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Hospital Products Division

V.1

Many hospitals mistakenly assume that air systems designed and installed as per standards with HEPA filters and other air purification methods will produce sterile air. Purity and sterility of air may be very difficult to achieve.

Airborne transmission mechanism of infectious diseases depends on the concentration of breathable infectious pathogens (germs) in the indoor air.

Airborne transmission is the spread of infectious pathogens over large distances through the air or atmosphere.

Infectious pathogens, include fungi, bacteria, and viruses, which vary in size and can be dispersed into the air. Small drops of moisture carrying infectious pathogens are referred to as droplet nuclei.

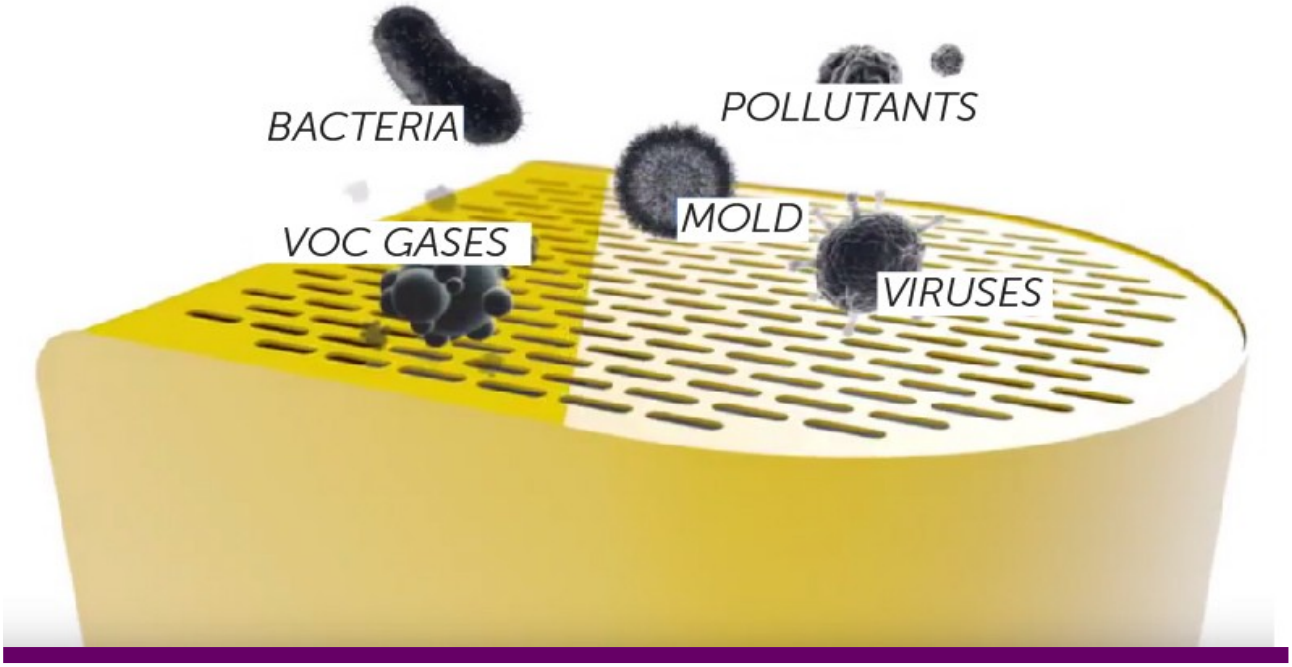
Droplet nuclei are about one to 5μm in diameter. This tiny size partly permits them to remain suspended in the air for many hours and be carried by air currents over sizeable distances.

Droplet nuclei are accountable for the transmission mechanism of infectious diseases like T.B., varicella, rubeola, and disseminated herpes shingles, whereas close contact is required for the transmission mechanism of infectious diseases transmitted by droplets, such as contagious disease (the flu) and respiratory illness.

