

Occupational diseases due to allergic and toxic chemicals in health care workers: fitness for work

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KEY WORDS

Health care workers; fitness for work; allergic risk; chemical risk

PAROLE CHIAVE

Lavoratori della sanità; giudizio di idoneità; rischio allergologico; rischio chimico

SUMMARY

The purpose of this review is to suggest job fitness criteria for health care workers exposed to sensitizing or chemical agents. These recommendations are derived from a comparison between previous documents on prevention and management of allergic and chemical risks in health care settings and updated evidence; the job fitness criteria and the main documents on these topics are summarized in tables. Glove allergy, in particular latex allergy, is still a significant problem but we should remember that a wide choice of alternative materials is now easily available; many different alternative health products are also currently available when an allergy to disinfectants or detergents is diagnosed. Hence the prevention of allergic diseases is mostly based on an appropriate choice and use of the gloves and health products according to the specific tasks and possible individual susceptibility; this meets the requirements of the "good health care organization", which translates into lower costs, if possible, as well as the best protection of worker's health. Concerning chemical risk, it should be remembered that during the last 20 years the improvements made in work environments have profoundly changed the mode and the levels of exposure to chemical substances and the current recommendations concerning the management of workers exposed to anesthetic gases, antineoplastic agents and sterilizers/disinfectants significantly differ from those of early 1990s. However, the past prudential guidelines are still valid for formaldehyde.

RIASSUNTO

«Patologia da agenti chimici sensibilizzanti e tossici nei lavoratori della Sanità: il giudizio di idoneità lavorativa». Questa review propone, alla luce delle attuali conoscenze, alcuni criteri per la gestione del giudizio di idoneità di lavoratori della sanità ipersuscettibili o con patologie correlate a fattori di rischio allergologici o chimici. Dal punto di vista pratico, le indicazioni che sono emerse da un confronto tra precedenti documenti e le più recenti evidenze di letteratura, sono state sintetizzate in alcune tabelle di agevole consultazione. Sicuramente in ambito allergologico il rischio tuttora più rilevante è quello derivante dall'uso di guanti, soprattutto di lattice, ma al mo-

Pervenuto il 19.12.2011 - Accettato il 29.2.2012

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mento attuale esiste sia un'ampia scelta di guanti di materiali alternativi che di prodotti alternativi, laddove si configuri ad esempio una allergia a disinfettanti o detergenti, che consente una agevole gestione del lavoratore sensibilizzato. Peraltro la scelta accurata (in termini di qualità e funzionalità) del prodotto/dispositivo di protezione più idoneo per lo svolgimento di ogni specifica attività/mansione, associata ad una adeguata sorveglianza sanitaria, rappresenta la miglior possibilità di prevenzione di queste patologie. Per quanto attiene al rischio chimico, negli ultimi 20 anni le condizioni degli ambienti di lavoro sono notevolmente migliorate e sono nettamente diminuiti i livelli di esposizione a gas anestetici, chemioterapici o ad altre sostanze chimiche e le attuali indicazioni per la gestione dei lavoratori esposti a questi fattori di rischio, ad esclusione degli ambiti in cui viene utilizzata la formaldeide, differiscono significativamente da quelle degli anni 90'

INTRODUCTION

The priorities for the health and safety of workers were recently reviewed (3). The risk of developing occupational diseases caused by sensitizing or chemical agents is common among health care workers. The purpose of this review is to establish, where possible, job fitness criteria for health care workers exposed to the above mentioned risks. For practical purposes the most relevant data are summarized in tables.

EXPOSURE TO SENSITIZING AGENTS

Skin allergies (contact eczema and urticaria), are the most frequent occupational allergic diseases among health care workers whereas respiratory allergies (bronchial asthma and rhinitis) are less frequent. These disorders are mainly due to the exposure to natural latex, drugs, cleaning and sterilizing agents, laboratory animals and other factors (36, 52). The main sensitizing agents are reported in table 1. Many epidemiological, clinical and preventive issues on the use of gloves in health care settings were recently discussed since medical gloves still represent an important source of allergic problems (10, 17, 18, 23, 28, 30, 31, 34).

