Speaking Group of the ISFG, a quality control directed to forensic and paternity laboratories known as "Study of DNA polymorphisms in bloodstains and other biological samples". After the evaluation of the results remitted by the participants in 2020, a resume was done, and also a final report of participation and results with the methodologies and results of each laboratory and with the assigned value, performing on each of the occasions a report for each level: basic, advanced and animal item.

About the evaluation certificates, a total of 295 certificates were issued corresponding to 4 types of participation certificates with an evaluation of results: basic level kinship module and forensic module, advanced level forensic module and animal identification (**see 8.1.4, Interesting case**)

11. Internal audits. In 2020, 10 audits were carried out: 6 personnel audits to assess the degree of implementation of the Biology, Chemistry, Biology (genetics and forensic microbiology), Valuation, and Drugs Services; 1 to review the management system of the Intercomparison Exercise, 1 to assess the management of equipment, 1 in which the degree of quality system was reviewed and 1 audit before the destruction of Drugs. As a result, 6 deviations were detected and corrected by the Services.

12. Quality system review. In 2020, the testing activities were revised following the new points established by the latest version of the Standard. The activities as a Provider of the Forensic Intercomparison Exercise were also reviewed. The results of both reviews were recorded in the corresponding minutes prepared by the SGC staff.

13 to 15. Non-conforming works, improvement, and corrective actions. In 2020 we have managed 63 NCs, 6 of them related to some coordination aspect in the Intercomparison Exercise that the INTCFM organizes ("Study of DNA polymorphisms in bloodstains and other biological samples"). Corrective actions were established for only 19 of the NCs, all of which were implemented during 2020.

The main sources of detection were the deviations of the proper staff services (38%) and the evaluation activities in the quality of the tests (51%). The SGC also manages actions, either at the proposal of the Service or by the SGC itself, to improve the management system and the laboratory's activities (standardization of processes, optimization of Quality management, optimization of methods, etc.). In 2020, 24 improvement actions were opened, 7 of which were developed in 2020.

16. Actions to address risks and opportunities. 5 risks were identified and evaluated: 3 related to equipment/test methods and 2 of staff.

17. Management of claims and complaints. This year 22 claims were managed and 2 of them were repetition analysis or counter-analysis requests, 1 was a claim related to the INTCFM activities, and the rest were complaints by delay in the issuing of reports.

In terms of complaints, one was received, related to the management of sample referrals.

8.1.2. Intercomparison exercises in which INTCFM Services participated in 2020

The Table 8.1.3 lists the inter-comparison exercises in which INTCFM Services participated in 2020.

Table 8.1.4. Intercomparison exercises in which the INTCFM participated in 2020

Intercomparison exercises participation of the Biology Service
Program: analysis DNA polymorphism in blood stains and other biological samples Organiser: INTCF-GHEP-ISFG Periodicity: Annual Parameters: Forensic and kinship genetics, in blood, hair, and other preliminary studies
Program: GEDNAP Proficiency test Organiser: GEDNAP-ENFSI (German Speaking Working Group of the International Society for Forensic Genetics) Periodicity: Annual Parameters: Forensic and kinship genetics in blood stains and other biological fluids
Program: Vitreous Fluid Post-mortem Organiser: College of American Pathologists (CAP) Periodicity: Semester Parameters: Glycemia in vitreous body
Program: Bacteriology Organiser: Sociedad Española de Enfermedades Infecciosas y Microbiología Clínica (SEIMC) Periodicity: per month Parameters: cultivation, identification, and resistance to antibiotics
Program: Streptococcus pyógenes Antigens Detection (D9) Organiser: College of American Pathologists (CAP) Periodicity: Semestral Parameters: Streptococcus pyogenes antigen detection on swabs
Program: Amplification of nucleic acids of respiratory virus (ID-2) Organiser: College of American Pathologists (CAP) Periodicity: Semester Parameters: Molecular analysis of the following viruses: Adenovirus, Coronavirus/Rhinovirus, Influenza, Parainfluenza, and Respiratory Syncytial in liquid samples.
Program: SARS-CoV-2 Special, Molecular Organiser: College of American Pathologists (CAP) Periodicity: Semiannual Parameters: Molecular Detection of SARS-CoV-2 Virus

Intercomparison exercises participation of the Criminalistic Service
Program: Adhesive Tape Analysis Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters: Adhesive analysis
Program: Questioned Documents Examination-Forensic Testing Program Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters: Document analysis
Program: Fibers analysis Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters: Fibers analysis
Program: Human vs Non Human Bone Origin Determination Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters: Bone origin determination
Program: Handwriting Examination-Forensic Testing Program Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters: Written documents and signatures study
Program: Paint analysis Organizer: Collaborative Testing Services (CTS) Periodicity: Annual
Program: GSR (Gun Shoot Residues). Distance Determination Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters: Shooting distance on clothing samples
Program: ENFSI Proficiency test on identification of GSR (Gun Shoot Residues) by SEM/EDX Organiser: ENFSI Firearms/GSR by SEM Working Group Periodicity: Annual Parameters: Analysis of gunshot residues in firing kits
Program: Collaborative Exercise Fiber analysis Organiser: ENFSI European Textile & Hair Working Group Periodicity: Annual Parameters: Fibers analysis
Program: EDEWG QA Trial Organiser: ENFSI European Document Expert Working Group (EDEWG) Periodicity: Annual Parameters: Analysis of documents
Program: Collaborative Exercise ENFSI (ENFHEX) Organiser: ENFSI European Handwriting Expert Periodicity: Annual Parameters: Analysis of handwritten documents
Program: Hair-Examination Collaborative Exercise Organiser: ENFSI European Textile & Hair Working Group Periodicity: Annual Parameters: Hair studies

Participation in intercomparison exercises from the Drugs Service
Program: Proficiency Study AQA. Organiser: National Measurement Institute of Australian Government (NMI) Periodicity: Quarterly Parameters/samples: Heroin, cocaine, amphetamine compounds in powder-solid samples
Program: International Quality Assurance Programme (IQAP) Seized materials Group Organiser: United Nations Office on Drugs and Crime (UNODC) Periodicity: Twice a year Parameters/samples: Drugs in powder-solid samples
Program: Interlaboratory Exercise on Habitual Illicit Drugs in Seize Material Organiser: INTCF-Barcelona Periodicity: Annual Parameters/samples: Drugs in powder-solid samples
Program: International Quality Assurance Programme (IQAP-UNODC) Biological Specimens Group. Organiser: United Nations Office on Drugs and Crime (UNODC). Periodicity: biannual. Parameters/samples: Identification and quantification of the most common drugs in urine
Program: Forensic Blood Toxicology Proficiency Testing (Quartz) Organiser: LGC Periodicity: Quarterly Parameters/samples: Drugs and psychotropic in blood
Program: Drugs in Hair Proficiency Test (DHF) Organiser: Arvecom Gesellschat für Toxikologishe und Forensisde Chemie (GTFCh) Periodicity: Quarterly Parameters-samples: drugs and psychotropic in the hair
Program: Drugs in Serum Organiser: Arvecom Gesellschat für Toxikologishe und Forensisde Chemie (GTFCh) Periodicity: Quarterly Parameters/samples: Drugs and psychotropic in serum
Program: Drugs in serum and urine Proficiency Test Organiser: Arvecom Gesellschat für Toxikologishe und Forensisde Chemie (GTFCh) Periodicity: Quarterly Parameters/samples: GHB in serum and urine
Program: Toxicological analysis for drivers fitness determination Organiser: Arvecom Gesellschat für Toxikologishe und Forensisde Chemie (GTFCh) Periodicity: Quarterly Parameters/samples: Drugs and medicines in urine

Intercomparison exercises participation of the Chemistry Service
Program: Whole blood Alcohol/Volatiles survey Organiser: College of American Pathologists Periodicity: Quarterly Parameters/samples: Alcohol, volatiles, and ethylene glycol in blood
Program: Forensic Toxicology (criminalistics) Organiser: College of American Pathologists Periodicity: Twice a year Parameters/samples: Medicines and drugs in blood and urine
Program: Blood Oximetry Survey Organiser: College of American Pathologists Periodicity: Quarterly Parameters/samples: Carboxyhaemoglobin in blood
Program: Flammable analysis Organiser: Collaborative Testing Service Periodicity: Annual Parameters/samples: Combustion-accelerating substances in various media
Program: Forensic Blood Toxicology Proficiency Testing (Quartz) Organiser: LGC Periodicity: Quarterly Parameters/samples: Drugs and psychopharmaceuticals in blood
Program: Drugs in Hair Proficiency Test (DHF) Organiser: Arvecom Gesellschat für Toxikologishe und Forensisde Chemie (GTFCh) Periodicity: Quarterly Parameters/samples: Drogas de abuso y psicofármacos en pelo
Program: Blood Drug Analysis Organiser: Collaborative Testing Service Periodicity: Annual Parameters/samples: Drugs of abuse and psychotropic drugs in the blood
Program: Quality control of ethyl alcohol in the blood Organiser: INTCF- Seville Periodicity: Quarterly Parameters/samples: Ethyl and methyl alcohol in blood
Program: Drugs in Oral Fluid PT Scheme Organiser: LGC Proficiency Testing Periodicity: Quarterly Parameters/samples: Drugs of abuse in oral fluid
Program: Vitreous Fluid, Post-mortem Organiser: College of American Pathologists Periodicity: Twice a year Parameters/samples: Sodium and potassium, and ethyl alcohol and acetone in vitreous body

Participation in intercomparison exercises of the Toxicological and Environmental Assessment Service
Program: Non Specific Determinands. Aquacheck - Group 11. Organiser: LGC Standards Periodicity: Semester Parameters-samples: DBO, DQO, MBAS, COD/COT, suspended solids in aqueous matrix
Program: Aquacheck. Grupo 17 D Organiser: LGC Standard Periodicity: Annual Parameters-samples: Total phenol, ammonia, total phosphorus, and total nitrogen in wastewater.
Program: Aquacheck. Grupo 17 C Organiser: LGC Standard Periodicity: once a year Parameters-samples: Metals in wastewater
Program: Aquacheck. Grupo 12 C Organiser: LGC Standard Periodicity: Twice a year Parameters-samples: Chromium VI in effluent matrix
Program: Aquacheck. Group 12 Organiser: LGC Standard Periodicity: Annual Parameters-samples: Metals in effluent matrix
Program: Quality in Water Analysis Scheme (QWAS) WT 419 Organiser: LGC Standards Periodicity: Semester Parameters-samples: Total coliforms, fecal coliforms, and fecal streptococci in waters
Program: Quality in Water Analysis Scheme (QWAS) WT 422 Organiser: LGC Standards Periodicity: Annual Parameters/samples: Total coliforms, fecal coliforms, and fecal streptococci in marine waters
Program: Effluent, waste water, Contaminated Land, and Hazardous waste Organiser: Laboratory Environmental Analysis Proficiency (LEAP) Periodicity: Semester Parameters-samples: pH and conductivity in aqueous matrix
Program: Effluent, waste water, Contaminated Land, and Hazardous waste Organiser: Laboratory Environmental Analysis Proficiency (LEAP) Periodicity: Semester Parameters-samples: Settled solids in aqueous matrix
Program: Effluent, waste water, Contaminated Land, and Hazardous waste Organiser: Laboratory Environmental Analysis Proficiency (LEAP) Periodicity: Twice a year Parameters-samples: Nitrate, nitrite, ammonium, chloride, orthophosphate, total phosphorus, total nitrogen in aqueous matrix

Participation in intercomparison exercises of the Toxicological and Environmental Assessment Service (cont.)
Program: Effluent, waste water, Contaminated Land and Hazardous waste Organiser: Laboratory Environmental Analysis Proficiency (LEAP) Periodicity: twice a year Parameters/samples: Bromide and fluoride in aqueous matrix
Program: Effluent, waste water, Contaminated Land and Hazardous waste Organiser: Laboratory Environmental Analysis Proficiency (LEAP) Periodicity: Twice a year Parameters/samples: Calcium, magnesium, potassium, sodium, hardness, alkalinity in aqueous matrix
Program: Wastewater: Toxicity (GSCAR4) Organiser: Quality Services Office (GSC) Periodicity: Annual Parameters/samples: Toxicity (Inhibitory Matter) in wastewater

8.1.3. Accreditation scope

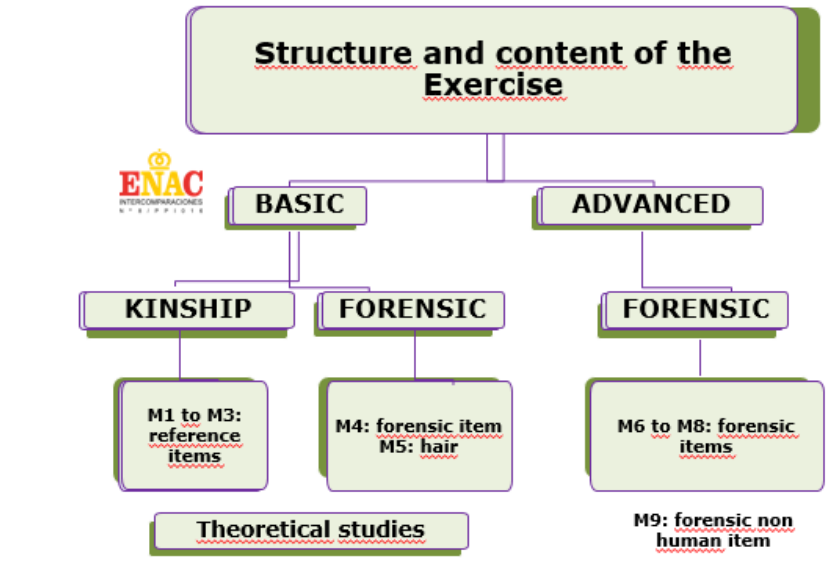
The Madrid Department has two accreditation files, the file Accreditation no. 297/LE1367 and the file Accreditation no. 297/LE1366, that bring together testing methods in the forensic and environmental areas respectively.

It is also responsible for the accreditation of the INTCF under ISO 17043, as Intercomparison Program provider in the file Accreditation no. 8/PPI016.

8.1.4. Interesting case: Intercomparison exercise of "Analysis of DNA polymorphisms in bloodstains and other biological samples"

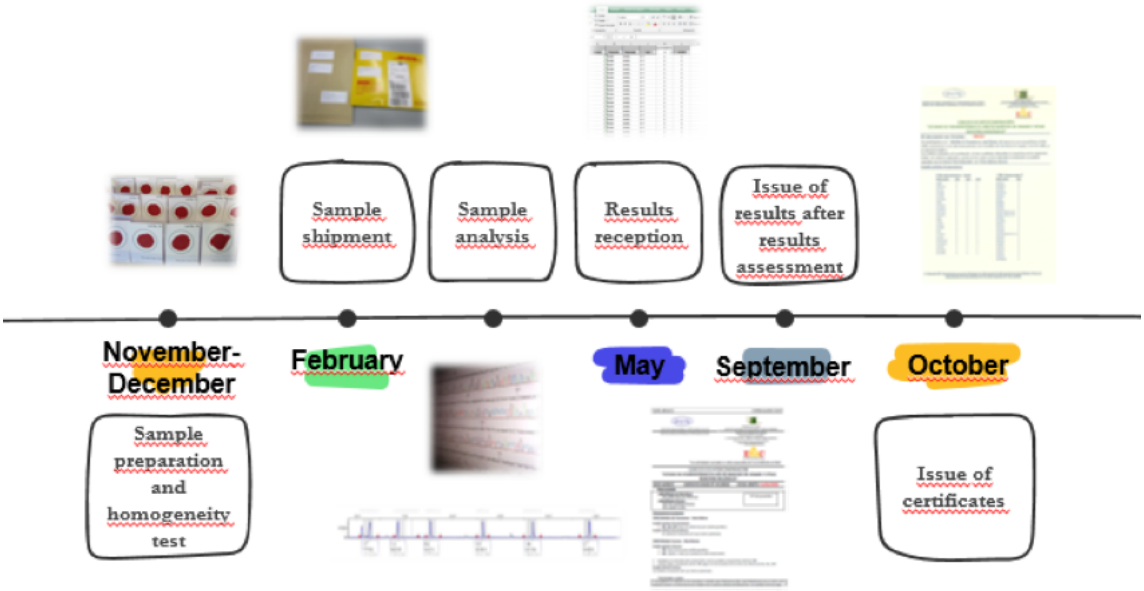
The Quality Assurance Service of the Madrid Department coordinates since 1992 an annual quality control, the intercomparison exercise of "Analysis of DNA polymorphisms in bloodstains and other biological samples".

