

**Specific  
recommendations  
for the unification  
of judicial autopsies  
at the Institute of  
Legal Medicine of  
Catalonia**



Generalitat de Catalunya  
**Departament de Justícia**

Centre d'Estudis Jurídics i Formació Especialitzada  
Institute of Legal Medicine of Catalonia

**SPECIFIC RECOMMENDATIONS  
FOR THE UNIFICATION OF  
JUDICIAL AUTOPSIES AT THE  
INSTITUTE OF LEGAL  
MEDICINE OF CATALONIA**

**COORDINATORS:**

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## Preface

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First of all, I would like to publicly thank Dr. Josep Castellà Garcia, Head of the Forensic Pathology Service at the Institut de Medicina Legal de Catalunya (IMLC – Institute of Legal Medicine of Catalonia), Dr. Teresa Marrón Moya, current Head of the Forensic Laboratory Service at the IMLC, and Ms. Isabel Recio Andrés, administrative officer in the Forensic Pathology Service at the IMLC, for their work with all the authors taking part in this series of recommendations for judicial or medico-legal autopsies at the IMLC. Over the last three years there have been many meetings and online connections to outline and finally decide on what is now a reality.

I would also like to thank the Centre for Legal Studies and Specialised Training in the Department of Justice of the Government of Catalonia, and in particular its Director, Mr. Josep Xavier Hernández i Moreno, Ms. Montserrat Martínez Corral and Ms. Cinta Vizcarro Masia, for their support and interest in bringing out this publication; without them it would not have been possible. I would also like to acknowledge the work done by the staff at the Judicial and Forensic Training Unit.

Drawing up guidelines or recommendations for medico-legal autopsies is not new. There are a number of examples including the “Code of Practice and Performance Standards for Forensic Pathologists” by the Male Office and The Royal College of Pathologists (UK, November 2004) and the “Forensic Autopsy Performance Standards” by the National Association of Medical Examiners (USA, October 2005). In Europe there is the Council of Europe’s “Recommendation No. R (99)3 on the harmonization of medico-legal autopsy rules” (Strasbourg, 28 October 1998).

The coordinators and authors provide recommendations for 21 specific situations: NN (“No Name”) bodies, hazardous autopsies, charred bodies, dismembered bodies, decomposing bodies, death in water, death with suspected child abuse, death of an athlete, death under restraint, death in the elderly, fire deaths, perinatal maternal

death, sharp force trauma, shooting fatalities, drug-related deaths, sudden infant, child and adolescent death, death in sexual assault, sudden cardiac death, death by cervical compression, signable deaths and death in traffic accident. This broader, more specific case-based vision has been given rather than an overview of medico-legal autopsy, examining in each case the situations that create most problems and providing easy and understandable solutions to them.

Forensic pathology has been, and is, an ever-evolving science, to which have been added medical changes and tools such as imaging, toxicology laboratory and molecular genetics diagnostic tests, not only for human identification but also for the diagnosis of mutations and detection of disease in cases where macroscopy and histopathology provide nothing more than a suspicion. This involves an obvious expansion of the role of the forensic pathologist. It is not enough just to play a diagnostic and expert role. Perhaps at the judicial level diagnosing the cause and circumstances of death and identifying the corpse is sufficient, but from a broader perspective the forensic pathologist has other responsibilities. They are an expert in public health, they deal with death by drugs, sudden death, peripartum death, death in traffic accidents and others with the chance to learn about mortality rates and injuries and use them to improve health. Also significant are the recommendations for autopsy in cases of death in custody or under restraint due to the institutional liability that may arise and which provide the pathologist with a tool to solve the problem.

These recommendations have been made possible as part of the wide-ranging changes taking place in forensic medicine. The creation of institutes of legal medicine has driven a change in the conception and service of forensic medicine. It is an organisational and technical change and also a structural and functional change. The disappearance of "judicial morgues" as places for the practice of medico-legal autopsy and the gradual setting up of forensic pathology centres has led to autopsies being carried out in line with technical standards and with greater occupational health and safety. All of you who have done autopsies in those morgues, in cemeteries with minimal or non-existent sanitary conditions, with no water or electricity, will remember this. We can now proudly say that we have turned this situation around. However, there is still room for improvement and these recommendations will help towards that end.

I would not wish to close this preface without a vision of the future. Forensic and legal medicine has evolved enormously. The setting up of institutes of legal medicine has been a major factor, as I said before. But we need to continue moving forward and we need still more change. Some legislators want to get rid of the legal medicine speciality without trying out a system of residents as has been done in other specialities. Institutes of legal medicine would be an ideal framework for this specialisation and I can say from first-hand experience that they are ready to do so. The disappearance of the spe-

ciality would mean heading in the opposite direction to the rest of Europe. We cannot stand idle. The practice of medicine is moving beyond the bounds of the classical disciplines and is now highly specialised. We cannot continue forensic medicine without specialities and without creating core fields to develop knowledge and practice in the areas concerned. In other words, the vision of the traditional medical examiner is completely obsolete and what may have been valid in the 19th and 20th centuries is not so in the 21st. We have to move towards a specialised system based on the various areas of forensic medicine (forensic traumatology, forensic psychiatry and forensic pathology) in which the medical examiner with the corresponding specialisation has the core skills that enable them to deal with specific problems when working in their field. Nowadays you cannot do everything. The administration of justice requires experts with specific knowledge to solve specific problems. This means we need to move towards general medical examiners, forensic traumatologists, forensic psychiatrists and forensic pathologists.

Finally, I would encourage the coordinators and authors to continue the work started here and build on the recommendations with new contributions and adaptations of existing ones in the light of the new requirements of forensic medicine and pathology.

Jordi Medallo Muñiz  
Director of the Institut de Medicina Legal de Catalunya  
Barcelona, 18 April 2013

## Traffic accident

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*Authors:* M. Victoria Bonastre Paredes, Santiago Crespo Alonso, M. Carmen Rebollo Soria, Ana María Taranilla Castro  
*Coordinator:* M. Carmen Rebollo Soria

### Definition

A traffic accident is one that takes place or has its origin on a road covered by traffic, motor vehicle and road safety legislation and as a result of which one or more persons are killed or injured or only property damage occurs and in which at least one moving vehicle is involved (Order of the Ministry of Parliamentary Relations and the Government Secretariat of 18 February 1993). WHO includes deaths that take place up to 30 days after the accident.

The definition also includes accidents with fixed route vehicles (trams, underground railways and trains).

### History

### Clinical

- a) Medical history: arteriosclerosis, heart disease, high blood pressure, stroke, diabetes mellitus, epilepsy, visual and/or hearing impairments, mobility impairment, need for adapted cars, prior traffic history.
- b) Surgical history.
- c) Psychiatric history.
- d) Pharmacological treatment: pay special attention to cardiovascular system drugs, anti-epileptics, anti-diabetics, psychotropic medication.
- e) Alcohol, tobacco and drug use.

## **Court and police**

- a) Obtain police report whenever possible.
- b) If they have received medical care: obtain medical report whenever possible (therapy and surgery, medication, imaging test results, etc.).
- c) Concerning the accident:
  - 1. Type of accident: vehicle/pedestrian collision, front/side/rear-end collision, rollover.
  - 2. Time and place of the accident: visibility, pedestrian crossing, intersection, bend, etc.
  - 3. Weather: visibility, roadway conditions
  - 4. Type of road: roadway conditions, high speed road, speed limit on the road, etc.
  - 5. Use of safety systems: seatbelt, airbag inflated, child restraint systems, helmet.
  - 6. Special situations such as fire, rollover, etc.: see relevant recommendations
  - 7. Traces, marks or clues at the scene that help determine how the accident took place.
- d) Concerning the vehicles:
  - 1. Type of vehicles involved.
  - 2. State of the vehicle, areas of the vehicle hit with greatest permanent deformation.
  - 3. Estimated speed.
  - 4. Vehicle/pedestrian collision: deformation of the bumper and bonnet and pattern of windscreen breaking or deformation of the windscreen crossbeam.
- e) Concerning people:
  - 1. Deceased: driver/front passenger, survival after the accident, therapy measures used, CPR, transfer to hospital.
  - 2. Other people involved in the accident: blood alcohol level, history.
  - 3. If professional vehicles are involved: rest hours observed.
  - 4. Information provided by witnesses.

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## **Preliminary diagnostic tests**

- a) X-rays when possible.
- b) Photographs of the body dressed and naked.
- c) Police: fingerprinting the deceased if an NN.



## External examination

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- a) Age, weight and height.
- b) Examination of clothing and footwear: match between skin lesions and clothes, remnants of vehicle (glass, paint, etc.), tyre marks, heel height, etc.
- c) Remains of paint, glass, tyre marks, grease stains on the body surface.
- d) Description of external injuries, size, direction of impact and location: erosions, abrasions, haematomas, serous effusion, ligament injuries, closed and open fractures, with special attention to the height of injuries to the legs (calculate the height of the injury bearing in mind heel height) and the direction of impact.
- e) Rule out other injuries that are not associated with traffic accident.

## Internal examination

- a) Complete autopsy: skull, spine, chest, abdomen and pelvis for both recent and delayed deaths.
- b) Gravid uterus.
- c) Fracture site opening.
- d) In cases of vehicle/pedestrian collision:
  - 1. Longitudinal opening of the lower limbs in vehicle/pedestrian collision, removal of muscle and evaluation of bone lesions (height and direction of fractures, contacts between the tibial plateau and femoral condyles) and study of the knee tendon.
  - 2. Peel-off.
- e) In accidents with fixed route vehicles, tailor autopsy technique to the condition of the body.

## Sampling

### Toxicology

- a) Collection of blood and/or vitreous humour samples.
- b) Collection of urine and/or bile.

## Histology

- a) If a natural death and subsequent accident is suspected: collection of samples of major organs; see recommendations for sudden cardiac death in adults.
- b) If diffuse axonal injury is suspected (death between 3-24 hours):
  1. Corpus callosum and posterior frontal parasagittal white matter.
  2. Splenium or labrum of the corpus callosum.
  3. Posterior internal capsule grey matter.
  4. Cerebellum.
  5. Cerebellar peduncles.

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## Diagnostic criteria

- a) In vehicle/pedestrian collision:
  1. Search for injury due to shock, falling, dragging or crushing to establish the diagnosis of typical or atypical collision, the direction of the vehicle, or if they were standing or lying.
  2. Injuries from the first impact (against the vehicle) and the second impact (against the ground).
- b) Vehicle occupant injuries:
  1. Injuries compatible with dashboard components (steering wheel, glove compartment, etc.) and other parts of the vehicle that would indicate the occupant's position inside it.
  2. Injury due to retention mechanisms:
    - Airbag: injury to the temporomandibular joint, erosions on the face, neck and chest, chemical keratitis, bronchospasm or dermatitis.
    - Seatbelt: diagonal trunk abrasions, fractures of the collarbone, ribs, dorsolumbar vertebrae or visceral lacerations.
  3. Deceleration injuries.
- c) Using data from the removal of the body/police report/medical report and autopsy findings: rule out natural death and suicide and homicide medico-legal manner of death.
  1. High ISS with no natural pathology determining death (Adams and Hirsch) indicates death due to traumatic injuries.
  2. If ISS is low, look for cause of death in delay in medical care, misdiagnosis, existence of concomitant cause, natural death.
  3. Suicide: police report, witnesses, medical records (previous suicide attempts, mental disorders, etc.)
  4. Homicide: accident injuries sustained after death, existence of other injuries due to sharp force trauma, gunshot, etc.

## Specific causes of death

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- a) Head trauma.
- b) Chest trauma.
- c) Abdominal trauma.
- d) Destruction of vital centres.
- e) Spinal cord injuries.
- f) Hypovolemic shock.
- g) If delayed death:
  - 1. Intracranial hypertension.
  - 2. Pulmonary thromboembolism.
  - 3. Infectious complications.
  - 4. Decompensation of previous disease.
  - 5. Fatty embolism.

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## **Sexual assault**

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### **Definition**

Deaths in which sexual assault or offence is suspected with or without related injury due to violence.

### **History**

#### **Somatic**

- a) Special reference to gynaecological history: STDs, genital birth defects, birth control methods (IUD carrier, spermicides, oral contraceptives, condoms).
- b) Childbirth, pregnancies, abortions, date last menstruation.
- c) Pharmacological and/or hospital treatment.

#### **Psychiatric** (mean greater vulnerability)

- a) Mental retardation, mental disorders, civil disability, admission to mental health centres, psychotropic treatments, psychiatric and/or psychological monitoring and episodes of attempted suicide.

#### **Alcohol, tobacco and drug use**

- a) Regular consumption of alcohol and drugs of abuse (especially in young women).

## Court and police

- a) **Identification of the victim.**
- b) **Circumstances of the facts:**
  1. Time and place of facts and/or discovery of the body.
  2. Violence at the scene and description of where the body was at time of removal (public highway, home, transfer to hospital).
- c) **History concerning the body:**
  1. Position and state, with particular emphasis on clothes (dressed, naked, clothes missing, torn, stained).
  2. External signs of violence.
- d) **Witnesses:**
  1. Last person to have seen them alive and person who found the body.
- e) **Number of perpetrators.**
- f) **Family, emotional, social and occupational history:**
  1. Special importance for breakups, ex-partners, change in friends or lifestyle in recent months.
  2. Sexual behaviour: prostitution, promiscuity (heterosexual and/or homosexual), exhibitionism, transvestism.
- g) **Court/police records of the victim and alleged perpetrator(s):**
  1. Complaints about domestic violence, restraining orders, history of abuse.
- h) **Medical treatment:**
  1. CPR and/or administration of drugs at the scene or in hospital (for interpreting subsequent toxicological results).
- i) **Assessment of photographs:**
  1. Photographs of the body on removal.

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## Preliminary diagnostic tests

To be evaluated based on the availability of means and resources.

- a) **Photos:** especially for studying injuries and stains, condition of clothing (serial photography before and after being stripped and washed is important).
- b) **Optional radiological study:** to rule out fractures, locate projectiles, etc.
- c) **Dental study of the victim** (self-defence biting of the assailant) **and/or any bites** (by the assailant[s]) **they present.**
- d) **Examination of the body with/without specific light to detect biological stains.**
- e) **Taking samples before handling the cadaver.**

1. At the scene: fluid stains (blood, semen), hair, drugs, weapons, items, notes.
2. On the body:
  - **For identification:** fingerprinting the deceased.
  - **For toxicological study:** ask for alcohol or other drugs that may lead to the unconsciousness or death of the victim in blood, vitreous humour, urine or bile in the absence of the anterior uterus.
  - **For time of death study:** vitreous humour.
  - **For criminology study:** gathering evidence and specific study based on cause of death or injuries present. Where possible dip swabs in distilled water as saline solution can alter the quality of sperm.

Evaluate:

  - Study of violence in clothing, ropes and other objects (send them dry in paper bags).
  - Study of gunshot residue on hands and clothing.
  - Study of injuries (always fresh and with normal contralateral skin).
  - Collection of unknown and known source samples (hairs and fibres) and other remains (which provide guidance about the scene).
  - Collection of condom and its content for DNA study (well tied so it does not spill, inside a wide mouthed plastic bottle and sent refrigerated).
  - **For biological study:**
    - *Mouth samples to search for semen* (must be done first as semen remains disappear very quickly in the mouth). Gently wipe two sterile swabs under the tongue, around the gums, teeth and palate without rubbing too much. Put into cardboard boxes.
    - *Brushing pubic hair and collecting unknown source hairs:* known source hairs taken from various areas of the victim should be sent; minimum of 10.
      - Pubic hair: soft brushing of pubic hair on white paper which is then folded and sent with the comb in a small paper bag.
      - Other hair: from hands, nails, body and clothing to be collected with sterile tweezers, with slightly adhesive backing stuck on a sheet of acetate.
    - *Vaginal, cervical and external genital samples* (sperm can be seen up to three days after assault and determine PSA around 24 hours after aggression): in order and before vaginal washing; 1 sterile swab for vulva area, two sterile swabs for vaginal cavity and 2 sterile swabs for the cervix. To be sent in cardboard boxes.

- *Vaginal washing*: with 10 ml of distilled water or sterile saline solution if not available. To be collected in a plastic tube or jar. To be sent refrigerated.
- *Anal and perianal samples* (view sperm in rectum up to 24 hours); wipe the anal margin and anorectal canal with two dry sterile swabs. Do not send stool.
- *Samples of clothing worn by the victim of the assault*: wrap each piece individually in paper and put in paper bags.
- *Body surface samples*: evaluation of saliva, blood, semen, sweat, urine and other biological fluids on the body of the victim and bite marks. Stains to be collected with sterile swabs slightly moistened with distilled water or saline solution if not available. The entire area has to be cleaned with a single swab. To be put in a cardboard box.
- *Nails*: examine hands and nails and collect any hairs or fibres with sterile tweezers. Cut the distal edge of the nails to examine for possible presence of traces of blood and skin (DNA). Every nail should be collected on a piece of paper which is then folded and put into a small paper bag. There is no need to remove the entire nail.
- *Pregnancy test*: urine and/or blood.
- *DNA samples*: victim's peripheral blood.

## External examination

Provide written description of observed injuries and depict them with anatomical diagrams, determine their chronology (old or recent) and relate them to the victim's sexually transmitted infections and sexual habits.

## General injuries

- a) **Miscellaneous injuries**: due to neck compression, sharp force trauma or gunshot, blunt force violence (presence/absence fractures), signs of suffocation, chest compression.
- b) **Venipuncture injuries**: due to subduing the victim with medication or drugs.
- c) **Indications of possible sexual violence**: marks of ties, cigarette burns, self-defence injury, pulling hair, scratching, biting. Conduct special study of: hands, wrists, forearms, face and neck, nipples, breasts, back, inner thighs, buttocks, vagina, penis, scrotum and perineal area.



- d) **Mouth injuries:** bitten lips, ecchymosis, internal injuries of the gingival mucosa, presence of haemorrhagic infiltration due to external compression or dental injury, tongue examination, presence/absence of teeth (do odontogram to identify if there is self-defence biting of the perpetrator) (Appendix 1).
- e) **Bites study:** determine perpetrator odontogram.

## Genital injuries

- a) **In relation to the victim's age:** assess anatomic changes of the external genitalia (hymen) due to the effect of estrogens.
- b) **Rule out congenital and infectious lesions vs. traumatic ones:** differentiate hymenal clefts, highly variable hymen morphology, infectious disease (50% of vestibular erythema in pre-pubertal girls are nonspecific vulvovaginitis), dermal diseases (psoriasis, herpes, etc.).
- c) **Areas of highest prevalence of lesions in women:** posterior fourchette, labia minora, hymen and fossa navicularis.

## Anal and perianal injuries

- a) **Anus study:** the anteroposterior diameter of the anus increases with age. Hence dilation of the anal opening is not specific to sexual assault per se. Post-mortal dilation of the anus is common in children.
- b) **Other anal and perianal injuries:** fissures, sphincter relaxation, rectal prolapse, inversion of the conus (chronic). Carefully assess erythema, pigmentation and venous congestion, especially common in children and young people.
- c) **Differentiate from dermatological or infectious disease:** lichen sclerosus, polyps, streptococcal cellulitis and herpes zoster.

## Internal examination

- a) **General regulation autopsy:** based on observed injuries and cause of death (neck compression, suffocation, sharp force trauma or firearm injuries, extraneous internal bodies, TBI, etc.).
- b) **Dissection of all soft tissues and muscles** in the back plane of the body, including limbs, in all deaths due to sexual and/or trauma assault.
- c) **Pelvic autopsy:** en bloc dissection of internal and external genital organs is recommended. Take any required samples from

orifices and cavities beforehand when there is suspicion of trauma. The rectum, anus and perineal tissues with vulva, uterus and vagina in women must be extracted en bloc (Appendix 2).

- d) **If pregnant:** study embryo or foetus.

## Sampling

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- a) **Toxicology study:** samples that add to those already taken; viscera, bile, peripheral blood. Study alcohol, specific drugs that are suspected and general screening.
- b) **Histopathological study:** uterus is to be sent open, separating the front from the rear side, cutting edges from the neck with scissors and the bottom with a knife. Adnexa are left attached to the back of the uterus.
1. **Intravital occurrence:** determining age of injury. If possible, send one part without formol and another with.
  2. **Differential diagnosis of disease or malformation:** genital region, rectum-anus (in formol).
- c) **Criminology study:** other samples or objects found in the internal examination; fingerprints, shoe or lip marks, earth, grass, stains, etc. (without formol).
- d) **Biological study:** determination of semen, PSA, acid phosphatase, infectious diseases. Determination of sweat, urine, saliva, faeces, gastric contents.

## Diagnostic criteria

- a) Be careful with the presence/absence of injuries as they do not always mean the attack has/has not taken place.
- b) Evaluate findings indicative of any kind of sexual assault in the autopsy, with the presence/absence of other types of injuries and the presence/absence of biological findings (sperm determination or PSA, the latter being very important in the vasectomised or azoospermic).

## Specific causes of death

- a) **Derived from the severity of genital lesions:** hypovolemic shock, vagal syndrome or death due to inhibition.
- b) **Arising from subduing/injuring the victim with/without weapons:**

1. Poisoning or adverse reaction to drugs, psychotropic substances.
  2. Compression of the neck, suffocation (pillows, plastic bags), hypovolemic/traumatic shock due to multiple injuries, injuries from sharp force trauma or gunshot.
- c) **Derived from prior condition of the victim:** disorder destabilised by the traumatic situation (older victims) and causing death in the context of the violent situation:
1. CHD death.
  2. Cerebral aneurismal rupture secondary to hypertensive crisis.
  3. Gas embolism syndrome.

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## Appendix 1. Bites

- a) Number of injuries.
- b) Region.
- c) Individualised description.
- d) Sample of saliva.
- e) Describe them graphically.
- f) Photographs with metric photomacrographic scale.
- g) Measure each one.
- h) Determine dental organ imprint with acetate sheet: trace imprint and draw contour.
- i) Acetate plate with bite registration.
- j) Get an odontogram of the potential perpetrator:
  1. Compare the size and similarity of the marks with the perpetrator's dental arch.
  2. Malposition of teeth.
  3. Correlate incisal edges of teeth with skin marks.

## Appendix 2. Genital autopsy technique

To extract the pelvic cavity organs:

- a) Pelvic parietal peritoneum dissection by circular incision of the pelvic inlet and dissecting the serosa and underlying tissues around the cut until you reach the perineum.
- b) Anterior dissection and disconnection of soft pubic tissue, cutting anterior bladder ligaments and dissection of the parietal peritoneum sacrum as far as the internal rectal sphincter and pelvic floor at the rear.
- c) With the body at the end of the anatomy table and the lower limbs hanging in hyperextension, bend the knees as much as possible.
- d) Lateral incision of the internal concavity from the pubis to the coccyx, including the vulva and anus.
- e) Upward traction of the peritoneal sac, releasing all pelvic organs surrounded by the peritoneal sac.
- f) Placing the genital block on the ancillary anatomy table, with the rectum up and anus close to the explorer.
- g) Opening of the rectum and vagina to the bottom of vaginal sac with Mayo scissors.
- h) Opening of the uterus from the right side to the right tubal insertion.
- i) Ovaries exploration: an incision on the back edge.
- j) Fallopian tubes examination: with transversal incisions.

Turn over the pelvic block to display the bladder and urethra, which should be opened to the urinary meatus.

## Hazardous autopsy

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### Definition

**Hazardous autopsy:** exposure to various hazards – mechanical, chemical, electrical, ionising radiation, physical (Appendix 1) and biological agents – while doing an autopsy. Exposure to biological agents is the most frequent forensic medicine hazard and the main point of these recommendations.

**Biohazard autopsy:** post-mortem study of a dead person who has had or is likely to have had a serious infectious disease that can be transmitted to all those present in the autopsy room and thus cause them serious illness and/or premature death.

**Notifiable diseases (ND):** transmissible diseases that doctors and laboratories are required to report to the appropriate public health centre because they are of special importance to the community. Each state sets its epidemiological surveillance list (Appendix 2).

**Following suspicion/detection at autopsy of a previously undiagnosed ND, the relevant regional epidemiological surveillance units should be contacted**

(<http://www.gencat.cat/salut/depsalut/html/ca/dir2089/index.html>).

### Main biological hazards in forensic medicine

#### a) Transmission mechanism

1. Inhalation due to exposure to aerosols.
2. Direct cutaneous inoculation (due to prior skin lesion) or due to cuts or pricks by instruments (especially scalpel blades), foreign bodies or anatomical structures of the body (e.g. fractures, bone splinters, rib fragments, etc.).

3. Mucocutaneous exposure (eye, oral membrane) due to contact with droplets from tissues or fluids. Very low risk.
- b) **Main biological agents:** see Appendix 3.

## History

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### Clinical

- a) Symptoms/signs suggesting acute or subacute infectious disease whether respiratory (fever, cough, haemoptysis, dyspnoea), tuberculosis, neurologic (encephalopathy, seizures, polyneuropathy, unexplained dementia), gastrointestinal (acute bloody diarrhoea without melena, hepatitis, jaundice), skin (rash, abscesses, necrotising cellulitis) or immunological (atypical opportunistic infections).
- b) History or suspicion of parenteral drug use (IDU).
- c) History of chronic exposure to blood products before the introduction of the HCV test, including treatments with haemodialysis.
- d) Personal/work habits:
  1. Recent history of travel to endemic infectious disease areas.
  2. Evidence of occupational hazard (e.g. health professionals, prostitution, etc.).

### Court and police

- a) Drugs and objects (needles, syringes, etc.) found at the scene.
- b) Circumstances of death (where and how it occurred, report on deceased's habits, hazardous job, poverty, Diogenes syndrome, etc.).
- c) Caution in the event of exhumation (infectivity of microorganisms after a time) (Appendix 4).

### Preliminary diagnostic tests

- a) Radiology study prior to autopsy: recommended if there is suspicion of objects (sharp filters in vena cava, needles or fragments in intravenous drug users, etc.).
- b) We recommend a pre-autopsy biohazard screening test: if suspicion of group 3 microorganisms (Appendix 5), blood (in hepatitis and HIV), nasopharyngeal and bronchial swab (in influenza virus).

## **Protection/containment measures. Universal precautions**

**Biosafety:** preventive techniques, measures and standards to avoid unintentional exposure to pathogens and toxins and accidental release.

**Hazard assessment:** based on the hazardousness of the microorganisms (4 hazard groups, WHO). There are 4 “biosafety and containment levels” concerning a combination of practices and techniques, safety equipment and facilities (WHO).

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These protection measures are determined by the hazard group of the biological agent (Appendix 5) and route of transmission. Depending on the agents set out, all applicable measures should correspond to biosafety level 3 (Appendix 6).

## **External examination**

- a) Abnormal colorations, rashes, abscesses, necrotising cellulitis, etc.
- b) Marks of drugs of abuse (see drug death protocol).
- c) Presence of tattoos.

## **Internal examination**

Signs of anatomical pathology syndromes (Appendix 7).

## **Sampling**

**It is important that the biological material identifying label should be on the samples that are sent to the laboratory:**



Refer to Appendix 3 for the various agents.



## Diagnostic criteria

A biohazard autopsy involves:

- a) Any body with a known medical history featuring any of those listed or in which anatomical pathology syndromes are found during autopsy.
- b) Any body with no known medical history but it is known or suspected that there are hazardous factors such as drug addiction, alcoholism, risk behaviour or travel to endemic infectious disease areas.

## Specific causes of death

- a) Related to the infectious disease: encephalitis, respiratory failure due to epiglottitis, pneumonia, pulmonary oedema; pulmonary thromboembolism; endocarditis; septic, hypovolemic, cardiogenic shock.
- b) Not related to the infectious disease: natural/violent.

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## Appendix 1. Non-biohazards

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<b>Electric</b>	<b>Automatic implantable defibrillator (AID)</b>	Remove this device like a pacemaker, but it could generate discharges (the electrical impulse it transmits to the myocardium is a million times more powerful than a pacemaker). If it appears during the autopsy it must be an expert (cardiologist or other) who identifies and extracts it after deactivation, following the manufacturer's instructions (or if that is not possible, by placing a round magnet on the impulse generator). In the same way as pacemakers, they should be extracted when the body has to be incinerated due to the risk of explosion with heat.
<b>Chemical</b>	<b>Formaldehyde</b>	Presents toxicity due to inhalation, ingestion and contact with skin, causes burns, skin sensitisation, it is flammable and has carcinogenic effects (main risk; reclassified as carcinogenic to humans from Group 2A to Group 1). Studies show exposure to high levels during autopsies. Spanish legislation specifies replacing it. When this is not possible, reduce exposure to the lowest levels possible (keep it in tightly closed containers and handle with filters for organic vapours).
<b>Ionising radiation</b>		When the deceased was subjected to internal radiation treatment by radioactive implants (cancer therapy). The medical history will report this. In these cases, consult the person responsible for radiation protection at the centre to decide on the measures to be taken.

## Appendix 2. Notifiable diseases (ND) in Catalonia

Numerical notification (weekly)	Individualised notification (less than 24 hours)	Urgent notification (less than 24 hours). Notify if the first diagnosis
Enteritis and diarrhoea (excluding dysentery) Scarlet fever Flu Chlamydia Condyloma acuminata Trichomonas infection Genital herpes (HSV 1 and HSV 2) Leptospirosis Other sexually transmitted infections (excluding genital herpes, genital human papilloma virus, trichomonas infection, chlamydia) Neonatal ophthalmia Chickenpox	Amebosis Brucellosis Anthrax Diphtheria Spotted fever Typhoid and paratyphoid fever Hepatitis A Hepatitis B Hepatitis C Other hepatitis (excludes A, B, C) Hydatid Gonococcal infection HIV infection Legionella Leishmaniasis Leprosy Lymphogranuloma venereum Tuberculous meningitis Malaria CRS AIDS Syphilis Congential syphilis Shigella Tetanus Neonatal tetanus Pertussis Trichinosis Pulmonary tuberculosis Other tuberculosis (excluding pulmonary tuberculosis and tuberculous meningitis)	Botulism Epidemic outbreaks of any aetiology Cholera Diphtheria Yellow fever Gastroenteritis E. coli 0157: H7 Invasive disease due to <i>Haemophilus influenzae</i> b Meningococcal disease Mumps Plague Polio Rabies Rubella Haemolytic-uremic syndrome Exanthematic typhus Measles  <b>Epidemiological Monitoring Emergency System in Catalonia (SUVEC). Phone 627480828.</b> Deals with notification of urgent disease and/or epidemic outbreaks at weekends and on public holidays and outside working hours on working days.

