



HEALTHCARE IN INDIA

Health, Safety & Savings

Air Quality Management in Indian Healthcare

May 2019

Institutional Partner



Magneto
Clean Tech



In association with



IGBC



IGBC Introduction

The Indian Healthcare sector is growing at a rapid pace with wider coverage, more robust services and increasing expenditure, by the public as well as private players. The healthcare sector will see radical growth in the next 10 years. According to IBEF, the healthcare sector in India is expected to reach US \$ 372 billion by 2022. With the growing healthcare sector, there is an immense need for introducing green concepts & techniques in the healthcare sector for sustainable development.

CII established the Indian Green Building Council (IGBC) in 2001 to facilitate Green building movement. Since then, Green building movement has gained tremendous momentum & today, India has the second largest registered green buildings in the world.

Benefits to Green Building - Hospitals

Green buildings help to reduce energy spends significantly by 30%-40% and water savings by 20%-30%. Some of the intangible benefits of green buildings include improved indoor air quality, improved health & hygiene, enhanced daylight, improved productivity, better infection control, faster recovery of patients & reduction in patient stay.

The IGBC Green Healthcare Rating System

The IGBC has introduced Green Healthcare Rating System to address the national priorities. This rating system helps the designer to apply green concepts & techniques and reduce environmental impacts.

IGBC rating system addresses the following aspects:

- Indoor Environmental Quality
- Sanitation & Hygiene
- Water Conservation
- Energy Efficiency
- Building Materials and Resources
- Site Selection & Planning

IGBC Green Healthcare Rating system Certification Levels

There are different levels in green building certification & they are awarded based on the total credits earned. However, every green newbuilding should meet certain mandatory requirements, which are non-negotiable.

The threshold criteria for certification/pre-certification levels are as under:

| Certification Level | Credits (New Healthcare Facilities) | Credits (Exiting Healthcare Facilities) | Recognition |
|---------------------|-------------------------------------|---|-------------------------|
| Certified | 50 - 59 | 45 - 53 | Best Practices |
| Silver | 60 - 69 | 54 - 62 | Outstanding Performance |
| Gold | 70 - 79 | 63 - 71 | National Excellence |
| Platinum | 80 - 100 | 72 - 90 | Global Leadership |

Vision

IGBC is actively involved in promoting Green building Movement in the country & the aim of IGBC is to facilitate 10 billion sq.ft of green building footprint by 2022. The Green building Movement by IGBC will enhance the quality of life & will have a radical effect on the health and well being of the occupants.





Indian Green Building Council
C/o. Confederation of Indian Industry
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29 April 2019

Message from Chairman, Indian Green Building Council

IGBC is in its 20th year of formation and going strong with a footprint of 6.75 billion sq.ft. What started as a green building movement for commercial buildings is now pervading into all forms of built environment and most importantly, the health care sector. Never in the history of mankind have we accorded such importance for air quality, infection control and healing architecture, as we are doing now. IGBC with the support of experts and stakeholders is committed to advance the subject to the country, so that the common man gets benefitted, for generations to come.

"Further the IGBC Green Health Care Rating takes into account holistic approach to sustainable development with passive & active design and construction inputs for integrated energy management for energy efficiency, integrated water and waste water management for water savings and reuse, integrated waste management for scientific treatment of all wastes including bio medical wastes leading to healthy and hygienic environment, carbon footprint reduction and expanding green cover. Overall quality of life is enhanced for patients, healthcare workers and out patients and visitors. It is observed that Green healthcare centres contribute to speedier recovery environment"

I congratulate PGIMER Chandigarh in joining hand as Institutional Partner for this event and also as role model by demonstrating these advanced technologies in their newly built 334 bedded hospital in their campus along with various stakeholders.

I congratulate **Prof (Dr) Chandrashekhar** for his leadership in driving the green building movement in healthcare sector.

I wish the team all success on this "Awareness programme on Green Hospitals" being held in PGIMER Chandigarh on 1st May 2019.

V Suresh
Chairman
Indian Green Building Council

Visionaries



To enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025.



PGI, Chandigarh has always been a top notch name in terms of the academics and the quality of the treatment. PGI has shown it's thought-leadership by investing in such project and making sure to provide a clean, green and safe solution to people and assets. The team of PGI has always been at the forefront in terms of making efforts, showing vision and taking their projects to the next level.



Indoor Environment Quality (IEQ) and Healing Architecture are the focus world over, for prevention of Hospital Acquired Infection (HAI) and reducing average length of stay of patients. By maintaining clean IAQ (Indoor Air Quality) and connecting patients with Nature in the form of daylight and landscapes would give a new dimension to healing. The adoption of sustainable design has been encouraging, but it's now time to accelerate, as our collective commitment to the planet. IGBC is committed to be a part of this drive with the support of all stakeholders.

*-Dr.Chandrashekhar R.
Chairman, IGBC, Green Healthcare Rating*



As a Mechanical Ventilation & Air Conditioning Electrical Engineering Building Services Consultants we also look to not only to provide an advanced technology to our clients but a safer & healthier solution too. The work we have done at PGI, Chandigarh has set a benchmark in healthcare sector in terms of safe, green and clean solution. We, as a company, had advocated for such solution because we believe apart from the commercial aspect it saves and adds on a value to people's life and this syncs with our mission and vision.

*-Pramod Dhir
Director, Dew Point Consultants Pvt. Ltd.*



Building a great nation requires sustainable infrastructure. Healthcare is the core of any country, and at Magneto, we believe that world-class technologies, designed, optimized for our indigenous environmental conditions at economical costs are the key to make that possible. Every product we build meets a very high engineering standard and is affordable. Our vision is to provide "Clean Air for masses" it is the only way to move the country forward.

*-Himanshu Agarwal
CEO & Founder, Magneto CleanTech*

Synergising the vision

PGI, Chandigarh has always been a top notch name in terms of the academics and the quality of the treatment. PGI has shown its thought leadership by investing in such a project and making sure to provide a clean, green and safe solution to people and assets. The team of PGI has always been at the forefront in terms of showing vision and taking their projects to the next level.

