Synbio® Air

Airborne synbiotic hygiene

Chrisal

Air is vital. We stay in it permanently and breathe everything that is present in that air. We spend most of our lives indoors: at home, in the workplace, in public buildings, at school, in a restaurant or café, in the sports club ...

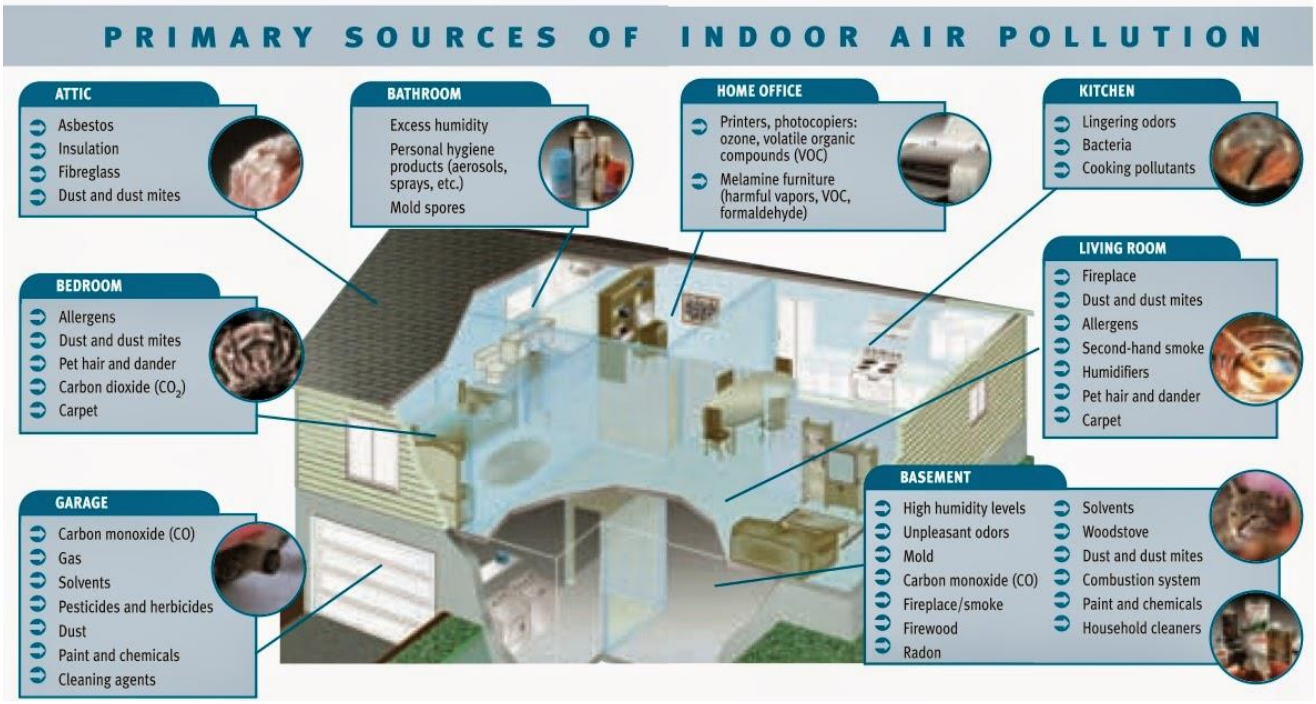
It is known that the quality of outdoor air is problematic in many areas and has a negative impact on our health. However, indoor air is also an increasing health risk. And where improving outdoor air requires long-term and large-scale (government) measures, we can quickly improve the quality of indoor air ourselves.

World Health Organization

"In 2016, indoor air pollution was responsible for 3.8 million deaths worldwide; that is 7.7% of the global mortality!"

Bron: https://www.who.int/airpollution

Indoor air can be polluted with many different things:



Bron: METROPOLITAN ENGINEERING CONSULTING, FORENSICS AND ENVIRONMENTAL SERVICES

The main air pollutants are:

- Germs and mold
- Odor nuisance (from biofilm, moisture, microbial activity ...)
- Allergens (dust mites, pets, pollen…)
- Fine dust (VOCs ...)

However, **air itself is not a source of pollution**! The air is only the carrier that picks up micro-organisms, allergens or other harmful substances somewhere and spreads them throughout space and ultimately also transfers them to humans and animals. So it is important to tackle the source of air pollution; and for that goal Chrisal developed a technology that makes use of the same carrying and dispersing power of air:
Synbio ® Air - Airborne Synbiotic Hygiene!