### Appendix 3. Main biological agents: hazards and additional tests

Agents	Hazards	Additional tests
<p><b>Hepatitis B and C and HIV</b></p>	<ol style="list-style-type: none"> <li>1. Postponing the autopsy does not reduce risk. Considered infectious and contagious up to 2 weeks post mortem (HIV). Not isolated from cranial sawing dust (HIV). Cases have been documented of infection 16 days post mortem, so they are supposed to be always infectious (B and C).</li> <li>2. High prevalence in medico-legal autopsy bodies, especially in deaths due to adverse reactions to drugs of abuse (up to 60% for HCV).</li> <li>3. The risk of transmission is relatively much lower than frequency of exposure.</li> <li>4. The risk of seroconversion depends on the viral load/HIV status, volume of fluid injected and individual susceptibility and.</li> <li>5. For accidental percutaneous exposure it is estimated at between 1 and 31% for HBV, between 0 and 7% for HCV and between 0.2 and 0.5% for HIV. Mucosa contamination risk is lower (0.03% in HIV).</li> <li>6. Inactivated by heat sterilisation or usual chemicals. Formol inactivates HIV, HVB, HVC (brain 2 weeks in formol).</li> <li>7. Notifiable disease (ND).</li> </ol>	<p><i>Histology:</i></p> <ol style="list-style-type: none"> <li>1. Large container for 10 times its volume in fixative solution.</li> <li>2. Decontaminate exterior and interior.</li> <li>3. Identification hazardous substances labels.</li> <li>4. Retain samples until complete fixation.</li> <li>5. Once fixed in formaldehyde solutions no problem to include and cut in paraffin.</li> </ol> <p><i>Other determinations (toxicology and microbiology):</i></p> <ol style="list-style-type: none"> <li>1. Fresh samples in airtight container and transport for hazardous biological substances with specific labelling.</li> </ol>
<p><b>Tuberculosis (TB)</b></p>	<ol style="list-style-type: none"> <li>1. <i>Mycobacterium tuberculosis</i>: prototype of organism potentially transmissible by aerosol generation during the autopsy (cutting lungs or removing airways). Requires intense and prolonged contact.</li> <li>2. Transmission by inhalation and skin. 90% of cases are pulmonary TB acquired by inhalation. Mucocutaneous transmission at autopsy has not been documented.</li> <li>3. Brief exposure in autopsy involves a high risk of infection.</li> <li>4. Inactivated by heat sterilisation and disinfection substances. Formalin inactivates all strains of <i>M. tuberculosis</i>.</li> <li>5. ND.</li> </ol>	<p>Idem.</p>

Agents	Hazards	Additional tests
<b>Flu</b>	<ol style="list-style-type: none"> <li>1. Influenza virus. Hazard group 2 (moderate individual risk, low population risk), but its mutations are hazard group 3 (high individual risk, low population risk).</li> <li>2. Notifiable disease (H1N1 Virus).</li> </ol>	
<b>Other viruses</b>	<ol style="list-style-type: none"> <li>1. Responsible for hemorrhagic fever (Ebola, Marburg and Lassa). By percutaneous inoculation, unlikely through aerosol (documented cases due to the highly insecure conditions in which autopsies were performed). In hazard group 4 (high individual and population risk).</li> <li>2. DO NOT DO the autopsy.</li> <li>3. If absolutely necessary to do it, it should be performed in facilities with maximum containment (4).</li> </ol>	
<b>Prions (spongiform encephalopathies transmitters)</b>	<ol style="list-style-type: none"> <li>1. Risk of infection in autopsies is lower. Not evenly distributed in the tissues, so the level of infectivity varies.</li> <li>2. Increased risk in neural tissue (brain, spinal cord) and eyes. Low risk in spinal fluid and lymphoreticular tissue. Negligible risk in blood and other fluids.</li> <li>3. Transmitted by percutaneous, mucosal exposure; there is no evidence of transmission by aerosols.</li> <li>4. Transmission by inhalation of infectious particles seems to be ruled out; however, it is recommended to take (as it is still a relatively new disease for which there is no scientific literature in this respect) a precautionary position as an additional safety measure.</li> <li>5. ND.</li> <li>6. They are extremely resistant, are not removed during formol or phenol fixation and withstand routine physical and chemical decontamination methods.</li> <li>7. It is recommended to record those present at the autopsy for a minimum of 40 years.</li> </ol>	<ol style="list-style-type: none"> <li>1. Special fixation measures: brain fixed in saline formol (10%) without phenol. Dissection in secure microbiological cabinet with hand and eye protection. Other samples in formol.</li> <li>2. Disposable materials used and subsequent incineration.</li> <li>3. Material used to inactivate it: sodium hypochlorite, sodium hydroxide and formic acid.</li> </ol>

## Appendix 4. Additional information in case of exhumation

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Agent/disease	Transmission mechanism	Survival	Note to guide the exhumation
<i>Bacillus anthracis</i> (anthrax)	Aerosols, direct contact with skin wound or mucous contact.	Indefinitely in the form of spores.	Anthrax spores can be found in the exhumed body and in objects such as pillows and lining stuffed with horsehair. Any horsehair stuffing should be bagged and eliminated as clinical waste.
<i>Variola major virus</i> (verola)	Inhalation and contact.	Can survive for long periods in dry scabs (13 years has been documented). However, under normal environmental conditions, the virus is unlikely to survive more than 48 hours.	The virus cannot grow so it is not considered infectious.
<i>Clostridium tetani</i> (tetanus)	Wounds to the skin.	Commonly found in soil.	Workers should be immunised against tetanus.
<i>Leptospira icterohaemorrhagiae</i> (Weil's disease)	Wounds to the skin.	Found in association with others.	The agent is excreted in the urine of infected rats and therefore may be present in soil and water.
Prions (transmissible spongiform encephalopathy)	Wounds to the skin from sharp objects or injured skin; by splashing of the mucous membranes.	Remains on body for a long period of time.	Take precautions in exhumation cases where the disease is suspected or confirmed.

## Appendix 5. All cadavers are potentially infective. Hazard groups

<b>Disease in humans</b>	Unlikely	May cause	Severe	Severe
<b>Hazard for workers</b>		May entail	Serious hazard	Serious hazard
<b>Spread to the community</b>		Unlikely	Risk present	Highly likely
<b>Prophylaxis and/or treatment</b>		Yes	Yes	No
	<b>Hazard group 1</b>	<b>Hazard group 2</b>	<b>Hazard group 3</b>	<b>Hazard group 4</b>
<b>Example bacteria</b>		<i>Haemophilus</i> <i>Legionella</i>	<i>Brucellosis</i> <i>Mycobacterium tuberculosis</i>	
<b>Example virus</b>		<i>Cytomegalovirus</i> <i>Epstein-Barr</i>	<i>Hepatitis</i> <i>HIV</i>	<i>Lassa Virus</i> <i>Marburg Virus</i>
<b>Example parasite</b>		<i>Fasciola</i> <i>Toxoplasma</i>	<i>Leishmania</i> <i>Taenia solium</i>	
<b>Example fungi</b>		<i>Aspergillus</i> <i>Candida</i>	<i>Coccidioides</i> <i>Histoplasma</i>	



## Appendix 6. Universal protection measures

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<p><b>Facilities</b></p>	<p>Specified in the regulations on the prevention of occupational hazards. Essentially design and maintenance must include three basic areas: clean, dirty and transition. Staff working in these areas must be trained in the precautions to be taken in each area.</p> <p>Autopsy regulations require autopsy rooms for high risk of infection autopsies with a specific safety design.</p>
<p><b>Workers exposed</b></p>	<ol style="list-style-type: none"> <li>1. <b>Immunisation:</b> make available vaccines against tetanus, tuberculosis, influenza and hepatitis B.</li> <li>2. <b>Basic hygiene measures:</b> it is very important to cover wounds and injuries on hands with waterproof dressings; use specific containers (colour-coded) for used clothing and personal protective equipment (PPE); do not take boots or leggings out of the dirty area; keep material used outside the autopsy clean; do not touch objects (e.g. mobiles, cameras) with autopsy gloves; no smoking, no eating in autopsy rooms.</li> <li>3. Use of <b>EU-approved personal protective equipment (PPE):</b> <ul style="list-style-type: none"> <li>- <b>Gloves:</b> there are none specifically for biohazards. Wearing double ones (combined cut protection/biohazard protection, i.e., thick latex or nitrile) and changing them frequently is recommended. Sometimes triple are recommended (with metal mesh between latex and nitrile).</li> <li>- <b>Airtight eye protection:</b> there are several types, e.g. airtight goggles, masks for respiratory protection, screens and hoods (protects the entire head to chest).</li> <li>- <b>Respiratory protection</b> not independent of the ambient atmosphere (only required for level 4). A surgical mask does not provide effective protection against the risk of transmission of airborne microorganisms. To avoid contamination by microorganisms by aerosols or splashing, it is better to use facial adapters. Appropriate filters are required (P3 filters can be used in Europe to prevent airborne transmission and have 99.95% efficiency in particle retention).</li> <li>- <b>Protective clothing:</b> protective cap and waterproof clothing. Highly waterproof surgical gowns with long sleeves and plastic apron can be used.</li> <li>- <b>Footwear:</b> non-slip, closed, waterproof, easy to clean and resistant to disinfectants. High rubber boots are recommended.</li> </ul> </li> <li>4. <b>Minimum number of individuals moving around the facility:</b> personal «brut» (patòleg i tècnic); personal «net» (circula a «dirty» personnel (pathologist and technician); «clean» personnel (moving with specific functions: check cleaning and proper use; prevent spread outside the unit; avoid the presence of other people in the room; photography; taking notes and other).</li> <li>5. Inform personnel who may handle or have contact with the body and/or samples of the existence of the hazard and precautions (do not diagnose).</li> </ol>

<b>Instruments</b>	<ol style="list-style-type: none"> <li>1. Saws: with suction system to reduce aerosols; cover head with plastic bag during opening. Use manual costal saw.</li> <li>2. Safety when using cutting instruments; do not use pointed instruments, must be strong and sharp but with blunt tip. Do not pass instruments from hand to hand during the autopsy.</li> <li>3. Dispose of waste in suitable containers (do not fill above ¾ full).</li> <li>4. Use autoclaves/disinfection products suitable for all material that is reusable.</li> <li>5. If there is suspicion of prions such as TSE (transmissible spongiform encephalopathies), use disposable equipment. Cover the table with absorbent sheet, waterproof on reverse, or with a plastic blanket with absorbent material.</li> </ol>
<b>Body and visceral handling</b>	<ol style="list-style-type: none"> <li>1. Recommended, if possible, pre-autopsy biohazard screening test (if group 3 suspected). Blood (hepatitis and HIV), nasopharyngeal and bronchial swab (in influenza virus).</li> <li>2. Caution with sharp bone fragments (protect them).</li> <li>3. Using mechanical costal saw (manual).</li> <li>4. Avoid visceral handling and washing under water pressure to prevent aerosol formation (in the case of intestines, opening in the water) and splashing.</li> <li>5. Evisceration organ by organ (Rokitansky technique) versus en bloc handling (Letulle).</li> <li>6. Caution with unexpected objects (sharp filters in vena cava, needles or fragments in intravenous drug users, etc.). If there is suspicion, can recommend prior radiology.</li> <li>7. If an implant, e.g. a pacemaker, is extracted, disinfect it before doing the examination.</li> <li>8. In cases of suspected TB, plug oronasal area with wet gauze during evisceration of heart and lungs.</li> <li>9. It is not recommended to use sutures for closure; it is better to use staples, adhesives or place the body in a double sealed bag and not rebuild it.</li> <li>10. Creutzfeldt-Jakob disease: minimise risks and localise research in the anatomical region of interest. If it has to be more complete, take samples without evisceration. Cranial opening with sufficient absorbent material under the head and neck.</li> <li>11. Body preservation measures (embalming): not recommended in HIV+, hepatitis B and C, invasive streptococcal infections, hemorrhagic viral fevers.</li> </ol>

## Appendix 7. Anatomical pathology findings

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<b>Neurologic</b>	Encephalitis
<b>Respiratory</b>	Pharyngitis Epiglottitis Bronchitis/bronchiolitis (no history of COPD) Community-acquired pneumonia Diffuse alveolar injury Mediastinitis haemorrhage without prior trauma
<b>Cardiac</b>	Myocarditis Endocarditis
<b>Gastrointestinal</b>	Acute hepatitis/fulminant hepatic failure (non-alcoholic) Enterocolitis (diffuse mucosal inflammatory lesion, non-inflammatory ulcers)
<b>Dermatological</b>	Soft tissue lesions (necrotising cellulitis, sores, abscesses)
<b>Multisystem</b>	Lymphadenitis (swollen, necrotic or haemorrhagic lymph nodes) Sepsis (disseminated intravascular coagulation, adrenal haemorrhage, skin petechiae, etc.)

## **Dismembered body or severed body parts**

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### **Definition**

Bodies which have one or more limbs amputated, or when there are separate human body parts.

### **History**

#### **Clinical**

- a) Collect all kinds of medical or surgical history if possible (person identified or suspected identity), especially psychiatric and drug addiction.

#### **Court and police**

- a) Area where the body or amputated body part was found and possible geographical correlation with respect to workplace, own home, home of relatives or partner, etc.
- b) Location of the person on removal, nearby weapons or tools, etc.
- c) History of previous complaints about threats, domestic abuse (especially in women), relationship with neighbours, relatives, partners and co-workers, financial debts, previous suicide attempts, substance abuse.
- d) Collect history of possible animals in proximity to the body.
- e) Testimony of family, neighbours, co-workers: date, time and place when last seen, daily routine, habits, hobbies, changes in friendships or routines in the days prior to disappearance.
- f) Photographs of the scene from where body is removed.

## **Preliminary diagnostic tests**

### **Optional**

- a) Radiology for study of osteosynthesis material, old or recent fractures.
- b) Wide and close-up photographs of the dismembered body or amputated limb.
- c) Fingerprinting of the deceased when possible (police work).

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### **External examination**

- a) Anatomical location, morphology, size and number of amputated parts, measurement of amputated parts or fragments.
- b) Study of the section surface with description of amputation area by levels: cutaneous, subcutaneous, muscle, bone. Intravital occurrence of injuries.
- c) Determination of sex and approximate age.
- d) Determining the probable mechanism of injury or type of instrument used to distinguish between accidental, surgical, self-harm or criminal medico-legal cause of death.
- e) Calculating the relationship between different bone fragments to see if they come from the same body.

### **Internal examination**

- a) Dissection by layers in the area of amputation is only to be done if there is an injury causing death (e.g. stab wound).
- b) In other cases it is better not to tamper with the part and send it to the Anthropology Unit.
- c) Send the part with references or photographs to show what is anterior, posterior, right and left. Put a stitch below the amputated skin surface to identify the amputation area and what requires study.
- d) Anthropology Unit: study of the part with skeletonisation that does not produce artefacts; enhanced view of the surface to infer the type of weapon(s); take photographs of the findings.

## **Sampling**

### **Histopathology**

Samples of the skin section surface for the study of intravital occurrence. Even though regulations in Order JUS/1291/2010 of 13 May say that in these cases samples must be sent fresh, other studies that are not the usual microscopic ones are not done. So they are sent in formol and an undamaged fresh area can also be sent for control purposes.

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### **Toxicology**

If a cephalic extremity: hair samples for toxic study, nasal swabs, vitreous humour.

### **DNA**

Muscle in good condition (red colour) or end of long bone that has not been amputated. If there is only the sample to be used for the anthropological study, send it and from there it will be forwarded for DNA. State that it is pending submission of sample for DNA in the forwarding document for the Anthropology Unit.

### **To send to Anthropology Unit**

Section of the amputation surface marking the area where the new section has been made by the medical examiner or forensic pathology technician so that there is no confusion between the area amputated and that sectioned in the autopsy room.

### **Diagnostic criteria**

- a) The only case in which the cause of death can be established is if there is an injury likely to have caused it in the surface under study.
- b) Surgical amputations: cut with clean and regular surface. The technique used (different section height in each layer) may indicate it is professional.
- c) Accidental amputations: due to vehicle/pedestrian collision, tearing off, crushing. Surfaces are irregular, uneven, dirty, bone

with signs of cracking (splinters); when torn off the bone is often separated at the joint.

- d) Criminal amputations: generally involve dismemberment; typically section positions do not coincide with anatomical regions and the technique is rudimentary.

## **Specific causes of death**

Determinable only if there are injuries explaining death (sharp force, firearm, etc. injury).

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## Charred body

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### Definition

Body with over third degree burns.

### History

#### Clinical

- a) Surgical, medical history (psychiatric or neurological illness, alcohol, tobacco and drug use, disabilities, etc. that may explain death). Dental history.
- b) Identifying features: malformations, scars, prostheses, osteosynthesis material, IUD, etc.

#### Court and police

- a) Time and type of facts.
- b) Witnesses.
- c) People who handled the body after the event (fire brigade, medical personnel, police officers, emergency teams, etc.).
- d) What the weather was like at the time.
- e) Accidental or intentional fire depending on the location of the body and circumstances of the case.
- f) Presence or absence of combustion accelerants, remains of explosives, electrical circuits, biological remains, etc.
- g) Photographs of the scene where body removed.



- h) Possible prints, projectiles and other items of interest at the scene.
- i) Search for teeth and accessories: scattering of dental items and removable prostheses from the body.

## **Preliminary diagnostic tests**

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- a) General and specific photographs of identifying features and marks.
- b) Serial radiology or radioscopy may be advisable.
- c) Dactyloscopy (where possible).
- d) Panoramic radiograph when possible (in case of studies to identify the body).

## **External examination**

- a) Weight and size unreliable (due to cadaver volume reduction).
- b) Description and examination of clothing, documents and personal items.
- c) Description of type, shape, depth and extent of burns (Appendix 1).
- d) Description of other types of injuries: sharp force injuries, firearms, injuries that could be hidden by the action of fire.
- e) Individualising features: scars, tattoos, etc.
- f) Signs of sexual identification (internal organs or through forensic-anthropological study of bones): according to the condition of the body they may be observed directly in external examination.
- g) Differential diagnosis (DD) between pre- and post-mortem injuries.

## **Internal examination**

- a) Skull examination: DD epidural haematoma, due to heat or trauma.
- b) Mouth examination: buccal mucosa, tongue; if they have burned, epiglottis.
- c) Trachea and airways (bronchi and lungs) examination: if there are particles of carbon, carbon black or traces of ashes.
- d) Stomach examination: in case there are traces of ash or soot.
- e) Bone injury examination: DD, due to heat or trauma.
- f) Search for visceral lesions that explain the cause of death.
- g) Search for identifying injuries or changes: appendectomy, cholecystectomy, hysterectomy, breast implants, IUD, osteosynthesis materials, prosthetics, etc.

- h) Dental examination on the spot or maxillary extraction (Luntz technique), fill in odontogram. Photos with metric photomacrophographic scale.

## **Sampling**

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### **Chemical-toxicological study**

- a) Blood and urine (if there is no blood, it is very useful to take epidural haematoma):
  1. Carbon monoxide.
  2. Hydrocyanic acid and derivatives.
  3. Derivatives of sulphur and nitrogen.
  4. Alcohol, psychoactive drugs and drugs of abuse.
- b) Clothing and objects:
  1. Combustion accelerators.

### **Biological study**

- a) DNA or genetic identification study.
  1. Non-fragmented long bone (femur).
  2. Deep muscle tissue (gluteus, psoas) not destroyed by the fire.
  3. Molars that have no treatment or decay (4 teeth).
  4. Semisolid heart cavity blood.
- b) Vaginal, anal and oral swabs if sexual assault is suspected.

### **Criminology study**

- a) If a firearm is involved, collect projectile by removing it with tweezers protected by paper so as not to scratch it.
- b) Metal objects that are altered to determine melting temperatures.
- c) Clothing.

### **Histopathological study**

- a) Upper airway and lung for study of carbon black.
- b) Skin from burns for intravital occurrence study with unharmed tissue remains if any.
- c) Visceral segments to determine pathology that can explain death or the consequences of the action of fire.

## **Anthropological study**

- a) Skull, femur, pelvis, tibia, sternum, atlas, axis, coxal if study required of race, sex, height and age. The soft tissue must be removed.

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## **Diagnostic criteria**

- a) Diagnosis of burns.
- b) Diagnosis of aetiological agent.
- c) Differential diagnosis of pre- and post-mortem burns.
- d) Determine whether breathed in fire.

## **Specific causes of death**

### **Immediate death**

- a) Neurogenic shock due to burns.
- b) Inhalation of smoke at high temperatures.
- c) Poisoning by CO, cyanide and other combustion products. Metabolic asphyxiation.
- d) Direct thermal effect on the respiratory mucosa. Asphyxiation by blocking of mechanical breathing.

### **Delayed death**

- a) Early death (24-48 h): hypovolemic shock or respiratory failure secondary to trachea bronchopulmonary damage.
- b) Late death: infectious complications such as sepsis, pneumonia or diffuse alveolar damage.

Other causes of death, whether accidental (traumatic brain injury due to fall of beams, ceilings, etc.) or homicide (burning to conceal murder) must be ruled out.

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## Appendix 1. Wallace's Rule of Nines

Head and neck:	9% (4.5% front and 4.5% back)
Front trunk:	18% (thorax 9 and abdomen 9)
Back trunk:	18% (upper back 9 and lower back 9)
Lower limbs (each):	18%
Upper limbs (each):	9%
Perineum:	1%

## **Decomposed body**

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### **Definition**

Recent and/or advanced decomposed bodies (chromatic period, emphysematous, colliquative) in which this process limits external and internal examination.

### **History**

#### **Clinical**

When gathering medical history (medical, psychiatric, surgical) special attention should be paid to processes that may condition the evolution of decomposition, mainly infectious diseases, antibiotics and consumptive diseases.

#### **Court and police**

It is especially useful in these cases to:

- a) Ask about the time and place when the person was seen alive.
- b) Obtain information about the circumstances of the discovery.
- c) Obtain information about the victim's habits and daily routine.
- d) Have a description of the tidiness of the scene and sanitation and hygiene conditions.
- e) Obtain data if need be about temperature, humidity, wind and rain for a time band based on inferred evolution period.
- f) Describe the existence and type of animals in relation to the body.
- g) Do a photo report of the scene and any cadaveric fauna.

## Preliminary diagnostic tests

- a) At the scene of removal, collect cadaver entomology (Appendix 1).
- b) Do a radiological series in cases where external examination suggests the presence of traumatic skeletal injuries that cannot be assessed during internal examination, or where a radiological pattern is the way to obtain information about the mechanism of production or conditions the internal examination technique.
- c) In the case of no name bodies, follow the appropriate recommendations.

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## External examination

- a) Describe the stage, pattern and evolution of the decomposition.
- b) Identify the presence of any alteration in the expected decomposition rate and pattern.
- c) Differentiate ante mortem (prior to death with evidence of healing processes), peri-mortal (related to the circumstances of death) and post-mortal (pseudolesion artefacts) injuries.
- d) In the case of no name bodies, follow the appropriate protocol.

## Internal examination

- a) Follow the same system as with a recent corpse although taking into account that the list of organ and viscera weights and measures will be distorted by decomposition. In these cases the exclusion criterion prevails.
- b) Differentiate ante mortem, peri-mortal and post-mortal injuries.
- c) In the case of no name bodies, follow the relevant protocol.

## Sampling

- a) As far as possible, routine sampling of blood, urine, bile, vitreous humour or gastric contents should be done.
- b) In cases where this sampling cannot be done or needs to be expanded, send samples of target organs involved in the kinetics of the suspected toxic(s). The samples should be sent separately and without formol.
- c) In cases of advanced active decomposition where it is not possible to take the above samples, samples of decayed mate-

rial should be sent separated by anatomical location and without formol.

- d) Given the state of decomposition and on suspicion of disease, take samples for additional histopathological study.
- e) In the case of no name bodies, follow the relevant protocol.
- f) Entomological fauna samples must be collected as a priority when removing the body (Appendix 1).

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## **Diagnostic criteria**

- a) Diagnosis by evidence of acute lesions: differential diagnosis with pseudopathology.
- b) Diagnosis by exclusion: clearly establish in the autopsy report, when necessary, that “given the autopsy limitations due to state of decay it is concluded that it is a natural death after excluding violent death”.

## **Specific causes of death**

Analogous to a recent body.

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# Appendix 1. Entomological studies

## General collection rules

- a) Samples for entomological studies should be taken in the place where the body was found, both from the body and under and around it. They can also be taken during the autopsy if required and bearing in mind environmental conditions and elapsed time.
- b) The following information should be provided to complete the entomological study:
  1. If it is a violent death with open wounds.
  2. The decomposition stage the body is in.
  3. The date and time of collection of entomological samples.
  4. The place of the discovery of the body and its situation.

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If found outdoors, describe the surrounding environment, orientation, temperature, humidity, etc. If possible, send photographs. If found in an enclosed space, report the situation of the body in this space, environmental conditions, especially temperature, light, ventilation and sanitary conditions, and the presence of physical objects that may alter these conditions, such as heating and air conditioning.

Also indicate if the body has been kept in special conditions, such as submerged, buried, burned or other.

- c) All containers must be labelled indicating the anatomical origin of specimens.

## Type of samples

- a) Larvae and pupae. The samples should be divided into two groups:
  1. In the first, the larvae are killed before putting them into a container with preservative fluid, 70% alcohol with a few drops of glycerine, in which they are sent to the laboratory.
  2. In the second, live larvae should be packed and sent accompanied by a nutritional substrate such as chicken liver.
- b) Adult or imago insects. To be sent in a jar with wood shavings and cotton impregnated with ethyl acetate.



## **Recent no name (NN) body**

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### **Definition**

Any body that has no documentation proving their identity or identification by a family member, an acquaintance or a close person, and any body which does have documents but they do not match (e.g., national ID card that is not theirs, multiple documents but in different names, etc.).

### **History**

#### **Clinical**

Not available in these cases.

If there is an idea as to who the person may be, collect all possible medical, surgical and dental history documents for comparison.

#### **Court and police**

Analogous to an identified body with special attention to obtaining identification data: where found, documents carried, albeit not matching, etc.

### **Preliminary diagnostic tests**

- a) Fingerprinting the deceased (police). It can be done as a first test.

- b) Photographs: head and face (front and side) as natural as possible and once the body is clean, teeth, individualising traits, clothing and objects associated with the body.
- c) Radiology (optional, test to be evaluated):
  1. Sinuses (Waters projection) in all cases.
  2. Carpal-sternoclavicular in children and adolescents (Greulich and Pyle 1959; Hernández and Sánchez, 1991).
  3. Orthopantomography or periapical: depending on the dental findings (Dermijian et al., 1973).
  4. Other locations if scars observed.
- d) Blood for genetic study.

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## External examination

- a) Individualising characteristics and traits (Appendix 1).
- b) Dental examination: option of oral autopsy, maxillary extraction, preparation of moulds. Check with forensic dentist.

## Internal examination

Individualising characteristics and traits (Appendix 2).

## Sampling

The type of sample depends on the laboratory of origin. The options are:

- a) Skeletal muscle.
- b) Blood.
- c) Buccal mucosa.
- d) Teeth (2-6 teeth without cavities or root canals; preferably molars).
- e) Bones (long bone without soft tissue).

## Diagnostic criteria

Analogous to recent corpse.

## Specific causes of death

Analogous to recent corpse.

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## Appendix 1. Individualising characteristics and traits in external examination

### a) Clothing and objects

- Description: type, colour, material, label, size, pictures, writing, inscriptions.
- Documents.
- Photographs.

### b) Sex

Not assessable

Male

Female

- c) **Apparent age**  
 Not assessable  Child 0-10  Subadult 11-20   
 Young adult 20-40  Mature adult 41-60  Elderly > 60
- d) **Height** cm Not assessable
- e) **Weight** kg Not assessable
- f) **Build**  
 Not assessable  Thin  Normal  Burly
- g) **Source population**  
 Not assessable  Caucasian  Black  Asiatic   
 Skin colour: Light  Medium  Dark   
 Additional description:
- h) **Hair**  
 Not assessable  Natural  Artificial  Shaved   
 Short  Medium  Long  Blonde   
 Brown  Black  Redhead  Grey   
 White  Smooth  Wavy  Curly   
 Bald: No  Yes : Frontal  Parietal  Occipital   
 Total   
 Other:
- i) **Forehead**  
 Not assessable  Narrow  Medium  Wide   
 Other:
- j) **Eyebrows**  
 Not assessable  Blonde  Brown  Black   
 Redhead  Grey  White  Thin   
 Normal  Thick  Joined   
 Other:
- k) **Eyes**  
 Not assessable  Blue  Green   
 Grey  Brown  Black   
 Ocular prosthesis  Enucleation  Micro tattoos eyelids   
 Other:
- l) **Nose**  
 Not assessable  Large  Medium  Small   
 Hooked  Sharp  Sign of glasses   
 Other:

m) **Facial hair**

Not assessable  Shaven  Moustache   
 Beard and Moustache  Goatee  Sideburns   
 Blonde  Brown  Black   
 Redhead  Grey  White   
 Other:

n) **Ears**

Not assessable  Large  Medium  Small   
 Sticking out  Normal  Close to head  Holes   
 Hearing aid   
 Other:

o) **Mouth**

Not assessable  Small  Medium  Large

p) **Lips**

Narrow  Medium  Thick  Painted   
 Modified   
 Other:

q) **Chin**

Not assessable  Pointed  Prominent   
 Rounded  Receding  Central cleft   
 Other:

r) **Neck**

Not assessable  Goitre  Prominent Adam's apple   
 Other:

s) **Hands**

Not assessable  Large  Medium  Small   
 Thin  Normal  Wide   
 Other:

t) **Nails**

Bitten  Manicured  Artificial   
 Painted : Colour:  
 Other:

u) **Feet**

Not assessable  Thin  Normal  Wide  Bunions   
 Calluses  Yes : Left  Right   
 Nails: Bitten  Manicured  Artificial   
 Painted : Colour:  
 Other:

v) **Body hair**

- |                |                          |        |                          |       |                          |          |                          |
|----------------|--------------------------|--------|--------------------------|-------|--------------------------|----------|--------------------------|
| Not assessable | <input type="checkbox"/> | None   | <input type="checkbox"/> | Light | <input type="checkbox"/> | Average  | <input type="checkbox"/> |
| Abundant       | <input type="checkbox"/> | Blonde | <input type="checkbox"/> | Brown | <input type="checkbox"/> | Black    | <input type="checkbox"/> |
| Redhead        | <input type="checkbox"/> | Grey   | <input type="checkbox"/> | White | <input type="checkbox"/> | Gynecoid | <input type="checkbox"/> |
| Android        | <input type="checkbox"/> |        |                          |       |                          |          |                          |
| Other:         |                          |        |                          |       |                          |          |                          |

w) **Pubic hair**

- |                |                          |        |                          |       |                          |          |                          |
|----------------|--------------------------|--------|--------------------------|-------|--------------------------|----------|--------------------------|
| Not assessable | <input type="checkbox"/> | None   | <input type="checkbox"/> | Light | <input type="checkbox"/> | Average  | <input type="checkbox"/> |
| Abundant       | <input type="checkbox"/> | Blonde | <input type="checkbox"/> | Brown | <input type="checkbox"/> | Black    | <input type="checkbox"/> |
| Redhead        | <input type="checkbox"/> | Grey   | <input type="checkbox"/> | White | <input type="checkbox"/> | Gynecoid | <input type="checkbox"/> |
| Android        | <input type="checkbox"/> |        |                          |       |                          |          |                          |
| Other:         |                          |        |                          |       |                          |          |                          |

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x) **External genitals**

- |              |                          |                      |                          |
|--------------|--------------------------|----------------------|--------------------------|
| Circumcision | <input type="checkbox"/> | Ablation of clitoris | <input type="checkbox"/> |
| Other:       |                          |                      |                          |

y) **Personal signs**

- Scars
- Piercings
- Tattoos
- Malformations
- Pre-mortal amputations
- Protheses
- Nevus

z) **Other information:**

## Appendix 2. Individualising characteristics and traits in the internal examination

a) **Head**

1. Valves, operations
2. Other

b) **Thorax**

1. Pacemakers and defibrillators
2. Valve replacement
3. Breast implants
4. Other

c) **Abdomen**

1. Gallstone
2. Appendix
3. Other

- d) **Pelvis**
  - 1. Uterus/intrauterine device
  - 2. Pregnancy
  - 3. Prostate
  - 4. Other

- e) **Serial radiology**
  - 1. Old fractures
  - 2. Recent fractures
  - 3. Prostheses
  - 4. Other

**Appendix 3. Document for family identification of body**

Barcelona, ..... on ..... 201...

Please be advised that today identification has been made of the body of .....

Recorded in our archive under no. ...., who was admitted as unidentified to this Forensic Pathology Service on ....., from ..... The body is available to Magistrates Court no. .... in .....

The identification has been made by ....., National ID/Foreigner ID/Passport no. .... whose address is ....., in ....., and who signs below:

Signature:  
Mr/Ms .....  
Relationship with the deceased .....

Signature forensic pathology specialist	Signature of the medical examiner on duty
Mr/Ms .....	Mr/Ms .....

MAGISTRATE OF MAGISTRATES COURT NO. ....  
IN .....

## Death in water

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*Authors:* M. Victoria Bonastre Paredes, Josep Maria Casadesús Valbi, Santiago Crespo Alonso, Helena Martínez Alcázar, Manuel Martínez Vecoña, Mercè Subirana Domènech, José Manuel Tortosa López  
*Coordinator:* Josep Maria Casadesús Valbi

### Definition

Death in a liquid medium, mainly secondary to an episode of submersion.

