

SUSTAINABLE HIGH QUALITY HEALTHCARE FACILITIES

INDOOR AIR QUALITY AS HEALTH PROMOTER IN HEALING ENVIRONMENTS

Marco Gola - Supervisor and Tutor: Stefano Capolongo

Co-Supervisor: Gaetano Settimo

Introduction

Hospitals are supposed to preserve Public Health, but they are also highly energy-demanding and socially impact on communities and they can determinate negative effects on quality of health of users and performances of environments. Healthcare facilities are able to deal with the definition of Health as the complete well-being and which can fit to the future means constructing sustainable structures. These ones work as a whole, which can be productive only if all its components are healthy. So, speaking about healthcare facilities, sustainability must be analyzed as the major requirement because it must ensure high standards.

Although nowadays there are many evaluation systems that assess building's performance and its sustainability, among the criteria the evaluation of **Indoor Air Quality (IAQ)** is postponed to the regulations into punctual hospital areas.

Starting from the definition that health promotion is also due to environmental factors, the medical activities that are carried out, the design features, the finishing materials and furniture, the maintenance and management activities, etc., the research work has the aim to provide an analysis

on the State of the Art of indoor air in healing environments, in particular related to chemical pollution, highlighting and verifying all the factors that affect the air quality and, supported by an investigation on the current state of inpatient ward, giving rise a tool for healthy inpatient rooms, through the support of *Istituto Superiore di Sanità (ISS)* in Rome.

State of the Art

In recent years, Indoor Air Quality becomes a primary issue that needs more and more to focus because of the increasing number of exposed population due to lifestyles and the permanence in confined environments (about 90% of the day). Even European

Community underlines the priority of energy efficiency strategies, in the same time it recommends to reach healthier indoor environments and the development of a specific European strategy on IAQ. Currently several EU countries have introduced in their legislation rules relating to IAQ; in Italy, there is not any specific reference around the topic. The research project analyses the Scientific Literature, WHO guidelines and also ISO, CEN and UNI standards, norms and guidelines by other European regions and/or other standard values, such as guideline or reference values regarding outdoor and indoor air, for

better understand the current framework.

Since several years, critical factors due to the exposure to indoor air pollutants have been a matter of concern for national as well as EU legislators, and an increasing numbers of states have been addressing the need for policies regarding health promotion strategies through specific studies. The European Union has often highlighted the importance to investigate and assess indoor air, the relative impacts on health status and possible recommendations regarding future measures.

Although the present criticisms, currently in several countries air quality monitoring are carried out in those professional workplaces in which chemicals are used, but also in some generic indoor spaces for building hygiene assessments. A list of case studies and best practices in terms of design, management and sampling activities has been defined by a systematic review (Figure 1).

Methodology

Starting from these considerations, the research project investigates the current state of the art of many inpatient rooms analyzing volatile organic compounds (VOCs), and the relative influence of microclimatic parameters, ventilation systems and concentration of pollutants, for giving rise to considerations on the design and management for healthier hospital settings. In fact, in the light of the State of the Art, it is considered to be of primary importance to proceed an investigation of selected

VOCs, obtaining indications on concentration levels of pollutants, whose values have not been fully investigated, such as *acetone, benzene, chloroform, dichloromethane, ethyl benzene, o,m,p-xylene, styrene, tetrachlorethylene, trichlorethylene, formaldehyde and acetaldehyde*, as well as carbon monoxide and carbon dioxide.

The definition of methods for pollutants' type, detection and analytical methodologies, instrumentation, etc. has been defined with some expertise on the field considering the specific indoor air standards ISO 16000 and guidelines by ISS.

Results and Discussion

For the development of the research project, some healthcare facilities have been are involved. The analysis last for one year, analyzing winter and summer seasons. The data processing has been carried out by and with ISS; the samples, after extraction with solvent, were subjected to the GC-MS and HPLC analysis. Data have been analyzed with the support of all the useful materials and activity logs, filled out by hospital staff.

The data process permits to obtain a comparative matrix in which is possible to highlight the current criticisms in healing environments into the complexity of all the activities done inside the hospital. In particular Formaldehyde, Benzene and Carbon Dioxide report inadequate values. Starting from the cross-sectional analysis of data, several considerations on the main common aspects around design and management criticisms and

strategies on how to improve the air quality in indoor healing environments, giving rise to:

- a Decalogue of best design and management strategies for healing spaces in inpatient rooms;
- check-lists for a pre-assessment of the performances of the inpatient room, analyzing the room features, construction materials, daily procedures and products;
- the definition of a protocol for monitoring if chemical pollution in IAQ in healthcare facilities and for a wide investigation in Italy, for supporting ISS for future guideline values' definition.

Conclusions and outlooks

In the light of the outputs and data analysis, several considerations on the development of knowledge on these topics, how to implement the current research work, and how to expand the research internationally are listed. Although the application on several inpatient rooms obtained adequate results, as WHO suggests, it is advisable to reduce more and more pollution concentrations for guaranteeing healthier environments for users.

Keywords

Indoor Air Quality; Healthcare facilities; Sustainability in healthcare; Chemical pollution; VOCs; Monitoring activity; Air Quality guidelines; Design strategies; Management strategies; Protocol for monitoring activities; Guideline values; Guidelines for inpatient room; Strategies for inpatient room's design.



Fig. 1 - Factors that affect indoor air quality in inpatient room.