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# **Ad interim provisions to prevent and manage the indoor environment in relation to the transmission of the infection by the SARS-CoV-2 virus.**

**Updating Rapporto ISS COVID-19 n. 5/2020 Rev. 2**

ISS Working Group Environment and Indoor Air Quality

Version of April 18, 2021



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## **ISS Working group Environment and *Indoor* Air quality**

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ISS Working group Environment and Indoor Air Quality

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To counteract the spread of the SARS-CoV-2 pandemic, ensuring indoor air quality is critical in protecting the health of citizens and workers. The report provides a series of recommendations to be followed in both home and work environments to maintain a good level of indoor air quality in relation to the containment of the risk of infection by COVID-19.

The original Italian version of ISS COVID-19 Reports are available from: <https://www.iss.it/rapporti-COVID-19>

The reports translated in English are available from: <https://www.iss.it/rapporti-iss-COVID-19-in-english>

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## Target

The main recipients of this document are citizens, workers, employers, Protection and Prevention Services (PPS), property managers, and health authorities of the National Health Service Prevention Departments (SSN), each committed to their role, adoption and compliance with the COVID-19 action programs in order to respond to the needs of protection and prevention of the health of personnel and the community in the current context.

## Update

Compared to the previous version of 25 May 2020:

- The advice and recommendations provided are intended to facilitate the management of the various working spaces and environments following the issuing of the National Guidelines that, for the main areas of activity, contain the operational guidelines and the different organizational measures to be implemented.
- The procedures to be put in place to ensure a good exchange of natural air and appropriate mechanical ventilation in different indoor environments are specified, to recommend the appropriate filtration, the direction of air flows from potentially less contaminated clean areas to potentially more contaminated/polluted areas, the control of temperature and relative humidity of the air and the periodicity of cleaning and maintenance of the systems.

## Acronyms

<b>HVAC</b>	Heating, Ventilating, and Air Conditioning
<b>ISS-SG-IP</b>	Study Group “Indoor Pollution” of the Istituto Superiore di Sanità
<b>PM</b>	Particulate Matter
<b>PPS</b>	Protection and Prevention Services
<b>VOCs</b>	Volatile Organic Compounds



# Introduction

In order to cope with the circulation and spread of the SARS-Cov-2 virus and its variants, the recommendations of prevention and protection in the field of health must be applied in the multiple indoor and work environments. Indoor air quality is an integral part of the hierarchy of risk management: improving indoor air quality has always been a real strength to promote and safeguard the health of citizens and at this time it is even more so, whereas more time is spent indoors, particularly in one's own homes, even if there is a tendency to return to more active normality.

Studies carried out on public indoor environments of different types, particularly crowded ones, not adequately ventilated ( $\ll 3$  L/s/person) and with infected people not wearing masks for the duration of their stay, have shown that the risk of exposure to SARS-Cov-2 is much higher than in outdoor environments, where dilution of any viral particles allows a significant reduction of risk. In fact, at a distance from an infected person, in a closed and not aerated space, at a short/close distance or even long range, accumulates a greater viral load carried by droplets and other aerosols released by the infected subject (1-5).

The report focused on preventive measures and actions to be implemented with respect to:

- replacement of natural air, mechanical ventilation, centralized and not, promoting the opening of windows and balconies, remodeling the operating conditions of technological systems, frequencies and maintenance modes, improving the effectiveness of ventilation, which must be increasingly user- and health-oriented;
- microclimatic parameters to avoid values of temperature and relative humidity of the air too high or too low. These factors play a central role on respiratory defense capability, droplet evaporation dynamics, distance travelled, viability and virus;
- indications that encourage the adoption of correct behavior and protect those most at risk avoiding closed and crowded spaces, properly wearing a mask, keeping physical distance from people, performing the hygiene of the hands. We also provide some practical advice to be adopted when using products and equipment used in cleaning, sanitizing and disinfection. Some products may lead to emissions of Volatile Organic Compounds (VOCs) and/or contribute to the secondary formation of other pollutants of sanitary interest (e.g., formaldehyde, PM<sub>10</sub>, PM<sub>2.5</sub>);
- loads of work and levels of occupancy of environments with the aim of ensuring and maximizing in all conditions the health protection of citizens, visitors, customers and workers, and ensure the reduction of the risk of transmission.

In this document two different types of indoor environments are considered according to this scheme:

- *Domestic environments*  
such as homes in which only household members interact daily, where one can continue to work and engage in educational activities at a distance through digital technologies;
- *Work environments designed with standards dedicated to specific purposes*  
such as public and private offices, schools, universities, banks and post office, health facilities, pharmacies, parapharmacies, supermarkets, cinemas, theatres, gyms, airports, stations and public transport (railways, buses, subways, etc.) in which they interact, for different needs, employees, customers, pupils, visitors, operators of external companies, suppliers and travelers.

This report updates and deepens the precautionary guidelines and good practices published by the ISS in the poster New coronavirus Tips for indoor in March 2020, and available on the official ISS website in the

section New coronavirus (<http://www.iss.it/infografiche>) that has made use of the experience of the National Study Group (GDS) Indoor Pollution of the ISS (see the poster in the appendix to the attached document).

