



Exploration & Production

GENERAL SPECIFICATION

Medical

GS EP MED 063

Specific risks: clinical and therapeutic elements

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Contents

1. Scope	3
2. Reference documents.....	3
3. Medical procedure for acute and sub-acute intoxication	4
3.1 Hydrogen Sulphide (H ₂ S).....	4
3.2 Sulphur dioxide (SO ₂)	5
3.3 Smoke/ Fumes from fires.....	5
3.4 Carbon monoxide (CO).....	7
3.5 Chlorine	8
3.6 Chlorinated solvents	8
3.7 Hydrocarbons	9
3.8 Organophosphates	10
3.9 Alcohols	11
3.10 Mercury.....	12
3.11 Ionizing radiation.....	13
3.12 Nitrogen and nitrogen oxides.....	14
4. Response to risks associated with the local environment.....	14
4.1 Vaccinations	14
4.2 Hot climates	15
4.3 Cold climates	18
4.4 Altitude.....	19
4.5 Malaria	19
4.6 Arthropods (except Anopheles)	21
4.7 Snakes.....	22
4.8 Rodents	23
4.9 AIDS and Sexually Transmitted Diseases (STDs).....	24
Appendix 1 Bibliography	25

1. Scope

The aim of this General Specification is to define the medical reference procedures to be followed in the event of acute and sub-acute poisoning and in response to risks associated with the local environment.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
Report N° 343	Managing health for field operations in oil & gas activities, OGP, May 2003
Report N° 398	Health aspects of work in extreme climates. A guide for oil and gas industry managers and supervisors, OGP, December 2008
Report EHS23	Guidelines for environmental health for offshore installations, UKOOA, January 2007

Regulations

Reference	Title
Code du travail français (édition 2008) (French legislation)	Titre I: Obligations du maître d'ouvrage pour la conception des lieux de travail (article R 4211 et suivants) Titre II: Obligations de l'employeur pour l'installation des lieux de travail. Chapitre 1 ^{er} : Dispositions générales (article R 4221)
SI 1976/1019	The offshore installations (operational safety, health and welfare) Regulations 1976 (amendment of regulations 4&5, 14&15, schedule 1, schedule 4 in SI 1998/2306)
SI 1999/3242	The management of health and safety at work Regulations 1999 (amendment of regulation 22 in SI 2006/438)



Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
ISBN 9789241547611	Guidelines for drinking-water quality, 3 rd edition incorporating the 1 st and 2 nd adenda, Vol. 1, Recommendations – WHO
ISBN 9781882417797	2008 Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs), American Conference of Governmental Industrial Hygienists

Total General Specifications

Reference	Title
GS EP MED 060	Onsite medical structures
GS EP MED 061	Medical support for E&P sites
GS EP MED 062	Hygiene in bases and living quarters

3. Medical procedure for acute and sub-acute intoxication

3.1 Hydrogen Sulphide (H₂S)

3.1.1 Critical concentrations

The telltale odour of rotten eggs can serve as an alarm signal, but once the concentration has reached a level of 150 ppm, the olfactive nerve is paralysed.

A concentration of more than 1000 ppm causes acute neurological traumas after only a few seconds' exposure.

3.1.2 Toxic-physiopathology

Just like cyanide, H₂S acts as a cytochrome oxydase poison, blocking the final element in the electron transmission chain, thus inhibiting cellular respiration.

The symptoms which appear progressively are: cephalalgia (headaches), nausea, coughing, dizziness, local irritation of mucous membranes and airways.

H₂S can cause bronchospasm and, at a higher concentrations, a pulmonary oedema with dyspnoea (shortness of breath) and respiratory distress, hypotension, disturbance of the cardiac rhythm, convulsions, coma and death. In the event of exposure to very high concentrations, death may be almost instantaneous.

3.1.3 Procedure to follow

- Transport patient in the open air and provide oxygen supply.
- Do not perform mouth to mouth respiration (ventilation using mask + Ambu).
- Endotracheal intubation and assisted ventilation if necessary.
- Controlling convulsions. Maintenance of haemodynamics. Fight against pulmonary oedema (lesional or combined) and cardiac rhythm disturbance.
- Nitrites (amyl nitrite) could theoretically be useful. However, this therapy is only effective if administered immediately at the site of the accident. A test for methemoglobinemia should be performed subsequent to nitrite use. Moreover, Nitrites are often “misused” as a euphoriant for self-intoxication, which means that they cannot be used in industrial practice.

3.1.4 Secondary effects

Neurological side effects in the form of memory problems, shaking, tiredness, balance problems, have been reported in patients who have been severely intoxicated.

3.2 Sulphur dioxide (SO₂)

3.2.1 Toxic-physiopathology

If inhaled: eye irritation, irritation of the mucous membranes, coughing, respiratory difficulties, inflammation and oedema of the respiratory tract (formation of sulphuric acid on mucus membranes), mental disorders.

If large quantities are absorbed: pulmonary oedema with respiratory distress, circulation and cardiac disorders.

3.2.2 Actions to be taken

In case of contact with the skin: wash off with plenty of water. Remove any contaminated clothing.

In case of contact with the eyes: rinse with plenty of water for at least ten minutes, keeping the eyelids wide open. Consult an ophthalmologist immediately.

In case of inhalation: transport patient in the open air or provide oxygen supply. Take preventive measures against bronchospasms (Beta mimetics).

In case the patient risks falling unconscious or is showing signs of respiratory distress: endotracheal intubation and assisted ventilation.

