

# Use of disinfectants in the health care sector: Chemical hazards and preventive measures

## Factsheet 7: Skin and hand disinfection

### Foreword

The Chemical Risks workgroup of the Health Services Section of the International Social Security Association (ISSA) has studied the risks linked to disinfection activities in the health care sector and the preventive measures that should be applied. This workgroup has defined a position shared by all the occupational health and safety organisations represented within the group: BGW (Germany), INRS (France) and Suva (Switzerland).

This project included a collaboration with the Infectious Risks workgroup of the Section, to summarise the general principles of disinfection (Factsheet 1) for the audience targeted by the current series (see below).

For practical reasons, the results of this work will be presented as a series of technical Factsheets:

Factsheet 1: Principles of disinfection

Factsheet 2: General principles of prevention

Factsheet 3: Hazards of chemical disinfectants

Factsheet 4: Selecting safe disinfectants

Factsheet 5: Surface disinfection

Factsheet 6: Instrument disinfection

Factsheet 7: Skin and hand disinfection

Factsheet 8: Specific procedures (disinfecting premises, medical equipment, linen and clothing)

Each factsheet contains the essential information relating to the theme covered, and can therefore be read separately. These factsheets are destined for use by those responsible for organising and performing disinfection tasks in the health care sector, by occupational physicians and by all those involved in preventing occupational risks – in particular occupational hygienists and safety officers – as well as interested personnel and their representatives.

For questions on hospital hygiene and environmental protection, the reader is invited to consult the specialised literature.



INTERNATIONAL SOCIAL SECURITY ASSOCIATION

Section on *Prevention of Occupational Risks in Health Services*

## 1. Definition/field of application

In the health care sector, skin and hand disinfection includes the following two types of activities:

- skin disinfection for patients (e.g. before a surgical intervention)
- skin disinfection for personnel. In this case, the disinfectant may be used before a medical intervention (hygienic disinfection) or a surgical intervention (surgical disinfection) (see Factsheet 1).

These two activities must be considered separately as the products and procedures used will differ. In the case of skin disinfection for personnel in particular, contact between the skin and the disinfectant is required as part of the work procedure.

## 2. Generalities / Regulatory aspects

In Europe, until the implementation of the regulations relating to biocides, disinfectant products used on the human body were considered according to the regulations relating to medicinal products. Now, however, the European Commission classes most of these products in the type 1 biocides category, which is regulated by Regulation (EU) No 528/2012. There is an exception for products with indications for the prevention or treatment of diseases. Therefore, unless there is an explicit indication that the product can be used to treat a disease, disinfectants are now considered to be biocides.

Ultimately, only products containing substances found on positive lists will be authorised on the market.

The European regulations refer to Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products [1].

The Regulation distinguishes between 22 types of biocidal products which aim to destroy harmful organisms, deter them or render them harmless. These are classed in four main categories:

- general disinfectants and biocidal products;

- pest control products;
- preservatives;
- other biocidal products (antifouling products, embalming and taxidermist fluids, etc.).

The substances used for hand disinfection are classed as product-type 1 *Human hygiene biocidal products*.

The active biocidal substances are present on the positive lists under EU-Regulation 528/2012.

In contrast, disinfectants applied to patients' skin are medicinal products, and must therefore undergo the relevant homologation procedures for these types of substances.

These distinctions can lead to differences in regulatory requirements: biocides are regulated based on research into their health and environmental effects, thus their classification and labelling is the same as that for chemical substances regulated by the European harmonised system of classification of chemicals and mixtures (CLP: Classification, Labelling and Packaging) and they are covered by the chemical and carcinogenic, mutagenic and reprotoxic (CMR) risk prevention regulations. In contrast, medicinal products undergo tests to determine their therapeutic efficacy. They are excluded from labelling procedures but nevertheless require the same preventive rules to be applied in an occupational setting.

## 3. Main methods used

### Skin disinfection for patients

The procedure will depend on the state of the skin - healthy or damaged - and on its state of cleanliness - clean or soiled. In the simplest case, disinfection will be performed in two steps: application of the disinfectant followed by drying. Soiled skin must first be cleaned using a disinfectant soap, which should be rinsed and dried before applying the disinfectant and final drying. During all these steps, the carer may be exposed by skin contact or inhalation, particularly of aerosols. In general, these procedures are performed on small areas,

but sometimes - such as before surgery - they can involve large areas of skin. Indeed, in some cases, the disinfection procedure involves taking a shower using the disinfectant product. This can result in exposure of the care personnel to aerosols, particularly when patients are not autonomous.