Natural rubber latex allergy is one of the most significant problems we have had to face in occupational allergy in recent years (12, 14). Latex allergy involves both the skin and respiratory systems, can cause severe reactions, especially during surgery and medical procedures. Another frequent complication

of latex allergy is the association with the so-called *latex-fruit syndrome*, a food allergy with potentially serious clinical consequences that persists after exposure has ceased (11).

Contact eczema, even if generally less severe than latex allergy, is probably one of the most common occupational diseases among health care workers. Both sensitizing and irritant agents are involved in the pathogenesis of this disease. The distinction between occupational and non-occupational eczema is often difficult, because occupational and non-occupational dermatoses generally have a similar clinical onset. Therefore a proper job fitness for work evaluation requires an accurate assessment of the causal factors of the dermatosis. Once a careful etiological diagnosis has been made, we can apply effective preventive measures such as: removal of etiological agents, changes in working procedures, use of personal protective devices and only when other measures have failed, moving to another job. A review of some primary prevention intervention studies pointed out that the use of low-protein powder-free latex gloves or latex-free gloves greatly reduce latex aeroallergens, latex sensitization and asthma in health care workers. This trend was confirmed in a recent study based on national compensation data (27, 54). Other authors suggest the need for further secondary preventive measures just to prevent the onset of symptoms in already sensitized workers (33).

When a change of job is necessary, it is important to be sure that the new job does not involve exposure to the previous sensitizing and/or irritant factor(s). Several Guidelines, Consensus Docu-

ments, Alerts or Position Papers for the prevention and management of glove/latex allergy in health care workers have been published since the early 1990s (51) and some examples are reported in table 2, but few studies suggesting possible criteria for job fitness evaluation in allergic health care workers are available (2, 35, 47). Based on the experience of working groups in the early 1990s the main guidelines for the prevention of latex allergy were drawn up between 1995 and 2008. Published guidelines, although heterogeneous being addressed to different targets, including doctors and nurses with different specialties, have much in common: 1) *Operating methodology*. In the first place a multidisciplinary team must be set up to address the problem, collect information on the composition and the correct use of gloves, issue patient protection warnings, along with primary and secondary prevention and fitness for work criteria. 2) *Prevention*. All guidelines distinguish between preventive measures for health care workers and protection of latex sensitized patients in the health facilities. 3) With regard to *patients*, special

attention is given in all guidelines to Emergency, Operating and Delivery rooms. At first, the guidelines prescribed procedures reserved for allergic patients, then this requirement was overcome by the availability of non-latex, non-powdered gloves. Many Guidelines suggest screening for latex allergic patients who must be identified. The guidelines recommend the establishment of latex-safe operating and delivery rooms. 4) For *health care workers*, particular attention is paid to the choice of the right gloves for each operation. In this way the use of latex gloves is considerably reduced. The use of non-powdered gloves dramatically reduces the airborne spread of latex allergens. In addition, the last generation of gloves has a low protein and latex allergens content. The new synthetic, non-allergenic gloves offer satisfactory elasticity, strength, comfort and protective efficacy against biological risk. At the same time a large number of latex devices have been replaced with non-latex products. 5) All guidelines indicate as a priority *adequate information and qualification* of health personnel.

Table 1 - Occupational allergic diseases in health care workers: main etiological agents

Products/devices/job	Agents
<i>IgE-mediated allergy: Bronchial Asthma, Rhinitis, Urticaria</i>	
Gloves and other latex devices	Latex
Drugs handling, administration of aerosolized medications	Penicillin, cephalosporins, salicylates, chlorpromazin, cisplatinum, bleomycin, psyllium
Disinfectants, cleaning and sterilizing agents	Formaldehyde, glutaraldehyde, chloramine T, phenols, ethylene oxide, hexachlorophene
Others	Acrylates
<i>Cell-mediated allergy: Allergic Contact Dermatitis (ACD)</i>	
Gloves and other latex devices	Rubber chemical accelerators (e.g. thiurams, carbamates, mercaptobenzothiazole, dialkyl thioureas) and antioxidants (Isopropyl N-phenyl-p-phenylenediamine and similar substances)
Preservatives/disinfectants	Quaternary ammonium salts, o-phenylphenol, chlorhexidine, chlorocresol, chloroxylenol, povidone iodine, alcohols, formaldehyde releasers.
Drugs	procaine, amylocaine, chloramphenicol, gentamycin, cephalosporins, steroids, FANS, neomycin, bacitracin etc.
Others	Polyurethanes, acrylates (plasters); hydroquinone, pyrocatecol (developers, fixing)