But more importantly hospitals must have a detailed protocol and procedure for their indoor atmosphere / air disinfection.

All the current air purification or disinfection methods and approaches to infection control have not been very reliable and very effective.

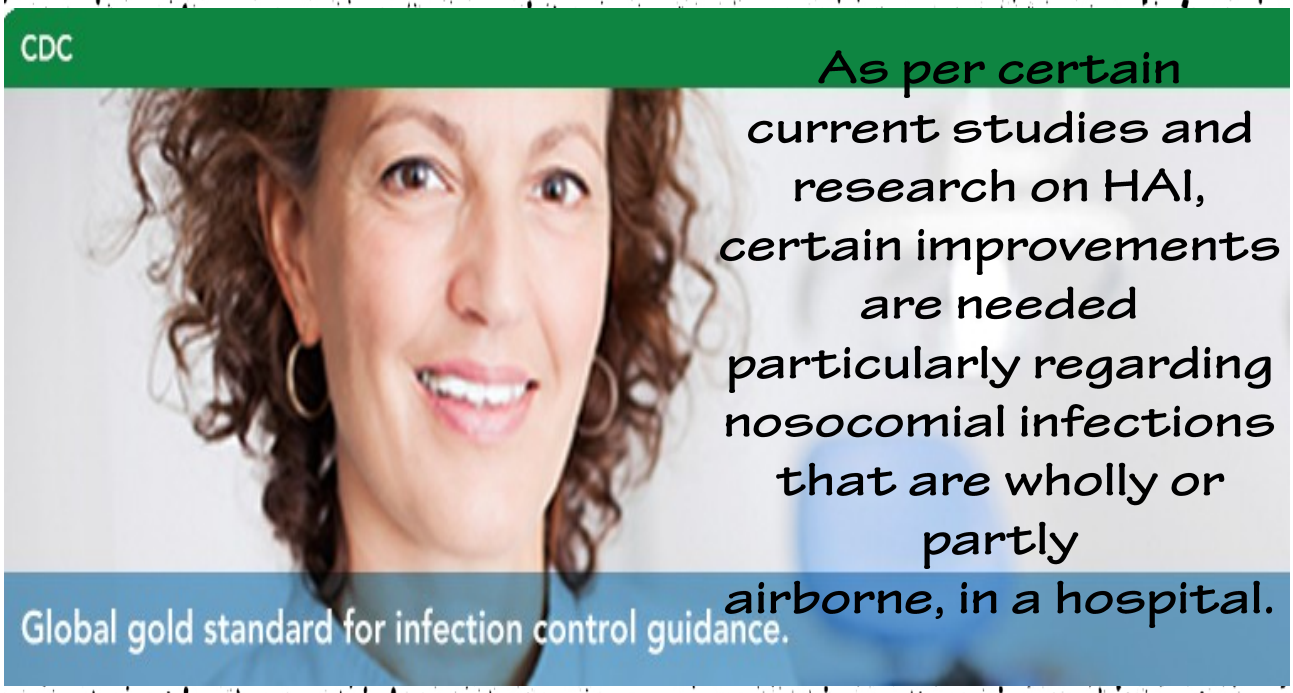
More awareness is needed urgently to define and improve the influence of every hospital's protocols and methods on airborne spread of infectious diseases.



The magnitude of this problem in a developing country like India is even more serious since there is no established statistics available.

This situation is still more pathetic when it comes to the government sector as maintenance and monitoring are questionable.

Even though, it is not possible to eradicate the nosocomial or hospital acquired infections entirely, many of them can be prevented by proper disinfection measures..



As per certain current studies and research on HAI, certain improvements are needed particularly regarding nosocomial infections that are wholly or partly airborne, in a hospital.

The purpose of this report, is to provide a snapshot of some of the current developments in the areas of airborne transmissions, focusing specifically on the hospital environment.

Although movement of indoor air may play a role in moving pathogens between spaces, they have a potential to act as secondary sources when they sediment onto inanimate or animate surfaces.