Skin disinfection for personnel

The intensity of disinfection required will be determined by the procedures to be performed, from straightforward washing with a disinfectant soap to surgical scrubbing followed by alcohol-based antiseptics.

#### 4. Main disinfectants/active substances and groups of active substances

Skin disinfection for patients

For these procedures, the active substances used are iodine or chlorine derivatives, hydrogen peroxide, biguanides or ethanol. These products, as a general rule, present the fewest dangerous characteristics and thus the lowest risk for patients and personnel.

Skin disinfection for personnel

This requires personnel to apply antiseptics directly onto the skin, generally on the hands and forearms, before and after some care activities or medical or surgical interventions. The fear of transmitting pathogenic agents leading to nosocomial infections (hospital-acquired infections) has significantly increased the frequency of use of this type of disinfection, in particular using hydro-alcoholic products (HAP). As these products are used repeatedly, the active substances must not pose a risk to the health of personnel.

A survey performed in France in 2005 [INRS, unpublished] showed that HAP contained the following active substances:

- Aliphatic alcohols
  - \* Ethanol, Propan-2-ol, Propan-1-ol, Benzyl alcohol

- \* Propanediol (1,2-propanediol), Propanetriol
- Glycol derivatives
  - \* 2-Phenoxyethanol
- Phenol derivatives
  - \* Triclosan [5-chloro-2-(2,4-dichlorophenoxy)phenol]
- Quaternary ammonium compounds
  - \* Mectronium ethylsulfate
- Biguanides
  - \* Chlorhexidine gluconate
  - \* Octenidine dihydrochloride
- Other substances
  - \* D-panthenol

For skin disinfection applications, the most frequently used products are alcohols, mainly ethanol and isopropanol.

#### 5. Assessing exposure (by inhalation and dermal route)

Skin disinfection for patients

Exposure by inhalation is possible when products - particularly volatile products such as alcohols - are applied to a large area. The risk of transdermal exposure to undiluted antiseptics should also be considered. Most antiseptics are available in a diluted "ready-to-use" formulation, this presentation should, naturally, be preferred. Nevertheless, in some cases it may still be necessary to dilute or transfer a product (e.g. in the central pharmacy supplying a hospital). During these procedures there may be a risk of inhalation exposure with volatile products or due to aerosol production.

When using antiseptics, inhalation and skin exposure are both possible if the carer has to help the patient to shower with an antiseptic solution. The use of compresses soaked in antiseptics can lead to dermal exposure if the preventive measures ap-

plied are insufficient.

#### Skin disinfection for personnel

An INRS study characterising occupational exposure to ethanol based on data in the Colchic database (which contains the results of measurements taken by the French official prevention services [2]) and on models of exposure to hydro-alcoholic products, and enriched by interviews with many industrial partners, made it possible to define exposure scenarios for health care professionals. Variations in blood alcohol levels were estimated

using a scenario involving 42 applications of a hydro-alcoholic product (HAP) or 60% denatured alcohol to the skin over 8 hours [3].

These data on occupational exposure to ethanol were then compared to various existing reference values from the literature, particularly endogenous blood alcohol levels.

The estimated blood alcohol levels due to **inhalation exposure** for the occupational tasks identified were as follows:

Ethanol exposure situation	Type of scenario	Maximal blood alcohol level estimated by the model (mg.L <sup>-1</sup> )	Endogenous blood alcohol level (mg.L <sup>-1</sup> )
When using hydro-alcoholic products	42 single applications per day with a hydro-alcoholic gel containing 60% ethanol	1.28	0 - 35

**Transdermal penetration** can also be considered negligible, even when using hydro-alcoholic products (HAP).

It is important to compare these results to endogenous blood alcohol levels for humans which, beyond any exposure to ethanol, vary between 0 and 35 mg.L<sup>-1</sup> of blood depending on the study. The blood alcohol levels estimated from measurement data and exposure models as part of the above-mentioned study are within the range of values covered by endogenous blood alcohol levels.