Figure 8.1.4.1. Levels and modules of the Intercomparison exercise



It should be noted that the kinship and forensic modules of the basic level of this exercise have been accredited under the criteria set out in the UNE-EN ISO 17043 standard since 2014.

Figure 8.1.4.2. Schedule of the Intercomparison Exercise "Study of DNA polymorphisms in bloodstains and other biological samples"



In 2020, the timing of the Exercise was influenced by the pandemic. Because many laboratories were unable to access their facilities during the lockdown and that there was a

time lag in the evolution of the health crisis, depending on the continents, the deadline for the submission of results had to be delayed. The deadline was in July instead of May, as planned. The rest of the schedule remained the same.

In this exercise, the basic kinship module included two blood stains and one saliva stain. The forensic basic level included a stain consisting of a mixture of semen and blood and one hair sample. The advanced level included a total of three forensic samples with different biological fluids of human origin, all of them being mixed: two salivae, a mixture of semen and blood, and the blood of three people. A sample with the animal blood was sent upon request by the participant.

The basic level also included a theoretical kinship exercise and a theoretical forensic exercise.

Before the samples, homogeneity studies and contamination control were realized through fluid nature studies and genetic analysis in a collection of representative samples to send.

The following is the general data on the participation of the laboratories during the Exercise of 2020.

Figure 8.1.4.3. Distribution of participation in modules and levels. Although initially more laboratories registered for the different modalities of the Exercise, due to the COVID 19 situation the number of participants submitting results decreased

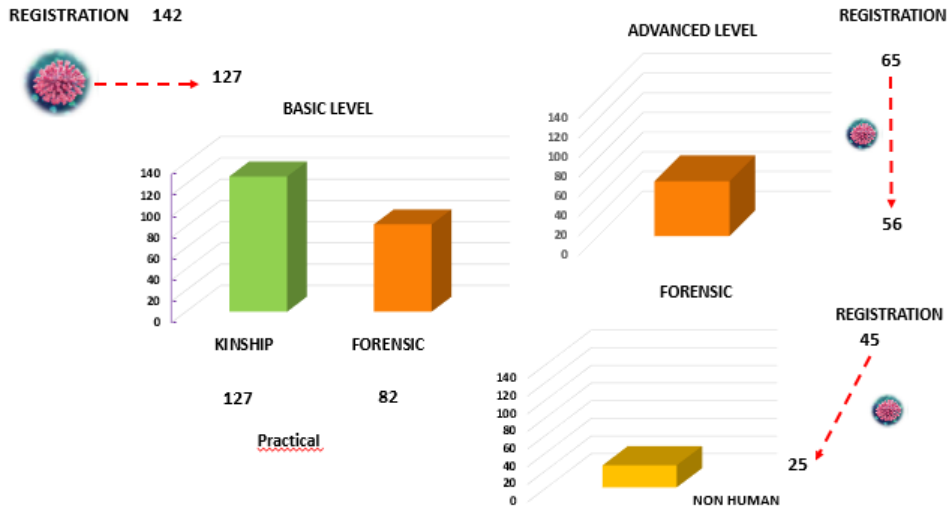
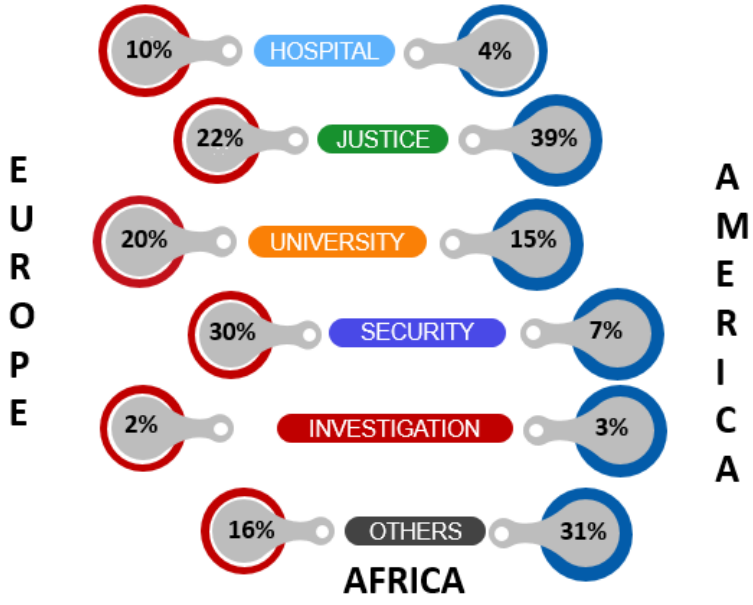


Figure 8.1.4.4. Geographical distribution of participants.
Arrows indicate new laboratories

Figure 8.1.4.5. Type of laboratories (%) distributed by continent.
Public laboratories are mainly linked to Justice/Judiciary and Law Enforcement;
to a lesser extent they belong to hospitals and research centres



After evaluating the results, a non-reporting summary was issued for each level and a final report of participation and results, with the methodologies and results of each laboratory and the assigned values.

Subsequently, each participant received an individual certificate for each level and module in which they had participated.

8.1.5. Scientific and teaching activity

8.1.5.1. Participation in investigation projects and collaboration with other institutions

The Madrid Department Quality Assurance Service on behalf of the INTCF, has participated in the working group of the European Network of Forensic Science Institutes (ENFSI) in charge of updating the Manual of Good Practices related to the Training of Personnel.

Personnel from this Service have collaborated as teachers in Activity 3.8: Interlaboratories: Proficiency testing in Forensic Biology and DNA typing, which forms part of the twinning project with Turkey TR16 IPA JH 03 18 managed by the FIIAPP (Fundación Internacional y para Iberoamérica de Administración y Políticas Públicas).

8.1.5.2. Contribution in scientific congresses

Fernández Oliva K. Results of the Intercomparison Exercise “Study of DNA polymorphisms in blood spots and other biological samples”. Presentation. 25th Meeting of Forensic Genetics organized by the Spanish and Portuguese Speaking Group of the ISFG (GHEP-ISFG). Online . 14-16 December 2020.

8.1.5.3. . Scientific publications

Barrio P, García O, Phillips C, Prieto L, Gusmão L, Fernández C, Casals F, Freitas JM, González-Albo MC, Martín P, Mosquera A, Navarro-Vera I, Paredes M, Pérez JA, Pinzón A, Rasal R, Ruiz-Ramírez J, Trindade BR , Alonso A. The first GHEP-ISFG collaborative exercise on forensic applications of massively parallel sequencing. *Forensic Sci. Int. Genet.* 2020, Nov; 49:102391 (doi: 10.1016/j.fsigen.2020.102391).

8.1.5.4. Teaching and training activities

Muñoz Nieto-Sandoval M. Introduction. Activity: Interlaboratories: Proficiency testing in Forensic Biology and DNA typing. Twining Project TR16 IPA JH 03 18. 28 September 2020.

Fernández Oliva K. Organization of a Proficiency Test. Activity: Interlaboratories: Proficiency testing in Forensic Biology and DNA typing. Twining Project TR16 IPA JH 03 18. 29 September 2020.

Fernández Oliva K. Conformity assessment. Activity: Interlaboratories: Proficiency testing in Forensic Biology and DNA typing. Twining Project TR16 IPA JH 03 18. 30 September 2020.

Muñoz Nieto-Sandoval M. How to choose an appropriate PT. Activity: Interlaboratories: Proficiency testing in Forensic Biology and DNA typing. Twining Project TR16 IPA JH 03 18. 28 September 2020.

Fernández Oliva K. Results assessment. Activity: Interlaboratories: Proficiency testing in Forensic Biology and DNA typing. Twining Project TR16 IPA JH 03 18. 1 October 2020.

Fernández Oliva K. The Quality Assurance Services of the INTCF. Organized by the Centre for Legal Studies (CEJ.) INTCFM. Madrid. November 2020.

Fernández Oliva K. Quality management. Forensic Laboratories. UNE-EN ISO/IEC 17025 Standard. Degree in Criminalistics. Forensic Instrumental Analysis. Organized by the University of Alcalá. 20 October 2020.

Fernández Oliva K. Evaluation of the quality of tests. Intercomparison exercises. Degree in Criminalistics. Forensic Instrumental Analysis. Organized by the University of Alcalá. 10 December 2020.

Fernández Oliva K. Chain of custody. Traceability. Degree in Criminalistics. Forensic Instrumental Analysis. Organized by the University of Alcalá. 10 December 2020.

Fernández Oliva K

- Expert informative introduction to the different INTCF Services. Organized by the Centre for Legal Studies (CEJ). Online. 16-18 November 2020.
- Bioinformatics tools for the assessment of likelihood ratios (LR). Organized by the Centre for Legal Studies (CEJ). Online. 23-27 November 2020.

Muñoz Nieto-Sandoval M

- Validation of methods in Forensic Sciences. Organized by the Centre for Legal Studies (CEJ). Online. 28 September-1 October 2020.
- Multidisciplinary investigation of sexual aggressions in forensic laboratories. Organized by the Centre for Legal Studies (CEJ). Online. 9-13 October 2020.
- Informative introduction to the scientific and forensic activity of the different INTCF Services. Organized by the Centre for Legal Studies (CEJ). Online. 16-18 November 2020.
- Bioinformatics tools for the assessment of likelihood ratios (LR). Organized by the Centre for Legal Studies (CEJ). Online. 23-27 November 2020.

– Polluted soils and groundwater: Update of analytical techniques and ecotoxicity tests. Bioinformatics tools for the assessment of likelihood ratios (LR). Organized by the Centre for Legal Studies (CEJ). Online. 30 November-3 December 2020.

Pérez Vergas R.

– Validation of methods in forensic sciences. Organized by the Centre for Legal Studies (CEJ). Online. 28 September-1 October 2020.

– Update in Forensic Chemistry and Toxicology. From the laboratory to the courts. Organized by the Centre for Legal Studies (CEJ). Online. 19-23 October 2020.

– Multidisciplinary investigation of sexual aggressions in forensic laboratories. Organized by the Centre for Legal Studies (CEJ). Online. 9-13 October 2020.

– Informative introduction to the scientific and forensic activity of the different INTCF Services. Organized by the Centre for Legal Studies (CEJ). Online. 16-18 November 2020.

– Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics. Organized by the Centre for Legal Studies (CEJ). Online. 23-27 November 2020.

8.2. Quality Assurance Service of Barcelona Department

8.2.1. Activities performed by the Service

Most of the activities and functions carried out by the Quality Assurance Service during 2020 are shown in Table 8.2.1 below:

Table 8.2.1. Activity data of 2020

Activities	
1. Development of new Standard Operating Procedures and modification of procedure versions	62
2. Elaboration of new annexes and modification of annex versions	68
3. Training programs and qualification certificates of the staff	38
4. Initial and going training of personnel in the Quality System	1
5. Management and evaluation of external and internal equipment calibrations, and physical patterns	159
6. Validation studies of analysis methods	8
7. Evaluation of the participation in intercomparison exercises	43
8. Conformity assessment of organizers in intercomparison exercises in which the Department participates	2

Activities (cont.)	
9. Evaluation of external participant	26
10. Evaluation of external participants (reports)	1
11. Internal audits	5
12. Management quality system review by the Department	1
13. Incidences, nonconformities, or nonconforming work records register and following	87+14
14. Corrective action records	4
15. Recording and monitoring of improvement actions	4
16. Records of actions to address risks and opportunities	15
17. Claims and complaints management	22
18. SGC valuation reports	3

In more detail, the related activities have consisted of:

1 and 2. Management of system documents. In 2020, a total of 62 work procedures were drawn up and/or revised, as well as 68 annexes, documents that provide additional data (tables, specific calculations, etc.), and/or the necessary records for data collection for the activities described in the procedures.

The Quality Assurance Service has not only drawn up or revised the standard operating procedures (SOPs) derived from the Quality Manual, those of the Quality Assurance Service, but has also participated actively, as usual, in the drafting of a large part of the technical procedures prepared in the services.

Once the procedures have been drawn up, reviewed, and approved, the Quality Assurance Service continues managing their distribution and archiving.

3 and 4. Staff training. During 2020:

- The specific training and coaching programs carried out (3 programs) and the internal training and coaching records for trainees submitted (36 records) were reviewed. A large part of the time is spent on advising the staff who have to prepare them and on bringing the documents already drawn up into line with the pre-established requirements.
- Quality training was given to new staff and trainees to familiarise them with the Quality System implemented in the Department (2 informative sessions).
- All documentation of training records, records of authorized signatures, and all other documentation related to the education/training and qualification of laboratory personnel was managed and archived.

5. Management of external equipment calibrations. Of the programmed activities that can be carried out internally, the Quality Assurance Service has reviewed and assessed the conformity of the results of 87 calibrations (automatic pipettes and balances).

About the calibrations that, due to technical requirements, have to be performed externally, the Quality Assurance Service has managed the following:

- The contracting of external calibration services for weights (physical standards).
- Has coordinated the shipment of weights and automatic pipettes with a volume equal to or less than 10 µl for calibration by laboratories accredited under the ISO 17025 quality standard.
- Has assessed the conformity of the external calibrations carried out.

In 2020, approximately 48 pipettes and 12 weights were sent for external calibration, and a total of 72 calibrations were assessed.

6. Method validation studies. In 2020, work was carried out, in collaboration with the Biology, Chemistry and Drugs and Toxicological Assessment and Environment Services, on the validation of new methods of analysis and interpretation and statistical assessment of profile compatibilities and the verification of methods with new equipment (8 validations/verifications).

7. Intercomparison exercises in which the INTCFB participates. The Quality Assurance Service participates in this type of activities:

- Requesting the budgets for the interlaboratory exercises in which the Department participates.
- Making the requests for participation in each of the exercises, and monitoring the approval of the purchase orders generated.
- Resolving the incidents that occur while receiving the samples for the different controls that form part of the exercises.
- Once the exercise organizer issues the results report, evaluate the outcome of the INTCFB's participation.

During 2020, the technical services of the INTCF Barcelona Department participated in a total of 25 intercomparison exercises, some of them with several annual rounds that are processed and evaluated independently. This participation has generated 43 evaluation reports from the Quality Assurance Service.

8. Conformity assessment. At the end of 2020, the SGC assessed the characteristics and technical aspects of a new THC quantitative analysis exercise for the upcoming participation in 2021 of the Chemistry and Drugs Service, leaving a record of the evaluation carried out internally developed based on the quality criteria recommended in the policies and guidelines on intercomparisons published by ENAC.

9 and 10. Intercomparison exercises that the INTCFB organizes. In fulfillment of its role as a reference centre, the INTCFB acts as a provider of Intercomparison Exercises by organizing a Quality Control exercise aimed at national public laboratories that analyze drugs

of abuse. The “Interlaboratory Exercise on Usual Drugs of Abuse found in Stashes (DAHA)” (**see 8.2.4, Case of Interest**).

After evaluation of the results submitted by the participants, the SGC issues a full report with information on the organization of the exercise, the preparation of the samples, the methodologies used for data processing and evaluation of the data, the results obtained, additional information provided by the participants, results obtained with the data processing and re-evaluation of results and any other issues that may be of interest.

11. Internal audits. In 2020, the Quality Assurance Service staff carried out 4 horizontal internal audits of purely administrative activities and participated in implementing technical and quality activities related to ENAC-accredited testing.

12. Quality system review. In the 2020 Quality System Review, information was obtained on the conformity of the activities carried out with the Quality System implemented and the requirements of the ISO 17025 standard, information that was duly documented in a comprehensive and detailed report drawn up by the Quality Assurance Service. This report not only includes the findings of the review, it also includes any need for change detected and the proposed improvement actions.

13 al 15. Non-conforming works, improvement, and corrective actions. When any aspect of the activities carried out under the Quality system does not comply with the established procedures or requirements, an incident is recorded. It is usually resolved with a remedial action without the need to establish corrective action. A Non-Compliant Work is opened when the deviation or incident is repetitive, or the importance or seriousness of the non-compliance or incident that has occurred requires it. When a non-conforming work (or non-conformity) is opened, INTCFB staff study the causes of the deviation, assess the influence it may have had on other areas and the risk it poses to the laboratory’s activity. Once the true causes of the deviation are known, the necessary corrective actions (CA) are established to rectify the causes of the deviation and prevent it from recurring. The SGC documents the incidents occurring in some Services and those detected in the exercise of its functions of supervision and control of technical and administrative activities, it also documents all the TNCs identified, evaluates the corrective actions proposed and monitors their implementation and effectiveness.