The hospital environment is usually, and specifically a place where there are a mixture of sick, infected and immune-compromised individuals sharing the same area, and where there is some element of crowding, there is a risk about the spread of infection.

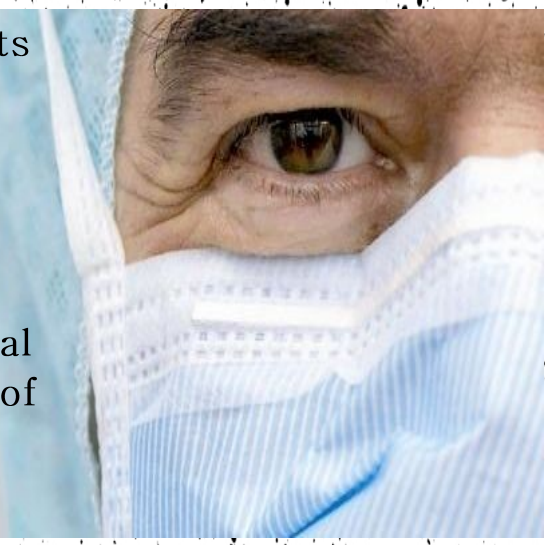
While in such situations, transmission by air occurs between all personal, this is currently the focus of many research groups internationally.

The survivability of pathogens in the air depends on many factors, including residence time in the air, the level of moisture (which in part depends on temperature), atmospheric pollutants and UV light from the sun.

Both temperature and humidity affect the lipid envelope and protein coat, affecting the period of survival. Temperature and humidity will work together to either destroy the organisms or stabilize them.

The survival of any infectious agent (viruses, bacteria or fungi) depends partially on ambient environmental factors such as temperature and humidity (relative or absolute), as well as UV light and other atmospheric pollutants, as summarized by Tang (2009).

The transport of such airborne droplets can be driven by various other environmental factors, such as local ventilation airflows (reviewed by Nielsen 2009 and simulated by Eames et al. 2009), as well as the movement of people and their clothing and thermal gradients produced by various pieces of electrical equipment (as discussed by Clark & de Calcina-Goff 2009).



Another issue of interest is the pattern of receptors required for some infectious agents to initiate successful infection and, eventually the disease.

Whilst bacteria and fungi can exist independently of host cells, viruses require specific receptors to which they can bind before entering and replicating within particular host cells.

This has been offered as one of the explanations for why certain individuals may have been infected with avian influenza A(H5N1) and perhaps why others have not.

Levels of airborne microbes are not routinely checked in hospitals; however, a variety of studies have indicated that the indoor air in Hospital areas are rarely, pathogen free.

It was studied and tested in one hospital, that heavy infectious contamination was found in the lunchroom and the rest rooms of the hospital, from which doctors and nurses apparently were carrying infectious organisms on the soles of their shoes into and around the other areas of the hospital, including the O.T and ICU.

In clear view, is the fact that all measures to contain the threatening invasion of infections in hospitals is due to the fact that there are no proper disinfecting techniques and products available in the market today.

Most of the disinfectants that are marketed and sold, with an ocean of scientific studies and papers and articles, to back up their claims on potency on microbes, still leave a large gulf of space between what is required and what is available.