What are the main air pollutants?

Micro-organisms are important contaminants in air. These bacteria, viruses and fungi can come from:

- Contaminated surfaces. Air circulation can easily propel micro-organisms from surfaces into the air. Contaminated surfaces can be, for example, bathrooms (eg mold on the walls), toilets and kitchen worktops. The presence of biofilm on surfaces is always a source of germs and odors.
- HVAC systems (air conditioning, heating, ventilation) in which dirt and condensation water often accumulate, which is a breeding ground for micro-organisms, including germs. These are then continuously blown into the indoor air. Certainly as a result of modern construction techniques and energy legislation, buildings are increasingly insulated, so that artificial ventilation is required. This artificial ventilation builds up indoor pollution.
- Humans and animals. We ourselves are also carriers of many micro-organisms and through breathing, sneezing or coughing we also permanently contaminate our indoor environment. So do our pets.
- Outdoor air. Indoor air is always partly connected to the outdoor air. Outdoor air can bring in small numbers of contaminants, which then further increase in concentration in the indoor environment due to lack of ventilation or internal circulation; comparable to the air conditioning of a car.

In addition to micro-organisms, **allergens** are also important contaminants of indoor air. These can come from outside (pollen from trees or grass) or from internal contamination (dust mite allergens, pet allergens in textiles). The presence of these allergens provokes allergic reactions in many people. Allergens are always very small substances that are easily carried by air and can be spread throughout the building.

Perhaps not always harmful to health, but all the more annoying are **bad smells**. Many of these odors come from microbial activity (eg in air conditioning, floor drains, toilet…). For many people, odor control is an important aspect of air treatment and often this still happens with very harmful chemical products.

Sources of air pollution

As mentioned, the air itself is not the source of pollution. **The main source of air pollution in the indoor environment are the surfaces in the indoor environment itself!** Floors, counters, carpets, seats, beds, toilets, bathrooms, ventilation systems, air conditioning ... all these surfaces already bear the above-mentioned pollution and these can be spread by means of the indoor air circulation throughout the entire indoor environment.

In order to obtain a healthy and hygienic indoor environment, it is therefore important to keep all surfaces in the indoor environment as clean as possible. Chrisal proved years ago with his probiotic cleaning that this is perfectly possible for solid surfaces that are frequently cleaned. However, difficult to clean surfaces remain a source of contamination and they are now also kept perfectly clean via the **Synbio® Air technology**!

Health problems due to indoor air pollution

The severity of the harmful health effects of indoor air quality depends on a few things, notably how contaminated your indoor air really is and how long you have been exposed to the hazardous pollution. Symptoms commonly associated with indoor air pollution can range from **coughing, sneezing, watery eyes, fatigue, dizziness, headaches, and upper respiratory tract overload**.

While these short-term effects may not sound too threatening, there are also long-term effects that are a much greater risk to your health. Long-term effects can range from **asthma, allergies, autoimmune diseases, cardiovascular disease or even depression**.

Asthma: More than 18 million adults and 6 million children suffer from asthma, according to the World Health Organization. Indoor air pollutants and allergens play an important role in triggering asthma attacks, as well as triggering asthma symptoms or worsening asthma in general.

(Rosati et al, 2005)

Allergy: Allergies arise when allergens find their way to your lungs. Indoor allergens are the leading source of allergy symptoms, according to the Institute of Medicine: rash, headache, sneezing, runny nose, swelling, and fatigue. The most common allergens in a building are those from dust mites, pets, pollen and mold spores.

(*Indoor Allergens: Assessing and Controlling Adverse Health Effects. Institute of Medicine (US) Committee on the Health Effects of Indoor Allergens*)

Auto immune disease: Autoimmune diseases are characterized as an immune response that in turn leads to the destruction of the body's own tissues and organs. Any trigger in the environment can trigger this response, and recent research shows that air pollutants are also a hazard for people with autoimmune disease.

(Salvador 2010: Air Pollution Linked to Autoimmune Diseases).

Vascular diseases: The EPA has conducted research on the link between air pollution and vascular diseases. It has been found that when you breathe air pollutants it can negatively affect your cardiovascular system. In essence, increased air pollution in the environment results in an increase in oxidative stress and inflammation at the cellular level of the body, leading to an increased risk of arteriosclerosis.

