

# Assessment of Thermal Comfort in Hospital Rooms and Health Status of Patients

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**Abstract:** The paper carefully assessed the thermal comfort in hospital rooms and health status of patients. Thermal comfort in hospital environments is mandatory, as the nature of patients' sickness directly correlates with their thermal sensation, metabolic rate, and regulatory response. A good environment contributes a lot toward patient recovery and wellbeing. Hospital buildings are required to secure a variety of indoor environments according to the diverse requirements of patients and staff. Among these requirements, thermal comfort is an important design criterion for indoor environmental quality that affects patients' healing processes and the wellbeing of medical staff. The patients' thermal comfort is given priority due to their medical conditions and impaired immune systems. A high indoor environmental quality (IEQ) can improve the recovery process and create a pleasant working environment for the health personnel. While a poor IEQ causes nosocomial diseases that are harmful to the patients as well as the hospital staff. The paper reviewed the concept of thermal comfort, health status of patient, hospital rooms, and the effect of thermal comfort on patient's health. It was on this basis that the study concluded that; ventilation systems play a key role in maintaining acceptable, thermally-comfortable conditions for patients and medical staff. It was also concluded that thermal comfort can foster the healing process of patients in hospitals and that it is highly case-dependent and varies substantially based on the health condition of the patient as well as the type and level of staff activities to bail the unfortunate condition. One of the recommendations made was that in order to foster the healing process of patients in hospitals there is dire need to promote thermal comfort in the hospital building at all cost.

**Keyword:** Thermal Comfort, Hospital Rooms, Health Status and Patients

## Introduction

Thermal comfort describes the satisfactory perception of an individual regarding the thermal environment (Weirich 2018). It is considered as one of the most critical conditions for improving occupants' comfort and satisfaction within the indoor environment. Hospital buildings are mainly designed to accommodate patients, usually with diverse health conditions which impose specific indoor environmental requirements. At the same time, a comfortable and safe working environment in hospital buildings is necessary for the staff. These requirements make hospital buildings rank among the most energy-intensive of all commercial and residential building types.

According to Djongyang et al. (2014) and de Dear et al. (2013), thermal comfort is required in indoor environments because it directly affects people's perception, in terms of health/wellbeing and productivity. Thermal comfort in hospital environments is mandatory, as the nature of patients' sickness directly changes their thermal sensation, metabolic rate, and regulatory response. A good environment contributes a lot toward patient recovery and wellbeing, the primary focus of any hospital. Additionally, the evaluation of thermal conditions and their requirements plays a critical role in verifying which critical settings may affect medical staff performance. A hospital indoor environment is subdivided into different functional areas, such as surgery and critical care, nursing, ancillary services, administration, diagnostic and treatment, sterilizing and supply, service, etc. . Each functional zone has different requirements for the indoor environment. These characteristics give the hospital building its complexity. Because of the special characteristics of different

groups served by hospital buildings, a healthy and comfortable indoor environment plays an important role in stabilizing patients' emotions and enabling staff to work efficiently. Moreover, an improved indoor environment in a hospital building can reduce costs associated with airborne illnesses by 9–20% (Kurnat, 2016). There is, therefore, a growing need for maintaining a comfortable indoor environment in hospitals. For hospital buildings, maintaining health and comfort is an issue that can never be compromised or neglected. Thermal comfort, acoustics, lighting, electromagnetic frequency levels, potable water surveillance, and indoor air quality (IAQ) constitute the IEQ of a building. Among these parameters, IEQ is mostly affected by thermal comfort (Katafygiotou 2014).

According to Ormandy (2012), people with certain chronic medical conditions are more susceptible to heat, such as cardiovascular and cerebrovascular diseases, diabetes, respiratory and renal diseases, Parkinson's disease, Alzheimer's disease, and epilepsy. Khodakarami, (2012) established that patients expect a warmer indoor environment than neutrality. Kameel et al. (2013), in their study have explained that relative humidity and air temperature can inhibit or promote the growth of bacteria and viruses. So the temperature and humidity should be in a particular range to control infection and provide thermal comfort. Nomura et al. (2016), have observed that to satisfy patient comfort, the total air changes per hour must be a minimum of 6 ACH, but in rooms with supplemental heating and cooling this rate may be reduced to 4 ACH.

