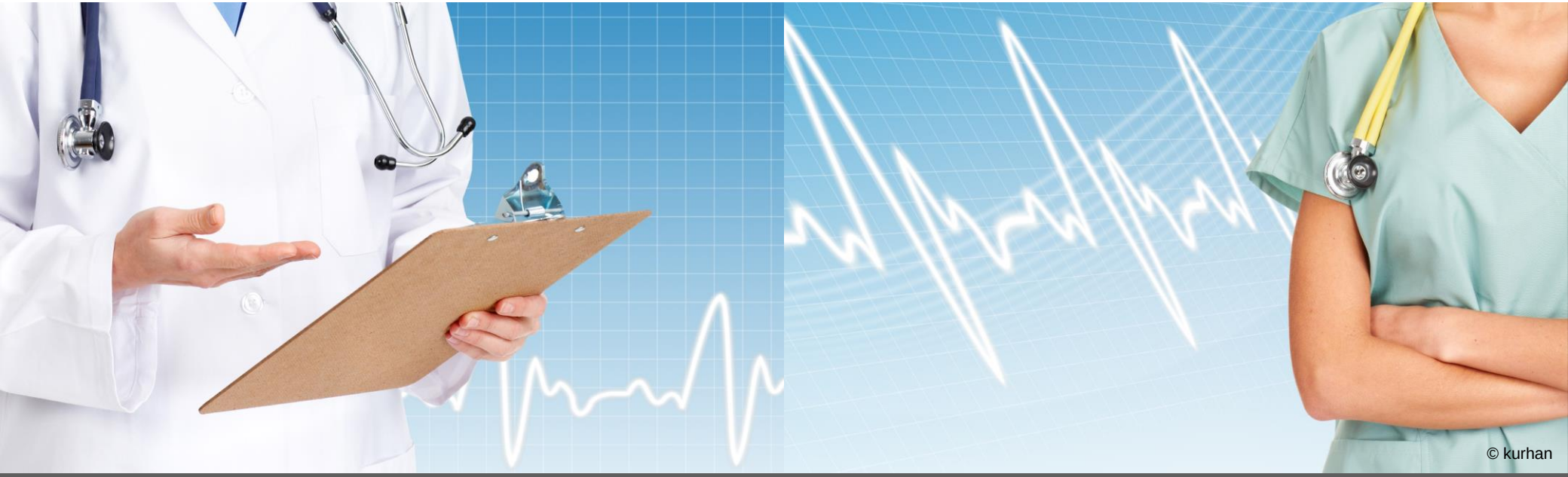
EUROFLUOR

Responsible Care
OUR COMMITMENT TO SUSTAINABILITY



GUIDELINES IN CASE OF EXPOSURE WITH HYDROGEN FLUORIDE (AHF) AND HYDROFLUORIC ACID (HF)

Information for First Aiders + Health Professionals

cefic sector group

EUROFLUOR

(European Technical Committee for Fluorine)

www.eurofluor.org

Version: 10.10.2018

CONTENT

- Disclaimer
- General Information
  - Utilization of AHF and HF in industry
  - Classification
  - Physico – Chemical Properties
  - General Hazards
  - Physiopathology & Toxicology
- Treatment of injuries
  - Activate the Emergency Chain including specific documentation for health professionals
  - Decontamination
  - First Aid
  - Medical treatment
- Appendix:
  - Preparation of Calcium Gluconate Gel / Solution
  - Anamnesis / Questionnaire
  - Content of a First aid Kit
  - Literature

DISCLAIMER

- This Recommendation is based on the various measures taken by member companies of Eurofluor.
- It in no way is intended as a substitute for the various national or international regulations, which should be respected in an integral manner.
- It results from the understanding and many years experience of the AHF/HF producers in their respective countries at the date of issue of this particular document.
- Established in good faith, this recommendation should not be used as a standard or a comprehensive specification, but rather as a guide which should, in each particular case, be adapted and utilised in consultation with an AHF/HF manufacturer, supplier or user, or other experts in the field.

DISCLAIMER

- It has been assumed in the preparation of this publication that the user will ensure that the contents are relevant to the application selected and are correctly applied by appropriately qualified and experienced people for whose guidance it has been prepared.

- Eurofluor does not, and indeed cannot, make any representation or give any warranty of guarantee in connection with material published in Eurofluor publications and expressly disclaims any legal liability or responsibility for damage or loss resulting from the use, or misuse, of information contained in this document.

- It is for each reader to decide to apply this recommendation (in full or partly), or not.

- Always refer to the English version of this document in case of any misunderstanding / misleading information within existing translations.

CONTENT

- Disclaimer
- General Information about Anhydrous Hydrofluoric Acid (AHF) and Aqueous Hydrofluoric Acid (HF)
  - Utilization of AHF and HF in industry
  - Classification
  - Physico – Chemical Properties
  - General Hazards
  - Physiopathology & Toxicology
- Treatment of injuries
  - Activate the Emergency Chain including specific documentation for health professionals
  - Decontamination
  - First Aid
  - Medical treatment
- Appendix:
  - Preparation of Calcium Gluconate Gel / Solution
  - Anamnesis / Questionnaire
  - Content of a First aid Kit
  - Literature

UTILIZATION OF AHF / HF IN INDUSTRY

Industry	Usage of AHF/HF
ELECTRONICS	Production of microchips, cleaning agents for electronic circuits
METALLURGY	Metal cleaning/aluminium production
PETROCHEMICALS	As catalytic agent when alkylising petrol
GLASS INDUSTRY	Glass etching
COOLANTS	Air conditioning, refrigerators
EXTINGUISHING AGENTS	Fire extinguishers
FLUOROCHEMISTRY	Production of fluoride salts, production of Fluoroplastics
MEDICINES	Propellant for medication, anaesthetic gases, production of antibiotics, production and coating of surgical prostheses, production of medicines
NUCLEAR INDUSTRY	Processing of uranium ore
AGROCHEMISTRY	Pesticides
CLEANING AGENTS	Rust removers, outer wall cleaners

CLASSIFICATION OF ANHYDROUS HF (AHF)

Concen-tration %	CLP CLASSIFICATION CLP – Classification, Labelling and Packaging	ADR / RID CLASSIFICATION ADR - European Agreement on International Carriage of Dangerous Goods RID – Regulations Concerning the International Carriage of Dangerous Goods
AHF + HF > 85%	ACUTE TOXICITY (oral, dermal and inhalation) Cat. 1 and 2 SKIN CORROSION Cat 1A  Hazard statements (H Statement) H300: Fatal if swallowed H310: Fatal in contact with skin H330: Fatal if inhaled H314: Causes severe skin burns and eye damage	HYDROGEN FLUORIDE, ANHYDROUS CLASS 8 PG I CT1 : CORROSIVE SUBSTANCE, TOXIC, LIQUID 886 1052  HYDROFLUORIC ACID with more than 85% of hydrogen fluoride CLASS 8 PG I CT1 : CORROSIVE SUBSTANCE, TOXIC, LIQUID 886 1790 

CLASSIFICATION OF AQUEOUS HYDROFLUORIC ACID (HF)

<table>
<tr><th>Concen-tration
%</th><th>CLP CLASSIFICATION
CLP – Classification, Labelling and Packaging</th><th>ADR / RID CLASSIFICATION
ADR - European Agreement on International Carriage of Dangerous Goods
RID – Regulations Concerning the International Carriage of Dangerous Goods</th></tr>
<tr><td>HF > 60%
HF < 85%</td><td rowspan="2">ACUTE TOXICITY (oral, dermal and inhalation)
Cat 1 and 2

SKIN CORROSION
Cat 1A

Hazard statements (H Statement)

H300: Fatal if swallowed
H310: Fatal in contact with skin
H330: Fatal if inhaled
H314: Causes severe skin burns and eye damage</td><td>HYDROFLUORIC ACID
with more than 60% but not more than 85% hydrogen fluoride
CLASS 8 PG I
CT1 : CORROSIVE SUBSTANCE, TOXIC, LIQUID

886
1790

  </td></tr>
<tr><td>HF ≤ 60%</td><td>HYDROFLUORIC ACID
with not more than 60% of hydrogen fluoride
CLASS 8 PG II
CT1 : CORROSIVE SUBSTANCE, TOXIC, LIQUID

