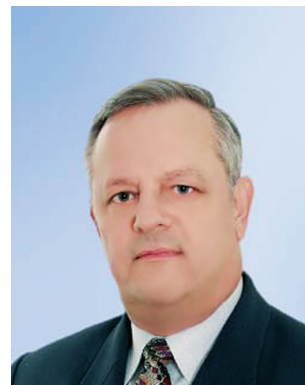


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## Prevention of allergic diseases caused by domestic allergens

**In** accordance with recommendations of World Health Organization (WHO, 1997), the main ways of treatment for allergic diseases (AD)

include:

- education of patients;
- elimination therapy;
- pharmacotherapy;
- allergenic vaccination.

In our opinion, the first two bullets are always combined in practice. This article specifically focuses on issues of elimination therapy and education of patients in the field of preventing AD (as elimination activities are mostly carried out by patients themselves). Besides, as majority of AD (particularly, perennial allergic rhinitis (PAR) and bronchial asthma (BA)) are etiologically caused by so-called domestic allergens (DA), this article will address possible ways of preventing contact with them.

As you know, AD progress:

- in people with atopy even with minimal influence by DA;
- in other people when DA are abundant in indoor environment.

We are convinced that today the main allergenic agents which people contact in everyday life and which are capable of causing AD both in the first and in the second case are house dust mites, microfungi (micromyces), epidermal agents, waste products of insects, animals, etc.

According to B. Guerun (1994), sources of origin of

house dust protein products in their relevance to formation of domestic sensitization are distributed as follows:

- house dust mites;
- domestic animals;
- mold fungi;
- insects.

Speaking of house dust mites, worthy of mention is a recent publication of Kazakh scientists R. D. Zhaksylykova and A. D. Akhimova (2009) in which they raise an issue of **acariasis**, i.e. diseases caused by mites. In their opinion, small mites becoming residents of our indoor environment produce acariasis which progress due to lack of dedicated control. The most serious manifestations and complications of acariasis are registered in medicine under the guise of familiar allergic, skin, rheumatic, cardiovascular, oncologic and other diseases. Health professionals, acarologists, engineers, biologists, chemists, workers of social and governmental organizations, etc need to consolidate their efforts in order to eliminate acariasis. Authors point out that during the 20th century researchers acknowledged finding small dust mites in human residences rising in number and in specific proportion. Small mites of **Dermatophagoides** genus prevail in domestic and occupational dust almost in all countries of the world. Multiple facts of detecting small mites in people's egesta, organs and tissues (even in depth of atherosclerotic plaque of human aorta) described in scientific literature

are interpreted as occasional. Besides, no attention is paid to cases or even small epidemics of pulmonary acariasis, harvest itch, mite dermatitis, mite gastroenterocolitis, etc.

Many authors point out that allergenic combativeness of house dust depends largely on number and species composition of mites inhabiting it which belong mainly to *Dermatophagoides* genus of *Pyroglyphidae* family. The mites *D. pteronyssinus* and *D. farinae* are the most widely spread making up to 90% of acarofauna in indoor environment. By now, about 150 species of mites have been found in house dust. They are called dermatophagoides or pyroglyphidae. According to one theory, initially these mites dwelled in birds' nests, and later they "crawled" into our houses and apartments. 1 gram of house dust may contain up to several thousand species, and anything from 100 to 500 mites can cause a frank sensitization in humans (Harvey P., May R., 1990). Dust mites life cycle lasts for 10 weeks. Females lay anything from 40 to 80 eggs during this period. Taking into account that house dust mites defecate 20 times per day, one dust mite female and her offspring will defecate 8 mln times during their life cycle.

The mites quantity (a species sized 10 to 40 micrometers) per 1 m<sup>3</sup> of air is 100 thousand species. This number may increase thousandfold in the unaired dwellings. It has been proved that DA exposure of house dust is a significant factor evoking onset of BA, especially in new-born and babies.

**Exposure to DA is trigger for 85% of patients suffering from BA.**

It is extremely difficult to eliminate DA prevailing in the structure of "etiological DA" of PAR. Looking back into 1964, a team of Dutch scientists found mites in house dust belonging to species *Dermatophagoides pteronyssinus* (family *Pyroglyphidae*, class *Arachnospodea*). DA received from these mites caused definitive skin reaction in medical cases of allergy to house dust. As the result, concept about connection between house dust and AD was broadened. In addition, a suggestion was made about leading role of DA of specific species of micromites, which was fully proved in after years.