Submersion is the process that results in respiratory failure secondary to immersion in a liquid medium, usually water.

In any episode of submersion it is recommended to describe possible predisposing factors:

- a) Syncope or seizures, epilepsy.
- b) Alterations in the level of consciousness and/or motor function due to drugs, alcohol, hypothermia and/or head trauma.
- c) Circulatory arrest (loss of electrical conduction or ventricular fibrillation).
- d) Unconsciousness due to any other reason (ischemic heart disease, arrhythmogenic channelopathies such as long QT syndrome, etc.).

### History

#### Police

Collect and evaluate witness statement, contextual, technical, operational and environmental (water sample taken from the scene: 100 ml.) data.

#### Court and medical

Assess the medical and forensic removal of the body report and, if the death occurred in a hospital, assess the court statement of death and medical care report.



## Preliminary diagnostic tests

- a) Photo and/or video report if appropriate.
- b) Radiology study: optionally can assess the presence of fluid in the sinus (non-specific sign).

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## External examination

- a) **Signs of permanence of the body in water:** cooling rate, colour of cadaveric lividity, presence of algae and mud and appearance of the skin.
- b) **Signs of submersion before death:** identify the existence of foam fungus.
- c) **Description of the body's external injuries:** type (by aquatic animals, aquatic medium elements or by third parties) and origin (pre- or post-mortal).

## Internal examination

- a) **Skull autopsy:** identify the existence of a middle ear haemorrhage (non-specific sign).
- b) **Chest autopsy:**
  - 1. Dissection of the airway (trachea and bronchi) to identify the existence of tracheobronchial foam and the presence of foreign bodies (sand, grass, etc.).
  - 2. Description of the lungs: appearance, weight, size and extent of emphysema.
  - 3. Evaluate the presence of transudate fluid in the pleural cavities.
  - 4. Evaluate the existence of intramuscular haemorrhages in neck (anterior and posterior) and pectoral muscle groups.
- c) **Abdomen autopsy:**
  - 1. Evaluate the content and amount of fluid in stomach or duodenum.
  - 2. Evaluate the existence of tears in the mucosa of the cardia.

## Diagnostic criteria and sampling

Macroscopic submersion diagnostic criteria: see Appendix 1.  
Sampling: see Appendix 2.

## Specific causes of death

- a) **Asphyxia by submersion** (drowning).
- b) **Natural pathology:** mainly cardiac in origin. Evaluate the option of requesting genetic studies.
- c) **Trauma pathology:** traumatic injuries caused by elements in the aquatic environment; by nautical collision; by aquatic animals; typical of diving (barotrauma with cerebral gas embolism); and due to the action of others.
- d) **Intoxications.**
- e) **Hypothermia.**
- f) **Vasovagal inhibition:** exclusion diagnosis.

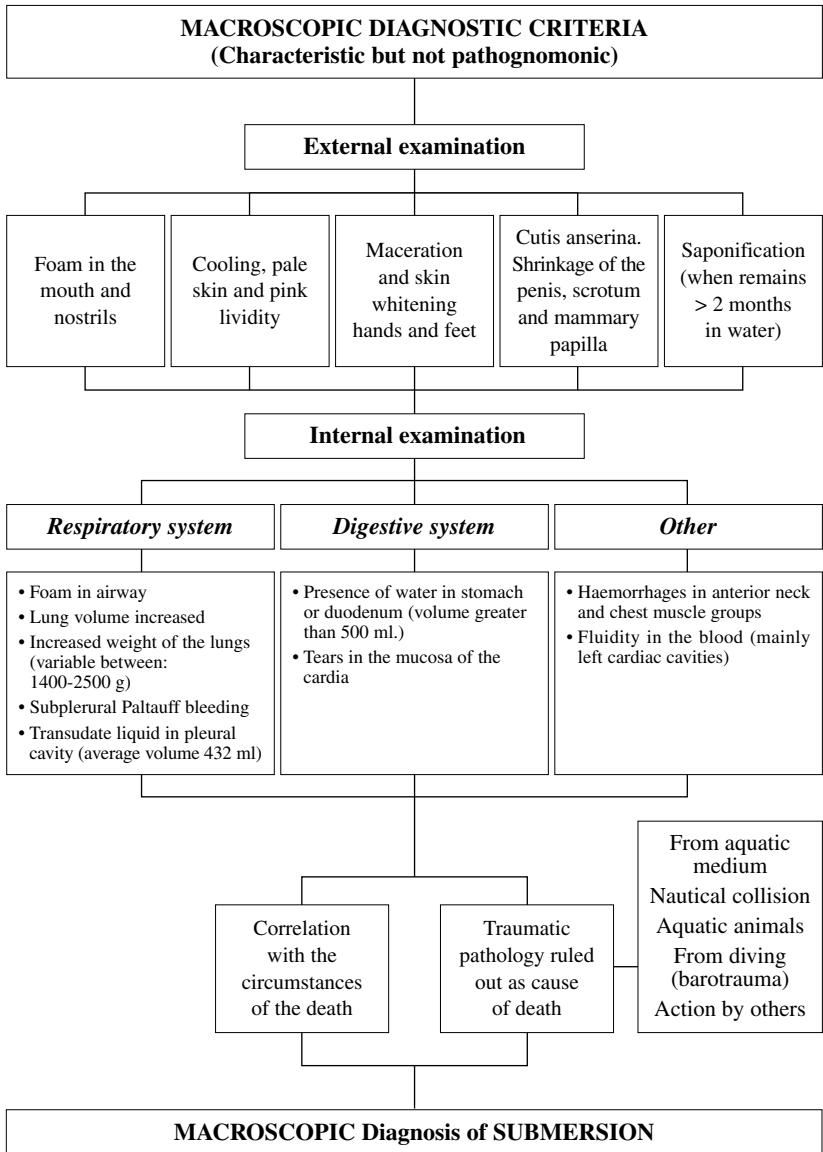
65

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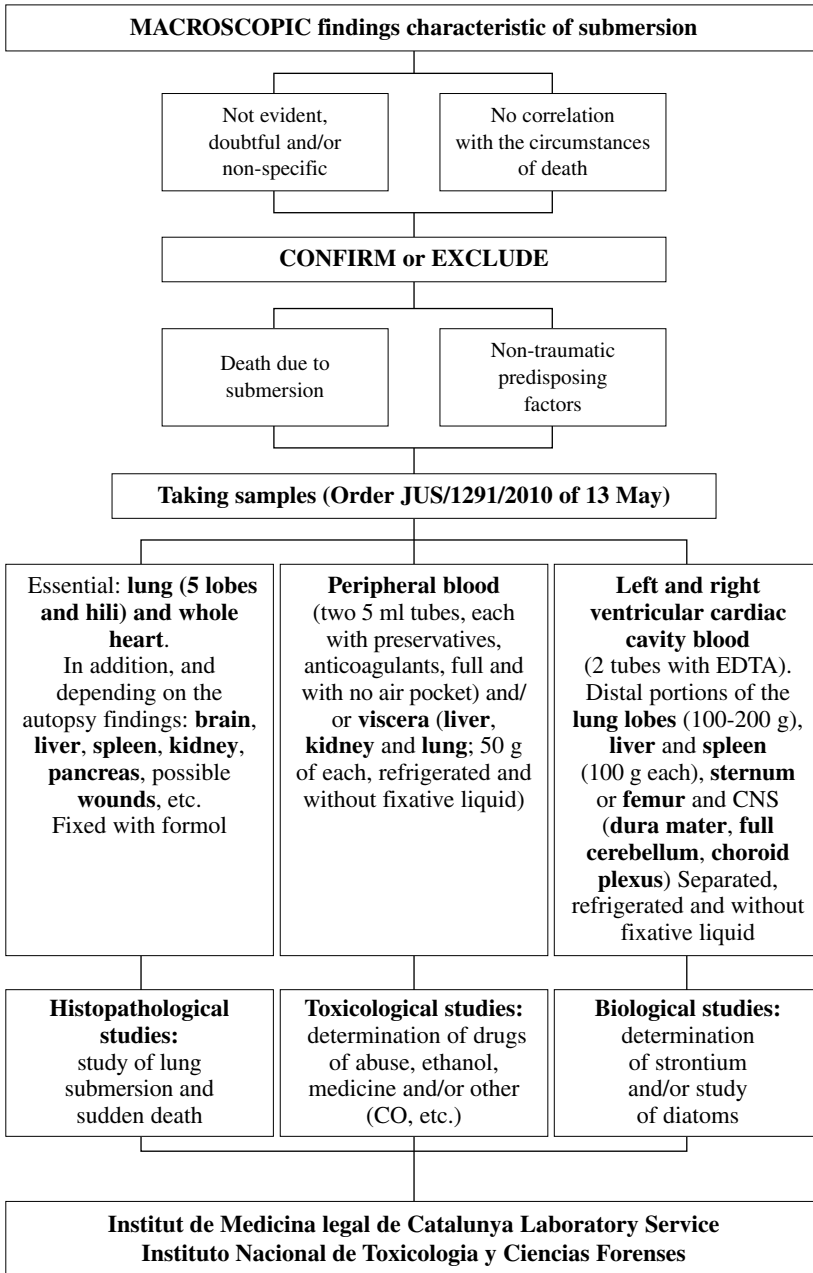
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## Appendix 1. Diagnostic criteria

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## Appendix 2. Sampling



## Death by sharp force trauma

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*Author:* Manel Joan Salas Guerrero

### Definition

Any death where the damaging agent involved is an object which acts by means of a point or blade or both at once.

### History

Indicate whether there is documentary evidence of these medical and/or psychiatric histories or if they are only related by family members, neighbours or friends.

### Clinical

- a) **Systemic or local organic diseases:** recent hospitalisation, congenital malformations, prostheses and current drug treatment.
- b) **Surgery:** admission data for recent surgery and reason for operation.

### Psychiatric

- a) **Psychiatric and psychological disorders and current treatment:** note down the centre conducting outpatient follow-up and/or the psychiatrist treating them. Previous attempts at suicide and means used.
- b) **Admission to psychiatric centres:** admission and discharge data. Hospital where admitted.

- c) **Toxic history:** alcohol and drugs of abuse, noting toxic class, usual dose, means of administration and admission to detoxification centres with admission details or outpatient follow-up in detoxification centres.

## Police and court

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- a) Time and place of events.
- b) Direct and indirect witnesses.
- c) State if the body has been moved by medical staff, witnesses, etc.
- d) State if there has been any attempted resuscitation and treatment.
- e) Document the scene by taking photographs and using diagrams and maps to show the location of the body and its position relative to the weapon, rooms and reference points.
- f) Position of the body.
- g) Presence or absence of weapon and position relative to the body.
- h) Bloodstains: distribution and concordance with respect to the position of the body, shape, size, type (runoff, impregnation, rubbing, cleaning and spatter).
- i) Other dripping blood stains indicating survival and movement of the victim or which might belong to the perpetrator or perpetrators.
- j) Post-mortem changes (rigidity, coldness, lividity, general or partial cadaverous spasm).
- k) Struggle and self-defence injuries.
- l) State of clothes, match with skin lesions, distribution of bloodstains.
- m) Protect the victim's hands with paper bags tied at the wrist to prevent the bag falling off.
- n) Handle the body as little as possible to prevent loss of evidence.
- o) Evaluate farewell notes and items related to drug use.
- p) Victim's police and court record (restraining orders, drug trafficking, etc.) and determine the tidiness of the domicile.
- q) Collect biological material from blood stains and other fluids for genetic analysis.

## Preliminary diagnostic tests

- a) Serial wide and close-up photographic report with metric photomacrographic scales before and after removal of clothing from the victim. Take photos of the clothes laid out on a table.
- b) Dental study if victim not identified.
- c) Optional examination of the body with forensic light (UV).
- d) Fingerprinting of the deceased (police work) will not be done until the autopsy is completed or after cutting nails.

## External examination

### Clothing

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- a) Cut clothing around the edges, if allowed by the rips produced by the sharp force weapon or tearing in a struggle or self-defence that may provide evidence to determine the circumstances of the death under investigation, detailing their morphology and location.
- b) Search for other possible biological evidence (hair, other biological fluids, etc.). Send to the laboratory pursuant to the regulations of the Instituto Nacional de Toxicología y Ciencias Forenses.

Let clothing dry for hours or days and then pack preferably in cardboard boxes for sending to the lab for biological or criminology analysis. Do not use watertight plastic containers to lessen the risk primarily of fungal contamination.

### Epidermis/dermis

- a) Observe all natural orifices of the body to rule out injuries that may otherwise go unnoticed.
- b) Examine post-mortem changes to determine time of death and confirm or otherwise the data from the removal of the body.
- c) Describe and measure sharp force trauma injuries, bringing their edges together (measure with edges together). Detail topographically the direction of the wound in the two planes (horizontal and vertical) and with anatomical points of reference.
- d) Describe lines and individualise entry and exit ones.
- e) Do not handle injuries or use guides until the internal examination has been completed to assess the trajectory so as not to create false tracks.
- f) Make wide and close-up photographic documentation of each injury individually with a metric photomacrographic scale.
- g) Assess the intravital occurrence of wounds and injuries and location with respect to first order fatal areas.
- h) Injuries adjacent to the wound (ecchymosis, abrasions, etc.), size, exact topography and morphology.
- i) Describe injuries consistent with signs of struggle and self-defence (wounds and abrasions on hands, forearms and thighs, recent ecchymosis or haematomas in different parts of the body); measure them, specify their topography with reference points and take photographs.

- j) Marks of venipuncture or injury in the nasal septum (description, age) compatible with addiction, old or recent scars from sharp force or gunshot injury or other injury such as attempted suicide or self-harm.
- k) Identify possible signs of sexual assault.

## Internal examination

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Do not make incisions over any injuries on the body. Modify opening to preserve the injuries.

Dissect by layers and if possible by trajectories, placing injured anatomical structures sequentially and detailing dimensions and characteristics of lesions in the various structures of the trajectory.

Evaluate the affected organs to determine faster or slower fatal injuries, both in terms of the cause of death and the possibility of medical treatment that could have saved the victim.

Describe the trajectory in the three spatial planes:

1. **Sagittal or medial plane** (right to left or vice versa).
2. **Frontal or coronal plane** (anteroposterior or postero-anterior).
3. **Horizontal or transversal plane** (superoinferior or infero-superior).

If there are injuries to the bone or cartilage, send fragments with wide margin to criminology to determine the type of weapon or its mould.

## Diagnostic tests. Sampling in the autopsy

### Preliminary (before the internal examination and body wash)

- a) Cut nails or take smears from their inside to determine biological traces (blood, dermis) of the possible perpetrator. Send each nail separately in a folded and identified piece of paper and put all of them in a paper bag.
- b) Once completely dry, the body's clothes are to be packed in paper bags if thought necessary.
- c) The following fluids are required for chemical and toxicological determination:
  1. Venous blood: in two full 5 ml tubes with no air pocket.
  2. Urine: as much as possible in a 50 ml security jar.



3. Vitreous humour: as much as possible without damaging the ocular structures and in an appropriate tube to prevent an air pocket.
4. Bile: as much as possible.
- d) Blood as a known source sample for biological studies (in two 5 ml refrigerated tubes). Smears of blood or blood drops on absorbent paper can be used in case of lack of sufficient blood.
- e) In case of suspicion of sexual assault, vaginal, anal and oral swabs, vaginal washing, brushing pubic hair and smears from breasts or bites (fresh if recent; serum swab if dry). See sexual assault protocol.
- f) Send fibres and hair taken from the external examination of the body with clean tweezers and packed in paper bags.

## **Final**

- a) Histological studies as deemed appropriate.
- b) Study of dermal wounds to determine their characteristics.

All of these samples should be packed and sent pursuant to Instituto Nacional de Toxicología y Ciencias Forenses regulations under Order 1291/2010 of 13 May 2010.

## **Diagnostic criteria**

- a) Exclude other types of death.
- b) Establish sharp force trauma injuries.
- c) Determine the trajectory or trajectories of the wounds and correlate them with numbered skin lesions.
- d) Organs damaged and type of damage.

## **Specific causes of death**

- a) Haemorrhagic or hypovolemic shock.
- b) Destruction of vital centres.
- c) Late deaths (infections, complications, etc.).

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## Shooting fatalities

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*Authors:* M. Victoria Bonastre Paredes, Honorio Joaquín Recio García, Manel Joan Salas Guerrero, Mercè Subirana Domènech, José Manuel Tortosa López

*Coordinator:* Manel Joan Salas Guerrero

### Definition

Any death involving one or more projectiles as a damaging agent. Set of injurious effects on the body resulting from the action of shots from firearms loaded with different types of gunpowder or other explosives that fire one or projectiles more causing death.

### History

Indicate whether there is documentary evidence of these medical and/or psychiatric histories or if they are only related by family members, neighbours or friends.

### Clinical

- a) **Systemic or local organic diseases:** recent hospitalisation, congenital malformations, prostheses and current drug treatment.
- b) **Surgery:** admission data (all information must be collected).

### Psychiatric

- a) **Psychiatric and psychological disorders and current treatment:** note down the centre conducting outpatient follow-up and/or the psychiatrist treating them. Previous attempts at suicide and means used. Admission (collect all the information).

- b) **Toxic history:** alcohol and drugs of abuse, noting toxic class, usual dose, means of administration and admission to detoxification centres with admission details or outpatient follow-up in detoxification centres.

## Leisure and occupational

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- a) **Occupational:** car mechanics, metallurgy, foundries, car battery factories or other jobs involving using other metal items and which may interfere with the results of the samples analysed in the components the shot.
- b) **Leisure:** if the above occupational activities are involved in it.

## Police and court

- a) Time and place of the event.
- b) Direct and indirect witnesses.
- c) State if the body has been moved by medical staff, witnesses, etc.
- d) State if there has been any attempted resuscitation and treatment.
- e) Handle the body as little as possible to avoid loss of evidence.
- f) Document the scene by taking photographs and using diagrams and maps to show the location of the body and its position relative to the weapon, rooms and reference points.
- g) Position of the body.
- h) Presence or absence of weapon and position relative to the body.
- i) Bloodstains: distribution and concordance with respect to the position of the body, shape, size, type (runoff, impregnation, rubbing, cleaning, low, medium or high speed spatter, etc.).
- j) Other dripping blood stains indicating survival and movement of the victim or which might belong to the perpetrator or perpetrators.
- k) Post-mortem changes (rigidity, coldness, lividity, general or partial cadaverous spasm).
- l) Number of impacts and orientation between entry and exit holes.
- m) Struggle and self-defence injuries.
- n) State of clothes, match with entry and exit holes, distribution of bloodstains.
- o) Protect the victim's hands with paper bags tied at the wrist to prevent the bag falling off.
- p) Look for other types of weapons or suicide mechanisms.
- q) Evaluate farewell notes and items related to drug use.
- r) Victim's police and court record (restraining orders, drug trafficking, etc.), and determine the tidiness of the domicile.
- s) Collect biological material from blood stains and other fluids for genetic analysis.

## Preliminary diagnostic tests

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- a) Serial wide and close-up photographic report with metric photomacrographic scales before and after removal of clothing from the victim. Take photos of the clothes laid out on a table.
- b) Serial radiology of the whole body subject to availability and need.
- c) Dental study if victim not identified.
- d) Optional examination of the body with forensic light (UV).
- e) Fingerprinting of the deceased (police work) will not be done until the autopsy is completed or when nails have been collected and hands tested for gunshot residue.

## External examination

There are 4 layers divisible into:

1. Clothing.
2. Epidermis/dermis.
3. Bone.
4. Viscera.

The external examination looks at the first two and the internal examination at the latter two.

## Clothing

Cut clothing around the edges, if allowed by the holes made by the projectile and rips or traces of elements making up the shot and which may provide evidence to determine the circumstances of the death under investigation.

Careful observation of clothes to determine:

- a) The location and morphology of the entry hole(s) produced by the projectile, assessing traces of smoke, gunpowder grains, burn marks on clothing and the hole, measuring tearing, its morphology (Nerio Rojas cruciform, fusiform, starred, etc.), mark of underwear on underwear.
- b) Location of exit holes. Both the entry and exit hole are to be placed in topographic relation with those found in the epidermis.
- c) Rips caused by tearing in case of struggle.
- d) Morphology, distribution and extension of bloodstains and how they were produced whether by spatter, imbibition, impregnation, runoff, rubbing or cleaning.

- e) Search for other possible biological evidence (hair, other biological fluids, etc.). Send to the laboratory pursuant to the regulations of the Instituto Nacional de Toxicología y Ciencias Forenses.

## **Epidermis/dermis**

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Observe all natural orifices of the body to rule out shots in these areas that may otherwise go unnoticed.

Examine post-mortem changes to determine time of death and confirm or otherwise the data from the removal of the body.

## **Gunshot injuries**

- a) Describe and measure firearm injuries (entry and exit holes).
- b) Do not handle injuries or uses guides until the internal examination has been completed to assess the trajectory so as not to create false tracks.
- c) Make wide and close-up photographic documentation of each injury with metric photomacrographic scales.
- d) In the case of multiple impacts, differentiate entry and exit holes which do not necessarily have to agree in number.
- e) Assess the intravital occurrence of wounds and injuries and location with respect to first order fatal areas.

### **Entry hole study**

- Measure and locate it topographically with anatomical reference points.
- Description of the morphology (spindle, starred, circular, etc.).
- Measure the contusion and drying ribbon and locate it with respect to the body; specify if it is concentric, eccentric and side where it is located and refer to the time sphere.
- Presence or absence of other elements of the shot (carbon black and tattoo of powder grains, burns).
- Measure carbon black and its distribution with respect to the hole and the body.
- Measure the horizontal and vertical dispersion of powder grains and location with respect to the entry hole.
- If burns are found, state if they are concentric or eccentric, and if first or second degree.
- Check for impression marks of the muzzle if at point blank range from contusion of the skin by the firearm.
- In the case of high speed projectiles, take care not to confuse residue from the shot with lead vapour deposited around the hole.

- **In the case of firearms with multiple projectiles**, in addition to the above also describe and measure the central wound and determine its morphology, specify the number and location of satellite holes and also establish the horizontal and vertical dimensions of the projectile dispersion area.
- Try to retrieve a representative number of pellets or slugs and make photographic documentation of the recovery site.

### **Exit hole study**

- Topographic location with body reference points; measurements and shape of the hole with close-up photos and metric photomacrographic scale.
- The exit hole may have abrasions or contusive areas similar to the contusion ribbon if resistance found on exit (trouser belts, car seatbelts, harnesses, rigid vests, etc.).

### **Study of the direction and distance of the shot**

- The distance is determined by the study of the presence or absence of elements of the shot (carbon black, powder and dispersion, burns and bruising caused by the muzzle).
- The direction of the shot is assessed by the distribution or relative position of the contusion ribbon, the dispersion of the powder, carbon black and burns with respect to the entry foramen.

### **Other injuries**

- a) **Injuries compatible with struggle and self-defence:**
  - Accurate topographic description with body reference points.
  - Type of injury and state of evolution.
  - Measurements and direction of these lesions.
  - Wide and close-up photos of each one.
- b) **Venipuncture marks or injury to septum.**
- c) **Old or recent scars due to sharp force weapon or other suicide injuries.**
- d) **Identify any signs of sexual assault.**

### **Study of hands**

- a) **Bloodstains:**
  - Description of type (spatter, rubbing, runoff, etc.) and specific topography in relation to the position of the hands.
  - Measure scatter diameter.
- b) **Fibres and hair:**
  - Accurate topographic location and collection for criminology analysis.

- c) **Nails:**
  - Examination of microtraumas (broken nails, etc.) that can be classified as signs of struggle and self-defence. Close-up photos and note down type and location of these microtraumas.
  - Cut nails for biological determination of perpetrator blood or skin residue.
- d) **On the dermis of the hands:**
  - Search for and describe erosion or contusion microtrauma or other wounds, location and photographs.
- e) **Gunshot residue** (Appendix 1-a):
  - Powder residue on hands.

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## Internal examination

Do not make incisions over any injuries on the body. Modify opening to preserve the injuries.

Dissect by layers and if possible by trajectories, placing injured anatomical structures sequentially and detailing dimensions and characteristics of lesions in the various structures of the trajectory.

Evaluate the affected organs to determine faster or slower fatal injuries both in terms of the cause of death and the possibility of medical treatment that could have saved the victim.

Describe the trajectory in the three spatial planes:

1. **Sagittal or medial plane** (right to left or vice versa).
2. **Frontal or coronal plane** (anteroposterior or postero-anterior).
3. **Horizontal or transversal plane** (superoinferior or infero-superior).

Recover projectile and foreign bodies in the corpse (Appendix 1-b).

## Bone layers (Appendix 1-c)

- a) **Long bones:**
  1. Specify types of fractures.
- b) **Flat bones:**
  1. Measure holes by smallest diameter.
  2. Determination of truncated cone in skull (Appendix 1-d).
  3. The fragments move more and splinters indicate the direction of the shot or projectile trajectory.



## **Visceral layer**

- a) Study of the viscera from two points of view which alone may be the cause of death independently.
  - 1. Penetration of the projectile: specify each of the affected viscera and organs, trajectory and exit of the projectile with wide and close-up photography.
  - 2. Expansive effect of the projectile.

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## **Diagnostic tests. Sampling in the autopsy**

### **Preliminary (before the internal examination and body wash)**

- a) Cut nails or take smears from their inside to determine biological traces (blood, dermis) of the possible perpetrator. Send each nail separately in a folded and identified piece of paper and put all of them in a paper bag.
- b) Once completely dry, the body's clothes are to be packed in paper bags if thought necessary.
- c) The following fluids are required for chemical and toxicological determination:
  - 1. Venous blood: in two full 5 ml tubes with no air pocket.
  - 2. Urine: as much as possible in a 50 ml security jar.
  - 3. Vitreous humour: as much as possible without damaging the ocular structures and in an appropriate tube to prevent an air pocket.
  - 4. Bile: as much as possible.
- d) Blood as a known source sample for biological studies (in two 5 ml refrigerated tubes). Smears of blood or blood drops on absorbent paper can be used in case of lack of sufficient blood.
- e) Cutaneous sample of the entry hole with undamaged edges for criminology study of firing distance. Cut the dermis surrounding the wound with plenty of margin to avoid leaving elements of the shot. Send it without formol, fresh and refrigerated in a wide mouth plastic jar. Attach a control dermis area (better contralateral or area similar to the problem dermis).
- f) In case of suspicion of sexual assault, vaginal, anal and oral swabs, vaginal washing, brushing pubic hair and smears from breasts or bites (fresh if recent; serum swab if dry). See sexual assault protocol.
- g) Send hair and fibres taken from the external examination of the body with clean tweezers and packed in paper bags.

## Final

- a) Histological studies as deemed appropriate.
- b) Exploded bone fragments can be sent to the Anthropology Unit for reconstruction and interpretation whenever deemed necessary to specify entry and exit holes and gun calibre.

All of these samples should be packed and sent pursuant to Instituto Nacional de Toxicología y Ciencias Forenses regulations under Order 1291/2010 of 13 May 2010.

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## Diagnostic criteria

- a) Exclude other types of death.
- b) Establish entry and exit wounds.
- c) Determine the trajectory of the shot or shots.
- d) Organs affected and type of damage (by contusion due to the expansive effect and by the trajectory). Appendix 1-e.

## Specific causes of death

- a) Haemorrhagic or hypovolemic shock.
- b) Destruction of vital centres.
- c) Traumatic shock (late).
- d) Fat embolism.
- e) Hospital complications if treated (pneumonia, sepsis, etc.).

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## Appendix 1

- a) Traces of gunpowder on the hands: mostly in case of suicide and largely on the dorsal side of the hand that holds the gun on its index and middle fingers, although it may also be effective on the front of these fingers. In the event of self-harm there may be traces of gunpowder if the shot was at short range and the person has put their hands on the palmar side. Take four smears from this area and send to criminology indicating the hand from which they are taken and the area of each smear.
- b) Remove the projectiles with tweezers with tips protected by paper or similar to avoid damaging them and for comparison with the firearm.  
Retrieve foreign objects (not just the projectile) that may be found in the trajectory such as cartridges or elements of objects that have been targets before penetrating the body (intermediate targets) such as fragments of clothing, foam from chairs, armchairs, etc.  
Shots from high velocity firearms may leave small metal fragments which even though they may not make up an entire projectile may still be essential to determine its calibre.
- c) Caution when deducing calibre from the hole in the bone area. Projectiles deform in thick bones and can make holes usually larger than expected by calibre, but they can also be smaller. There may also be intermediate targets in the free trajectory of the projectile before hitting the body that can deform or fragment it.
- d) Size difference between the inner and outer diploë in the entry and exit holes which will give the trajectory and specify which hole is the entry and which the exit.

- e) Assessment of the affected tissue may be important as it is sometimes the cause of death due to the amount of affected organ (lung, liver) both by the contusion it causes and the bleeding produced by the temporary cavity of the projectile as it goes through the different tissues, causing rapid or late shock. Use volumetric mathematics to evaluate the affected tissue. The projectile, in the ballistic of effects on the body, causes a trajectory and a contusive area due to the temporary cavity or shockwave, i.e., a cylinder. To determine the affected area of each organ assess the contusion halo created by the projectile during its passage. A rudimentary way of doing it approximately is:
1. In the case of full metal jacket projectiles (not deformable), the radius is about five times the diameter of the projectile (it gives us the circumference of the cylinder base).
  2. In the case of non-full metal jacket projectiles (semi-full metal jacket or soft which are deformable) the radius is about ten times the calibre of the projectile.
  3. Therefore together with the trajectory inside the organ (length or height of the cylinder) you can determine the affected area which will be the effective injury area. Each tissue has a degree of elasticity and the impact can be greater or lesser depending on the tissue affected. For example, in skull shots if we have an affected area greater than 25 cc, this means a massive and global brain injury.

In the case of abdominal or chest organs, the reference is given by the tissue affected by diffuse bleeding and systemic inflammatory response (e.g. the lung is greatly damaged by the contusive distensibility it sustains, and therefore apart from the pulmonary bleeding it causes difficulty due to competing with the air intake and due to the exchange of oxygen and carbon dioxide).

## Death by cervical compression

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### Definition

Death caused by constriction of the neck as a result of the application of a longitudinal or transversal force.

### History

#### Clinical

- a) Pathological:
  - 1. Physical: heart, respiratory, neurological disease; drug treatment.
  - 2. Psychiatric: treated/untreated pathology diagnosis, previous admission, attempted suicide.
- b) Alcohol, tobacco and drug use: alcohol, other drugs.

#### Court and police

- a) Circumstances and scene of death:
  - 1. Information from the removal of the body: time and place, position of the body, post-mortem changes; signs of CPR; presence/absence of external injuries; presence of conjunctival petechiae (any petechial bleeding above the constricted area).
  - 2. Information from inspection of the scene: tools or devices (stools, bags, ropes, ties, etc.) assisting the action (suspected suicide or autoeroticism accident); disorder, environment, presence of substances; farewell notes.

- b) Police/court information: previous reports (gender violence) if the victim is a woman.

## Preliminary diagnostic tests

- a) Photo report of the body and scene.
- b) Recommended radiology study: other injuries, assess osteocartilaginous structures of the neck (rule out post-mortal injury due to handling the body).
- c) Trace samples: vitreous humour (date of death) in cases of suspected manual strangulation, with the presence of nail abrasions, serum swab to obtain exfoliated cells from the perpetrator.
- d) Measurement of rectal and ambient temperature (time of death).

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## External examination

- a) Signs of extrinsic cervical compression in any of its variants:
  1. Longitudinal compression (**hanging**): ridges (direction, number, depth, location, appearance, continuity) and adjacent lesions.
  2. Transversal compression (**strangulation**):
    - Ligature: characteristics of the furrow depending on the ligature; differential diagnosis with false furrows (natural, positional, artificial – shirt, tie), pathological furrows (dermal disease), furrows due to decomposition. Remember that the furrow may disappear if the body has been in water.
    - Manual: finger ecchymosis, nail abrasions (may not be seen if the skin is wet from exposure to water. Let the skin dry; distinguish whether they are produced by CPR – isolated at edge of jaw).
    - Forearm or with rigid object: minimal or no injury. Mark on skin may reproduce the object.
- b) Other injuries: self-defence/struggle.
- c) New assessment of post-mortem changes.