For a long time, the Gds-ISS has published a series of reference documents on indoor pollution in order to implement nationally harmonized actions to reduce and mitigate indoor pollution exposure and health effects, to improve risk exposure in indoor workplaces, to raise awareness of behavior and make the population aware of one of the topics of great relevance and priority for our country. The following is the list:

- *Rapporti ISTISAN 20/3*  
*Indoor air quality in schools: strategies for monitoring chemical and biological pollutants;*
- *Rapporti ISTISAN 19/17*  
*Indoor air quality in schools: strategies for monitoring chemical and biological pollutants;*
- *Booklet on indoor air quality "The air in our home": 2017;*
- *Rapporti ISTISAN 16/16*  
*Monitoring strategies to PM<sub>10</sub> and PM<sub>2.5</sub> in indoor environments: characterization of inorganic and organic micropollutants;*
- *Rapporti ISTISAN 16/15*  
*Presence of CO<sub>2</sub> and H<sub>2</sub>S in indoor environments: current knowledge and scientific field literature;*
- *Rapporti ISTISAN 15/25*  
*Microclimate parameters and indoor air pollution;*
- *Rapporti ISTISAN 15/5*  
*Monitoring strategies to assess the concentration of airborne asbestos and man-made vitreous fibres in the indoor environment;*
- *Rapporti ISTISAN 15/4*  
*Workshop. Indoor air quality: current national and European situation. The expertise of the National Working Group on indoor air. Istituto Superiore di Sanità. Rome, May 28, 2014. Proceedings;*
- *Rapporti ISTISAN 13/39*  
*Workshop. Issues related to indoor air pollution: current situation in Italy. Istituto Superiore di Sanità. Rome, June 25, 2012. Proceedings;*
- *Rapporti ISTISAN 13/37*  
*Monitoring strategies of biological air pollution in indoor environment;*
- *Rapporti ISTISAN 13/4*  
*Monitoring strategies for Volatile Organic Compounds (VOCs) in indoor environments.*

At the same time several campaigns have been launched by the ISS on social sites, with the aim of promoting greater attention to indoor air quality, regular air changes, ventilation and the combination of both in order to improve air quality in the most frequented indoor environments (through the strengthening of air exchange, the increase in flow rate, the flow of air from the cleanest areas to the dirtiest ones, the reduction of recirculation if possible, the most effective filtration, control of relative humidity and temperature).

The air changes can be improved by using as much as possible the openings of windows and balconies, this is among the easiest to implement immediately, the entry of an "external air flow", continuous intermittent



or crossed and ensure dilution/reduction of the various indoor pollutants, including any viral units present (in this regard, the appendix contains some infographics used by the ISS). Even today many people ignore the fundamental need for air circulation because they consider thermal comfort, or the energy aspect to be predominant in an attempt not to “waste” or reduce energy consumption and associated costs, especially on days when weather conditions are characterized by low or high temperatures. With these weather conditions one tends to stay indoors for longer with windows and balconies kept closed or otherwise little open and for short times, and/or one uses air conditioning/ cooling systems that always recirculate the same air, without exchange with the outside. For this reason, there is a need for training/information on the importance of indoor air quality, and on the close relationship between indoor environment and health, with the aim of promoting and facilitating exposure reduction actions, clearly explaining the role played by air exchanges through window openings and balconies and with mechanical systems.

From an operational point of view, it is useful to recall that the optimization of air and, more generally, ventilation, although part of the general prevention strategy, is only one of the actions to be taken, and alone has a partial effect on reducing the risk of contamination and transmission of the virus and its variants, if all other personal risk prevention and reduction actions are not respected, and above all physical distance, the use of masks (source control), hand washing, respiratory label for coughing and sneezing. **The reduction of the risk of contamination and spread is based precisely on the integrated and comprehensive implementation of these personal and collective measures, which are still the most effective. No single measure alone can reduce risk. In this connection it must be remembered that the general prevention strategy must continue to be applied even at this time when part of the population has been vaccinated.**

In March 2021, the World Health Organization (WHO) published a new document entitled *Roadmap to improve and ensure good indoor ventilation in the context of COVID-19* (6), where they are examined for different indoor environments, natural and mechanical ventilation modes to improve and ensure good air exchange within buildings in order to reduce the risk of SARS-COV-2. The WHO reiterates that natural and mechanical ventilation is a strategic part of the prevention and control of the risk reduction of transmission of COVID-19. The WHO recommends using an external air flow that must not be less than 10 liters per second per person (10 L/s/person) as a minimum requirement in different indoor environments, recalling the indications contained in UNI EN 16798-1:2019. In this context it should not be forgotten that in Italy, in addition to the package of standards UNI EN 16798, is presented another important standard, the UNI 10339:1995 currently under review and the “Guidelines Microclimate, ventilation and lighting in the workplace. Standard requirements. Operational and design requirements”, 2006.

## General measures for domestic environments

Even today, attention to the prevention and reduction of the risk of transmission of the SARS-Cov-2 virus gives priority to housing, many of which are transformed into “new” workstations, classrooms or gyms, where it is easier to spread the virus given the close internal and external family relationships, especially in the most numerous and multigenerational families, with the possible presence of fragile and vulnerable subjects.

In the first place, it should be noted that knowledge on the transmission of the SARS-Cov-2 virus is constantly evolving from the results obtained in the new studies. The virus mainly spreads through the interhuman **contact between person and person, when the infected individual releases respiratory fluids** through the activities and physical acts of breathing, talking, singing, playing wind instruments, dancing, doing physical activity, cough and sneeze, **the wide size spectrum of the respiratory particles (droplets and other aerosols)** that are transported differently from the air flow, changing size and composition depending on the microclimatic conditions of the air environment (e.g. temperature, relative humidity, just to name a few) or through **contact with contaminated surfaces** on which they went to settle the droplets.

In this context, the document lists a series of recommendations and advice to be adopted, organically on a daily basis, during the period of stay in housing:

- **Ensure good air exchange in all domestic environments**, in a natural way, and more frequently by slightly **opening** one or more doors of the **windows** and **balconies** and at the same time the **doors of the rooms, as a measure to increase the entrance of “new fresh air outside”**. This helps not only to dilute the contamination of any pollutant in the air but reduces both the accumulation and the concentration of viral units and also the risk of exposure for those staying there. This measure significantly improves the discomfort that can occur in poorly ventilated dwellings, where symptoms can be reported, such as malaise, headaches, eye and throat irritations, respiratory fatigue, asthma, allergies, cardiovascular disorders, reduced cognitive performance, reduced productivity. However, make sure that the opening of windows, balconies and doors does not pose a risk to the safety of persons, in particular elderly, disabled and/or children.