86
1790

  </td></tr>
</table>

PHYSICO – CHEMICAL PROPERTIES

SUBSTANCE NAME	HYDROGEN FLUORIDE (AHF) HYDROFLUORIC ACID (HF)
CHEMICAL FORMULA	HF
IDENTIFICATION	CAS NUMBER: 7654-39-3 EINECS NUMBER: 231-634-8 UN NUMBER: 1052 / 1790 RTCES/NIOSH NUMBER: MW 7875000
STATE OF MATTER	Liquid. When its vapours get in touch with humidity create abundant and dense white fumes.
COLOUR	Colourless
ODOUR	Sharp Pungent Odour. Odour Threshold: 0.04 – 0.13 p.p.m.
PH	<1
STABILITY	Stable under normal conditions. There is a great tendency to polymerization, not considered dangerous
SOLUBILITY IN WATER	100% by weight

EXPOSURE CONTROLS / PERSONAL PROTECTION (SEE SDS)

Control parameters

Type Limit value

IOELV = indicative occupational exposure limit values
TWA = Time-weighted average concentration (8 hours)
STEL = Short Term Exposure Limit (15 minutes)

Europe, IOELV: TWA (hydrogen fluoride) 1,5 mg/m³; 1,8 ppm
Europe, IOELV: STEL (hydrogen fluoride) 2,5 mg/m³; 3 ppm

DNEL: Derived no effect level (AHF) Exposure pattern	Route	DNEL	SYMPTOMS	
Acute and systemic local effects)	Inhalation	2.5 mg/m3	Irritation (respiratory tract)	Workers
Long-term acute and systemic effects	Inhalation	1.5 mg/m3	Irritation (respiratory tract)	Workers

EMERGENCY RESPONSE PLANNING GUIDELINE

ERPG 1 (Emergency Response Planning Guideline)

"The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour = 2 ppm"

ERPG 2 (Emergency Response Planning Guideline)

"The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action = 20 ppm"

ERPG 3 (Emergency Response Planning Guideline)

"The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects = 50 ppm"

DO's and DON'Ts when working with HF

Always treat HF with the Greatest Respect.	Don't eat, drink or smoke when wearing work clothes or PPE.
Always assume chemical contamination exists even after decontamination, therefore wear appropriate PPE.	Don't store or re-use contaminated PPE without completely decontaminating it first.
Carefully inspect and test Personal Protective Equipment (PPE) before wearing it.	Don't delay with HF First-Aid. Don't forget to protect yourself and those administering aid or assistance.
Remove immediately, with caution and without hesitation any work clothes contaminated with HF.	Don't store work clothes with personal clothes.
Neutralise any spillage of HF immediately.	Don't carry out any maintenance or work on a HF system against a single isolation valve.
Always follow up HF First-Aid Treatment and go to the Medical Department, even if any pain has receded.	Don't touch any liquid in the workplace. Don't assume it's harmless.
Apply HF First-Aid Treatment with any suspected HF contamination. "Better to be Safe, than Sorry"	Don't share Personal Protective Equipment (PPE).

CTEF – Comité Technique Européen du Fluor

CTEF (Comité Technique Européen du Fluor) represents the major producers and users of hydrogen fluoride (HF) and fluoride chemicals in Europe. CTEF aims to assure safe production, storage, transportation and use of hydrofluoric acid.

For more information, visit our website: www.eurofluor.org

CAUTION !

Responsible Care
OUR COMMITMENT TO SUSTAINABILITY

Be careful!

ANY EXPOSURE OF AHF / HF

MUST BE TREATED

IMMEDIATELY

AND

SPECIFIC

TO AHF/HF!

GENERAL HAZARDS OF AHF/HF

HAZARDS FOR HUMAN HEALTH

- Fatal if inhaled, if swallowed and/or in contact with skin
- Causes severe skin burns and/or eye damage (blindness)
- Needs specific medical treatment
- Prolonged exposure may cause occupational disease

HAZARDS FOR ENVIRONMENT

- Surface and groundwater and soil pollutant
- Air pollutant
- Hazardous for aquatic life

GENERAL HAZARDS OF AHF/HF

CAUTION !

AHF/HF exposures are different from other acid exposures :

- Hydrogen fluoride is corrosive to skin, eyes and the mucous membranes of the respiratory and digestive tracts
- Skin burns are accompanied by severe pain due to fluoride, not the acidity
- The extent and intensity of systemic complications are directly related to the
  - Amount of AHF/HF
  - Exposed area of the body
  - Concentration of AHF/HF absorbed
- Subcutaneous deposits of AHF/HF under the burnt area are responsible for ongoing supply of fluoride ions to the blood stream and the exposed tissues

GENERAL HAZARDS OF AHF/HF

CAUTION !

AHF/HF is corrosive and toxic and may cause:

1. Serious toxic systemic effects, that will require specialized (intensive) care
   - Serum hypocalcemia, serum hypomagnesaemia, serum hyperkalaemia
   - Life threatening cardiac arrhythmias
   - Metabolic acidosis (acidification of blood)
2. Irritation of airways that can lead to bronchitis or even pulmonary oedema
3. Asphyxia (severely deficient supply of oxygen)
4. Severe and painful burns of the skin (potential tingling)
5. Severe and painful burns of the eyes leading to blindness
6. Severe and painful burns of the digestive track

Note: *All or any of the above effects may be delayed in onset and/or be accompanied by toxic systemic effects.*

Even moderate exposures to concentrated HF or AHF may rapidly progress to a fatality if left untreated

GENERAL HAZARDS OF AHF/HF

CAUTION !

- Industrial experience indicates that prompt treatment, as described, will prevent the development of serious injury
- Therefore, speed is essential.
- Delays in decontamination, first aid care or medical treatment or improper medical treatment will likely result in greater damage or may, in some cases, result in a fatal outcome.
- Relief of pain is an important guide to the success of the treatment; therefore local anaesthesia should be avoided

GENERAL HAZARDS OF AHF/HF

CAUTION !

- Symptoms of serious intoxications include:
  - Hypocalcaemia (low calcium level in the blood)
  - Hypotension (very low blood pressure),
  - Tetany and/or laryngospasm (involuntary contraction of muscles either muscles or vocal cords)
  - Often respiratory failure (possibly due to pulmonary oedema)
  - Ventricular tachycardia (abnormal high pulse cardiac rate)

    => Ventricular fibrillation (heart quivers)

    => Cardiac arrest.

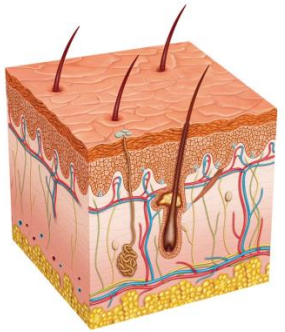
Renal and hepatic functions may be impaired and muscular damage may be secondary to tetany

Prolonged Q-T intervals in ECG/EKG as a result of hypocalcemia

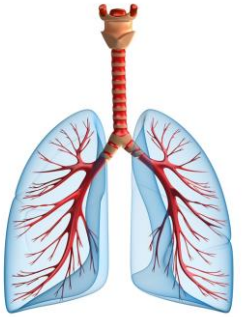
PHYSIOPATHOLOGY & TOXICOLOGY

Potential contact through:

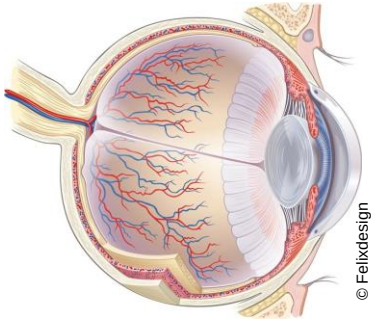
SKIN


© Alex Luengo

AIRWAYS


© Alex Mit

EYES


© Felixdesign

MOUTH
(gastrointestinal system)


© Leonello Calvetti

Types of exposure by AHF/HF (Note: also a high risk in low concentrations!):		
Liquid	Gas	A combination of liquid and gas

PHYSIOPATHOLOGY & TOXICOLOGY

CAUTION !

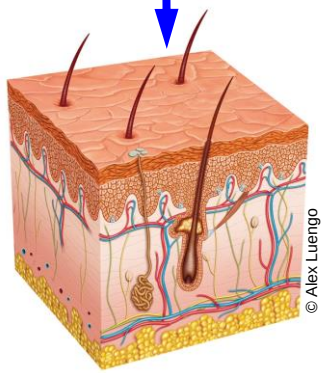
AHF/HF exposures are different from other acid exposures:

- AHF/HF penetrates all tissue, it comes in contact with and does not remain on the surface.
- Once absorbed AHF/HF rapidly dissociates into ionic Hydrogen and Fluoride. Hydrogen is in this context of less importance.
- Fluoride migrates and continues to destroy deep tissue layers as it migrates and will create soluble and insoluble compounds that are the basis for the systemic toxic effects.
- And unlike other acids that are rapidly removed or neutralized, the corrosive and toxic effects may continue for days if left untreated.