During 2020, 87 incidents and 14 Non-Conforming Works have been recorded and followed up, and a total of 4 corrective actions have been documented, the rest being remedial actions.

16. Actions to address risks and improvement actions. In 2020, 15 risks have been identified. Some actions have already been initiated to minimize them. Regardless of the risks identified, 4 actions to improve activities and processes have been documented and are in the process of being implemented

17. Management of claims and complaints. In 2020, no citizen complaints were received. A total of 23 complaints were assessed, of which just over half highlighted errors made by the INTCFB (mainly transcription errors in manual reports).

In addition to the above, the staff of the Quality Assurance Service carries out the following activities:

- Completion of surveys related to the Department's Quality Management.
- Drawing up internal reports requested by the Department Management.
- Drawing up reports for the management, information, or assessment of matters related to issues dealt with by the Quality Assurance Service.

The staff of the Quality Assurance Service also participates in additional activities related to the centralized management for the acquisition of external controls and standards necessary for the performance of the tests:

- Requesting quotations for the interlaboratory exercises in which the Department participates.
- Requesting interlaboratory exercises using the purchasing application, monitoring the approval of orders, and resolving any incidents that occur.
- Preparation of the necessary documentation (customs authorization, etc.) for the delivery of external controls and standards to the Department when required.
- Request, management, and filing of Import Authorizations for narcotic and psychotropic substances required as external quality controls (interlaboratory exercises) or reference materials for the Chemistry and Drugs Service.

8.2.2. Intercomparison exercises in which the INTCFB Services participated in 2020

Table 8.2.2 Intercomparison exercises in which the INTCFB Services participated in 2020

Participation in intercomparison exercises of the Biology Service
Program: Analysis of DNA polymorphism in blood stains and other biological samples Organiser: INTCF-GHEP-ISFG Periodicity: Annual Parameters: Forensic and kinship genetics, in blood, hair, and other preliminary studies
Program: GEDNAP Proficiency test Organiser: GEDNAP-ENFSI (German Speaking Working Group of the International Society for Forensic Genetics) Periodicity: Annual Parameters: Forensic and kinship genetics in blood stains and other biological fluids

Participation in intercomparison exercises of the Biology Service (cont.)
Program: GHEPMIX 8 Validación LRmix Studio Organiser: INTCF-GHEP-ISFG Periodicity: Annual Parameters: Assessment of mixed profiles

Participation in intercomparison exercises of the Chemistry and Drugs Service
Program: Proficiency study AQA Organiser: National Measurement Institute of Australian Government (NMI) Periodicity: Quarterly Parameters/samples: Heroin, cocaine, amphetamine compounds in powder-solid samples
Program: ENFSI Proficiency test Organiser: ENFSI Drugs Working group Periodicity: Annual (this Service participated in the 2019 round received in 2020) Parameters/samples: Heroine, cocaine, others in powder-solid samples
Program: International Quality Assurance Programme (IQAP-UNODC) Biological Specimens Group. Organiser: United Nations Office on Drugs and Crime (UNODC) Periodicity: Biannual Parameters/samples: Identification and quantification of the most common drugs in urine
Program: Interlaboratory Exercise on Habitual Illicit Drugs in Seize Material Organiser: INTCF-Barcelona Periodicity: Annual Parameters/samples: Drugs in powder-solid samples
Program: Blood Alcohol Intercomparison Exercise Organiser: INTCF-Seville Periodicity: Quarterly Parameters/samples: Ethyl alcohol and other volatile compounds in blood and plasma
Program: Whole blood Alcohol/Volatiles Survey (AL1) Organiser: College of American Pathologists Periodicity: Quarterly Parameters/sample: Blood ethyl alcohol, volatiles, and ethylene glycol
Program: Toxicology Blood (quantitative) Organiser: LGC Standards Periodicity: Per month Parameters/samples: Carboxyhaemoglobin in blood
Program: Forensic Toxicology Criminalistics (FTC) Organiser: College of American Pathologists Periodicity: Biannual Parameters/samples: Drugs in blood and urine
Program: International Quality Assurance Programme (IQAP) Biological Specimens Group Organiser: United Nations Office on Drugs and Crime (UNODC). Periodicity: Biannual Parameters/samples: Identification and quantification of the most common drugs of abuse in urine

Participation in intercomparison exercises of the Chemistry and Drugs Service (cont.)
Program: Drug Facilitated Crime (DFC) Organiser: College of American Pathologists Periodicity: Biannual Parameters/samples: Crime-facilitating drugs and psychotropic drugs in blood and urine
Program: Toxicology (T) Organiser: College of American Pathologists Periodicity: Quarterly Parameters/samples: Drugs and psychotropic drugs in serum and urine
Program: Ignitable liquid identification Organiser: Collaborative Testing Services (CTS) Periodicity: Annual Parameters/samples: Combustion-accelerating substances in different carriers

Participation in intercomparison exercises of the Toxicology and Environmental Assessment Service
Program: Ecotoxicology. Aquacheck – Group 50 Organiser: LGC Standards Periodicity: Twice a year Parameters: Toxicity with Daphnia magna in effluents
Program: Non Specific Determinands. Aquacheck - Grupo 11. Organiser: LGC Standards Periodicity: Twice a year Parameters: DBO, DQO, MBAS, COD/COT, suspended solids in aqueous matrix
Program: IELAB Physicochemical parameters Organiser: IELAB Periodicity: Biannual Parameters/samples: Ammonium, nitrates, BOD5,COD, suspended solids, fluorides, and toxicity in wastewater
Program: Effluent, waste water, Contaminated Land and Hazardous waste – Group 3 Organiser: Laboratory Environmental Analysis Proficiency (LEAP) Periodicity: Twice a year Parameters: Nitrate/Nitrite, Ammonium, Chloride Sulfate, PO4, Total Phosphorus, Total Nitrogen/ Kjeldahl in aqueous matrix
Program: Wastewater: Toxicity (GSCAR4) Organiser: Quality Services Office (GSC) Periodicity: Annual Parameters: Toxicity (Inhibitory Matter) in wastewater
Program: Aquacheck. Group 12 Organiser: LGC Standard Periodicity: Twice a year Parameters: Metals in effluent matrix
Program: Quality in Water Analysis Scheme (QWAS) Organiser: LGC Standards Periodicity: Semestral Parameters: Total coliforms, fecal coliforms, and fecal streptococci in waters

Participation in intercomparison exercises of the Histopathology Service
Program: Forensic Pathology (FR)
Organiser: College of American Pathologists (CAP)
Samples: Case histories and images of crime scenes, external examinations, and macroscopic and microscopic images of 6 real cases
Periodicity: Biannual
Parameters: Final diagnostic

8.2.3. Accreditation scopes

The Barcelona Department has two accreditation files open in accordance with the requirements of UNE-EN ISO/IEC 17025 standards: Accreditation no. 297/LE640 file and Accreditation no. 297/ LE639 file, which bring together several test methods in the forensic area and in the environmental area respectively.

8.2.4. Interesting case: Common drugs of abuse exercise in stashes (DAHA)

In 2020, the Barcelona Department has reached once again organizing a new control of the Intercomparison Exercise in Common Drugs of Abuse in Stashes, a proficiency testing that permits laboratories that analyze these type of substances for public administrations to dispose of a useful and economic tool for the quality evaluation in the analyzes they conduct.

The high cost that the interlaboratory exercises of drugs and acquisition of reference materials of narcotics and psychotropic substances supposes adequate for the quality insurance of this kind of analysis makes the work of drug testing laboratories difficult.

Aware of this problem and in fulfilment of its role as a reference centre, the INTCFB Quality Assurance Service has worked throughout the year in the search and selection of adequate samples that come from illegal drug seizures and the request for judicial authorisations for the use of these samples in the preparation of the exercise items.

All this effort was materialised with the shipment, in November 2020, of the DAHA 1/20 Control, a collection of 7 drug samples of different nature and/or concentration for identification and quantification by the participating laboratories.

The activity concluded in December 2020 with the issuance of a Results Report prepared by the Quality Assurance Service with the information from the exercise, the results issued by all participants, the statistical treatment of the data, and the evaluation of the performance of the laboratories.

Figure 8.2.4.1. Photograph of drug samples submitted

The participants in the DAHA 1/20 Control were the following:

	Lab. participants	Lab. which issue results
Control DAHA 1-20	27	26

The ranking of the participating laboratories according to equity ownership was as follows:

Public laboratories	52
Private laboratories	6

The participating laboratories according to their field of activity are listed in Figure 8.2.4.2.

Figure 8.2.4.2. Participating laboratories according to their field of activity

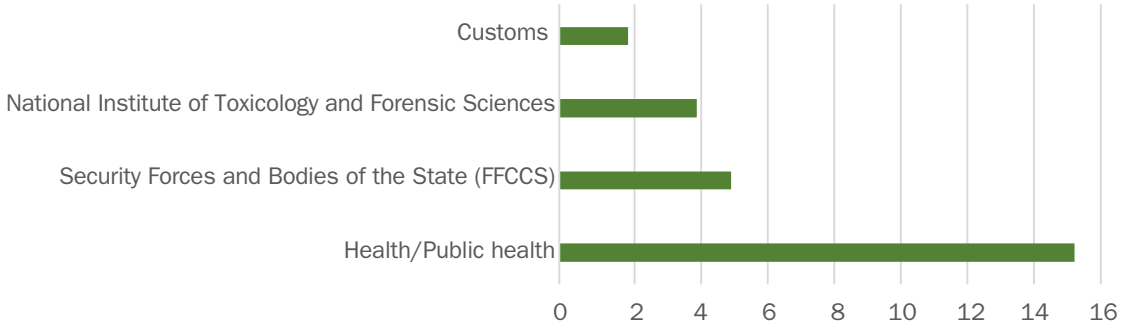
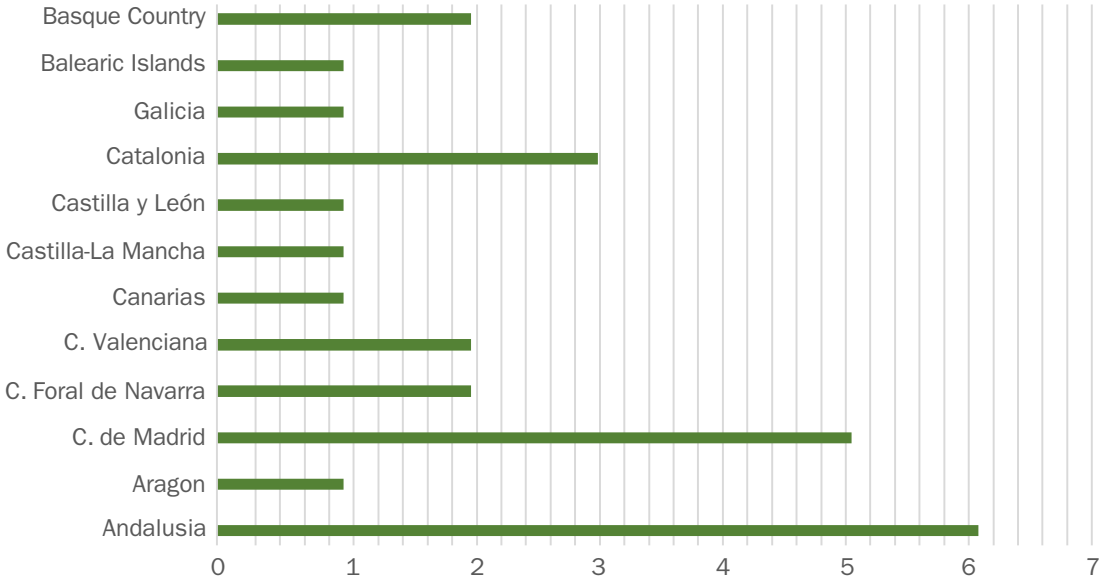
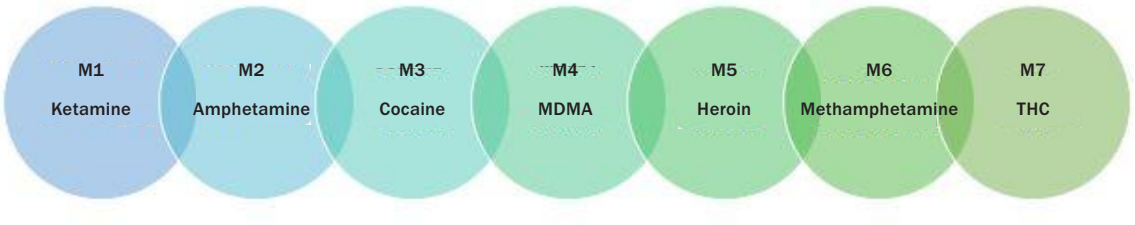


Figure 8.2.4.3. Geographical distribution of participating laboratories



The DAHA 1/20 Control has allowed the self-assessment of 26 laboratories in the qualitative and quantitative analysis of 7 different drugs, substances to which reference values have been attributed, allowing the use of the surpluses as internal quality controls.

Figure 8.2.4.4. Drugs of abuse included in each of the samples



8.2.5. Teaching and scientific activities

8.2.5.1. Participation in investigation projects and meetings related to quality

Personnel from this Service have collaborated as lecturers in Activity 3.7: Interlaboratory Exercise In Analysis Of Illicit Drugs, which forms part of the twinning project with Turkey TR16 IPA JH 03 18 managed by the FIIAP (Fundación Internacional y para Iberoamérica de Administración y Políticas Públicas).

Staff from this Service have collaborated as lecturers in the ICrime Project on Cooperation in Criminal Investigation in Central America to combat crime and drug trafficking at the international level (LA/2017/39066) and reinforcement of investigation units, forensic institutes, networks, and criminal investigation procedures in the Central American Integration System (LA/2018/403-729).

8.2.5.2. Training and teaching activities

Teaching activities

Izquierdo Vigil R. About Interlaboratory Comparisons (ILC) and Proficiency Testing (PT). Selecting PT Scheme and Provider. Activity: Interlaboratory Exercise In Analysis Of Illicit Drugs. Twining Project TR16 IPA JH 03 18. 21 September 2020.

Izquierdo Vigil R. About Proficiency Test Of Usual Illicit Drugs In Seized Materials (DAHA PT): History and Facts. Activity: Interlaboratory Exercise In Analysis Of Illicit Drugs. Twining Project TR16 IPA JH 03 18. 22 September 2020.

Enreig Cabanes E. About Proficiency Test Of Usual Illicit Drugs In Seized Materials (DAHA PT): Organization and Preparation. Activity: Interlaboratory Exercise In Analysis Of Illicit Drugs. Twining Project TR16 IPA JH 03 18. 22 September 2020.

Izquierdo Vigil R. Statistics for Proficiency Testing (Part 1): Homogeneity Testing. Activity: Interlaboratory Exercise In Analysis Of Illicit Drugs. Twining Project TR16 IPA JH 03 18. 23 September 2020.

Enreig Cabanes E. Statistics for Proficiency Testing (Part 2): Homogeneity Testing. Activity: Interlaboratory Exercise In Analysis Of Illicit Drugs. Twining Project TR16 IPA JH 03 18. 24 September 2020.

Enreig Cabanes E. Management system requirements. Reporting results and ensuring the validity of results. Activity: Module 1. The importance of quality assurance in forensic laboratories. Online training program in relation to quality. ICrime Project. October 2020.

Enreig Cabanes E. Tools for internal control of results. Control charts. Criteria for the choice of the RM. Related documentation. Activity: Module 2. Assurance of the validity of the results. ICrime Project. November 2020.

Training activities

Izquierdo Vigil R

- Validation of methods in forensic sciences. Organized by the Centre for Legal Studies (CEJ). Online. 28 September-1 October 2020.
- Informative introduction to the scientific and forensic activity of the different INTCF services. Organized by the Centre for Legal Studies (CEJ). Online. 16-18 November 2020.

Enreig Cabanes E

- Validation of methods in forensic sciences. Organized by the Centre for Legal Studies (CEJ). Online. 28 September-1 October 2020.
- Bioinformatics tools for the assessment of likelihood ratios (LR) in forensic genetics. Organized by the Centre for Legal Studies (CEJ). Online. 23-27 November 2020.