#### Inhalation exposure

In humans, inhalation of ethanol at an atmospheric concentration of 1900 mg.m<sup>-3</sup> (which corresponds to the current French occupational exposure limit) over an 8-hour period leads to blood alcohol levels between 2 and 10 mg.L<sup>-1</sup>. Once again, this level cannot be distinguished from endogenous blood alcohol levels.

For the other ingredients contained in HAP, the risks are mainly related to local effects: irritation, and for some a sensitizing effect. These effects will be increased by repeated applications, wearing gloves over wet skin and damage to the carer's skin.

The occupational exposure limit (Arbeitsplatzgrenzwert=AGW) applicable in Germany for ethanol is 960 mg/m<sup>3</sup>, and 500 mg/m<sup>3</sup> for 2-propanol [4]. To reach these levels in a non-ventilated room measuring 50 m<sup>3</sup>, it would be necessary to apply or spray 48 g of pure ethanol or 25 g of pure 2-propanol. This corresponds to around 25 disinfections of the hands using 80% ethanol or 17 disinfections of the hands using 60% 2-propanol. Thus, in a naturally ventilated room (e.g. in a care unit) atmospheric levels are never expected to exceed the limit values simply due to routine hand disinfection.

Disinfection of the skin over larger areas (e.g. be-

fore surgery) sometimes involves the use of much larger quantities of antiseptic and could, theoretically, lead to a higher level of worker exposure. However, in an operating theatre equipped with a ventilation system conforming to current standards (standard DIN 1946-Teil 4 in Germany, [5]), which ensures a flow-rate of fresh air of 1200 m<sup>3</sup>/h, it appears impossible to exceed the limit values for these substances [6].

A study of exposure in operating theatres and zones where anaesthesia is performed in various hospitals in the Łódź region in Poland reveals levels temporarily exceeding 1000 mg.m<sup>-3</sup> of ethanol. However, overall exposure remained low, with a geometric mean of 13.3 mg.m<sup>-3</sup> for a series of 227 measurements. In addition, over half the measurements were below the limit of detection [3].

In France, the data present in the Colchic database indicate that for the health and social work sectors, the mean ethanol concentration for a series of 251 measurements in occupational atmospheres is 40.53 mg.m<sup>-3</sup>, with a median of 12.33 mg.m<sup>-3</sup> [3].

## 6. Risk assessment

Although a very large number of ingredients are used in antiseptics, only a small number of them have an occupational exposure limit (OEL). The most frequently used alcohols: ethanol and isopropanol do have an OEL (see Factsheet 2, Table 2). Because of the lack of regulations for most ingredients, in most cases exposure to a product can only be assessed qualitatively.

Among the anecdotal effects described with antiseptics, burns to the hands have been reported in workers using hydro-alcoholic gels followed by exposure to a source of heat [7].

Disinfectants which can be used on the skin are extensively tested; thus the risks encountered are only irritant effects or allergic-type reactions, as indicated by a literature review. Among the causes of skin diseases in the health care sector, the most

frequently mentioned relate to working with wet skin, this is partly due to the obligatory hand washing and disinfection procedures and to wearing gloves (prolonged contact with the skin). Several publications indicate that the use of HAP alone does not lead to any effects on the skin, it could even have a protective effect when used intensively [8].

The following types of exposure should be avoided as far as possible:

- Any contact, of short- or long-duration, between the skin/mucous membranes and the concentrated antiseptic, due to the risk of acute effects. Concentrated antiseptics for use on humans should be diluted before use.
- Any contact between the skin/mucous membranes and the dilute solution if the concentrated product is labelled R40 to R43. As far as possible, substances labelled with these risk phrases should be prohibited.
- Inhalation of projections and aerosols.

## 7. Preventive measures

The fact that skin disinfection is obligatory for personnel in some situations makes it impossible to avoid skin exposure, but the number of repetitions should be limited to what is strictly necessary to maintain the appropriate level of hygiene.

Because of the skin and respiratory risks, personnel should avoid contact with disinfectants, particularly in their concentrated forms. Their regular use and standard hand washing procedures also lead to frequent wetting of the skin.

