**Section No. 793**

# Rx Medical Prescription for a Healthy Building

**Carlos Gonzalez Boothby, ASCS, CIE, CMR**
**Technical Director**
**Indoor Environmental Consultants**
**San Juan, P.R.**

## Introduction

As a result of modern lifestyle, people spend 90% of their time in indoor environments and this is why, each day, sustaining acceptable indoor air quality (IAQ) becomes more important.

The indoor environment of any building is the result of the interaction of its localization, climate, HVAC systems (original design and modifications), contamination sources (building materials, furniture, equipments, activities, indoor activities and process and exterior sources) and building occupants. The Environmental Protection Agency has included IAQ among the top five environmental risks to public health.

We define Indoor Air Quality as the effect that contaminants that are generated or trapped in the building indoor environment have on the health and well-being (comfort) of its occupants. The term "indoor air" is usually applied to non-industrial indoor environments such as office buildings, public buildings (school, hospitals, theaters, restaurants, etc.) and individual homes. .

We must point out that recent studies attribute 15 % labor absenteeism to respiratory conditions. Natural composition of air is 21% oxygen, 78% nitrogen and other traces of gases as 0.96% argon and 0.04% carbon dioxide, helium and water.

Technically we define an acceptable IAQ an air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction. This definition is used by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) in their standard 62.1-2007. Or, in simpler terms, an air that people perceives as fresh, comfortable, with no irritants or stuffy effect and that when inhaled will not represent any health risk.

Let us remember that we breathe approximately 3,600 liters of air a day in about 23,000 inhalations and in this intake of air we introduce to our body 5 million particles per minute (7,200 millions of particles a day).

## Contaminants

Basically everything we find in an indoor environment can become a source of contaminants, releasing particulate (dust) or gases, or supporting microbial growth (mold or bacteria). Office equipment, such as photocopiers or laser printers, produces gases (ozone); curtains and furniture release fibers (particulate); inadequate cleaning, pest control and maintenance practices, result in an increase in airborne particles and gases; cosmetics, deodorants, and perfumes of the occupants, releases organic volatile compounds. Possibly the occupants are the mayor producers or contributors of contaminants, as human beings naturally produce carbon dioxide ($CO_2$) and water vapor (respiration and transpiration), particulate (skin flakes) and biological aerosols.

These contaminants can be classified in three main groups, which are: gases or vapors, particulate, and biological. Among the gases we can mention carbon monoxide, product of the combustion of vehicles (underground parking garages, loading zones, etc.), volatile organic compounds (VOCs) generated by glue (adhesives), inks, and plastic materials used in the manufacturing of furniture and other materials. How can we describe the smell of volatile organic compounds? When we are inside a new car, we say, “Hmmmm, it has a new car smell,” this smell is the gases that are emitted by the plastics, vinyl, and other synthetic materials used in the manufacturing of its interior. Lastly, we should mention tobacco smoke (cigarettes), it is important to enact laws and regulations that prohibit smoking in private and public buildings.

We must remember that all indoor air was, at some point, outdoor air, and therefore contains particulate (dust) generated by traffic, constructions (demolitions) and manufacturing processes. We must use caution with contaminated air released outdoors via exhaust systems (bathrooms, kitchens, printing areas, etc.) since it may be re-introduced via fresh air intakes or infiltrations. We add to this particulate generated on the interior, among these we may emphasize fiberglass, used as insulation material and acoustical ceilings.

Lastly, but not least important, biological contaminants [fungi (mold) and bacteria] growth favored by water leaks or spills, poor maintenance of the HVAC drain pans or cooling towers, and excessive accumulation of particulates on surfaces.

## Sick Building Syndrome

Indoor Air Quality subject is better known as “Sick Buildings” or Sick Building Syndrome. It was in 1982 that the World Health Organization describes this phenomenon which refers to a series of symptoms that affect the health of some of the occupants (usually 20% or more) that appear to be linked to time spent in a building which lessen or disappear during the periods in which they are out of the building.