Perea Falomir M

- Validation of methods in forensic sciences. Organized by the Centre for Legal Studies (CEJ). Online. 28 September-1 October 2020.
- Analysis of pesticides in environmental samples and wildlife poisoning. Organized by the Centre for Legal Studies (CEJ). Online. 5 -9 October 2020.

8.3. Quality Assurance Service of the Seville Department

We have to recognize that 2020 has been a year with many issues that we have had to overcome to continue developing the tasks requested as a Quality Assurance Service. They are aimed at monitoring and improving of the Quality System implemented in the INTCF.

The publication of the new version of ISO/IEC 17025:2017, General requirements for the competence of testing and calibration laboratories, has supposed an adaptation of procedures and documents to continue stating the fulfillment of the requisites in the estimated time-limit to implement it.

These adaptations have supposedly involved the Department staff diffusing all the requisites of the rule and actual procedures collaborating with them and proportioning our assessment and support. In this way, the validations methods of anions by ion chromatography and the analysis of metals by inductive plasma atomic emission spectrometry have been initiated.

In the first quarter, the scope of the Accreditation File LE 1833 was extended, with the recognition by the Spanish Accreditation Body (ENAC), including two new kits for application in forensic genetics (AmpFISTR® YfilerTMPlus and Power Plex® Fusion 6 C System) obtaining, as in the rest of the accredited tests included in our Technical Annex (ENAC), the formal recognition of the competence and technical capacity. We have also undergone an internal audit by an external entity to review the quality system and accredited tests.

As a reference centre recognized in the LOPJ and the INTCF Regulations in matters specific to its activity, the Quality Assurance Service has organized and coordinated the “Interlaboratory Exercise on ethyl alcohol in blood samples” (EIAS) with three rounds. Each with three samples of biological fluids. It is helpful for the participants (58) from different fields who

carry out this analysis. Concerning this exercise, several proposals for improvement have been made for implementation in 2021.

The mobility restriction has been compensated with the development of national and international activities programmed virtually, and the staff has participated coordinating and being part as teachers in training courses, national (CEJ) and international (Twining Project, ICrime Project) as well as in national meetings with the Forensic Network of Official Laboratories (RLFOE) and as a member of Subcommittees SC1 and SC2 of the Technical Committee CTN 197 Expert, forensic and mediation services of UNE and international QCLG-QCC Measurement Uncertainty (MU) Project (ENFSI).

8.3.1. Activities performed by the Service

Table 8.3.1 Activity data for 2020

Activities	
1. Development of new standard opening procedures (SOPs) and of results collection sheets (HRD), and modification of existing ones	16 (PNT) 6 (HRD)
2. New annexes elaboration and modification of annexes versions	2
3. Training programs and staff qualification certificates	16
4. Initial and ongoing training of personnel in the Quality System	–
5. Calibration equipments management	153 (internal) 102 (external)
6. Validation methods analysis	1
7. Assessment of participation in intercomparison exercises	22
8. Conformity assessment of organisers of Intercomparison Exercises in which the Department participates	–
9. Evaluation of external participants (reports)	3
10. Evaluation of external participants (certificates)	57
11. Internal audits	1
12. Management review of the quality system by the Direction	1
13. Records of non-conformities or non conformity works	9
14. Records of corrective actions	9
15. Records of improvement actions	3
16. Records of actions to address risks and opportunities	2
17. Claims and complaints management	9

The activities in 2020 have consisted:

1 and 2. Management of system documents. As a consequence of the entry into force of the new version of Standard 17025:2017, a total of 15 general and one technical procedure, one general and one technical annex, and 4 data collection sheets of the general procedures, and 2 of the technical one have been updated.

3 and 4. Training programs and staff qualification certificates. During 2020, 22 training programs were managed and reviewed, of which 6 were training programmes for recruits or staff who changed service, 15 were continuous training programs. One was a re-qualification program. In all cases, the corresponding Certificate of Qualification was issued.

During the year, all queries made by staff from the Services were also dealt with, especially those related to calibrations, intercomparison exercises, and the issuing of reports.

No courses on Quality were given to newly hired facultative staff, as they received a selective course by staff from this Department in the Centre for Legal Studies.

5. Management of internal and external equipment calibrations. External calibrations are performed by ISO 17025 accredited suppliers. For automatic pipettes with a volume equal to or less than 10 µl, external calibration is by centralized contract. In all cases, the SGC evaluates both internal calibrations or verifications and external calibration certificates, and assesses the possible significance with the heads of the Services.

6. Method validation studies. In 2020, three validations started; one of them, from the Biology Service, has been completed (Powerplex® Fusion 6C System). The other two, from the Toxicological and Environmental Assessment Service, are in progress (metal analysis by inductive plasma atomic emission spectrometry and determination of anions by ion chromatography). The SGC collaborates with those responsible for those aspects that are required.

7 and 8. Intercomparison exercises evaluation participation. The Services of the Seville Department participated in 13 intercomparison exercises that generated 22 evaluations by the SGC. Some of them have more than one round. Annually, the SGC updates the Quality Control Activities Plan in collaboration with the Services and periodically manages participation in the different exercises that have been selected according to their needs and suitability. No conformity assessment of exercise organizers was carried out in 2020.

9-10. Evaluation of external participants. The Seville Department organizes and coordinates the blood alcohol intercomparison exercise for different types of laboratories

performing this analysis. It consists of three rounds with three samples of biological fluids (blood and plasma) and 57 laboratories (6 from abroad) participating. After the results submitted by the participants, the SGC issues the corresponding report with the results of all laboratories. The last round sends the corresponding certificate to each of them (**see 8.3.4, Case of interest**).

11-12. Internal audits and Quality System Review. In 2020 an internal audit has been performed for the accredited tests and management system and the corresponding Quality System Review. Reports with findings and actions to be taken are drafted by the SGC.

13-15. Non-conformity records (NC) non-conforming works (TNC), and corrective actions and (AC) improvement. The SGC documents the mentioned actions, and carries out the cause analysis and extension analysis to determine the impact of the deviation on the Quality System. During 2020, 9 non-conformities and 9 corrective actions were opened. In all cases, the analysis of causes and extension analysis has been carried out. Four of them were related to deviations corresponding to internal and external quality controls and the rest to inadequate management of equipment and spreadsheets. Only those with a long estimated implementation period are open due to the type of corrective action established. Three improvement actions have been opened. Two are already closed.

16. Actions to address risks and opportunities. In 2020 we have identified two risks related to staff training, which are still under monitoring.

17. Management of claims and complaints. In compliance with the complaints procedure of this Department (PNT-MC-005) and once it is linked in the LIMS to the corresponding issue, the signed complaint form is delivered to the SGC, which proceeds to open the request in the application, assesses whether a non-conformity should be applied and controls the closure of the same. A total of 13 complaints have been opened referring to errors detected in the reports (5) or delays in the issuance of issues (8). No complaints have been received from citizens.

In addition to the aforementioned activities, it is worth mentioning that the SGC has managed the user satisfaction survey, understood as the IMLs, Environmental Prosecutor's Offices, and SEPRONA.

8.3.2. Intercomparison exercises in which the INTCFS Services participated in 2020

Participation in intercomparison exercises of the Biology Service
Program: Study of DNA polymorphisms in blood stains and other biological samples. Basic and advanced levels Organiser: INTCF-GHEP-ISFG. Samples: Blood, hair and other matrices Periodicity: Annual Parameters: Preliminary biological fluids, identification by DNA techniques.
Program: GEDNAP Proficiency test Organiser: GEDNAP-ENFSI (German Speaking Working Group of the International Society for Forensic Genetics) Samples: Blood stains and other biological fluids Periodicity: Annual Parameters: Preliminary biological fluids, identification by DNA techniques

Participation in intercomparison exercises of the Chemistry Service
Program: Blood Alcohol Intercomparison Exercise Organiser: INTCF-Sevilla Samples: Blood, plasma Frequency: Four-monthly Parameters: Ethyl alcohol and other volatile compounds
Program: International Quality Assurance Programme (IQAP-UNODC). Determination of psychotropic substances and narcotic drugs in consignments Organiser: United Nations Office on Drugs and Crime (UNODC) Samples: 4 powder samples (solids) Periodicity: Biannual Parameters: Identification and quantification of most common drugs of abuse.
Program: International Quality Assurance Programme (IQAP-UNODC). Biological Specimens Group Organiser: United Nations Office on Drugs and Crime (UNODC). Samples: 4 urine samples Periodicity: Biannual Parameters: Identification and quantification of most common drugs of abuse
Program: Interlaboratory Exercise on Drugs of Abuse Commonly Abused in Addictions Organiser: INTCF-Barcelona Samples: Powder-solid (stashes) Frequency: Annual Parameters: Qualitative and quantitative analysis of drugs of abuse and qualitative analysis of adulterants and diluents.
Program: Forensic Blood Toxicology PT-Quartz Scheme Organiser: LGC Standards Samples: Blood (3 samples per shipment) Frequency: Biannual Parameters: Identification and quantification of substances of toxicological interest

Participation in intercomparison exercises of the Toxicological and Environmental Assessment Service
Program: IELAB Physico-chemical parameters Organiser: IELAB Samples: Environmental matrices Periodicity: One round Parameters: Ammonium, nitrates, BOD5, COD, suspended solids, fluorides, and toxicity (EC50) - Microtox
Program: IELAB Microbiology and Physiochemical Parameters Organiser: IELAB Samples: Seawater Periodicity: One round Parameters: Total coliforms, Escherichia coli, enterococci. Ammonium, nitrates and pH
Program: Exercises in the environmental sector: wastewater Organiser: Quality Services Office Samples: High salinity water Periodicity: One round per year Parameters: Conductivity, ammonium, nitrate, fluoride, total phosphorus, pH, chlorides, nitrites, sulphates, phosphates, arsenic, boron, copper, iron, nickel, and lead
Program: Exercises in the environmental sector: wastewater Organiser: Gabinete de Servicios para la Calidad (Quality Services Office) Samples: Wastewater Periodicity: One round per year Parameters: Toxicity
Program: General parameters in water Organiser: Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible. Regional Government of Andalusia Samples: Seawater and wastewater Periodicity: one round per year Parameters: phosphates (seawater), suspended solids, total phosphorus (wastewater)
Program: Metals in water Organiser: Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible. Regional Government of Andalusia Samples: Inland water Periodicity: One round per year Parameters: Aluminium, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, and selenium.
Program: General parameters Organiser: LGC-AQUACHECK PT SCHEME Samples: 4 wastewater samples (of different nature) containing metals Periodicity: One round per year Parameters: Aluminium, antimony, arsenic, barium, boron, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, mercury, nickel, selenium, silver, tin, vanadium, zinc, titanium, vanadium, zinc, and titanium

Participation in intercomparison exercises of Toxicological and Environmental Assessment Service (cont.)
Organiser: Society of Hair Testing (SOHT) Samples: Hair (three samples per shipment) Frequency: Biannual Parameter(s): Identification and quantification of ethylglucuronide
Program: Toxicology Programme Organiser: LGC Standards Samples: Blood Frequency: Biannual Parameter(s): Identification and quantification of carboxyhaemoglobin
Program: Toxicology Programme Organiser: LGC Standards Samples: Blood Frequency: Biannual Parameters: Identification and quantification of ethanol in blood
Program: Drugs of abuse in hair testing Organiser: Society of Hair Testing Samples: Hair (3 samples) Frequency: Biannual Parameters: Identification and quantification of drugs of abuse in hair

8.3.3. Accreditation scopes

The SGC acts as the main interlocutor and is responsible for the quality of the Seville Department facing the National Accreditation Body (ENAC).

The Seville Department has two accreditation files opened, Accreditation no. 297/LE1833 Rev. 9 file, corresponding to toxicological and forensic testing (Chemistry and Biology Technical Units), and Accreditation no. 297/LE2239 Rev. 5 file, correspondent to the environmental testing (Toxicological and Environmental Assessment Technical Unit).

8.3.4. Interesting case: Intercomparison exercise o Ethyl Alcohol in Blood (EIAS)

In 2020 the Seville Department has organized the intercomparison exercise of ethyl alcohol in blood (EIAS) being the characteristics of this exercise:

- **Rounds and type of samples**. Consists of three rounds of analysis, with three samples each of blood (2) and plasma (1). Participants identify and quantify the ethyl alcohol in each of the samples. In addition, in one of the rounds, a sample is spiked with another volatile. (This situation is frequently encountered in routine).
- **Homogeneity and stability studies**. They are carried out by the procedures set out in Annex A of ISO ISO 13528:2015, "Statistical methods for use in proficiency testing by interlaboratory comparisons", and of the AOAC 2016.
- **Assigned value.** The assigned value is defined as "value attributed to a particular property of an aptitude test element". In this study, the property is the concentration of the analyte in the test samples. The assigned values were the robust averages of the participants' results. Both the assigned value (by consensus) and its uncertainty, as well as the robust standard deviation, are obtained following the procedure described in Algorithm A of the international standard ISO 13528:2015 mentioned above (Annex C of ISO 13528). The robust standard deviation is the one used for the calculation of the z-score.
- **The evaluation criterion used for the quantitative results is the z-score**. For its calculation, in addition to the result of the participating laboratory, the assigned value and the robust standard deviation are required.

As for the results, the distribution of the results is studied to rule out the possibility of a bimodal distribution.

Figure 8.3.4.1. Distribution by participating countries

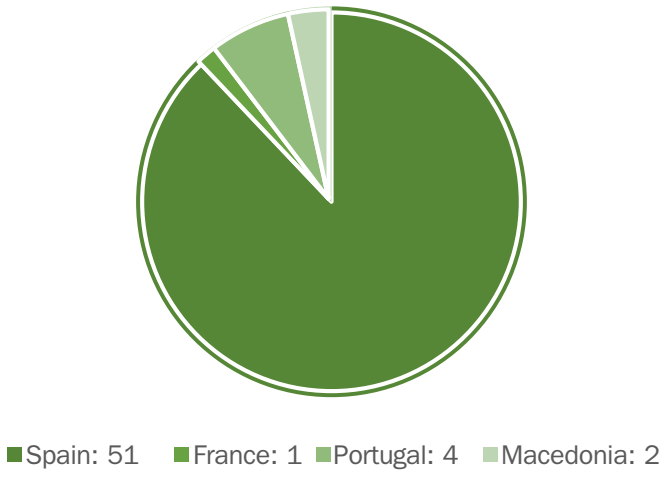


Figure 8.3.4.2. Total of participants in each round

	Number of participants	Emitting results
EIAS 1-20	58	46
EIAS 2-20	57	49
EIAS 3-20	57	55
TOTAL	172	150

Figure 8.3.4.3. Analysis techniques used

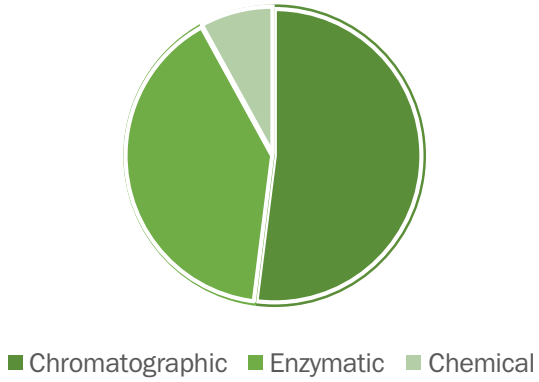
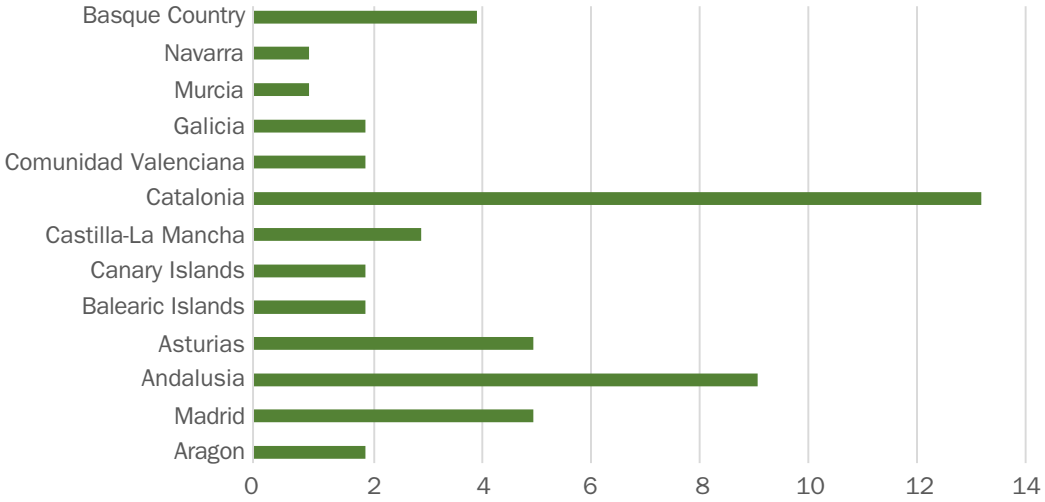


Figure 8.3.4.4. Distribution by Autonomous Community of the 51 Spanish laboratories

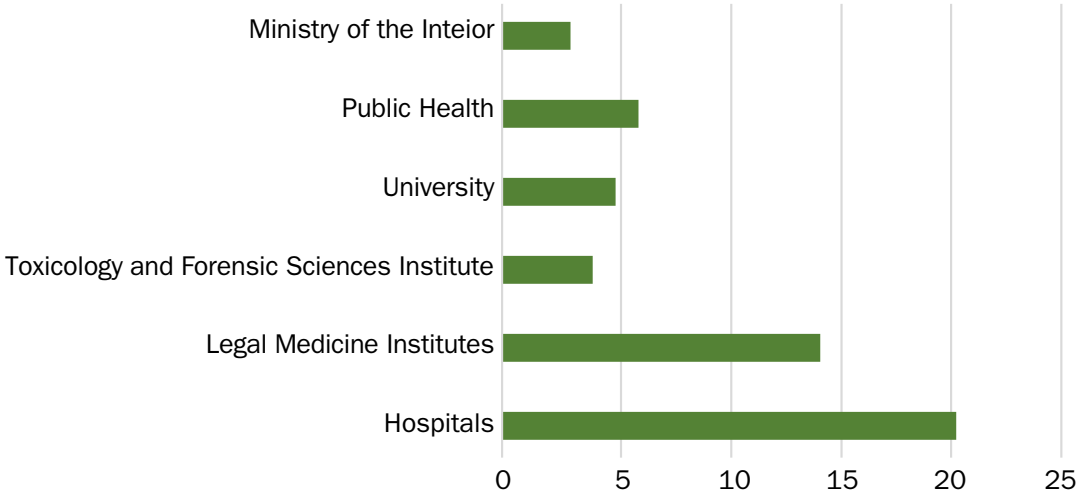


Regarding the distribution of participating institutions:

Public laboratories	52
Private laboratories	6

The public laboratories are distributed as shown in Figure 8.3.4.5.