PHYSIOPATHOLOGY & TOXICOLOGY

SKIN CONTACT:

AHF / HF



- Rapid dissociation at pH 7.4 (body)
- Fluoride (F^-) forms salts with the electrolytes in the blood
- Rapid Ionisation of F^- causes severe systemic effects

H^+ + F^- →

$2\ F^- + Ca^{2+} = CaF_2$

$2\ F^- + Mg^{2+} = MgF_2$

PHYSIOPATHOLOGY & TOXICOLOGY

After ionisation the fluorine forms insoluble and soluble salts, which reduce the needed electrolytes in the blood and lead to severe systemic problems

Insoluble salts:

$2\ F^- + Ca^{2+} = CaF_2$ (Calcium fluoride)

$2\ F^- + Mg^{2+} = MgF_2$ (Magnesium fluoride)

Soluble salts:

$F^- + Na^+ = NaF$ (Sodium fluoride)

$F^- + K^+ = KF$ (Potassium fluoride)

Acute/primary effects

- Corrosive effects
  - Concentration >50% results in immediate serious tissue destruction/blisters, exceptionally painful
  - At lower concentrations, a delay of symptoms is possible several hours up to 48 hours after exposure!

- Systemic effects
  - Low electrolyte level (calcium, magnesium etc.) in the blood (cardiac rhythm disorders/arrest) and
  - fluoride intoxication (hepatic and renal disorders)

CONTENT

- Disclaimer
- General Information about Anhydrous Hydrofluoric Acid (AHF) and Aqueous Hydrofluoric Acid (HF)
  - Utilization of AHF and HF in industry
  - Classification
  - Physico – Chemical Properties
  - General Hazards
  - Physiopathology & Toxicology
- Treatment of injuries
  - Activate the Emergency Chain including specific documentation for health professionals
  - Decontamination
  - First Aid
  - Medical treatment
- Appendix:
  - Preparation of Calcium Gluconate Gel / Solution
  - Anamnesis / Questionnaire
  - Content of a First aid Kit
  - Literature

ADVICE FOR FIRST AIDERS

DO NOT DELAY !

AS A RESCUER: PROTECT YOURSELF,
REMOVE VICTIM FROM EXPOSURE AREA, AND

Pay attention not to get yourself contaminated

Wear appropriate PPE and
AHF / HF resistant gloves

ADVICE FOR FIRST AIDERS

START THE INTERNAL EMERGENCY CHAIN AND DECONTAMINATION AND FIRST AID TREATMENT

WITHOUT DELAY

ANY EXPOSURE TO AHF/HF DEMANDS IMMEDIATE CONTACT WITH

THE FIRST AID AND THE MEDICAL TEAM, SO

OBTAIN MEDICAL ATTENTION IMMEDIATELY

ENSURE THAT THE VICTIM IS ALWAYS ACCOMPANIED AND GUIDED BY A RESCUER

ADVICE FOR FIRST AIDERS / EMERGENCY CHAIN MEMBERS

Make sure, to have a proper documentation with all needed information about

- Contamination including
  - Concentration of AHF/HF,
  - Amount of AHF/HF and
  - Affected body area,
- decontamination and
- applied treatment

parallel to the treatment of the patient for further medical therapy

(use the questionaire – see appendix 3)

DECONTAMINATION

- Use huge amounts of water of a safety shower / eyewash to decontaminate the affected areas
- AHF/HF is very water soluble, so water decontamination is highly effective
- Begin decontamination as soon as possible
- Clothing, personal protective equipment and jewellery/ watches/ shoes etc. should be assumed to be contaminated and removed during showering
- Check with pH paper (on skin, in eye and in mouth) if decontamination was efficient

DECONTAMINATION - EYES

- Initial decontamination with huge amounts of water from an eyewash or similar high flow device
- Flow and open and close your eye lids. It must be assured that there is adequate irrigation under the lids and in the corners of the eyes
- There is considerable discomfort associated with irrigating under the eyelids and in the corners of the eyes
- Therefore for eyes only (!), if available for application by trained personnel, use of a topical anaesthetic is recommended after an initial brief decontamination

FIRST AID - SKIN

© alexwhite

- Principle: flush off and dilute
- Remove <u>all</u> contaminated clothing (jewellery/watches/shoes etc.!) under the safety shower
- Finally, remove protective goggles, looking towards the shower spray with closed eyes.
- 1 minute of flush after undressing is sufficient!
- But continue with showering until Calcium Gluconate is available!
- Rub in Calcium Gluconate 2.5% gel as soon as possible
- Continue massaging for at least <u>15 additional minutes</u> after the pain disappears (make sure that ”used” Calciumglugonate is removed before reapplying new Calciumgluconate)
- Bring to qualified medical attention immediately:

“WET & NAKED…..”

(completely decontaminated and pre-treated with Calcium Gluconate)

FIRST AID - EYES

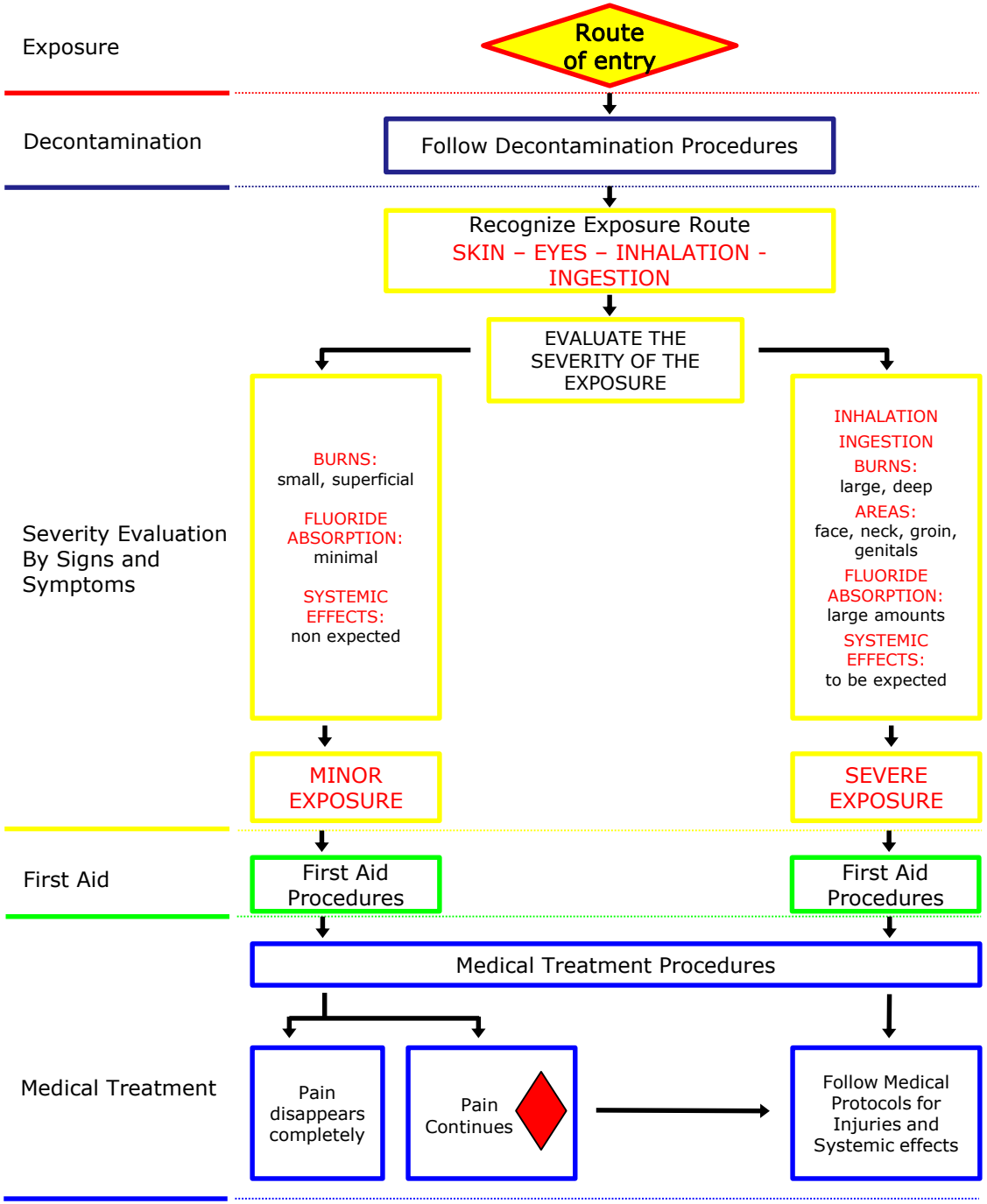
- Once decontamination has been completed, continue irrigation with a low flow solution
- Irrigate each eye with 1% Calcium Gluconate solution
  (If allowed by local legislation, otherwise, irrigate with 0,9% saline solution (Ringer solution))
- This should be continued while the individual is transported for medical evaluation by an eye specialist.
- Bring to qualified medical attention immediately
- Obtain specialised ophthalmic attention.