This green, clean and safe project was a combined effort of academia, consultants, solution providers and green bodies. This collaboration enabled occupants to have a healthy environment that also protects all surrounding assets. Air Pollution is a challenging problem, and it is only through the combined efforts of every individual that it can be solved. The work at PGI, Chandigarh has been truly pioneering, where teams of diverse background worked together to set a benchmark for other health-care units to have such solutions in their properties to protect people and assets. This project did not only provide the commercial benefits to the hospital but also had a huge social impact, paving the path for others to follow. The entire globe is heading towards the clean air direction providing awareness and solutions to more and more hospitals & buildings, and this initiative has displayed India's leadership to innovate and tackle an extremely complex socio-economic problem.



Summary

This study describes the various aspects of indoor air quality management in the healthcare sector. It examines the unique air quality related challenges in medical centers and discusses effective strategies to combat the problem, while referencing the pioneering work of the Indian Green Building Council, Magneto Cleantech, and DewPoint Consultants at PGI Chandigarh. Since there is a lot more to air pollution control beyond protecting occupants from dust, especially in a healthcare setting, this book covers a diverse set of topics, ranging from complex Hospital Acquired Infections to innovative, upcoming IAQ solutions, discussing the vision needed from the engineering stakeholders to protect people from this invisible killer. Finally, the book also mentions the visionaries in this new field who are striving to address the dangers of poor air quality in healthcare through increasing awareness and forward looking action.



Introduction

Surprisingly, the state of air quality in India is visible through the naked eye. The Indian air pollution is highly dangerous for the human body and the surroundings. Air Quality has become a major concern for Indians and international visitors to India. Unfortunately, though, a large proportion of people are still unaware or uneducated about air pollution. Despite the several harmful effects of air pollution on people, there are popular misconceptions, and the facts about air pollution are unknown to the layman.

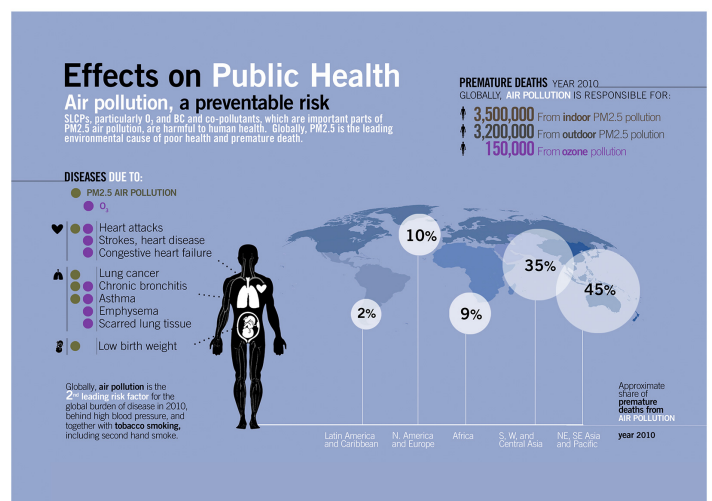
Recently, people have started talking more about the dropping level of air quality in the Indian cities and the preventive measures needed because the situation has become critical. The 91% of the world's population breathes air the World Health Organisation (WHO) deems unsafe, every time one takes a breath, microscopic particles are being drawn into their lungs. They get into the bloodstream, causing cancers, strokes and heart disease, stunting children's growth and development, and even reducing intelligence. The situation in India is much worse. A new study by Greenpeace has identified cities across the world with the highest levels of air pollution. The list is dominated by India, with seven of the worst 10 cities, and 22 of the worst 30. While the conversations about air pollution are being held on several platforms by government bodies and some organizations, the problem requires a long-term discussion and action. Air pollution needs to be tackled not only when it is clearly visible, but also when it is invisible and just as lethal.

Indoor Air Quality

India's future economic growth will largely depend on harnessing the power of its massive workforce, which will require improving the health of employees and occupants for better productivity. Uncomfortable indoor conditions arise from poor indoor air quality. Stuffy air, for example, has been known to cause people to feel unwell or sluggish. Indoor air quality generally seems better than the quality of the air outside, where visible clouds of dark smoke are seen leaving cars, factories, and homes. The opposite can be the case when considering the concentration levels of pollutants in an enclosed space.

The Environmental Protection Agency (EPA) reports that air quality inside could be 2-5x worse than outside, based on its studies assessing indoor concentrations of airborne chemicals. Understanding and controlling common pollutants indoors can help reduce the risk of indoor health concerns.

Also, reports suggest that each year more than 7 million people across the globe die because of exposure to indoor and outdoor air pollution. Of those 7 million premature deaths, 4.3 million are caused by exposure to indoor air pollution.



Pollutant sources

1. Particulate Matter

Particulate matter or PM (also called particle pollution) is the collection of all solid and liquid particles suspended in air many of which are hazardous. This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets.

Particle pollution includes

PM 10: Inhalable particles, with diameters that are generally 10 micrometers and smaller; and

PM 2.5: Fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

Particulate matters have a negative effect on the people constrained in the indoor space. These are particles that are so small that they can be inhaled and cause serious health problems. Some particles less than 10 micrometers in diameter can get deep into the lungs and some may even get into the bloodstream. Of these, particles less than 2.5 micrometers in diameter, also known as fine particles or PM 2.5, pose the greatest risk to health.