(Kelly et al, 2017)

Depression: The true cause of depression can be difficult to determine, but research has shown that air pollution can increase the intensity of depressive symptoms. As many as 8 out of 10 studies show a significant correlation between long-term exposure to indoor air pollution and depression.

(Lopuszanska et al, 2017)

The impact of indoor environmental pollution therefore goes much further than one would initially think. There is an urgent need for a healthy indoor environment!

Synbio® Air
Airborne synbiotic hygiene

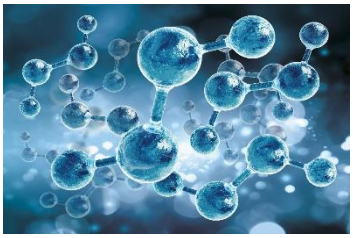
Synbiotic hygiene by air

Synbio® Air is a revolutionary technology that blows prebiotics and probiotics into the air via venturi nebulization. These **100% natural ingredients** spread quickly throughout the entire interior and ensure a healthy microflora on all surfaces that come into contact with the air. This clears these surfaces of contaminants, which in turn ensures:

- Less risk of germs
- Less organic pollution (such as biofilm)
- Less allergens
- Fewer smells

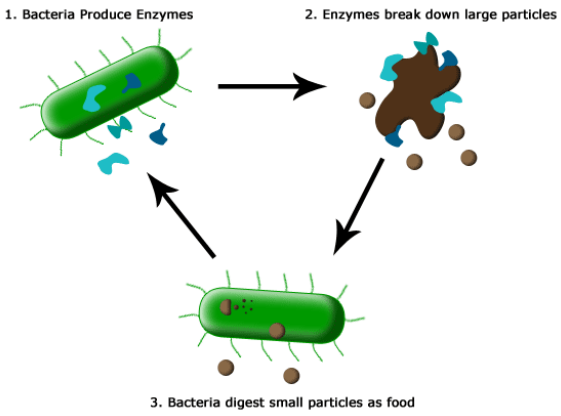
Synbiotics: the combination of probiotics and prebiotics.
Probiotics: good bacteria that improve human and animal health
Prebiotics: nutrients that stimulate the development of good bacteria


Probiotics


Prebiotics

After years of research, Chrisal has developed a technology in which **Adaptive nebulizing technologies** are able to generate miniscule synbiotically charged water particles. This creates a very fine synbiotic mist , which is immediately distributed throughout the air and the entire room. The pre- and probiotics can travel throughout the entire indoor environment and eventually settle on all vertical and horizontal surfaces, to form a healthy microflora that then biologically cleans the surfaces.

The **probiotics** analyze the surface to see what type of contamination is present. They then produce highly targeted enzymes for days in a row that break down the dirt found and separate it from the substrate and bring it into a dissolved or colloidal state, making it easier to remove mechanically and / or physically. This ensures a very effective and deep dirt removal. The **prebiotic sugars** first of all support our own probiotics by quickly activating them. In addition, they also stimulate the growth of existing good micro-organisms in order to stimulate a healthy microflora on the surfaces.

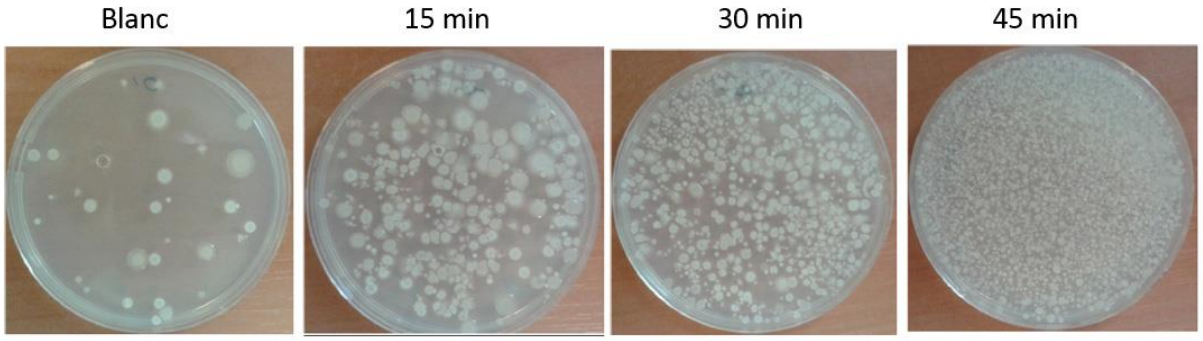


Synbio® Air provides optimal purity of all interior surfaces via the air and thus also a healthy indoor environment!