Figure 8.3.4.5. Affiliation of participating public laboratories

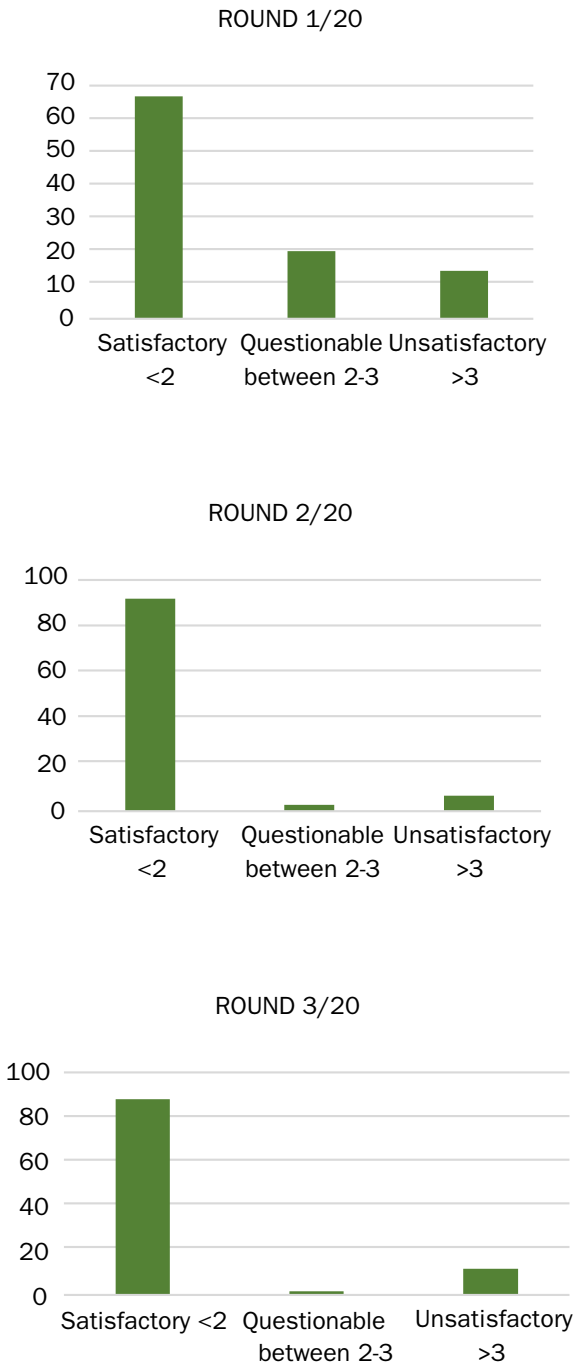


As indicated above, the criterion for evaluating the acceptability of the results taking into account the assigned value, the participant's value and the robust standard deviation is the calculation of the z-score so that:

If /Z-score/≤2	Satisfactory
If 2< /Z-score/≤3	Questionable
If /Z-score/>3	Unsatisfactory

After applying the evaluation criteria to each of the results obtained by the different laboratories on each of the samples, the percentages of the z-score ranges obtained in 2020 are as shown in Figure 8.3.4.6.

Figure 8.3.4.6. Percentages of z-score ranges, obtained in 2020



Considerations

Although this exercise is not yet accredited by ISO/IEC 17043, it has several characteristics that make it suitable for the intended purpose. These include:

- The samples received are in the same matrix as samples routinely analyzed in the laboratory at concentrations within the working range.
- In this exercise, the organizer estimates the assigned value of the measure by consensus among the results issued by the participating laboratories using robust statistical techniques. The estimate is influenced by the number of participants. In this case, the number of participants in this exercise (between 50-60) ensures the statistical validity of the results.
- Robust statistical techniques are used to minimize the influence of extreme results in the calculations performed (ISO 13528:2015 Robust Analysis Algorithm A).
- Calculation of the z-score parameter, using as a standard deviation the robust standard deviation calculated using Algorithm A.
- It is currently under review by the SGC Seville Department to make a series of improvements, including the establishment of a target sigma.

8.3.5. Scientific and teaching activities

8.3.5.1. Participation in investigation projects and collaboration with other institutions

On behalf of the INTCF, he is part of the working group CTN197-SC2 Forensic Services in the Spanish Standardization Organisation (UNE). Among other activities, this group reviews and provides comments on the documents of the ISO 21043: Forensic sciences standard, which is being prepared by the different ISO/TC 272 working groups. This year, the modifications proposed by ISO/TC 272 for the parts ISO CD 21043-3: Analysis, ISO CD21043-4: Interpretation, and ISO CD21043-5: Reporting, has been reviewed, and will be defended by the Spanish delegates in the ISO Technical Committee. In this working group, the opinions requested by UNE are agreed upon, especially those related to ISO/TC 272.

On behalf of the INTCF, it is in the group CTN197-SC1 Expert Services in UNE. The activity of this group has been directed to the confirmation as well as the constitution of working groups for the revision of the UNE 197010 Standard on ICT.

The staff of this Service has participated as an expert in the international project TR 16 IPA JH 03 18 (Turkey) with the collaboration in the activity no. 3.2 Seminar about 17025:2017 of the EU Twinning Project on Forensic Training Towards Advanced Examination Methods (June 2020).

Also as an expert, the staff of this Service has collaborated in the ICrime Project: Cooperation in a criminal investigation in Central America to combat crime and drug trafficking at international level", both in the on-site mission to the National Forensic Science Service of Belize for "Strengthening of investigation units, forensic institutes, networks,

and criminal investigation procedures in the Central American Integration System and Improvement activity in the chemistry service and in the quality system" (February 2020), and the online coordination and collaboration in the Central American Training Meetings on quality.

In 2020, the first meetings of the QCLG-QCC Measurement Uncertainty (MU) Project (ENFSI) working group started to update the current ENFSI documents related to the calculation of measurement uncertainty, in which this Service participates.

8.3.5.2. Teaching and training activities

Education activities

Soria Sánchez ML. Coordinator of the course Validation of methods in forensic sciences. Organized by the Centre for Legal Studies (CEJ). September 2020.

Soria Sánchez ML. Validation of methods. General aspects. Organized by the Centre for Legal Studies (CEJ). September 2020.

Soria Sánchez ML. Verification and transfer of methods. Organized by the Centre for Legal Studies (CEJ). September 2020.

Garcia Repetto R. Validation of qualitative and quantitative instrumental methods. Organized by the Centre for Legal Studies (CEJ). September 2020.

Garcia Repetto R. Validation of quantitative instrumental methods: Case studies. Organized by the Centre for Legal Studies (CEJ). September 2020.

Soria Sánchez ML. Activity: Seminar about ISO 17025:2017 Twining Project TR 16 IPA JH 03 18 (June 2020).

Soria Sánchez ML. Coordinator of the online training programme related to quality. ICrime Project: Cooperation in criminal investigation in Central America to combat crime and drug trafficking at international level".

Soria Sánchez ML. Specific standards, guidelines, and manuals in standardization. Organizations for the development of standards. Activity: Module 1. The importance of quality assurance in forensic laboratories. Online training program in relation to quality. ICrime Project. October 2020.

Soria Sánchez ML. Assurance of the validity of results. General aspects. Activity: Module 2. Assurance of the validity of results. Online training program in relation to quality. ICrime Project. November 2020.

García Repetto R. Tools for external control of the validity of results. Activity: Module 2. Assurance of the validity of results. Online training program in relation to quality. ICrime Project. November 2020.

Soria Sánchez ML. Accreditation bodies. Activity: Module 3. Accreditation. Online training program in relation to quality. ICrime Project. December 2020.

García Repetto R. Accreditation process. Activity: Module 3. Accreditation. Online training program in relation to quality. ICrime Project.

Soria Sánchez ML. Drugs of Abuse: Legal Framework. Degree in Criminology. Toxicology of Drugs of Abuse. Organized by the University of Seville. February 2020.

Soria Sánchez ML. Chemical submission. Degree in Criminology. Toxicology of Drugs of Abuse. Organized by the University of Seville. March 2020.

Soria Sánchez ML. The Chemical Toxicology Report. Degree in Criminology. Introduction to Forensic Sciences: Toxicology and Legal Medicine. Organized by the University of Seville. March 2020.

Soria Sánchez ML. Practical cases. Degree in Criminology. Toxicology of Drugs of Abuse. Organized by the University of Seville May 2020.

Garcia Repetto R. Associate teacher at the Pablo de Olavide University of Seville in the Degree in Criminology and Double Degree in Law and Criminology.

García Repetto R. Teacher in the Master's Degree in Criminology and Forensic Sciences. Pablo de Olavide University of Seville.

García Repetto R. Collaborating teacher in the International Master's Degree in Toxicology.

Training activities

Soria Sánchez ML. Estimation of Measurement Uncertainty in Chemical Analysis (MOOC online). University of Tartu (Estonia). May 2020.

The staff of the Quality Assurance Service of the Seville Department has attended the following courses organized by the CEJ in online mode:

- Study of the methodology of comprehensive forensic assessment in gender-based violence. CEJ. Madrid. 5-6 March 2020.
- Validation of methods in forensic sciences. CEJ. September 2020.
- Refresher course in forensic chemistry and toxicology. From the laboratory to the courts. LSA. October 2020.
- Analysis of pesticides in environmental samples and wildlife poisoning. LSA. September 2020.
- Informative introduction to the scientific and expert activity of the different INTCF Services. LSA. November 2020.

- Polluted soils and groundwater: update on analytical techniques and ecotoxicity tests. LSA. December 2020.
- Multidisciplinary investigation of sexual aggressions in forensic laboratories. LSA. November 2020.
- Multidisciplinary forensic studies of deaths by drowning. LSA. November 2020.

Other activities

Soria Sánchez ML. Member of the Reviewer Board of *Toxicology and Forensic Medicine-Open Journal* (TFMOJ).

Soria Sánchez ML. Consejo Asesor de la *Revista de Medicina Legal Española.* Toxicología Forense.

9. Toxicology Information Service

The Toxicology Information Service (SIT) began institutional work as a technic auxiliary body from the Department of Justice in February 1971. It started at the requests of courts, magistrates, judges, legal medicine institutes, and medical examiners in matters within its competence. It performs the functions of the National Anti-poison Centre. They immediately attend citizens to any consultation about poisoning or exposure to substances or toxic compounds. The consultations are effectuated by particulars and by the staff of medical centres attended by physician's experts in toxicology that administer the indicated toxicology information to prevent, diagnose, and start treatment of the intoxication making the consultation. They initiate an assessment and give immediate medical advice. At no time do they have face-to-face contact with the intoxicated person, so they cannot directly assess the intoxication or confirm the information provided by telephone, either by health personnel or private individuals.

The SIT has a Documentation Section apart from the medical and the administrative staff, made up of facultatives with academic training in the sanitary area. They develop the functions to elaborate, review, and maintain the database with the information of compounds, toxicity, and dangerousness of the products commercialized in Spain and previously notified to the INTCF. It is for this reason that the SIT is the only organism that receives information on the hazardous nature of the substances included in the products available on the market, in order to issue a health response in accordance with intoxications or toxic exposures that may occur.

The SIT is a unique reference service at the national level, because its number for Toxicology Emergencies, 915620420, is on the packaging labels of marketed and properly registered products that may generate toxic problems through previous communication to the SIT. The number diffusion facilitates direct and immediate contact of the Service doctors with the poisoned person in the mornings, afternoons, or evenings.

The year 2020 was the year of the SARS-CoV-2 pandemic. It changed our lives and how we approached our work. Throughout the year, we have experienced the difficulty of continuing of providing a public service to the population. In March, we had to adapt suddenly and unexpectedly the functions of an anti-poison centre, which are usually carried out in person, to having to carry them out virtually, with remote customer service by telephone. All was possible thanks to the telephone diversions and scheduling the shifts of all the staff using the teleworking method. It had never been developed in our Service before.

The computer equipment was available to the technical staff to attend companies in the chemical sector, to calls received due to poisoning, managed and resolved by mobiles provided to the staff. It is also worth highlighting the added problem of covering absences from work, with the human factor, with its effort and availability having to double shifts, being the best resource this Service has had in this unusual and complicated year.

The Documentation Section was also obliged to adapt to this exceptional situation, managing the information sent by companies, queries on the procedure to be followed to the

regulations in force through teleworking, contacting the company that makes the query within 24 hours for the corresponding resolution.

Among the various activities carried out by the SIT during 2020, the following stand out:

1. The press releases and alert communications issued by the SIT after detecting in its records the incessant increase in toxic exposures and intoxications produced by:

- The mixture of cleaning products (bleaches associated with different products).
- Miraculous mineral substance (chlorine dioxide or MMS).
- Hydroalcoholic gel (especially in children).

Since the beginning of the pandemic, consultations for toxic exposures and intoxications due to the overuse of cleaning products, especially those mixed, have been increasing steadily over the weeks. Concerning the role of toxic vigilance that characterizes the anti-poison centre as a means of preventing poisoning in the population, a follow-up of the records collected by the SIT was carried out. The evaluated and abnormally increased casework in the first months of the pandemic can be justified by the repeated commitment to cleanliness and the eagerness to eliminate SARS-CoV-2 from our environment by associating bleach with other cleaning products, the overuse of hydroalcoholic gel, especially in the child population, as well as the erroneous belief of using chlorine dioxide (miraculous mineral solution) to cure it.

These communications had a media impact through the digital press and social networks, in numerous interventions on radio and television, managing to alert users to the escalation of toxic exposures in the population caused by such cases.

2. In the first months of the pandemic, the cleaning products sector detected a major problem when obtaining some of the raw materials necessary to manufacture its products (window cleaners, floor cleaners, etc.), as they were being diverted to other sectors). As they were diverted towards the manufacture of surface disinfectants and hydroalcoholic gels for hospital use, difficulting manufacture and market products for cleaning surfaces (floors, glass, tiles, etc.) containing these raw materials, which were in great demand by society in its need to clean and sanitize the home. A toxicological study was carried out on the chemical substances which, according to the industry, could replace the raw materials diverted to other sectors, to safely and quickly authorize their replacement in cleaning products. It could reduce the administrative burdens and speed up regulatory procedures, given the exceptional situation in which we find ourselves due to Covid-19.