The natural ventilation of the rooms depends on numerous factors, such as weather parameters (e.g., outdoor air temperature, wind direction and speed), physical parameters such as open surface of windows and balconies and duration of opening. Fresh outdoor air works by dilution/reduction of both pollutant concentrations (e.g., Volatile Organic Compounds-VOCs, Particulate Matter-PM<sub>10</sub>, odors, and bioaerosol that can carry bacteria, viruses, allergens, filamentous fungi [mold], to name a few), as well the CO<sub>2</sub> and relative humidity present in homes. In general, it is known that scarce air exchange favors, in indoor environments, the exposure to pollutants and can facilitate the transmission of pathogens.

Opening times should be optimized according to the number of persons in the household and the activities carried out in the room/environment to avoid discomfort (hot or cold air currents directly on people). In the winter period, where the temperature difference between the inside and the outside is greater, a few minutes of opening can be enough to provide the same amount of air flow; unlike the summer period that may require longer times (e.g., the doors of the windows and balconies must not all be open as in the hottest summer). **Generally, it is preferable to open for a few minutes several times a day**, compared to only once a day for a long period **(also called intermittent ventilation)**.

It is recommended to **open windows and balconies of the rooms that overlook the less busy roads and during periods of lesser passage of vehicles**, especially when the house is in an area with problems related to traffic and environmental noise.

Even if some rooms of the house are equipped with autonomous fixed heating/cooling systems (e.g., split heat pumps air conditioners,, which are quite common, and consisting of an indoor unit generally mounted on a wall and an outdoor unit containing the compressor-motor, condenser and fan, air-to-water air conditioners with indoor unit type fan coil, portable air conditioners connected with a flexible air drain pipe to the outside), **which do not use “new outdoor air” for their operation, but always the same recirculated air that is heated/cooled**, it is important not to forget to **open windows and balconies for a few minutes several times a day**, for dilution/reduction of the concentrations of both the pollutants accumulated in the air that is recirculated (e.g., VOCs, PM<sub>10</sub>, odors, bioaerosol which can carry bacteria, viruses, allergens, filamentous fungi [molds]), and the CO<sub>2</sub> and the relative humidity of the air present in all dwellings. Considering the size of the rooms, it is recommended to place in an appropriate way portable air conditioners (e.g., do not place near the corners or walls of the room or close to the sofas).

In all these environments during the use of the systems you will have to:

- Avoid directing the flow of air directly on persons or among persons present;
- Do not forget to maintain suitable microclimatic conditions in the environments (e.g., the ideal temperature for physiological well-being in the winter is between 20 and 22°C and in the summer between 24 and 26°C with a relative humidity of 40-60% depending on the needs. In this interval the respiratory system defenses function effectively, and the viability of microorganisms and this virus is reduced thanks to chemical-physical reactions). The use of portable dehumidifiers could be useful, although their scope often depends on the models and operating modes and is limited to individual rooms/environments of the home. However, it is recommended before and after the use of dehumidifiers to carry out the cleaning of the hands and a regular cleaning of the different components of the appliances (following the manufacturer’s instructions according to the type of model). On the other hand, pay attention to excessive relative humidity levels of more than 70% because in this situation the growth of microbial contaminants (especially filamentous fungi [molds] and bacteria can be encouraged);
- Clean the recirculation air filters supplied with the system/air conditioner regularly according to the frequency of use and according to the instructions provided by the manufacturer and with the system stopped in order to maintain adequate levels of filtration/removal of the “dust” present in the air (they are generally made of plastic material such as polyethylene PE, polyester PL, polyamide or nylon PA, etc.). Some brands use very high efficiency filters called High Efficiency Particulate Air filter-HEPA or Ultra Low Penetration Air-ULPA (UNI EN 1822:2019). The dust captured by the filters constitutes an environment favorable to the proliferation of bacteria and fungi, and in any case of biological agents. Avoid using and spraying cleaning agents or disinfectants directly on the filter in order not to inhale pollutants (e.g., VOCs) during operation. It is not recommended to perform these cleaning operations when other people are present;
- Clean the ventilation inlets and grates regularly with microfiber cloths moistened with water and common soaps, or with a solution of ethyl alcohol with a minimum percentage of 70% v/v, and subsequently drying. The cleaning of the grills contributes to the good general maintenance of air in the rooms;
- The same attention must be paid to the positioning of personal portable mini air conditioners, to the cleaning of filters and water container.

If some rooms of the house are equipped with ceiling or portable floor or table fans that involve a significant movement of the air, **but do not replace the exchanges of external air**, it is advisable to pay particular attention in the presence of subjects not belonging to the family unit. However, if this equipment is used (e.g., during high temperatures and heat waves) by people from the same household, it does not represent a problem. **In any case, remember to place the fans at a certain distance from people**

**avoiding directing the flow of air directly on people or between people to reduce the spread of particles potentially containing the virus).** In the presence of several people not belonging to the family unit, it is advisable, in relation to the new variants of the virus, to avoid the use of equipment, if possible, by turning off the fan, or bringing it closer and facing it towards the open windows of the room in order to increase the air flow to the outside. In these cases, it is advisable to ventilate the room by opening windows and balconies.

In environments/rooms without windows (e.g., closets, bathrooms, etc.), but equipped with fans/extractors, these must be kept running at least for the entire time people stay in the area to help reduce the concentrations of pollutants in the air, keeping the doors closed to avoid dispersion in contiguous environments.

Regarding house cleaning, before using any cleaning and disinfection products **it is advisable to read the labels and the instructions for use, respecting the quantities recommended by the producers** (e.g., using the measuring cap present on all product packages). Incorrect use or incorrect dilution of a product can reduce the effectiveness of cleaning and lead to unexpected results. The effectiveness of disinfectants (e.g., ethyl alcohol with a minimum content of 70% v/v, sodium hypochlorite diluted with 0.1% active chlorine) is linked to the need to preventively remove the “dust” and dirt, keeping into consideration the compatibility with the material, the use and the environment. In addition, excessive and repeated use can cause irritation of the respiratory tract and dermatitis, making people more vulnerable to bacteria and viruses and more generally to indoor air pollution (the danger symbols on the labels must be checked). **Choose, if possible, products without perfumes/fragrances and allergens remembering that the clean has no smell.** Detergent fragrances contain VOCs that degrade indoor air quality and should not be used in the presence of asthmatic subjects.