3.3 Smoke/ Fumes from fires

Fires cause three types of physical injuries:

- Thermal injuries – cutaneous burns or tracheobronchial burns.
- Traumatic injuries can be caused by an explosion (blast phenomenon, projections) or to a fall as the patient was fleeing the fire.

- Toxic injuries are the result of inhaling smoke/ fumes from the fire. Independently of the temperature of the gases, the smoke/ fumes cause damage due to their own toxic nature which depends on the type of materials which are burning.

3.3.1 Toxic-physiopathology

Carbon monoxide (CO) has a very high affinity for haemoglobin and myoglobin (resulting in an incapacitating effect). It also affects the mitochondrial respiratory chain.

Carbon dioxide (CO₂) is produced in very large quantities when something burns. It causes hypercapnia which in its turn causes hyperventilation, increasing the absorption of other toxic products.

Cyanhydric acid and cyanide derivatives block cellular oxidation. They provoke a state of shock and coma.

Other toxic derivatives are produced by the combustion of polymer-based industrial materials (PVC, etc.). They can cause pulmonary or systemic intoxication (hydrochloric and fluoric acids). The products of combustion of natural fibres, such as wool and silk or of synthetic fibres such as polyesters produces sulphurous anhydride and acid anhydrides. Aldehydes also induce pulmonary toxicity.

3.3.2 Actions to be taken

Intoxication by fire smoke/fumes often affects a number of victims simultaneously.

The toxic effects of fumes appear rapidly which means that the condition of the victims has to be rapidly assessed: number, circumstances of the accident (explosion, associated intoxication).

The medical response includes:

- Extracting the victims from the toxic environment.
- Maintaining the vital functions.
- Early oxygen therapy: freeing the respiratory tracts and administration of oxygen at a high flow rate (10 l/min using a high concentration mask) for all victims undergoing spontaneous ventilation.
- Confirmation of the diagnosis that fumes have been inhaled and prevention of delayed onset respiratory or toxic injuries. Dysphonia is a serious clinical symptom and could indicate a laryngeal oedema.
- If the patient shows signs of falling unconscious: endotracheal intubation and assisted ventilation (very broad indications).
- Blood samples should be taken as early as possible (at least two heparinised tubes to test carbon monoxide and cyanide levels).
- Search for signs of any change, even temporary, of the victims' state of consciousness (coma, confusion syndrome, aggressiveness).
- Haemodynamics: if an initial state of shock is detected (tachycardia associated with a collapsus) the patient should be examined for a post-traumatic hemorrhagic injury, which may require vascular filling and emergency surgery, or in the rarest cases, a myocardial failure (an attack of angina pectoris, myocardial infarction, or rhythmic disorder which may

go as far as ventricular fibrillation). An ECG shall be performed and the patient monitored using an electrocardioscope.

- Injury report: cutaneous burns, traumatic injuries, blast, and ocular injuries – either burns or injuries caused by exposure to irritant gases.

3.3.3 Antidotes

The antidote to CO poisoning is oxygen.

The antidote for cyanide poisoning is hydroxocobalamin (commercialised in France as Cyanokit®). This product is sold freeze-dried in two phials of 2.5g.

Dosage of hydroxocobalamin: 5 g in a slow perfusion (15 minutes) to be repeated depending on the neurological and haemodynamic responses. In the event of cardiac arrest or persistent haemodynamic instability, repeat immediately after the first dose. The product tolerance is excellent. Cyanokit® shall be used at an early stage, on the disaster site itself.

3.4 Carbon monoxide (CO)

3.4.1 Origin

CO is an undesirable waste product of many thermal processes. Carbon monoxide is emitted whenever carbon or any of its composites is burned in an environment with a poor oxygen supply.

3.4.2 Toxic-physiopathology

The toxicity for humans and animals is associated with the fact that CO prevents the haemoglobin in red blood cells from being used. Red blood cells are responsible for transporting oxygen (CO affinity approx. 250 times greater than that of oxygen).

Absorption occurs solely by inhalation.

Carbon monoxide is invisible: it is odourless, colourless, and does not cause any skin irritations or pain.

Acute poisoning causes symptoms such as cephalia (headaches) nausea, muscular atony, loss of consciousness, respiratory difficulties and may, depending on the concentration and length of exposure, cause death.

3.4.3 Actions to be taken

- Extracting the victims from the toxic environment.
- Maintaining the vital functions.
- Early oxygen therapy (oxygen is the antidote for CO poisoning), endotracheal intubation and assisted ventilation if the patient shows signs of falling unconscious.
- Confirmation of the diagnosis of CO poisoning from blood samples, which shall be taken as soon as possible (heparinised tubes).
- If the clinical examination, the results of blood tests and the ECG all confirm benign CO poisoning, the patient can be discharged after approximately 4 hours of observation. Otherwise, oxygen therapy shall be maintained and the patient kept under observation, in hospital for 24 to 48 hours.

- Hyperbaric oxygen therapy is the best treatment for severe carbon monoxide poisoning (objective neurological symptoms, myocardial ischemia). Call a hyperbaric specialist if necessary, for an expert opinion. In all cases, the effectiveness of the treatment depends on how quickly it is administered. Hyperbaric oxygen therapy is not contra-indicated for pregnant women in the event of severe poisoning.

3.5 Chlorine

3.5.1 Exploration & Production context

Chlorine is used to disinfect water. Another important chlorine derivative is bleach, which may give off chlorine vapours if mixed with an acid-based product.

3.5.2 Toxic-physiopathology

Chlorine has a highly caustic effect on the skin (chemical burn).