### **Statement of Problem**

The challenge of thermal comfort in health care settings is the lack of well design structure. Most hospitals do not have good structural design to for ventilation. In such a hospital where is no thermal comfort rather create negative effects on the patients. Therefore, there is need for hospitals to design hospitals with structures that will let in proper ventilation to the comfort of the patients.

### **Concept of thermal comfort**

Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment (Laupland, 2019). Thermal comfort is a subjective expression of our minds regarding the level of satisfaction with the thermal environment. It involves the combination of physics, physiology, and psychology expressed in terms of thermal sensation, thermal acceptability, and thermal preference (Keeling et al. 2016). Thermal comfort describes the satisfactory perception of an individual regarding the thermal environment. It is considered as one of the most critical conditions for improving occupants' comfort and satisfaction within the indoor environment. Dissatisfaction may be caused by the body being too warm or cold as a whole, or by unwanted heating or cooling of a particular part of the body (local discomfort). When people are dissatisfied with their thermal environment, not only is it a potential health hazard, it also impacts on their ability to function effectively, their satisfaction at work, the likelihood they will remain a customer, and so on. The human thermal environment is not straight forward and cannot be expressed in degrees. Nor can it be satisfactorily defined by acceptable temperature ranges. It is a personal experience dependent on a great number of criteria and can be different from one person to another within the same space for example, a person walking up stairs in a cold environment whilst wearing a coat might feel too hot, whilst someone sat still in a shirt in the same environment might feel too cold. The Health and Safety Executive (HSE) suggest that an environment can be said to achieve 'reasonable comfort' when at least 80% of its occupants are thermally comfortable. This means that thermal comfort can be assessed by surveying occupants to find out whether they are dissatisfied with their thermal environment.

The environmental variables that influence thermal comfort are the air temperature, the mean radiant temperature, the air velocity, and the water vapor pressure in ambient air. Two other important variables are the person's activity level and clothing. Thermal comfort is important for buildings, especially in tropical climate region where intensive cooling capacity is needed (Designing buildings 2023). Satisfaction with the thermal environment is important because thermal conditions are potentially life-threatening for humans if the core body temperature reaches conditions of hyperthermia, above 37.5–38.3 °C (99.5–100.9 °F), or hypothermia, below 35.0 °C (95.0 °F). Buildings modify the conditions of the external environment and reduce the effort that the human body needs to do in order to stay stable at a normal human body temperature, important for the correct functioning of human physiological processes (Brown, 2012). Thermal comfort results from a combination of environmental factors and personal factors. The environmental factors influencing thermal comfort are;

**Air temperature;** The temperature of the air that a person is in contact with, measured by the dry bulb temperature (DBT).

**Air velocity;** The velocity of the air that a person is in contact with (measured in m/s). The faster the air is moving, the greater the exchange of heat between the person and the air (for example, draughts generally make us feel colder).

**Radiant temperature;** The temperature of a person's surrounding (including surfaces, heat generating equipment, the sun and the sky). This is generally expressed as mean radiant temperature (MRT, a weighted average of the temperature of the surfaces surrounding a person, which can be approximated by globe thermometer) and any strong mono-directional radiation such as radiation from the sun (Designing buildings 2023).

The personal factors influencing thermal comfort are;

**Clothing;** Clothes insulate a person from exchanging heat with the surrounding air and surfaces as well as affecting the loss of heat through the evaporation of sweat. Clothing can be directly controlled by a person (i.e. they can take off or put on a jacket) whereas environmental factors may be beyond their control.

**Metabolic heat or level of activity;** The heat we produce through physical activity. A stationary person will tend to feel cooler than a person who is exercising.

**Wellbeing and sicknesses;** Such as the common cold or flu which affect our ability to maintain a body temperature of 37°C at the core. Other contributing factors can include; access to food and drink, acclimatisation (this can be more difficult where there is a high outdoor-indoor temperature gradient) and state of health.