3. The development of the Procedure for adaptation to the European Harmonization Project led by the European Chemicals Agency (ECHA), for the implementation of a centralized platform on toxicity data for all substances declared as hazardous by the Chemical Industry in the European Union countries, which should come into force on 1 January 2021.

The Documentation Section has actively participated in the working groups set up by ECHA. They have continued their work throughout the year. They have been holding

videoconference working sessions and issuing reports, allowing the work started in 2010 to continue, and finalizing the development of the ECHA European portal for the notification of chemical mixtures and its interoperability with the databases of the Poisons Centers of the EU Member States in which chemical mixtures are placed on the market. It will be available on the date determined in the regulation (1 January 2021). The working groups in which members of the Documentation Section have participated are the following:

- IT tools WG: Working Group for the development and revision of the IT application developed by ECHA for the preparation of the export file in a harmonised format for the entire European Union (PCN format).
- Guidance WG: Working Group for the adaptation of the ECHA Guidance to the legal regulations (Annex VIII of the CLP Regulation and article 25 of the CLP Regulation itself).
- Validation Rules (VR) WG: Working Group for the development and revision of validation rules for notifications submitted by the chemical industry.
- PCN Data Base WG: Working Group for the design and revision of ECHA's central database.
- Expert Group for the final revision of the Guidelines (PEG), working group nominated by the CARACAL Competent Authority (in Spain, the Ministry of Health).

The SIT staff is formed by different professional categories that belong to Medical examiners, facultatives, and different administrative scales. Integrated in this Service, is the Documentation Section with its corresponding headship.

Table 9.1. Toxicology Information Service staff

	Toxicology Information Service
INTCF	1
Head of the Department	1
Documentation Section Head	1
Facultatives	17
Medical examiners	7
Administratives	7

A total of 13 Facultatives and 7 medical examiners with a university degree in Medicine and Surgery attend 24 hours telephone service, while 5 facultatives (Head of the Section included) with the university degree in Pharmacy, Medicine, Surgery, and Biological Sciences attend the Documentation Section.

The activity carried out throughout the year 2020 by the SIT with respect to telephone consultations managed and reports made by medical personnel is shown below.

85,283 telephone queries were resolved in 2020. It is noteworthy that this figure represents an increase of almost 7 % compared to the average number of telephone queries collected in recent years (around 80,000 queries per year).

According to the data provided collected in the telephone consultations, two large groups are differentiated:

- "Toxic consultations" for toxic exposures or intoxications to any potentially toxic substance or product responsible for the call.
- "Informative consultations", not related to toxic exposures or intoxications as such.

All requesting calls are attended both to citizens without specific health training (by telephone 915620420) and to health personnel from health centers, hospitals and hospital and out-of-hospital emergency services (by telephone 914112676 and for the exclusive use of said personnel).

Throughout 2020, 160 toxicological reports were issued by medical staff, and 3,747 reports were issued by the Documentation Section to answer the requests for information from companies in the chemical sector. In the latter case, there has been a significant increase of more than 140 % in the number of reports issued by the Documentation Section in the previous year (Figure 9.1).

The reports managed by the SIT Documentation Section come mainly from Catalonia (22.9 %), the Valencian Community (12.2 %) and the Madrid Community (11.9 %).

We will also highlight the requests for information from other EU Member States, consulting their doubts in reference to the procedure established in Spain for the notifications of mixtures classified as dangerous that are marketed in our country, with 26.8 % of the requests for information. registered in the Documentation Section, throughout the year 2020 (Figure 9.2).

Figure 9.1. Distribution of reports issued by the Toxicological Information Service in 2020

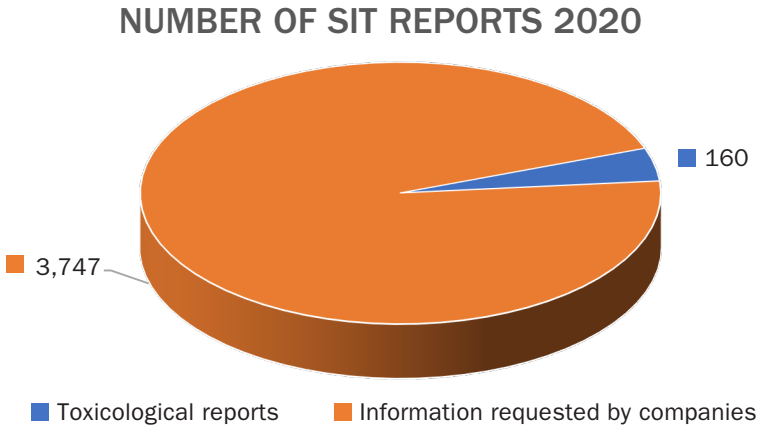
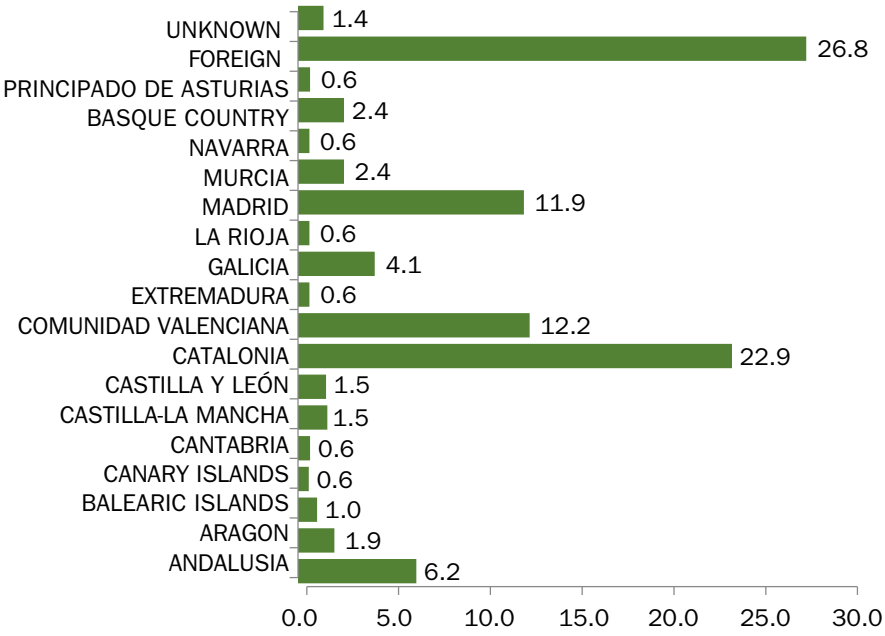


Figure 9.2. Distribution of information requests registered in the Documentation Section (in %) according to their geographical origin



The report classification by the medical staff is determined depending on the request, cataloged as M, ME, or IC reports (Figure 9.3).

In the case of M-20 Reports, these are sent after a detailed study of a requested topic, either from the Administration of Justice or from other institutions.

A total of 52 reports were issued and drawn up following requests mainly from the Justice Administration (22 reports) for expert opinions for courts and tribunals, as well as information from other administrations, health institutions, or private individuals. A detailed study of the request is required. These requests are assigned consecutively and drawn up by the SIT doctors.

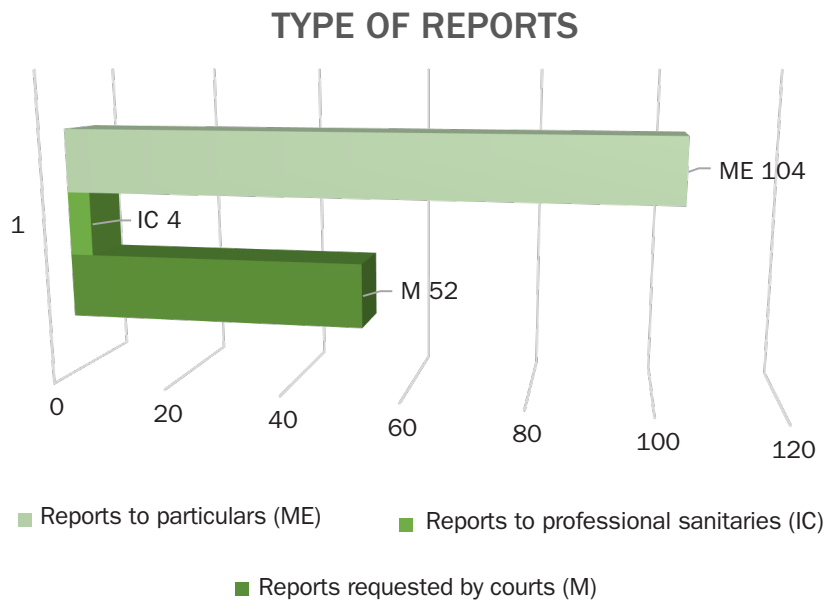
About ME-20 Reports, this information is sent by e-mail at an early stage as they are requests from the public and do not require detailed toxicological assessment.

A total of 104 reports were issued and drawn up following requests mainly from users and individuals. The Head of the Service replies by e-mail promptly to the request from the public, in general.

IC Reports answer the health professional's requests related to toxicology cases, sending requested complementary information by email.

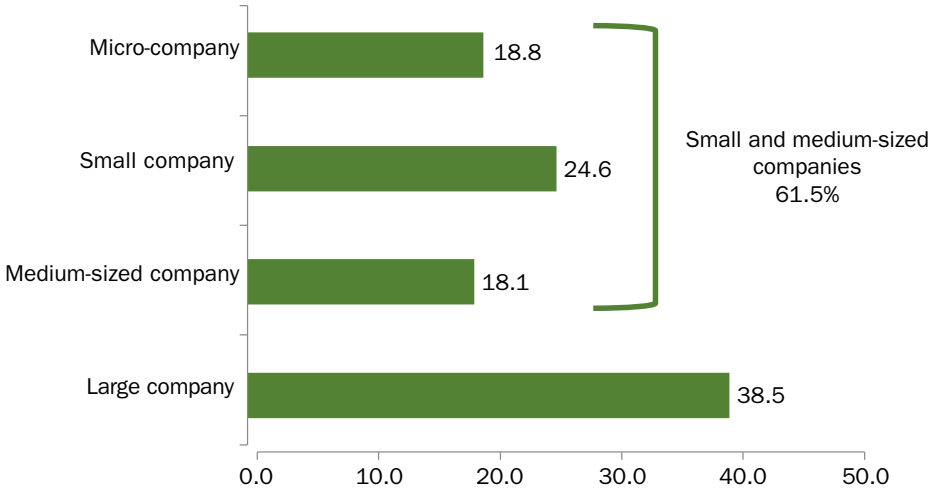
Four informative replies were issued following requests from health professionals. A reply was sent immediately by e-mail about a toxicological case requiring additional information exchanged by telephone with the said professionals.

Figure 9.3. Types of Reports issued by the medical personnel of the SIT during 2020



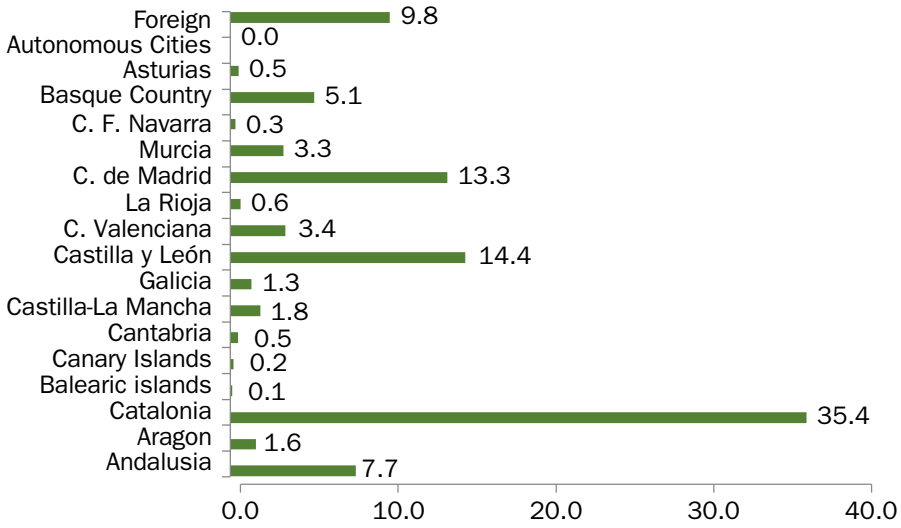
The Documentation Section, in addition to the 3,747 requests for information reflected in the previous section, has registered 9,860 submissions from the 5,148 companies that have been registered in the Company Registration System (SRE) and are authorized to make notifications of the products they market in Spain. In these 9,860 shipments, a total of 40,326 products have been notified during 2020, and 61.5% of these mixtures are marketed by Small and Medium-sized Companies, as they constitute a significant volume of the Spanish industrial network (Figure 9.4).

Figure 9.4. Distribution of products notified to the INTCF (in %) in 2020, according to the size of the company placing them on the market



The following figure shows the distribution of the products notified in 2020 by the Autonomous Communities. As in previous years, the high proportion of notifications made from the Autonomous Communities of Catalonia, Valencia, and Madrid stand out. Despite being an atypical year, with little communication between EU countries, 9.8% of the notifications received in the INTCF were made from another EU Member State (Figure 9.5).

Figure 9.5. Distribution of products notified to the INTCF (%) in 2020, according to the regional distribution of the notifying company



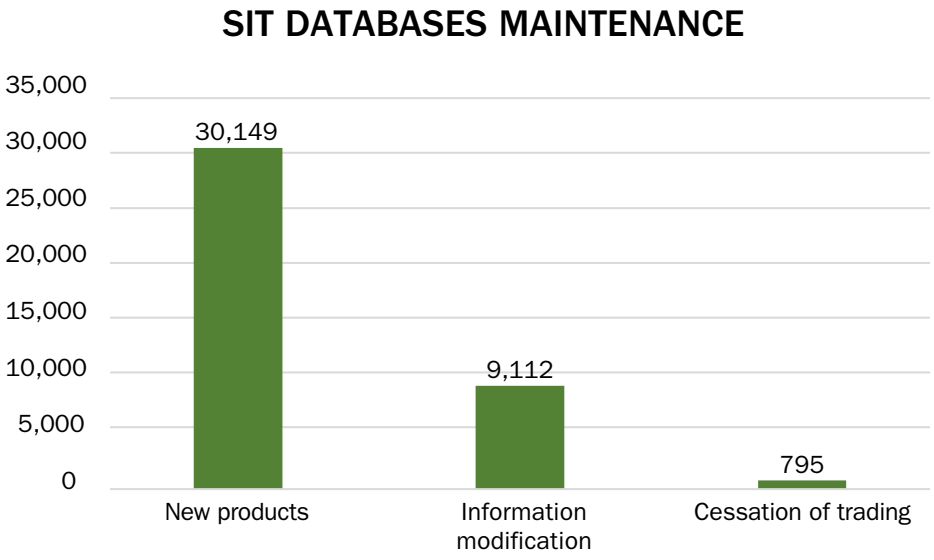
9.1. SIT databases and European harmonization process

9.1.1. Maintenance of the Fichas SIT databases (SIT databases sheets)

The Documentation Section during 2020 included 30,149 new products and 9,112 formula modifications of products previously notified to the INTCF in the SIT database. Each product is incorporated in the SIT database, the complete mixture compound, the dangerousness classification, the physical characteristics, the information present in the labeling, and safety data sheets, apart from other data that allow knowing the product toxicity and providing an immediate medical response to a consultation due to a potentially toxic exposure with any of the products notified to the SIT (Figure 9.1.1.6).

Likewise, throughout 2020, the information on 9,112 products previously notified on their labels, safety data sheets, packaging size, etc., was updated, so that the database contains valid and updated information on the products being marketed in Spain. Finally, 795 products have been removed from the SIT database because, according to the information submitted by the responsible company, they are no longer marketed in Spain (Figure 9.1.1.6).

Figure 9.1.1.6. Distribution by type of update of the SIT database



9.1.2. Notification of chemical substances and mixtures to INTCF

Throughout this year, the study and development of the computer system made it possible to include the 40,326 mixtures notified by the Spanish and European chemical industry in the INTCF database (called FICHAS SIT = FSIT) have continued. The work has been carried out by the Documentation Section, together with the Subdirectorate General for Territorial Organisation and Coordination and the Subdirectorate General for New Technologies of the Department of Justice.