The symptoms of poisoning after inhalation are:

- Eye irritation and irritation of the mucus membranes in the airways.
- Painful cough accompanied by dyspnea (shortness of breath) cephalia (headaches) and vomiting.
- At a degree of severity one level higher: bronchospasms and acute lesional pulmonary oedema. This phenomenon may develop and lead to death if symptoms of acute respiratory distress continue.

The inhalation of chlorine vapours may be responsible for delayed onset respiratory disorders (up to 48 hours after exposure).

3.5.3 Actions to be taken

- Evacuate the patient from the contaminated environment, put them in the recovery position
- Administer oxygen by inhalation using a mask and bronchodilators (Salbutamol +/- atropinics) by nebulisation.
- If necessary: administer beta mimetics (Salbutamol, Adrenalin) by continuous injection using an electrical syringe and respiratory resuscitation by intubation and assisted ventilation.
- Clinical and radiological observation in a hospital environment.

3.6 Chlorinated solvents

3.6.1 Toxic-physiopathology

The inhalation of large quantities of chlorinated solvents causes a narcotic effect with depression of the central nervous system, preceded by a phase of excitation and ebriety.

Some of these agents, such as chloroform and trichloroethylene increase the heart's sensitivity to beta mimetics and can cause ventricular fibrillation.

Methylene chloride is partially metabolised as carbon monoxide with the formation of carboxyhaemoglobin up to a concentration of approximately 10%. In the event of poisoning, an



acute coronary syndrome can occur in patients with coronary deficiencies.

Carbon tetrachloride causes the delayed onset (24 to 48 hrs) of hepatic damage (cytolysis which develops into hepatic failure) and acute anuric renal failure.

In the event of external contact, these agents can cause skin and eye irritation.

3.6.2 Actions to be taken

- Wash with plenty of water in the event of contact with the eyes or skin
- If ingested:
 - Gastric lavage is only possible after endotracheal intubation and assisted ventilation in a hospital environment.
 - Haemodynamic monitoring in case of chloroform or trichlorethylene poisoning. Adrenergic drugs are not recommended. Use of beta-blockers by continuous perfusion (Propranolol, Atenolol) in the event of cardiac rhythm disorder with myocardial hyperexcitability.

3.7 Hydrocarbons

3.7.1 Industrial context

Three types of hydrocarbons are discussed here; aromatic hydrocarbons (Benzene, Toluene, etc.), aliphatic hydrocarbons (Hexane) and alicyclic hydrocarbons (Cyclohexane).

3.7.2 Toxic-physiopathology

These are central nervous system depressants.

The inhalation of hydrocarbon vapours causes a state of euphoria with a feeling of ebriety followed by drowsiness, cephalia, vertigo and nausea followed by coma.

The ingestion of large quantities of hydrocarbons is followed by digestive disorders: nausea, vomiting with a sensation of buccopharyngeal, retrosternal and epigastric burning, diarrhoea. Frequently, an inhalation pneumopathy can also occur.

Skin and eye irritations may also occur in the event of prolonged contact with the product.

Moreover, they are substances which produce chronic toxicity requiring medical observation (occupational medicine). Animal testing has shown that certain substances belonging to the hydrocarbon group are carcinogenic and that some of them may even have a mutagenic effect. The carcinogenic nature of benzene has been clearly proven.

3.7.3 Actions to be taken

In the event of external contact: wash contaminated areas with plenty of water.

If ingested:

- Onsite: do not induce vomiting, or make the victim drink. Place the victim in the lateral safety position to prevent the poison from reaching the airways.

- In a medicalised environment:
 - Gastric lavage shall not be performed immediately: this may worsen the inhalation pneumopathy. Gastric lavage shall only be performed after endotracheal intubation and artificial ventilation if the victim is comatose.
 - A pulmonary X-ray enables the degree of parenchymatous damage to be evaluated and the course of treatment to be determined.
 - If there is no inhalation pneumopathy: administer of a gastrointestinal tract mucoprotective agent and keep victim under observation for 48 hours for signs of irritation (cough) temperature monitoring.
 - In the event of inhalation pneumopathy:
 - If only one lobe is affected, the prognosis is good. The patient shall be clinically, radiologically and biologically monitored and undergo antibiotherapy for several days.
 - If several lobes are affected, the victim shall be taken to the resuscitation unit to continue treatment.
 - The remainder of the treatment is symptomatic.

3.8 Organophosphates

3.8.1 Industrial contexts

Organophosphates are broad-spectrum insecticides which act by contact, ingestion or inhalation. Approximately seventy products are used against biting and sucking insects which attack agricultural crops, as well as against mites, coleopters and caterpillars.

These insecticides are phosphates thiophosphates and halogen dithiophosphates.

They are generally applied by spraying and are highly toxic.

3.8.2 Toxicophysiopathology

Human intoxication can be caused by ingestion inhalation or penetration through the skin. Organophosphates are rapidly absorbed and dispersed in the organism. They irreversibly inhibit acetylcholinesterase, preventing the central nervous system and the neuro-vegetative system from functioning normally.

Acute intoxication is materialised by the following typical symptoms:

- Cephalia, hyperperspiration, hypersalivation and bronchial hypersecretion.
- Vision disorders (miosis).
- Gastro-intestinal disorders (diarrhoea, spastic gastro-intestinal pain).
- Dyspnea, then respiratory distress (paralysis of the respiratory muscles and severe laboured breathing).
- Myoclonia, convulsions.
- Loss of consciousness.
- Cardiorespiratory arrest.

These symptoms may appear several hours after intoxication.