## Internal examination

### Technique

Previous head and chest autopsy to relieve the neck area. Appearance of artefacts minimised: posterior oesophagus surface bleeding (Prisloo and Gordon), oesophageal bands (areas of pallor in the oesophageal mucosa due to compression of anatomical structures on hypostasis area) and in anterior longitudinal ligament of cervical spine. Opening by anatomical layers, in situ examination and careful dissection of structures.

### Significant findings

- a) Longitudinal neck compression (hanging).
  1. Soft tissue: infrequent muscle bleeding (if present it is more frequent in the clavicular insertion of the sternocleidomastoid).
  2. Vascular injury: greater incidence than in other ways. Carotid lesions.
  3. Laryngeal skeleton: systematic study to find injuries. They are rare. Assess “hidden injuries”. Look for fracture without haemorrhage (post-mortal due to prolonged suspension). Fractures are more common in the elderly due to prior calcification. Assess anatomic variants vis-à-vis fractures (Appendix 1).
  4. Neck spine: hanging with freefall. Most common level of spinal injury is C2-C3.
- b) Transversal neck compression: (strangulation):
  1. Soft tissue: in manual strangulation, extensive muscle ecchymosis (bilateral laryngeal muscles) and more in sternocleidomastoid; in ligature strangulation: muscular ecchymosis in ligation area.
  2. Vascular injury: rare.
  3. Laryngeal skeleton: if there is suspicion of strangulation carry out dissection to view the inside of the thyroid cartilage and carry out horizontal incision of the cricoid cartilage. In manual strangulation, haemorrhage in internal laryngeal mucosa (vocal cords) is frequent. Exclude intubation. More frequent is detection of fractures (upper thyroid horn followed in frequency by fracture of the greater horn of the hyoid bone). Forearm and ligature strangulation: fractures rare.
- c) Other findings: intravital signs of hanging (haemorrhagic infiltration of the lumbar intervertebral disc – Simon’s sign).

## Sampling

Pursuant to Order JUS/1291/2010 of 13 May of the INTCF:

**Chemical-toxicological study:** biological samples of peripheral venous blood, vitreous humour, urine and bile. Non-biological samples related to the deceased such as drugs found at the scene, syringes, etc.

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**Histopathological study:** samples in formol (unless other criminology or intravital studies have to be done). Study of intravital occurrence of injuries, previous illnesses and injuries typical of compression with description of compression type and the autopsy findings; send a bilateral sample of previously dissected neck structures (complete neck circumference, both sternocleidomastoid muscles, both vascular nerve packages, carotid arteries, jugular veins and nerves, and hyoid larynx complex).

**Criminology study:** the victim's fingernails (DNA), swabs taken from external injuries (nail abrasions), study of the rope or ligature.

If there are signs of any other type of violence, collect samples according to appropriate recommendations (sexual assault, sharp force weapon, gunshot).

## Diagnostic criteria

In these cases establish the diagnosis by the presence of signs of extrinsic neck compression (depending on type), with signs of intravital reaction of these injuries, plus signs of death mechanism.

## Specific causes of death

- a) Anoxic anoxia due to airway obstruction: occlusion of the tongue against the pharynx by retropulsion.
- b) Brain anoxia due to arterial or venous vascular obstruction.
- c) Reflex inhibition due to carotid sinus stimulation.
- d) Spinal cord injury: rare; limited to hanging with freefall.

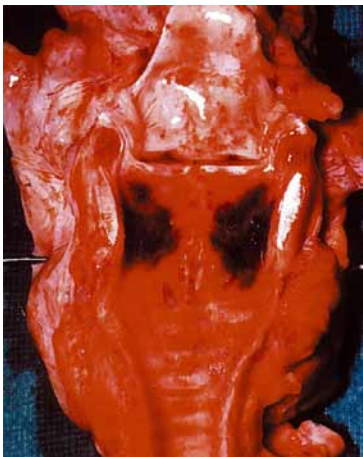
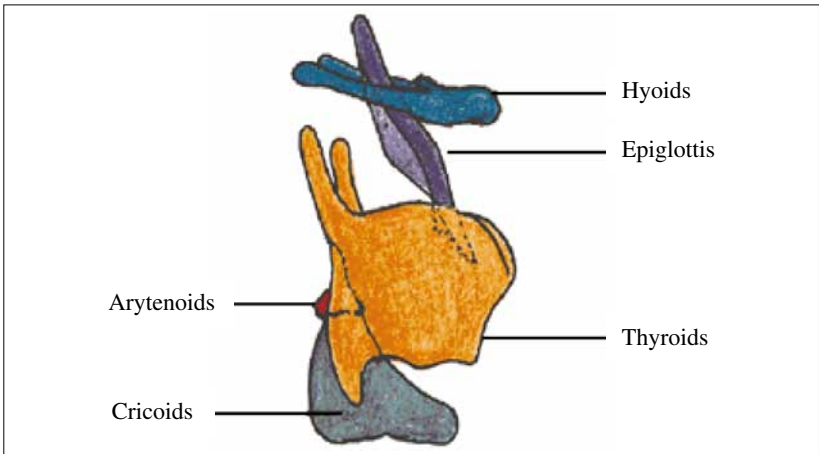
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**Appendix 1**



*Laryngeal mucosa haemorrhage due to manual strangulation*



*Oesophageal haemorrhage infiltration, post-mortem artefact*

## Death due to drugs of abuse, alcohol and psychoactive drugs

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*Coordinator:* Amparo Arroyo Fernández

### Definition

These are deaths due to acute or adverse reactions to psychoactive substances after nonmedical and intentional consumption of psychoactive substances and alcohol.

Death by acute reaction or poisoning takes place shortly after consumption without other intermediate problems.

The concept of overdose should not be used because there may be different toxic, allergic or other mechanisms involved (National Drug Plan).

The following concepts should be borne in mind:

- *Body packet:* they swallow drug containers.
- *Body stuffer:* drug containers are introduced rectally, vaginally or via other body orifices (nose, ear canal, etc.). They are containers made of different material, the drug is packed worse and there is a smaller quantity, but the risk of breakage is higher.

### History

#### Clinical

- a) Evidence of recent and/or chronic consumption of psychoactive drugs and alcohol.
- b) History of drug abuse, drug maintenance programmes.
- c) Clinical evidence of acute intoxication by substances recorded in a document (medical records, hospital report).
- d) External physical signs of recent and/or previous substance administration: venipuncture, traces of substances in mouth, nostrils, stomach, smell of solvents in hair, breath, clothes, etc.

- e) Presence of substances for consumption at the scene of death (syringes, foil, pill jars, aerosols, inhalation bags, etc.).
- f) Recent consumption and/or situations related to likely consumption, reported by family or friends.
- g) Positive toxicological analysis for substances (conventional drugs of abuse).
- h) Documented history of drug addiction or consumption.
- i) Knowledge of possible HIV/HCV/HBV infection and other associated diseases.
- j) Deaths in custody/restraint.
- k) Psychiatric patients with suspected overdose.
- l) Deaths caused by diseases that can be worsened or complicated by recent consumption of substances.

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**Exclusion criteria.** Not included in these recommendations are:

1. Deaths from adverse reactions to psychoactive drugs.
2. Deaths from solvent use other than inhalation and sniffing: other routes not associated with drug abuse, accidental causes.

## **Court and police**

- a) Scene of death: time body found, place (home, public highway, public venue – disco, bar, etc.), body position and clothing, presence/absence of syringes, pills, drug packaging, substances of abuse, etc.
- b) Provisional description of the body.
- c) Imprisonment details.
- d) Information about the people who discovered the body, relationship with the deceased.
- e) Recent medical contacts of the deceased, including the EMS report and whether or not cardiopulmonary resuscitation was attempted.
- f) Collecting all the paraphernalia found at the scene of death and sending to the laboratory.
- g) History of attempted suicide.

## **Preliminary diagnostic tests**

In these cases additional tests are not mandatory except for sampling. To be assessed according to the case.

## External examination

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- a) Examination of clothing.
- b) Inspection of natural orifices, especially anus and female genitals (rule out body stuffer drug transport mechanisms).
- c) Inspection of all skin to find old and/or recent signs of venipuncture as well as areas of hyperpigmentation in venous regions (in skin and mucous in regions with easily accessible veins); do not forget: interdigital areas, malleolar areas, neck, abdomen, femoral area, sublingual, penis and female external genital area. Pay particular attention to tattooed areas.
- d) Exploring nostrils (ulceration) and nasal septum (perforation).
- e) Examination of the tongue and oral cavity to rule out the presence of tablets, substances, LSD stamps, etc.
- f) Description of the characteristics of gastric content that comes out of the mouth. Description, if necessary, of foam fungus and its evaluation.
- g) Search for conjunctive stamps compatible with use of LSD, cocaine, ketamine, stimulant tablets (e.g. Calvin Klein), etc.
- h) Examination of burns on fingertips and hands.
- i) Examination to rule out stains or substances.

## Internal examination

- a) Follow the most stringent safety standards listed in the high biohazard autopsy protocol.
- b) Dissection of the neck vessels, injection areas and exploration under tattoos.
- c) Examination and detailed description of the heart according to recommendations for sudden cardiac death in adults to confirm or rule out any kind of heart disease.
- d) Examination and detailed description of lungs.
- e) Gastrointestinal examination. Gastric contents should be collected. Fully open the small and large intestine in order to exclude the presence of substances and transport mechanisms (body packet).
- f) Complete female genital examination: substances and transport mechanisms (body stuffers).

# Sampling

## Toxicological

### General rule

- a) Peripheral blood in two completely filled 5 ml tubes with no air pockets and at least one of them with sodium fluoride as a preservative and potassium oxalate as an anticoagulant. If this cannot be obtained, take a sample of heart blood and specifically indicate its source.
- b) Route of elimination: urine (all you can get, in a 50 ml security bottle) or alternatively bile (all you can get).

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If the patient was in hospital, ask for samples taken on arrival there.

### Other possibilities as appropriate

- a) Vitreous humour (all you can get, in a tube of adequate size to prevent air pockets).
- b) Gastric juice (all available; if not all is sent, indicate the initial volume).
- c) Nasal, oral, vaginal and anal swabs.
- d) Hair: head (occipital area preferable), armpit, pubis (not in principle analysed but to be collected and stored; will be eliminated if blood and urine/bile results do not provide information).
- e) Objects: pipes, syringes, etc.
- f) Samples of clothing impregnated with substances.

Liver, brain and kidney (fresh; in approximately 50 g fragments): if no fluids available. To be collected in wide opening plastic airtight container.

If serology is relevant: blood for HBV, HCV and HIV.

Blood for the determination of tryptase (allergic reaction to drugs). Should not be done routinely; it is a very specific possibility.

## Histopatològiques

All samples are sent in 4% formol in plastic containers at room temperature.

The INTCF recommends the same sampling as in sudden death: heart, pancreas, kidney, spleen and adrenal glands.

Recommended.

- a) Heart: sent whole.

- b) Lungs: samples of 5 lung lobes and hili, distinguishing right from left.
- c) Liver: a fragment of each lobe.
- d) Brain: preferably complete with stem and cerebellum up, plentiful formol; otherwise, protocolised sampling.
- e) Intestine: if a body packet, send intestine complete, opened and washed.
- f) Injection sites in doubtful cases: methodology is not specified in INTCF regulations for collecting samples.
- g) Quadriceps and psoas if rhabdomyolysis is suspected: longitudinal fragment.

## **Diagnostic criteria**

### **Specifically significant organs (Appendix 1)**

- a) Heart: myocardial infarction, old infarction (fibrosis and scarring) with unaffected or little affected coronary, epicardial petechial haemorrhages (cocaine and amphetamines).
- b) Lungs: non-cardiogenic acute pulmonary oedema, septic embolism due to endocarditis, pulmonary abscesses, opportunistic infections, foreign body granuloma due to talc and other adulterants, aspiration pneumonia (heroin), pleural petechial haemorrhages (cocaine).
- c) Liver: hepatitis due to HBV, hepatitis due to HCV, alcoholic and/or toxic liver disease, fibrosis, steatosis.
- d) Brain: subarachnoid haemorrhage, intraparenchymal haemorrhage, stroke (cocaine and amphetamines).
- e) Stomach and intestine (body packet).
- f) Vagina, anus and natural orifices (nose, ear canal): body stuffer.
- g) Inhalation pneumonia (solvents).
- h) Other anatomical pathology autopsy findings consistent with death by drug consumption.

### **Complications related to the process of drug abuse**

- a) Infective endocarditis: damage to the valves of the right side, especially the tricuspid valve, is more frequent.
- b) Aortic mycotic aneurysm: due to complication of an infective endocarditis, due to spread of contiguous suppurative focus or due to infection by circulating microorganisms.
- c) Infection by HCV, HBV and HIV.
- d) Pulmonary hypertension.

- e) Abscesses, calluses, necrotic ulcers, phlebitis, cellulitis, thrombosis (due to IV injection).
- f) Secondary amyloidosis.
- g) Nasal septum perforation.

## Specific causes of death

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### Cocaine and amphetamines

- a) Arrhythmia.
- b) Acute ischemia due to coronary spasm.
- c) Subarachnoid haemorrhage due to rupture of cerebral aneurysm.
- d) Cerebral intraparenchymal haemorrhage due to increased blood pressure.

### Heroin and opiates

- a) Respiratory depression of central origin.
- b) Respiratory failure due to acute non-cardiogenic pulmonary oedema.
- c) Respiratory failure due to bronchoaspiration.

### Alcohol

Considered to be fatal poisoning in case of alcohol test results  $> 4$  g/l.

#### Diagnostic decision tree

- If the drugs are the cause of death.
- If the drugs indirectly contributed to death.
- If the drugs are irrelevant to the cause of death.
- If the cause of death is uncertain or indeterminate.

Quantitative laboratory results are hard to interpret as they rarely yield numbers which by themselves make it possible establish death due to direct drugs of abuse intoxication.

*Karch's Pathology of Drug Abuse* is especially recommended due to its importance and in cases that are difficult to interpret.



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## Appendix 1. Specific pathology to be assessed in autopsy findings for deaths due to drugs of abuse

### Opiates

- Hepatic steatosis
- Hepatitis
- Pulmonary oedema
- CHD
- Endocarditis
- Cerebral oedema
- Myocardial fibrosis
- Aortic atherosclerosis
- Gastrointestinal ulcers
- Pneumonias
- Lung abscesses
- Tuberculosis
- Bone and joint infections

### Cardiac lesions found in opiate abuse (Dressler and Roberts 1989)

Cardiomegaly	68%
Endocarditis	48%
CHD	21%
Valvular heart disease	10%
Myocardial disease	8%

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## **Cocaine**

### **Central nervous system disease**

- Stroke: thrombosis and haemorrhages.
- Cerebral infarction.
- Cerebral vasculitis.
- Subarachnoid and intraventricular haemorrhage.
- Vasospasm.

### **Heart disease**

- Band necrosis.
- Infarcts.

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## Amphetamines

### Abnormalities in methamphetamine consumer autopsies (Karch 1999)

Abnormalities	%
Fatty liver	16,2
Moderate CHD	10,3
Cirrhosis	9,0
Pneumonia	8,2
Myocardial fibrosis	6,7
Severe CHD	6,1
AIDS	5,4
Emphysema	5,1
Hepatitis	4,1

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## Alcohol

Liver disease in 60% of cases in chronic alcoholism.

## Death of athlete

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### Definition

For the purposes of this protocol, athlete means anyone who plays a federation sport with a regular training schedule, competes and has to have a series of medical tests.

Death of an athlete means death that takes place unexpectedly, with syncope, associated or not with prior symptoms, during or up to 24 hours after doing physical exercise or sport.

### History

#### Clinical

Collect information about the following points:

- a) **Family history:** sudden death, syncope of unknown origin, heartbeat disorders, cardiovascular diseases, congenital malformations.
- b) **Personal history:** medical checkups, diagnostic tests conducted (an electrocardiogram is of special significance and must be asked for in order to re-evaluate it), smoking, alcohol, existence of non-cardiovascular diseases such as dyslipidemia, epilepsy, asthma.

## Court and police

### Removal of body

Collect information about:

- a) Previous symptoms 24 hours before death: possible cardiac symptoms (murmurs, fatigue, syncope, dyspnea, palpitations) and from ingestion of potential doping substances.
- b) In case of death in hospital request medical records.
- c) Kind of sport being done (endurance, strength, explosive), duration, intensity, time, warm-up, time between exercise and death and, if applicable, emotional stress.
- d) Use of resuscitation techniques. If none, find out why.
- e) Consumption of illegal (cocaine, heroin) and energising, anabolic steroid or stimulant (ephedrine, amphetamines) substances.
- f) Associated symptoms (dyspnoea, dizziness, light-headedness, weakness, blurred vision, nausea or vomiting, vertigo, chills, syncope, syncope recovery, sweating, tachycardia).
- g) Weather conditions, type of clothing, body and environmental temperature (differential diagnosis of heat stroke and dehydration).
- h) Photos of body removal scene.

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## Preliminary diagnostic tests

Not required.

## External examination

External examination does not provide much information in these cases. Only pay special attention to the existence of signs of cardiopulmonary resuscitation, presence of haemorrhagic infiltrates related to the impact of blunt objects such as balls, or localised contusions on the head (in order to rule out traumatic death). Indicators of muscle mass (waist/hip ratio, abdominal diameter, skinfold).

## Internal examination

Complete and formal autopsy including opening all cavities and extracting the visceral package using the en masse technique of Letulle.

Study of the heart is extremely important. Follow the directions about macroscopic study and system set out in the **recommendations for sudden cardiac death in adults**.

In the lungs it will be necessary to dissect the vascular tree to rule out pulmonary thromboembolism, atherosclerotic plaques and limited air flow.

In other organs, carry out general macroscopic study in order to rule out sudden extracardiac deaths, following the autopsy data collection protocol.

The presence of devices such as defibrillators and pacemakers is especially significant and they must be removed as indicated by occupational health and safety recommendations.

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## Sampling

### Toxicology

Special attention should be paid to sampling to study the use of toxic substances. To do this take at least the following samples:

- a) Peripheral venous blood, two 5 ml tubes.
- b) Urine.
- c) Vitreous humour.
- d) Hair to rule out chronic use. Take a thickness of 7 mm from the occipital area close to the scalp. Place on a piece of paper with adhesive tape indicating the end closest to the root and the distal area or tip (Article 11 Order JUS/1291/2010 of 13 May).
- e) Any medication or drugs near the body.
- f) In the case of known biochemical parameters, diagnosis of renal failure, diabetes, etc., vitreous humour is used as a reservoir (Article 39 Order JUS/1291/2010 of 13 May).

Retain two vials of blood. One of the vials is to be stored in the freezer in case it is needed for genetic study of heart disease. The other will be for follow-up testing if necessary.

Qualitative and quantitative study of:

1. Stimulants: cocaine, amphetamines.
2. Narcotic analgesics: opiates.
3. Local anaesthetics: lidocaine, procaine, bupivacaine.
4. Cannabis and derivatives.
5. Alcohol.
6. Beta-adrenergic blockers: atenolol, propranolol.
7. Anabolic substances: androgenic anabolic steroids and beta 2 agonists.
8. Peptide hormones, mimetic and analogue substances: human chorionic gonadotropin, pituitary or synthetic origin gonadotropin (LH), adrenocorticotrophic hormone (ACTH), erythropoietin (EPO), growth hormone (GH).

9. Corticosteroids: cortisone, dexamethasone, methylprednisolone.
10. Diuretics.

## Histology

- a) Heart: conduct sampling as set out in the **recommendations for sudden cardiac death in adults** for study of cardiac and coronary walls, conduction system.
- b) Other viscera: those that provide information to rule out extracardiac sudden death or co-adjutant diseases and in any case the lungs, liver, spleen, pancreas, adrenal gland and kidney. In case of aortic dissection send it together with the heart. (Article 17. *Recomendaciones de muestreo según el tipo de muerte*. Order JUS/1291/2010 of 13 May).

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## Diagnostic criteria

Diagnostic criteria for the death of an athlete are:

- a) Person who does a sport that requires training and who competes.
- b) Death occurs during this exercise or within the first 24 hours after exercise.
- c) The existence of macroscopic pathological processes diagnosing the cause of death by themselves such as stroke, aortic aneurysms, etc.
- d) The type of activity has to be correlated with the findings and with the histological and toxicological results.
- e) The existence of trauma has to be ruled out. If death is due to trauma, this protocol for athlete's death would not be applicable.

## Specific causes of death

The cause of death will be determined by the autopsy findings and the correlation with the results of the diagnostic tests and the activity performed. Hence the range is very wide and specific causes for this type of situation cannot be established.



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## Signable deaths: natural death with medical documents

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### Acronyms

CDI:	Commission on Teaching and Research at the Institut de Medicina Legal de Catalunya.
EMLC:	Medico-legal study of the body.
IMLC:	Institut de Medicina Legal de Catalunya.
LRC:	Civil Registry Office Act.
LECrIm:	Criminal Procedure Act.
MFG:	Medical examiner on call.
SML:	Medico-legal system.
SPF:	Forensic Pathology Service at the Institut de Medicina Legal de Catalunya.

The working group on “Signable deaths: natural death with medical documents” appointed by the Head of the Forensic Pathology Service.

### WHEREAS:

1. The purpose for which it has been appointed is to certify death versus conducting internal examination or versus taking the body to the SPF office, based on sufficient knowledge of the cause of death.
2. In forensics, certification of death is subject to the same standards of good practice that are applicable in medical care, standards which are often produced by forensics (4).

3. Forensic medicine intervention in cases of death also takes place in an explicit legal framework at the orders of the relevant judicial authority.
4. In forensics, certification of death may be made under Article 85 of the LRC and Article 778.4 of the LECrim (see Appendix 1).
5. This legal framework is contentious, is applied by the courts with considerable variability and is being reformed (7).
6. In the professional field the question is perceived as a lack of specificity of the SML inasmuch as non-tributary cases of forensic medical intervention are nevertheless subject to it (8).

**It STATES:**

1. There are no empirical data on the frequency of death certification in the terms described, on the differential characteristics of cases ultimately certified or on the specificity of the SML.
2. Even though the issue is debated in professional circles, reference publications do not tackle it (6) and the current “removal” form at the IMLC (Appendix 2) contains one provision concerning it but has no guidelines for action.
3. A proposal has been made whereby “certification would be a reasonable alternative to autopsy” in death due to abnormal evolution and in the elderly if certain requirements are met (5).
4. Other working groups have been set up about sudden death in adults and death in the elderly, whose conclusions are referred to concerning the proposal mentioned in the previous point.
5. The percentage of judicial autopsies in Catalonia approaches 7% of global mortality, and this figure is relatively low compared to other developed countries (3).
6. Limitations in the validity of external examination as a method to establish the cause of death are known, limitations that are increased in cases of death at home (2).

**And therefore it RECOMMENDS:**

1. The SPF, together with the Forensic Medicine Clinic and Laboratory Services, should draw up a guide for MFG action in relation to deaths; this guide should include, where appropriate, communication between the MFG and SPF.
2. An agreement with a purpose similar to the one established in the Basque Country (“improve action in the event of death”) should be introduced and the access of IMLC services to existing care information should be considered.<sup>1</sup>
3. The IMLC Teaching and Research Committee should drive empirical studies on the specificity of SML, if necessary by

setting up a unified register of deaths involving medico-legal intervention.

4. The EMLC at the SPF should abide by the corresponding autopsy protocols, without prejudice to any alternative actions explicitly under the LRC or the best judgement of the MFG when also responsible for completing the EMLC.
5. All forensic medical intervention, including that resulting in death certification by the healthcare services, should be properly documented judicially and internally.

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## **Appendix 1. Relevant legislation**

### **Civil Registry Office Act**

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Article 85. A medical certificate of the existence of unequivocal signs of death is required to register the death. In cases where a medical certificate is missing or is incomplete or contradictory, or the manager deems it necessary, the medical examiner assigned to the Civil Registry, or their substitute, shall issue an opinion on the cause of death if necessary by examining the body on their own initiative.

### **Criminal Procedure Act**

Article 340. If the investigation takes place because of a violent or suspected criminal death [...]

Article 343. In the summaries referred to in Article 340, even if merely by external inspection the cause of death can be presumed, the medical examiners or, if applicable, the ones the court appoints shall carry out an autopsy on the body and after exactly describing this operation they shall report on the cause of death and its circumstances. [...]

Article 778.4. The court may rule that the autopsy shall not be done when the medical examiner or the person acting in their stead dutifully rules on the cause and the relevant circumstances of death without an autopsy.

Article 778.6. The court may authorise the medical examiner to attend the removal of the body in its stead, in which case a report shall be attached to the proceedings including a detailed description of its status, identity and circumstances, especially those which are related to an offence.

## **Appendix 2. Current IMLC form**

The IMLC's current removal of the body form, entitled "Removal of Body Forensic Medical Report", includes a final section called "Remarks" which has the following three options:

- ( ) The duty magistrate/judge is advised due to the circumstances of the case.
- ( ) A judicial autopsy is considered necessary (grounds must be specified otherwise).
- ( ) Other:

## Death due to cold

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### Definition

Death occurring due to a drop in core body temperature (hypothermia) that is incompatible with life. Death typically occurs at around 25°C body temperature.

There are two types:

- a) Primary hypothermia: due to exposure of the body to intense environmental cold (environmental/cold water immersion).
- b) Secondary hypothermia: in vulnerable people (risk factors or abnormal thermoregulation) in the event of stressful situations caused by slightly lower temperatures (around 10°C can cause death).

### History

### Clinical

- a) **Pathologic:**
  1. Metabolic disorders: hypothyroidism (more common in women; facilitator drugs in these cases are imipramine, chlorpromazine and diazepam), hypoadrenalism, hypoglycaemia, malnutrition and cachexia.
  2. Central nervous system disorders: hypothalamic dysfunction – thermoregulatory centre (Wernicke encephalopathy, anorexia nervosa, pinealoma and other tumours), disorders (stroke, dementia and spinal cord injuries).
  3. Skin disorders: severe and extensive burns and others (psoriasis, erythroderma).

4. Major trauma (serious injuries).
  5. Therapeutic interventions (surgery).
- b) **Toxic:**
1. Alcoholism (inhibits heat production).
  2. Consumption of psychotropic drugs (barbiturates, phenothiazines, morphine, etc.).
  3. Anaesthetics.

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## Court and police

- a) **Circumstances and scene of death:**
1. Weather conditions in the area (low temperatures, snow, degree of humidity [multiplies the action of cold by 14], presence of wind [multiplies the action of cold by 10], etc.). It is estimated that exposure to temperatures of  $-30^{\circ}\text{C}$  kills in 1.5 hours; to  $+5^{\circ}\text{C}$  in around 12 hours; and to  $-10^{\circ}\text{C}$  in between 3 and 6 hours.
  2. Low local ambient temperature (unheated house, shanty).
  3. Submersion in cold water (water enhances the effect of cold on tissue). The body loses heat in water three times faster than when exposed to the same temperature in cold air. Hypothermic death usually occurs within one hour of submersion if the water is around  $5^{\circ}\text{C}$ .
  4. Place of death:
    - Detailed analysis of the scene (check all data tally, footprints, place accessible to the deceased, etc.).
    - Frequent places: mountain sports (climbers, skiers, cavers, hikers), water sports, hidden places (most common in children who are playing) confinement in cold storage rooms.
    - Assess carefully and *not to be confused* with cases of homicide:
      - “*Hide-and-die syndrome*”: are found in hiding places (under piles of objects, under beds, clothes, etc.). They are usually elderly. It is considered a perimortal action to protect themselves from the cold.
      - “*Paradoxical nudity*”: found undressed or partially dressed. It is considered a perimortal action secondary to a paradoxical sensation of heat due to the vasoconstriction that occurs.
- b) **Concurrence of individual risk factors:**
1. Age: infants and young children (little body fat, lose heat faster) and the elderly (little muscle and low mobility).
  2. Homeless and people who remain out in the open for prolonged periods.

3. Drugs or substances that increase body temperature drop (alcohol, barbiturates, central antihistamines, antipsychotics, anaesthetics).

## Preliminary diagnostic tests

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Photo report recommended at the scene (possible change in injuries/other findings).

Rectal temperature and environmental conditions (temperature, humidity, wind) at the removal site. Intrahepatic temperature if these thermometers are available (they can also measure ambient temperature).

## External examination

The autopsy findings depend on whether the cooling process was quick and sharp (few signs) or prolonged and progressive (you can find external injuries due to freezing and general injuries). Local freezing injuries alone do not indicate death by cold, as they can also be found in bodies exposed to cold after death.

### a) **Post-mortem changes:**

1. Rigidity slow in onset but persists almost indefinitely; cutis anserina (post-mortem artefact).
2. Bright red lividity (not to be confused with carbon monoxide (CO) poisoning, cyanide, or with cases of bodies exposed to cold after death).

### b) **Injuries:**

1. Frost erythema: skin colour pink to red-brown (in 50% of cases).
2. Not well defined plaques on face extensor to arms and legs and joints (knees, hips, elbows). Not to be confused with haematoma (no extravasation of red blood cells).
3. Swelling of hands, feet and face (distal tissues).
4. Abrasions on the palms of hands and flexor surfaces due to accidental falls (rule out other causes).
5. Freezing lesions in acral parts (nose, ears, fingers and toes). Four degrees of lesions (erythematic, vesicles, superficial necrosis and deep necrosis).
6. Abnormal paleness of limbs (cyanosis may also appear), with white feet and ankles. Cyanosis of fingers and nail bed.
7. Existence of injury artefacts caused by freezing/thawing/decomposition (it is important to assess possible external injuries before the occurrence of these changes).



## Internal examination

Standard opening technique and en bloc extraction or by organs.

### a) **Significant findings:**

1. Microcirculation disorders in the stomach and digestive tract:
  - Pinpoint bleeding erosions in the gastric mucosa (Wischnewsky spots), blackish-brown, in small or very large quantity (more than 100), 1 to 20 mm in diameter; the incidence is variable (40% to 90%).
  - Can also be found in the duodenum and jejunum (in these cases are also always found in gastric mucosa). More rarely, ulcers in the ileum and colon (haemorrhagic infarcts have also been described). Not to be confused with true haemorrhagic erosions produced in the context of a disease.
2. Major dehydration of tissue (of the mucous membrane with environment contact, but the most significant is of the bronchial tree).
3. Tissue lipid accumulation:
  - Renal: the most significant; lipid accumulation in the epithelial cells of the renal proximal tubule.
  - Cardiac: fatty degeneration of myocytes (less significant than the previous one but there is a positive correlation between gastric lesions and these changes).

### b) **Other findings:**

1. Pancreas: a variety of changes described (focal or diffuse pancreatitis, haemorrhagic pancreatitis, fat necrosis plaques on the surface of the organ). Not to be confused with autolysis findings (histology).
2. Muscle bleeding in central muscle (such as iliopsoas muscle; not very frequent and may be a post-mortem artefact).
3. Skull: possibility of skull fractures due to increased internal pressure from freezing (post-mortem artefact).
4. Cerebral and pulmonary oedema (not significant).
5. Liver: not significant steatosis (present in other diseases).
6. Endocrine glands (thyroid and adrenal): morphological findings in the case of prolonged exposure (5-10 days), not in short exposures (less than 7 hours).
7. Specific findings of previous disease (symptoms described in medical history).

## Sampling

- c) **Toxicology study:** blood, urine, vitreous humour, for determination of alcohol, drugs of abuse and medicines.
- d) **Histopathological study:** visceral lung fragments with bronchial tree, myocardium, stomach, pancreas, liver, kidney, muscle (psoas, carpal and tarsal muscles) and skin (pulp of fingers and toes).
- e) **Biochemical study:** ionogram, glucose and catecholamines, ketone bodies, in blood and vitreous humour. Has little diagnostic relevance.