2. Airborne Microorganisms (Bio Aerosols)

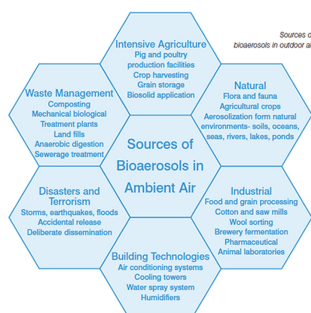
Airborne particles are a major cause of respiratory ailments of humans, causing allergies, asthma, and pathogenic infections of the respiratory tract. Airborne fungal spores are also important agents of plant disease, and the means for dissemination of many common saprotrophic fungi. For example, during a sneeze, millions of tiny droplets of water and mucus are expelled at about 200 miles per hour (100 metres per second). The droplets initially are about 10-100 micrometres diameter, but they dry rapidly to droplet nuclei of 1-4 micrometres, containing virus particles or bacteria. This is a major means of transmission of several diseases in humans such as Tuberculosis, Chickenpox, Smallpox, etc.

The importance of air in the transmission of infection has always interested microbiologists, as the terms "miasma" and "malaria" indicate. Many viral, bacterial and fungal infections are spread by the airborne route and infection control procedures acknowledge this, as in the isolation of a patient with open (smear positive) tuberculosis in a single room. However, it is difficult to quantify the risk from airborne pathogens in specific infections and there are no widely accepted standards for the quality of air inhaled by hospitalised patients, although there is agreement about the need to reduce the number of bacteria in operating theatres to prevent post-operative infection. Interest in the environment, and its relationship with the source and transmission of infection, has increased due to the greater number of vulnerable patients in hospitals where they are exposed to food, water and air, all of which may be contaminated with potential pathogens.

Bioaerosols are the tiny airborne particles present in the indoor air. They could be live or dead fungi and bacteria, their secondary metabolites, viruses, pollens, molds, plant fibres, etc. Their size varies from between 1 µm to 100 µm in aerodynamic diameter. The viable bioaerosol particles can be suspended in air as single cells or aggregates of microorganisms as small as 1–10 µm in size. Their concentration in indoor environments depends upon various environmental factors, such as temperature, humidity, seasonal variations, geographic location, characteristics of ventilation system and also on the type of building materials used. Identification and quantification of different airborne microorganisms in various indoor environments is necessary to identify the associated risks as these bioaerosols in indoor air environments may lead to both infectious (for example, tuberculosis, Pneumonia, Legionnaires disease etc.) and non-infectious diseases (asthma, allergy and SBS symptoms like upper respiratory irritative symptoms and rashes) depending upon their sources and origin. High bioaerosol concentrations in hospital environments may lead to hospital acquired infections.

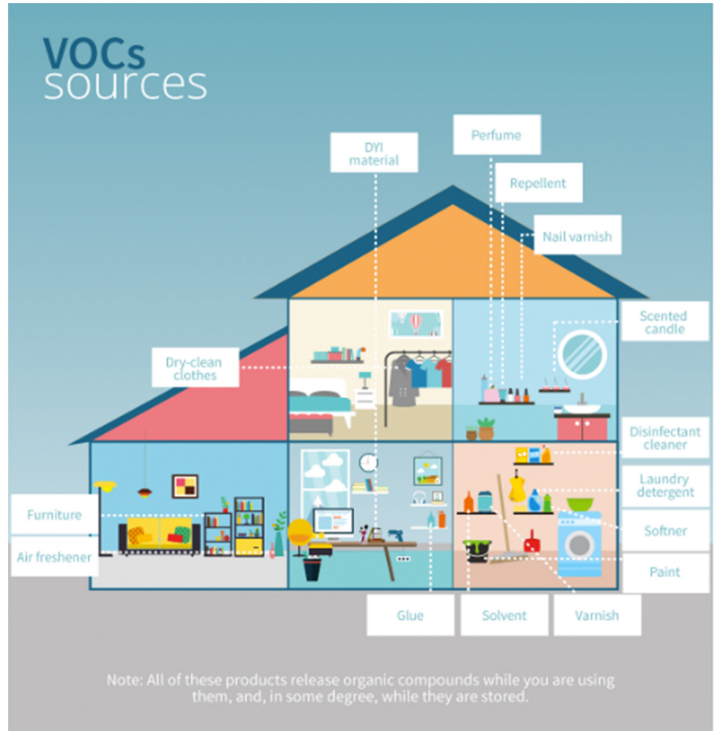
Indoor Environment Quality is not currently well addressed in the design and use of built environment in India. In specific, the subject of Indoor Air Quality (IAQ) has not yet received the importance and traction that it deserves. It is surprising that India does not have standards for indoor air quality even today. Studies on the assessment of health impacts due to indoor air pollution have been rather scant and there are no third party certifications to know the efficacy of indoor air pollution control equipment. Therefore, it is a high time that the Government and the concern departments such as a Ministry of Environment & Forests & Climate Change (MoEFCC) should come up with national guidelines on Indoor Air Quality. We will also need a multi-pronged approach by involving "green" builders, architects, air ventilation experts, paint manufacturers and furniture makers to come up with a rounded strategy. Relying on regulations alone is not going to be effective.

-Radha Goyal, IPCA



3. Volatile Organic Compounds

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short-term and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of common household products, including paints, thinners, adhesives, dry cleaning fluids, air fresheners and many more. When VOCs combine with nitrogen oxides in the air, they form smog. Short term exposure to various VOCs may cause irritation in the eyes and respiratory tract, headaches, dizziness, visual disorder, whereas long term exposure may cause serious terminal diseases like cancer.