3.8.3 Actions to be taken

- Symptomatic treatment:
 - If exposure is external, decontaminate the skin by undressing the victim and washing the affected areas with soap and water, if the poison is ingested, gastric lavage shall be performed (hospital environment), even some time after the incident if large quantities have been ingested.
 - Respiratory resuscitation: endotracheal intubation and artificial ventilation enabling the victim to breathe in at regular intervals.
 - Atropine (a parasympatholytic) administered intravenously in high doses: 2 mg by IVD followed by 2 mg IVD every 10 minutes until signs of atropinic impregnation appear (mydriasis (pupil dilation)), then continuous intravenous perfusion. This treatment shall be continued for several days.
- Specific antidote treatment:
 - The pralidoxime (Contrathion®) regenerates the cholinesterases by displacing the organophosphates from their of fixation site.
 - This treatment shall be administered as soon as possible.
 - It shall be associated with the administration of atropine.
 - Adult dosage is 1 to 2 g in 100 to 250 ml normal saline solution in an IV perfusion of 30 minutes. If necessary, continue treatment with a dosage of 500 mg/h as a continuous perfusion.

3.9 Alcohols

3.9.1 Toxicophysiopathology

Alcohols are generally used as solvents in various industries.

Alcohols have a direct depressive effect on the central nervous system. The intoxicated victim is in a state of ebriety which can lead to a calm, areflexic hypotonic coma.

The ingestion of 30 to 100 ml of methyl alcohol (methanol) can be fatal if the victim is not treated. After a latency of several hours, symptoms such as digestive disorders, consciousness disorders and ocular disorders with a risk of blindness appear, as well as a risk of severe metabolic acidosis with haemodynamic complications.

Butyl alcohol can cause severe burns to the cornea if splashed into the eyes.

Ethyl alcohol (ethanol) has a chronic toxicity: chronic ethylism.

3.9.2 Actions to be taken

- Symptomatic treatment:

To maintain the vital functions:

 - Respiratory resuscitation, endotracheal intubation and assisted ventilation if required.

- Correction of hydro-electrolytic imbalances.
- Specific treatment for methanol poisoning:
Antidote for methanol: blockage of the alcohol dehydrogenase by:
 - Intravenous ethanol perfusion (CURETHYL()) 10 to 15 ml/h with an initial dose of 0.6g/kg. An ethanol concentration of approximately 1g/l shall be maintained.
 - Administration of 4-methylpyrazole in a dose of 15 mg / kg immediately, then 10 mg/kg every 12 hours.
 - The victim shall be transferred to a specialist environment.

3.10 Mercury

3.10.1 Toxic physiopathology

Once absorbed, mercury can accumulate in certain organs, the liver, the red blood cells, the bone marrow, the kidneys, the spleen, the intestines, the lungs, the skin and the central nervous system.

- Symptoms of mercury poisoning (hydrargyrisms).
- Affects pulmonary function if inhaled: irritation of respiratory tract.
- Affects digestive function if ingested: stomatitis, metallic taste, hypersalivation, transit disorders: diarrhoea sometimes containing blood, tenesmus (anal discomfort, burning sensation and continuous desire to defecate or urinate).
- Affect the function of the nervous system: trembling, abnormal movements, convulsions. These neurological symptoms may be accompanied by a state of coma.
- A state of shock may occur, which manifests itself by an anuria (total loss of urination). Renal damage may occur up to two weeks after poisoning.

Progressive penetration of mercury into the organism causes chronic poisoning, generating the following disorders:

- Nervous system function: cephalgia, vertigo, asthenia, disturbed sleep patterns, tremor in the tongue (affecting the hypoglossal nerve).
- Cutaneous damage: erythema (skin rash) affecting the palms of the hands and the soles of the feet, urticaria (hives).
- Digestive system function: hypersalivation or dry mouth.
- Renal function: proteinuria (nephrotic syndrome) accompanied by microscopic hematuria (blood in the urine).

3.10.2 Actions to be taken

- In an emergency, in the event of acute mercury poisoning, a gastric lavage shall be performed (if the mercury has been ingested), the patient shall be suitably rehydrated, and the elimination of urine and solid waste shall be encouraged.
- The antidotes are dimercaprol (BAL), and D Penicillamine. Elimination of the mercury in the urine shall be monitored. This medication shall be taken until the level of mercury excreted in the urine falls under 50 micrograms per twenty-four hours.

- In the event of anuric renal insufficiency, haemodialysis shall be performed, associated with the administration of dimercaprol.

3.11 Ionizing radiation

3.11.1 Physiopathology

Ionizing radiation (X-rays, neutrons, protons α or β particles, γ rays) cause direct or indirect tissular lesions. A distinction is made between:

- Irradiation from a source of ionizing radiation which causes lesions, the gravity of which depends first and foremost on the levels absorbed, but also on the rate of absorption and the radio-sensitivity of the affected tissues. The bone marrow is the most sensitive tissue to ionizing radiation. The biological effects of massive, acute irradiation are very different from those of weak, chronic irradiation. The former cause massive cell death and appear within several hours, days or weeks. The latter are better tolerated since certain lesions trigger cell repair. However, doses of radiation which are too weak to cause cell death, can nevertheless cause changes in cell behaviour, the consequences of which only become apparent after several years.
- Radiation contamination which is the result of radioactive particles and can be:
 - External: on the skin.
 - Internal: inside the organism, due to inhalation, ingestion or penetration through a wound.

3.11.2 Early effects of acute irradiation

The consequences of cell death appear when a large number of cells in the same tissue are destroyed. The early effects appear several days or several weeks after the irradiation of tissues which regenerate rapidly.

Cerebral syndrome: this is secondary to high doses of radiation (> 30 Grays) causing a cerebral oedema. Death occurs within 48 hours.