FIRST AID - INHALATION

- Administer 100% oxygen by mask.
- Nebulize 2.5% calcium gluconate in normal saline solution continuously until medical evaluation.
- If respiratory assistance is needed use indirect methods such as a respiratory bag or valved mask
- Bring to qualified medical attention immediately

FIRST AID - INGESTION

- Do not induce vomiting
- Maintain life support
- Bring to qualified medical attention immediately


Exposure
Route of entry
Decontamination
Follow Decontamination Procedures
Recognize Exposure Route
SKIN – EYES – INHALATION - INGESTION
EVALUATE THE SEVERITY OF THE EXPOSURE
Severity Evaluation By Signs and Symptoms
BURNS:
small, superficial
FLUORIDE ABSORPTION:
minimal
SYSTEMIC EFFECTS:
non expected
INHALATION
INGESTION
BURNS:
large, deep
AREAS:
face, neck, groin, genitals
FLUORIDE ABSORPTION:
large amounts
SYSTEMIC EFFECTS:
to be expected
MINOR EXPOSURE
SEVERE EXPOSURE
First Aid
First Aid Procedures
First Aid Procedures
Medical Treatment Procedures
Medical Treatment
Pain disappears completely
Pain Continues
Follow Medical Protocols for Injuries and Systemic effects

Exposure

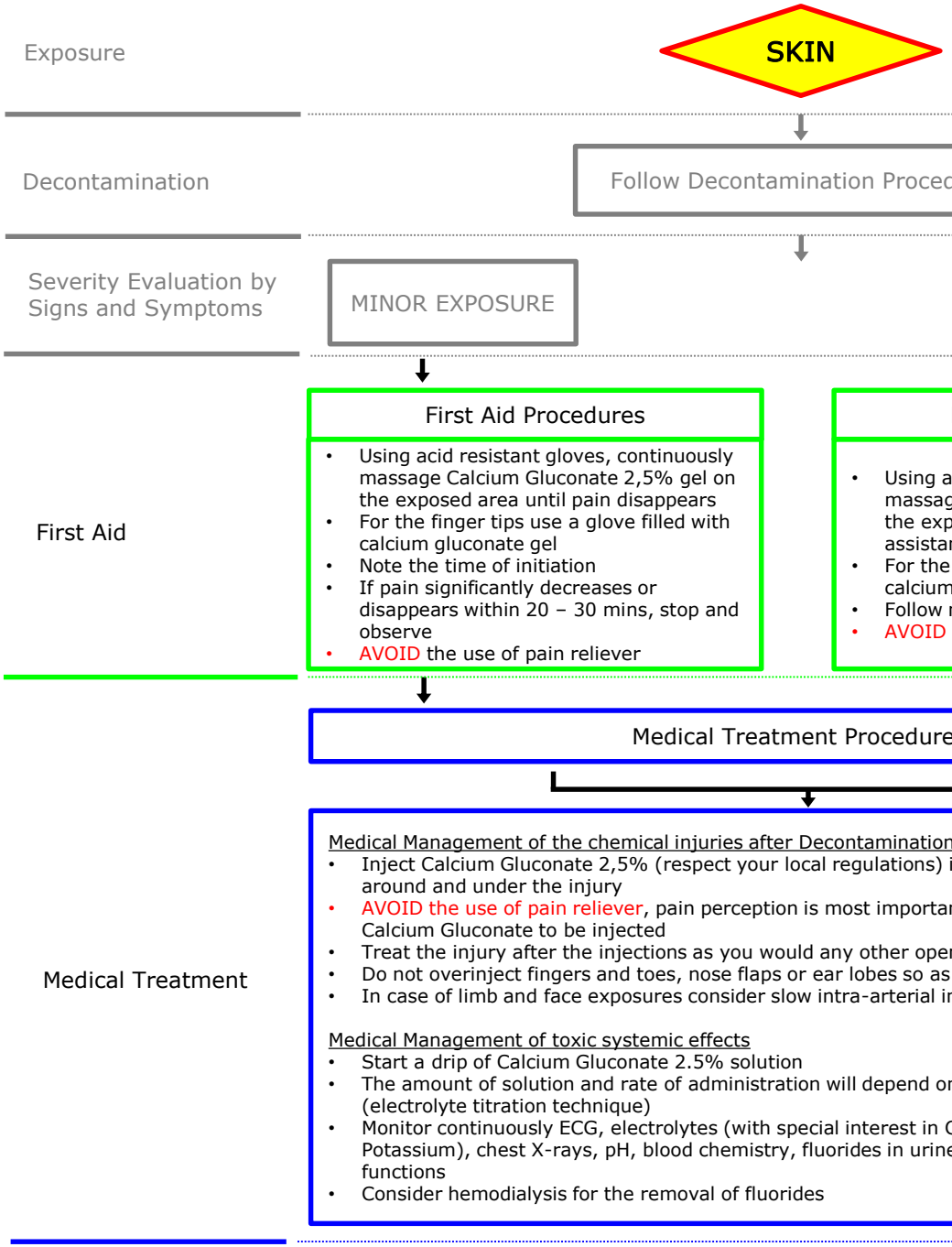
SKIN

	Decontamination Procedures for AHF & Aqueous HF Solutions	Decontamination Procedures for AHF/HF containing Tars & Oils and not water soluble substances
Decontamination	• Go to the nearest source of clean water or safety shower • Open the water valve • Remove **all** your clothing, shoes and jewelry under the safety shower • Finally, while closing your eyes and facing the water flow, remove your googles or respirator face mask • WASH WITH COPIUS AMOUNT OF CLEAN WATER FOR ONE MINUTE (respectively until Calcium Gluconate is available)	Protecting your hands with PVC, Nitrile or Neoprene gloves proceed to: • Mechanically remove the tar or oil using gauze, tongue depressor, paper towels etc. Consider all discarded materials hazardous waste and handle them appropriately • Use hydrophobic substances (like oil) to remove leftover tar, oil or substances • Remove oil residue thoroughly by washing with soap & water • Or use a citrus oil solvent and water and then • WASH WITH COPIOUS AMOUNT OF CLEAN WATER FOR ONE MINUTE (respectively until Calcium Gluconate is available)

Severity Evaluation By Signs and Symptoms

MINOR EXPOSURE	SEVERE EXPOSURE
• Exposure to solutions of HF < 30% • Exposed body surface to < 20 cm^2 • Injury and/or pain appears up to 48 hours after exposure • Superficial injuries • Tissue is whitish, no blistering, no swelling • Patient is conscious, stable, cooperative • No systemic toxic effect	• Exposure to solutions of HF > 30% or AHF • Exposed body surface to > 20 cm^2 • Injury appears immediately after exposure, with severe pain, redness/ blanching • Exposure of the face, groin, genitals or neck • Patient is unconscious and unstable • Cardiac arrhythmia (irregular heart beats) • Systemic toxic effects present
First Aid Procedures	First Aid Procedures
Medical Treatment Procedures	

See next slide


Exposure
SKIN
Decontamination
Follow Decontamination Procedures
Severity Evaluation by Signs and Symptoms
MINOR EXPOSURE
SEVERE EXPOSURE
First Aid
First Aid Procedures
• Using acid resistant gloves, continuously massage Calcium Gluconate 2,5% gel on the exposed area until pain disappears
• For the finger tips use a glove filled with calcium gluconate gel
• Note the time of initiation
• If pain significantly decreases or disappears within 20 – 30 mins, stop and observe
• AVOID the use of pain reliever
First Aid Procedures
• Using acid resistant gloves, continuously massage Calcium Gluconate 2,5% gel on the exposed area until you reach medical assistance
• For the finger tips use a glove filled with calcium gluconate gel
• Follow medical procedures
• AVOID the use of pain reliever
Medical Treatment Procedures
Medical Treatment
Medical Management of the chemical injuries after Decontamination & First Aid
• Inject Calcium Gluconate 2,5% (respect your local regulations) in normal saline solution into, around and under the injury
• AVOID the use of pain reliever, pain perception is most important to determine the amount of Calcium Gluconate to be injected
• Treat the injury after the injections as you would any other open wound
• Do not overinject fingers and toes, nose flaps or ear lobes so as to avoid ischemic necrosis
• In case of limb and face exposures consider slow intra-arterial infusion of 2,5% Calcium Gluconate
Medical Management of toxic systemic effects
• Start a drip of Calcium Gluconate 2.5% solution
• The amount of solution and rate of administration will depend on the patient's serum calcium (electrolyte titration technique)
• Monitor continuously ECG, electrolytes (with special interest in Calcium, Magnesium, Sodium and Potassium), chest X-rays, pH, blood chemistry, fluorides in urine and blood, liver & kidney functions
• Consider hemodialysis for the removal of fluorides