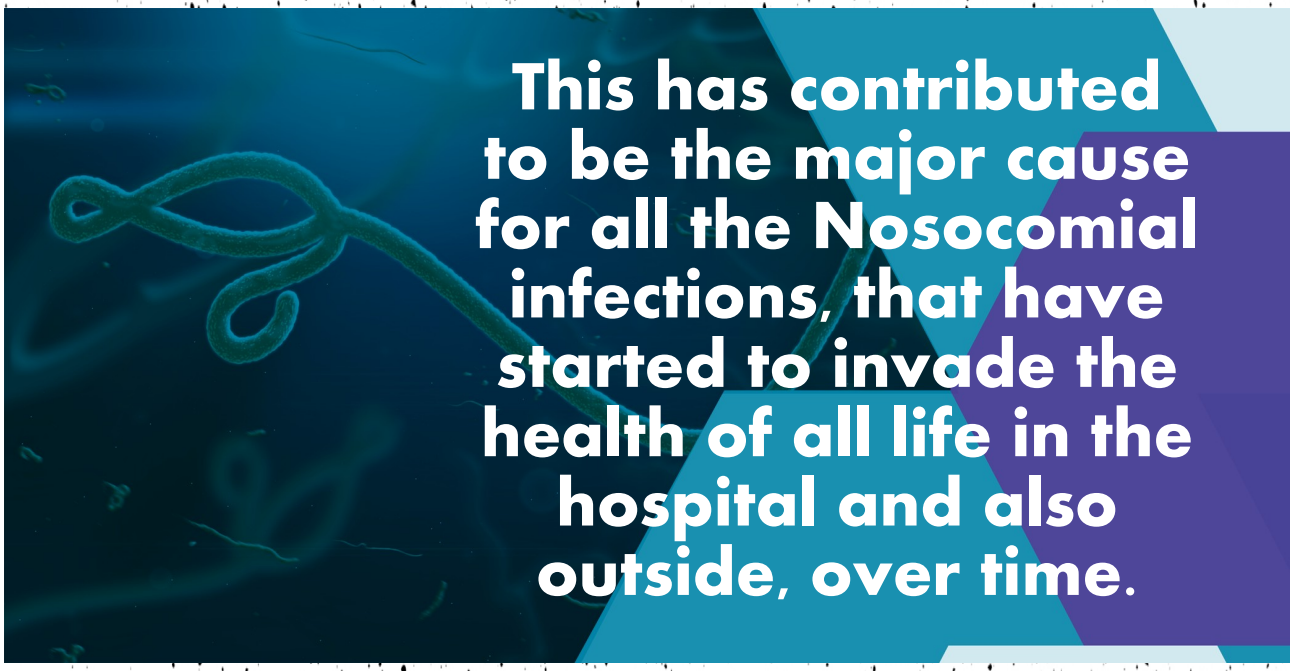
Although the current methods of practice for controlling nosocomial infections, have shown some good, there certainly is a lot of room for improvement, as there has been no permanent solution to the never ending problem of Airborne pathogens, this is the case all over the world.

Almost all disinfectants available today in the market globally are made with chemical ingredients, that are not safe, which are hazardous, toxic, carcinogenic, mutating, etc.

Adding to these, they need all kinds of personal protective gear during use, have a very strict dilution methods and techniques, and most of them cannot be used, when the patient is admitted, or undergoing treatment.

Or in the presence of any life.

It is also a known fact, and based on various studies by many, most hospitals do not fumigate most areas of their facility at all.
And those who do so, only fumigate the O.Ts, at an interval of a week, or fortnight, etc.



Of course, hospitals cannot be blamed for not being able to fumigate their facility, as the very critical, critical, or semi critical and including the non critical areas, in most hospitals are never empty or free of personal including patients, to conduct a fumigation with chemical disinfectants.

By and large all the hospitals are on the lookout for an apt or the best alternative solution to this pressing need.
Almost all available solutions have been used and tried, and they have only been able to provide some relief, temporarily, but in most hospitals, controlling and preventing infectious pathogens has been a challenge, till now.

The real fact is that all chemical disinfecting products that are currently available are either not safe for use or they do not act effectively against many pathogens, which has caused an increase in anti microbial resistance.

IT IS ALSO VERY IMPORTANT TO NOTE THAT, WHEN CHEMICAL ANTIMICROBIAL SOLUTIONS OR DISINFECTANTS ARE USED, RESEARCHERS HAVE FOUND THAT THEY ACTUALLY MAKE CERTAIN MICROORGANISMS STRONGER AND RESISTANT TO ANTIBIOTIC TREATMENT. THIS IS TRUE IN ALL HOSPITAL SETTINGS.