- **Be careful during use not to mix the cleaning products**, those containing sodium hypochlorite, such as bleach, with ammonia, or other acidic substances, such as vinegar, and do not add ammonia to antiscalc/descaler to **avoid the production of splashes and sprays. The products should be used with extreme caution in the recommended doses.** Many common household cleaning products, if used properly, can quickly inactivate the SARS-Cov-2 virus.

In all cases:

- Perform cleaning with gloves.
- Air the rooms/environments both during and after the use of cleaning products, especially if you intensively use disinfectant/detergent products that have danger symbols on the label (flammable, corrosive, irritating, harmful, etc.).
- When materials or furniture cannot be washed (e.g., carpets and mattresses), use a steam cleaning appliance.
- Make sure that all cleaning products are kept out of the reach of children, teenagers and pets. Store all products in a safe place.
- It is useful to limit or avoid the use of incense sticks, essential oils (7), diffusers and fragrances in environments, as they emit chemical pollutants (VOCs, PM<sub>10</sub> and PM<sub>2.5</sub>). In fact, despite the fragrance, the use of these products adds unnecessarily pollutants and degrades indoor air quality.

**WHO indications for estimating the natural ventilation rate through windows and balconies**

*(Roadmap to improve and ensure good indoor ventilation in the context of COVID-19):*

Ventilation rate [L/s]=k x wind speed [m/s] x minimum aperture area [m<sup>2</sup>] x 1000 [L/m<sup>3</sup>]

k = 0,05 in the case of unilateral ventilation

k = 0,65 in the case of ventilation

in case of mosquito net = ventilation rate x 0.5 wind speed: wind speed refers to the value at the height of the building in a site far enough away from the building without obstacles (e.g., airport).

## General measures for working environments

In this emergency context, awareness of the role of indoor air quality has grown, especially in working environments, in line with new health protection needs (PNP 2020-2025, United Nations Agenda 2030, Air Pollution Strategy-Country Profile Italy, Rapporti *IST/SAN* of GdS Indoor Pollution). It can be assumed that no other health prevention measure has received similar attention, since the need for a mandatory level of improvement has been an important opportunity to address, in recent years, with greater awareness, some crucial and highly topical issues, until now too often neglected.

At the operational level, with the updating and application of the “anti-contagion protocols”, organic strategies have been implemented, which consider the essential measures to contain and combat the spread of the pandemic, to meet the needs health protection for both the staff and the users/public, and for those figures involved in the various activities (cleaning companies, maintenance, suppliers), including the workers' vaccination program. These programs can be summarized as follows:

- adaptation of spaces and areas to standard configurations, increase of physical distances between activities and workstations, delimitation of specific routes (e.g., differentiated entrances and exits), quota of personnel (less people = less chance of spreading the virus), differentiation and staggering of working hours, avoiding where possible the return of workers with different susceptibility and disabilities or respiratory diseases, alteration of the immune system, spacing out, restricting the areas to avoid close contacts and gatherings, supporting the training of personnel on the main risks, procedures and technical measures for personal prevention and protection, periodic repetition of training/information, dissemination of signs describing health prevention and protection measures (especially with regard to physical spacing, constant use of the mask, air changes and frequent washing of hands with water and soap or the use of disinfectants when one does not have the ability to wash with water and soap), modification of the cleaning frequency of the filters of the systems and terminals, and of the sanitization interventions.

The following are some general advice, actions and recommendations to be implemented daily to continue to limit any form of spread of SARS-CoV-2 virus and its variants, which must be part of an integrated risk prevention and mitigation strategy (not individual stand-alone actions) to maintain good indoor air quality in work environments, in buildings:

- **Ensure good air exchange by natural or mechanical means** in all environments and areas where people are present and in workstations, with the general aim of continuously improving the supply of primary external air and facilitating the opening of windows and balconies. The general principle is to provide, as much as possible the movement of outdoor air inside the environments and work areas, and at the same time, dilute/reduce the concentrations of specific pollutants (e.g., VOCs, PM<sub>10</sub>, odors, bacteria, viruses, allergens, filamentous fungi [mold], etc.), CO<sub>2</sub>, relative humidity in the air, and, consequently, the risk of exposure for staff and users/public in the building. Scarce air changes favor, in indoor environments, the accumulation and exposure to pollutants that can facilitate the transmission of pathogens between workers and users.
- The air exchange must consider the characteristics of the building, its dimensions and the amplitude of environments, areas and rooms, the number and age of workers and users present, the type of activity carried out, the duration of permanence in environments and areas to prevent health effects.
- Natural ventilation of environments depends on several factors, such as external weather parameters (e.g., outdoor air temperature, wind direction and speed), and physical parameters such as the surface and position of windows and the duration of their opening. This parameter is **perceived**

**negatively** by those who, especially during the cold season, remain in indoor environments and influence air quality. Indeed, it is considered that **not opening the windows or balconies allows to avoid situations of thermal discomfort and reduces energy consumption. Otherwise, these behaviors do not favor indoor air health conditions.** It is certainly appropriate to avoid during the natural exchange of air the creation of discomfort (air currents or excessive cold/heat) for staff and users. Therefore, it is recommended, where possible, to improve the arrangement of workstations to ensure that staff and users are not directly exposed to draughts or excessive cold/heat. In the winter period, where the temperature difference between the inside and the outside is more marked, a few minutes of opening can be enough to provide the same amount of air; unlike the summer period that needs longer times.