Some of the typical symptoms are headaches, dizziness, nausea, irritation of the upper respiratory tract and eyes, congestion, dry cough (not related to smoking habits), fatigue, and difficulty concentrating. We must always keep in mind that there are other factors, not related to Indoor Air Quality, inside a building that may cause these symptoms, such as lighting (poor or too much light, lamp positions, etc.), noises, vibrations, labor / management relationships or interpersonal relationships.

Sick Building Syndrome is a problem that has worsened due to the construction of buildings designed to be airtight and which recycle air, with less introduction of fresh air from the exterior, as an energy efficiency approach.

## Building Related Illness

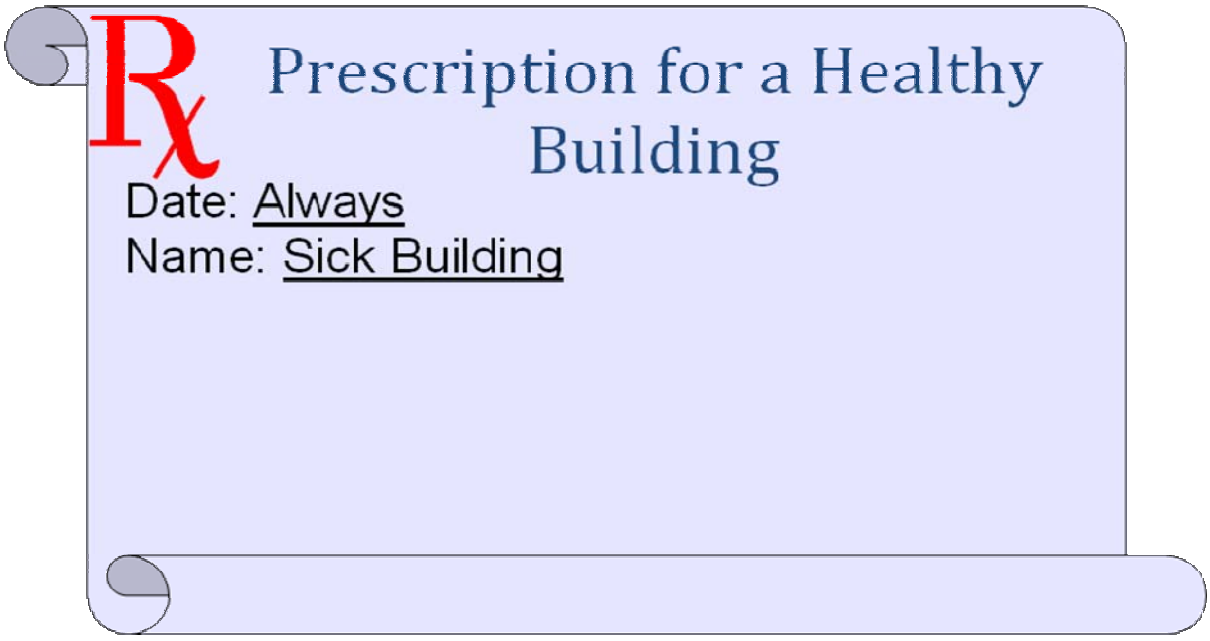
This term is used to describe a diagnosable illness whose symptoms can be identified and whose cause can be directly attributed to airborne building pollutants. Among the typical symptoms are cough, chest congestion, fever, muscular pain, and shivers. The typical illnesses are Legionnaire's disease, hypersensitivity pneumonitis, flu (influenza) /cold caused by viruses.

## Air Conditioning Systems (HVAC)

Air conditioning is a process which cools (or heats) (72° to 76° F**)**, cleans (filters), and circulates (ventilates) air, in addition, it controls the humidity content (30% to 60%). In ideal conditions it manages to do all this simultaneously.

Theoretically, the HVAC systems in buildings should be the first line of defense in capturing and diluting the contaminants that may affect Indoor Air Quality. The reality is that, throughout the years, this system doesn't receive adequate maintenance, or its original design is altered, and it becomes the vehicle for the dispersion of contaminants (dust, spores, bacteria, and gases) towards the occupied (inhabited) areas.

According to the National Institute of Occupational Safety and Health (NIOSH), 52% of indoor contamination problems are caused by or related to HVAC systems. Another study by Health Building International (HBI), which included 813 buildings and 750,000 occupants, reflected that 75.5% of IAQ problems came from faulty or poor maintenance of HVAC systems.