The SIT notification system allows the intercommunication between the companies and the INTCF via an information shipment system through an encrypted file with the required information online and complying with the regulation to notify the INTCF to which they are obliged by Law 8/2010, of March 31. In this way, 40,056 products have been notified through said system throughout 2020, with 725 new companies registered, which means a total of 5,148 companies enabled to send notifications to the Institute.

9.1.3. European harmonization of notifications to designated bodies

Throughout 2020, and despite the existing difficulties due to the pandemic caused by COVID-19, the Documentation Section has continued to participate in different working groups created to establish a harmonized notification procedure throughout the European Union. It was initiated in 2010 and is due to be completed in January 2021. The harmonized notification process will allow the chemical industry to notify in all the countries

where it markets a mixture classified as hazardous, in the same electronic format, and with the same information in all the European Union.

The CLP Regulation, article 45, established the necessity to harmonize the information that the chemistry industry must remit to the organisms designated in each State member to proportionate the sanitary response. This need has forced important work from the industry, from the centres (in Spain the INTCF), and the European Commission as moderator and arbitrator of these meetings, to define the essential requirements. The notification procedure has ended with the publication of Annex VIII of the CLP Regulation in Commission Regulation (EU) 2017/542, of 22 March 2017, and its two delegated Regulations: Commission Delegated Regulation (EU) 2020/11, of 29 October 2019, and Commission Delegated Regulation (EU) 2020/1677, of 31 August 2020.

The harmonization has to end on 1 January 2021, the date where all these necessary tools for the notification of products should be available free of charge for consumer and professional use, collaborating in:

- Development of an informatics program that allows the notification of the information with the chemical compound of all mixtures classified as dangerous for health.
- Develop the information validation standards that the chemistry industry will remit to ECHA.
- Development of the European notification site, to be available in January 2021, sharing the INTCF experience in the online notification system (SRE System) already existing in Spain.
- Elaboration of Guidances, with the participation of groups established in the European Commission to interpret the regulation concerning organism notifications designed by each State member.
- Participation in the "Workability study concerning implementation of Annex VIII of CLP", to study the notification to organisms designated from certain sectors of the chemical industry which represent a special casuistic when implementing the CLP European regulation.
- Toxicovigilance and intoxication prevention continues with the INTCF collaboration in the harmonization of product categories used by all the State members in the notifications to the anti-toxic centres for toxicological monitoring and prevention of poisoning at the European level.
- The Implementation of a Unique Formula Identifier (UFI), that the companies must include in the product labels they commercialize, through the workgroup "Workshop on the study on analysis, development, and testing of the Unique Formula Identifier (UFI) for information to be submitted to poison centres, according to article 45 (4) of EC Regulation No 1272/2008 (CLP regulation)".

- Report elaboration requested by ECHA, following requests for extraordinary reports requested about certain aspects of the notifications which have been responded to, based on INTCF's experience.
- Reports elaboration requested by the Ministry of Health for European legislation harmonization meetings (CARACAL). Collaborating with numerous reports for the Spanish authorities (Ministry of Health) to document the issues treated in the meetings maintained with the European Commission in Brussels.
- Collaboration with Reports requested by the Ministry of Health for meetings maintained with the European Commission. For the drafting of amendments to Annex VIII of the CLP Regulation (REACH Committee).
- Presence in the Meeting of the REACH CLP, to discuss the consultations that arise from the Regulation implementation of REACH and CLP to the industry sectors regulated representing the Ministry of Justice.
- Reports development for the group of the European Association of Poisons Centres and Clinical Toxicologists (EAPCCT), informing about the criteria and Spanish experience in the notifications process of a dangerous chemical mixture to the INTCF.

9.2. Description of an interesting case with media coverage

During the first eight months of 2020, the SIT received a total of 874 hydroalcoholic gel poisonings. Of these, 226, 159, and 172 occurred in May, June, and July respectively. These data were significant in this type of intoxication in Spain during the SARS-CoV-2 pandemic. Only 90 were received throughout 2019.

Of the total number of poisonings, 67 % (585 cases) occurred in children, and 42 % (368 cases) in children under 2 years of age. The etiology of the vast majority of these poisonings was accidental, with 84 % entering the body by the oral route and 7% by the ocular route.

Such was the magnitude of the casework collected by the SIT that the Minister of Justice, Juan Carlos Campo, intervened in September in a statement disseminated on social networks through the Ministry's Twitter account. He was alerting the population about the problem arising from the overuse of hydroalcoholic gels due to their incidence of poisoning in young children and calling for caution.

The SIT carried out report M20-09408 at the request of the Communications Office of the Minsitry of Justice, with a detailed study of the cases collected up to August, extending this study of cases to include October through report M20-09617, where the cases of toxic exposure and intoxication by this product continued to increase due to the new waves of the pandemic.

9.3. Teaching and scientific activity

9.3.1. Participation in investigation projects and collaborations with other institutions

Investigation project

"Detergent capsules – accidentology proyect (laundry, dishwasher and others)".

Collaborating entities: International Association for Soaps, Detergents and Maintenance Products (AISE), Toxicological Information Service, and other European Anti-toxin Centres.

Period of execution: 2012-2020.

Brief summary of objectives: Retrospective (2012-2016) and prospective (2017-2020) study of toxicological surveillance of accidental exposure to detergent products in capsule format (laundry, dishwasher, and others), by means of the six-monthly submission of the number of cases of patients exposed to these cleaning products in this commercial format.

The SIT reports data with the aim of establishing improvements in the properties of the packaging and design of commercially marketed containers to make the use of these products safer, especially aimed at the paediatric population due to their particularly attractive format. It also includes an estimate of the severity depending on each toxic exposure.

Collaborations with other institutions

- Member State Communicators Network meeting (ECHA).
- Consultation Plan and Questionnaire on the Appointed Bodies and Poison Centres (ECHA).
- Working group on the Appointed Bodies and Poison Centres – Portal Notifications database (ECHA).
- Eurocigua. Grupo de trabajo de Intoxicaciones por ciguatera.
- Centro Coordinador de Alertas y Emergencias Sanitarias (CCAES). Ministerio de Sanidad. Grupo de trabajo Joint Action BICTRA. Toxicidad de cigarillos electrónicos.
- Confederación Española de Consumidores y Usuarios (CECU).
- Instituto de Toxicología de la Defensa. Ministerio de Defensa.
- Comisión Asesora del Organismo Notificado. Agencia Española de Medicamentos y Productos Sanitarios (AEMPS).
- Comité Científico de Productos Sanitarios. Agencia Española de Medicamentos y Productos Sanitarios (AEMPS).

- Departamento de Medicamentos Veterinarios. Agencia Española de Medicamentos y Productos Sanitarios (AEMPS).
- Campaña MedSafety Week. Agencia Española de Medicamentos y Productos Sanitarios (AEMPS).
- Comisión Nacional para el uso forense del ADN. Ministerio de Justicia.
- Comisión Interministerial para la Ordenación Alimentaria (CIOA). Agencia Española de Seguridad Alimentaria y Nutrición (AESAN).
- Grupo Interministerial de Coordinación de Asuntos REACH y CLP.
- Working Group on Poisons Centre Activities & European Regulatory Issues. European Association of Poison Centres and Clinical Toxicologists (EAPCCT).
- Meeting of the CARACAL Sub-group on ATPs to CLP. European Commission, Brussels.
- Guidance WG on Poison Centres (ECHA) .
- Partner Expert Group (PEG) (ECHA).
- Federación Empresarial de la Industria Química Española (FEIQUE).
- Asociación Española de Fabricantes de Pinturas y Tintas de Imprimir (ASEFAPI).
- Asociación de Empresas de Detergentes y Productos de Limpieza (ADELMA).
- Federación Empresarial Catalana del Sector Químico (FEDEQUIM).
- Instituto Tecnológico del Plástico (AIMPLAS).
- Asociación Nacional de Perfumería y Cosmética (STANPA).
- Asociación Empresarial Española de la Industria de Sanidad y Nutrición Animal (VETERINDUSTRIA)
- Asociación Empresarial para la Salud, la Nutrición y el Bienestar Animal (ADIPREM).
- Asociación Española del Comercio Químico (AECQ).
- Asociación Química y Medioambiental del Sector Químico de la Comunidad Valenciana (QUIMACOVA).
- Asociación Empresarial para la Protección de las Plantas (AEPLA).
- Universidad San Pablo CEU.

9.3.2. Scientific publications

CI Vardavas, C Girvalaki, S Odani, A Alonso, R Martinez, JL Conejo et al. “Profile of incidental exposures to e-cigarette liquids in Europe, 2018–2019”. Human and Experimental Toxicology 1-6. The Author(s) 2020. Article reuse guidelines: sagepub.com/journals-permissions. DOI: 10.1177/0960327120975828 journals.sagepub.com/home/het

9.3.2. Teaching and training activities

Conejo JL. Speaker at the clinical session "The SIT and the INTCF: its institutional utility". Infanta Leonor Hospital, Madrid. 22 January.

Ucha M. Collaboration in the campaign "E-cigarette, do you really think it doesn't harm your health? European Network for Smoking Prevention (ENSP), Official College of Doctors, Official College of Pharmacists, Official College of Physiotherapists, and Official College of Dentists and Stomatologists of Madrid. January.

Martínez Arrieta R. "Notification news in the Anti-toxicity Centers" presented at the Jornada informativa de 2020, organized by the Detergents and Cleaning Products Association (ADELMA). Madrid. February 2020.

Martínez Arrieta R. "Notificación al INTCF. Harmonized future". In the informative conference Harmonized procedure for notifications to Anti-toxicity Centers. Organized by the Business Association for the Protection of Plants (AEPLA). Madrid. March 2020.

Martínez Arrieta R. "Notification to Anti-toxicity Centers. Art. 45 CLP Regulation. Current situation and harmonized future". In the informative conference: The essential on legislation for 2020. Organized by Soluciones Informáticas y Medioambientales (SIAM) and EPSON. Vitoria. April 2020.

Martínez Arrieta R. "Basic principles in risk assessment" (2 hours). In the 10th Edition of the Title of Safety Assessment and Cosmetic Product Information File. Organized by the Faculty of Pharmacy of the San Pablo CEU University, National Association of Perfumery and Cosmetics (STANPA), Official College of Pharmacists of Madrid (COFM), Spanish Association of Pharmacists of the Industry (AEFI), Spanish Society of Cosmetic Chemists. Online. June 2020.

Martínez Arrieta R. "Main factors in the safety assessment of cosmetics according to SCCSS recommendations" (2 hours). In the 10th Edition of the Own Title of Safety Assessment and Cosmetic Product Information Dossier. Organized by the Faculty of Pharmacy of the San Pablo CEU University, National Association of Perfumery and Cosmetics (STANPA), Official College of Pharmacists of Madrid (COFM), Spanish Association of Industry Pharmacists (AEFI), Spanish Society of Cosmetic Chemists. Online. June 2020.

Martínez Arrieta R. "Systemic toxicity of cosmetics today. The vision from an anti-poison centre" (1,5 hours). In the 10th Edition of the Title of Safety Assessment and Cosmetic Product Information File. Organized by the Faculty of Pharmacy of the San Pablo CEU University, National Association of Perfumery and Cosmetics (STANPA), Official College of Pharmacists of Madrid (COFM), Spanish Association of Industry Pharmacists (AEFI), Spanish Society of Cosmetic Chemists. Online. June 2020.

Conejo JL. Director of the Course "Platform SIT Cards and management of computer tools for the statistical processing of data collected in the Service". Continuous Training Plan 2020. CEJ. Online modality. 6, 7 and 8 October.

De la Oliva S. Speaker of the communication “Ozone in times of COVID-19” (De la Oliva S, Trompeta I, Mencías E. INTCF-SIT). 24th Conference on Clinical Toxicology and 14th Conference on Toxicovigilance. Online modality. 22 and 23 October.

Lázaro Trueba I. “Adaptation of Designated Bodies and Anti-toxicological Centres to the European harmonization process (Art. 45 of the CLP Regulation - Annex VIII)”. In the course “Plataforma Fichas SIT informatics tools handling for the statistical processing of data recorded in the Service”. Organized by the Centre for Legal Studies (CEJ), in the 2020 Continuing Education Plan. Online. October 2020.

Martínez Arrieta R. “General structure and functionality of the SIT Cards Database and its interrelation in the different Catalogues: Products, Substances and Families”. In the course “Platform Fichas SIT and Management of computer tools for the statistical processing of data collected in the Service”. Organized by the Centre for Legal Studies (CEJ), in the 2020 Continuing Education Plan. Online. October 2020.

Conejo JL. Speaker of the communication “The Toxicological Information Service of the INTCF”. Course “Informative introduction to the scientific and expert activity of the different Services of the INTCF”. Continuing Education Plan 2020. CEJ. 18 November.

Lázaro Trueba I. “Implementation of Annex VIII – Spain”, in the Conference: Poison Centre Notification: “Poison Centres - What Does Annex VIII Mean?”, of the NCEC (National Chemical Emergency Centre – UK). November 2020.

Martínez Arrieta R. “What’s new in the harmonized notification process from 2021”, in the informative Webinar on what's new in the harmonized notification process from 2021, organized by the Detergents and Cleaning Products Association (ADELMA). Online. November 2020

Martínez Arrieta R. “Regulatory developments in the notification of mixtures to the INTCFW”. In the information day: Virtual Regulatory Update 2020, organized by the National Association of Perfumery and Cosmetics (STANPA). Online. November 2020.

Martínez Arrieta R. “Harmonized Notification (Poison Centres). Current and future situation”, in the training session Poison Centres. Harmonised Notification. Organized by the Business Association for Animal Health, Nutrition, and Welfare (ADIPREM). Online. November 2020.

Martínez Arrieta R. Update of notifications to the INTCF, according to article 45 of CLP”. Presented at the online training day New European procedure for notifications to poison centres. Organized by the Spanish Chemical Trade Association (AECQ). Online. November 2020.

Martínez Arrieta R. “News on Notification to INTCF of animal health products. CLP Regulation”. In the Online Training Workshop on Animal Health Products, Diagnostics, and

Biocides in Animal Health. Organized by the Spanish Business Association of the Animal Health and Nutrition Industry (VETERINDUSTRIA). Online. December 2020.

Martínez Arrieta R. “Novelties in the case of harmonized notification to the Anti-toxin Centres, from 2021”. Informative seminar Update of notifications to INTCF according to Annex VIII, organized by the Chemical and Environmental Association of the Chemical Sector of the Valencian Community (QUIMACOVA). Online. December 2020.

10. Other INTCF Units in support of forensic activity

According to article 13 of INTCF Regulation, it counts for operation with the necessary support staff that is established in the job relationships of work. It is to perform technical and administrative functions of economic management, of personnel, building, informatic and communication systems and other similar ones.

In the following headings, the units are described, whose functions are essential to the good functioning of the expert Services of the INTCF.

10.1. Sample and Waste Management Area

Each INTCF Department counts with a Sample and Waste Management Area. The mission is to manage the samples from their arrival to the laboratory until their distribution to the Services. It is to ensure the safekeeping of post-analysis samples.

The staff of these units from the different headquarters of the INTCF during 2020 is shown in Table 10.1.

Table 10.1. Sample and Waste Management staff during 2020

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA	INTCF-LA LAGUNA
Facultatives	2	2	1	1
Specialists Technicians	6	-	1	1
Laboratory assistants	4	7	7	–
Administratives	5	–	–	–

According to these functions, the work developed in this area consists fundamentally in:

- **Reception of analysis requests and samples in the INTCF**. Upon the arrival of a shipment of samples or a request for analysis, they will proceed to the register in the Laboratory Information Management System (LIMS), collecting all the data, including the chain of custody inside the laboratory.
- **Analysis and samples request acceptance.** Each collection of samples corresponding to the same judicial procedure must comply with the collection, transfer, and custody standdards that ensure compliance. The INTCF established them in the JUS/1291/2010 Order of 13 May.
- Reasons for rejection of requests for analyses and/or samples by the INTCF must be fully justified.
- **Coolers and packages opening**. Each cooler or package will be opened individually to follow the security rules that guarantee the sample protection and the operator.
- **Cases and samples identification. Labeling.**

- **Adequacy and storage previous to the analysis**. These actions must not expose in danger the sample integrity. The most common are: individualization in separate containers, drying of clothes, the addition of formalin, repackaging of sharp objects or poorly protected weapons, etc. The previous analysis storage will be done in optimal conditions to the sample type and their preservatives.
- **Assignation and distribution to the Services**. Cases and samples will be assigned and distributed to the different Services taking into account the type of analysis requested. The judicial priority (cases with prisoners, fast trials...), the analysis priority (microbiological studies, volatiles, wounds, biochemical...), the amount of sample sent, the preservatives used, whether more than one Service intervenes on the same sample, etc.
- **Post-analysis custody.** Once the analysis is finished, the samples will be maintained, labeled, and classified in a chamber located for that purpose.
- **Return/sample destruction and residues management.**

During the state of alarm, declared on 14 March 2020 to deal with the health emergency caused by COVID-19, the functions of the staff in the Sample Management Area were assumed by the minimum authorized services.