Cutaneous syndrome: this is materialised as radiological burns. The first signs appear as soon as the dose exceeds 5 Grays. The prognosis, as for any burn, depends on the depth and extent of the injury.

Haematopoietic syndrome: this is caused by exposure to doses of 2 - 10 Grays. Damage to the formed elements of the blood leads to bone marrow failure.

Gastro-intestinal system: damage to the intestinal cells leads to severe diarrhoea with dehydration in excess of 7 Grays.

When a significant quantity of a radioiodine is incorporated into the organism, the iodine is taken up preferably by the thyroid cells, causing cancer of the thyroid.

3.11.3 Delayed effects of acute irradiation

Delayed effects appear several years or decades after the irradiation of tissues which regenerate slowly.

These effects do not affect the organisation of operational medicine.



3.11.4 Internal or external radiation contamination

The source of radiation contamination emits a variable dose of radioactive particles which initially affect the internal or external tissues close to it.

3.11.5 Actions to be taken

In the event of a radiological alert: take one potassium iodide tablet.

After irradiation: symptomatic treatment of anoxia, coma or state of shock, depending on the case.

After radiation contamination: wash immediately with large amounts of water and chelating agents in solution (EDTA or ethylenediaminetetraacetic acid). Eliminate ingested radioactive substances by gastric lavage (or induce vomiting) if the substance has been recently absorbed.

3.12 Nitrogen and nitrogen oxides

3.12.1 Toxic-physiopathology

Nitrogen, which represents 75% of air, is not inherently dangerous, but an excessive concentration in a confined environment may lead to hypoxemia due to the lack of oxygen in the inspiratory air.

The Nitrogen Oxides: (NO, NO₂, N₂O₄) may cause:

- In the event of massive intoxication: cardio-respiratory arrest.
- In the event of acute inhalation: irritation of the eyes and airways accompanied by lacrimation, coughing, dyspnea, and nausea. Then after a latency period which may last up to 24 hours, a lesional pulmonary oedema and an Adult (Acute) Respiratory Distress Syndrome (ARDS) may occur.

3.12.2 Procedure to follow

- Immediately: remove the patient from the toxic environment and administer a high concentration of Oxygen using an oxygen mask. If necessary, perform cardio-respiratory resuscitation.
- During the latency phase: medicalised transport of the patient to a medical resuscitation service where the pulse oxymetry (SpO₂) shall be continuously monitored.

4. Response to risks associated with the local environment

4.1 Vaccinations

The Group vaccination policy is defined by the International Medical Department (IMD) (foreign missions medical service, henceforth referred to as the IMD in the present document) in keeping with international recommendations and regulations.

In addition to the vaccinations which are obligatory in Europe (BCG, Diphtheria, Tetanus, Poliomyelitis), it is recommended that "standard" expatriation vaccinations (Yellow fever, Hepatitis A and B, Typhoid and Meningococcal meningitis) be added, depending on the geographical area and job type.

Advice and recommendations from the IMD are sent to the medical examinations centres in



Paris, Pau and Montpellier in charge of conducting the medical aptitude examinations for Group personnel with French status and to the CONTRACTOR company centralising the Global Health Monitoring for Group expatriates not having French status.

Certain vaccinations are recommended in response to very specific risks:

- Japanese encephalitis, Central-European tick-borne encephalitis: rapid evolution meningoencephalitis affecting areas which, at present, are fairly restricted. The vaccinations are recommended if the stay in a rural area is three weeks or more.
- Leptospirosis: given that the spirochete is transmitted by rodents (mainly rats), this vaccination should be given to anyone who have to carry out earthworks, work in sewage treatment works, etc.
- Rabies: the Rabies virus is transmitted into the saliva of stray animals who have not been vaccinated (dogs, cats, foxes, etc.). The vaccine can be administered in two instances:
 - As a preventive measure for personnel living or working in a rural or urban zone where the disease is endemic.
 - As a response to the patient having been bitten by an animal suspected of having rabies.

4.2 Hot climates

4.2.1 Medical fitness

Significant excess weight is not recommended for people working in very hot environments since it disturbs the acclimatisation mechanisms. The tolerated fitness standard is a Body Mass Index (BMI) less than or equal to 35.

$$\text{BMI} = \text{Weight in kg} / (\text{height in m})^2$$

Certain treatments and illnesses may cause adverse effects in hot, sunny climates. The annual medical examination enables them to be identified.

A specific point is the photosensitizing effect of Doxycycline, used in the chemoprophylaxis of malaria. To avoid this, the tablet should be taken before the evening meal.

4.2.2 Acclimatisation

Acclimatisation is the process by which the human body adapts to a new climate (heat - humidity). This process takes at least 10 days. To reduce the risks, sport is not recommended for the first ten days subsequent to arrival in a zone to which the body is not adapted, if the local conditions are significantly different from the climate of origin. The required adaptation of work patterns is set out in § 4.2.4.

Controlling physical activity and regular rehydration are the best ways of preventing effort hypothermia or "heatstroke".

4.2.3 Drinking

Drinking water is vital in hot climates. The most frequently asked question is: how many litres per day?

The evaluation of water loss by transpiration is a source of error: remember that the means by which the human body loses heat include conduction, convection, radiation and evaporation



mechanisms. The last mechanism (evaporation of sweat) is hindered by hygrometry: as the quantity of water in the air increases, the evaporation process becomes less efficient. Finally, physical activity generates a lot of heat and if intense, requires additional water intake to disperse the heat.