Exposure

EYE

Responsible Care
OUR COMMITMENT TO SUSTAINABILITY

Decontamination

Decontamination Procedure:

- Go to the nearest Eye Wash or clean source of water
- Open the water valve
- Put your eye(s) in the water flow
- Do not delay irrigation while waiting for any contact lens removal[1]
- Open and close your eyelids for 5 min. maximum. If you cannot open them, use your fingers with gloves to maintain your eyelids open or ask for help
- The use of anesthetics may help for decontamination of the eye

Severity Evaluation by Signs and Symptoms

Severity:
All exposures are considered serious because of the danger of vision loss
Consider the following information:

Exposure Effects on:	Minor Exposures	Severe Exposures
Skin (near the eye):	Minor irritation, reddening or swelling	Severe irritation – evidence of chemical burns of the eye lids and peri-ocular skin
Conjunctiva:	Minimal irritation and reddening	Severe irritation, reddening and swelling, possible ulcerations
Cornea:	No evidence of injury or minor irritation	Corneal opacification, pitting or ulceration with vision loss and intense pain
Vision:	No evidence of vision loss	Vision loss that can be temporary if it is only due to corneal opacification or permanent vision loss if retinal death occurs due to increased intraocular pressure

First Aid Procedures

Medical Treatment Procedures

See next slide

[1] If contact lenses are present, consider removing them only once in presence of medical professionals or at medical facility, with careful attention and possibly using contact lenses removal tools. There is a potential risk of contamination for the person who removes the lenses, and the cornea of the victim could be injured in the process.

Exposure

Decontamination

Follow Decontamination Procedures

Severity Evaluation by Signs and Symptoms

Severity:
All exposures are considered serious because of the danger of vision loss

First Aid

First Aid Procedures

- Irrigate the eye(s) with a 1% Calciumgluconate solution, and if not allowed in your country use saline solutions (Ringer solution) for a minimum period of 15 min or if necessary until medical assistance is available
- The use of local anaesthetic (suitable for eyes) may facilitate the irrigation of the eye(s)
- Always obtain specialized medical evaluation & treatment

Medical Treatment

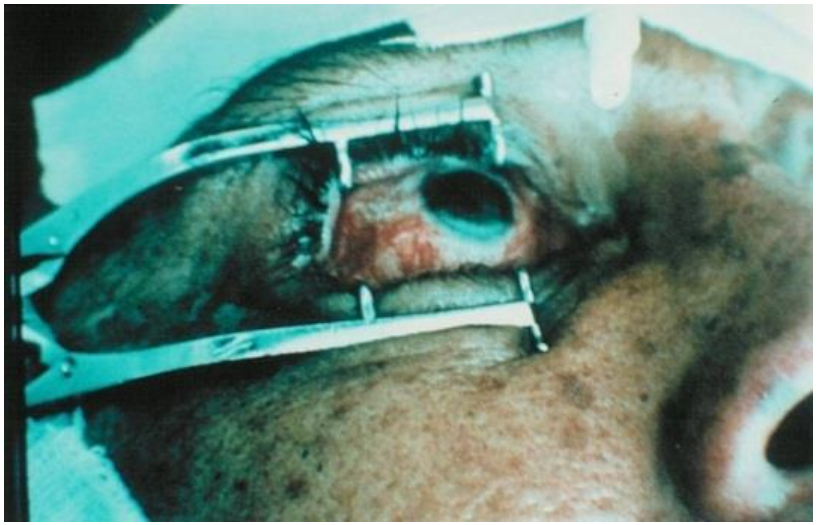
Medical Treatment Procedures

EVALUATION:
- You should always obtain a specialized medical evaluation which includes a detailed study of the exposed eye(s) using a slit lamp, determination of ocular pressure and fundoscopy

TREATMENT:
- Antibiotics and steroids can be used as indicated by an eye specialist
- Monitor ocular pressure
- Evaluate corneal opacification and conjunctival injury frequently
- If skin, inhalation or ingestion exposure occurred do not forget to follow decontamination First Aid and medical treatment for those entry routes, including systemic toxicity treatment protocols

MEDICAL TREATMENT - EYES

Example for applying irrigation with a Calcium Gluconate solution (1%) or Ringer - solution:



Exposure

INHALATION

Decontamination

Decontamination Procedure:

- It is not possible to decontaminate the respiratory tract
- If exposed to AHF/HF vapors, expect to see skin and eye exposures
  Follow decontamination procedures for these entry routes as described

Severity Evaluation by Signs and Symptoms

Signs & Symptoms:

- No signs & symptoms
- Minor coughing
- Erythema (reddening) and minor mucosal edema, swelling of the mouth, nose and throat

Minor Exposure
With minimal or no systemic effects expected

First Aid Procedures

Signs & Symptoms:

- Coughing
- Labored breathing
- Shortness of breath
- Erythema (reddening), swelling of mouth, nose and throat
- Bronchial spasm
- Mucosal bleeding
- Upper airway edema
- Pulmonary edema
- Cardiac arrhythmia (irregular heart beat)

Severe Exposure
With respiratory skin, eyes and systemic effects

First Aid Procedures

Medical Treatment Procedures

See next slide

Responsible Care
OUR COMMITMENT TO SUSTAINABILITY

Decontamination

Follow Decontamination Procedures

Severity Evaluation by Signs and Symptoms

MINOR EXPOSURE

SEVERE EXPOSURE

First Aid

First Aid Procedures

- Administer O_2 by mask 12l a min.
- Nebulize Calcium Gluconate 2,5% in normal saline solution for 15 to 20 min minimum
- Nebulize until medical evaluation, at least 15 – 20 minutes, and again especially if pain reappears
- Obtain medical evaluation & observe

First Aid Procedures

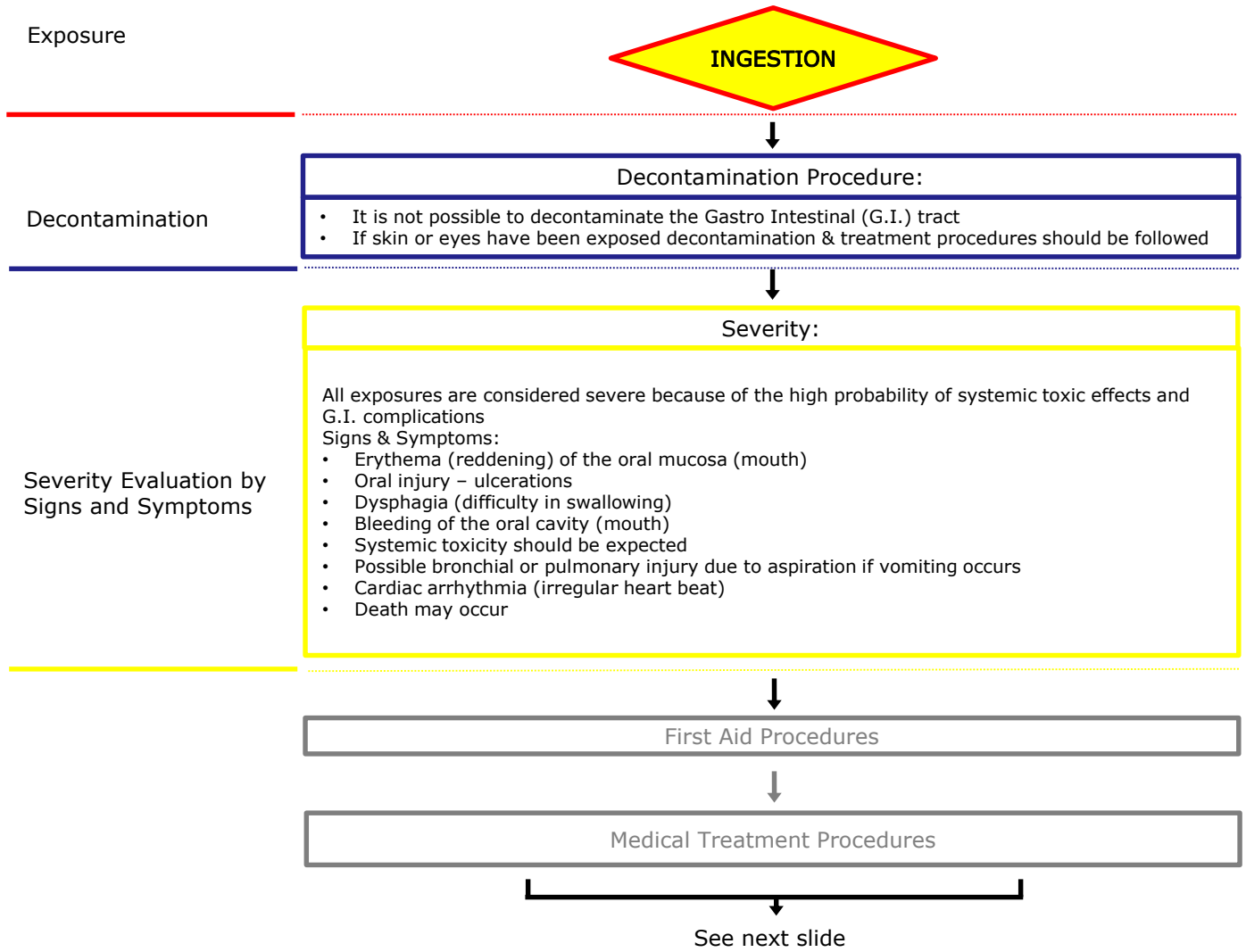
- Administer O_2 by mask 12l a min.
- Nebulize Calcium Gluconate 2,5% in normal saline for 15 to 20 min minimum
- Nebulize until medical evaluation, at least 10-15 minutes, and again especially if pain reappears
- Obtain medical evaluation & observe
- If respiratory assistance is needed do not use direct methods, consider to use indirect methods such as a respiratory bag or valved mask