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## Diagnostic criteria

Combined assessment of:

- a) **Circumstances of death** (scene examination, environmental conditions study, external examination of the body and rectal temperature) and medical history.
- b) **Autopsy findings:**
  1. Combined assessment of significant findings for death by hypothermia: frost erythema, demonstration of oedema focus in distal tissue, thrombosis in microcirculation (gastric erosions, etc.), major tissue dehydration (bronchial tree) and lipid accumulation (significant in renal proximal tubules).
  2. Exclusion of other causes of death (natural/violent).

## Specific causes of death

The final cause of death is *cardiac arrhythmias*, both *ventricular fibrillation and asystole*. These occur when the core body temperature drops to 25-28°C.

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## Fire deaths

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### Definition

Death occurring immediately or later on as a result of a fire due to breathing toxic products resulting from combustion during the fire, as a result of smoke inhalation, due to suffering lethal burns or being subjected to heat stroke or multiple injuries during the fire.

### History

#### Clinical

- a) Medical history of alcoholism, drug addiction, crippling diseases, neurological and/or psychiatric disorders.
- b) History of medical care if they have been hospitalised before death or CPR has been tried with them, etc.

#### Court and police

- a) Type of fire: flame, smoke poisoning, along with police and/or fire brigade information making it possible to infer where the fire started, how it began, etc.
- b) The condition of the materials at the scene making it possible to infer the temperatures reached (for example if metal has melted, etc.).
- c) Materials at the scene which might have been impregnated with combustion accelerators.
- d) Location of the person at the scene of the fire.
- e) Photos of the place of removal of the body.

- f) Absorbent materials that may be found such as wood, upholstery, fabrics, etc., should be collected at the starting point of the fire and sent in glass or metal containers, but not in plastic ones (Order JUS/1291/2010 of 13 May).

## **Preliminary diagnostic tests**

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### **Optional**

- a) Serial radiology in cases where the identity of the deceased is not known or to rule out the presence of projectiles, fractures, etc.
- b) Photographs of the body.
- c) Fingerprinting of the deceased (police work) if NN body.

### **External examination**

- a) Examination of clothes or remains of clothes.
- b) Description of the size of skin lesions following the nine rule (Appendix 1) and of damage to hair and mucous.
- c) Description of the depth of skin lesions (Appendix 2).
- d) Description of traumatic injuries concurrent with or consecutive to the fire.
- e) Recognition and correct interpretation of artefacts and post-mortal lesions which appear to be intravital occurrences: continuity of the skin versus incised wounds; phlyctenae (2nd degree burns) versus decomposition blisters or vesicles; explosion of the skull due to heat versus intravital skull explosion.

### **Internal examination**

- a) Description of thermal injury to the airway, chemical, irritant or asphyxia due to smoke and soot inhalation (laryngitis, tracheitis, oedema, ulceration, diffuse lung injury) and injuries caused by heat (burst skull, visceral cooking).
- b) Search for individualising injuries or changes: pacemakers, osteosynthesis material, cholecystectomy, appendectomy, hysterectomy, etc.
- c) Rule out natural death causes. Complete autopsy.

## **Sampling**

### **Toxic study**

#### **Blood, vitreous humour, bile and urine:**

Request study of alcohol, drugs and psychoactive drugs, CO, HCN, explaining in detail the known circumstances of the case, in order to proceed with the protocolised analysis according to the laboratory analysis system for fire deaths. First CO is determined and if necessary then continue with other substances which may include volatile ones (acetone, methanol), solvents (toluene and xylene) and other combustion accelerants depending on the specific case and type of fire.

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### **Biochemical studies**

Establish possible metabolic disorders in relation to cause of death.

### **Histopathological study**

Sampling skin and airways.

- a) Take damaged area and undamaged control area making a spindle dissection that includes both areas. Incisions for histopathological study will be transversal so as to send a sample of burnt area and undamaged area as a control.
- b) Complete visceral sampling to rule out sudden death: sending to INTCF brain (half brain coronal incision), samples of each lung lobe that are not only subpleurals and one of each hilum, heart, liver fragment, kidney, spleen and rib in formol.

### **Microbiological study in case of post-burn skin or respiratory infections**

See Appendix 3.

### **Identity study**

- a) Dental study on the spot or jaw extraction.
- b) Samples for DNA: contact the laboratory beforehand to find out the type of sample to be sent. Possible samples are blood (semisolid from the heart cavity), dental without caries or en-

dodontics (four teeth on paper), bone (femur wrapped in paper) or muscle in good condition (deep muscles: psoas, gluteus).

## **Study of sexual assault**

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Oral cavity, anal and vaginal swabs and vaginal washings if thought necessary. Send them without preservatives.

## **Diagnostic criteria**

It will be concluded that death was due to fire:

- a) If the person was alive when the fire began based on the determination of CO, signs of intravital occurrence of the skin or airway lesions, or due to the arrangement of lesions.
- b) Based on the size and depth of lesions.
- c) Based on later complications: respiratory or renal failure, infections or evolution of trauma injuries sustained.

## **Specific causes of death**

- a) Thermal shock.
- b) Inhalation of smoke.
- c) CO poisoning.
- d) HCN poisoning.
- e) Traumatic injuries as a result of the fire including crush syndrome.
- f) Kidney failure.
- g) Respiratory distress.
- h) Infections.
- i) Disseminated intravascular coagulation.

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## Appendix 1. Wallace's Rule of Nines

Head and neck:	9% (4.5% front and 4.5% back)
Front trunk:	18% (thorax 9 and abdomen 9)
Back trunk:	18% (upper back 9 and lower back 9)
Lower limbs (each):	18%
Upper limbs (each):	9%
Perineum:	1%

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## Appendix 2. Depth of burns

- a) First degree: superficial, redness (erythema) without vesicle.
- b) Second degree: affect the dermis and there are blisters or phlyctenae.
- c) Third degree: affect the dermis and underlying conjunctive tissue.
- d) Fourth degree: affect all layers of the skin, muscle and even bone.

## Appendix 3. Sampling in infections

### a) Abscesses

1. Closed: aspiration of pus with a syringe and needle, preferably through an area of healthy skin. If a sample is not obtained, inject subcutaneous sterile saline solution and aspirate again. Once aspiration has been completed, expel the air and inoculate the sample in a sterile tube, preferably with means of transport for anaerobes.
2. Open: take the sample with a swab.

### b) Wounds

1. After disinfection of the outer area of the skin using a turunda, take samples of subcutaneous tissue from the wound edges or the base of the lesion.
2. With very dry wounds it is recommended to impregnate the turunda with sterile saline solution before taking the sample.

## Perinatal maternal death

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### Definition

The Tenth International Classification of Diseases (ICD-10) defines:

**Maternal death:** occurring during pregnancy and in the subsequent 42 days, regardless of the length of pregnancy, due to any cause related to or aggravated by the pregnancy or care for it, but not due to accidental or incidental causes (ICD-10, O95).

As alternative definitions:

**Maternal death related to pregnancy:** during pregnancy and in the 42 days following delivery, regardless of the cause of death. Includes accidental and incidental causes.

**Late maternal death:** occurring more than 42 days but less than one year after delivery, from direct obstetric cause – pregnancy complications – or indirect obstetric cause – diseases prior to pregnancy or which evolve during it, aggravated by the physiologic effects of pregnancy (ICD-10, O96).

### History

#### Clinical

- a) Pre-existing diseases in pregnancy which may worsen during pregnancy or have a harmful effect on it (Appendix 1).
- b) Gynaecological history: pathologies in this category prior to pregnancy, such as pelvic inflammatory disease, fertility treatments, contraception methods, multiparity, multiple pregnancies, evolution of pregnancy, pre-term and/or post-term deliveries and

mode of delivery (normal, caesarean), miscarriages or voluntary interruption of pregnancy, uterine surgery, tubal surgery, cervical insufficiency, bicornuate uterus, etc.

- c) Obstetric history: pregnancy unwanted or not, fertility treatment, risk pregnancy (age, hypertension, diabetes), gestational risk factors (Appendix 1), interventions throughout the course of pregnancy (amniocentesis, foetal surgery) and its evolution, assisted delivery, surgery during delivery (caesarean section, tubal ligation, hysterectomy due to uterine rupture).
- d) Ask for clinical data (history) or from witnesses (home births, in a means of transport, in a cell, etc.).

## **Court and police**

Collect all data prior to death: personal and family situation, socio-cultural context, unwanted pregnancy, unsafe abortions, domestic violence, accident prior to death, childbirth at home, drug use, etc.

In-hospital death related to medical practice (hospital, health centre, emergency medical services) or at home delivery, supervised by medical or nursing staff (midwives).

## **Preliminary diagnostic tests**

Radiological tests, optional depending on the case (chest X-ray, serial bone, CT, etc.).

Other tests that will be decided in each specific situation.

Photo report detailing the presence or absence of lesions.

## **External examination**

### **Of the mother**

- a) Signs of natural disease (obesity as measured by body mass index, phlebitis, oedema in lower extremities, anasarca, signs of venous insufficiency, etc.).
- b) Determine uterine height by abdominal palpation.
- c) Examination of external genitalia looking for vaginal tears, infectious secretions, childbirth remains, etc.
- d) Examination of placenta on maternal and uterine side. Examination of the cord: anatomic configuration (two arteries and a vein), implantation area and its condition; pulled off, cut, with surgical changes.

- e) Signs consistent with acute trauma causes: haematomas, fractures, etc.

### **Of the foetus/baby**

- a) Anthropometric data: height, weight, head, thoracic and abdominal circumference, foot length and description of overall condition.
- b) State of the cord (torn, cut, anatomic configuration [umbilical arteries and vein] etc.).
- c) Signs of trauma.

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Follow specific recommendations.

### **Internal examination**

Complete autopsy as for any sudden death (follow recommendations for sudden cardiac death in adults) and also determine uterine height, uterine status (broken, surgery, bicornuate uterus, etc.), placental implantation, status of placenta and cord (if any), presence of pelvic blood clots, pulmonary thromboembolism, etc.

Dissecting veins of the lower limbs to look for blood clots.

Recent surgical changes: hysterectomy, post-curettage changes, etc.

### **Recollida de mostres**

#### **Histology**

- a) Serial sampling, as set out in the recommendations for sudden cardiac death in adults.
- b) In cases of hysterectomy, in-hospital birth, etc., recover samples of organs or tissues removed.
- c) Uterus open and the front and back separated, unless there has been perforation.
- d) Placenta with umbilical cord.
- e) Complete embryo for study.
- f) In case of foetus/baby: viscera in a container and rest in another. Follow the recommendations for child death/sudden infant death.

#### **For toxic and/or biochemical study**

Vitreous humour, blood, gastric contents, bile and urine. Organs: lung, liver and kidney (fresh 50 gram fragments). Hair (in case of suspicion of chronic drug use).

## Microbiology

Serial sampling as in the recommendations for sudden cardiac death in adults.

Vaginal exudate; blood, preferably peripheral, and serum; cerebrospinal fluid; fresh tissues and organs; urine; pharyngeal exudates; nasopharyngeal aspirate; other body fluids (pleural, abdominal); bronchial aspirate; faeces; abscesses and wounds. Assess the type of sample depending on the case.

Remember that for any queries you should contact the histopathology, toxicology and/or biology services or units at the Institut de Medicina Legal de Catalunya and/or the Instituto Nacional de Toxicología y Ciencias Forenses.

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## Diagnostic criteria

Rule out murder, accidental death (domestic or traffic accident, food poisoning, due to metal, dehydration or excessive hydration, hyponatraemia, carbon monoxide, drugs of abuse) or suicide in cases where there is a psychiatric history, except postpartum depression, a condition that is typical of puerperium.

Confirm pregnancy if the cause of death is derived from a complication of pregnancy, childbirth or postpartum (including postpartum depression).

## Specific causes of death

- a) Bleeding (puerperal associated with hypovolemic shock, ectopic pregnancy, spontaneous rupture of uterine vessels, dystocia, uterine rupture, etc.).
- b) Stroke.
- c) Septic shock.
- d) Infections.
- e) Hepatic diseases characteristics of pregnancy (hepatic rupture associated with preeclampsia or HELLP syndrome – haemolysis, elevated liver enzymes and low platelet count – spontaneous hepatic rupture, fulminant hepatitis).
- f) Preeclampsia (placental abruption).
- g) Eclampsia.
- h) Amniotic fluid embolism, pulmonary thromboembolism, air embolism, trophoblastic embolism.
- i) Hypercoagulability (mesenteric artery thrombosis, ovarian vein thrombosis).

- j) Disseminated intravascular coagulation (DIC).
- k) Peripartum cardiomyopathy as a cause of death without previous cardiac disease.
- l) Hypovolemic shock.
- m) Suicide due to postpartum depression.
- n) Decompensation of pre-existing disease (cardiac, thyroid, aneurysms due to connective tissue disease, etc.).
- o) Other causes.

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## Appendix 1. Classification of obstetric risk

Existence of groups of pregnant women who are particularly vulnerable to the emergence of specific problems during pregnancy or present higher perinatal mortality or morbidity.

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a) **Low risk or 0:**

- Healthy woman in the absence of risk factors.

b) **Medium risk or 1:**

- Pelvic abnormalities identified clinically and/or radiologically (cause problems during delivery)
- Mother's low height (<1.5 m); if she gives birth to a large baby, she will have problems at birth.
- Heart disease 1: it does not limit physical activity.
- Unfavourable socioeconomic conditions.
- Psychosocial pathology.
- Insufficient monitoring of pregnancy: less than 4 prenatal visits or the first visit after 20 weeks.
- Extreme age: under 15 or over 35. In a woman aged under 17, her pelvis is underdeveloped. In a woman aged over 38, increased risk of chromosomal abnormalities (e.g., trisomy 21)
- Unwanted pregnancy.
- Previous sterility lasting 2 or more years.
- Habitual smoker.
- Date of last menstruation uncertain.
- Rh negative pregnant woman.
- Grand multiparity: 5 or more foetuses at least 28 weeks.
- Bleeding in the first trimester of pregnancy.
- Rh incompatibility.
- Weight gain less than 5 kg or more than 15 kg at the end of pregnancy.
- Lower urinary tract infection or asymptomatic bacteriuria (by urine culture)
- Obesity (BMI >30)
- Period between births less than 12 months.

c) **High risk or 2:**

- Severe anaemia (haemoglobin <9 g/dl or haematocrit <25%).
- Heart disease 2: slight limitation of physical activity. This graduation corresponds to a functional classification, so that grade 2 must abstain from overstrain.
- Previous uterine surgery.
- Endocrinopathy (diabetes mellitus)
- Gestational diabetes.

- Twin or multiple pregnancy. In women > 30 years it is important to rest because of the increased risk of preterm delivery.
- Prolonged pregnancy: more than 42 weeks.
- Endocrine diseases.
- Bleeding in the second and/or third trimester.
- Hydramnios or oligohydramnios.
- Unfavourable obstetric history: two or more abortions, caesarean section, one or more premature births, difficult births, mental or sensory deficiency probably of obstetric origin.
- Maternal infection, especially STD: hepatitis B or C, toxoplasmosis, pyelonephritis, rubella, syphilis, HIV, Strep B.
- Morbid obesity (BMI > 40). An increase of up to 9-13 kg during pregnancy is considered normal.
- Mild preeclampsia (DBP  $\geq$  90 mmHg and/or SBP  $\geq$  140 mmHg). Preeclampsia is a hypertensive condition during pregnancy in which diastolic pressure is more important; it is considered mild if diastolic pressure is between 90 and 110 mmHg.
- Suspected foetal malformation.
- Abnormal presentation observed after 38 weeks of gestation.

**d) Very high risk or 3:**

- Threat of premature labour (before 37 weeks).
- Multiple pregnancy, increasingly common due to the use of assisted reproduction techniques.
- Heart disease 3 or 4: entails major restriction on physical activity as the latter causes decompensation. Grade 3 takes place at rest while in grade 4 there is decompensation.
- Diabetes mellitus I and II before pregnancy.
- Consumption of toxic substances (alcohol, drugs). Drug addiction increases the number of intrauterine growth retardations. Alcoholism generates lots of malformations.
- Uterine cervical incompetence. A normal cervix is closed during pregnancy until the end, but if it is weak it can open and the foetus may fall because foetal weight is greater than the strength of the cervix.
- Rhesus isoimmunisation (rare today): positive indirect Coombs test in Rh-negative patient.
- Uterine malformations.
- Recurrent perinatal death.
- Placenta praevia.
- Severe preeclampsia (DBP  $\geq$  110 mmHg and/or SBP  $\geq$  160 mmHg)
- Serious comorbidity (e.g. renal transplant).
- Intrauterine growth retardation.
- Confirmed foetal malformation.
- Threat of premature labour.



- Premature rupture of membranes. If they break before 37 weeks this increases the risk of infection because a sterile cavity, namely the amniotic cavity, is connected with a dirty cavity with great microbial life. This increases the risk of foetal infection due to amnionitis leading to maternal sepsis.
- HIV-positive, AIDS and related complexes.

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The presence of one risk factor entails the inclusion of the pregnant woman in the corresponding group.

If there is more than one risk factor, the woman is included in the group with the highest risk factor.

## Death under restraint

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*Coordinator:* Josep Castellà Garcia

It is advisable that the autopsy should be conducted by at least two medical examiners.

### Definition

Deaths related to the subduing, immobilisation and restraint of a person by law enforcement agencies, private security firms or hospital staff. It does not concern death in custody in general, but very specifically restraint-related death.

If the findings are nonspecific and sudden cardiac death is suspected, follow the appropriate protocol.

### History

#### Clinical

It is very important to learn about:

- a) Attempted resuscitation and type.
- b) Other therapy measures.
- c) Alcohol, tobacco and drug use: type of toxic substances, acute/chronic use, route of administration, detoxification/abstinence treatments.
- d) Chronic diseases: heart disease, drug treatments, obesity, medical centre and attending doctor.
- e) In case of death in hospital: treatment performed, results of analytical tests, results of other diagnostic tests.

## Court and police

Mainly:

- a) Number of officers.
- b) Type of restraint.
- c) Timeline of intervention.
- d) Length of the intervention and the restraint.
- e) Positions during restraint.
- f) Position at the end of restraint.
- g) Position when resistance ceased.
- h) Use of special weapons or instruments (sprays, batons, special guns – Taser).

## Preliminary diagnostic tests

### Optional

Radiology: useful to diagnose bone injuries.

## Sampling preliminar

- a) Blood.
- b) Subungual scraping.
- c) Oral and nasal turunda (spray and drugs of abuse).

## External examination

### Compulsory

Photographs: of the whole body dressed and stripped (the absence of lesions is also useful as a “negative photo”) and of all lesions numbered and with metric photomacrographic scale.

Full examination, preferably rounded off with ultraviolet light study.  
Enumeration and individual morphological study of lesions.

## Internal examination

Based on usual technique it may also include:

- a) Peel-off.

- b) Subcutaneous dissection of neck and face.
- c) Dissection of carotid sinus.
- d) Dissection of spinal cord.

## **Samples**

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### **Chemical-toxicological study**

- a) Blood: two 5 cc tubes with sodium fluoride and/or potassium oxalate.
- b) Urine: 10 cc.
- c) Vitreous humour: everything possible from both eyes in the same tube.
- d) Bile.
- e) Gastric contents, without any additional treatment.
- f) Fragment of brain, liver, kidney and lung: fresh, without preservatives and in separate containers.
- g) Hair: occipital region and in a tube without preservative. The Laboratory Service will not process it immediately and will do so only based on the results of other analyses.

### **Biochemical study**

- a) Blood.
- b) Urine.
- c) Vitreous humour (ionogram).

The chemical-toxicological and biochemical studies will be processed in accordance with the Laboratory Service's analytical protocols and based on subsequent findings. Interpretation of the results will always be within the clinical context and histopathological results.

### **Biological study**

Subungual scraping.

### **Histological study** (samples in formol at 4%)

- a) Brain: upper and middle frontal gyrus, basal ganglia, basal ganglia with thalamus, hippocampus, pons, midbrain, medulla and cerebellum.
- b) Spinal cord.

- c) Heart (according to recommendations for sudden cardiac death).
- d) Lung (five lobes).
- e) Liver (both lobes).
- f) Kidneys.
- g) Suprarenal.
- h) Thyroid.
- i) Spleen.
- j) Diaphragm.
- k) Digestive tube.
- l) Pancreas tail.
- m) Lymph nodes.
- n) Rib.
- o) Peripheral nerve.
- p) Striated muscle.

If it is not possible to take samples properly, the heart and brain can be sent whole to the analysis centre.

## Diagnostic criteria

Death under restraint is not defined by specific autopsy findings but rather by the measures taken with the individual. These recommendations are applicable provided that one or more people in any field have attempted to restrain, subdue or immobilise a person and this triggers death.

## Specific causes of death

Generally a number of factors are involved in this type of death which require study and evaluation of a number of actions. The usual process is as follows:

- a) Preliminary report: cause undetermined.
- b) Session to close the case when all the material is available.
- c) Final report:
  - 1. If there is evidence of a natural or violent cause which alone leads to death it is to be described as such: natural or violent with the corresponding specific mechanism.
  - 2. If there are a number of factors, the influence of each factor on the pathophysiological mechanism of death must be set out and the death described as natural or violent depending on the most determining factor.

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## **Sudden cardiac death in adults**

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*Coordinator:* Teresa Marron Moya

### **Definition**

Natural and unexpected death occurring within 1 hour after the onset of symptoms in cases witnessed. In the case of deaths not witnessed, the subject must have been seen alive for the last time and stable (having ruled out all potentially fatal non-heart causes) 24 hours or less before being found death.

### **Inclusion criteria**

- a) Natural death (cardiac arrests with resuscitation and subsequent death are not exclusion criteria).
- b) Unexpected, in a person who is healthy or in good health.

### **Exclusion criteria**

- a) Cause of death not cardiac.
- b) Decomposition.

### **Problems to be solved**

- a) Rule out violent death.
- b) If death is attributable to cardiac causes or to other causes of sudden natural death.
- c) Nature of the heart disease.
- d) If the heart disease is hereditary, the family must be told and frozen blood kept.
- e) Histopathology and toxicology study is required.



## History

### Clinical

Gather on removal of the body or from medical staff if attended in a hospital setting:

#### **Family history:**

- a) Family history of sudden death or cardiovascular disease.

#### **Personal history:**

- a) Risk factors for cardiovascular disease: smoking, obesity, diabetes, hypertension, hypercholesterolemia, etc.
- b) Electrocardiographic abnormalities diagnosed in life.
- c) Non-cardiovascular disease history, especially asthma and epilepsy.
- d) Current treatments.
- e) Resuscitation attempts and type: include ECG if possible.
- f) Alcohol, tobacco and drug use.

### Court and police

- a) Symptoms prior to death and peri-mortal circumstances with special reference to physical activity or emotional stress.
- b) Death witnessed.
- c) Prior medical assistance.

### Preliminary diagnostic tests

#### **Sampling:**

- a) Peripheral blood: two 5 cc tubes.
- b) Vitreous humour.
- c) Urine by suprapubic aspiration with prior disinfection with antiseptic (not alcohol). If not possible, subsequently attempt direct bladder aspiration.
- d) Hair: preferably occipital; to be processed according to IMLC Laboratory Service standards.

## External examination

- a) Height and body weight (the latter measured or estimated) to establish the relationship with heart weight (0.45% of the total weight for a man and 0.40% for women) and the thickness of its walls. Calculate body mass index (BMI) and measure abdominal circumference.
- b) Assess for recent therapy signs: IVs, intubation, ECG electrodes, defibrillator burns, etc.
- c) Rule out the existence of pacemaker or defibrillator (see hazardous autopsy protocol).
- d) Rule out trauma injuries.

## Internal examination

- a) Complete autopsy with evisceration preferably en bloc.
- b) Protocolised macroscopic heart examination (Appendixes 1 to 8).

## Sampling

### Heart:

Two options:

- a) Send whole heart to a specialised centre for study:  
Wash the heart.  
Send it:
  1. Whole.
  2. Make a biventricular transversal incision parallel to the atrioventricular groove, by half the ventricular cone, below the papillary muscles of the mitral valve.
 Wash again.  
Weigh and fix in formol at 4%.
- b) The medical examiner should perform the dissection and macroscopic heart study. Keep the whole heart for possible reinclusions. Sampling for histopathological examination: Appendix 9.

## Other diagnostic tests

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- a) **Toxicology studies:** Appendixes 9 and 10.
- b) **Toxicology studies:** Collect heart blood samples if it is not possible to obtain peripheral ones. Urine by direct aspiration if not obtained by suprapubic aspiration. Bile if there is no urine available. Studies:
  - 1. Request qualitative and quantitative analysis of: cocaine and metabolites, amphetamines, opiates, alcohol and cardiotoxic drugs such as neuroleptics, or cardiac medications.
  - 2. With SCD in athletes it is advisable to rule out doping (see specific protocol).
- c) **Biochemical study:** Optionally, collect blood (preferably serum), pericardial fluid for cardiac enzymes. Vitreous humour (depending on IMLC Laboratory Service protocols).
- d) **Molecular autopsy:** Frozen blood: 5 cc with EDTA if there is ventricular hypertrophy, arrhythmogenic right ventricular dysplasia, or if there is a structurally normal heart in person aged under 50.

## Diagnostic criteria

This means findings that make it possible to include the death being studied in the type described. For example, sudden ischemic heart death: no violence, no extra-cardiac pathology that explains the death and evidence of fatal ischemic heart disease (acute and/or coronary thrombosis with obstruction greater than 75%).

([http://scielo.isciii.es/pdf/cmfn55/contribucion\\_especial1.pdf](http://scielo.isciii.es/pdf/cmfn55/contribucion_especial1.pdf))

## Specific causes of death

Gather immediate and fundamental causes which most often lead to death as well as the factors that may influence it.

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## Appendix 1. Macroscopic heart study

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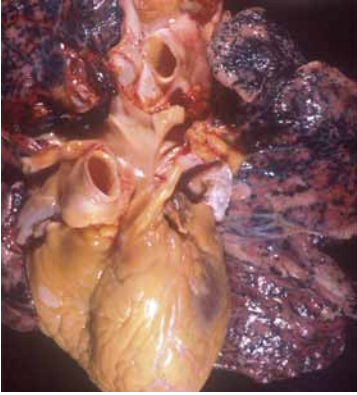
1. Inspect the pericardium, open it and explore the pericardial cavity.
2. Inspect the anatomy of the great arteries. Open the trunk of the pulmonary artery in situ to check the existence of thrombi (Appendix 2). Dissect arteries 3 cm above the aortic and pulmonary valves.
3. Examine and dissect the pulmonary veins. Cut the superior vena cava 2 cm above the point where it joins the crest of the right atrial appendage (to preserve the sinus node). Dissect the inferior vena cava near the diaphragm.
4. Open the right atrium (Appendix 3) from the inferior vena cava to the apex of the atrial appendage (to preserve the sinoatrial node). Open the left atrium between the pulmonary veins and thence to the atrial appendage (Appendix 4). Examine the atrial chambers, the interatrial septum and determine if the foramen ovale is complete. Assess mitral and tricuspid valves from above and determine the integrity of the papillary muscles and chordae.
5. Inspect the aorta, the pulmonary artery and aortic and pulmonary valves from above.
6. Examine the coronary arteries, with special relevance in the main ones (common trunk of the left coronary artery, left anterior descending, circumflex and right coronary artery):
  - a) Assess size, shape, position, number and permeability of the coronary ostia.
  - b) Evaluate size, course and dominance of the major epicardial arteries.
  - c) Make transversal incisions at 3 mm intervals along the course of the major epicardial arteries and their branches, such as the diagonal or marginal ones, and determine their permeability.
  - d) Heavily calcified coronary arteries can usually be opened with sharp scissors. If this is not possible, they should be dried intact, decalcified and opened transversely.
  - e) Coronary segments containing a metal stent should be referred whole to the laboratory by resin fixation and subsequent processing and cutting.
  - f) Coronary arteries with a bypass (saphenous veins, internal mammary arteries, radial arteries, etc.) should be examined carefully by transversal incisions. The proximal and distal

anastomoses require particularly careful examination. Staples or sutures next to the vessel facilitate its identification, especially in the case of internal mammary grafts.

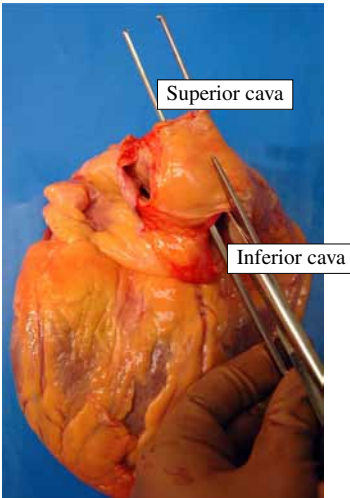
7. Make a complete transverse incision (short axis) of the heart ventricles at about 3 cm below the atrioventricular groove and parallel to it, followed by parallel biventricular incisions at intervals of 1 cm towards the apex and carefully evaluate the morphology of the walls and cavities in these incisions (Appendix 5).
8. Once bloodless, record the following measures:
  - a) Total weight of the heart: assess heart weight using tables of normal weights for age, sex and body weight (Appendix 6).
  - b) Wall thickness: examine the endocardium, measure the thickness of the middle region of the free wall of the left ventricle, right ventricle and septum (excluding the trabeculae) and compare the measurements with the tables for normal thickness by age, sex and body weight (Appendix 7).
  - c) Measure ventricular chambers in the cardiac base, latero-lateral, two centimetres below the atrioventricular valves (Appendix 8).
9. Dissect the basal half of the heart following blood flow and carry out a full examination of the interatrial and interventricular septum, atrioventricular valves, ventricular inflow and outflow tracts and the semilunar valves.

## Appendix 2. Anterior study to rule out PTE

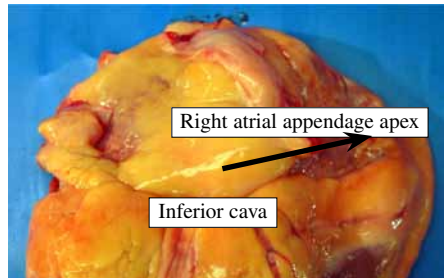
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## Appendix 3. Opening the right atrium

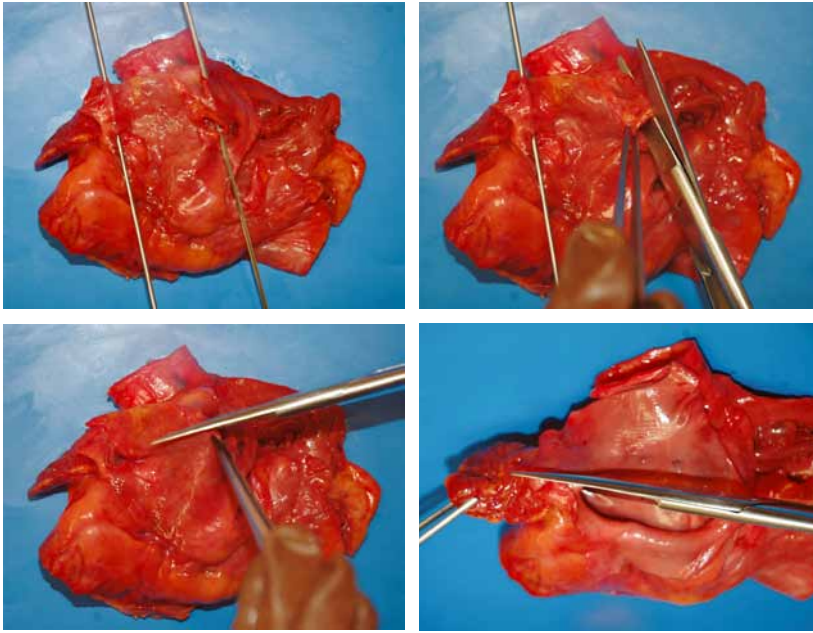


*Procedure not recommended  
in sudden cardiac death (SCD)*



*Procedure recommended in SCD*

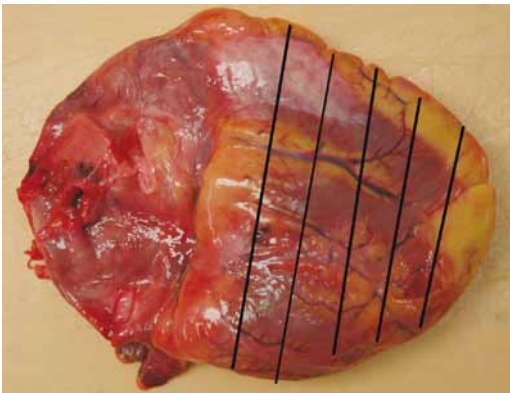
## Appendix 4. Opening the left atrium



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## Appendix 5. Biventricular incisions

1. Anterior side of heart on the table.
2. Incisions parallel to the atrioventricular groove:
  - a) Every 1 cm.
  - b) From the tip to 2-3 cm from the groove.
3. Provides 4 or 5 biventricular slices.