- In buildings that do not have specific ventilation systems, it is more appropriate to slightly open windows and balconies that overlook less busy roads, during periods of reduced passage of vehicles, especially when the building is in a busy area. In general, it is recommended to avoid opening windows and balconies during peak traffic hours or leaving them open at night (this option may be valid during high summer temperature days or in periods of heat waves but making sure that it does not pose a risk to safety). It is preferable to open for a few minutes several times a day by performing intermittent and cross-ventilation (dilution effect) rather than only once for long periods.
- In properly designed buildings with specific HVAC ventilation systems that handle outdoor air through motors/fans and distribute it through ducts and grids/diffusers positioned on the ceiling, on the walls or on the floor, allowing air exchange in all occupied areas/environments of the building, these facilities, where thermal loads allow, can keep the air inlet and outlet active 24 hours a day, 7 days a week, also reducing ventilation rates at night and weekends when the building is not in use and/or when it is switched on (e.g., two hours before the opening or entry of the first workers, when the workers of the companies carrying out the cleaning activity are present and continue for another two hours after the closing/non-use of the building) (4, 6). **The advice is to maintain the same level of protection by eliminating, where possible, the air recirculation function** to avoid the possible transport of chemical and biological agents (e.g., bacteria, viruses, etc.) accumulated in the air, thus also favoring the reduction of contamination by SARS-Cov-2 virus and protecting workers, customers, users and visitors even at the expense of less thermal comfort. It is now known that many systems have been designed with a share of air recirculation (measure exclusively linked to the reduction of energy consumption of the system); in this context it is clearly necessary to **increase the primary air in a controlled manner under all conditions.** It is recommended, **where it is not possible to deactivate this share of recirculation**, because of the operating specifications related to the design, **to operate the system by adapting and correctly remodulating the amount of primary air needed for these purposes and reducing the amount of recirculation air.** Always considering the safety conditions, it is advisable to open windows and balconies several times a day during the working day to further increase/strengthen the level of air exchange (dilution effect resulting in what is called combined ventilation). The decision to do so is generally up to the head of the structure in agreement with the employer.
- In the package of standards UNI EN 16798, in UNI 10339 and in the “Microclimate, ventilation and lighting guidelines in the workplace. Standard requirements. Operational and design indications”, the minimum ventilation flows to be used for natural ventilation and mechanical ventilation systems are indicated.
- Please note that effective ventilation is a **necessary action to achieve and maintain good indoor air quality and that no HVAC ventilation system can eliminate all risks alone.** However, ventilation systems, if properly designed and sized according to the **characteristics of the building, to users who attend it, balancing well the flows, temperature, relative humidity, filtration,**



properly combining the need for air spare parts and energy efficiency, maintained in efficient operation, can help reduce the risks of exposure and contamination by the virus. In several European documents (e.g., *Promoting healthy and highly energy performing buildings in the European Union, Implications of a health-based ventilation in Europe Healthvent*) (8, 9) the difference in the performance of these systems between what is designed and what is subsequently measured is highlighted (e.g., stale air stagnations, high concentrations of VOCs, CO<sub>2</sub>, relative humidity, etc.).

- Acquire all information on the correct operation of the HVAC system (e.g., check of operating efficiency, loss of load, check of flow log, air recirculation quota, maintenance expiration times, type of filter pack installed, scheduled interventions, etc.). If you are close to the moment of replacement of the filter pack (e.g., if the differential pressure indicates a high increase in load losses, or if a few weeks after scheduled maintenance, etc.), in order to improve the filtration of incoming air and recirculation air, it is recommended, where possible and compatible with the functionality of the system, to replace with more efficient filter packs (e.g., UNI EN ISO 16890:2017: like ISO ePM<sub>10</sub>, ISO ePM<sub>2.5</sub> and ISO ePM<sub>1</sub>, the filters F7-F9 of the old classification UNI EN 779). Not all systems are compatible with the installation of high efficiency filters, because they can lead to a pressure drop that can decrease the flow of air and damage the system. Once the replacement has been carried out, make sure it is airtight in order to avoid possible leakage from the new filter pack installed.
- In buildings equipped with heating/cooling systems with local terminal equipment (e.g., internal units such as fan coil) whose operation and speed regulation can be centralized or controlled by individual workers occupying the environment, it is recommended, following the updates and reorganizations of the “anti-contagion” measures, **to keep the system running for all hours of presence of workers inside buildings**, operating a decrease in the level of ventilation during the night hours of non-use of the building or a remodulation of the on/off times, e.g. two hours before the opening or entry of workers, and continue for another two hours after the closing/non-use of the building), regardless of the number of workers present in room. It is recommended to check that in the vicinity of outlets and ventilation grids of the terminals, there are no curtains, objects and plants, which may interfere with the proper operation/ distribution of the air flows. To this end, it is advisable to schedule periodic cleaning (also depending on the risk that each employer wants to assume), which considers the health situation, based on the indications provided by the manufacturer with the system stopped, of the recirculating air filters, of the fan coil, to maintain adequate filtration/removal levels of the coarse/total suspended particulate material (PM). In general, cleaning filters, checking the heat exchange coil and condensation trays can help make buildings healthier and safer by reducing the transmission of diseases, including the SARS-CoV-2 virus.
- **Avoid using and spraying cleaning agents/spray disinfectants directly on the filter in order not to inhale pollutants (e.g., VOC) during the operation of the plants.** Pay particular attention to the use of spray in the case of personnel with respiratory problems, e.g., asthmatic subjects. Cleaning products/spray disinfectants must be approved in advance by Risk Prevention and Protection Service.
- Clean the ventilation inlets and grates with clean microfiber cloths moistened with water and common soaps, or with a solution of ethyl alcohol with a minimum percentage of 70% v/v drying subsequently.
- In case some individual rooms or working areas are equipped with small, fixed heating/cooling systems (e.g., split heat pump air conditioners or air-to-water air conditioners), or portable **air** conditioning systems are used, where it always **recirculates the same air** that is not replaced with “fresh air outside”, regularly open windows and balconies for a **few minutes several times a day** (intermittent ventilation).