### *Substitution*

Among the appropriate disinfectants from the point of view of hospital hygiene, it is important to choose those presenting the lowest potential risk for patients and personnel. If health problems arise when using a disinfectant, first of all the possibility of replacing it by another product presenting fewer

health risks should be examined (see Factsheets 2 and 3). In the context of disinfection of the hands and skin, the main thing to avoid is allergic reactions in workers. The potential risk of fire or explosion can be reduced by choosing antiseptics with a relatively high flashpoint. In addition, procedures giving rise to aerosol formation (use of sprays) should be avoided as far as possible.

#### *Technical preventive measures*

- Dilution and/or transfer of disinfectants:
  - \* When it is necessary to dilute or transfer disinfectants into another container this should be done in a designated area (central pharmacy).
- When disinfecting patients' skin:
  - \* Avoid applying the disinfectant directly; handle soaked compresses with forceps whenever possible.
  - \* Close recipients when not in use.
- Skin disinfection for personnel:
  - \* Use ready-to-use disinfectant solutions.
  - \* Install disinfectant dispensers in order to avoid splashes into the eyes.
- Ventilation:
  - \* Ensure an adequate supply of fresh air (see the national regulations relating to ventilation)

#### *Organisational preventive measures*

- Limit skin disinfection for carers to what is strictly necessary.
- Label diluted solutions.
- Prohibit disinfection by spraying.
- Do not store disinfectants in examination rooms or near to sources of heat.
- In case of accidental spillage or splashing, wipe up the product rapidly to avoid worker exposure by inhalation.

- The cleaning utensils used for disinfection should be disposed of in closed containers.
- Always close containers containing disinfectant solutions, except during use.
- Avoid all contact between disinfectants and hot surfaces.
- Never disinfect the hands and skin with an alcohol-based disinfectant near to a source of flames.
- Be careful that disinfectants are only used by duly qualified personnel, who have been informed of the related risks and receive regular in-service training.
- Be careful that the appropriate hygiene plan and skin protection regulations are applied.

#### *Personal protective measures*

- Eye protection:  
When handling a concentrated product, and during dilution or transfer of disinfectants, and if there is a risk of aerosol formation, wear protective eyewear, a mask or a face screen.
- Hand protection:  
This is only possible when performing procedures involving application of disinfectants to patients' skin. Gloves should be worn to protect against a risk of infection and against the action of disinfectants. To improve comfort when worn for long periods, cotton lining gloves may be worn under the protective gloves. These should be washed regularly.  
Appropriate protective gloves should be chosen for the disinfectants used and the potentially infectious products that will be handled.  
The use, after work, of skin-care preparations on the areas most exposed to disinfectants can help to maintain the skin's natural barrier.
- Respiratory protection:  
Respiratory protection should generally not be required (see section 5) and would not be reasonably acceptable.

## 8. Medical prevention

Personnel using disinfectants should undergo regular medical examinations in line with national regulations.

During these examinations, particular emphasis should be placed on symptoms of localised intolerance, such as irritation or allergy. These will be more likely to be found on the hands, but respiratory intolerance should also be considered (rhinitis).

In the context of medical prevention, workers will be reminded of the rules of hygiene and the preventive measures to be applied to avoid the appearance of symptoms of intolerance to disinfectants.

Examinations should also take other risk factors at the workstation into consideration (e.g. infectious risk).

## 9. Checking the efficacy of preventive measures

When national limit values for substances contained in disinfectants exist, the employer must prove that the preventive measures implemented allow these values to be respected. For this, they can measure concentrations, compare data with published data, or apply validated calculation and assessment methods.

Once it has been established that the task in question can be performed without risks, it is sufficient, in the follow-up, to periodically check the efficacy of the steps taken to ensure that the task has not changed significantly (e.g. extent of the task, how the chemical products are used).

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12/2014

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#### Published by

ISSA International Section on Prevention of  
Occupational Risks in Health Services  
Pappelallee 33/35/37  
D 22089 Hamburg  
Germany



#### Publication number

ISBN 978-92-843-6210-3

#### Design

Susanne Stamer  
Berufsgenossenschaft für Gesundheitsdienst und  
Wohlfahrtspflege (BGW), Hamburg (D)