Source: www.apcfilters.com

Indian Environment & Air Pollution

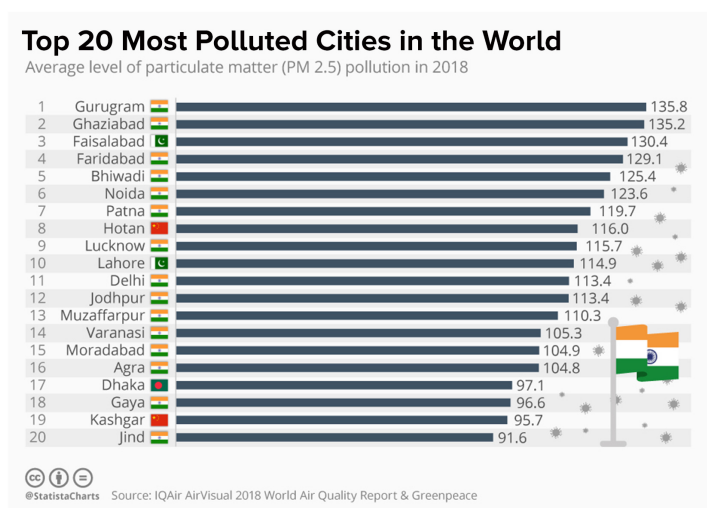
India is a big tropical country and is famous for its diverse climatic features. It experiences a variety of climates ranging from tropical in the south to temperate and alpine in the Himalayan north. The elevated areas receive sustained snowfall during winters. The Himalayas and the Thar Desert strongly influence the climate of the country. This climate change has the potential to influence India's biological system, however, its effects on human health are more extreme. Still falling under the category of developing nation with limited resources, we expect to face a host of health effects due to climate change, including air-borne and water-borne diseases.

Infectious disease distribution involves complex social and demographic factors. These include human population density and behaviour, housing type and location, quality of air, water supply, sewage and waste management systems, land use and irrigation systems, availability and use of vector control programmes, access to health care, and general environmental hygiene. Meteorological factors that influence transmission intensity of infectious diseases include temperature, humidity, and rainfall patterns. Social and demographic factors such as population growth, urbanization, immigration, changes in land use and agricultural practices, deforestation, international travel, and breakdown in public health services have been mainly responsible for the recent resurgence of infectious diseases. The Intergovernmental Panel on Climate Change noted in its 2007 report that climate change may contribute to expanding risk areas for infectious diseases such as dengue and may increase the burden of diarrhoeal diseases, putting more people at risk.

India in every season whether it is summer, winter or spring, experiences some of the worst air quality in the world. Even among countries gasping for breath, India stands out for air that is consistently, epically terrible. Drawing on measurements and calculations as of 2016 from air monitoring stations in 4,300 cities, the WHO reported in March that India's cities suffer the most.

The foremost reason behind the worst air quality in India is high frequency of dust storms. Chandra Bhushan, deputy director general at the Centre for Science and Environment (CSE), emphasised "With the rise in global temperature the soil is going to become drier. So, the amount of soil that wind can carry is also increasing. With both the intensity of the wind and dryness of the soil increasing, the intensity of dust storm is going to further increase in the future. Climate change is intensifying all extreme weather events". On May 2, 2018, severe dust storms and thunderstorms hit parts of Rajasthan, Uttar Pradesh, and other adjoining regions. At least 111 people were killed in the northern states of Uttar Pradesh, Rajasthan and Punjab, with many of them in Agra. In addition to widespread damage they caused to property and human life, these storms affected changes in air quality and atmospheric chemistry which may be harmful for human health. "An increase in ozone precursors carbon monoxide and nitrogen oxide - takes place after major dust events, which is likely to enhance surface ozone. Such processes also increase PM2.5 and PM10 and harmful greenhouse gases at the surface that has an adverse impact on human health," researchers have concluded. "The dust storms have both short and long-term impacts and some of the short-term impacts can have very real consequences for human health. Mainly, the damage to air quality is seen to come from an increase in aerosol concentration, increases in respirable suspended particulate matter and also temporary fluctuations in tropospheric greenhouse gases like carbon monoxide and ozone," explained Sudipta Sarkar, a scientist at the NASA Goddard Space Flight Center and a member of the research team, while speaking to India Science Wire.

Looking at the database's ranking of particulate pollution in cities, 15 of the 20 cities with the highest levels are located in India. Gurugram tops the list with a yearly average of 135.8 micrograms per cubic meter of PM2.5, the most hazardous particle commonly measured.



Source: www.weforum.org

Frequent unhealthy levels of pollution from sources ranging from vehicles to the burning of coal and wood for cooking, dust storms, or forest fires affect most of the country. India's hills and mountains also act as basins that trap toxic air over vast swaths of the country, sometimes making the air too dangerous to breathe.

Delhi, India's capital region is notorious for choking air. Dozens of other Indian cities are dealing with severe pollution too, but many of the particulates that blanket the metro regions originate in rural areas, and rural areas are just as badly affected by poor air. In 2015, 75 percent of deaths in rural areas were linked to poor quality of air.

Effects of Air Pollution

There is a lot about air pollution that Indians are still ignorant of—factors that they need to take cognizance of and choices that they can make to improve their health and protect their loved ones.

1. Impact on humans

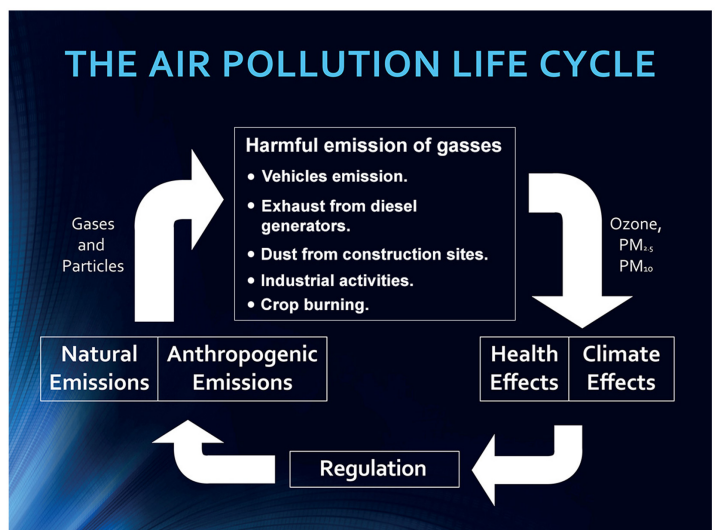
The most significant impact of the deleterious air pollution levels in India is on the health of its citizens, most particularly children. The problem is more pronounced for children who are grappling with respiratory disorders from the day that they are born. Before they can even develop strong immunity, children are exposed to the most harmful levels of toxicity possible that is leading to issues ranging from sleep apnea, disorientation, wheezing, coughing to impaired neurodevelopment and cognitive abilities, which can eventually trigger asthma and even childhood cancer.