The quantity of water to drink shall be based on kidney function: the necessary, sufficient production of urine is 1ml/ min., i.e. 1.5 l / 24hrs. The answer to the question is therefore: enough water shall be drunk to produce 1.5 l of urine per 24hrs. To evaluate this quantity, it suffices to simply observe the colour of the urine, which shall be clear.

Enough water shall be drunk to ensure that the urine is clear. This might be several tens of litres a day if you are working intensively in a very hot, very humid environment. It is much less if you are working in an air-conditioned office on the same site.

Finally, contrary to popular belief, alcoholic drinks, even weak ones, cause the organism to consume more water than they provide it with.

4.2.4 Pace of work and protective measures that may influence it

In hot climates, personnel are required to work in hot conditions, and a wide variety of factors come into play, both in terms of the degree of heat they are actually exposed to (which is affected by temperature, humidity, etc.) and individual tolerance (acclimatisation, constitution, diet, rest conditions, etc.) All of this means that a specific pace of work cannot be recommended.

The document [ISBN 9781882417797](#) describes the complexity of these measurements and the appropriate equipment.

Each individual needs to determine his/her own pace of work. In extreme conditions, where staff perform moderate to intense work and wear specific clothing, exposure should be limited to a few minutes followed by a long rest in a cool, air-conditioned area.

Workers exposed to extreme heat shall attend specific training so they may recognise the onset of a heat stroke in other team members; since altered judgment is one of the first symptoms, the victim may not be able to diagnose it him/herself.

The rest area shall be air-conditioned with cold beverages available and workers shall have continuous access to a "refrigeration" unit capable of misting water at a temperature of around 15°C.

Table 1: summary of protective measures and actions

Measure	Actions
Practical measures	
Reduce body heat production	Mechanise tasks
Stop exposure to radiated heat from hot objects	Insulate hot surfaces. Use reflective shields, aprons, remote controls
Reduce convective heat gain	Lower air temperature. Increase air speed if air temperature is below 35°C Increase ventilation Provide cool observation booths
Increase sweat evaporation	Reduce humidity Use a fan to increase air movement
Administrative measures	
Acclimatisation	Allow a sufficient acclimatisation period before full workload
Duration of work	Shorten exposure time and use frequent rest periods
Rest areas	Provide cool (air-conditioned) rest areas
Water	Provide cool drinking water
Pace of work	If practical, allow workers to set their own pace of work
First-aid and medical care	Determine emergency procedures Assign one person trained in first-aid to each work area Train workers in recognition of symptoms of heat exposure

4.2.5 Photoprotection

Personal sensitivity varies greatly according to the phototype (ranging from white albino to black). The fairer the phototype, the more exposure to the sun shall be limited in duration and intensity.

Protection by clothing depends on the colour, composition and density of the weave and the humidity of the clothes (a wet T-shirt does not provide any protection).

Protective power of different textiles:

Table 2: protective power of different textiles

Fabric	% transmission	Protection coeff.
Clear tights	75	1.3
White cotton shirt	14	7
Heavy cotton shirt	5	19
Heavy green velour	2	50
Dark blue heavy cotton trousers	0.0006	1700

Sunscreens (gels, creams, lotions, solutions, sticks, etc.) contain filtering agents and screening agents. They are characterised by a protection coefficient against UVA and UVB rays. They do not replace fabrics or shelter from exposure.

The filter lenses of glasses shall have a UV protection coefficient higher than 70%. The arms of the glasses shall not be made of metal. Lateral protection mounts prevent light from penetrating from the sides (useful in situations where intense reverberation occurs, e.g. at sea).

4.2.6 Diet

Systematically adding salt to the diet is no longer recommended. A normal diet provides adequate amounts of salt, except in cases where very large volumes of water are transpired. In this case, 500 mg of salt per day should be added to the diet.

4.3 Cold climates

Risks associated with the cold and its combined effects with the wind are very well explained in the document [Report N° 398](#). The wind chill factor provides an assessment of the combined effects of cold and wind. This combination is the true determining factor of heat loss by convection.

4.3.1 Medical fitness

Certain treatments and chronic illnesses may cause adverse effects in cold environments. The annual medical examination enables them to be identified. Among the illnesses which are a concern in cold climates the main ones are:

- Raynaud's syndrome.
- Asthma triggered by cold air.

4.3.2 Drinking

Contrary to popular belief, alcoholic drinks, even weak ones, cause vasodilation which increases calorie loss. Vasomotor flush gives a false sensation of heat.

Even if perspiration is unfavourable when not fully absorbed by the underwear, it is however necessary to be well hydrated in cold environments. Hence the saying: "ration sweat, not water".

The daily calorie intake in cold environments should be increased to up to 4000 Kcal depending on the case, including approximately 60 % carbohydrates.



4.3.3 Clothing

The only really effective protection against cold environments is to build up layers of clothing. Each layer shall have specific characteristics in terms of insulation and watertightness. These are mentioned in the document [Report N° 398](#).

4.3.4 Work conditions

Breaks shall be scheduled into the work programme so that workers operating in severe cold environments can warm themselves up. The document [Report N° 398](#) (see appendix 2, table 11) includes a table of the work conditions which should be implemented depending on the climate.

4.4 Altitude

Hypobaric-hypoxia is inevitable above 2,500 m. For someone who is not trained, the simple fact of exerting any effort at 2,500 m or just being at 3,000 m altitude causes an initial oxygen debt.

4.4.1 Medical fitness

Cardiovascular and thromboembolic diseases and respiratory disorders (obstructive and restrictive) are contra-indications to working at high altitudes.