### Concept of Hospital Room

A room in a hospital for patients is typically called a patient room. This is the space where patients receive care and treatment from medical staff. The patient room may have a bed, a chair, and a television, as well as other medical equipment. The patient room is usually located in the main hospital building. In your home, you'll find typical furniture, such as beds, bedside tables, and chairs. If you have a phone and a television, your room will most likely include a window. Bathrooms are typically available in most hospital rooms. Your room may be shared with another patient, but you can occasionally use a private room at the hospital (Samuel 2022).

Safe rooms, which are located in a secure room, allow hospital staff to put aggressive patients in a calm environment until they calm down or until immediate medical problems are addressed, which can be transferred to a mental health facility. An operating room, also known as an OR or surgery center, is a hospital setting where surgeons perform surgery (in this case, SUR-juh-ree). Hospital room design has a significant impact on patient care and recovery outcomes. Patients rely on staff to respond to emergency situations quickly, check in on them frequently, and ensure a full recovery (HMC Architects, 2019) However, staff can only treat patients effectively when they can perform their tasks efficiently and have equipment and supplies that are easily accessible.

There are many items in a typical patient's room. These items might include a

**A Bed:** You can adjust your bed for sitting up or reclining. Bedside rails have controls for the bed, TV and a nurse call button. You may also use the control box to control all these activities. If you'd like the room temperature adjusted, ask any member of your health care team.

**Communication Board (Whiteboard);** your room has a white communication board that you can see from your bed. Your nurse will write the names of staff members who will be working with you on each shift, each day. Your nurse will also list your goals and activities for each day. Please review your whiteboard with your nurse.

**Alarms:** Each patient room has different alarms for your care and safety. Examples of alarms can include heart monitors, bed alarms or medicine pumps.

**TV Services:** Health education and basic TV channels are available in your room, including the Continuous Ambient Relaxation Environment® (C.A.R.E.) channel. This therapeutic tool combines peaceful video scenes of nature with beautiful music. The C.A.R.E. Channel is appropriate for patients of any age, gender or culture. It significantly contributes to improved satisfaction and patient outcomes, and helps create a healing environment for patients, families and staff (John Hopkins 2023).

There are many different types of rooms in a hospital. The most common are the patient room, the operating room, the emergency room, and the intensive care unit. Each type of room has a different purpose, and each is equipped with different types of medical equipment. A single or two-bed room is available in either a private or semiprivate setting. The Admissions office is usually the place to inquire about renting a private room. Except for the intensive care unit, there is an intercom system in all of the rooms. To use the beds, you must raise your side rails while asleep or sedated. You should provide your phone number so that family and friends can call you directly (Samuel 2022). Phone calls can be made at any time, but incoming calls are limited to seven a.m. to ten p.m. Strange surroundings and sleeping medications can make waking up in the middle of the night an even more difficult experience.

A patient's room should feel comfortable in addition to having enough light, a comfortable chair or sofa, and a window. The patient should feel at ease in a relaxed and pleasant environment, and the doctor should be able to communicate effectively. In addition to being clean and orderly, a patient's room should be well-lit. There should be all necessary equipment and supplies on hand, as well as a clean and hygienic examination room. An examination room, a doctor's office, and a patient room are some of the terms used to describe rooms where patients are examined or treated. The average hospital has between 100 and 200 patient rooms. However, the number of rooms can vary greatly depending on the size and type of hospital (Health, 2023). For example, a small rural hospital may only have 25 patient rooms, while a large urban hospital could have over 1,000 patient rooms. The number of patient rooms in a hospital can vary greatly depending on the size and type of facility.

### **Concept of Health Status**

Health status is a measure of how people perceive their health. It is a predictor of important health outcomes including mortality, morbidity, and functional status. Health status is the impact of disease on patient function as reported by the patient. More specifically, health status can be defined as the range of manifestation of disease in a given patient including symptoms, functional limitation, and quality of life, in which quality of life is the discrepancy between actual and desired function. Health status is sometimes equated with having one or more physical, psychological, or mental diseases or conditions (Remington, 2011). A variety of approaches can be used to measure disease incidence and prevalence, including reporting of a diagnosis by a health-care provider, reporting of symptoms (if an appropriate symptom battery exists), medication use, and direct diagnostic testing. Health status can be measured using pathological and clinical measures and is usually observed by clinicians or measured using instruments. Types of disease measurement include: Signs - blood pressure, temperature, X-ray, tumour size, and Symptoms - disease specific checklists.