2. Impact on the environment

Air pollution harms the environment in more ways than one and the most apparent of these is climate change. Many of the gases that cause air pollution also have a greenhouse effect because they trap the Sun's heat and push up the Earth's temperature. This has resulted in unusual weather conditions across the globe, including prolonged but warmer winters in Northern India and an unpredictable monsoon across the rest of the country. Further, such alterations in the climate, especially the rainfall levels, have terribly impacted the livelihood of a vast percentage of Indians who are primarily dependent on agricultural produce for survival. Therefore, the upshot of air pollution has a global climatic impact, making the world unsustainable for our future generations.

3. The vicious cycle of growing pollution

One of the most saddening narratives in this crisis is that of its repetitive nature, it is truly a vicious cycle that never seems to end. The primary cause of air pollution is the harmful emission of gasses from the ever-growing number of vehicles on Indian roads, crop burning and unorganized recycling of e-waste and plastics. However, many other similar activities have combined to make the problem a disastrous epidemic. Exhaust from diesel generators, dust on construction sites, industrial activities, mismanaged landfills, burning of old leaves and tyres amongst others. Where some progress seems to be made in one aspect, one can see a simultaneous decline in another. The conundrum of whether to look at automotive sales and industrial activity as progress or as dangers to the environment, further adds to the complexity of the situation. This trade-off between rapid growth and pollution is only going to gain more prominence as our emerging economy continues to expand.



Source: www.openaccessgovernment.org



Indoor Air Quality in Hospitals

Indoor Air Quality refers to the quality of air within and around building structures. Maintaining healthy IAQ is a challenging task due to rapid industrialization & urbanisation.

Hospitals have an essential role in our society – to ensure good health and vitality of the members of the community. The bad air quality in hospitals, however, can unexpectedly lead to new illnesses and poor health of the visitors and patients.

Hospital Acquired Infections(HAI)

Hospital Acquired Infection(HAI) (also known as nosocomial infection) is an infection that is acquired in a hospital or other health care facility. Hospital-acquired infections are caused by viral, bacterial, and fungal pathogens. Poor Indoor Air Quality (IAQ) in the hospital buildings is one of the main factors leading to HAI and can lead to other building-related illness such as headaches, fatigue, eye, skin irritations, and other symptoms. So, it is important for hospitals to ensure a good IAQ to safeguard patients, nursing staff and visitors from the hazards of occupational diseases and nosocomial or hospital-acquired infections (HAI).

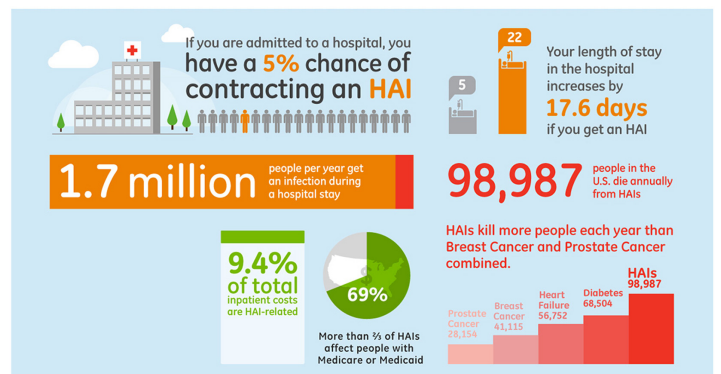
Types of Hospital Acquired Infections (HAI)

- Bloodstream infection (BSI)
- Lower Respiratory Infections
- Urinary tract infection (UTI)
- Surgical site infection (SSI)
- Cutaneous Infections

Impact of Hospital Acquired Infections (HAI)

Hospital Acquired Infection (HAI) lead to emotional & financial distress among the patients. HAI reduces the quality of life of patients and have a significant impact on the length of hospital stay & medical care cost. HAI also affects the hospital staff productivity leading to reduced work capacity or missed work entirely due to illness. HAIs account for a large proportion of the harms caused by health care and are associated with high costs. Better evaluation of the costs of these infections could help providers and payers to justify investing in prevention.

Healthcare Associated Infections: The Unknown Killer



Source: eraycollins.blogspot.com

Using estimates from a recent study published in JAMA Internal Medicine, this graph shows the overall cost and per-case cost for each of the five major hospital-acquired infections (HAIs) in the US. The costs, which are measured in 2012 US dollars, show that central line associated bloodstream infections, with a per-case cost of \$45,814, were the most costly HAIs on a per-case basis. Surgical site infections, with an overall cost of \$3.3 billion, had the highest share of the total annual costs, estimated to be \$9.8 billion, among the five major HAIs.

Prevention of HAI

- Administration of antibiotic therapy & carrier staff to source patient to destroy the pathogenic agents.
- Proper sterilization & disinfection.
- Disinfectant excreta & infected material.
- Regular Hand Washing.
- Surface Sanitation.



PM 2.5



Good

VOCs



Good

CO2

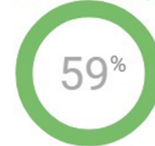


Poor

Temperature



Humidity



Air Quality Monitoring (Dashboard)

Source: draikin

Concerns to maintain IAQ in Hospitals

“According to the World Health Organization, at any given time over 1.4 million people across the globe suffer from a nosocomial or hospital-acquired infections.”

Thus, healthcare facilities are under pressure to maintain good IAQ as many people are at risk because of the infectious diseases that can spread through air. Hospitals are under intense scrutiny by the government to adhere to strict regulatory standards to ensure the safety and comfort of patients, visitors, and staff. IAQ is the most important factor to ensure that the standards of hygiene, safety, and comfort are met.