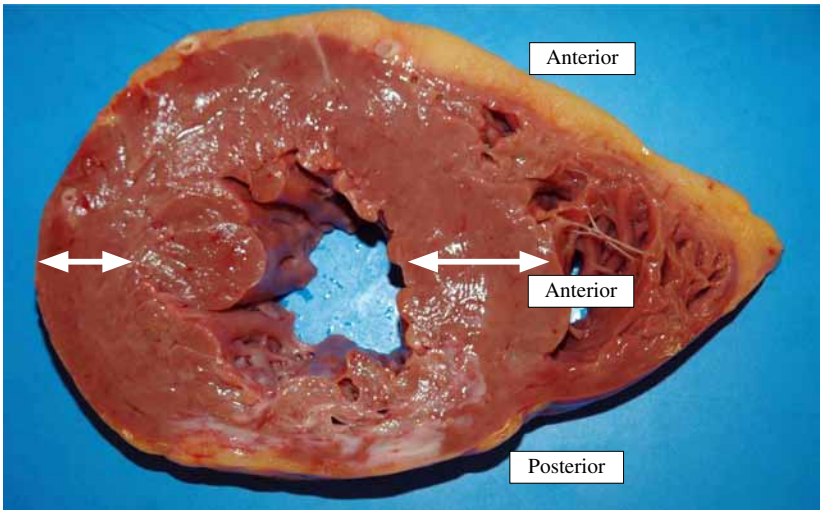
## Appendix 6. Tables of normal weights by age, sex and body weight

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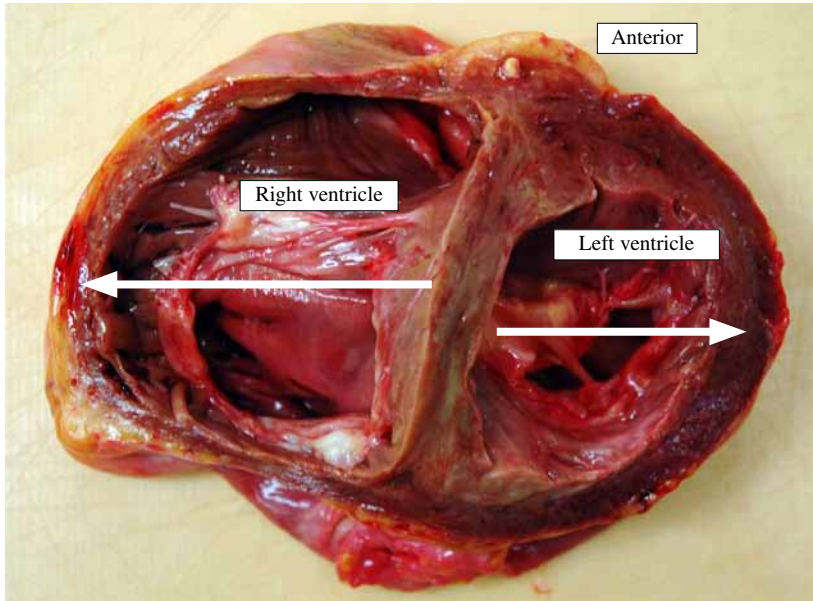
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## Appendix 7. Wall thickness

1. Measure the thickness at the incision where the papillary muscle cupola goes (basal or midbasal).
2. When the above procedure is not possible (infiltrated fat, etc.), measure the right or left ventricle at 1.5 cm from the pulmonary valve and the mitral valve.



## Appendix 8. Measuring cardiac base cavities (latero-lateral)



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## Appendix 9. Sampling for histopathological study

### Heart:

**Myocardium:** take labelled blocks according to Appendix 10.

**Coronary arteries:** a block of each of the three main arteries cut at one centimetre from source; in the case of coronary heart disease take the most severe focal lesions.

**Other cardiac samples:** when necessary in the reference centre (due to clinical suspicion or existence of prior ECG, etc.) for study of the conduction system.

### Other tissues:

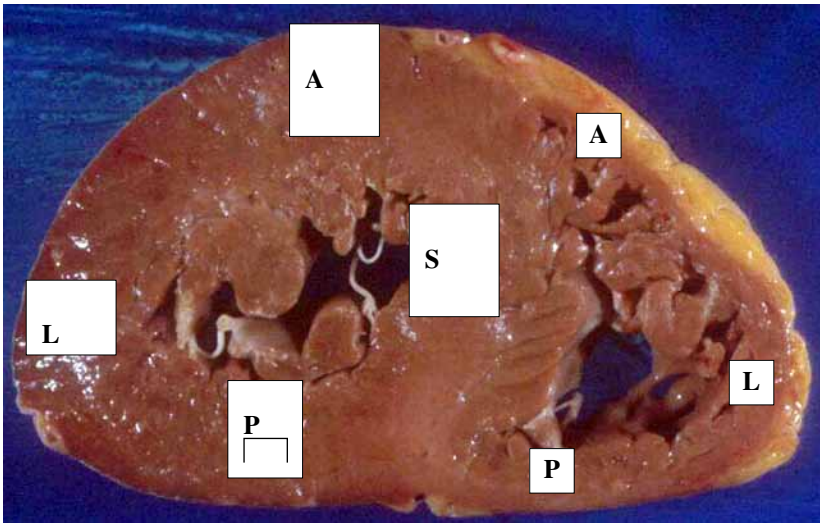
Fragment samples should be routinely collected of the five lobes of the lung, thyroid, rib, fragments of left and right liver lobes, spleen fragment and kidney, adrenal gland and pancreas fragments (identify the samples on the left with an incision or put them in a separate jar).

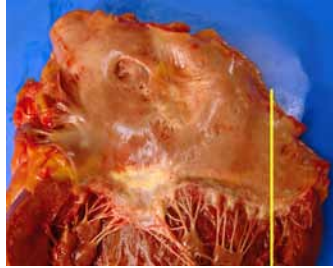
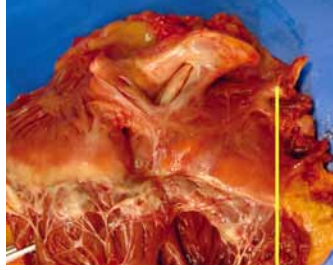
**Brain:** usually take samples from the upper and middle frontal gyrus, basal ganglia, basal ganglia with thalamus, hippocampus, pons, midbrain, medulla and cerebellum.

Depending on the medical history and circumstances of death, take the necessary samples of other organs to complete the investigation.

## Appendix 10. Myocardial samples

1. Left ventricular free wall (anterior, lateral and posterior region) at two levels separated by 2 cm.
2. Interventricular septum (anterior and posterior region) also on two levels.
3. Right ventricular free wall (anterior, lateral and posterior region), at one level.
4. Right ventricle outflow tract.
5. A sample of the atrium – tricuspid valve and right ventricle and a sample of atrium – mitral valve and left ventricle.
6. Area samples with significant macroscopic abnormalities.





## Death with suspected child abuse

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*Coordinator:* Helena Martínez Alcázar

### Definition

Set of recent and old injuries suffered by young children which may lead immediately or later on to the child's death, usually caused by adults in the child's family and social environment by action or omission.

### History

#### Clinical

Data collection:

- a) Vaccination card update.
- b) Paediatric checks (regular/irregular/nonexistent).
- c) Congenital diseases.
- d) Most recent hospitalisations (watch for Munchausen syndrome by proxy).
- e) Medical and surgical history.
- f) Psychiatric history: visits to psychologists and/or psychiatrists.

#### Court and police. Removal of the body

- a) **Family history:** alcoholism, drug addiction, psychiatric history and/or criminal record, single parent family, low income and educational level, young parents, stepparents, history of abuse against the woman (battered mother) and pregnancy checks.
- b) **Removal:** time and place of events (time since death until medical and/or police personnel advised). Position of the body.

Person who found the body. Investigate the presence of drugs (benzodiazepines, barbiturates, hypnotics and medicines for children, syrups), dummies, baby bottles and their contents, cleaning products, toxic substances, plastic bags, toys (balls, marbles, etc.) near the body or at home and collect them for analysis. Hygienic and sanitary conditions and habitability of the home (child's room, kitchen, dining room). State of clothes or nappies worn by child (stained, dirty). Check for paradoxical lividity or transposing of it (change in body posture). Find out if there has been CPR.

- c) **Other relevant information:** complaints to police due to prior history of abuse of the child or siblings. Symptoms prior to the time of death. Adequacy of schooling, school adaptation and academic performance. Attitude and emotional burden of the parents vis-à-vis the event. Account of events by parents: inconsistencies, discrepancies and incongruence in the explanation of the circumstances, especially in cases of suspected accidental falls from the bed resulting in skull fractures, burns, injuries, haematomas.

## Preliminary diagnostic tests

- a) Radiological study: always to be done. With two projections, complete serial study of the entire body: fractures in different stages of evolution, pulling of metaphysis, vicious consolidation.
- b) Always a photographic study, especially if there are scarring injuries due to sharp force or other types of injuries.
- c) Gather clothes and nappies.
- d) Optionally a CT scan as a cranial diagnostic test and/or MRI (for old injuries) depending on what you are looking for.

## External examination

Systematically of clothing and the whole body. Take special care over the specific features:

- a) Anthropometric measurements (depending on the age of the child). Fontanelle closure, head, chest and abdomen circumference.
- b) Eye fundus.
- c) Hygiene and nutrition condition.
- d) Mucocutaneous lesions:
  1. Haematomas: different evolutionary stage and different locations (non-prominent and protected areas).

2. Periorbital hematoma. Eyelid oedema.
  3. Systematic search for eye injuries.
  4. Oral mucosal lesions due to introducing objects, pharynx and/or oesophagus perforation, burns, broken teeth.
  5. Bites (arcade size with photos with metric photomacro-graphic scale).
  6. Gunshot and sharp force wounds.
  7. Alopecia (occipital, occipitoparietal regions) due to pulling.
  8. Burns: perineum, buttocks and genitals, extremities (mirror image), reproduction of the object (cigarette, iron, etc.); scalding on hands and feet (forced immersion in containers of hot water).
  9. Specific lesions of possible sexual abuse.
- e) Musculoskeletal injuries. Usually associated with other injuries, multiple fractures in different stages of evolution.
1. Extremities:
    - Due to stretching: pulling and bone fragmentation at the bone ends.
    - Metaphyseal fractures: due to direct trauma.
    - X-ray: “bucket handle image”.
    - Assess deformities, deviations and shortenings of limbs.
  2. Skull fractures:
    - By direct impact on the skullcap: clean linear and margins.
    - With sinking.
    - Comminuted.
    - With edge separations (diastasis) that are seen together with intracranial injuries: subdural haematoma; if there are retinal haemorrhages due to shaken baby syndrome, rib lesions can sometimes be seen too.
    - The typical skull fractures are those that cross sutures.
  3. Rib fractures in posterior and lateral regions.
  4. Broken nose, cheekbones and orbits.

## Internal examination

As in adults, but taking into account the specific characteristics depending on age:

- a) External and internal cranial injuries: subdural haematoma. Determine weight in relation to the brain and its extension; these data are objective of the severity of subarachnoid haemorrhage.
- b) Study of the eye (retinal damage).
- c) Visceral and chest injuries as with an adult. Especially look for: intramural duodenal haematoma (due to trauma on spine

with duodenum compression); pancreatic pseudocysts (traffic accident, falls and sports); tears in intestines, stomach and hemoperitoneum; fatty liver degeneration compatible with malnutrition.

## Sampling

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**For toxicological study:** blood, urine, bile, vitreous humour, stomach contents, viscera (liver, kidney and lung), pericardial fluid, leftover from bottle, baby cereal and other products. Always to be collected separately and without preservatives.

**For histopathological study:** sampling of all organs as for sudden infant death (brain, mouth-cervical-thoracic visceral block, abdominal visceral block including kidneys, adrenal glands, urinary tract and internal genitalia; Appendix 1).

**For biological evidence:** in case of suspicion of sexual assault, usual samples.

## Diagnostic criteria

Once congenital osteoarticular pathology (e.g., osteogenesis imperfecta) is ruled out, assess:

- a) Any type of fracture observed in a child too young to walk or crawl (location of the fractures; old fractures).
- b) Shaken baby syndrome (retinal haemorrhages, subdural haematoma and rib fractures).
- c) Direct cranial contusions and/or fractures.
- d) Epiphyseal fractures of long bones or spiral fractures resulting from twisting.
- e) Rib fractures (especially posterior).
- f) Internal damage, such as bleeding or rupture of an organ, due to blunt trauma.
- g) Multiple contusions or haematomas produced at different ages, especially in unusual areas of the body or with patterns that suggest choking, twisting or heavy contusions with objects or hands.
- h) Other unusual skin damage, including burns or burn scars.
- i) Subdural haematoma without reasonable cause.
- j) Asphyxia by suffocation, airway obstructions, objects.
- k) Malnutrition.
- l) Abandonment.



## Specific causes of death

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- a) Cerebral haemorrhage due to TBI (subdural, extradural).
- b) Injuries due to blunt force, sharp force, gunshot or burns.
- c) Multisystem failure due to malnutrition or dehydration.
- d) Septic shock.
- e) Hypovolemic shock.
- f) Poisoning.
- g) Asphyxia: airway obstruction by suffocation, presence of foreign bodies, strangulation, submersion in swimming pool or bath.

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## Appendix 1. Sampling

**For toxicological study:** blood, urine, bile and vitreous humour, stomach contents, viscera (liver, kidney and lung), pericardial fluid, leftover from bottle, baby cereal and other products.

**For biological evidence:** in case of suspicion of sexual assault, normal samples.

**For histopathological study:** sampling of all organs as for sudden infant death (brain, mouth-cervical-thoracic visceral block, abdominal visceral block including kidneys, adrenal glands, urinary tract and internal genitalia). Sampling must meet international standards whether it is done at the time or if it is done after fixation the following day.

The entire brain is sent with stem and cerebellum facing up in a 3-litre security container.

**BRAIN:** weighed fresh. Weigh the brain post fixation and then weigh separately brain and cerebellum with brainstem. Take dura mater samples in cases of suspected meningeal disease or in venous sinuses. Brain fragments from the bilateral anterior frontal part; bilateral frontoparietal convexity at 1 cm from the interhemispheric fissure; lateral portion of the temporal (second temporal gyrus); both hippocampi; a section of the calcarine fissure of both hemispheres; basal ganglia of the brain basis with internal capsule and adjacent ventricular wall; thalamus; midbrain transversal slice; another of the middle portion of the pons and of the medulla oblongata at the rhomboid fossa and first level cervical cord.

**Sampling will vary** according to the suspicion of certain pathologies, especially in the case of suspected shaken baby syndrome (whiplash syndrome). Sampling should be tailored to this entity: corpus callosum, splenium, fornix, centrum semiovale white matter, eyeballs with optic nerve. In case of subdural haematoma take samples of the most evolved portions to date the injury.

A fragment of tongue, sublingual and palatine tonsils, submandibular glands, epiglottis. A vertical uni-or bilateral laryngeal slice comprising band, laryngeal ventricle and vocal cords. One or two transverse slices inferior laryngeal with thyroid (probably containing

at least two parathyroid glands), a transverse slice of trachea with soft mediastinum tissues (lymph nodes, etc.), thymus.

**LUNGS**, after weighing, a sample of each ileum with artery, vein and bronchus; an identified fragment of each lung lobe.

**HEART:** parietal pericardium in case of abnormalities.

After opening the aorta and checking for possible patent ductus arteriosus and after ruling out anomalies in the great vessels, dissect both aortic and pulmonary pedicles 2 cm above the semi-lunar valves. Anatomical dissection in the direction of blood flow to rule out malformations in the position and/or internal structures such as communications, permeability of the foramen ovale, anomalies of the coronary arteries. Samples must be taken of the conduction system for partial study (sinus node, atrioventricular node, Hiss piercing and branching, and both branches); take a vertical slice right atrioventricular and another of the left containing tricuspid and mitral valve. Also study a slice of left ventricular free wall, septum IV and right ventricular free wall.

**ABDOMINAL BLOCK:** take samples of cardia, pylorus (longitudinal section containing pyloric antrum, sphincter and first centimetre of duodenum), head of pancreas with duodenal frame (after checking permeability of bile duct or malformation); a segment of jejunum, ileum with cecum (Peyer's patches and cecal ileus valve), caecal appendix. In case of Meckel's diverticulum take a segment, with fragments of the colon and rectum. Mesenteric lymph; spleen fragment; a fragment of each adrenal gland; a middle transverse fragment (cortex, medulla, papilla, renal pelvis) of each kidney; female internal genitalia or testes. In case of suspected abnormalities in the urinary tract include fragments of it.

**OTHER:**

Also take samples from the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> right costochondral joint, a sternal fragment for bone marrow, diaphragm muscle and psoas muscle.

In the case of fractures take the fracture ends containing all components of the recent fracture in consolidation or fracture callus to date it.

In the case of wounds, haematomas or ecchymosis, especially cutaneous, take samples of the intersection between the preserved and damaged parts, always oriented with sutures, photos or drawing.

With very recent wounds, doubtfully intravital, always mark the area to be studied; the same should be done with dubious bone fractures: always indicating the supposed fracture zone.

## Death in the elderly

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### Definition

For the purposes of these recommendations: death of any person aged over 70.

According to the WHO, people aged 60 to 74 are considered elderly, from 75 to 90 old and those aged 90 or older extremely old or long-lived. Anyone over 60 is called a third age person.

In 1990, the WHO considered the elderly population to be made up of people aged 65 or over.

Some authors define old age or the third age as being over 60 and some from 65-70.

The UN considers anyone over 65 in developed countries and over 60 in developing countries to be old.

### History

### Clinical

They are varied and must be investigated, even though in many cases they are non-specific (Appendix 1). Especially important are cardiovascular and respiratory disorders, blood dyscrasia, strokes, previous trauma and confinements (hospitals or health centres) where it is important to know the time of admission and treatment received. Dementia, psychiatric disease. Usual medication.

### Court and police

Where the body was (toilet, bedroom) and position.

Dressed or naked. If dressed, condition of clothes and position of the body.

Issue of biological fluids (urine, faeces, vomit). Medications.

Room: tidy/untidy. State of home (Diogenes syndrome).

Lived alone or with others. Institutionalised. Care received. Assistant. Reports of previous trauma. History of abuse in the family.

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## **Preliminary diagnostic tests**

They are not necessary unless abuse or accident is suspected.

## **External examination**

Special reference to the existence of bruising due to violence, especially when found in different locations, chronology and variety. Study of cachexia, low weight and dehydration. Also any signs that indicate a lack of care. Search for signs of restraint.

## **Internal examination**

En bloc extraction with study of all viscera and with special reference to:

- a) Brain: vascular and ischemic pathology.
- b) Trachea: obstruction by food.
- c) Heart: ischemia, with signs of senile changes (calcification, dilatation, deposit).
- d) Lungs: infectious, vascular (pulmonary thromboembolism).
- e) Digestive: obstruction, intestinal ischemia.

## **Sampling**

Blood and urine, routine to rule out the presence of central nervous system depressants, sedatives and cardiotonics. Likewise for the study of clinical entities such as kidney failure or diabetes (Art 39. Order JUS/1291/2010 of 13 May, por la que se aprueban las normas para la presentación y remisión de muestras objeto de análisis por el Instituto Nacional de Toxicología y Ciencias Forenses. Madrid. BOE de mayo de 2010. BOE núm. 122. Sec.I. Pág. 43459 or IMLC Laboratory Service).

Histological examination will be based on the findings, but obtaining heart, lungs and brain is especially recommended (Art 17. *Recomendaciones de muestreo según el tipo de muerte*. Order JUS/1291/2010 of 13 May, por la que se aprueban las normas para la presentación y remisión de muestras objeto de análisis por el Instituto Nacional de Toxicología y Ciencias Forenses. Madrid. BOE de mayo de 2010. BOE núm. 122. Sec.I. Pág. 43459 43459).

## Diagnostic criteria

Diagnostic categories:

- a) Those given by the existence of an evident, macroscopically demonstrable natural disease; for example, pneumonia, pulmonary thromboembolism, etc.
- b) Those evident violent mechanisms that determine death per se, such as pulmonary thromboembolism due to femur fracture or subdural haematoma due to head trauma. Cases of abuse.
- c) Nonspecific pathology where signs of violence are ruled out and where diagnostic tests do not provide sufficient information. These would be cases where people have died basically due to old age.
- d) When the existence of signs of violence cannot be ruled out, overall assessment is required using information from the removal of the body or even a thorough investigation to rule out the existence of signs of violence. This would be the case, for example, when the body presents extreme cachexia and it has to be decided whether this is a case of abuse or the existence of consumptive disease.

## Specific causes of death

Based on the abovementioned categories (Appendix 2).

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## **Appendix 1. Risk factors in the elderly**

- a) High blood pressure.
- b) Obesity.
- c) Hyperhomocysteinaemia.
- d) Dyslipidemia.
- e) Sedentary lifestyle.
- f) Diabetes mellitus.
- g) Giving up smoking.

## **Appendix 2. Statistics and causes of death by age**

Between 65 and 74 years (in order of highest to lowest frequency):

- a) Heart conditions.
- b) Cancer.

- c) Cerebrovascular processes and respiratory diseases (pneumonia and pulmonary embolisms). After the age of 75 strokes become more common than cancer.

Almost a third of people aged over 65 are hypertensive (and almost half of those over 80) which increases the risk of heart disease, heart failure and stroke.

The possibility of developing lower limb arterial disease increases with age, especially among males. The Framingham study confirmed the prevalence of these disorders at 12% after 65 years of age.

10% of the elderly aged over 80 suffer from type II diabetes.

Neurological disorders are very common in the elderly and range from shaking to dyskinesias. They include Parkinson's disease and other extrapyramidal syndromes, which are often caused by taking psychotropic medications.

Men between 60 and 70 frequently suffer from digestive tumours of the stomach and colon and bronchial carcinoma. Between 70 and 80 prostate, colon and rectum tumours predominate. After 80 the order of frequency is colon, rectum and prostate.

Breast cancer is the most common in elderly women, followed by uterus and stomach tumours. From the age of 80, after breast cancer colon and rectum cancer predominate.

In developed countries acute strokes are the third biggest cause of death in the elderly and lead to a large percentage of physical and mental disability.

Bone and joint disease is the leading cause of loss of physical autonomy; cardiovascular disease causes the most deaths and mental illness causes the most serious disability.

According to the WHO, 25% of the elderly have a mental disorder, the most common is depression.



## **Specific protocols: infant, child and adolescent death**

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## Sudden infant death

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### Definition

Sudden unexpected death which apparently occurs during sleep and is inexplicable after the autopsy of an infant (child aged one or under) in apparent good health, and in which careful investigation of the circumstances of death and evaluation of the removal of the body, together with a review of previous medical history, do not reveal a mechanism of violent death.

### Problems to be solved

- a) Establish if the death is attributable to a natural disease process (infection, metabolic disorders, congenital malformations, etc.).
- b) Consider the possibility of:
  1. Accidental death (trauma, poisoning, heat, choking, asphyxia and/or blocking of airway, etc.).
  2. Non-accidental injury.
- c) Document the presence or absence of disease processes and contribute to the multidisciplinary clinicopathological evaluation of the death.

### History

#### Clinical

- a) **Family history:** siblings or twins in SIDS deaths and other causes (hereditary, etc.).

- b) **Social aspects:** population group (Caucasian, Asian, etc.), low socioeconomic status, young single mother (<20 years), multiparous, inadequate room temperature (too low or too high), excess bed linen/clothing, soft surfaces in bed, lots of toys in bed, etc. and whether there is suspicion of family or infant abuse.
- c) **Obstetric history:** wanted/unwanted pregnancy, existence/lack of personal care, smoking and use of other drugs, delivery presentation, single or multiple delivery, natural or caesarean section delivery, delivery in or out of hospital, Apgar test, intrauterine growth retardation with low birth weight for gestational age (specify weight, height and head circumference), preterm birth, sex of the newborn, breast feeding/artificial, etc.
- d) **Pathological history:** growth retardation, no vaccination or possible reactions to vaccination, febrile seizures, surgery, anaemia, bacterial (*S. aureus*, *E. coli*, etc.) and viral infections, medication allergies, gastro-oesophageal reflux disease, episodes close to sudden death, sleep apnoea, major difficulties in food intake with apnoea and bradycardia, banal episodes of airway obstruction and respiratory infections, paroxysmal vagal hypertonia with cardiac arrhythmias and sinus arrest (especially during sleep), etc.

### Police and court

- a) It is very important that death should not be certified in these cases. A judicial autopsy needs to be conducted to exclude other causes of death and not lose the information.
- b) Special care and vigilance if there has been prior medical care.
- c) Find out:
  1. If the police have been called to this home before and if so why.
  2. If the family has required social assistance and for what reason.
  3. Investigate prior legal complaints.

### Removal of the body

- a) Time when last seen alive and time when found dead.
- b) It is highly recommended to go to the place where the child is (home, hospital, nursery school) and also the death scene.
- c) Room temperature of the house, layers of clothing, overheating due to clothing or bedding, heating on, etc.
- d) State of health and safety of the home (drinking water, smell of cleaning substances, paints).

- e) Check whether the place where the child was found was where they regularly slept.
- f) Sharing cot or bed or not (check if the adult was under the influence of sedatives, hypnotics or other toxics: suffocation through crushing by body weight).
- g) Position of the body in the cot or bed (reminder of risk position: sleeping in the prone position on a soft surface with the head covered).
- h) Rule out suffocation by bedding or clothing cords and by head sliding between the cot and the mattress, etc.
- i) State of the cot: stains on sheet (vomiting).
- j) Hazardous objects near the child or in the cot/bed that could obstruct airways (electrical wiring, household appliances, cords, plastic bags, etc.).
- k) Existence of pets, rodents, etc.
- l) Findings of alcohol, drugs, medication and other toxic substances in the flat or near the child.
- m) Sampling at the time of removal of the body. Collect:
  1. The nappy and clothes worn at the time of death.
  2. Samples from the last bottle and formula used (breastfeeding or not).
- n) Photography during the removal.
- o) Check whether resuscitation has been attempted.

## **Preliminary diagnostic tests**

- a) Carry out radiological studies of the whole body (skull, spine, chest, abdomen, limbs) if indicated and feasible (study ossification centres and possible fractures).
- b) Photographic studies: whether or not there are injuries (negative photography).
- c) Taking fingerprints or footprints or specific samples for genetic identification.

## **AUTOPSY**

### **External examination**

It is important to record the time when the autopsy is performed.

- a) Description of race, apparent age, gender, hair colour, iris colour, birthmarks, etc.

- b) General appearance/development by age of the infant (presence of lanugo, etc.).
- c) Placement of ears and morphological abnormalities or deformities.
- d) State of maceration (as it is an infant there will only be maceration if found in a liquid medium), characteristics of the skin and loss of substance.
- e) Nutritional status (normal, deficient, obesity).
- f) Hydration: skinfold, fontanelle, eyes, tongue (normal, dehydrated, oedematous, pale).
- g) Weights and measures:
  - 1. Bodyweight.
  - 2. Total length (from skull vertex to heel).
  - 3. Length from skull vertex to coccyx.
  - 4. Head circumference (occipitofrontalis).
  - 5. Biparietal diameter.
  - 6. Chest circumference (by mammas).
  - 7. Abdominal circumference (by navel).
  - 8. Limb length.
  - 9. Other: external and internal intercanthal distance, interpupillary distance, intermamilar distance, philtrum length, etc.
- h) Assess:
  - 1. Skull: fontanelle, sutures, bone defects, etc.
  - 2. Neck: hygroma, length, etc.
  - 3. Trunk.
  - 4. Abdomen.
  - 5. Sexual characteristics: male/female (position testes, genital ambiguity, etc.).
  - 6. Limbs: changes in size, shape, number and position, etc. Presence and shape of nails, etc.
- i) Explore natural orifices (nose, mouth, ear, anal, urethral, vaginal) and eyes: rule out airway obstruction due to the presence of foreign bodies, food, vomiting, etc. Assess the presence or absence of secretions or blood in the mouth and nostrils.
- j) Rule out signs of violence and suspected child abuse (see recommendations for child abuse): particularly in the cephalic region (old scars on the scalp), chest, upper and lower limbs and external genitalia (ecchymosis, haematoma, lacerations, abrasions, burns, etc.).
- k) Check for presence of petechiae on skin and mucous membranes, conjunctiva, etc.
- l) Evidence of cardiopulmonary resuscitation: marks on face, abrasions to lips, chest ecchymosis, ECG suckers, defibrillator marks, venipuncture.

## Internal examination

- a) Complete autopsy preferably using en bloc evisceration.
- b) Frequent pathology summarised in Appendix 1.

## Sampling

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(See summary in Appendix 2.)

## Microbiological and virological studies

**Before beginning the autopsy** we recommend sampling nasopharyngeal aspirate, throat exudate, faeces, blood, serum, CSF, body fluids and swabs of any lesions.

**During the autopsy** we recommend sampling tissues, mainly spleen, lung, myocardium, brain, liver, bronchial swabs and purulent exudate.

All microbiological studies should be sent to the Biology Service at the Instituto Nacional de Toxicología y Ciencias Forenses in Madrid (Tel: +34 91 768 98 00) immediately; storage between 2 and 8°C. If shipping is delayed by more than 24-48 hours, the sample should be frozen at -70°C and the cold chain maintained during transport:

- a) Nasal aspirate for virological culture and blood for bacteriology (up to 48 hours after death).
- b) Lung samples for bacteriology and virology; heart and brain for virology; intestinal contents for bacteriology and virological studies if there is a history of diarrhoea.

## Study to detect botulinum toxin

Stool sample or stained nappy.

## Histopathological study (formol at 4%)

- a) Ways of sending samples
  1. Entire viscera en bloc.
  2. Thoracic viscera en bloc and abdominopelvic cavity en bloc (separating them).
  3. Organ by organ.

Bear in mind the age and weight of the infant when choosing each type.

All organs should be sent, whether the complete thoracic abdominal visceral block all together or the thoracic block and abdominal block separately in two containers. In both methods the digestive tract should be sent resected and opened for better preservation of the mucosa.

In cases with no clinical evidence or lack of macroscopic findings while performing the autopsy to explain the cause of death, it is highly recommended that the entire brain should be examined after formol fixation for 2 weeks.

- b) Recommended histopathological sampling
1. **Respiratory system:** vertical slice with epiglottis, vallecula and root of the tongue; larynx (slice with band, ventricle and vocal cord, larynx, trachea and main bronchi with carina nodes); lungs (a block of each lobe and one of each hili with carina nodes); tonsils.
  2. **Cardiovascular system:**
    - Send heart with vascular pedicle.
    - Send samples and keep heart in case reinclusions are required:
      - On the short axis (transverse direction) the middle third of both ventricles and the interventricular septum.
      - On the long axis (longitudinal direction), slice right and left atrioventricular including mitral and tricuspid valve (atria, valve and ventricle).
      - Conduction system (SA node, AV node, Hiss bundle and branches).
  3. **Digestive system:** tongue, proximal oesophagus (with pharynx oesophagus transition), salivary glands (submandibular), cardia, gastric body and pylorus, pancreas (with duodenal frame), small intestine (jejunum, ileum), large intestine (ileocecal valve and appendix), liver (a section of each lobe), mesentery (with mesenteric lymph).
  4. **Mononuclear phagocyte system:** sublingual and palatine tonsils, thymus, spleen, lymph nodes and bone marrow.
  5. **Endocrine system:** adrenals, thyroid with trachea (transverse).
  6. **Urinary tract:** a block for each kidney including cortical and medullary with renal calyces and pelvis.
  7. **Brain:** complete, according to the general rules. Weigh whole and also the brain separately from the cerebellum and stem. If sampling is conducted get: brain (frontal – middle portion – and lateral temporal lobe convexity, semioval centre, grey nuclei with internal capsule and lateral ventricle wall, calcarine fissure – occipital – thalamus, hippocampus, midbrain), cerebellar hemisphere with dentate nucleus, pons

(two levels), bulb with the obex (minimum), cervical spinal cord and meninges (if necessary).