Health is a state of complete physical, mental, and social well-being, and not the mere absence of disease or infirmity (World Health Organization, 2020). An overarching goal of public health agencies is to increase the quality and years of healthy life and to eliminate health disparities. Tracking historical trends in general health status can help identify where interventions have improved the health of a population or where interventions may be needed (e.g., by exploring causative factors and preventive measures). For example, at the beginning of the 20th century, the U.S. population was characterized by a low standard of living, poor hygiene, and poor nutrition; communicable diseases and acute conditions were major causes of most premature deaths (National Center for Health Statistics 2017). Over the course of the century, public health measures such as improved sanitation and drinking water treatment led to a dramatic decrease in deaths due to infectious diseases and a marked increase in life expectancy.

Health status measurement directly promotes patient-centered care, but can also support several other quality care aims as outlined by the Institute of Medicine. For example, the delivery of effective care includes, "applying evidence-based medicine to avoid both the underuse of effective care and overuse of ineffective care that is more likely to harm than help the patient."1 By accurately measuring the symptom burden, function, and quality of life of our patients, we can make more informed clinical decisions about the use of therapies for which the primary goal is to improve health status.

The health status of a population can be measured by a wide range of factors: birth and death rates, life expectancy, quality of life, morbidity from specific diseases and conditions, environmental risk factors, use of ambulatory care and inpatient care, financial and geographical accessibility of health personnel and facilities, health insurance coverage, and many other factors (Remington, 2011). Health status is an individual's relative level of wellness and illness, taking into accounts the presence of biological or physiological dysfunction,

symptoms, and functional impairment. Health perceptions (or perceived health status) are subjective ratings by the affected individual of his or her health status<sup>6</sup>. Some people perceive themselves as healthy despite suffering from one or more chronic diseases, while others perceive themselves as ill when no objective evidence of disease can be found. A good health status of an individual can lead to a quality life. Quality life Quality of life is a measure of the difference between the hopes and expectations of the individual and the individual's present experience (Fayers 2009). Health-related quality of life is primarily concerned with those factors which fall within the spheres of influence of health care providers and health care systems.

### **Concept of Patients**

A patient is a person who is receiving medical treatment from a doctor or hospital. A patient is also someone who is registered with a particular doctor. A patient is any recipient of health care services that are performed by healthcare professionals. The patient is most often ill or injured and in need of treatment by a physician, nurse, optometrist, dentist, veterinarian, or other health care provider (Reader 2014). Health services throughout the world strive to provide care to people when they are unwell and assist them to stay well. Primary care services are increasingly at the heart of integrated people-centred health care in many countries. They provide an entry point into the health system, ongoing care coordination and a person focused approach for people and their families. Accessible and safe primary care is essential to achieving universal health coverage and to supporting the United Nations Sustainable Development Goals, which prioritize healthy lives and promote well-being for all.

Primary care providers are placed to engage patients in a dialogue about their health conditions, circumstances, health needs and personal values and preferences. Informed patients are more likely to feel confident to report both positive and negative experiences and have increased concordance with mutually agreed care management plans (WHO, 2016). This not only improves health outcomes, but also advances learning and improvement, while reducing adverse events. Patient safety is a discipline in the health care sector that applies safety science methods toward the goal of achieving a trustworthy system of health care delivery. Patient safety is also an attribute of health care systems; it minimizes the incidence and impact of, and maximizes recovery from, adverse events. The goal of the field of patient safety is to minimize adverse events and eliminate preventable harm in health care. Depending on one's use of the term "harm," it is possible to aspire to eliminate all harm in health care. Patient care is an interdisciplinary process centered on the care recipient in the context of the family, significant others, and community. Typically, patient care includes the services of physicians, nurses, and members of other health disciplines according to patient needs: physical, occupational, and respiratory therapists; nutritionists; psychologists; social workers; and many others. Each of these disciplines brings specialized perspectives and expertise.