Steps to maintain good Indoor Air Quality (IAQ) in hospitals

There are numerous steps that hospitals must take to maintain clean air in the facility, free from airborne infectious diseases and respiratory illness causing dust particles.

Air Quality Monitoring in Hospitals

The facility should track the air quality in different locations, including the common waiting area, wards, ICU, ERs, etc. through the use of appropriate air quality sensors and conduct regular air quality tests.

Sanitation

To protect the visitors and healthcare workers, the overall air distribution must be sanitized and purified, the fine particulate matter and the airborne microbes must be removed.

Installing Central Air Cleaners

Due to the massive size of typical facilities, standalone air purifier cannot work and a central air cleaning approach needs to be taken. The challenge with traditional HEPA (high-efficiency particulate absorber) or MERV filters is that although they capture dust effectively, they are in turn a secondary source of pollution. Since these filters only capture dust and bacteria, harmful microbes actually accumulate and proliferate on their surfaces, increasing the risk of these microbes being present in the air. Instead central air cleaning type electromagnetic filters must be applied that not only capture tiny dust particles with high efficiency but also kill all microbes on the surface on the filters. These can have up to MERV 15 dust removal efficiency and proven kill rates of 99% on E. Coli. UVGI (ultraviolet germicidal) and PCO (photocatalytic oxidation) are also known to deactivate and destroy bacteria and viruses upon exposure.

Investment in IAQ – A Differentiator

It is important to maintain good IAQ in the healthcare sector because the quality of indoor air directly impacts the patients as well as caretakers. Having clean air is of paramount importance to maintain the health of patients, staff, and visitors. Maintaining good IAQ is extremely important for patients with respiratory problems & who requires extreme care needs such as organ failures or cancer patients. Hence a good IAQ is essential to provide safe environment within the hospitals and it can be achieved if healthcare planners, patient care personnel & administrators work together.

The hospitals that have invested in improving the Indoor Air Quality in their buildings have the following benefits:

- Reduced Maintenance costs of the machinery
- Reduced absenteeism and increased productivity of the hospital staff
- Reduced hospital downtime
- Reduced risk of infections
- Patients stay in hospitals reduced by 11%
- Medication costs reduced by 12%
- Increased patient satisfaction

Technologies for HealthCare Sector

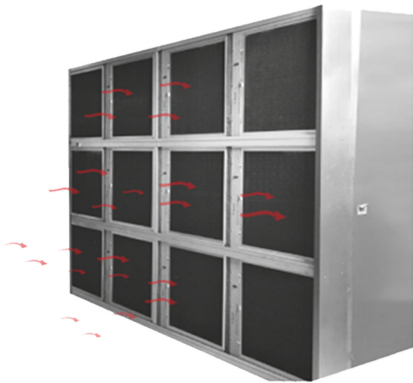
Health Care facilities are subject to microbiological airborne hazards that can cause infections in both patients and health care workers. Hospital acquired, or nosocomial, infections have been a persistent problem in hospitals and they can have complex multifaceted etiologies. It is possible that as much as a third or more of all nosocomial infections may be the result of airborne transmission at some point and, if so, air disinfection technologies may be able to reduce the nosocomial infection rate. Few such technologies are :

Central Air Cleaner (CAC)

The large-scale air pollution problem requires a central, integrated system for removing particles, infectious disease and carcinogenic gases in a natural manner at no recurring cost, no landfill, least environmental impact, with added energy saving benefits.

Central Air Cleaner is based on Magnetic Filterless Technology. It is a modular unit that can be attached to all types of old or new air conditioning (HVAC) systems to provide complete clean air to occupied spaces. This technology eliminates the need for a large number of stand alone type air purifiers that are inefficient and very expensive for purifying large spaces. Best of all, since the air purification process is magnetic, there are no consumable costs which are prevalent in conventional air media filters.

This technology not only captures tiny dust particles with high efficiency but also kill all microbials on the surface of the filters. These can have up to MERV 15 dust removal efficiency and proven kill rates of 99% on E. Coli.



MCAC

Photocatalytic Oxidation

Photocatalytic oxidation (PCO) is an advanced air purification process through which volatile organic compounds (VOCs), bacteria, mold and fungus are destroyed by incorporating photonic ultraviolet (UV) energy combined with a catalyst creating an oxidizing effect on the pollutants. A PCO filtration system can be designed for a small room to effectively remove microbes, such as fungi and bacteria, and odors caused by organic elements, smoke, etc. This would be appropriate in places such as homes with smoke damage or high levels of microbial contamination. Or a large scale PCO unit can be designed for integration in air handling units to control smell from smoke or musty odors in areas such as airports, offices, hospitals, hotels, etc.

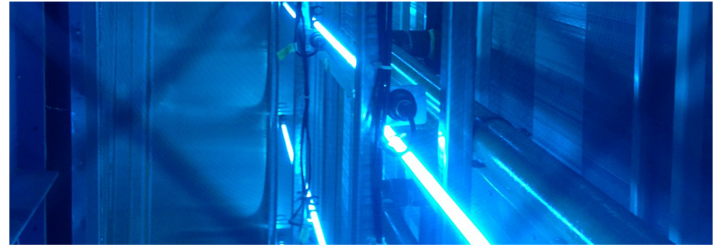


PCO

Ultraviolet Germicidal Irradiation (UVGI)

For over a century, scientists have known that certain frequencies of light have a devastating effect on microbial life. We now know that exposure to ultraviolet light in the range of 254 nm (UV-C band) disrupts the DNA of micro-organism thus preventing them from reproducing, thereby effectively killing them.

