

## Exploring health care professional's awareness on moisture Control and Mould prevention in hospital buildings

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### Abstract:

A hospital is an institution that is built, staffed, and equipped for the diagnosis of disease, treatment, both medical and surgical, of the sick and the injured, and for their housing during this process. Hospitals need to be able to serve their intended purposes and to become a beautiful and essential shelter for human activities. Buildings also must resist various service loads, environmental stresses caused by temperature, humidity, wind and even those rare events of earthquakes or flooding. They must also provide a healthy indoor environment eliminating air pollutants, control of moisture and prevention of mould in our buildings; and they must maintain these functions over the full intended service life. This study aims to inspect health professional's awareness on the effect, causes and prevention of mould and moisture control within the healthcare facility. Purposive sampling was done and a case study was selected. Primary data were collected through field work by participant observation, Questionnaire, and structure Interview. The result reveals that 47.1% of the medical personnel have a clear understanding of "Moisture Control and Mould Prevention (M.C.M.P)" while 20.6% do not have the slightest idea on M.C.M.P. Recommendation made is acquiring the Knowledge of mould prevention, its health significance and the factors that cause mould growth is key to enabling action by relevant stakeholders including building owners, developers, users and occupants – to maintain clean indoor air.

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### 1. Introduction

Hospitals (sometimes referred to as healing centres) have long been a significant institution in every civilization. It has been evident that we shape our buildings and afterwards our buildings shape us. A functional design can promote skill, economy, conveniences, and comforts; a non-functional design can impede activities of all types, detract from quality of care, and raise costs to intolerable levels [1]. Hospitals are the most complex of building types [2]. Each hospital is comprised of a wide range of services and functional units. These include diagnostic and treatment functions, such as clinical laboratories, imaging, emergency rooms, and surgery; hospitality functions, such as food service and housekeeping; and the fundamental inpatient care or bed related function. Among the concerns that people face when dealing with moisture problems are how to prevent microbial growth from starting and how to get rid of established growth safely and effectively [2].

Most hospitals are termed 'general' since they admit all types of medical and surgical cases, and they concentrate on patients with acute illness needing relatively short-term care. These patients, then, do not necessarily receive all the benefits of modern medicine, public health measures, and hospital care. "Historically, general hospitals

have on the whole confined their attention to dramatic short-term illness and not all of it, at that". Hence the need for specialized healthcare centres to cater for long-term patient illness [3].

Well-designed buildings have many virtues, among them the ability to serve their intended purposes and to become a beautiful and essential shelter for human activities. Buildings also must resist various service loads, environmental stresses caused by temperature, humidity, wind and even those rare events of earthquakes or flooding [1].

Well-designed buildings must also provide a healthy indoor environment eliminating air pollutants; and they must maintain these functions over the full intended service life [4]. Most of these attributes can be affected by moisture. Uncontrolled moisture may reduce the structural soundness of buildings through dry rot in wood, corrosion in steel, freeze-thaw cycles in masonry, and other damage mechanisms. Moisture also can affect the health of occupants typically through the potential for breeding harmful organisms [2].

With other words, uncontrolled moisture will negatively affect all the most vital attributes of buildings. On the other hand, moisture reduces the shrinking cracks of wood and

furniture, and up to a point, is necessary to avoid respiratory discomfort. Thus, moisture is both a necessary constituency of our built environment and a potential liability. The issue, then, is not to eliminate moisture from our buildings, but to control it and its movements [4].

Many hospitals are "built catastrophes, anonymous institutional complexes run by vast bureaucracies, and totally unfit for the purpose they have been designed for [5].

In addition to satisfying the basic exigencies of the modern healthcare institution, such as minimal travel time for personnel and transportation of patients between units while maximizing the efficiency of the whole system, there should be a conscious urge to satisfy other significant factors that largely constitute to the efficiency of healthcare centres. A major player is the environment itself which often has a role in the development and progression of diseases. There is strong evidence that significant diseases can result from dampness and fungi in habitable buildings [6]. Dust mites in damp environments explain some of the relationship between excessive moisture and respiratory symptoms. However, the causal relationship between the damp environment and health symptoms, including respiratory symptoms, headache, fatigue, and recurrent infections, is less well understood, and mould seems to represent part of the explanation [7].

These factors combine in indoor environments to support mould growth and the corresponding potential for human exposure to mould

- a. Moisture from leaking roofs, leaking pipes, or from condensation on or water intrusion through walls or basements;
- b. Inadequate or poorly maintained ventilation systems that may not provide enough air for dilution or dehumidification or that may themselves harbour sources of mould or disperse mould spores into the occupants' breathing zone.

For the purpose of this study, it is important to note the conditions necessary and sufficient for mould and other biological growth to occur on surfaces. According to the American Society of Heating, Refrigerating, and Air Conditioning Engineers, (ASHRAE) Fundamentals [8], they are:

- a. The presence of dampness spores
- b. The presence of nutrient base (most surfaces harbour nutrients).
- c. The presence of a temperature range between 4.4°C – 37°C.
- d. The presence of relative humidity adjacent to surface above 70%.