Synbio® Air
Airborne synbiotic hygiene

Synbio® Air device can mist about **1 million probiotics per second**! A short (few minutes) nebulization period of probiotics results after a few hours in a healthy probiotic microbiology in the treated room.

The test below shows, via plates on which bacteria are grown in a lab, how the probiotics spread and multiply quickly in an area that was briefly treated with the ultrasonic atomization:



The end result is an air and surface microbiology that almost exclusively consists of healthy probiotics.

Which solutions does synbiotic air hygiene provide?

Synbio® Air can solve a number of important indoor environmental problems:

1. Microbial contamination – Sick Building Syndrome

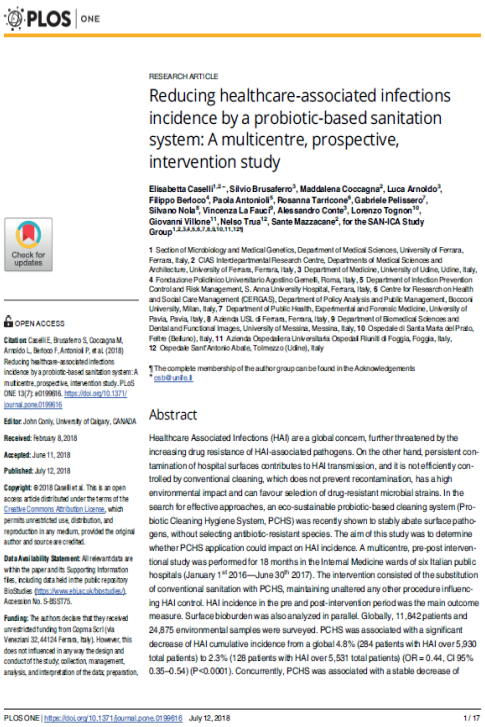
Although invisible, air still contains micro-organisms, including a number of germs, such as moulds. These can cause illness immediately if inhaled, or settle on surfaces in the home and further multiply there to cause contamination afterwards. Very often moisture strongly stimulates the number of germs in air and air conditioning systems or poor ventilation can cause high concentrations of harmful germs.

An unhealthy microbiology causes the **Sick Building Syndrome (SBS)** in which residents of a building experience acute health problems, which seem to be linked to the time spent in the building concerned.

How Synbio® Air helps:

The highly efficient and rapid dispersion of the synbiotic particles ensures healthy microbiology in the air and all vertical and horizontal surfaces, including ceilings, textiles, etc. Furthermore, the nanoparticles penetrate into the smallest openings and thus reach places that are totally unreachable for cleaning. This is, for example, very important for buildings with an air conditioning installation which is often the source of germs due to condensation in the system. **Synbio® Air also keeps the air conditioning clean** so that there is a greatly reduced risk of the presence of germs.

That occupation of surfaces with prebiotics and probiotics gives rise to a healthy microbiology with a lower risk of germs has already been scientifically proven and published:



PLOS ONE

RESEARCH ARTICLE

Reducing healthcare-associated infections incidence by a probiotic-based sanitation system: A multicentre, prospective, intervention study

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Abstract

Healthcare Associated Infections (HAI) are a global concern, further threatened by the increasing drug resistance of HAI-associated pathogens. On the other hand, persistent contamination of hospital surfaces contributes to HAI transmission, and it is not efficiently controlled by conventional cleaning, which does not prevent recontamination, has a high environmental impact and can favour selection of drug-resistant microbial strains. In the search for effective approaches, an eco-sustainable probiotic-based cleaning system (Probiotic Cleaning Hygiene System, PCHS) was recently shown to stably abate surface pathogens, without selecting antibiotic-resistant species. The aim of this study was to determine whether PCHS application could impact on HAI incidence. A multicentre, pre-post intervention study was performed for 18 months in the Internal Medicine wards of six Italian public hospitals (January 1st 2016—June 30th 2017). The intervention consisted of the substitution of conventional sanitation with PCHS, maintaining unaltered any other procedure influencing HAI control. HAI incidence in the pre and post-intervention period was the main outcome measure. Surface bioburden was also analyzed in parallel. Globally, 11,842 patients and 24,875 environmental samples were surveyed. PCHS was associated with a significant decrease of HAI cumulative incidence from a global 4.8% (284 patients with HAI over 5,930 total patients) to 2.3% (128 patients with HAI over 5,531 total patients) (OR = 0.44, CI 95% 0.35–0.54) (P<0.0001). Concurrently, PCHS was associated with a stable decrease of

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Caselli et al, 2018. *Reducing healthcare-associated infections incidence by a probiotic-based sanitation system: A multicentre, prospective, intervention study*.