In addition to protein component of animal hair, their sebaceous matter and saliva have sensitizing effect, and these can be not only from domestic animals but also from rodents. Thus, 19% to 24% of sick with BA living in bad indoor environment have specific IgE-antibodies for DA of hair of mice and rats (Kang B., Kang J., 1989).

Moreover, expressed sensitizing role of fowl feathers used for stuffing pillows and feather beds has been proved, geese feather having the most antigenic activity.

**Sensitization to feathers of parrots, pigeons, hens and ducks often causes not only BA, but also exogenous allergic alveolitis.**

Frequency of sensitization to feather DA for the sick with BA ranges from 5% to 60% (A. V. Bogova, 1984). It is also very important that birds' contactants often contain the same components as DA of house dust. This results from long use of things made of feathers inhabited by micromites of *Dermatophagoides* genus. DA of insects dwelling in human habitat also act as allergens. In recent years, many researches turned their attention to house cockroaches and their waste products as a cause factor of human sensitization. Thus, antibodies to DA of American cockroaches are detected in 68 – 76% of people with domestic sensitization (Kang B. et al., 1989; Sperber K. et. al., 1993). In Europe, one of the most widespread species of cockroaches is *Blatella germanica*, whose immunogenic properties are higher than those of cockroaches dwelling in America and countries of the East.

Sensitization to DA of cockroaches is a significant risk factor of BA pathological process in countries with warm tropical climate and in indoor environment with central heating. These DA have the highest level in kitchens and in bathrooms. According to P. Rosenstreich et al. [1982], concentration of cockroaches DA from 9 to 1,000 NPU per 1 gram is truly significant risk factor for BA. Positive results of tests with cockroach DA were registered in 60% of BA medical cases (S. V. Zaikov., A. P. Hryshylo, 2008). Some authors point out that children with BA sensitized to cockroach DA are hospitalized 3 times more frequently with relation to this disease if apartment has a large population of these insects. The abovementioned fact proves an important role of on-going exposure to cockroach DA in progress of BA.

Thus, importance of human milieu as a source of allergy is evident. That is why diagnostic and therapeutic DA obtained from materials taken directly from sick people apartments or in the rooms where they work are the most efficient.

So-called **epidermal DA** may be a part of house dust or have independent meaning. They include dandruff from humans, horses, pigs, hair of sheep, dogs, cats, rabbits, guinea pigs, goats, etc. Perhaps, we underestimate the role of sensitization to epidermal DA as we do not completely understand their nature. Thus, animal hair itself is not DA. However, particles of animal saliva, epidermis, sometimes urine have significant meaning in body allergization. Frequency of

sensitization to DA of domestic animals makes up 1 – 4% for adults and about 11% for children. Allergy to hair of dogs and cats occurs more often. There is data about higher sensitizing activity of these animals saliva in comparison with hair: for cats it is the main source of DA. These DA are small-sized (<2.5 micrometers) and remain in the air for more than an hour. Their high concentration is a true BA risk factor.

Male cats unlike female cats produce DA with urine and are more harmful in terms of allergy pathological process. Even when cat is removed from the room, DA will remain in it up to 24 weeks. Some authors think that up to 40% of the sick with BA have allergy to hair of this animal.

DA of dogs have been found in dandruff, saliva, urine and serum. Dogs of different breed have different allergenicity. It is important how often animals are walked and washed. However, there are no "non-allergenic" dogs.

Dandruff of horses also has significant meaning in progress of allergy as horsehair is used for making mattresses, felt and carpets. Medical serums that are made during hypersensitization of horses also should not be forgotten.

Fur of sheep and goats is used for making clothes, blankets, carpets increasing its role in pathogenic mechanism of allergy to these animals.

Epidermal DA get into body by different ways: inhalation, contact (when contacting animals, wearing respective clothes, hats, footwear).

Human sensitization to **microfungi** populating indoor environment in abundance is very important. Fungi *Aspergillus*, *Penicillium*, *Alternaria*, *Mucor*, *Candida*, *Aureobasidium*, *Cladosporium* are pointed out more frequently in samples of house dust and air of indoor environment. Species composition and the number of spores in the air are affected by the nature of indoor environment or industrial enterprise. Such spores of fungi growing indoors as, for example *Aspergillus* and *Penicillium* are found in great concentration in the air in the autumn or in the summer.

Currently there is no generally accepted ratio of fungi content in the air of indoor environment. Some scientists consider a conditional dosage to be about 500 spores per 1 m<sup>3</sup>.