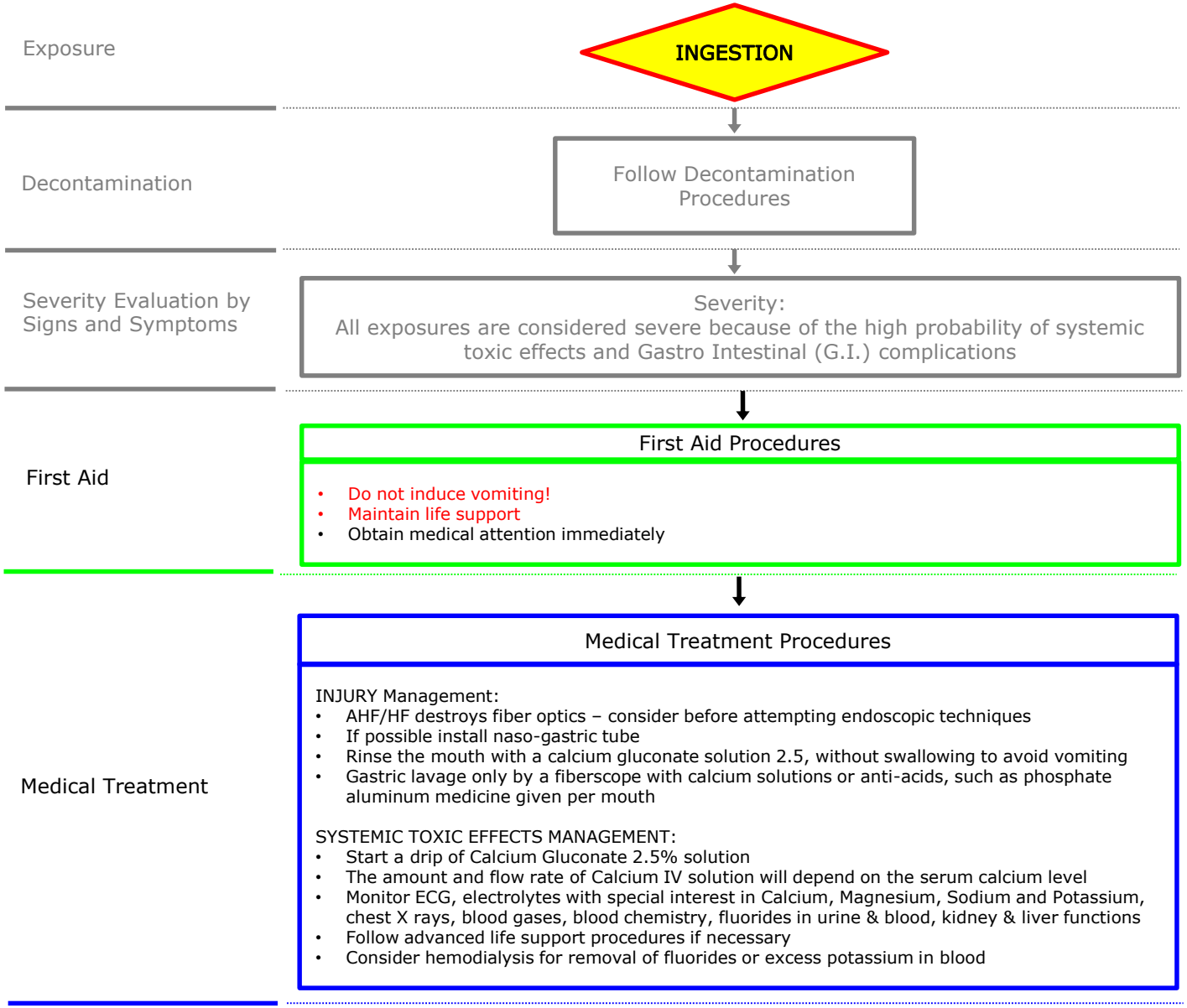
Medical Treatment

Medical Treatment Procedures

For the respiratory tract & toxic systemic effects

- Remember your ABC's (**A**irways, **B**reathing, **C**irculation) secure airway and breathing, follow advanced life support procedures
- Intermittent positive pressure breathing (lppb) and positive end expiratory pressure (peep) may be necessary
- Respiratory assistance may be necessary until edema has resolved and normal blood gases are stabilized
- The use of bronchial dilators steroids and antibiotics may be necessary
- Start a drip Calcium Gluconate 2.5% solution. The amount & flow of this solution will depend on the electrolyte results (Ca)
- Phosphate aluminum medicine given per mouth reduced pain of the pharyngeal area
- Monitor: Chest X rays, ECG, blood gases, electrolytes with special interest in Calcium, Magnesium, Sodium and Potassium, blood chemistry, fluorides in urine & blood and kidney & liver functions
- Consider hemodialysis for the removal of serum fluorides and excess potassium
- Consider the use of an external oxygenation system (such as ECMO) to oxygenate the blood and give the lungs the opportunity to recover.


Exposure
INGESTION
Decontamination
Decontamination Procedure:
• It is not possible to decontaminate the Gastro Intestinal (G.I.) tract
• If skin or eyes have been exposed decontamination & treatment procedures should be followed
Severity Evaluation by Signs and Symptoms
Severity:
All exposures are considered severe because of the high probability of systemic toxic effects and G.I. complications
Signs & Symptoms:
• Erythema (reddening) of the oral mucosa (mouth)
• Oral injury – ulcerations
• Dysphagia (difficulty in swallowing)
• Bleeding of the oral cavity (mouth)
• Systemic toxicity should be expected
• Possible bronchial or pulmonary injury due to aspiration if vomiting occurs
• Cardiac arrhythmia (irregular heart beat)
• Death may occur
First Aid Procedures
Medical Treatment Procedures
See next slide


Exposure
INGESTION
Decontamination
Follow Decontamination Procedures
Severity Evaluation by Signs and Symptoms
Severity:
All exposures are considered severe because of the high probability of systemic toxic effects and Gastro Intestinal (G.I.) complications
First Aid
First Aid Procedures
• Do not induce vomiting!
• Maintain life support
• Obtain medical attention immediately
Medical Treatment
Medical Treatment Procedures
INJURY Management:
• AHF/HF destroys fiber optics – consider before attempting endoscopic techniques
• If possible install naso-gastric tube
• Rinse the mouth with a calcium gluconate solution 2.5, without swallowing to avoid vomiting
• Gastric lavage only by a fiberscope with calcium solutions or anti-acids, such as phosphate aluminum medicine given per mouth
SYSTEMIC TOXIC EFFECTS MANAGEMENT:
• Start a drip of Calcium Gluconate 2.5% solution
• The amount and flow rate of Calcium IV solution will depend on the serum calcium level
• Monitor ECG, electrolytes with special interest in Calcium, Magnesium, Sodium and Potassium, chest X rays, blood gases, blood chemistry, fluorides in urine & blood, kidney & liver functions
• Follow advanced life support procedures if necessary
• Consider hemodialysis for removal of fluorides or excess potassium in blood

CONTENT

- Disclaimer
- General Information about Anhydrous Hydrofluoric Acid (AHF) and Aqueous Hydrofluoric Acid (HF)
  - Utilization of AHF and HF in industry
  - Classification
  - Physico – Chemical Properties
  - General Hazards
  - Physiopathology & Toxicology
- Treatment of injuries
  - Activate the Emergency Chain including specific documentation for health professionals
  - Decontamination
  - First Aid
  - Medical treatment
- Appendix:
  - Preparation of Calcium Gluconate Gel / Solution
  - Anamnesis / Questionnaire
  - Content of a First aid Kit
  - Literature

PREPARATION OF CALCIUM GLUCONATE GEL/SOLUTION

- CALCIUM GLUCONATE 2.5% GEL for SKIN TREATMENT
  - Mix 10ml of a 10% calcium gluconate solution with 30ml of a water soluble lubricant to obtain 40ml of calcium gluconate 2.5% gel by weight

- CALCIUM GLUCONATE 5% SOLUTION FOR INJECTION
  - To obtain 100ml of a 5% calcium gluconate solution, mix 50ml of a normal saline solution with 50ml of a 10% solution of calcium gluconate.
  - To obtain 1000ml of a 5% calcium gluconate solution, mix 500ml of a normal saline solution with 500ml of a 10% solution of calcium gluconate.