Table 2 - Guidelines, Alerts, Consensus Documents, Position Papers for the prevention and management of glove/latex allergy: some examples

Title	References
Latex sensitivity: an occupational health strategic plan	(32)
Allergic and irritant glove-related diseases in health care workers and their prevention. Document of the Italian Society of Preventive Medicine for Health Care Workers	(2)
NIOSH alert. Preventing allergic reactions to natural rubber latex in the workplace	(38)
AAOHN position statement. Natural rubber latex sensitivity	(1)
Guidelines for management of latex allergies and safe use of latex in perioperative practice settings	(48)
American Academy of Dermatology's position paper on latex allergy	(5)
Guidelines for preventing reactions to natural rubber latex in the workplace.	(15)
American Nurse Association position statement on latex allergy	(6)
Latex allergy awareness and protocol	(45)
Guidelines for the prevention of allergic reactions to latex in patients and health personnel	(35)
Guidelines from Lombardy Region for "Prevention of allergic reactions to latex in patients and health care workers"	(29)
Primary prevention of natural rubber latex allergy in the German health care system through education and intervention	(4)
Guidelines for preventing sensitivity and allergic reactions to natural rubber latex in the workplace	(49)
Potential for sensitization and possible allergic reactions to natural rubber latex gloves and other natural rubber products	(40)
Consensus document. Update on latex exposure and use of gloves in Italian health care settings	(18)

SENSITIZING AGENTS: FITNESS FOR WORK

Latex allergy and/or sensitization to glove components heavily affects work ability and the need for effective prevention procedures. Every possible effort should be made to maintain the worker in his/her job, although the risk of possible severe reactions should not be underestimated. In table 3 we summarize some criteria for job fitness management aimed at avoiding both the worsening or persistence of symptoms in already sensitized workers and the onset of new cases of sensitization in predisposed subjects. In the same table the recommendations reported in the Italian Consensus Document published in 1996 (2) were compared with updated evidence. It is interesting to note that the present recommendations do not significantly differ from those of 1996. However, when proposing job fitness criteria, we must remember that a

wider choice of alternative gloves and materials is currently available (8, 23, 34). Some materials (e.g. neoprene and nitrile) have good biocompatibility and physical properties and protective efficacy similar to latex. Moreover, allergic reactions to synthetic gloves occur only occasionally. Thus we believe it is of practical interest to report in table 4 some information on the prescription of "safe" gloves in subjects with allergy to latex or some glove additives.

EXPOSURE TO CHEMICAL AGENTS

Exposure to chemical risks has been a well-known problem among health care workers for a long time, but it became clearly evident from the 1980s (13, 24, 37, 42, 43, 46). The main chemical agents are summarized in table 5. As for latex al-

Table 3 - Glove allergy: criteria for job fitness management in health care workers. Consensus document of the Italian Society of Preventive Medicine for Health Care Workers (1996) and current evidence from scientific literature

Critical points	Consensus Document 1996	Current evidence
Latex allergy	<ol style="list-style-type: none"> 1. Only skin symptoms: avoid latex contact: inform the worker about the risk, provide latex-free gloves, replace latex devices 2. Rhinoconjunctivitis and/or asthma associated or not with skin symptoms: avoid latex contact, powder-free latex gloves should be provided to all workers in the department or they must use latex-free gloves 3. Severe asthma or anaphylactic reactions: as step 2 plus assignment to areas where the use of latex devices can be avoided (latex safe areas). Other choice: job change 	1996 proposals still valid - latex-free gloves should be used - avoid direct and airborne latex exposure
Allergic contact dermatitis caused by gloves	The use of gloves devoid of the sensitizing agent is required	1996 proposals still valid - It should be noted that currently a wide choice of alternative gloves is available
“Atopic” worker	The use of latex-free gloves is recommended	1996 proposals still valid - workers with atopic eczema must use latex-free gloves
Previous skin diseases	Allergic Contact Dermatitis: latex-free gloves are required Irritant Contact Dermatitis: powder-free gloves are required and protracted use should be avoided	- No skin lesions and no relapses for at least one year: no preventive measures are required
Current skin lesions (fissures, cuts, scaling or other skin lesions)		- latex-free gloves are required (skin lesions could promote sensitization)