8. **Musculoskeletal:** costochondral joint if possible from 5th and 6th right ribs (2 cm per side) (for study of growth plate), psoas iliacus muscle (fixed and non-fixed), diaphragm, sternal bone marrow or vertebral body (for haematopoietic cellularity study).
9. **Skin:** if there are injuries.

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### Chemical-toxicological study

- a) Peripheral blood (if not possible, take from heart) and urine.
- b) If there is no urine, take bile.
- c) Gastric contents and vitreous humour recommended.
- d) Where it is not possible to find samples of blood or elimination pathway, send viscera (50g of liver and gallbladder without preservative and fragment of lower renal pole of the kidney without preservative).

### Genetic studies

Blood, 5 ml, with anticoagulant (EDTA), frozen or at 4°C.

### Study of metabolic diseases: if applicable.

- a) Serum, plasma, cerebrospinal fluid and urine which should be frozen immediately at -20° C.
- b) Whole blood with heparin or EDTA (freeze at -20°C).
- c) Whole blood (1 drop) on filter paper.
- d) Skin biopsy (3-4 mm) for growing fibroblasts (to be put in a jar with physiological serum at room temperature with extreme sterility measures).

### San Diego criteria for diagnosis

(SIDS: *sudden infant death syndrome*.)

Diagnosis is essentially by exclusion after performing the autopsy, studying the medical history and investigating the circumstances of death.

- a) **CATEGORY IA SIDS:** includes infant deaths that meet the general criteria and all of the following criteria:



1. CLINICAL
  - >21 days (d) and <9 months (m) in age.
  - Normal medical history.
  - Pregnancy at term (gestational age 37 weeks or more).
  - Normal development and growth.
  - No similar deaths in siblings, close relatives (uncles/aunts or first cousins) or in children supervised by the same person.
2. CIRCUMSTANCES OF DEATH
  - Investigation of the scene and circumstances of death do not provide any explanations.
  - No evidence of an accident; safe environment in the place where the child slept.
3. AUTOPSY
  - No evidence of unexplained trauma, abuse, negligence or unintentional injury.
  - No fatal pathological findings in the autopsy (discrete inflammatory infiltrates in the respiratory system are accepted; intrathoracic haemorrhagic petechiae support the diagnosis but are not mandatory or pathognomonic).
  - No “thymic stress” (thymus weight < 15g and/or moderate to severe cortical lymphocyte depletion; occasional “starry sky” pattern of thymic macrophages or minor cortical depletion is accepted).
  - Toxicological, microbiological, radiological, vitreous biochemical and metabolic screening analyses are negative.
- b) **CATEGORY IB SIDS:** includes infant deaths that meet the general criteria except:
  1. There has been no investigation of the scene.
  2. And/or one or more of the toxicological, microbiological, radiological, vitreous biochemical and metabolic screening analyses have not been performed.
- c) **CATEGORY II SIDS:** includes infant deaths that meet the general criteria and for category I with one or more of the following exceptions:
  1. CLINICAL
    - Age different to the range in category I (younger than 21 days or older than 9 months up to 1 year).
    - Similar deaths in siblings, twins, close relatives (uncles/aunts or first cousins) or in children supervised by the same person.
    - Perinatal or neonatal pathology that was already resolved at the time of death (e.g., arising from a preterm delivery).
  2. CIRCUMSTANCES OF DEATH
    - Possible asphyxia or suffocation due to non-demonstrable crushing.

### 3. AUTOPSY

- Abnormal development or growth without contributing to the cause of death.
- Marked inflammatory changes or abnormalities not sufficient to cause death.

d) **UNCLASSIFIABLE SUDI (SUDDEN UNEXPECTED DEATH IN INFANCY) CATEGORY:** this includes deaths that do not meet any of the above criteria for inclusion in the various categories but where there is no alternative diagnosis of natural or violent cause of death. It also includes cases where an autopsy was not conducted.

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SIDS	Clinical criteria	Circumstances of death	Autopsy
<b>Category IA</b>	>21d - < 9m Normal medical history. Normal development and growth. No similar deaths	Investigation of the scene and circumstances. Safe environment	No fatal findings No trauma No thymic stress Additional studies negative
<b>Category IB</b>	>21d - < 9m Normal medical history Normal development and growth. No similar deaths	No investigation	One or more additional studies missing
<b>Category II</b>	< 21 d - > 9m Preterm Resolved neonatal pathology Similar deaths	Suspected mechanical asphyxia or suffocation (not proven)	Abnormal development and growth Marked inflammatory changes or abnormalities

## Specific causes of death

There are no specific causes (see Appendix 3).

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## **Appendix 1. Pathology found during the internal examination**

### **General**

- a) Nutritional deficit.
- b) Sepsis.
- c) Poisoning, suffocation, scalding.
- d) Hyperthermia (cystic fibrosis, congenital adrenal hyperplasia).
- e) Congenital metabolic disorders (e.g. defects in fatty acid oxidation).

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### **Cardiovascular**

- a) Congenital heart disease (hypoplastic left heart, hypertrophic cardiomyopathy, aortic stenosis).
- b) Myocarditis.
- c) Cardiomyopathy.
- d) Subendocardial fibroelastosis.
- e) Trauma (aortic rupture, cardiac tamponade).
- f) Coronary arteritis (Kawasaki disease).
- g) Total anomalous pulmonary venous connection.
- h) Idiopathic arterial calcinosis.
- i) Cardiac tumours.

### **Respiratory**

- a) Epiglottitis.
- b) Laryngotracheobronchitis.
- c) Bronchiolitis.
- d) Pneumonia/bronchopneumonia.
- e) Pulmonary hypertension.
- f) Bronchopulmonary dysplasia (chronic interstitial lung disease).
- g) Impaction of a foreign body.

### **Gastrointestinal tract**

- a) Enterocolitis with dehydration.
- b) Intestinal obstruction (volvulus, intussusception).
- c) Intestinal perforation with peritonitis.
- d) Visceral rupture with intestinal haemorrhage.

## Liver

- a) Hepatitis.
- b) Fatty liver (Reye syndrome, metabolic disorders).

## Pancreas

- a) Pancreatitis (viral, drug-induced).

## Kidney

- a) Pyelonephritis.
- b) Evidence of ischemia.

## Brain

- a) Meningitis, encephalitis.
- b) Arteriovenous malformations, intracerebral haemorrhage.
- c) Head injuries (skull fractures, subdural haemorrhage, diffuse axonal injury).
- d) Evidence of old or recent episodes of hypoxia and/or ischemia.

## Musculoskeletal system

- a) Soft tissue and bone: infections, inflammations.
- b) Fractures, dislocations.
- c) Skin and soft tissue injuries.

## Appendix 2. Diagnostic tests. Sampling. Other samples to consider

- a) **Bacteriology:** blood, respiratory tract; any infected lesion.
- b) **Virology:** post-nasal swabs or nasopharyngeal aspirate; lung; faeces if indicated.
- c) **Biochemical:** urine for metabolic and toxicology investigations; vitreous humour if there is suspicion of dehydration; bile; blood if there is strong suspicion of congenital metabolic disorders.
- d) **Toxicology:** at least peripheral blood, urine, vitreous humour, gastric contents (general sampling of toxics and determination of alcohol, or specify drugs in case of material suspicion).
- e) **Genetics:** blood or heart tissue sample.

## Appendix 3. Causes of death

- a) **Sudden unexpected death (group D):** accounts for 40% of cases, those with findings that show the cause of death. No doubt about the aetiology of death.
1. Infections: bronchopneumonia, interstitial pneumonia, bronchitis and bronchiolitis, septic processes, meningitis, laryngoepiglottitis.
  2. Cardiac malformations.
  3. Haemorrhages.
  4. Dehydration.
  5. CNS malformations.
  6. Anoxia.
  7. Anaphylactic shock.
  8. Tumours.
- b) **True sudden death:** in the remaining 60% of cases the autopsy findings cannot explain the cause of death.
1. **Genuine sudden death (group A or SIDS: Sudden Infant Death Syndrome):** sudden death without any anatomical pathological abnormality (20% of cases); negative autopsy.
  2. **The pathological lesions found are suggestive of the syndrome, but not specific, nor do they explain the cause of death (group B or SUDI: Sudden Unexpected Death in Infancy) (50% cases):**
    - Reactivity of the lymphoid system.
    - Lymph node enlargement.
    - Acute pulmonary oedema.
    - Thymus hyperplasia.
    - Visceromegalies.
    - Petechiae in thymus, pleura and pericardium.
    - Hepatic steatosis.
    - Signs of anoxia.
    - Local haemorrhages.
    - Adrenal hypoplasia.
  3. **Injuries or signs found could be the cause of death but due to their extension or intensity do not seem sufficient (group C or borderline) (30% of cases):** unexpected deaths that occur in children with an underlying pathology that makes them more vulnerable to certain intercurrent diseases which under other conditions would not be fatal.
    - Acrocyanosis.
    - Indirect signs of infection.
    - Source of infection.

- Aspiration.
- Lack of development.
- Non-fatal malformations.
- Airway secretions.
- Nutritional deficiency.

## **Sudden paediatric and early adolescent death**

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*Coordinators:* M. Teresa Marrón Moya, Manel Joan Salas Guerrero

### **Definition**

Any sudden death of a person older than one and less than 15.

Sudden death means any apparently natural and unexpected death that occurs:

- a) In cases witnessed: within approximately 1 to 6 hours after the start of symptoms.
- b) In cases not witnessed: the dead person must have been last seen alive and in stable condition at most 24 hours before having been found dead.

### **Inclusion criteria**

- a) Natural death (including cardiac arrests with resuscitation and subsequent death).
- b) Unexpected, in a healthy child or one in good health.

### **Problems to be solved**

- a) Rule out violent death: suffocation, choking, scalding, poisoning, foreign body impaction, head trauma, etc.
- b) Determine the cause of death: heart failure or other causes of sudden natural death.
- c) Genetic counselling for families in case of inherited disease: notify the family and refer them to the health services; keep frozen blood.
- d) Need for histopathological and toxicological and possibly microbiological study.



## Stages of life

- a) Early childhood: 1-3 years.
- b) Preschool: 3-6 years.
- c) School: 6-10 years.
- d) Adolescence: 10-19 years (early: 10-14 years).

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## Removal of the body

- a) Time and place of events.
- b) Symptoms prior to death (hours or minutes) and peri-mortal circumstances with special reference to physical activity or emotional stress.
- c) Direct and indirect witnesses.
- d) Previous medical care: resuscitation and treatment. Ask for medical documentation and collect it.
- e) Changes in body position made by medical staff, witnesses, etc.: who and why they did it.
- f) Examination of clothing. Placement, alteration, presence of organic remains.
- g) Photo report of the scene. Diagrams and maps with the positions of the body. Photograph the body before it is moved and from different angles. Photograph relevant aspects of the surroundings. Use metric photomacrographic scales.
- h) Post-mortem changes: description, position (stiffness, coldness, lividity, general or partial cadaverous spasm).
- i) Taking the body (rectal or subhepatic) and environmental temperature, especially if there is suspicion of death by heat stroke, hypothermia or delirium.
- j) Examination of the scene: disorder, presence of toxic substances, etc.

## History

Source of information:

1. Medical documentation.
2. Referred by family, friends or neighbours.

## Family history

Especially parents and siblings. It is important to know if there are other cases of sudden death. Hereditary diseases.

## Personal history

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### a) **Somatic:**

1. **Systemic or local organic diseases:** recent hospitalisation and causes, congenital malformations, prostheses, current drug treatment, previous school or sports check-ups with diagnostic tests (ECG, stress tests, etc.).
2. **Surgery:** details of admission and reason for surgery, type of surgery (technique).  
Ask for history from paediatrician/doctor usually attending: vaccinations, paediatric history, weights and heights.

### b) **Psychiatric**

1. **Psychiatric, psychological** disorder and current treatment: outpatient monitoring centre or psychiatrist treating them, suicide attempts and means used.
2. **Admission** in psychiatric centres: admission and discharge data. Centre.
3. **Alcohol, tobacco and drug use:** alcohol, drugs of abuse (toxic, usual dose and route of administration), admission to detoxification centres (details about admission or outpatient monitoring in detoxification centres).

### c) **Work and leisure**

1. **Studies and jobs.**
2. **Sports and leisure activities:** type of sport, intensity, registered with federation or not, frequency of doing sport, usual days for doing it, etc.

## Preliminary diagnostic tests

- a) It is recommended to do a general and detailed serial photo report with metric photomacrographic scales.
- b) Serial radiography if need be.

# AUTOPSY

## External examination

Bear in mind the differences between the body of a child and an adult:

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- a) Differences in proportions of certain viscera.
- b) Existence of physis in the long bones.
- c) Immaturity of sexual organs.

## Procedure

- a) The necropsy study should be performed as soon as possible (even more so if there is suspicion of infectious death: it should not be later than 24 hours and preferably within the first 15 hours). Take into account whether the body has been cooled and how.
- b) Detailed external examination, including natural orifices. Rule out head, buccal and labial and cervical injuries and external injuries consistent with violence.
- c) Nutritional status.
- d) Degree of hydration and cyanosis: examination of the skin (assessed best at nails and lips).
- e) Morphological changes compatible with congenital, hereditary or acquired malformations: description of type and intensity.
- f) Height, weight, head and chest circumference: determine growth development with reference to biological age.
- g) Description of old injuries or scars.
- h) Description of recent injuries (ecchymosis, haematomas, wounds, abrasions, etc.). Injury type, colour, measurements, topography and distance to reference points. Wide and close-up photography with metric photomacrographic scales. It is important to do the external examination of the face looking for lesions on the face, tears of the frenulum of tongue and conjunctival petechiae.
- i) Description of recent therapeutic and/or surgery signs. Resuscitation can produce lesions that may be confused with violence lesions; haematic infiltration in the soft tissues of the neck, face marks, lip abrasions that can be confused with occlusion lesions of the mouth or nostrils in cases of suffocation. Chest ecchymosis or defibrillator marks can lead to confusion.
- j) Time of death: evolution of post-mortem changes. Corroborate data from the removal of the body.

## Non-specific findings

The prone position is most common in younger children.  
Mucous material or foam around the mouth or nose.

## Internal examination

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### Procedure

- a) Dissection by layers and evisceration in a single block (preferably).
- b) Measure and weigh the different organs.
- c) Describe and photograph any anomalies.
- d) Careful macroscopic study of the heart and great vessels (see recommendations for sudden cardiac death in adults). The findings should be described and preferably photographed.
  1. Dimensions, morphology, weight, position relative to the other viscera, transposition of trunks, anomalous drainage, aortic or supra-aortic stenosis, aortic coarctation.
  2. Origin of coronary and angle, dominance, permeability with transversal incisions every 3 mm, myocardial bridges, dissections.
  3. Valvular circumference, chordae tendineae, etc.
  4. Thickness of ventricles and interventricular septum in the middle region, ventricular lesions, ventricular diameter, dimensions of the ventricles and relationship between them.
  5. Endocardial fibrosis, tumours, congenital abnormalities, conduction system, etc.

## Non-specific findings

No significant abnormalities are usually found except for those corresponding to the cause of death.

Common ones are:

- a) Visceral petechiae: thoracic, more frequent in the visceral pleura, epicardium and thymus. Their cause is unknown.
- b) Pulmonary congestion and oedema: increased weight, atelectasis areas (mosaic appearance), alveolar haemorrhage, bronchiolitis, pneumonia, excessive presence of macrophages in the alveolar lumen (indicative of previous hypoxia).
- c) Gastric contents: slightly tinged with blood, some degree of regurgitation associated with agony.

- d) Hyperplasia of lymphoid tissue: tonsils, mesenteric lymph nodes, thymus.

## Main causes of death

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- a) General: nutritional deficiency, sepsis, hyperthermia (cystic fibrosis, congenital adrenal hyperplasia).
  - b) Cardiovascular: **congenital heart disease** (left hypoplasia, hypertrophic cardiomyopathy, dilated cardiomyopathy, aortic stenosis), **myocarditis**, subendocardial fibroelastosis, trauma (aortic rupture, cardiac tamponade), coronary arteritis (Kawasaki disease), anomalous pulmonary venous drainage, idiopathic arterial calcinosis, cardiac tumours, **valvular disease**, endocarditis, **conduction system abnormalities**, primary arrhythmias, arrhythmogenic cardiomyopathy, origin, ectopia and anomalous courses of the coronary arteries, coronary bypass, coronary wall dissection.
  - c) Respiratory: epiglottitis, laryngotracheobronchitis, bronchiolitis, pneumonia, **bronchopneumonia**, pulmonary hypertension, pulmonary thromboembolism, bronchopulmonary dysplasia (chronic interstitial lung disease), **asthma**.
  - d) Digestive: **enterocolitis with dehydration, intestinal obstruction** (volvulus, intussusception), intestinal perforation with peritonitis, visceral rupture with intestinal bleeding.
  - e) Liver: hepatitis, fatty liver (Reye syndrome, metabolic disorders).
  - f) Pancreas: pancreatitis (viral, induced by toxic substances).
  - g) Renal: malformations, congenital disease (polycystic kidney disease), hydronephrosis, pyelonephritis, vasculitis, ischemia.
  - h) Central nervous system: **inhibition of brain centres** by haemorrhage, meningitis, encephalitis, arteriovenous malformations, epilepsy, tumours, evidence of episodes of hypoxia or ischemia, malformations (Arnold-Chiari, etc.).
  - i) Musculoskeletal system: infections, inflammations.

## Sampling in the autopsy

L'Instituto Nacional de Toxicología y Ciencias Forenses (INTCF) **recommendations** for this kind of death are:

## Samples of biological fluids

At least one peripheral blood sample and another from an elimination route (urine or bile) are recommended.

- a) Chemical toxicology:
  - 1. Venous blood: two full 5 tubes ml, no air pockets.
  - 2. Urine: as much as possible in a 50 ml security jar.
  - 3. Vitreous humour: all that can be got without damaging the ocular structures and in an appropriate tube to prevent air pockets.
  - 4. Bile: as much as possible.
  - 5. Gastric contents: as much as possible in a container suitable for its content.
- b) Genetic testing for inherited diseases:
  - 1. Frozen venous blood: one 5 ml tube with EDTA, frozen or at 4°C.
- c) Microbiology:

If infectious death is suspected, samples are collected before the start of the autopsy to avoid contamination.

  - 1. Blood: three 3 to 5 ml tubes, with prior disinfection of the area, first with an alcohol pad and then with antiseptic.
  - 2. Urine.
  - 3. CSF.
  - 4. Pharyngeal exudates or nasopharyngeal aspirate, bronchial aspirate: collect with two swabs, making several passes through the tonsillar area or areas of inflammation.
  - 5. Pleural effusions, abdominal, stool or purulent exudate.

In the event of queries call the INTCF's Microbiological Studies Section in Madrid on +34 91 768 98 00.
- d) Pericardial fluid for determining heart disease: as much as possible in suitable containers.

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## Visceral samples for histopathology

All samples should be sent in 4% formol, with a formol volume of 3 times the volume of the sample and in wide mouth plastic jars. Keep at room temperature.

### **Histopathological sampling is recommended in children under 2.**

It is advisable to send complete samples according to the sudden infant death recommendations.

Ways of sending samples:

- a) Entire viscera en bloc.

- b) Thoracic visceral en bloc and abdominopelvic cavity en bloc (separating them).
- c) Organ by organ.

If it is decided to send samples “organ by organ” or carry out inclusion, the following samples are recommended:

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- a) Respiratory system: epiglottis (vertical, with tongue root), vocal cord, larynx, trachea and main bronchi with carina nodes, lungs (a block of each lobe and one of each Hili with carina nodes). Tonsils.
- b) Cardiovascular system:
  1. Send heart with vascular pedicle.
  2. Send samples and keep heart in case reinclusions are required:
    - Transversal of middle third (both ventricles and the interventricular septum).
    - Longitudinal: atrioventricular block of posterior AV junction of the two ventricles with mitral and tricuspid posterior leaflet.
    - Conduction system (SA node, AV node, Hiss trunk and branches).
- c) Digestive system: proximal oesophagus (with pharynx oesophagus transition), salivary glands (parotid), cardia, gastric body and pylorus, duodenum with pancreatic head, pancreatic body and tail, small intestine (jejunum, ileum), large intestine (cecum and appendix), liver (a section of each lobe).
- d) Reticuloendothelial system: spleen, thymus, mesenteric lymph nodes, mesentery.
- e) Endocrine system: adrenals, thyroid with trachea (transverse).
- f) Urinary tract: a block for each kidney including cortical and medullary.
- g) Brain: complete, according to the general rules. If sampling is conducted get: brain (frontal lobe with semioval centre – pericallosal – lenticular striatum and thalamus, hippocampus), cerebellum, bulb with arcuate nucleus, cervical spinal cord and meninges.
- h) Skeleton: costochondral joint if possible from 5th and 6th ribs (for study of growth plate), psoas-iliacus muscle, diaphragm, sternal bone marrow or vertebral body (for bone marrow study).
- i) Skin: if there are injuries.

**Histopathological sampling is recommended in children over 2.**

- a) Brain (coronal slices) with dura mater, cerebellum, choroidal trunk and plexus: in a 3-litre container with plentiful formol if neurological death is suspected.

- b) Heart: whole. If aortic dissection is found, enclose it with the heart.
- c) Lungs: samples of the 5 lobes and hilar area (in two containers, one for each lung).
- d) Liver: two fragments measuring 2 cm, one from each lobe.
- e) Spleen: fragment measuring 2 cm.
- f) Pancreas: two fragments, one of the head and the other of the tail.
- g) Adrenal glands: whole.
- h) Kidneys: half of each kidney.
- i) Sternum or femur: 3-4 cm fragment in formol for bone marrow study.
- j) Other visceral samples according to the autopsy findings and medical or family history.

## **Visceral samples in case of suspected infectious death**

Samples sent in complete and appropriate aseptic conditions in 3 cubic cm fragments.

- a) Lung: samples of each lung lobe in 1 cubic cm fragments.
- b) (Be careful: macroscopic lung study in infant deaths can be misleading in terms of infections).
- c) Spleen.
- d) Myocardium.
- e) Central nervous system.
- f) Kidney.
- g) Liver.
- h) Adrenal glands.

All samples are to be packaged and sent in accordance with the regulations of the Instituto Nacional de Toxicología y Ciencias Forenses under Order JUS/1291/2010, of 13 May.  
<http://www.boe.es/boe/dias/2010/05/19/pdfs/BOE-A-2010-8030.pdf>

## **Diagnostic criteria**

- a) Exclude other types of death.
- b) Relevant findings at autopsy of any kind from the internal or external examination.
- c) Assess medical history, circumstances, histopathology and chemical toxicological analysis.  
They often act together and are multi-factor.



1. Anatomical factors.
2. Functional factors or triggers.

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## Infant body removal report

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*Coordinators:* Geli Gallego Herruzo, M. Teresa Marrón Moya

### Introduction

The information obtained when removing the body and examining the death scene is the basic element for a full investigation of the death of the child. It helps the medical examiner to establish hypotheses about the aetiology, cause and mechanism of death, to analyse it and relate it to the post-mortem findings.

Medical examiners need uniform policy recommendations in order to standardise our performance in the removal of the bodies of children. In these cases, it is important to know the medical history, conduct an assessment of environmental conditions which may help to understand the risks associated with sudden infant death, find out the rest of the data from the scene and carry out a complete study of the body.

In this paper we provide some structured recommendations to help the medical examiner removing the body to collect the specific data referred to in the international literature in this kind of removal of the body.

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Magistrates Court number ..... of .....  
(duty) Procedure: Investigation .....  
number .....

## Infant body removal report

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Dr ....., the duty medical examiner of this Institute, under the oath that they have made to well and faithfully exercise their office, reports that, with the permission of the magistrate and pursuant to Article 778 of the Criminal Procedure Act, they have attended the judicial process of removing the body conducted in ..... Street, in ..... at..... on ....., to report on its “state, identity and circumstances, especially all those relevant to the facts”.

### POLICE LIAISON OFFICER

Force and Badge No.: .....

### IDENTIFICATION DETAILS

Name: .....

Age: ..... Date of birth: .....

Sex: ..... Nationality: .....

Means of identification (family record book, identity card, passport, vaccination): .....

Name of relative, telephone number and relationship to the deceased:  
.....  
.....

### DEATH DETAILS

Month: ..... Day: ..... Time: .....

Time when was last seen alive and by whom:  
.....

Death witnessed: Yes  No

Town:  Address

Hospital: DOA  Death in resuscitation

Death on ward

Time of arrival at the hospital: .....

Person bringing them: .....

Other (kindergarten, street)

Resuscitation: Yes  No

Parents or other (specify)

EMS

Date and time of the conclusion of resuscitation:  
.....

**Treatment administered by the EMS and/or hospital:**

Medication: .....

Doses: .....

Date and time of administration: .....

Route of administration and anatomical location: .....

Medical devices used or inserted: .....

Brief explanation of the facts (indicate who gives the account: doctor, caregiver, grandparents, parents, etc.): .....

.....

**Antecedents (see expanded medical history appendix)**

Sources of information: documented  referred

Medical history: Yes  No

History of abuse: Yes  No

**In the 24 hours prior to death:**

Date and type of food last eaten: .....

Recent change of diet: .....

Medical/hospital care: Yes  No

Diagnosis: .....

Recent trauma or injury: Yes  No

Recent fall: Yes  No  Height ..... cm

Surface on which fell: .....

Activity of the child after the fall: .....

Recent changes in routine behaviour: Yes  No

Changes of residence in the last 24 hours: .....

Means of transport: .....

People in contact: .....

**In the 48 hours prior to death:**

Drowsiness, irritability or excessive crying: Yes  No

Changes in appetite: Yes  No

Episode of vomiting or choking: Yes  No

Fever or excessive sweating: Yes  No

Diarrhea or stool changes: Yes  No

**In the 72 hours prior to death:**

Vaccinations: Yes  No  (specify)

## Removal of the body or subsequent visual inspection of the scene of death (Despite the transfer of the body to the hospital)

### BODY

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#### General details:

Location of body:

Cot  Pram/pushchair  Sofa  Parent's bed   
Bed  Ground  Co-sleeping  Other

Suspected use of hypnotics/toxic substances by the adult who shared the bed with the child:

Yes  No

Body position:

Supine  Prone  Side  Other

Changes in body position:

Yes  No

Who and why?: .....

Position of the face when was found:

Left  Right  Face down  Face up   
Nose or mouth blocked or obstructed  Unknown

Slept with face resting on the pillow:

Yes  No

Sharp change of sleep position:

Yes  (specify) No

Change of the bed and/or room to sleep:

Yes  (specify) No

Amount and type of clothing of the body at the time of death (describe): .....

#### Determination of time of death:

Lividity: .....

Rigidity: .....

Dehydration: .....

Body cooling: .....

Putrefaction: .....

Circumstances that modify the determination of time of death:

Body temperature: ..... °C (If there is suspicion of sexual abuse, do not insert the thermometer in the rectum and/or vagina)

Ambient temperature: ..... °C

Orientation of the determination of time of death: .....

**Particular signs:**

**Injuries:**

Yes  No

Suspected abuse: Yes  No

Suspicion of suffocation or asphyxiation: Yes  No

**Signs of natural disease** (presence of secretions, skin colour, rashes, etc.): .....

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**Other:** .....

**SCENE**

Location of cot: .....

Soft or concave sleeping surface:

Yes  (specify) No

Amount and type of covering, stains on cot or bed, mattress twists (describe):  
.....

Total number of people living in the home:

Adults ..... Children .....

Number of smokers in the home: .....

Severe physical and/or mental illness of relatives:

No  Yes  (specify)

Sources of heat or cooling in operation near the body:

Yes  No

Hygiene/health conditions of the home:

Adequate  Not adequate

Pets:

Yes  No

Untidy environment:

Yes  No

Presence of medicines, homemade remedies or residual odours in the room or home:

Yes  No

Evidence of alcohol or drugs (and their paraphernalia):

No  Yes  (specify)

Biological or other evidence (description and location):

Yes  No



## COLLECTION OF SAMPLES AND DESTINATION

- |   |  |
|---|--|
| <input type="checkbox"/> Nappy ( <i>assess collection</i> ):  | <input type="checkbox"/> Child medicine: |
| <input type="checkbox"/> Baby's clothing:                     | <input type="checkbox"/> Syringes:       |
| <input type="checkbox"/> Bedding:                             | <input type="checkbox"/> Weapons:        |
| <input type="checkbox"/> Dummy:                               | <input type="checkbox"/> Other:          |
| <input type="checkbox"/> Bottle ( <i>assess collection</i> ): |  |

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**PHOTO REPORT** and/or diagram or sketch of the scene:  
By:

Recommended photos:

- Body and immediate surroundings.
- Baby's face.
- Location where body found.
- Sleeping surface, where the body was found, with and without body.
- Components or other items that could have been in the bed with the baby.

### MEASURES

- Police are informed of the requirement to find family, tell them the death has occurred and that they have to go to the court.
- Police are informed of the requirement to start identification process with scientific validity.

Plantar study can be done:

- From this time onward when the Police see fit.
- When the medical examiner authorises it when doing the judicial autopsy.

### REMARKS

The duty magistrate judge is advised due to the circumstances of the case.

### PROVISIONAL CONCLUSIONS

#### Medical and legal aetiology:

- |  |                                     |                                     |
|--|-------------------------------------|-------------------------------------|
| <input type="checkbox"/> Natural death:      | <input type="checkbox"/> Sudden     | <input type="checkbox"/> Not sudden |
| <input type="checkbox"/> Violent death:      | <input type="checkbox"/> Accidental | <input type="checkbox"/> Homicide   |
| <input type="checkbox"/> Indeterminate death |                                     |                                     |

#### Diagnostic orientation on the cause of death:

Having been read and approved, signed by the medical examiner and magistrate. I hereby attest.

# Expanded medical history appendix

## HISTORY

Information source:  Documented  Referred  
Data from the prenatal and perinatal periods:

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**Use of assisted reproduction:**  Yes  No

Prenatal care:

Folic acid supplement:

Medication during pregnancy:

Pregnancy monitoring: Yes  (from which month) No

Complications during pregnancy:

Alcohol, tobacco and drug use of the mother during pregnancy:

Smoking  quantity/day

Alcohol  quantity/day

Drugs  type and dosage/day

Prenatal diagnosis:

Ultrasound diagnosis:

Amniocentesis: Karyotype: .....

Biochemical screening ( $\alpha$ -fetoprotein,  $\beta$ HCG):

TORCH (Toxoplasmosis, Rubella, Cytomegalovirus, Herpes) serology:

GBS vaginal culture (Streptococcus agalactiae):

### Delivery:

Gestational age/DLP (Date Last Period):

Date and time: .....

Birth: Hospital  Home  Other

With medical care: Yes  No

Foetal monitoring: Yes  No

Difficult labour: Yes  No

Duration of labour:

Birth: Single  Multiple

Spontaneous labour  Induced  Caesarean

Presentation: Cephalic  Breech  Buttocks

Amniorrhexis: Spontaneous  Provoked

Amnionitis: Yes  No

Foetal distress: Yes  No

Other birth complications:

Placenta:

Weight: .....

Alterations: No  Yes  .....