Health and Safety for Healthcare

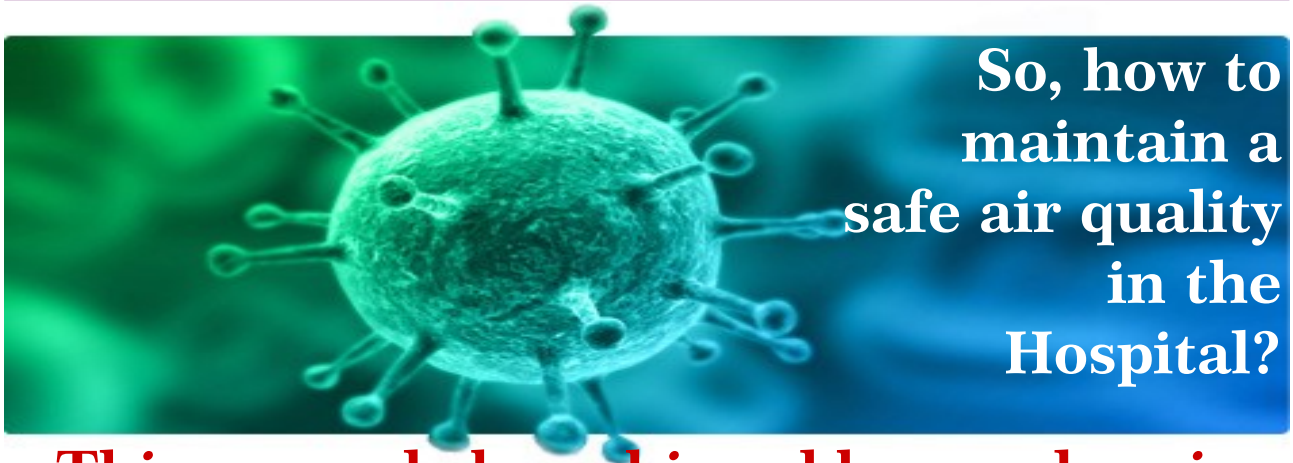
All hospitals are engaged in all essential and intensive efforts to prevent and control healthcare associated infections (HAIs).

HAIs are of particular concern to infection prevention professionals because many of these are caused by rapidly developing strains of multidrug-resistant organisms (MDROs).

These MDROs can cause serious illness in both patients and health care professionals and workers.

While demand for more effective cleaning and disinfecting is growing, there is also increasing evidence that exposure to chemical disinfectants can result in acute and chronic health effects, particularly respiratory illness.

In response, more and more hospitals are seeking less toxic, natural & organic disinfecting products.



So, how to maintain a safe air quality in the Hospital?

This can only be achieved by regular air quality assessment, monitoring and control.

For which, a regular microbial profiling of indoor air quality in hospitals, must be done to know and indentify the presence of aerobic infectious micro-organisms.

There are no established guidelines available regarding the permissible limits for exposure to infectious pathogens (also called bio-aerosols) in the hospital's indoor air, or in assessing their impact on health or their toxic effects on the personal present, due to the complexity of their composition, variations in human response to exposure, and due to the difficulties in recovering micro organisms that can pose a hazard in hospitals.

The microbial quality of the indoor air in any healthcare setting needs to be assessed, monitored regularly and controlled, especially in the context of healthcare settings being a source of nosocomial infections or HAI's, that can be unknowingly transmitted to patients, and increase the susceptibility of contracting among the healthcare professionals, workers and visitors, because the indoor air laden with microorganisms can be a source of infection via inhalation and also a source for colonization.

Several studies show that the bacterial counts are very high in ICUs, patient rooms and wards, neonatal and dialysis wards, and many other areas in the hospital, which are normally much higher than the recommended safer limits.