More than 10 years of research in hospitals with Chrisal's probiotic products showed that probiotic-containing surfaces lead to:

- Reduction of the risk of germs by more than 80% permanently.
- Reduction of resistance among germs
- **54,8% less infections**

Synbio® Air ensures a healthy microflora on ALL surfaces of the indoor environment and thus a greatly reduced risk of infections!

ATTENTION: Synbio® Air is not a disinfectant! When desired a room can be first disinfected using an official biocide. Synbio® Air can be continued.

2. Odor

Air can be a carrier of all kinds of annoying odors. Although the cause of the odor is often elsewhere, it is still possible to do odor control via air treatment. However, current methods are limited to masking odors with strong chemical perfumes or scent traps. These are very unhealthy and harmful to the environment.

Odors from faulty microbiology

The presence of some microorganisms, such as moulds, causes odor nuisance because these microorganisms produce all kinds of volatile molecules. Synbiotic air treatment solves this in two ways:

1) CURATIVE: The probiotic mist floating in the air can capture and neutralize some of these organic fragrances by breaking them down.

2) PREVENTIVE: The installation of healthy microbiology on all surfaces in a room or building reduces the risk of micro-organisms producing bad odors.

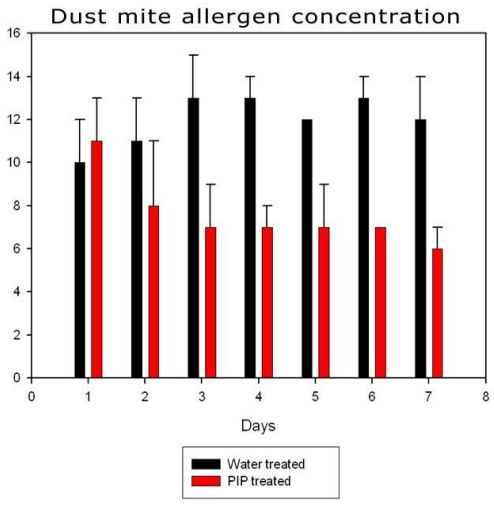
Odors from waste

Waste, or other contaminants such as urine, feces, produce unpleasant odors. These scents are often organic compounds that can be absorbed by the probiotics and processed into non-scented substances. Tests in public sanitary facilities near the city of Ghent showed that after 3 days of synbiotic air treatment (via atomization) the odor nuisance of urine had disappeared. Fogging in waste containers and waste collection areas with probiotics also works very efficiently in terms of odor reduction..

3. Allergens

Allergens are substances that trigger an allergic reaction and are very easily spread through the air. The most common allergens in the indoor environment are those of dust mites, dogs, cats, fungi and pollen. Allergens are often very small organic compounds such as proteins.

Chrisal already has 10 years of experience in the use of probiotics for the reduction of certain allergens. The probiotics produce enzymes that are able to break down the proteins and thus neutralize the allergens. This effect has been tested in Ghent University and the German BMA laboratory. Chrisal's probiotics were able to lower the allergens by an average of 60% on a 100% natural basis.