UVGI – a well established disinfection technology is now widely used in hospitals and laboratories to sanitize instruments and work surfaces and to prevent the spread of potentially lethal airborne infectious diseases. Installation of germicidal UV light inside the air system prevents the growth of mold which saves energy by improving heat transfer efficiency of HVAC Cooling Coil. A cleaner system also requires

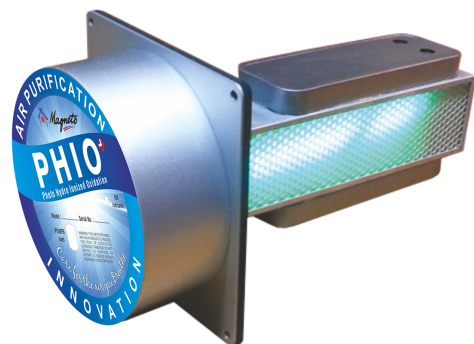


UVGI

Photo Hydro Ionized Oxidation Plus (PHIO+)

Photo Hydro Ionized Oxidation Plus is a hybrid active air purification technology that produces friendly ionoplasmatic hydrogen based oxidizers that improve indoor air quality. It purifies the air and improves the health of the users.

Einstein discovered in the early 1920's that in beaches and forest areas, the ion levels were very high as compared to cities. He found that ions are nature's way of controlling mould, bacteria, viruses and odours. He concluded that the mountain fresh air and the ocean air make people feel better due to the higher levels of ions. PHIO+ recreates this natural bipolar ionization process in your home and buildings. This technology is highly effective against microbes, TVOCs and gases, particles (dust, dander, pollen),E-smog and odour.

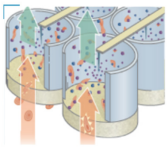


PHIO+

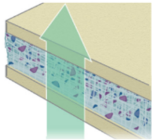
Hybrid HEPA

Hybrid HEPA is an innovative airborne decontamination system that assures both, destruction of airborne microorganisms, high efficiency particulate arrestance – HEPA Class particle removal (>99.97 % for particle / 0.3 micron in diameter) and optimized molecular filtration. It entails several integral processes that operate in series through four distinct modules which transform contaminated air into safe, clean air for a wide range of air-treatment applications.

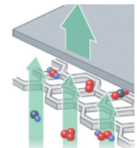
Hybrid HEPA technology goes beyond simple mechanical filtration and combines high efficiency particulate arrestance with destruction of the airborne microorganisms and molecular pollution removal for better control over the air. The keystone of the technology is a combination of non-thermal plasma in series with enhanced electrostatic filtration. The plasma serves to inactivate and charge airborne particulate matter thus rendering them inoffensive and more effectively captured through electrostatic forces.



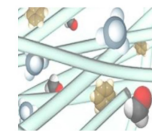
1. Microbial Destruction
Destruction of airborne microorganisms by exposure to strong electric fields and to oxidative species in unique non-thermal plasma chambers



2. Biological decontamination and High Efficiency Particulate Arrestance
Charged materials exiting stage 1 are captured by an electrically active media where organic materials are continuously exposed to the plasma ions



3. Catalytic Conversion
Oxidant chemical species are removed by a catalytic monolith (notably ozone and NOx)



4. Molecular Trapping
Organic and mineral volatile molecular pollutants are adsorbed onto an activated carbon medium

Wall Mounted Air Disinfection Unit

The Wall Mounted Air Disinfection unit which can also be used as a floor standing unit, is a device designed for use in enclosed indoor spaces.

The unit replicates a process that occurs in nature through the degradation of Ozone by naturally occurring olefins. A bi-product of this reaction is the Hydroxyl Radical, a reactive Oxygen Species which is highly unstable and reacts with bacteria, viruses and fungi by attacking most known species. The unit produces rapid disinfection in enclosed spaces and is also very effective at removing odours. It does all this without the need for air circulation or filtration and is quiet, compact and easy to operate. In contrast with some other products, it is not necessary to evacuate the room during sanitization; the AD unit is designed to operate in busy lived-in environments. It is commonly used to protect against bacteria, viruses and fungi in hospitals, care centres, health centres, doctors' surgeries, offices, hotels, gyms, changing rooms, schools, etc.



Air Disinfection Unit

Source: www.globalmedics.co.nz

Striking Solutions

Centers for Disease Control and Prevention (CDC)-funded, randomized clinical trial concluded that a combination of manual cleaning and measured-dose UV light results in a 30 percent reduction of infections for patients who stay in rooms previously occupied by infected patients.” This system uses a patented sensor 360 technology to provide total room disinfection.



1. Light Strike Robots
Light Strike Robots use pulsed xenon (non mercury bulbs) to create full-spectrum germicidal light that quickly destroys pathogens that can cause infections.



2. Micro Solution
Micro solution is proven to sanitize 99.9 percent of contaminants, including clostridium difficile and MRSA in 48 seconds.



3. Scrub In
Scrub in uses UV technology to clean and disinfect a variety of hospital equipment, including wheel-chairs.

This air disinfection technology is highly beneficial to the healthcare sector since it provides proven protection against transmission of airborne pathogens and is also effective against unpleasant odours.

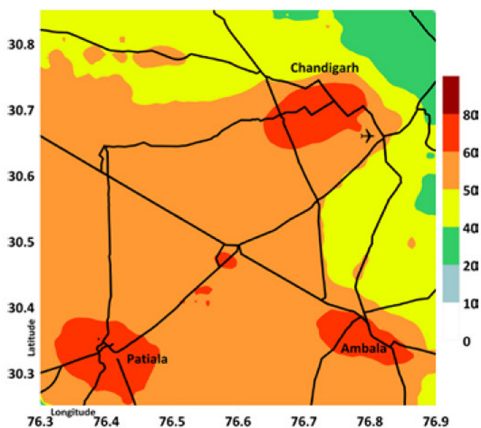
Air Pollution in Chandigarh

Particulate matter levels at Chandigarh are quite alarming. The AQI last year in June went beyond the severe limit of 500 to 575. The air quality deteriorated because of dust storms in western India, particularly Rajasthan. 33 flights, including three international flights, from Chandigarh International Airport were cancelled. "Due to the disruption caused by bad weather at Chandigarh, all flight operations from Chandigarh were cancelled for June 14," a communique from the airport public relations officer Deepesh Joshi said. Dr. Ravinder Khaiwal, associate professor, environment, School of Public Health, PGIMER, Chandigarh, conducted an analysis of last five days of June, 2018 and concluded that incoming flow of air from Afghanistan to Chandigarh intensified the situation of local dust storm. Confirming a big drop in air quality since Wednesday, Vivek Pandey of Chandigarh Pollution Control Committee said, "In this period air quality usually remains 'satisfactory,' ranging from 51-100."