In Saint Petersburg and in Leningrad Region, the main contaminants of indoor environment are fungi of genus *Penicillium* (64%), *Aspergillus* (48%), *Cladosporium* (20%), sometimes *Rhizopus* (12%) and *Alternaria* (12%). Dispersion of fungi spores concentration in the tested air was anything from 100 to 100,000 spores

per 1 m<sup>3</sup>. The highest content of fungi spores was detected on the first floors of buildings. The allergic examination of people living in the abovementioned premises showed increased susceptibility to fungi of genus *Penicillium* (37%), *Aspergillus* (15%), *Alternaria* (18%), *Rhizopus* (7%).

The air in the manufacturing facilities contained 15 mln spores of fungi in 1 m<sup>3</sup> of the air. Therefore, people who work there breathe in anything from 170 to 200 mln spores for 6 hours. At first, saprotroph microfungi or their metabolic products may produce pathologic processes, for instance invasive aspergillomycosis induced by *Aspergillus fumigatus*, primary liver cancer caused by aflatoxins (producer is *A. flavus*) etc. Such micromycetes may cause allergic state (PAR, BA) in persons inhaling the air contaminated with spores. Some fungi dwelling in paranasal cavities noninvasively are capable of triggering allergenic fungal sinusitis. In which case dark-colored species of genus *Alternaria*, *Bipolaris*, *Cladosporium*, *Curvularia*, *Nodulosporium*, as well as *Aspergillus*, *Chrysosporium*, *Fusarium*, *Mucor* become primary etiological agents. In addition to the above-mentioned agents, samples of house dust include particles of kitchen smut and tobacco smoke that are considered to be cancerogenic. Any aerosol dust including deodorants in aerosol cans are also harmful. Crumbling particles of parquet varnish are extremely harmful. Flour dust, harmful due to its allergic reactions, may be found in the kitchen; microfungi may be found in the bathroom. In houses where there are many books and paper, paper dust is abundant producing specific allergy often affecting librarians.

A person loses around 1 gram of skin per day and 2-3 grams during the night totaling 28 grams per week adding to composition of house dust.

It has been proved that humans breathe in about two table spoons of dust with the air per day, and the smaller it is, the deeper it penetrates into the lungs. Particles of dust damage walls of alveoli violating immune barriers and opening the way for infections and DA.

Among many directions of treatment for AD, one of the least studied but potentially the most efficient is elimination therapy. This point of view is shared by conciliative document ARIA – Allergic rhinitis and its impact on asthma (2001).

The main ways of eliminating the abovementioned agents contributing to removal or at least minimizing their sensitizing action on human body are as follows:

1. Using fabric and materials unacceptable for persistence of mites and microfungi in them in household and at manufacturing facilities.

2. Applying chemical agents such as insecticides to eliminate mite population.

3. Elimination of agents capable of sensitizing humans from the air and from things by mechanical means (mainly with air-sucking devices and subsequent adsorbing in the water).

T.M. Zheltikova et al. (2004) believe that due to increasing number of AD related to arthropods, there is emerging need to regularly use biocidal agents including insectoacaricides, i.e. to conduct activities controlling quality of mites and concentration of mite DA in indoor environment. First of all, it concerns the premises where children live because their contact with such DA as mites in the first years of their life is a decisive factor in developing sensitization to them in future.

The following groups of chemicals proved to be the most efficient:

- chlororganic compounds: lindane;
- organophosphorous compounds: dichlorvos, metaphos and others;
- pyrethroids: permethrin, deltamethryn, phenothrin and others;
- group of compounds regulating growth, breaking hormonal regulation of embryogenesis, molt blocking generation of chitin causing apogony of females: methoprene, teflubenzuron and others;
- blockers of electron transport during oxidative phosphorylation in mitochondria: imidazole;
- phytoogenous acaricides: oil of caraway, wormwood, lavender, Azadirachta indica, etc.

It should be noted that requirements to household chemicals used in indoor environment and most importantly in houses of people with AD are very high. Thus, acaricides must be not only highly efficient for house dust mites but also they must not have toxic effect on humans and domestic animals nor must they have sensitizing properties. That is why, although many medications gave a good account of themselves in laboratory conditions, scarce amount of acaricides are applied in practice of health protection.

The main downsides of acaricides include: first, impossibility to completely exclude their toxic and sensitizing effect on human body; second, acaricides lack of activity towards epidermal DA, micromyces, etc that remain in human milieu. Moreover, killed micromites and cockroaches keep their sensitizing properties (it is not improbable that their combination with acaricide may become completely new aggressive DA). Finally, acaricides do not eliminate mite waste products. Thus,

T. Seville, microbiologist from Dyson, says: "This is a common fallacy that allergic reaction is caused by dust mites themselves. In reality, allergy is caused by two dozens of droppings per day produced by each mite. Fighting dust mites, their fecal pellets and food sources will be much more efficient if we vacuum with the "right" vacuum cleaner such areas that we usually avoid while cleaning up: under the sofa and on the sofa, near the bed, in secluded spots of ante-rooms..." In this respect, means of mechanical elimination of DA represented chiefly by vacuum cleaners are worth attention.