1. Be Proactive, not reactive

The proactive approach is that which identifies the conditions or factors that lead to Indoor Air Quality problems before they occur or are heightened. If we allow an IAQ problem to develop, then we have two problems in our hands: solving the problem and making the occupants perceive that the problem was solved.

A mechanism we may use in order to be proactive is conducting a Phase I IAQ Assessment in our facilities. The purpose of this investigation is identifying those factors that may negatively impact Indoor Air Quality, causing discomfort or affecting the health of the occupants. Producing a detailed report of this investigation and identifying some of the possible corrective actions to improve and maintain good Indoor Air Quality.

As part of this investigation, we proceed with a representative monitoring (8 hours for a general office space) that includes temperature (72° to 76° F), relative humidity (30% to 65%), and carbon dioxide (RAL= <800 ppm) and carbon monoxide concentrations (RAL= <9 ppm). (Note RAL = Reasonable Achievable Limit.) We include monitoring of the airborne respirable particulate, as well as an inspection of the HVAC system which includes: visual representative inspection of the air handling unit, including the cooling coil, drain pan, fan, internal insulation, and filtration system (efficiency, integrity, and replacement frequency). An appropriate filtering system plays a very important role in maintaining good IAQ. Adequate filter selection that adjusts to the necessities of the occupied space may increase the HVAC system performance without consuming more energy.

Also the investigation includes a representative inspection of the interior of the ductwork system (supply and return) of the HVAC system, this can be performed through the use of robotic videos cameras and/or boroscopes. We verify the fresh air intake, including its location, quantity, and quality.

For the HVAC inspections we should follow the recommendations and guidelines contained in NADCA's ACR 2006 standard, ACCA standard, "Restoring the Cleanliness of HVAC Systems," and AHRAE/ACCA's standard 180-2008, "Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems."

This Phase I IAQ Assessment also includes a visual inspection to locate possible microbial contamination (acoustical ceilings, gypsum board walls or other materials that show water damage or mold growth), water activity (content) on hydroscopic (attract water) materials is monitored. The inspection is completed by verifying other factors that may affect IAQ such as cleaning and pest control practices, location of office equipment (photocopiers, paper shredders, laser printers), storage practices (chemicals, etc.), and verification of the pressures within and outside the structure.

The data obtained from this investigation is transcribed in a written report that should be used to begin creating, if it is necessary, a correction strategy.

## 2. ℞ Maintain a Good Maintenance Program for HVAC Systems.

As a reference to establishing our maintenance program we may use ASHRAE/ACCA's standard 180-2008, which establishes the minimum HVAC inspection and maintenance requirements that preserve system's ability to achieve

acceptable thermal comfort, energy efficiency, and indoor air quality in commercial buildings. We must also follow the equipment's manufacturer's instructions (when they are available).

**3.** Rx Improve air filtration system efficiency**.**

We may use the National Air Filtration Association's (NAFA) publication, titled User's Guide for ANSI/ASHRAE standard 52.2-1999., please see Table 1: Application Guidelines, as a reference.

**TABLE 1: APPLICATION GUIDELINES**

| MERV Std 52.2 | Average ASHRAE Dust Spot Efficiency Std 52.1 | Average ASHRAE Arrestance Std 52.1 | Particle Size Ranges | Typical Applications | Typical Filter Type |
|---|---|---|---|---|---|
| 1-4 | <20% | 60 to 80% | > 10.0 µm | Residential / Minimum Light / Commercial Minimum / Equipment Protection | Permanent / Self Charging (passive) Washable / Metal, Foam / Synthetics Disposable Panels Fiberglass / Synthetics |
| 5-8 | <20 to 35% | 80 to 95% | 3.0-10.0 µm | Industrial Workplaces Commercial Better / Residential Paint Booth / Finishing | Pleated Filters Extended Surface Filters Media Panel Filters |
| 9-12 | 40 to 75% | >95 to 98% | 1.0-3.0 µm | Superior/Residential Better/Industrial Workplaces Better/Commercial Buildings | Non-Supported / Bag Rigid Box Rigid Cell / Cartridge |
| 13-16 | 80-95% + | >98 to 99% | 0.30-1.0 µm | Smoke Removal General Surgery Hospitals & Health Care Superior/ Commercial Buildings | Rigid Cell / Cartridge Rigid Box Non-Supported / Bag |
| 17-20[1] | 99.97[2] 99.99[2] 99.999[2] | N/A | ≤ 0.30 µm | Clean Rooms High Risk Surgery Hazardous Materials | HEPA ULPA |

