# Chapter 4
# AI-Driven Environmental Monitoring Systems in Smart Hospitals:
## Enhancing Patient Outcomes and Sustainable Care

**Muhammad Usman Tariq**
https://orcid.org/0000-0002-7605-3040
*Abu Dhabi University, UAE & University College Cork, Ireland*

## ABSTRACT

*The convergence of artificial intelligence (AI), the Internet of Medical Things (IoMT), and advanced environmental surveillance in intelligent hospitals represents a transformative leap in healthcare. Continuing analysis of data on air quality, temperature, humidity, particle levels, and energy consumption optimizes KI-controlled environmental monitoring systems to support sustainable care. These intelligent systems actively identify deviations from optimal environmental conditions, reducing the risk of infection, improving patient comfort and recovery rates, and minimizing energy consumption and waste. Hospitals can utilize real-time views, adaptive controls, and predictions to deliver safer, greener, more cost-effective, and more effective services. This chapter examines key technologies, integration issues, regulatory considerations, and practical implementations worldwide that support these systems. Future discussions on in-depth research and analysis outline the path to an intelligent hospital ecosystem that prioritizes both patient outcomes and environmental responsibility.*

DOI: 10.4018/979-8-3373-5636-5.ch004

## INTRODUCTION

The global healthcare ecosystem is located at a central intersection. The increasing demand for care among aging groups and those with chronic diseases, rising capital costs, and more stringent environmental standards have put hospitals under multifaceted pressure. The hospital is consistently one of the most intense buildings of energy and resources. The extensive HLK network, lighting systems, sterilization processes, water consumption, and waste flows collectively contribute to a significant ecological footprint. Hospitals face these challenges and traditionally operate as a new system of clinical care, management, and administrative functions, with responsiveness that often requires independent action. The result is optimal use of resources, environmental pollution, and gaps in how the built environment supports patient outcomes (Pariso et al., 2025). In this regard, it has become increasingly clear that hospitals must evolve into intelligent and adaptive entities to monitor themselves, optimize their operations, and coordinate responses across clinical and environmental fields. Smart Hospital Sensor Network, Connectivity, Analytics, and Automation create real-time, dynamically adaptable environments. Air conditions, including internal air quality, temperature, lighting, humidity, and occupancy patterns, are continuously monitored using IOMT devices, which range from simple air quality sensors to sophisticated HLK performance measurement devices. In combination with AI algorithms, such data allows the system to recognize patterns, predict anomalies, and implement preventive controls. The air-absorbing unit in the ward may increase filtration before the microbial count increases. Lighting may be weakened to support the patient's sleep cycle. Heating and cooling can be adjusted to meet the occupancy level, thereby reducing waste without compromising comfort. This intelligent orchestration bridges two historical orders. It promotes optimal patient care and sustainable operation. Numerous studies have demonstrated that air quality, temperature stability, and lighting conditions have a significant impact on infection rates, medication errors, recovery time, and patient well-being. For example, inadequate ventilation can contribute to the spread of pathogens in the air. However, lighting and fluctuating lighting can interfere with circadian rhythms and stress responses. The psychological effects of environmental complaints, such as noise, air pollution, and heat stress, extend to both patients and staff, impairing healing and productivity (Maleki Varnosfaderani & Forouzanfar, 2024). In this sense, the design of intelligent hospitals transcends energy savings. It becomes the center of a healing environment that prioritizes human experiences at all levels.

Connective tissue provides the medical internet for these functions. IOMT includes devices that collect, transfer, and sometimes act on environmental and physiological data. Air quality monitors track the presence of fleeting organic compounds (VOCs), particulate matter, and humidity, specific to the smart Thermostat Control