A patient may be an outpatient or an inpatient. An outpatient is a patient who attends an outpatient clinic with no plan to stay beyond the duration of the visit. Even if the patient will not be formally admitted with a note as an outpatient, their attendance is still registered, and the provider will usually give a note explaining the reason for the visit, tests, or procedure/surgery, which should include the names and titles of the participating personnel, the patient's name and date of birth, signature of informed consent, estimated pre- and post-service time for history and exam (before and after), any anesthesia, medications or future treatment plans needed, and estimated time of discharge absent any (further) complications. Treatment provided in this fashion is called ambulatory care (Bloche, 2016). An inpatient on the other hand, is a patient who is admitted to stay in a hospital overnight or for an indeterminate time, usually, several days or weeks, though in some extreme cases, such as with coma or persistent vegetative state, patients can stay in hospitals for years, sometimes until death. Treatment provided in this fashion is called inpatient care. The admission to the hospital involves the production of an admission note. The leaving of the hospital is officially termed discharge, and involves a corresponding discharge note, and sometimes an assessment process to consider ongoing needs.

### **Effect of thermal comfort on patient's health**

The effect of thermal comfort in human activities is being considered extensively in all aspects of life such as energy management, energy efficiency, and environmental impact. Relative humidity and air temperature can inhibit or promote the growth of bacteria and viruses. So the temperature and humidity should be in a particular range as specified, to control infection and provide thermal comfort. Patients with certain chronic medical conditions such as cardiovascular and cerebrovascular diseases, diabetes, respiratory and renal diseases, Parkinson's disease, Alzheimer's disease, and epilepsy are more susceptible to heat, these

patients expect a warmer indoor environment than neutrality. Low humidity could increase susceptibility to respiratory disease as well as affect comfort. High temperature may cause increased out-gassing of toxins from building materials, and low temperature can cause occupant discomfort including shivering, inattentiveness and muscular and joint tension. Relative humidity affects patient's health both directly and indirectly. Low humidity affects comfort and health in ways such as drying nose, throat, eyes, and skin.

Temperature and humidity can inhibit or increase the growth of bacteria, and activate or deactivate viruses. Despite the great progress in medicine, the health of individuals and communities is strongly affected by atmospheric conditions (Blazejczyk et al. 2018). It has been stated that the absence of thermal comfort conditions causes negativities in many social, economic, physiological, and health conditions of people, and even causes death. Exposure to high temperatures can increase the risk of heat stroke (Bouchama, 2002), and health problems such as respiratory and cardiovascular hospitalizations and deaths in patients. There is strong evidence of an association between high temperatures and an increased risk of stillbirths and shortened gestation (Strand, 2011). Unlike cold, the heat-related health impact can occur relatively soon after exposure. As temperatures fall below 18oC, the potential impact on health increases in severity. The body's reaction to low temperatures includes thickening of the blood, and hypertension and an increase risk of cardiovascular or cerebrovascular events. Respiratory stress starts at around 16oC and cardiovascular stress when the temperature falls below 12oC. As the temperature falls, hypothermia (a drop in the body's core temperature), becomes a possibility. Also, low indoor temperatures are often associated with other threats to health such as dampness and mould (Marmot, 2011).

## Conclusion

The study concluded that thermal comfort can foster the healing process of patients in hospitals and that it is highly case-dependent and varies substantially based on the health condition of the patient as well as the type and level of staff activities to bail the unfortunate condition. Thermal comfort in hospital environments is mandatory, as the nature of patients' sickness directly changes their thermal sensation, metabolic rate, and regulatory response. A good environment contributes a lot toward patient recovery and wellbeing, the primary focus of any hospital. Additionally, the evaluation of thermal conditions and their requirements plays a critical role in verifying which critical settings may affect medical staff performance.

## Recommendation

1. To foster the healing process of patients in hospitals there is dire need to promote thermal comfort in the hospital building at all cost.
2. To maintain thermal comfort in hospitals, various passive cooling techniques should be used, to reduce the temperature significantly in some areas in the hospital.
3. Hospitals should be design with structures that will let in proper ventilation

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