Don't forget to:

- maintain suitable microclimatic conditions (e.g., the ideal temperature for physiological well-being in winter is between 20 and 22°C and in summer between 24 and 26°C with a relative humidity of the air between 35 and 45% in winter and between 50 and 60% in summer. References are contained in the “Guidelines Microclimate, ventilation and lighting in workplaces. Standard requirements. Operational and design guidelines”). In this interval, the respiratory system defenses function effectively and the viability of micro-organisms, as well as the virus, is reduced by chemical-physical reactions). On the other hand, pay attention to excessive relative humidity levels of more than 70% because in this situation the growth of microbial contaminants (mainly filamentous fungi [molds] and bacteria can be encouraged);
- carry out a regular cleaning of the air filter supplied to the system/air conditioner to maintain adequate filtration/removal levels (e.g., the filters are made of plastic material: PE polyethylene, PL polyester, polyamide or PA nylon, etc.). Some air conditioners already use high efficiency recirculation air filters called High Efficiency Particulate Air filter-HEPA or Ultra Low Penetration Air-ULPA (UNI EN 1822:2019). The cleaning must be carried out according to the instructions given by the manufacturer and with the system is turned off. It is recommended to schedule a frequency of cleaning of the filters that takes into account the actual operation of the air conditioner, climatic conditions, the activity carried out in the room and the number of subjects present. The “dust” captured by the filters represents an environment favorable to the proliferation of bacteria and fungi, and in any case of biological agents. Avoid cleaning in the presence of other persons.
- In the event that it is not possible to improve air changes and ventilation and you prefer to equip the rooms with portable air purification systems/devices (e.g., with High Efficiency Particulate Air filter-HEPA filters, for example), the choice of system/device (10-16) **must be made with great care, taking into account the wide variability of the services offered**: the type of technology and air filters used by the system, the power of the system as a function of the volume/size of the environment (Clean Air Delivery Rate- *CADR*\* expressed in m<sup>3</sup>/h represents the rate of filtered air emitted by the device), the layout of the environment, the type of activity carried out, the number of people, the performance data available on specific tests carried out in similar environments, certification, noise, the possible release of by-products of purification which may be persistent and dangerous (11-16). It is stressed that recirculation air does not replace air exchanges with “fresh outside air” in any way. If, downstream of the study, it is decided to equip them with portable air purification systems/devices, it is necessary to develop a protocol that contains the main advantages offered, the mode of operation, the correct positioning in the environment (e.g., direction of generated air flows) and use, durability, and maintenance activities.
- In the event that some work environments are equipped with ceiling or portable floor or table fans that involve significant air movement **but not the supply of “new fresh outdoor air”**, special attention should be paid to ensuring that the fans are directed as far as possible towards the open windows and balconies of the room in order to increase the flow of air from the inside to the outside; fans should not be directed directly to common areas (e.g., corridor) where there is passage of people. **In any case, remember not to direct the air flow generated directly on the person.** It is recommended to keep the room as airy as possible by opening windows and balconies. On days when the working environment is frequented by outside audiences it is recommended to turn off the fans.

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\*CADR= A measure of air cleaner performance, defined as the amount of contaminant-free air delivered by the device, expressed in m<sup>3</sup>/h.

- In classrooms characterized by structural, management and control heterogeneity, keep one or more windows and balconies and the door of the classroom **open slightly, intermittently** or continuously, as a measure aimed at maintaining a **constant and continuous the entry of “fresh air.”** This measure can achieve maximum efficiency if the windows, balconies and doors are on both sides of the classroom (cross ventilation). Bringing more outside “fresh air” into a classroom allows to dilute and reduce the concentrations of specific pollutants (e.g., VOCs, PM<sub>10</sub>, odors, bacteria, viruses, allergens, etc.), CO<sub>2</sub>, relative humidity and limit the risk of exposure and contamination to the virus for pupils and staff. On days with adverse weather conditions, it is possible to remodulate the frequency and opening periods of windows, balconies and doors (which must be more frequent and for longer periods to compensate) in order to ensure the essential entry of “fresh outdoor air” and limit the impact of external weather conditions. In relation to this type of environment, it is recalled that in the Report ISTISAN 20/3 Indoor air quality in school environments: strategies for monitoring chemical and biological pollutants (17) there was a need for greater attention to be paid to improving air and ventilation.
- Ensure that opening of windows and balconies does not pose a risk to the safety of persons.
- In the event that in the classrooms it is not possible to improve in any way the air exchange and the ventilation, it is necessary to carry out a study on the possible options to be adopted acquiring the characteristics of the technologies to be used (10-16), given the wide variability of the performance offered: the type of technology used by the system, the type of air filters used by the system, the power of the system-air flow rate as a function of the volume/size of the environment (*Clean Air Delivery Rate-CADR* expressed in m<sup>3</sup>/h used for portable air purification systems/devices), the classroom layout for correct placement, the number of students, the performance data available on specific tests carried out in similar environments, certifications, noise and the possible release of purification by-products that may be persistent and dangerous (11-16). It is stressed that recirculation air does not replace air exchanges with “fresh outside air” in any way. If, downstream of the study, it is decided to equip them with portable air purification/purification systems/devices, it is necessary to develop a protocol that contains the main advantages offered, the mode of operation, the correct positioning in the environment (e.g., direction of generated air flows) and use, durability, and maintenance activities.
- In classrooms equipped with specific ventilation systems HVAC, keep active the entry and extraction of air 24 hours a day, 7 days a week, reducing ventilation rates at night of non-use of classrooms and/ or ignition times (e.g., two hours before the opening or entry of the cleaning workers and continue for another two hours after the closing/non-use of the building) (4, 6). **The advice is to maintain the same level of protection by eliminating, where possible, the air recirculation function** to avoid the possible transport of chemical and biological agents (e.g., bacteria, viruses, etc.) accumulated in the air, favoring the reduction of contamination by SARS-CoV-2 and protecting teaching and non-teaching staff and students even at the expense of less thermal comfort. It is recommended, **where it is not possible to deactivate this recirculation** quota, due to the operating specifications related to the design, **to operate the system by correctly adapting and re-modulating the amount of primary air necessary for these purposes and reducing the amount of recirculating air.** Always considering the safety conditions, it is advisable to open the windows and balconies several times during the teaching day to further increase/strengthen the level of air exchange (to exploit the dilution effect by obtaining what is called combined ventilation). The decision to do so is generally up to the head of the structure in agreement with the employer.