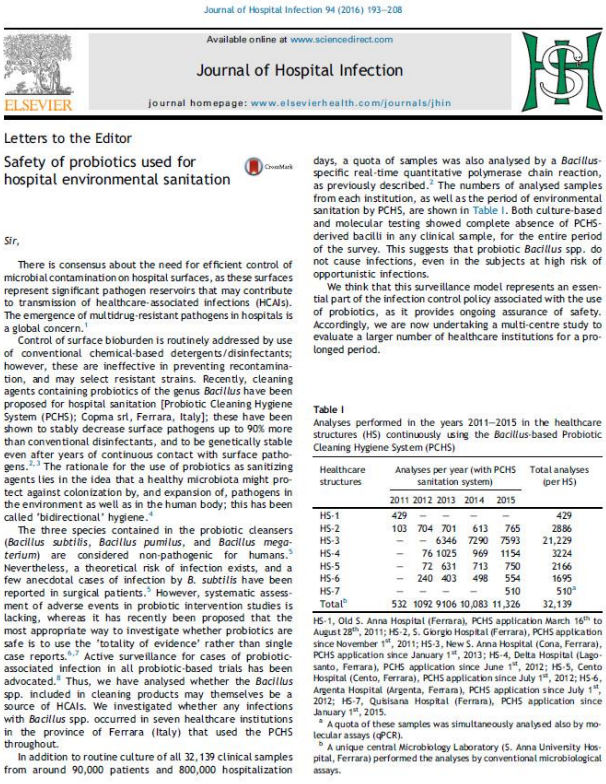
Synbio® Air fogging carries the probiotics everywhere (even deep into textiles) and brings them in close contact with the allergens to break them down and thus greatly reduce the risk of allergies!

Safety of synbiotics

Because airborne synbiotic hygiene is a new technology, Chrisal has devoted a great deal of attention to demonstrating the safety of the products, especially the probiotic strains used, from the very beginning of development.

Synbio® Air meets the following safety criteria:

1. All probiotics used belong to ATCC safety class 1 (= highest safety)
2. The pro / prebiotics are 100% natural, not genetically modified (non-GMO)
3. The pro / prebiotics are listed on the list of safe ingredients of the European Food Safety Agency (EFSA) for processing in food
4. Food safe according to the American FDA (GRAS status)
5. Passed the following official OECD safety tests:
    a. **OECD 403 Inhalation toxicity !!!**
    b. OECD 404 Acute skin irritation / corrosion
    c. OECD 405 Acute eye irritation / corrosion
    d. OECD 406 Skin sensation
6. The products meet the EU Ecolabel criteria
7. The prebiotics and probiotics meet the criteria for use in cosmetics
8. 10 years of safe use in hospitals and clinical studies



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Letters to the Editor

Safety of probiotics used for hospital environmental sanitation

Sir,

There is consensus about the need for efficient control of microbial contamination on hospital surfaces, as these surfaces represent significant pathogen reservoirs that may contribute to transmission of healthcare-associated infections (HCAIs). The emergence of multidrug-resistant pathogens in hospitals is a global concern.[1]

Control of surface bioburden is routinely addressed by use of conventional chemical-based detergents/disinfectants; however, these are ineffective in preventing recontamination, and may select resistant strains. Recently, cleaning agents containing probiotics of the genus *Bacillus* have been proposed for hospital sanitation [Probiotic Cleaning Hygiene System (PCHS); Copma srl, Ferrara, Italy]; these have been shown to stably decrease surface pathogens up to 90% more than conventional disinfectants, and to be genetically stable even after years of continuous contact with surface pathogens.[2,3] The rationale for the use of probiotics as sanitizing agents lies in the idea that a healthy microbiota might protect against colonization by, and expansion of, pathogens in the environment as well as in the human body; this has been called 'bidirectional' hygiene.[4]

The three species contained in the probiotic cleansers (*Bacillus subtilis*, *Bacillus pumilus*, and *Bacillus megaterium*) are considered non-pathogenic for humans.[5] Nevertheless, a theoretical risk of infection exists, and a few anecdotal cases of infection by *B. subtilis* have been reported in surgical patients.[5] However, systematic assessment of adverse events in probiotic intervention studies is lacking, whereas it has recently been proposed that the most appropriate way to investigate whether probiotics are safe is to use the 'totality of evidence' rather than single case reports.[6,7] Active surveillance for cases of probiotic-associated infection in all probiotic-based trials has been advocated.[8] Thus, we have analysed whether the *Bacillus* spp. included in cleaning products may themselves be a source of HCAIs. We investigated whether any infections with *Bacillus* spp. occurred in seven healthcare institutions in the province of Ferrara (Italy) that used the PCHS throughout.

In addition to routine culture of all 32,139 clinical samples from around 90,000 patients and 800,000 hospitalization days, a quota of samples was also analysed by a *Bacillus*-specific real-time quantitative polymerase chain reaction, as previously described.[2] The numbers of analysed samples from each institution, as well as the period of environmental sanitation by PCHS, are shown in Table I. Both culture-based and molecular testing showed complete absence of PCHS-derived bacilli in any clinical sample, for the entire period of the survey. This suggests that probiotic *Bacillus* spp. do not cause infections, even in the subjects at high risk of opportunistic infections.