Note: This table is intended to be a general guide to filter use and does not address specific applications or individual filter performance in a given application. Refer to manufacterer test results for additional information.
(1) Reserved for future classifications
(2) DOP efficiency

**4.** Do not use the HVAC room (AC or Mechanical room) as a storage area, janitorial or supply closet**.**

**5.** Rx Fresh air intake

Maintain sufficient intake of outside air to help dilute those contaminants generated or trapped in the interior of the structure. Table 6-1 from AHRAE's standard 62.1-2007 titled "Minimum Ventilation Rates in Breathing Zone," gives us the necessary amount of exterior air, expressed in cubic feet per minute (cfm) per occupant or per indoor space area.

We must be cautious as to where the exterior air intake is located, table 5-1 of ASHRAE's standard 62.1-2007, titled "Air Intake Minimum Separation Distance" Air Intake," indicates the minimum distance from the intake to any specific potential outdoor contaminant source, such has an exhaust system, dumpster, or truck loading area.

**6.** ℞ Program housekeeping activities for non-occupation hours and use cleaning products that are volatile organic compounds low emittants.

The cleaning practices such as sweeping and vacuuming will normally remove the bigger dirt particles, but tend to increase airborne concentrations of small dust particles in the air.

**7.** ℞ Program maintenance activities (renovations, painting, acoustical tiles replacement, etc.) for non-occupation hours; isolate the work area and place a portable machine as a "source capture."

We may use the guidelines established by SMACNA in its publication, "IAQ Guidelines for Occupied Buildings under Construction" (3rd edition)

**8.** ℞ Take immediate action to repair water leaks, dripping pipes, or any other water-related situation. Replace acoustical tiles with evidence of water damage or microbial contamination.

A useful publication one may use in case of water intrusion event is the standard IICRC S 500, "Standard and Reference Guide for the Professional Restoration of Water Damage. (3rd edition)"

**9.** Maintain relative humidity between 30 % to 60%

**10.** ℞ Use and store chemical products according to the manufacturer's instructions.

**11.** ℞ Any complaints related to Indoor Air Quality should be investigated and action should be taken to correct it.

When these complaints arise, we must take swift measures to prevent mayor consequences and psycho-social effects. The first thing is to determine the following, by conducting interviews or filling out questionnaires:

a. What are the specific complaints?
b. In which other part(s) of the building do people have similar concerns?
c. Under which circumstances does the problem occur?
d. When and where was it detected for the first time?
e. Is there a pattern (cycle) that the problem follows?
f. Who has been affected?
g. What symptoms are experienced?
h. Do the symptoms lessen or disappear after leaving the building?
i. Have you seen a doctor? What was the diagnosis?
j. Was there a recent change within or outside the building?
k. Did the in-house staff inspect the HVAC system? If they did, what conclusions did they reach?

Evaluate the information obtained, determine if the complaints follow a pattern and if they could be linked to an activity within or outside the building or HVAC system, if negative, begin a Phase I IAQ Assessment. It is importance that, whenever possible, document all findings and conditions trough photographic evidence.

**Remember: An unattended complaint does not go away they will worsen.**

**12.** ℞ The Surgeon General advice that the use of weekend specialists can be harmful to your health and your pocket ($$).

If an Indoor Air Quality problem were to arise, verify the credentials of the professional(s) you will hire. Remember that there should be a multi-disciplinary approach, where you may need an Indoor Environmentalist, Mechanical Engineer, Industrial Hygienist, Occupational Medicine Doctor, or any combination of these professionals. Among the certifications you should check that they are a member of ASSE and other recognized associations.