4.4.2 Acclimatisation

After an initial phase of 3 to 4 days characterised by a hyperventilation reflex causing hypocapnia and respiratory alkalosis, the body adapts progressively by polycythemia (production of extra red blood cells). This is effective after a minimum of 10 days. To minimise risks, it is not recommended to do any heavy, intensive work or practise sport during the first week after arrival on site.

4.4.3 Acute Mountain Sickness (AMS)

The prevention strategy is as follows:

- Do not climb too high, too fast (this is difficult if you land in La Paz, Bolivia).
- Drink plenty, eat moderately, do not drink alcohol.
- Do not take hypnotic, psychotropic medication.
- Take paracetamol rather than salicylates (4% to 40% retinal haemorrhaging has been recorded with the latter).
- "Pre-medication" by taking Acetazolamide is justified for people who know they are subject to AMS.
- If the first symptoms appear, the victim shall descend immediately and be attended to by the medical personnel.

4.5 Malaria

There is no panacea for protection against malaria. No single preventive measure ensures total protection. The strategy is to use three different measures at the same time.

4.5.1 Chemoprophylaxis

The Group chemoprophylaxis policy is defined by the IMD. This policy is constantly reviewed and updated in view of epidemiological knowledge and the evolution of chemoresistance. IMD sends information and advice to affiliates on their specific zone.

Abstaining from chemoprophylaxis in the event of a very short stay (currently less than 7 days) or a very long stay, is evaluated and recommended on a case-by-case basis.

Chemoprophylactic treatment shall only be prescribed after a medical consultation.

4.5.2 Preventive measures in and around the home and personal preventive measures

These measures aim to prevent Anopheles (Mosquito) bites.

- The premises shall be protected from intrusion by mosquitoes: walls perfectly joined, windows and openings fitted with mosquito nets (these measures alone are insufficient).
- Insecticides: targets and products
 - Areas which may serve as breeding sites for larvae or resting places for mosquitoes and which cannot be condemned, shall be treated with insecticides. This means mainly stagnant water receptacles (ponds, recipients, shrubs with sheathing leaves) and shaded areas (eaves, interiors). Their dispersion radius relative to Anopheles larvae breeding sites is 1.5 km.
 - The main insecticides are the pyrethrinoids and the pseudo-pyrethrinoids. Bioallethrin and bioresmethrin are not stable when exposed to light and have very short persistence. In addition to their strong insecticide effect, Permethrin and deltamethrin, have a long persistence. Etofenprox (pseudo-pyrethrinoid) has a comparable insecticide effect with a low toxicity for the environment.
 - Professional sprayers are required to treat large areas.
 - Fumigant spirals diffusing pyrethrinoids are for use outside or in a well-ventilated room.
 - Electrical diffusers have an effective duration of 8 to 10 hours in a closed room.
 - Insecticide sprays with a "knock down" effect only offer temporary protection.
 - Mosquito nets impregnated with insecticide are vital for a night spent in the open air or in a non air-conditioned, poorly insulated building (however, no premises are completely protected from mosquito intrusion). The effects of impregnation last between 6 – 8 months. Kits are available to renew the impregnation of the nets; when re-impregnated, the mosquito net shall be spread out flat and left to dry.
 - Clothes impregnated with insecticides complement the action of skin repellents. Clothing can be impregnated by spraying or soaking. The insecticide resists 5 washes on cotton clothing, 2 washes on synthetics. Such clothing shall be worn when working at night or in an area highly exposed to insects.
 - Canvas tents impregnated with pythrinoids provide complementary protection. Spraying shall be done on the inner surface of the canvas.
- Contact repellents shall be applied at nightfall on all areas of bare skin. They are only effective for a few hours, and their repellent action is reduced by the heat, transpiration and clothing rubbing against the skin.

- Given that they are not subject to scientific approval before being commercialised, there are a large number of repellents on the market with wide-ranging degrees of effectiveness. The “Guide d’Information et de Conseils Pratiques” published by the Traveller’s Health Society (Société de Médecine des Voyages) (see appendix 1) contains a table comparing the main repellents on the market. The most frequently used product is N,N diethyl-3-methylbenzamide (formerly N,N diethyl-m-toluamide: DEET).
- Clothing worn after sunset shall be loose and cover the body.

4.5.3 Vigilance

During the stay, any high fever, especially if accompanied by shivering, shall be diagnosed, even if a benign infectious disease is suspected.

Upon return, in addition to the continuation of chemoprophylaxis, malaria shall be considered as a possible cause for any symptoms of infection.

Refer to the HOTLINE MALARIA chart implemented by DMI and which reminds the cardinal signs of malaria, as well as the recommendation for the consulted doctor. It is attached to the emergency phone numbers card (payment card format) handed to expatriates.

4.6 Arthropods (except Anopheles)

- Other insects, vectors of other diseases, are also affected by the preventive measures taken against mosquitoes. Their dispersal radius from the breeding site is smaller on average. The case of phlebotomidae vectors of leishmaniasis is an exception: much smaller than the anopheles, they easily pass through the mesh of a mosquito net. “phlebotomidae” nets or mosquito nets made of very fine netting are difficult to tolerate as they are poorly ventilated. Here again, impregnation of the net with an insecticide increases the level of protection, though not fully.
- Reduviidae (assassin bugs) or triatoma (hemetophagous bugs) transmit the Chagas disease trypanosome (North and South America) and are not sensitive to repellents. They can only be destroyed by insecticides.
- Cockroaches, vectors of germs, can be destroyed by carbamate-based insecticides. These shall be regularly applied in all the nooks and crannies of the home, paying special attention to the safety advice given.
- Spiders hunt at night. To avoid them, the recommendations are to sleep under a mosquito net in an exposed area, to upturn and shake shoes before putting them on in the morning (in camps), to take a torch with you when moving about at night and be wary of the toilet area: spiders are attracted to them because of the large quantities of prey which inhabit these zones.
- Venom from dangerous species has mainly neurotoxic and haemolytic effects or causes necrosis.
 - The treatment for neurotoxic effects (which appear very suddenly) being essentially symptomatic, (sedation, assisted ventilation) the only appropriate response is to transfer the patient to a nearby medical structure, equipped with resuscitation equipment.
 - The often-spectacular localised effects, such as bleeding phlyctens (blisters), and cutaneous necrosis do not have an immediate effect on the vital prognosis, but given

the level of impairment they can cause, the patient shall receive medical care or even surgery.