We think that this surveillance model represents an essential part of the infection control policy associated with the use of probiotics, as it provides ongoing assurance of safety. Accordingly, we are now undertaking a multi-centre study to evaluate a larger number of healthcare institutions for a prolonged period.

Table I
Analyses performed in the years 2011–2015 in the healthcare structures (HS) continuously using the *Bacillus*-based Probiotic Cleaning Hygiene System (PCHS)

Healthcare structures	Analyses per year (with PCHS sanitation system)					Total analyses (per HS)
	2011	2012	2013	2014	2015	
HS-1	429	–	–	–	–	429
HS-2	103	704	701	613	765	2886
HS-3	–	–	6346	7290	7593	21,229
HS-4	–	76	1025	969	1154	3224
HS-5	–	72	631	713	750	2166
HS-6	–	240	403	498	554	1695
HS-7	–	–	–	–	510	510[a]
Total[b]	532	1092	9106	10,083	11,326	32,139

HS-1, Old S. Anna Hospital (Ferrara), PCHS application March 16th to August 28th, 2011; HS-2, S. Giorgio Hospital (Ferrara), PCHS application since November 1st, 2011; HS-3, New S. Anna Hospital (Cona, Ferrara), PCHS application since January 1st, 2013; HS-4, Delta Hospital (Lagosanto, Ferrara), PCHS application since June 1st, 2012; HS-5, Cento Hospital (Cento, Ferrara), PCHS application since July 1st, 2012; HS-6, Argenta Hospital (Argenta, Ferrara), PCHS application since July 1st, 2012; HS-7, Quisisana Hospital (Ferrara), PCHS application since January 1st, 2015.

[a] A quota of these samples was simultaneously analysed also by molecular assays (qPCR).

[b] A unique central Microbiology Laboratory (S. Anna University Hospital, Ferrara) performed the analyses by conventional microbiological assays.

ATCC®

EU Ecolabel
www.ecolabel.eu

efsa
European Food Safety Authority

OECD
BETTER POLICIES FOR BETTER LIVES

Product quality

Are you convinced of the synbiotic solution for your indoor environment? Perfect! But be aware, in order to enjoy the maximum effect and benefits of synbiotic air hygiene, the products must meet some important criteria:

Composition of the product

The selection of the types of probiotics and prebiotics are crucial for the proper functioning of the product. A wide variety of species are available and it is very important to know what effect a particular species has under certain conditions. Chrisal has been conducting research for many years to select the most performing probiotic bacteria and prebiotic sugars for the desired application. For example, a probiotic Lactobacillus, known from the probiotic food supplements, will be practically worthless for environmental applications. The Bacillus species, originating from soil and water, that Chrisal uses are ultra-efficient!

Stability of the product

The number of pre- and probiotics in the product is also very important. The organic pollution on a surface is often very strong. A probiotic product with only a few probiotics will not work. Chrisal products contain an absolute minimum of 50 million probiotics per ml. Certain products go up to half a billion per ml!

The prebiotics and prebiotics also have to survive the entire shelf life of the product. Chrisal is by far the market leader in stability and gives all its products a shelf life of at least 3 years!

Quality control of product

To guarantee the proper functioning and safety of each product, a solid quality system is of great importance. Chrisal has had the ISO9001 quality certificate since 1999. This guarantees the proper functioning of the entire company.

In addition, Chrisal has 2 laboratories that are equipped with all required, modern technology to be able to perform a thorough quality control. Producing products with probiotics is not easy and guaranteeing purity requires modern equipment and specialized lab technicians.

Efficacy of the product

The efficacy of all Chrisal products is always externally validated by specialized academic or private institutions. Chrisal's permanent research partners include UGent, Eurofins, SGS and BMA Labor.

Conclusion

With the Synbio® Air technology, Chrisal has found a true revolution and proven solution for achieving and maintaining a healthy indoor environment. A healthy microflora is applied to all surfaces in the indoor environment by air. These keep the surfaces clean and greatly reduce the risk of allergens, odors and infections. The superior efficacy in combination with optimal safety, durability and environmental friendliness, make this technology a much needed solution to obtain and maintain a sustainable hygiene that we all need.

In the coming years, this technology will be applied in an increasing number of sectors. You can help build a sustainable future!

Synbio® Air
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Be part of the difference for a better world!