Likewise, the collaboration of the Institutes of Legal Medicine and Forensic Sciences and the rest of the senders was requested to prioritize essential services by the instructions of the General Council of the Judiciary. From 13 March to 28 April 2020, the INTCF registered the samples corresponding to the 820 requests for analysis received during this period, broken down as follows: Madrid, 299; Seville, 232; Barcelona, 179; and La Laguna, 110. These figures represented about 16% of the number of requests registered in LIMS over the same period of the previous two years. The total activity was recovered by the De-escalation Plan for the Administration of Justice before COVID-19, approved in Order JUS/394/2020, of 8 May.

Figure 10.1. Different units of the Sample and Waste Management Area of the INTCF Madrid Department

10.2. INTCF Library

The main objective of the INTCF library is to meet, manage, diffuse, facilitate, boost, and potentiate the most complete, precise, and helpful information related to the forensic sciences fields, and to attend to all the informative needs generated by these activities.

The library pretends to be proactive in the control and diffusion of toxicological information with new information and communication technology use (IT), thus to contribute to the improvement of the quality of its services.

The library is located in the Madrid Department of the INTCF and divides its collections into a **reference room**: a free access space for current monographs and another for periodicals archive; **deposit**: monographs before 1990; and **museum**: old collection cataloged by Collective Catalog of Historical Heritage -CCPB-, free of charge, with the application of Law 16/1985, of 25 June, of the Spanish Historical Heritage under the Ministry of Culture and Sports. The institution's collection can be consulted at the following address:

http://catalogos.mecd.es/CCPB/cgi-ccpb/abnetopac/O12268/ID11627788?ACC=101

The consultation of all the funds of the institution can be made in advanced search in the field of copy data with the following word: M-R-INTCF. In the centre itself, it is also possible to consult, with previous authorization, the files made by the institution from 1887 to

1950 of incalculable historical value, distributed in 84 boxes. Through them, a historical view of the Spanish society and the judicial matters denounced by individuals at the request of the public prosecutor can be made.

The Services are:

The **Selective Information Dissemination** (DSI) provides information on the new online contents of publications. They send:

- Alerts adapted to the user's profile of journals subscribed and not subscribed by the institution.
- Periodic compilation lists of articles requested by users from the alerts sent during the current year and adapted to the user's profile. These are in the fields of Biology, Chemistry-Drugs, and Forensic Medicine.
- Bibliographic references about important titles, both by thematic or by authorship, highlighting when they are INTCF facultative.

The Document Obtention Service (**SOD**) is based on the articles' obtention, chapters, and external fund books through the interlibrary loan of hospitals and universities.

Also provides:

- **Bibliographic training to the facultatives from the Madrid Department who require it:**
  - Face-to-face and customized. It is required to arrange a meeting.
  - To small groups from the same service to focus on their specific field of knowledge.
- **Sending updated material on literature searches and workspace** from the Pubmed and Ebsco Discovery Service search engines to the INTCF facultative and professionals from the Institutes of Legal Medicine and Forensic Sciences (IMLCF).
- The **bibliographic searches** in collaboration with the facultative to redirect the results to the desired site.
- **Ebsco Discovery Service**

  The Ebsco platform allows direct and immediate access to both contracted journal articles and e-books purchased in perpetuity. This enhancement is of direct benefit not only to INTCF practitioners but also to transferred and non-transferred IMLCFs. The library administrator of the platform has the power to control the users who subscribe. In 2020, there is access to 15 journals, and 17 e-books have been purchased.

  About the activity carried out, note that the library receives requests from all the Departments and Delegations of the INTCF, IMLCF, and hospital libraries throughout Spain. The difference lies in the fact that the first two groups are users, who can request anything they need, while the hospital libraries can only request the institution's collection.

10.3. Supply Management Unit

The Supply Management Unit from the (INTCF) generally performs three activities. In the first place, applies the systematic established in the public sector contracts law to dispose of the budgetary credit to the centralized acquisition of the necessary service for the correct execution of the analytical activity in all the INTCF laboratories. In second place, controls the non-budgetary fund provisions, for current services of a periodic or repetitive nature, made through cash advances from the Justice Territorial Management of Central Organs. In third place, controls and processes the INTCF's accrued income to provide a non-free analytical service performed in the INTCF laboratories.

The activity of this unit is done at the Madrid Department with the support of practitioners in the rest of the sites. This unit staff on the different INTCF sites during 2020 is shown in Table 10.3.

Table 10.3. Supply Management Unit Staff during 2020

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA	INTCF-LA LAGUNA
Facultatives	1	–	–	–
Specialist technicians	1	–	–	–
Laboratory assistants	2	–	–	–
Administratives	1	1	1	1
Laboral	2			

This unit activity is done respecting the classification collected on the 20 January 2014 Resolution, of the General Directorate of Budgets, to be able to:

- Request the service and process the payment order for the invoices of chapter 2, "Current expenses in goods and services", necessary for the exercise of the INTCF activities, and that do not increase public assets. This refers mainly to recurring expenses that cannot be included in the inventory. Such as repairs and preventive maintenance of analytical equipment, calibration of equipment, balances and pipettes, supply of gases, material, and laboratory consumables, services for participation in interlaboratory exercises for quality control, among other unexpected expenses during the budget year.
- To request the investment and process the payment order for the invoices of chapter 6, "Real investments", which comprises the expenses to be incurred in the acquisition of goods of inventory nature, necessary for the operational functioning of the services. They include those new investments that increase the public capital stock

and those intended to replace deteriorated assets so that they can continue to be used to fulfill the purpose for which they were intended.

- Process and control the payment vouchers (Model 069) of judicial proceedings, companies, police stations, penitentiary centres, and INTCF agreements with other agencies through the computer application SIC3 of the State Budget Administration. With the ultimate aim of requesting the generation of revenue credit according to the economic classification of the revenue budget, chapter 3, "Fees, public prices and other revenues", for the provision of an analytical service not free of charge.

10.4. Occupational Risk Prevention Service

The Occupational Risk Prevention Service (SPRL) from the INTCF is a technical body whose mission is to proportionate the necessary assessment, support, and coordination to implement a managing system to prevent occupational hazards, complying with the regulation. The aim is none other than the improvement and safeguard of security and health from more than five hundred public employees of the institution. They are distributed among the departments of Madrid, Barcelona, Seville, and La Laguna.

Ubicated in the Madrid INTCF site since its implementation, the SPRL has two senior technicians to prevent occupational hazards. One of them is the head of the service. As explained before, the service manages the preventive activity according to the attributions given in the art. 37 of the Prevention Services Regulations approved by Royal Decree 39/1997, of 17 January. Covering the work security, the industrial hygiene, the ergonomy, the applied psychology, except for the vigilance and health control of the workers and those other preventive activities which, due to their volume or the technical requirements necessary for their execution, have to be outsourced to one or more external prevention services because the company's resources are not sufficient.

Among the SPRL's support, the tasks are the design, implementation, and application of an occupational risk prevention plan that enables the integration of prevention in the organization, the evaluation of risk factors that may affect the employee's security, the preventive activity planification, the determination of the priorities in preventive measures, the employees training, the first aids, the emergency plans, and the health vigilance related to risks derived from work.

The activity developed in the SPRL is not easily programmable. The same will depend to a great extent on the different needs and vicissitudes of the moment. During 2019 the actions carried out can be resumed in:

- Actualization and review of the prevention plans and their procedures.
- Follow-up of the risk evaluations in the different INTCF sites.
- Execution level control of the preventive activity planification.

- Evaluation of the work conditions and environment.
- Knowledge of the work incidents, investigating the causes, and making subsequent preventive recommendations.
- Overview of the occupational accident rate.
- Remission of information cards about the employees' risks.
- Elaboration of reports destined for the worker's communication with the SPRL or the personal situations.
- Training for the workers like those destined for emergency action or new workers.
- Employees' health vigilance: periodical medical examination, initial for incorporation or reincorporation to the job, occupational risk assessment during pregnancy, breast-feeding or for health reasons, and the administration of vaccines to workers exposed to biological risks.
- Concerning the workers especially sensible, their job vacancy adaptation, breast-feeding, or health causes.
- Coordination of business activities as planned in the article 24 of LPRL and the Royal Decree 171/2004, of 8 November.
- Information to the workers, thus by SPRL initiative or by the request that they do, the service responsible, the prevention delegates or union representatives when they are the ones who detect a need in this regard.
- Assessment reports destined to the INTCF directors and other Administration authorities.
- The advice of installation facilities, equipment acquisition, or protection material.
- Participation in the Security and Health Committees.
- Collaboration with the Labour Inspection and Social Security.
- Elaboration and management of the SPRL documentation.
- Communication with the companies and other institutions, especially with the Coordination of Occupational Risks.
- Collaboration with the Occupational Risk Coordination Unit and communication of all incidents of INTCF staff related to SARS-CoV-19.

In 2020 the SPRL collaborated with the other members of the INTCF in tackling the COVID-19 pandemic. They contributed to preparing the different documents and manuals with the preventive measures and procedures for action in the INTCF's scientific-technical activities facing the pandemic.

It is necessary to point out that the activity carried out at INTCF has several locations and workers. It would not be possible for only two secondary Prevention Technicians to perform their work without the personnel and Prevention Delegates. At the same time, as the regulation indicates, it is necessary to outsource several preventive tasks, mainly health

surveillance and those that require the use of extraordinary human or technological resources, which, being of occasional, do not justify their provision or acquisition and maintenance.

10.5. Secretarial staff

The secretarial staff plays a crucial role within the INTCF. It is the unit in charge of the management and administrative processing of the expert reports generated by INTCF Services. From the publication of the Royal Decree 1065/2015, of 27 November, about electronic communications in the Ministry of Justice (LexNet), the platform is used as a secure exchange of information to communicate the INTCF with the different judicial bodies and other legal operators. However, despite that, it is a safe information method using the cryptographic technique. It ensures the writing of presentations, documents, and reception of communications, its emission dates, the provision, and reception or access to the content. It ensures the content of the communications and the identification of the sender and recipient of the same. We are still obliged to use traditional mail, since that some Autonomous Communities have not implemented it in their territory.

Another function that deserves attention is the archiving of files and their management. The finished files that have been completed are kept in the different archives that the INTCF has set up. The rest of the years are in an external file managed by the company contracted by the Ministry of Justice. With the advent of zero paper and the consequent implementation of digital archiving, this problem will be corrected.

Finally, we must highlight the management of the videoconferencing systems, a task shared by the Secretarial Service with the aid of the rest of the judicial assistance staff working at the INTCF.

The staffing of the secretariat team at the different INTCF sites during 2020 is in Table 10.5.

Table 10.5. Staff of the INTCF Secretariat team during 2020

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA	INTCF-LA LAGUNA
Secretariat Staff Manager	1	1*	1*	–
Procedural Manager	1	–	–	–
Procedural procesor	1	11	9	3
Judicial assistance	4	3	3	1

* Procedure Manager.

10.6. Informatics System Section

The Informatics System Section is vital in the INTCF's functioning. It makes important functions managing the information generated by the analytical services such as the integration of the various INTCF databases and maintenance of the applications developed, the elaboration of reports and consultations of data, the office-based production of the Institute's annual activity report, and to assure of the security of the automatized files from the Institute. Besides that, the INTCF receives support from the Directorate General of Digital Transformation of the Ministry of Justice, specifically from the LIMS group-related consultations, incidences, and developments from the LIMS system of the INTCF.

The staffing of the IT Systems Section at the different INTCF sites during 2019 is shown in Table 10.6.

Table 10.6. Staff of the Informatics System Section during 2020

	INTCF-MADRID	INTCF-BARCELONA	INTCF-SEVILLA
Head of Informatics Systems Section	1	1	1

* The post of the Head of the IT Systems Section of the Madrid Department was vacant for the year 2020 until 1 October 2020.

Annexes

Annex I: Methodology used in obtaining the data and glossary of indicators used in the statistical data

The statistical data of the current report has been extracted from the information management system of the laboratory that the INTCF uses (LIMS system: Laboratory Information Management System) and from the databases of the Toxicological Information Service. The global data from the Departments and Services have been extracted with the consultation tool (Dashboard) on a specific date. There may be variations in data in subsequent queries due to occasional request openings.

Hereunder there is a brief explanation of the indicators used for the elaboration of this report:

- **Number of cases registered**. Relates the cases that the court ordered to send the samples to the INTCF to analyze them after by the correspondent Services.

- **Number of requests generated**. Measures the volume of analyses or study requests which determine the issue of a report.

- **Number of evidences registered**. Counts the objects, substances, samples, or pieces that each Service registers.

- **Number of samples analyzed**. Counts the objects, substances, samples, or pieces that each Service analyses. Generally, the number of samples is superior to the number of evidences. From one evidence (for example, trousers with biological evidence), diverse samples can be obtained (DNA traces in different locations on the trousers), which will be analyzed independently.

- **Number of analyses done**. Counts all the analytic tests over the samples of each INTCF Service.

- **Number of reports emitted**. After all the analysis and the register of results, an expert report is emitted to the required institution. This item relates to the number of reports issued by each Department or Service.

- **Number of company notifications**. Relates the amount of received information in the Institute and managed by the SIT, through the Documentation Section, about the composition of toxic products commercialized, through toxicological cards to Law 8/2010, 31 March, laying down the system of penalties provided for in the Regulations (EC) concerning the registration, evaluation, authorization, and restriction of chemical substances and mixtures (REACH), and on the classification, labeling, and packaging of substances and mixtures (CLP), which amends it. The toxicological data sheet preparation is carried out in compliance with the order JUS/909/2017.

– **Toxicological consultations by telephone**. Relates the number of consultations on poisoning and exposure to toxic substances. It is made by telephone by citizens and professionals.

Annex II: Regulations applicable to the National Institute of Toxicology and Forensic Sciences (chronological order)

Order JUS/288/2021, 25 March, regulating the procedure of notification of substances and chemical mixture to the National Toxicology and Forensic Sciences.

Royal Decree 63/2015, 6 February, modifying Royal Decree 862/1998, 8 May, approving the Regulation of the Toxicology Institute, the Royal Decree 386/1996, 1 March, approving the Regulation of the Institutes of Forensic Medicine, and Royal Decree 451/2005, 7 December, approving the Regulations for the entry, provision of jobs and professional promotion of civil servants in the service of the Ministry of Justice.

Order JUS/836/2013, procedure for notification of additions, deletions, and modifications of toxicological data sheets to the INTCF's SIT chemical register.

Order JUS/2267/2010, 30 July, modifying Order JUS/1294/2003, 30 April, determining the files with personal data of the department and public organisms (BOE no. 208, 27 August 2010).

Order JUS/1291/2010, 13 May, Rules for the preparation and submission of samples for analysis by the Institute of Toxicology (BOE no. 122, 19 May).

Order JUS/215/2010, 27 January, modifying Order, 24 February 1999, fixing the amount of the public prices for services provided by the Institute of Toxicology (BOE no. 33, 6 February 2010).

Order JUS/3403/2009, 17 November, approving the list of jobs of the INTCF (BOE no. 304, 18 December 2009).

Royal Decree 32/2009, 16 January, approving the National Protocol for Forensic Medical and Scientific Police action in events with multiple victims (BOE no. 32, 6 February 2009).

Royal Decree 1977/2008, 28 November, regulating the composition and functions of the National Commission for the forensic use of DNA.

Royal Decree 1451/2005, 7 December, approving the Rules of Entry, Job Provision, and Professional Promotion of Civil Servants in the Service of the Justice Administration (BOE no. 309, 27 December 2005).

Royal Decree 862/1998, 8 May, publishes the Organic Regulations of the National Institute of Toxicology and Forensic Sciences (BOE no. 134, 5 June 1998).

Organic Law 6/1985, 1 July, of the Judiciary.