When using ventilation systems in classrooms:

- Do not forget to maintain suitable microclimatic conditions (e.g., the ideal temperature for physiological well-being in winter is between 20 and 22°C and in summer between 24 and 26 °C with a relative humidity of the air between 35 and 45% in winter and between 50 and 60% in summer. References contained in the “Guidelines microclimate, ventilation and lighting in workplaces. Standard requirements. Operational and design guidelines”). In this interval, the respiratory system defenses function effectively and the viability of microorganisms, as well as that of the virus, is reduced thanks to chemical-physical reactions). On the other hand, pay attention to excessive relative humidity levels of more than 70% because in this situation the growth of microbial contaminants (mainly filamentous fungi [molds] and bacteria can be encouraged).
- Check whether the HVAC system complies with the minimum external air flow rate of 4-7 L/s/person in accordance with UNI 10339:1995 and the 2006 Guidelines. If the system allows it, it is suggested to increase the minimum external air flow rate of the system to 10 L/s/person as indicated by WHO Roadmap to improve and ensure good indoor ventilation in the context of COVID-19.
- Acquire all information on the correct operation of the HVAC system (e.g., operating efficiency check, load losses, check of the flow log, air recirculation rate, maintenance expiration times, type of filter pack installed, scheduled interventions, etc.). If you are close to the replacement time of the filter pack (e.g., if the differential pressure indicates a high increase in pressure drops, or if a few weeks after scheduled maintenance, etc.), in order to improve filtration of the incoming and recirculating air, it is recommended, compatibly with the functionality of the system, to replace with more efficient filter packs (e.g., UNI EN ISO 16890:2017: like ISO *coarse*, ISO ePM<sub>10</sub>, ISO ePM<sub>2.5</sub> and ISO ePM<sub>1</sub> the former class F7-F9 of the old classification UNI EN 779). Not all systems are able to use high efficiency filters, because they can lead to a pressure drop that can decrease the inlet air flow and damage the system. Once the replacement has been carried out, make sure it is airtight in order to avoid possible leakage from the new filter pack installed.
- Even in classrooms equipped with HVAC it is recommended to open several windows, balconies and doors more frequently.
- In ordinary hospitals and health facilities not dedicated to COVID-19 (e.g. suspected or confirmed), equipped with specific HVAC ventilation systems, make sure that the minimum external air flow rates are sufficient and that they comply at least with that provided for in the UNI 10339 (11 L/s/person) or the WHO one, paying attention to the direction of the air flow, also in relation to the pressures between nearby environments, to filtration, to improve the comfort and care of the patient and healthcare workers (6, 18, 19).

During the use of ventilation systems in general wards:

- Do not forget to maintain suitable microclimatic conditions (e.g., the ideal temperature for physiological well-being in winter is between 20 and 22°C and in summer between 22 and 26°C with a relative humidity of the air between 35 and 45% in winter and between 50 and 60% in summer. These references are contained in the “Guidelines Microclimate, ventilation and lighting in workplaces. Standard requirements. Operational and design guidelines”). On the other hand, pay attention to excessive relative humidity levels of more than 70% because in this situation the growth of microbial contaminants (mainly filamentous fungi [molds] and bacteria can be encouraged).
- Acquire all information on the correct operation of the HVAC system (e.g., check of the operating efficiency, load losses, check of the flow log, maintenance expiration times, type of filter pack installed, planned interventions, etc.). If it is close to the times of replacement of the filter pack (e.g., if the differential pressure indicates a high increase in pressure losses, or if a few weeks after

scheduled maintenance, etc.), in order to improve the filtration of incoming air, it is recommended, compatible with the functionality of the system, to replace with more efficient filter packs (e.g., UNI EN ISO 16890:2017 like class ISO *coarse*, ISO ePM<sub>10</sub>, ISO ePM<sub>2.5</sub> and ISO ePM<sub>1</sub> the former class F7-F9 of the old classification UNI EN 779). Not all systems are able to withstand the use of high efficiency filters, because they can lead to a pressure drop that can decrease the flow of air into and damage the system. Once the replacement has been carried out, make sure the air tightness in order to avoid possible leakage from the new filter pack installed.

- In ordinary single or shared patient stays in health facilities, not dedicated to the hospitalization of COVID-19 patients (suspected or confirmed), equipped with autonomous fixed heating/cooling systems (e.g., air-to-air conditioners, or split heat pumps, which are quite common, and consist of an indoor unit generally mounted on the wall and an outdoor unit containing the compressor-motor, condenser and fan, or air-to-water air conditioners with an indoor unit such as fan coil), that **do not use “new external air” but always recirculate the same air that is heated/cooled**, it is **important to open windows and balconies for a few minutes several times a day**, to dilute/reduce concentrations of specific pollutants accumulated in recirculated air (e.g., VOCs, PM<sub>10</sub>, odors, biological agents), CO<sub>2</sub>, relative humidity. It should be borne in mind that patients in health care establishments are a more vulnerable population, particularly sensitive to draughts, sudden changes in temperature or other uncontrollable conditions. It is advisable to schedule a periodic cleaning of the recirculation air filters (also depending on the risk one wants to take), which considers the health situation, according to the information provided by the manufacturer with the system turned off, to maintain adequate filtration/removal levels.
- In all other rooms of health facilities not dedicated to COVID-19, where there is public access (18, 19) it is recommended not to use portable floor or table fans that involve significant air circulation/movement, **and do not supply “new outdoor air”**. If it's not possible to do without fans (e.g., use in room/single room or single office), pay particular attention to ensuring that the system is directed towards open windows and balconies of the room/ environment in order to increase the flow of air from the inside to the outside, while avoiding directing it to common areas (e.g., the corridor) of passage or stay of persons. **In any case, remember not to direct the flow of air directly on people**. It is advisable to air the room opening one or more doors of the windows and any balconies.
- Ensure a good air exchange in environments/ spaces where there are vending machines for hot drinks, water and food. In these environments, periodic cleaning/sanitization (by professional cleaners) and daily cleaning/sanitization (by workers in charge of vending machines) must be guaranteed keyboards with special detergents compatible with the types of materials.
- In the case of rooms without windows (e.g., archives, changing rooms, toilets, etc.), but equipped with fans/extractors, these must be kept in operation for the entire working time and if possible, for the next two hours after occupancy to reduce concentrations in air. Fans should be put into operation early in the morning before workers' entry.
- Windows in public transport (e.g., buses, subways, taxis, etc.) must be **slightly open for continuous cross-air exchange**. Air conditioning in public transport and rental vehicles shall be maintained and, in order to increase the level of dilution/removal of air, the recirculation function must be eliminated in order to avoid the possible transport of biological contaminants in the air (bacteria, viruses, etc.). Maximum care must be taken to maintain the filters supplied to the vehicles (e.g., cabin or cabin filters). In this phase, if the weather conditions allow, it may also be useful to open the roof trapdoors to further increase the level of air exchange favoring the entry of external air. The front doors near the driver should be locked. Public transport must be cleaned and disinfected before leaving the terminal. Disinfect the interior, such as steering wheel, gear lever and seat belt when changing the driver of the vehicle. Clean and disinfect at least once a day the spaces and surfaces.