- If the patient displays extended or threatening anaphylactic or anaphlatoxic effects they shall receive immediate medical care.
- A certain number of specific serums are available and manufactured in the country but are only effective on the local species. Such serums shall be identified in advance to ensure that there is a sufficient supply in the onsite medical structure.
- Scorpions hunt at night and only sting if disturbed or surprised. Shoes should be upturned and shaken before putting them on in the morning (in camps), and personnel carrying out earth works should be informed (and provided with boots and gloves).
 - Venom from dangerous species have mainly neurotoxic effects, requiring essentially symptomatic treatment (sedation, assisted ventilation), the only appropriate response is to transfer the patient to a nearby medical structure, equipped with resuscitation equipment.
 - If the patient displays extended or threatening anaphylactic or anaphlatoxic effects they shall receive immediate medical care.
 - A certain number of specific serums are available and manufactured in the country but are only effective on the local species. Such serums shall be identified in advance to ensure that there is a sufficient supply in the on site medical structure.
- American ants (fire ants) trigger a strong anaphylatoxic and anaphylactic reaction. The victim's limb shall be raised immediately and corticotherapy, antihistamines and sometimes even adrenaline administered. The victim shall be hospitalised immediately due to the risk of compressive oedema. Treatment involves decompression incisions and sometimes amputation.

4.7 Snakes

4.7.1 Immediate response to a snake bite

- Immobilise and raise the bitten limb, possibly cool it down (this response is subject to debate and not a priority measure).
- Do not apply a tourniquet. At the most, a lightly compressive circular bandage may be applied, destined to slow the spreading of the poison in the body if it is not possible to hospitalise the victim within the 2 hours following the bite and if a dangerous species has been identified.
- Take off any rings, bracelets and other objects which may compress the limbs.
- Make sure the patient is resting, including throughout the (immediate) transfer to a medical structure). It may be useful to take the snake that bit the victim if this can be done without any further danger.
- If the eyes are affected by the venom of "spitting" snakes (Naja), the eyes should be washed with plenty of water in the same way as when chemicals are splashed into the eyes.
- Do not use salicylates or intra muscular injections.

- Do not use archaic techniques: sucking out the poison, incisions, cutaneous excercises, electrocution, etc.
- Venom pumps have no adverse effects and their use calms the patient. However, they have little or no effect given the depth at which the venom is injected by most dangerous species.
- Despite the fact that treatment shall be administered as soon as possible, the time between the victim receiving the bite and possible death is measured in days rather than hours. The response to this kind of injury should be well-thought out and rational.

4.7.2 Serotherapy

- This treatment is always administered by medical personnel using the adequate resuscitation equipment and a refrigerator should also be available to store the serum(s).
- It is only advised for patients displaying serious symptoms (details not given here). The quantity of serum to be injected depends on the degree of severity, but in the absence of a specialist laboratory capable of measuring the quantity of venom in the blood by immunological test, only an empirical quantity can be given.
- This kind of therapy is only beneficial if a serum specific to the species that bit the victim is available. Identifying the species is a major problem. The following serums may be available:
 - Polyvalent serums designed to act against the main known species in the region.
 - Monovalent serums, the choice of which is even more difficult given the similarity of the original clinical presentations.
- Prior identification of the species in the region enables the medical structure on site to ensure that it has a supply of the specific serums required.
- Serious anaphylactic reactions caused by the serum are quite common, and patients shall be hospitalised as soon as possible.

4.8 Rodents

Actions against rodents (mainly rats) include:

- Constructing premises whose openings have an airtight seal, particularly premises designed for waste storage. Avoid dark corners in the construction, cellars with ventilation holes, etc.
- Rigorous organisation regarding external storage (e.g. worn-out furniture, packaging boxes etc.) If this kind of storage cannot be avoided, items shall be stored on shelving, the lowest shelf being at least 20 cm above the ground. Ideally, the whole area should be lit up at night.
- Threading cones onto the mooring lines of boats.
- Ensuring that all storage areas for foodstuffs kept at an ambient temperature are permanently closed and airtight.
- Not leaving any possible food sources for rodents out in the open.



- Using poisons. The most commonly used are coumarin anticoagulants (warfarin, coumadin, etc.).

If bitten by a rat:

- Wash the area immediately using soapy water.
- Seek medical advice immediately.

4.9 AIDS and Sexually Transmitted Diseases (STDs)

With the exception of Occupational Blood Exposure which may affect personnel rescuing or administering medical treatment to a victim, contamination by a sexually transmissible germ is always the result of high-risk conduct for which the victim is responsible.

Avoid sexual promiscuity.

The HIV virus is transmitted during all types of sexual relations, including oral-genital contact.

The pharmacies in medical structures only have a limited quantity of supplies available to initiate an antiretroviral tri-therapy, given that the follow-up treatment can only be administered in the victim's country of origin.



Appendix 1 Bibliography

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