According to the Chandigarh Pollution Control Committee, if the level crosses 400, it can affect the respiratory system of even healthy people. Dr. Ravindra Khaiwal, assistant professor, PGI, said, "People who suffer from dust allergies and those with a compromised immune system should avoid leaving their homes during worse AQI. Regular washing of hands and eyes is recommended". Dr D Behera, professor, pulmonary medicine, PGIMER said, "People suffering from asthma, lung fibrosis or any other respiratory infection must stay indoors or wear a face mask."

Dr VK Maini, a pulmonary specialist in the city said, people with breathing problems should keep anti-allergy medication and inhalers handy. "Small water features can also be put in rooms as the resultant humidity can control the dust. Strenuous physical exercise should also be avoided," he added.

Modeled annual average PM_{2.5} concentration (2015) µg/m³



For urban Chandigarh, average PM_{2.5} concentration was 58.1 ± 6.9 µg/m³. This is more than 5 times the WHO guideline (10) and considerably higher than the national standard (40).

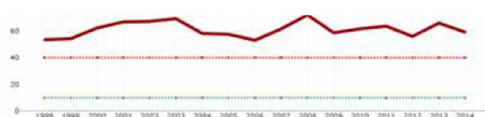
Air monitoring infrastructure

Chandigarh has 1 Continuous Air Monitoring Station (CAMS) reporting data for all the criteria pollutants and 5 manual stations reporting data on PM₁₀, SO₂ and NO₂. There should be at least 27 CAMS in the city for efficient reporting.

Annual averages from the national ambient monitoring program (2011-2015) µg/m³

| PM ₁₀ | NO ₂ | SO ₂ |
|------------------|-----------------|-----------------|
| 226.9 ± 103.6 | 44.3 ± 32.4 | 4.0 ± 1.9 |

Trend in PM_{2.5} concentrations, based on satellite observations and global model simulations (1998-2014) µg/m³



Source: www.urbanemissions.info

Congestion, pollution playing havoc with city'

HT Live Correspondent

CHANDIGARH: Chandigarh has highest per capita car ownership and vehicle density in the country - even higher than the metro cities like Delhi, and now congestion and pollution are playing havoc with the city's much vaunted urban design. This information was shared during a talk organised on Friday by New Delhi-based Centre for Science and Environment (CSE), a research and advocacy body, which laid bare the challenge of addressing perils of motorisation in an affluent city like Chandigarh. The talk on 'Air Quality and Transportation Challenge: An Agenda for Action' organised jointly by the CSE and the Chandigarh administration, brought together city transport planners, experts and civil society to discuss CSE's findings

of its review of the emerging challenges and second generation solutions in Chandigarh. "Chandigarh not only has highest per capita car ownership and vehicle density in the country, but also equals that of the rich cities of the Western world. Though much smaller in size, this rich city is now falling into the pincer grip of toxic air pollution, congestion and heat-trapping carbon dioxide," said Anumita Roychowdhury, CSE's executive director, research and advocacy, and head of its Right to Clean Air Campaign. Roychowdhury added "The pro-car urban design and policies are making people captive users of personal vehicles. This has upset the pollution and energy budget of this green, low-density and low-rise city - a city which otherwise has a regular traffic system."

"Chandigarh will have to plan alternative models of travel to demonstrate change to other cities. If the person-to-car ratio of Chandigarh is replicated in Delhi and other mega cities, they will run to a standstill with serious public health and energy costs." **HIGHEST PER CAPITA CAR OWNERSHIP** The challenge of motorisation in Chandigarh is different from most other Indian cities. In just one year (2010-2011), the number of vehicles has increased by 38% in contrast to 18% in Delhi and 9% in Bengaluru. Chandigarh has 227 cars per 1,000 people, whereas Delhi has 117 cars per 1,000. If two-wheelers are also included then Chandigarh has 878 personal vehicles per 1,000 people whereas Delhi has 362 personal vehicles per 1,000 people. If all vehicles are added, then

SUGGESTIONS

- Improve people carrying capacity of roads. The challenge is to improve mass modes and people-carrying capacity of roads as per the principle of the National Urban Transport Policy which states 'plan for people not vehicles'.
- Design roads for public transport, cycling and walking: Use of public transport can be optimised and scaled up only if walking infrastructure and design to access them is improved. Currently, 62% of the road length in Chandigarh does not have any footpath.
- Nurture strength of the city: Chandigarh has an inherent advantage in very high number of short trip length. More than 50% of daily trip length in the city is below 4 km. This makes the city very conducive to using non-motorised transport and public transport systems.
- Retain at intersections road design improvement to make them safer and calmer: Chand is known for its roundabouts which is a good way of managing traffic flow at intersections. But will require design improvement as they are becoming accident prone.

Chandigarh has 956 vehicles per 1,000 people - equivalent to Western world's motorisation rate. In Chandigarh, 43% house-

holds own cars, in Delhi it is less than 20%. Two-wheeler ownership is even higher. High rate of motorisation will soon strain urban infrastructure.

Source: www.hindustantimes.com

Air pollution is going to stay throughout the winter when temperature remains low and air pressure becomes high owing to which the velocity of wind slows down and polluted particles do not disperse and remain suspended in the air. These atmospheric pollutants also intensify the fog and cause smog in the season, leading to poor visibility

- T C Nautiyal, Member Secretary, Chandigarh Pollution Control Board

Source: www.timesofindia.com

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