ALSO, STUDIES HAVE SHOWN THAT THE MERE PRESENCE OF FUNGI IN HOSPITAL AIR IS OF SIMILAR CONCERN, BECAUSE MANY SPORES CAN BE RELEASED LEADING TO AN INCIDENCE OF NOSOCOMIAL INFECTIONS OR HAI'S AND OTHER OCCUPATIONAL INFECTIONS AMONG THE HEALTHCARE PROVIDERS.

SO IT IS VERY IMPORTANT AND NEEDS THE ATTENTION OF ALL HOSPITAL AUTHORITIES TO TAKE NECESSARY PREVENTIVE MEASURES TO CONTROL AND PREVENT SUCH MICRO ORGANISMS IN THE INDOORS OF THE HOSPITAL, TO MAINTAIN A VERY HEALTHY INDOOR ATMOSPHERE FOR THE PATIENTS, AS WELL AS THE HOSPITAL PERSONAL.

Hence it is recommended that air sampling of indoor air is to be done by using Petri plate gravitational settling (passive) method, to assess the extent of contamination in various areas of the hospital.

Spreading knowledge.
Preventing infection.®

This passive method is found to be the most ideal and suitable for sampling the indoor air, since the relative concentrations of micro organisms in the hospital settings, vary for each area.
This method is based on the adhesive property of the media used, that traps the airborne particles onto the surface when plates containing media are exposed face upwards to the atmosphere to collect particles settling by gravity.

- Samples of airborne particles are collected by exposing the Petri-plates containing media in different areas of the hospital for 20 minutes.

- **Petri-plates are placed at a height of 2 to 3 feet above ground level during sampling.**
- **Media used could include 5% Sheep blood agar (SBA), MacConkey agar (MCA), and Sabouraud Dextrose agar (SDA).**
  - **Of these SBA and MCA are used for bacterial sampling.**
  - **SDA is used for fungal sampling.**
  - **Duplicates of these plates can be done for obtaining an average count on the pathogens.**
- **After the sampling, the plates are subsequently taken to the lab for incubation and further processing and studies.**
- **The bacterial sample plates are incubated aerobically at 37 deg. C for 24 to 48 hrs.**
- **The fungal sample plates are incubated at room temperature, i.e., 25 to 27 deg. C, for up to 7 days.**
- **After the incubation period, the levels or count of airborne bacteria and fungi are calculated as colony forming units (CFU) and expressed in terms of CFU per plate, based on a viable colony count.**
- **Thus, the extent of contamination in each area of the hospital can be determined.**

- **The growth on the plates can also be subsequently processed for the identification of various predominant Gram-positive and Gram-negative bacteria, and yeasts and molds, as per established micro biological procedures.**

Optional: As per the technical lab facilities available, differentiation and characterization of each type of bacterial and fungal colony can also be determined.

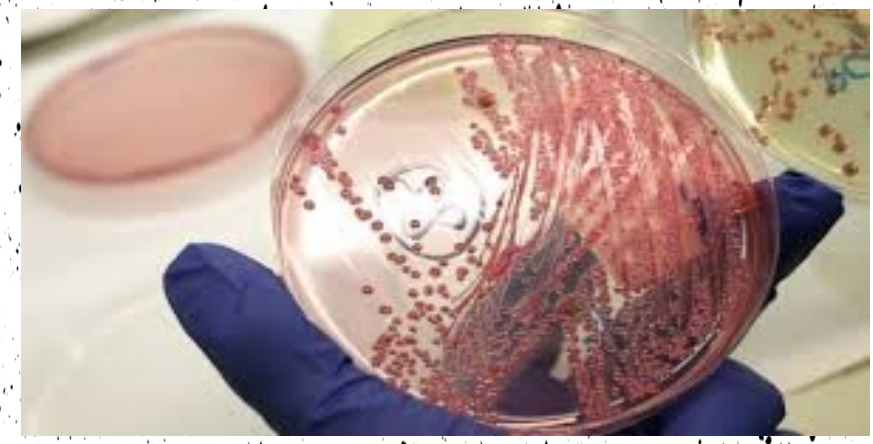
Bacterial identification and characterization:

- Growing colonies from SBA plates with different morphological characteristics can be transferred to another SBA plate and incubated for 24 hrs at 37 deg. C.
- These plates can then be examined for colony morphology of the bacteria, hemolysis in the SBA medium and lactose fermentation on MCA and smears made from the colonies then Gram stained.
- Gram positive bacteria can be identified by hemolysis and catalase and coagulase tests.
- Gram negative bacteria can be identified by lactose fermentation and a series of suitable biochemical tests like peptone water for indole production, MR-VP broth for the nature of fermentation, simmon citrate agar slants for citrate utilization, triple sugar iron agar for sugar fermentation and H_2S production, Christensen's urea agar for urease production, mannitol motilility test for motility and mannitol fermentation, and phospho phenylalanine agar for all nonlactose fermenters.
- Nonfermenters can further be identified using catalase and oxidase tests, based on their ability to grow on MCA at 42deg. C.

Fungal identification and characterization:

- Each fungal culture can be inoculated onto SDA slopes with or without actidione (cyclo-heximide) for identification and incubated at room temperature, i.e., 25 to 27 deg. C, for a period of 7 days in the dark, as per standard microbiological procedures.
- Fungal species can be indentified up to species level based on micro and macro morphology, rate of growth and pigment production, reverse and surface coloration of colonies on SDA media and by slide culture techniques.
- The determination of the morphological structures of fungi can be carried out on fungal material mounted in lactophenol cotton blue.

Quality air inside any hospital is fundamental to people's health and well-being.



The air we breathe can be degraded by a wide variety of contaminants, natural, synthetic, biological and inorganic.

The major sources of contaminants in any hospital are its occupants, furnishings and equipments etc.

Occupants generate odors, skin flakes, bacteria and other bio- effluents.

ROADMAP FOR

SUSTAINABLE HEALTHCARE

Improvement in indoor air quality in any hospital is a continuous process. It needs meticulous coordination and cooperation between the various departments of the health care unit.

Researchers throughout the world are working hard to come up with improved methods and protocols for the indoor air quality in hospitals. Indoor air quality requirements in hospitals are a complicated and delicate matter.

The objective is to provide a safe environment for the patient while protecting the health and well-being of the health care professionals and staff too.

Healthy indoor air quality is paramount in medical care facilities including hospitals, healthcare, nursing homes, assisted living and hospice care.

The complex hospital environment requires a very special attention to ensure healthful indoor air quality to protect patients and healthcare workers against hospital-acquired (nosocomial) infections and occupational diseases.

The chemicals used in hospitals for cleaning can introduce objectionable odors into the indoor environment. If the cleaned surfaces do not dry properly, they can provide an opportunity for mold growth.

Most healthcare facilities may not be aware that the air conditioning system is the single largest environmental reservoir of microorganisms implicated in HAI's (Hospital Acquired Infections).

Some medical procedures and patient conditions increase risk of exposure to airborne microorganisms.

Air quality management is vital in reducing these risks.

The nature of some airborne particles are inert and harmless. Others can trigger allergies, and some microorganisms, such as airborne viruses and bacteria and even common fungus spores, can cause infection.

When it comes to air quality issues, hospital facility managers face a significant challenge. Hospitals house patients highly vulnerable to airborne infection, as well as those whose coughs and sneezes can spew out dangerous microorganisms.

A large and busy staff is constantly on the move within an extremely complex physical infrastructure.

All of these factors place a high priority on air quality management.

Indoor Air Quality is a critical parameter in patient out-comes for hospitals and medical centers.

An exemplary level of IAQ for health facilities is an achievable goal – it just takes quality planning and implementation of a very rigorous attention to detail in the disinfection of the facility.