- CALCIUM GLUCONATE 2.5% SOLUTION FOR NEBULIZATION
  - To obtain 100ml of a 2.5% calcium gluconate solution, mix 75ml of a normal saline solution with 25ml of a 10% solution of calcium gluconate.
  - To obtain 1000ml of a 2.5% calcium gluconate solution, mix 750ml of a normal saline solution with 250ml of a 10% solution of calcium gluconate.

- CALCIUM GLUCONATE 1% SOLUTION FOR EYE TREATMENT
  - Mix 900ml of normal saline solution with 100ml of a 10% of a calcium gluconate solution

CALCIUM GLUCONATE AS RECOMMENDED TREATMENT

Use calcium gluconate because:

- ✓ It is an excellent Calcium source
- ✓ It is easy to prepare and use at workplace, during transportation and at hospital.
- ✓ It can be used such as gel, solution, infusion and nebulizer.
- ✓ It can be used for first aid as well as medical treatment.
- ✓ There is a huge clinical experience which supports its use.

ANAMNESIS / QUESTIONNAIRE

FIRST AID MANAGEMENT OF HYDROGEN FLUORIDE AND/OR HYDROFLUORIC ACID INJURIES

Name: _____

Sex: M / F Age: _____ Date and time: _____

DIAGNOSTIC (TICK APPROPRIATE)

This patient was exposed to

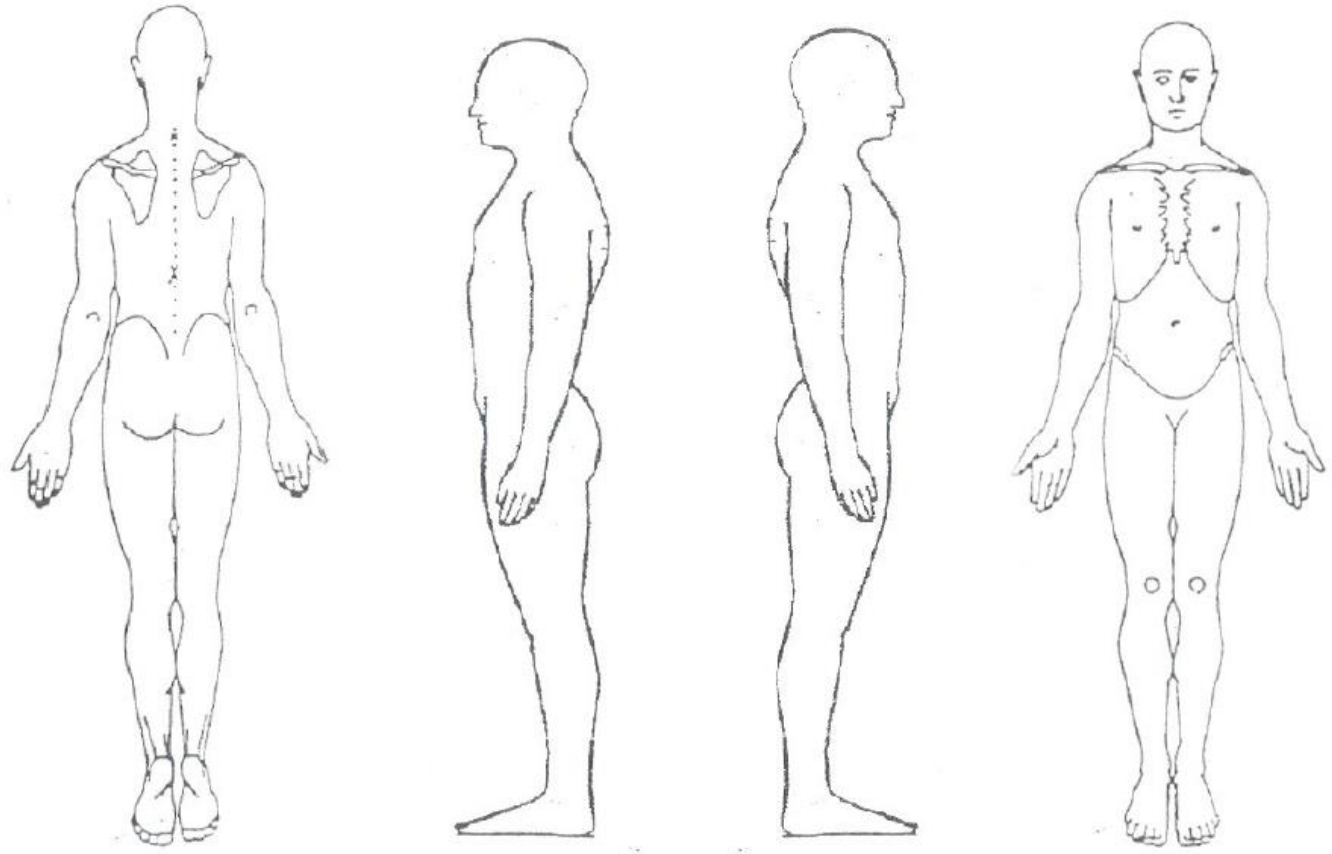
- ☐ Anhydrous Hydrogen Fluoride (AHF)
- ☐ Hydrofluoric acid _____ % solution (HF)
- ☐ other Fluoride? (specify _____)

Exposure date: _____ Exposure time: _____ AM/PM

Nature of exposure: ☐ Skin ☐ Eyes ☐ Inhalation ☐ Ingestion

ANAMNESIS / QUESTIONNAIRE

Affected body surface:



ANAMNESIS / QUESTIONNAIRE

☐	Showering, decontamination of the skin	Duration:	min
☐	Rinsing, decontamination of the eyes	Duration:	min
☐	Calcium Gluconate Gel	Duration:	min
☐	Eye irrigation with 1% Calcium Gluconate solution	Duration:	min
☐	Nebulization with 2.5% solution of Calcium Gluconate	Duration:	min
☐	Basic Life support	Duration:	min
☐	Other (specify _____)	Duration:	min

ANAMNESIS / QUESTIONNAIRE

Time between exposure and decontamination with water: _____ min.

Time between decontamination with water and other treatment: _____ min

☐ Dr.

☐ Nurse

☐ 1st Aider

Name and signature

_____

_____

Date: _____ Time: _____ AM/PM Place: _____

Note to First Aider: Patient should be accompanied by a doctor or nurse whenever possible

FOR FURTHER MEDICAL INFORMATION

Telephone: _____

Name: _____

FIRST AID KIT FOR AHF / HF

Example for a First Aid Kit:

- ✓ Calcium Gluconate Gel 2.5%
- ✓ Calcium Gluconate Solution 1% for the eyes (respect your local regulations)
- ✓ Calcium Gluconate Solution 2.5% for nebulization (respect your local regulations)
- ✓ Eyewash bottle
- ✓ Gauzes, bandages…
- ✓ Scissors (to rip the clothes).
- ✓ AHF/HF resistant gloves
- ✓ Instructions:

  + details

  + (filled) form for medical doctor

LITERATURE

References on skin exposure

- Brown T.D., *The Treatment of Hydrofluoric Acid Burns*.
- Journal of the Society of Occupational Medicine, vol. 24, no. 3, July 1974. And all references of the article.
- Dowback, Rose, Rohrich*. A Biochemical and Histological Rational for Treatment of Hydrofluoric Acid Burns with Calcium Gluconate*. UT Dallas, JUL-AUG, 14 (4) ; 324-7, 1994.
- EPA´s, (Environmental Protection Agency of the United States of America) *Fluoride Study, Report to Congress*, Section 301(N)(6), Clean Air Act Amendments of 1990-1992, Section 2, Properties, and all references of the document.
- Harris, Rumack. *Comparative Efficacy of Injectable Calcium and Magnesium Salts in the Therapy of Hydrogen Fluoride Acid Burns*. Clinical Toxicology, 18 (a), pp 1027-1032.1981.
- Kono, Kashida, Watanabe, Tanioka, Dote, Orita, Bessho,Yoshida, Sumi, Omebyshi. *An Experimental Study on the Treatment of Hydrofluoric Acid Burns*. Archives of Environmental Contamination and Toxicology Vol.22, No. 4, pp 414-418, 1992.
- NIOSH, *Profile on Hydrogen Fluoride*, (National Institute for Occupational Safety and Health) US Department of Health, Education & Welfare. Public Health Service and Center for Disease Control. 1976. and all references of the document.
- Sheridan, Ryan, Quimby, Blair, Tompkins, Burke. *Emergency Management of Major Hydrofluoric Acid Exposures*. Burns, Vol. 21, No. 1, pp 62-64, 1995, and all references of the article.
- Treviño, Herrmann, Sprout. *Treatment of Severe Hydrofluoric Acid Exposures*. Journal of Occupational Medicine, Vol. 25, No. 12, Dic. 1983. and all references of the article.
- Treviño, Herrmann. *Nueva Modalidad en el Tratamiento* de *Quemaduras con Acido Fluorhidrico*. Presented to the Dupont Medical Group Mexico City 1984.
- Upfal, Doyle. *Medical Management of Hydrofluoric Acid Exposures*, Journal of Occupational and Environmental Medicine, Vol. 32, No. 8, August 1990. And all references of the article.

LITERATURE

- Williams, Bracken, Cuppage, Mclaury, Kirwin & Klaussen. *Comparative Effectiveness of Topical Treatments* for *Hydrofluoric Acid Burns*. Journal of Occupational Medicine, vol. 27, no. 10, pp 733-739. And references of the article.
- *The Material Safety Data Sheets for AHF / HF* of EUROFLUOR

References on obsolete techniques for skin exposure treatment

- Cox, Osgood. *Intravenous Magnesium Sulfate for the Treatment of Hydrogen Fluoride Acid Burns*. Journal of Toxicology, Clinical Toxicology. 01-1994, 23(2): 123-36. And all referenced in the article.
- Henry, Hla. *Intravenuos Regional Calcium Gluconate Perfusion for Hydrofluoric Acid Burns*. Journal of Toxicology, Clinical Toxicology, Vol. 30, No. 2, pp 203-207.
- Heron. *Tratamiento con Acetato de Calcio de las Exposiciones al Acido Fluorhidrico*. Inedito.
- Lan, Mohr, Arenhiltz, Solem. *Treatment of Hydrofluoric Acid Burns to the Face by Carotid Artery Infusion of Calcium Gluconate*. Journal of Burn Care & Rehabilitation. Vol. 25, (5) Sept. Oct. 2004 pp 421-424. And all referenced in the article.
- Mackinnon. *Hydrofluoric Acid Burns*. Occupational Dermatoses, Dermatologic Clinics, Vol. 6, No. 1, Jan. 1988.
- Michelson, Martin, Cabaugh, Scheider. *Wave form Monitored Intraarterial Calcium Infusion for Hydrofluoric Acid Burns*. Vet. Hum. Toxicology; 34 (4), 1992, p 337.
- Shultz. *Hydrofluoric Acid Burns*. The Western Journal of Medicine, July 1989, p 71. And all referenced in the article.
- Vance, Curry, Kunkel, Ryan, Ruggeri. *Digital Acid Burns Treatment With Intraarterial Calcium Infusion*. Annals of Emergency Medicine 15:8, August 1988. And all referenced in the article.
- Williams, Hammad, Cotting, Herchelroad. *Intravenous Magnesium in the Treatment of Hydrofluoric Acid Burns in Rats*. Annals of Emergency Medicine 1994, March, 23(3): pp464-469.

LITERATURE

References on eye exposure

- Bentur, Tennenbaum, Yaffe, Helpert. *The Role of Calcium Gluconate in the Treatment of Hydrofluoric Acid Eye Burns*. Israel Poison Information Center. Rambam Medical Center, Jerusalem, Israel. Annals of Emergency Medicine 1993, Sep; 22(9); 1488-99, and the references of the article.
- Grant. *Hydrofluoric Acid, Toxicology of the Eye, 2nd Edition*. Charles C. Thomas, Springfield, Ill, 1974, p 557.
- McCully, Whyting, Peritt. *Treatment for Exposed Eyes to Hydrogen Fluoride*. LOM, 10, Vol. 25, No. 6, Jun. 1983.
- Rubenfield, Sivert, Aentsen, Laibson. *Ocular Hydrofluoric Acid Burns*. American Journal of Ophthalmology, 1145(4), pp 420-423, 1992
- Shewmake, Anderson. *Hydrofluoric Acid Burns*. Archives of Dermatology, 115: 593-596, 1979.
- Trevino, Herrmann, Sprout, *Treatment of Severe Hydrofluoric Acid Exposures*. Journal of Occupational Medicine, Vol. 25, No. 12, Dic. 1983
- *The MSDS's for Hydrogen Fluoride* from.- Mexochem Fluor, Dupont, Honeywell, Solvay, etc.
- Centre Antipoison, Centre Hospitalier Régional Universitaire de Lille, Magazine N°33: « Dangers de l'acide fluorhydrique », http://cap.chru-lille.fr/GP/magazines/96685.html

References on inhalation exposure

- Lee, David C. *Treatment of Hydrogen Fluoride Exposure with Nebulized Calcium Gluconate*. Medical College of Pennsylvania, Delaware, Valley Regional Poison Control Center. Presented at the American Chemistry Council, HF Panel Meeting in Hilton Head SC. USA. 1993.
- Lee, Wiley, Snyder. *Treatment of Inhalation Exposure to Hydrogen Fluoride Acid with Nebulized Calcium Gluconate*.
- Journal of Occupational Medicine, Vol. 35, No. 5, p 470, 1993.
- Mackinnon. *Hydrofluoric Acid Burns*. Dermatologic Clinics, Vol. 6, No. 1, pp 67-74, January 1988.

LITERATURE

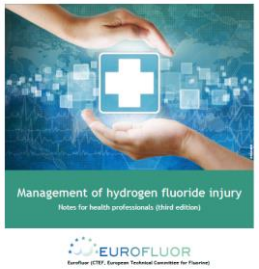
- Russi, EW, Ahmed. *Calcium and Calcium Antagonist in Airway Disease*. Chest 1984; 86 (3): 475-482
- Treviño, Herrmann, Sprout. Treatment of Severe *Hydrofluoric Acid Exposures*. Journal of Occupational Medicine, Vol. 25, No. 12, Dic. 1983.
- Upfal, Doyle. *Medical Management of Hydrofluoric Acid Exposures*. Journal of Occupational and Environmental Medicine, Vol. 32, No. 8. August 1990.
- *The MSDS´s for Hydrogen Fluoride* from Mexichem Fluor, Dupont, Honeywell, etc.
- Caravati 1988.- unable to obtain the article.
- Hydrofluoric Acid Inhalation Injury, Lambros Tsonis, Christina Hantsch-Bardsley, Richard L. Gamelli, J Burn Care Res (2008) 29: 852–855
- A review of treatment strategies for hydrofluoric acid burns: Current status and future prospects, Wang Xinganga, Zhang Yuanhaib, Ni Liangfang, You Chuangang, Ye Chunjiang, Jiang Ruiming, Liu Liping, Liu Jia, Han Chunmao, Burns 40 (2014) 1447-1457

References on ingestion exposure

- Monoguerra, Neuman. *Fatal Poisoning From Acute Hydrofluoric Acid Ingestion*. Journal of Emergency Medicine 1986, 4: pp 362-363 and al references for the article.
- Stemski, Grande, Ling. *Survival Following Hydrofluoric Acid Ingestion*. Annals of Emergency Medicine 1992, Nov; 21(11): 1396-9, 1992.

ADDITIONAL INFORMATION

More information/brochures



It is strongly recommended to download and read

- First Aid Brochure (Management of hydrogen fluoride injury)
- Material Safety Data Sheet (SDS) for AHF and different concentrations of HF

on website www.eurofluor.org under Publications & Recommendations

EUROFLUOR, the European Technical Committee for Fluorine
Avenue E. Van Nieuwenhuyse 4, B-1160 Brussels, Belgium
Tel. + 32.2.676.72.11 - info@eurofluor.org - www.eurofluor.org

A sector group of Cefic

European Chemical Industry Council – Cefic aisbl
EU Transparency Register n° 64879142323-90