Birth weight: Height: ..... Head circumference: .....  
Apgar 1' ..... Apgar 5' ..... Resuscitation: Yes  No   
Newborn blood group: A  B  O  AB  Rh: +  -

**Data from neonatal and postnatal periods:**

Breastfeeding: Natural  Artificial  Mixed

Vaccinations and type (date of last vaccination):

Behaviour: Calm  Nervous

Crying: Loud  Normal  Weak

Child's usual position:

Supine

Prone

Side

Sleep: Peaceful

Excited

Crying

Shared bed with parents: Yes  No

Slept in room with parents: Yes  No

Use of dummy: Yes  No

Neonatal jaundice: Yes  No

Days lasted:

Sweating during sleep: No  Little  Important

Paediatric care:

**Mother's history:**

Age:

Nationality:

Civil status: Married  Lives with partner  Single

Widow  Separated  Divorced

Education: Elementary  Medium  High

Occupation:

Labour activity: Works  Unemployed

Alcohol, tobacco and drug use: Smoking  Alcohol

Drugs  (specify type and how taken):

Pathological history: HIV+  HBV+  HCV+

Other infections:

TPAL (Term, premature, abortion, live births) gynaecology obstetrics  
formula: .....

Blood group: ..... Rh: .....

Previous pregnancy/pregnancies: Normal  Pathologic  (cause):

History of sudden death in other children: Yes  No

**Family history:**

Sudden death of siblings whether biological or not:

No  Yes  (specify dates and ages):

Other sudden deaths in the family: No  Yes  (specify):

Congenital and hereditary diseases: No  Yes  (specify):

Criminal or social services records:

No  Yes  (specify dates and reasons):

History of gender or family violence:

No  Yes  (specify):

**Family social situation:**

Type of home: Adequate  No adequate (specify):  
Type of residence: House  Flat   
Social level: High  Medium  Low   
Father: Nationality ..... Age ..... Job .....

**Child's main caregiver:**

Identification: .....  
Ethnicity, religion: .....  
Mental/physical state (stressors, alcohol, Mental Health Services):  
.....

**Other people connected with the child:**

Reaction of the people living in the home to the death of the child  
(special importance of the child's main caregiver):

## **Foetal/perinatal, child and early adolescence autopsy**

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*Authors:* Gemma Cardona Tur, Josep Castellá García, Raquel Esgueva Pallarés, Gabriel Font Valsecchi, Geli Gallego Herruzo, Vania Landívar Freire, M. Teresa Marrón Moya, M. Pilar Pérez Boutón  
*Coordinators:* Vania Landívar Freire, M. Teresa Marrón Moya

### **Introduction**

Paediatric autopsy is different to adult autopsy. A child is not a “small adult”; pathology and clinical manifestations, their evolutionary characteristics from the perinatal period to adolescence and morphological findings mean specific recommendations are needed for data collection at autopsy.

We have drawn up a paediatric and adolescent autopsy document which makes a distinction between children aged under and over 2 in external examination. The document includes specific anthropometric measures and uses specific items to refer to the most frequent pathologies by age groups. It also adds failure to give basic care and asphyxia while co-sleeping as another kind of violent death.

Careful external examination is especially required in these medico-legal autopsies because it may provide essential information about the mechanism and cause of death. En bloc cervical, chest and abdominal and pelvic evisceration is preferable in sudden infant death. It is important to study the placenta and umbilical vessels in perinatal deaths.

In child deaths, samples should be collected for further studies as needed including microbiological, toxicological, histopathological and genetic ones. Microscopic examination should also be conducted for sudden deaths in these age groups since most of the causes of death will not be detected by macroscopic examination.

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Division of  
Autopsy room of

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**FOETAL/PERINATAL, CHILD AND EARLY ADOLESCENCE  
AUTOPSY**

**Autopsy no.** .....  
**Last name :** ..... **Forename:** .....  
**Magistrates Court no.** ..... **of** .....  
**Proceedings:** ..... **No.** ..... / .....  
**Origin:** .....  
**Removal of body:**      **Date** .... / .... / ..... **Time:** ..... **Doctor:** .....  
**Autopsy:**                      **Date** .... / .... / ..... **Time:** .....  
**Medical Examiners:** .....  
**Technical Staff:** .....  
**Catalan Police/National Police:** .....

**CIRCUMSTANCES OF DEATH**

**MEDICAL HISTORY (child and relatives)**

**CLINICAL INFORMATION DATA PROVIDED**



# External examination

## EXAMINATION OF CLOTHING AND OBJECTS

Clothing of forensic medical interest  Yes  No

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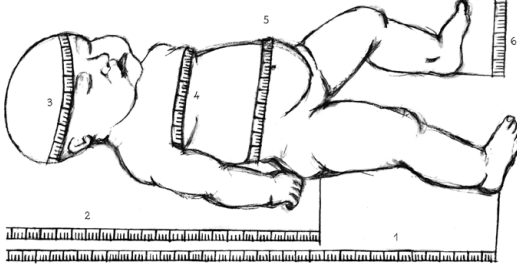
### Option A: \* Foetus,\* Perinatal and Children up to 2

(\*) The asterisk indicates options to collect only for foetus and perinatal.

#### IDENTIFICATION and ANTHROPOMETRIC DATA

Actual weight ..... Expected weight .....

#### Measurements:



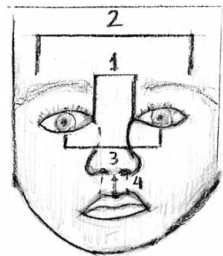
Measurements	
Length vertex-heel	
Length vertex-coccyx	
BPD (biparietal diameter)	
P. cephalic	
P. thoracic (at the nipples)	
P. abdominal (at the navel)	
Foot length	

#### Percentile for weight:

#### Percentile for size:

#### Percentile for head:

- Internal intercanthal distance<sup>1</sup> ..... cm
- External intercanthal distance<sup>2</sup> ..... cm
- Interpupillary distance<sup>3</sup> ..... cm
- Philtrum distance<sup>4</sup> ..... cm
- Intermammary distance ..... cm



\*Gestational age ..... weeks

Age (years and months)

Hygiene habits:  Good  Deficient Description:

\*Maceration: No  Cutaneous I  Cutaneous II   
 Cutaneous and visceral III  Cutaneous and visceral IV

\*Presence of lanugo: Yes  No

Hair: Facial: Yes  No   
 Body: Yes  No

**Geographical ancestry:**  Caucasian  Negroid  Asiatic  Other

**Hair:**  Absent  Present

Colour:  Black  Brown  Blonde  Redhead  Other

Length:  Shaved  Short  Medium (above the shoulders)

Long (below the shoulders)

Type:  Straight  Wavy  Curly  Other

**Eye colour:**  Brown  Black  Blue  Green  Other

**Dental study:**  Yes  No

Presence of teeth:  Yes  No

Upper arch teeth: .....

Lower arch teeth: .....

**SPECIAL MARKS**

**Scars:**  Yes  No

**Other:** .....

**SIGNS OF NATURAL PATHOLOGY**

**Skin/mucous membranes/nails:**

Birth marks: Yes  No

Jaundice: Yes  No

Pallor: Yes  No

Acrocyanosis: Yes  No

Petechiae: Yes  No

Rash: Yes  No

Other (scars, etc.)

**Dehydration:** Yes  No

Oedematous: Yes  No

**Skull and face:**

Normal configuration: Yes  No

Scalp and hair normal: Yes  No

Normal bone consistency: Yes  No

Bone abnormalities: Yes  No

**Eyes:**

Anomalous position: Yes  No

Abnormal conjunctiva: Yes  No

Jaundice: Yes  No

Cataracts: Yes  No

Petechiae: Yes  No

Other:

**Ears:**

Ear malformations: Yes  No   
 Ear placement: Normal  High  Low   
 Other:

**Nose:**

Normal configuration: Yes  No   
 Deviation of the septum: Yes  No   
 Choanal atresia: Right  Left  No   
 (bucconasal membrane of Hochstetter should break between day 35 and 38 of embryonic life)  
 Other:

**Tongue:**

Macroglossia: Yes  No   
 Abnormal fraenum: Yes  No   
 Other:

**Palate:**

Joined: Yes  No (cleft lip)  No (hare lip)   
 Prominent arch: Yes  No  Other: .....

**Jaw:**

Micrognathia: Yes  No  Other: .....

**Neck:**

Hygroma: Yes  No  Length shortened: Yes  No   
 Other: .....

**Trunk:**

Pectus excavatum: Yes  No  Pectus carinatum: Yes  No   
 Other:

**Abdomen:** Bloating: Yes  No Hernias: Yes  No 

Other: .....

**Navel:**Normal: Yes  No \*Presence of cord: Yes  No \*Normal cord (2 arteries, 1 vein): Yes  No  Abnormalities: .....**\*Placenta:**

Weight ..... Measurements ..... X ..... X .....

Cord length ..... Vessels .....

Cord insertion in the placenta:

Central  Marginal  Eccentric  Velamentous 

Weight at birth ..... Expected weight .....

**\*Membranes:** transparent or not, meconium, colour, exudates:

**External genitals:**

Ambiguous Yes  No : Male  Female   
Malformations: Yes  No

**Testicle:**

Descended: Yes  No   
Position: Intra-abdominal  Inguinal   
Other:

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**Anus:**

Imperforate: Yes  No   
Other:

**Extremities:**

Alterations in size and/or shape: Yes  No   
.....  
.....  
\*Presence and shape of nails: .....  
.....  
\*Folds of hands and feet: .....

**Other:**

NATURAL ORIFICES

**Nose:** \*Permeability: Yes  No   
Secretions: Yes  No   
**Mouth:** \*Permeability: Yes  No   
Secretions, sputum, vomit: Yes  No   
**Ears:** \*Permeability: Yes  No   
Secretions (blood, pus, serous)

**Other:**

ADDITIONAL IDENTIFYING TESTS

**No** not considered necessary  
 **Yes:**  
 Radiology  Fingerprint study  Plantar study  
 Photography  Filming  Other

## Option B: Child from 2 to 14

**Weight:** ..... (Percentile weight: .....) **Height:** ..... (Percentile height: .....)

**Age (years and months):** ..... **Sex:** Male  Female

**Nutritional status BMI (kg/m<sup>2</sup>):** .....

**Abdominal circumference:** .....

**Hygiene habits:**  Good  Deficient Description: .....

**Geographical ancestry:**  Caucasian  Negroid  Asiatic  Other

**Hair:**  Absent  Present Other (ringworm, etc.): .....

Colour:  Black  Brown  Blonde  Redhead  Grey  
 White  Dyed

Length:  Shaved  Short  Medium (above the shoulders)  
 Long (below the shoulders)

Type:  Straight  Wavy  Curly  Other

**Hair:**

Facial:  Absent  Moustache  Beard  Goatee  Sideburns  
 Black  Brown  Other

Chest and genitals:  Normal  Anomaly Gynecoid/Android

**Eye colour:**  Brown  Black  Blue  Green  Other

**Dental study:** Yes  No

**Special marks:**

Scars: Yes  No

Tattoos and piercings: Yes  No

Other: Yes  No

**SIGNS OF NATURAL PATHOLOGY**

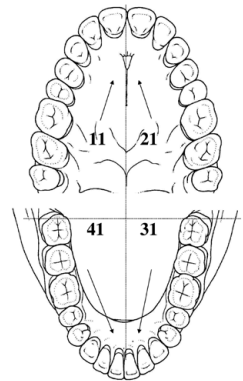
**Skin/mucous membranes/nails:**

**Musculoskeletal system:**

**Other:**

**NATURAL ORIFICES**  Unaltered

Specify pathology



**ADDITIONAL IDENTIFYING TESTS**

No not considered necessary

Yes:

Radiology  Fingerprint study  Photography  
 Filming  Other

**Option A and B: from foetus to 14**

## POST-MORTEM CHANGES

**Cooling:**  Yes  No**Lividity:**

a) Distribution:

Head and neck:  anterior  posterior  right /  left sideTrunk:  anterior  posterior  right /  left sideArms:  anterior  posterior  right /  left sideLegs:  anterior  posterior  right /  left side

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b) Colour:  Black vinous  Pink  Otherc) Intensity:  Dark  Lightd) Fixation:  No  Partial  Total**Rigidity stage:** Start  State  Resolution**Body temperature:** ..... °C (rectal)**Putrefaction:** Chromatic  Emphysematous  Colliquative Skeletal reduction**Cadaveric fauna:****Preservation:** Mummification  Saponification  Sealed zinc or lead container Freezing  Other:SIGNS OF RECENT THERAPY AND/OR SURGERY: Yes  No  Intravenous access Recent surgical wound Defibrillator marks ECG electrodes/suction caps Marks on face (abrasion on lips, etc.) Thoracic ecchymosis Endotracheal tube

(check location of tube end in the internal examination)

 Vascular catheter

(check location of the catheter tip in the internal examination)

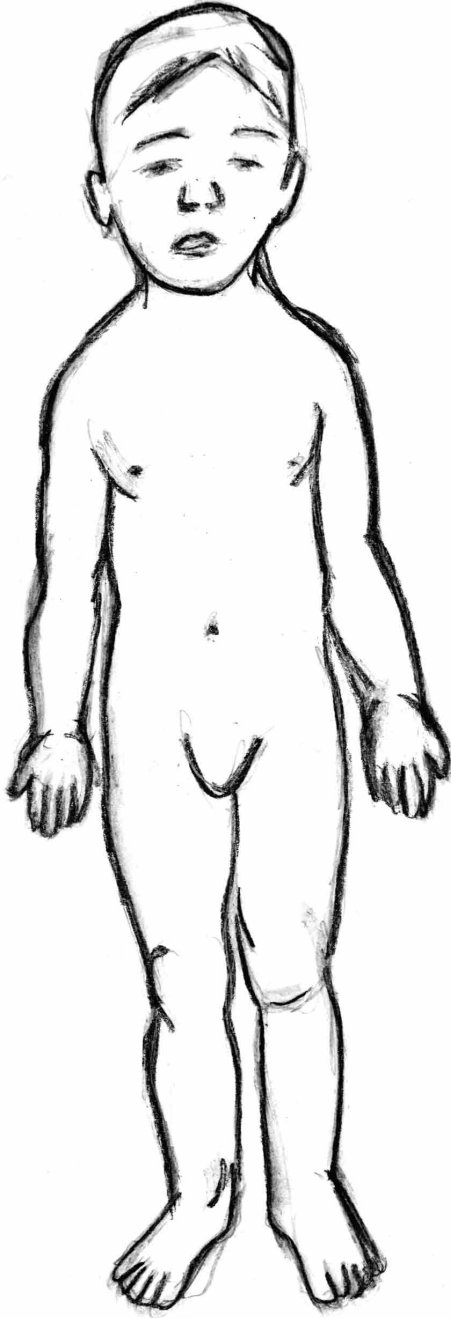
 Other

**SIGNS OF VIOLENT PATHOLOGY  
FRONT**

No     Yes

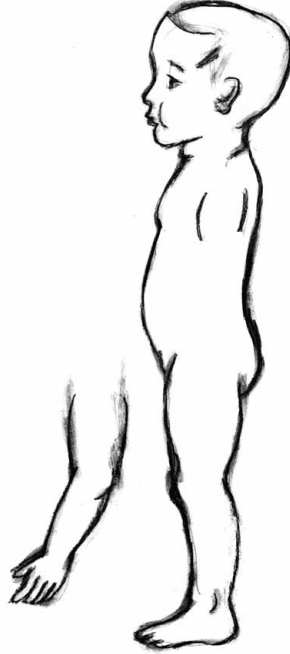
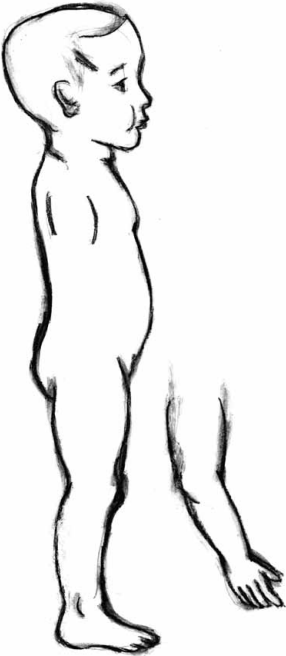
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**SIGNS OF VIOLENT PATHOLOGY  
LEFT AND RIGHT SIDES**

No     Yes





## SIGNS OF VIOLENT PATHOLOGY BACK

No     Yes



**Signs of recent violence in the external genital and/or anal region:**

No     Yes

**Signs of self-defence and/or struggle:**

No     Yes



## MOUTH AND NECK

**Subcutaneous tissue of the neck, muscles (muscles of the floor of the mouth, fraenum, soft and hard palate), pharyngeal pillars, uvula and posterior pharyngeal wall:**

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**Palatine tonsils, sublingual, submandibular glands and val-  
lecula (hypopharynx):**

**Tongue (teeth marks, other):**

**Cervical nerve vascular structures:**

**Pharynx:**

**Larynx (epiglottis):**

Presence of foreign bodies: Yes  No

Epiglottis: Yes  No

Narrow opening: Yes  No

Epiglottis: Yes  No

Other:

**Hyoid and thyroid membrane:**

**Thyroid:**

Cartilage:

Gland: ..... g

**Cricoid:**

**Trachea:**

Content:

Presence of foreign bodies: Yes  No

Mucous plug: Yes  No

Exudate obstruction: Yes  No

Aspirated gastric contents: Yes  No

Other:

Malformations (fistula, etc.):

Mucosa:

Location of endotracheal tube:

**Oesophagus:**

\*Oesophageal atresia: Yes  No

Content:

Stenosis, diverticula, tracheoesophageal fistula, etc.

Mucosa:

**Ganglia (laterocervical, other):**

**Other:**



**THORACIC CAVITY**

**Subcutaneous and muscle tissue:**

**Ribs and sternum:**

Rib fractures with bleeding: Yes  No

Rib fractures with callus formation: Yes  No

Other:

**Thymus:** ..... g      **Size:** ..... x ..... x ..... cm.

Lobulation:

Atrophy:      Yes       No

Petechiae: Yes Dorsal  Yes Ventral       No

**Situs inversus:** Yes  No

**Mediastinal lymph nodes:**

**Pleura and pleural cavity:**

Effusion (ml):  Transudate:  Exudate (serous, fibrinous, purulent):  
 Haemorrhagic:

Adhesions:

Parietal pleura petechiae: Yes Dorsal  Yes Ventral  No

Other:

**Lungs:**

**Right lung** ..... g Lobulation: Yes  No

Visceral pleura petechiae: Yes Dorsal  Yes Ventral  No

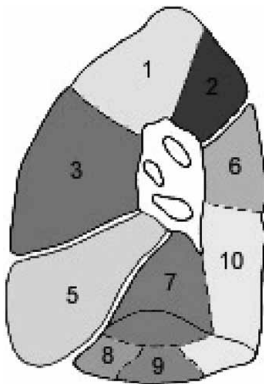
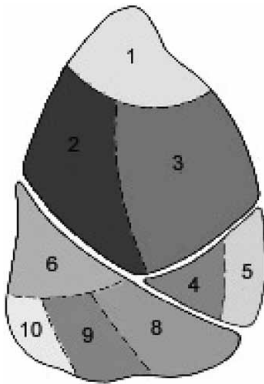
\***Pulmonary hypoplasia:** No  Yes  (pulmonary index < 0,013)

**Pulmonary index** (ratio: lung weight/body weight) .....

\***Hydrostatic pulmonary docimasia:** No  Yes

Positive  Negative  Indeterminate

**Description:**



**Left lung** ..... g Lobulació: Yes  No

Visceral pleura petechiae: Yes Dorsal  Yes Ventral  No

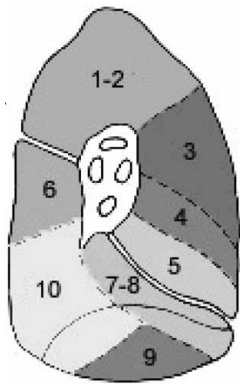
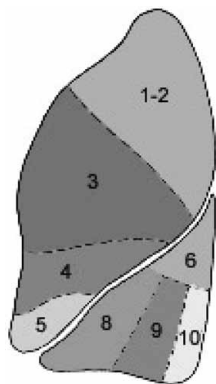
\***Pulmonary hypoplasia:** No  Yes  (pulmonary index < 0,013)

**Pulmonary index** (ratio: lung weight/body weight) .....

\***Hydrostatic pulmonary docimasia:** No  Yes :

Positive  Negative  Indeterminate

**Description:**



**Pulmonary arteries:**

**PTE:** Yes  No

Other:

**Lung hili:**

**Airways. Main bronchi:**

Content:

- Presence of foreign bodies: Yes  No
- Mucous plug: Yes  No
- Obstructive exudate: Yes  No
- Aspirated gastric contents: Yes  No
- Other:

Mucosa:

**Lymphatic / blood pathways:** Yes  No

**Mediastinum:**

**Pericardium:**

Spill (ml):

Adhesions:

Petechiae: Yes Dorsal  Yes Ventral  No

Other:

**Heart:**

**Weight** ..... g      **Expected weight** ..... g

Epicardial petechiae: Yes Dorsal  Yes Ventral  No

Epicardial adiposity: Normal  Reduced  Other:

Tricuspid ..... cm

Pulmonary ..... cm

Mitral ..... cm

Aortic ..... cm

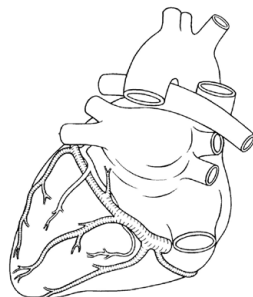
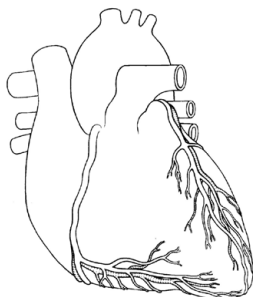
RV ..... cm

LV ..... cm

Septum ..... cm

RV cavity diameter ..... cm

LV cavity diameter ..... cm



- \*Patent foramen ovale:                    Yes     No
- \*Patent ductus arteriosus:            Yes     No
- \*Aortic coarctation:                    Yes     No
- Congenital heart disease:            Yes     No
- Atrial Septal Defect:                    Yes     No
- Ventricular Septal Defect:            Yes     No
- Anomalous pulmonary venous drainage:    Yes                     No
- Post-surgery status:                    Yes     No

Muscle tone:

escription:

**Coronary arteries**

- Coronary ostium: Patent:                    Yes     No
- Normal implantation:    Yes     No
- Right dominance                     Left dominance                     Codominance

**Aorta and great vessels**

Location of the vascular catheter tip:

**ABDOMINAL CAVITY**

**Situs inversus:**                    Yes     No

**Diaphragm:**

Diaphragmatic hernia    Yes     No

Other:

**Abdominal wall (subcutaneous and muscle tissue):**

Subcutaneous tissue thickness (1 cm below the navel): ..... cm

**Peritoneum:**

Spill (ml):                    Serous (ascites)     Fibrinous     Purulent

Haemorrhagic

Adhesions:

Petechiae:    Yes Dorsal                     Yes Ventral                     No

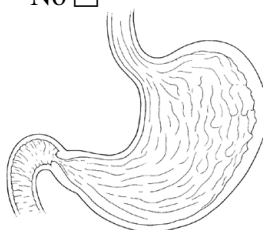
Other:

**Stomach:**

Content (volume):

Fundic (fundus and body) and antral mucosa:

Pylorus (stenosis):





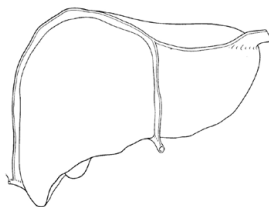
**Liver:** ..... g

**Smooth capsule:** Yes  No

**Lobulation:** Yes  No

**Colour:**

**Consistency:**



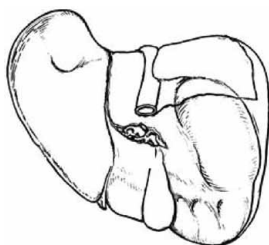
**Gall bladder and bile ducts:**

Lithiasis Yes  No

**Permeability of the bile duct**

**(choledochal up to the ampulla of Vater):**

Other:

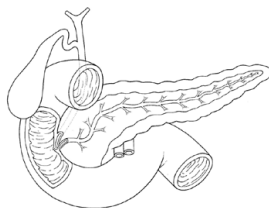


**Spleen:** ..... g

**Accessory spleens (splenunculus)**

**Pancreas:** ..... g

**Duct patency:**



**Small intestine (size)**

\*Necrotising enterocolitis: Yes  No

\*Intussusception: Yes  No

\*Meckel's diverticulum: Yes  No

\*Volvulus: Yes  No

\*Other:

Content:

**Large intestine and appendix (size):**

Appendectomy: Yes  No

\*Necrotising enterocolitis: Yes  No

\*Other:

Content:

**Mesentery and mesenteric arteries. Great vessels:**

**Mesenteric lymph:**

**Retroperitoneum:**

**GENITOURINARY SYSTEM**

**Adrenal: Right ..... g Left ..... g**

**Kidneys: Right ..... g Left ..... g**

**Ureters (malformations or not):**

**Urinary bladder (malformations or not):**

Content:

Anomalies:

**Genital system:**

Uterus:  not gravid  gravid

Ovaries and adnexa:

Prostate, testes and penis:

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**AUTOPSY OF LIMBS** (notes page)

**AUTOPSY OF SPINE** (notes page)

**MEDULLA STUDY:**

Inflammation  Contusions  Other

**OTHER: EYE, MIDDLE EAR, FACE, PEEL-OFF** (notes page)

## MACROSCOPIC DIAGNOSIS

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## DIAGNOSTIC TESTS

### TOXICOLOGICAL / BIOLOGICAL / BIOCHEMICAL STUDY

Place:  IMLC Laboratory     INT     Other

Samples sent:

- Sang
- Urine
- Bile
- Vitreous humour
- Nasal    /     oral swab
- Vaginal    /     rectal swab
- Vaginal    /     rectal wash
- Viscera: .....
- Other: .....

Studies requested:

### HISTOPATHOLOGY STUDY

Place:  IMLC Histopathology Unit     INT     Other

Samples sent:

- Brain
- Orocervical and thoracic block, if needed
- Thymus
- Heart and great vessels
- Lungs
- Liver
- Pancreas
- Stomach (cardia, gastric fundus wall, body and antrum, and pylorus)
- Spleen
- Adrenal glands
- Kidneys
- Bone marrow
- Other: .....

Studies requested:

### GENETIC STUDIES

Place:  IMLC Laboratory     INT     UGD-IDIBGI     Other

Samples sent:

Studies requested:

### OTHER STUDIES

Place:

Samples sent:

Studies requested:

## **FORENSIC MEDICAL CONSIDERATIONS**

**1- DEATH MECHANISM**

**2- OTHER**

# CONCLUSIONS

- Final     Provisional (pending results)

## 1. Type of death:

### Natural

### Violent. Type of violent death

- Gunshot
- Sharp force trauma
- Blunt force trauma
- Asphyxia
  - Strangulation / suffocation
  - Hanging
  - Burial / confinement
  - Foreign body
  - Submersion
  - Co-sleeping
  - Other .....
- Falling
- Precipitations
- Intoxication
  - Pharmaceuticals
  - Drugs
  - Other .....
- Traffic
  - Vehicle/pedestrian collision
  - Car       Driver       Passenger
  - Motorbike  Driver       Passenger
  - Train
  - Bicycle
  - Other .....
- Burns
- Explosion
- Electrocutation
- Heat stroke
- Hypothermia
- Omission of basic care
- Other .....

### Indeterminate/pending studies

## 2. Medico-legal aetiology:

- Accidental
- Suicide
- Homicide
- Indeterminate/under study

## 3. Causes of death:

### Immediate:

### Fonamental:

## 4. Underlying:

## 5. Other:

- Abortion
- Intrauterine and/or on birth foetal distress
- SIDS
- Sudden death
- Death doing sport
- Death under restraint
- Death in custody
- Donation/transplant
- Fire death
- Medical practice
- RADA

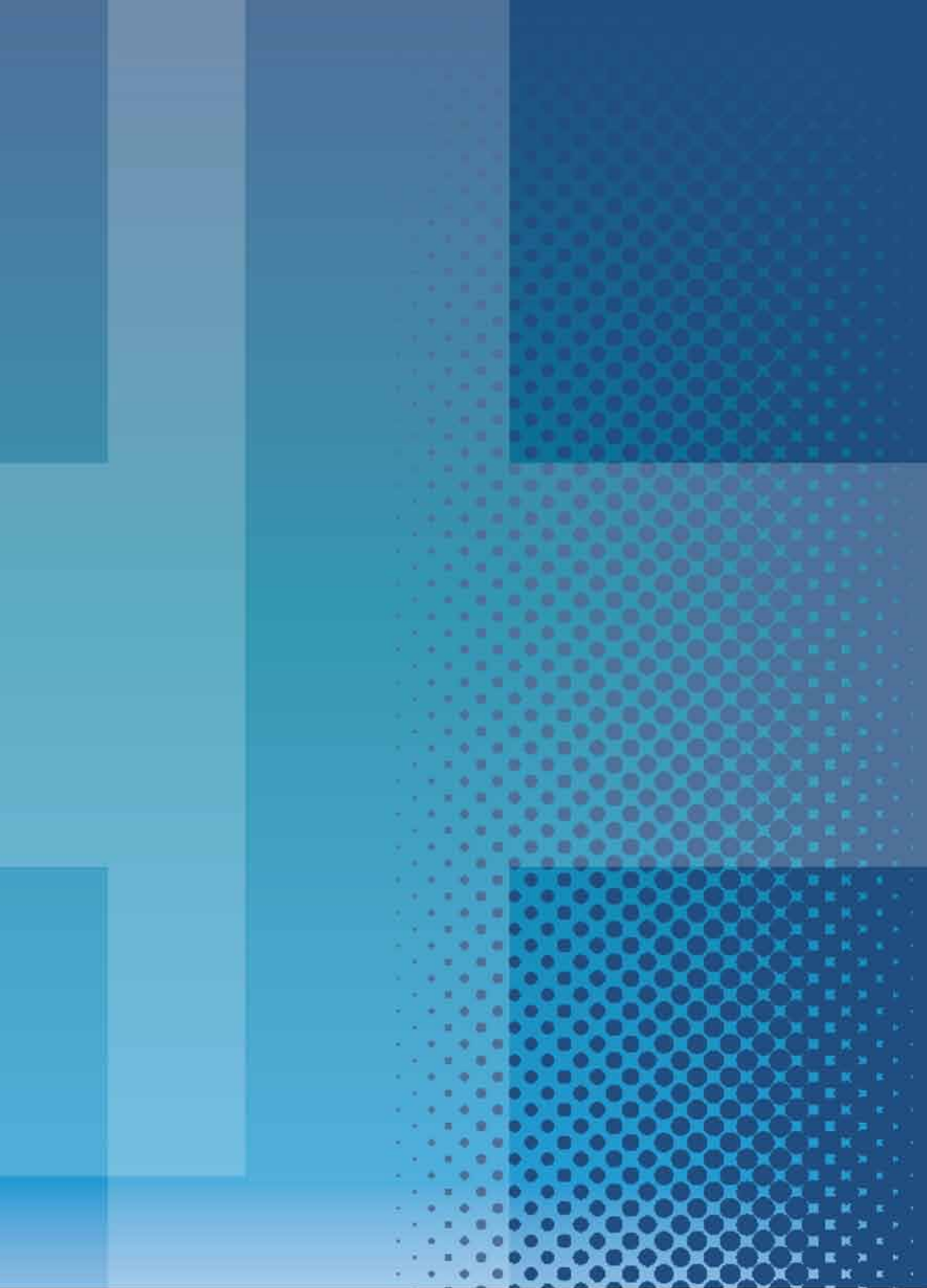
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DEPARTAMENT DE JUSTICIA – INSTITUT DE MEDICINA LEGAL DE CATALUNYA



Institut de Medicina Legal de Catalunya



Generalitat de Catalunya  
**Departament de Justícia**

Centre d'Estudis Jurídics i Formació Especialitzada  
Institut de Medicina Legal de Catalunya