lery, many Guidelines, Alerts or Consensus Documents for the prevention and management of chemical risk have been published since the early 1990s (table 6). It is interesting to note that during the last 20 years improvements made in workplace conditions, in particular in health care settings, has profoundly changed the mode and levels of exposure to the chemical substances listed in table 5.

CHEMICAL AGENTS: FITNESS FOR WORK

Tables 7 to 10 show criteria for assessment of fitness for work in health care workers exposed to

chemical hazards, in order to avoid the persistence or worsening of symptoms in specific pathological conditions. We examined the key scenarios related to exposure to chemicals in the workplace along with preventive measures, and compared the proposals of the past consensus documents (7, 9, 19, 25) with updated evidence (22, 26, 39, 53).

DISCUSSION AND CONCLUSIONS

The risk of developing occupational diseases caused by exposure to sensitizing or chemical agents became particularly significant among health care workers starting 30 years ago.

Table 4 - Practical suggestions for the management of glove-allergic workers: alternative gloves

Allergy	Alternative gloves	
	Surgical gloves	Examination gloves
Latex allergy	<ul style="list-style-type: none"> • Latex-free gloves: neoprene/chloroprene, synthetic polyisoprene, styrene-butadiene-styrene, styrene-ethylene-butadiene-styrene 	<ul style="list-style-type: none"> • Latex-free gloves: nitrile or vinyl
Carbamates allergy	<ul style="list-style-type: none"> • styrene-butadiene-styrene, styrene-ethylene-butadiene-styrene gloves* • Some neoprene gloves 	<ul style="list-style-type: none"> • Vinyl gloves • Some nitrile gloves
Thiurams allergy	<ul style="list-style-type: none"> • Latex-free gloves • Most of the latex powder-free gloves; 	<ul style="list-style-type: none"> • vinyl gloves • most of nitrile gloves
Mercaptothiazoles allergy	<ul style="list-style-type: none"> • Neoprene, styrene-butadiene-styrene, styrene-ethylene-butadiene-styrene gloves • Some latex gloves 	<ul style="list-style-type: none"> • Vinyl gloves • Some nitrile gloves
Glove allergy as it without specific reactions to known rubber chemicals	It is necessary to change glove material and in any case to control possible further adverse reactions	It is necessary to change glove material and in any case to control possible further adverse reactions
Reminder:		
<ul style="list-style-type: none"> • in the same materials different chemical additives can be present • if technical data sheets do not contain clear or sufficient information on glove composition ask manufacturers to provide more data • *synthetic rubbers styrene-butadiene-styrene (SBS) and styrene-ethylene-butadiene-styrene (SEBS) do not contain accelerators 		

Table 5 - Chemical risks in health care workers: the main etiological agents

Products	Agents
Anesthetic Gases	Nitrous Oxide Halogenated ethers (halothane, enflurane, isoflurane, sevoflurane, desflurane)
Antineoplastic agents	Cisplatin, 5Fluorouracile, Cyclophosphamide, Thiotepa, Doxorubicin...
Sterilizing / Disinfecting Agents	Glutaraldehyde, Peracetic Acid
Tissues fixatives	Formaldehyde

Table 6 - Guidelines/Consensus Documents for the prevention and management of chemical risks in health care settings: some examples

Title	References
Valutazione dell'esposizione professionale ad anestetici per inalazione (Monitoring of Occupational hazard from anesthetics inhalation)	(7)
Waste Anesthetic Gases - Occupational Hazards in Hospitals	(22)
Linee-guida per la sicurezza e la salute dei lavoratori esposti a chemioterapici antineoplastici in ambiente sanitario (Guidelines for health and safety of workers exposed to antineoplastic drugs in health care settings)	(16)
Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings	(21)
International Society of Oncology Pharmacy Practicioners (ISOPP) Standards of practice. Safe handling of cytotoxics.	(26)
Glutaraldehyde: Occupational Hazards in Hospitals	(20)
Chemical Hazards and Controls - Best Practices for the Safe Use of Glutaraldehyde in Health Care	(39)
IRIS Toxicological Review of Formaldehyde-Inhalation Assessment.	(53)