However, considering modern state-of-the-art appliances, even the most advanced conventional vacuum cleaner equipped with expensive stage filter has drawbacks of its predecessors: in its operation, it runs the air of cleaned room through itself for many times, throwing current of air filled with harmful dust microparticles and fungi spores at the outlet.

Thus, it is important not only to gather dust but also to keep it in the vacuum cleaner.

As you know, in conventional vacuum cleaners filters are bags or containers for collecting dust, various cartridges that have to be replaced regularly. However, conventional filters intercept only dust and big dust particles. The air containing its smallest particles gets back to the room.

Wet and dry vacuum cleaners (vacuum cleaners for wet cleaning) also do not solve this problem. When cleaning up the room with wet and dry vacuum cleaner, in addition to filters, various chemical solutions are applied which are impossible to remove completely afterwards. While drying up, all these "chemicals" start floating in the air and become the component of house dust.

Scientists from Mechnikov Research Institute of Vaccines and Sera RAMS have conducted researches to study efficiency of operation of different types of vacuum cleaners and proved that number of mites and concentration of guanine, which defines content of mite DA, was substantially reduced when the room was cleaned with HYL A device.

As for fungi spores, their number even increased after room was vacuumed with any vacuum cleaner having filtering systems, which was not the case when HYL A vacuum cleaner was used.

In this respect, particular attention should be paid to the vacuum cleaners of HYL A system manufactured by HYL A International GmbH & Co. KG (Stuttgart, Germany) well-known in more than 60 countries of the world. In its essence, HYL A is a multifunctional ecosystem ensuring cleaning of various surfaces and air from dust, bacteria and viruses in house and in the office. This system allows people to create comfortable and ecologically clean conditions of staying in indoor environment thus increasing their life quality and duration.



HYLA vacuum cleaner construction is designed according to separation concept. Coming through separator, which revolves with speed of 25,000 revolutions per minute, the air is intensively mixed with water, cleaned and returned into the room clean and ionized. Boiling water filter is capable of absorbing the smallest dust particles sized anything from 0.1 to 10 microns.

Degree of air cleaning at the outlet of HYLE vacuum cleaner makes up 99.96% which is extremely high rate.

It is interesting that these vacuum cleaners were named after frogling which is generally considered to be means of sanitation for marshes and lakes eating great numbers of various parasites such as gnat and blood-sucking insects.

Research conducted in reputable foreign laboratories showed that HYLE vacuum cleaner is capable of gathering 100% of dust particles sized 5 microns and more and 99% of particles sized up to 3 microns from large surface (20 m<sup>3</sup>).

Studies of HYLE capability to absorb microgerms (Lviv Research Institute of Epidemiology and Hygiene) showed that bacterial content was reduced 15-20 times after cleaning with the vacuum cleaner.

In 2004, Research Institute of Allergology and Clinical Immunology (Moscow) conducted research of "HYLA ecosystem." The results proved that sick with AD who used this system had substantially less attacks of BA even in the first month. The Institute specialists recommend using these vacuum cleaners in households of people (particularly children) who suffer from BA and chronic bronchitis.

It is worth pointing out that this vacuum cleaner or more specifically HYLE system allows to adsorb other various agents (chemicals, xenobiotics, etc.) dispersed in the air of indoor environment and on household objects as those have triggering effect on the sick with BA, PAR, i.e. in a non-allergenic way adding to onset of asthma and stuffiness in nose. Most probably, this is explanation for so quick manifestation of efficiency of HYLE ecosystem in patients suffering from BA.

Therefore, it should be acknowledged that not only the public but also Ukrainian allergologists do not pay enough attention to the issues of prevention of AD caused by DA. At the same time, according to foreign researches, an integrated approach including use of special fabric in which mites cannot dwell, disinsecticides and special dust-separating systems may decrease probability of onset of respiratory allergy or reduce frequency of recrudescence of PAR or BA in those who suffer from these diseases.

While selecting dust-separating home appliances capable of reducing house dust mite population and their

metabolic products, spores of fungi and other agents producing sensitizing effect on humans or triggering allergy, all the patients having symptoms of BA and PAR may be and need to be recommended HYLE vacuum cleaner.

It is necessary to carry out well-directed domestic researches in the field of AD prevention and to study different ways of eliminating DA surrounding people.

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