- Whenever entering or leaving the public transport, it is advisable to cleanse your hands with a hydroalcoholic gel.
- Professional workers/operators who carry out the daily cleaning of the rooms and/or places (dusting and sweeping wet or with dust-catching cloths, washing, disinfection, etc.) must follow correct procedures and protocols, starting cleaning from the cleanest areas to the dirtiest areas, wearing Personal Protection Devices (PPE) (e.g., referring to the provisions in the operational document drawn up for each environment, supplemented by the latest measures of the Government). **Avoid cleaning/disinfection in the presence of employees or other persons.**
- Daily cleaning of the rooms/areas must cover the surfaces most frequently touched (e.g., doors, handles, windows, glass, tables, light switches, toilets, taps, sinks, desks, chairs, trolley handles and shopping baskets, passenger handles, controls, steering wheel, seat belts, door handles, door release buttons, keypads, remote controls, printers). Use microfiber cloths, moistened with water and soap. The risk can be further reduced by using, immediately after cleaning with soap and water, an ethyl alcohol solution with a minimum percentage of 70% v/v or with a solution of sodium hypochlorite diluted in 0.1% water, active chlorine for toilets and other surfaces taking into account the type of material, paying attention to the correct use procedures for each surface to be cleaned (refer to the Guidelines for the implementation of containment measures of the contagion from SARS-Cov-2 through sanitation procedures of non-health structures (surfaces, indoor environments) and clothing, of the Ministry of Health n.0017644-22/05/2020-DGPRE-MDS-P).
- Ventilate environments both during and after use of cleaning products, especially if potentially toxic disinfectant/detergent products are used (check hazard symbols on labels), temporarily increasing ventilation rates of HVAC systems and opening windows and balconies. Avoid or limit the use of fragrant detergents, as, despite the fragrance, they add pollutants (e.g., VOCs) and degrade indoor air quality. **Choose products without perfumes, fragrances and allergens remembering that the clean has no odor.**



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**nuovo coronavirus**

### Consigli per gli ambienti chiusi

#### Ricambio dell'aria

- Garantire un buon ricambio d'aria in tutti gli ambienti: casa, uffici, strutture sanitarie, farmacie, parafarmacie, banche, poste, supermercati, mezzi di trasporto.
- Aprire regolarmente le finestre scegliendo quelle più distanti dalle strade trafficate.
- Non aprire le finestre durante le ore di punta del traffico e non lasciarle aperte la notte
- Ottimizzare l'apertura in funzione delle attività svolte.

#### Pulizia

- Prima di utilizzare i prodotti per la pulizia leggi attentamente le istruzioni e rispetta i dosaggi d'uso raccomandati sulle confezioni (vedi simboli di pericolo sulle etichette).
- Pulire i diversi ambienti, materiali e arredi utilizzando acqua e sapone e/o alcol etilico 75% e/o ipoclorito di sodio 0,5%. In tutti i casi le pulizie devono essere eseguite con guanti e/o dispositivi di protezione individuale.
- Non miscelare i prodotti di pulizia, in particolare quelli contenenti candeggina o ammoniaca con altri prodotti.
- Sia durante che dopo l'uso dei prodotti per la pulizia e la sanificazione, arieggiare gli ambienti.

#### Impianti di ventilazione

##### A casa

- Pulire regolarmente le prese e le griglie di ventilazione dell'aria dei condizionatori con un panno inumidito con acqua e sapone oppure con alcol etilico 75%.

##### Negli uffici e nei luoghi pubblici

- Gli impianti di ventilazione meccanica controllata (VMC) devono essere tenuti accesi e in buono stato di funzionamento. Tenere sotto controllo i parametri microclimatici (es. temperatura, umidità relativa, CO<sub>2</sub>).
- Negli impianti di ventilazione meccanica controllata (VMC) eliminare totalmente il ricircolo dell'aria.
- Pulire regolarmente i filtri e acquisire informazioni sul tipo di pacco filtrante installato sull'impianto di condizionamento ed eventualmente sostituirlo con un pacco filtrante più efficiente.

A cura del Gruppo ISS "Comunicazione Nuovo Coronavirus"  
Fonte ISS • 12 marzo 2020



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## COVID-19 LE AZIONI DI PREVENZIONE

Ricambio d'aria      Uso della mascherina

Distanziamento sociale      Igiene delle mani



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### Prevenzione e gestione ambienti indoor: le indicazioni dell'ISS



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## Rapporti ISS COVID-19 (ISS COVID-19 Reports)

ISS COVID-19 Reports are mainly addressed to healthcare professionals to cope with different aspects of the COVID pandemic. They provide essential and urgent directions for emergency management and are subject to updates. All reports have an English abstract.

The complete list is available at <https://www.iss.it/rapporti-COVID-19>.

Some reports (highlighted below) are also translated in English and are available at <https://www.iss.it/rapporti-iss-COVID-19-in-english>

### 2021

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