Table 7 - Criteria for job fitness management in health care workers exposed to anesthetic gases

Anesthetic Gases		
Exposure scenarios	Critical points	Fitness for work proposals
<i>Past criteria for job fitness management (early 1980s)</i>		
→ Operating rooms with little or no ventilation	a) - Pathological conditions: • anemia, leucopenia, thrombocytopenia	⇒ a) Unfitness for tasks involving exposure to anesthetic gases
→ Anesthetic apparatus with open circuits and high flows	• kidney diseases • liver diseases	
→ Constant use of N ₂ O and the more toxic halogenated anesthetics (halothane, enflurane)	• neuropathies	
→ Anesthetic procedures not controlled	b) - Early signs of: • anemia, leucopenia, thrombocytopenia	⇒ b) Restricted fitness: exclusion from jobs involving protracted exposure to anesthetic gases
→ Poor maintenance	• kidney diseases • liver diseases	
→ Lack of proper work practices and training	• neuropathies	
<i>Current criteria for job fitness management</i>		
→ Significant improvement in operating room ventilation systems	a) - Pathological conditions: • anemia, leucopenia, thrombocytopenia	⇒ a) case by case job fitness assessment
→ Use of closed circuit and low flows	• kidney diseases • liver diseases	
→ Anesthetics replacement: less use of N ₂ O; use of less toxic halogenated anesthetics (sevoflurane, desflurane)	• neuropathies	
→ More careful anaesthesiology procedures	b) - Early signs of: • anemia, leucopenia, thrombocytopenia	⇒ b) Full fitness
→ Accurate maintenance	• kidney diseases • liver diseases	
→ Frequent training	• neuropathies	
Both in 1980s and today	Pregnancy and lactation	⇒ Unfitness

Table 8 - Criteria for job fitness management in health care workers exposed to antineoplastic agents

Antineoplastic agents		
Exposure scenarios	Critical points	Fitness for work proposals
<i>Past criteria for job fitness management (early 1990s)</i>		
→ Free preparations in shared areas	Early signs and pathological conditions: • thalassemia, hemoglobinopathies, G6PD deficiency	⇒ Unfitness for preparation and/or administration of antineoplastic agents
→ No precautions to avoid aerosol	• anemia, leucopenia, thrombocytopenia	
→ No use of PPE	• kidney and liver diseases	
→ Prevalent use of antineoplastic drugs known to be carcinogens	• active or past cancer	
→ No knowledge of the risk	• previous exposure to ionizing radiations or carcinogenic....?	
→ Lack of proper work practices and training	• atopy	

(continued)

Table 8 (continued)- Criteria for job fitness management in health care workers exposed to antineoplastic agents

Antineoplastic agents		
Exposure scenarios	Critical points	Fitness for work proposals
<p><i>Current criteria for job fitness management</i></p> <ul style="list-style-type: none"> → Preparation always under exhaust hoods → Centralized preparation at the pharmacy → Use of PPE and specific working procedures → Use of devices to avoid spills → Use of new non-carcinogenic antineoplastic drugs (monoclonal antibodies) → Recurrent training 	<p>Early signs and pathological conditions: ⇒</p> <ul style="list-style-type: none"> • thalassemias, hemoglobinopathies, G6PD deficiency • anemia, leucopenia, thrombocytopenia • kidney and liver diseases • active or past cancer • previous exposure to ionizing radiations or carcinogenic...? • atopy 	<p>Early signs:</p> <ul style="list-style-type: none"> • Full fitness <p>Pathological conditions:</p> <ul style="list-style-type: none"> • case by case job fitness assessment
Both in 1990s and today	Pregnancy and lactation ⇒	Unfitness

Table 9 - Criteria for job fitness management in health care workers exposed to sterilizers/disinfectants

Sterilized / Disinfectants		
Exposure scenarios	Critical points	Fitness for work proposals
<p><i>Past criteria for job fitness management (early 1990s)</i></p> <ul style="list-style-type: none"> → Sterilization in the same room where the endoscopies were performed → Sterilization by immersion in open basins → Cleaning the endoscopes using open-circuit apparatus → Use only glutaraldehyde → No use of PPE → Lack of proper work practices and training 	<p>• Bronchial asthma ⇒</p> <p>• Glutaraldehyde sensitization</p>	<p>Unfitness</p>
<p><i>Current criteria for job fitness management</i></p> <ul style="list-style-type: none"> → Sterilization in specific area → Cleaning the endoscopes using closed-cycle apparatus → Sterilization under exhaust hood → Substitution of glutaraldehyde with peracetic acid → Use of PPE and specific working procedures → Frequent training 	<p>• Bronchial asthma ⇒</p> <p>• Glutaraldehyde sensitization with dermatoses ⇒</p> <p>• Glutaraldehyde sensitization with asthma ⇒</p>	<p>• Full fitness (except in case of asthma not controlled by therapy)</p> <p>• case by case job fitness assessment</p> <p>• Unfitness</p>
Both in 1990s and today	Pregnancy and lactation ⇒	Unfitness

Table 10 - Criteria for job fitness management in health care workers exposed to formaldehyde

Formaldehyde		
Exposure scenarios	Critical points	Fitness for work proposals
<i>Past criteria for job fitness management (early 1990s)</i>		
→ Sectioning anatomical parts on table, surrounded by many open containers*	• Bronchial asthma • Formaldehyde sensitization	⇒ Unfitness
→ No local exhaust ventilation		
→ No precautions when disposing of reserves of anatomical parts		
→ Lack of proper work practices and training		
<i>Current criteria for job fitness management</i>		
<i>Positive aspects</i>		
→ Sectioning anatomical parts under exhaust hoods	• Bronchial asthma	⇒ • Full fitness (except in case of asthma not controlled by therapy)
→ Containers of anatomical parts under exhaust hoods or in aspirated cupboards	• Formaldehyde sensitization with dermatoses	⇒ • case by case job fitness assessment
→ New processing apparatus	• Previous neoplastic disease	
→ Containers for anatomical parts and biopsies pre-prepared		
<i>Negative aspects</i>		
→ exhaust hoods misused, cluttered with boxes and drapes	• Formaldehyde sensitization with asthma	⇒ • Unfitness
→ manual reintegration of formaldehyde into processing apparatus	• Ongoing neoplastic pathology	
→ low security when disposing of reserves of anatomical parts		
Both in 1990s and today	Pregnancy and lactation	⇒ Unfitness

Concerning allergic diseases, the “epidemic” of latex allergy in the late 1980s represented the most important problem in occupational allergy in health care settings. A hospital policy based on replacement of latex gloves and of other latex devices, where necessary, with synthetic polymers or powder-free latex products, together with careful secondary prevention, reduces the incidence of latex sensitization and latex-induced occupational asthma and other symptoms. Hence most allergies in health care settings can be controlled by means of primary prevention actions such as exclusion or substitution of devices that could represent an allergologic risk. Good health care organization leads to a reduction in both direct and indirect costs of

management along with better protection of workers’ health.

Primary prevention interventions are insufficient in only a few situations, as in the case of workers with severe occupational allergies. In these cases the worker should be excluded from the job or from some working areas.

With regard to toxicological risks, it should be stressed that significant environmental improvements have been made in the last 20 years in operating rooms, chemotherapy units and endoscopy units, in which the levels of health care worker exposure to chemical hazards have significantly decreased (41, 44, 50). At present, proposals for managing current exposure to anaesthetic gases (table

7), antineoplastic agents (table 8), and to a lesser extent, sterilizers and disinfectants (table 9), differ enormously from those of the early 1990s. However, the changes in work procedures using formaldehyde (53) do not appear to be sufficiently effective to keep the risks under control and consequently do not allow us to modify the past prudent indications (table 10).

NO POTENTIAL CONFLICT OF INTEREST RELEVANT TO THIS ARTICLE WAS REPORTED

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