Amongst these conditions, relative humidity near surfaces is the most practical to control [8], and thus the principal objective of this research. Spores are always present in outdoor and indoor air. Almost all of the commonly used construction materials can support mould growth; therefore, control of available nutrients is limited, and human comfort constraints limit the use of temperature control [4].

The average annual relative humidity in Adamawa is 54.2% and average monthly relative humidity ranges from 54% in March to 78% in June, July, September and October [9]. This implies that the key to preventing the growth of mould on surfaces is to control the level of relative humidity

present in the building by keeping it well below 70%. Where relative humidity near surfaces is maintained below 70%, mould and other biological growth can be controlled. Since relative humidity is dependent on both temperature and vapour pressure, dampness control is dependent on controlling both the temperature and vapour pressure near surfaces [8]. This forms the one singular challenge in significantly preventing mould growth, hence the inevitable urge to controlling moisture as a means to prevention of mould in buildings.

### 1.1 Dampness in buildings.

Dampness can be defined as water penetration through the walls and certain elements of a building [10]. Dampness can also be defined as an excessive quantity of moisture contained in building materials and components which causes adverse movements or deterioration and results in unacceptable internal environmental conditions [11]. Dampness was defined as the amount of moisture content present in a material and can be classified as capillary moisture content, equilibrium moisture content, hygroscopic moisture content, total moisture content and potential moisture content [12].

Dampness is the most frequent and main problem in buildings and contributes more than 50% of all known building failures [10, 13]. Dampness is inextricably linked to most building deterioration [14]. A source of water close to a building will also be one of the problems associated with dampness. These problems include symptoms such as dirty spots on the building, biological plants like the growth of fungi, mosses and creeping plants, paint flaking, blistering etc. [10]. In order to successfully diagnose and make appropriate recommendations for remedial actions, one should understand dampness and its impact on buildings.

The ultimate objective of any dampness study is to identify the lead source of moisture in order to recommend actions to remedy the problem [10]. Sources of dampness can be classified as rising dampness, penetrating dampness, and condensation and pipe leakages. Dampness can be classified as air moisture condensation, penetrating dampness, and internal plumbing leaks, below ground moisture or building specific sources [12, 14].

Rising dampness occurs as a result of capillary suction of moisture from the ground into porous masonry building materials such as stone, brick, blocks, earth and mortar. The moisture evaporates from either face of the wall (inside or outside), allowing more to be drawn from below. The height to which the moisture will rise is determined by the evaporation rate and the nature of the wall. The normal limit for rising dampness ranges from 0.5 m to 1.5 m above ground level. Rising dampness may show as a high-tide-like stain on wall paper and other interior finishes, and, when it is severe, as blistering of paint and loss of plaster. Damp walls encourage the growth of mould which in conjunction with high humidity, can lead to health problems to occupants [15 - 19].

Water penetration through a building enclosure depends on the simultaneous occurrence of three things: the presence of water; an opening through which water can enter and a physical force to move the water [20]. Water can be present as rain, melting snow and soil moisture. Several

forces such as gravity, air currents, capillary suction, surface tension, kinetic energy, air pressure and hydrostatic pressure influence the penetration of water into buildings [20]. Drips from air conditioning or hot water system overflows, rain water, pipe leakages, water from horizontal directions, etc. can also cause penetration dampness in buildings. These sources tend to produce small, localized patches of dampness and decay, whereas rising dampness may affect the base of a whole building [19].

Dampness resulting from condensation occurs where water in the air inside a building condenses on a cooler surface [21]. This is usually indicative of cold spots in the building, sometimes called cold bridges. It can also occur where there is poor ventilation or where short intense heating cycles do not allow the walls to fully warm up [21]. This situation allows the heated air to hold more water, which condenses when the temperature drops. Excessive condensation frequently results in severe mould growth which can in turn create health hazards. Condensation is one of the most common forms of dampness in residential buildings, mainly caused by warm moist air formed from cooking, washing, bathing or even by just breathing, condensing onto colder surfaces in the homes [22]. Damp patches can appear on plaster walls in odd places, particularly on outside walls, often appearing and disappearing on a regular basis. Condensation is mostly accompanied by mould which is black in colour but can virtually be of any colour and is very common on walls and ceiling, underneath bay windows, etc. [22]. According to the British Research Establishment (BRE), 80-85% of dampness problems in the United Kingdom arise due to condensation or manmade moisture [23].

To determine moisture problems in buildings, one must correctly determine the moisture sources [4]. Excessive moisture within buildings can cause mould, mildew, and potentially damaging concealed condensation which, in time, distresses the building envelope's structural performance. Major sources of moisture are divided into three basic sections in this study. The first discusses construction moisture sources. These can be substantial and are generally important only during the first two to three years of a new building's life. The second section focuses on interior moisture sources resulting from the activities inside the conditioned space such as cooking, showering, and respiration of the occupants. The final section covers exterior moisture sources that enter the building by air movement, vapour diffusion, capillary suction, and liquid flow [4]. Newly constructed buildings give off significant quantities of moisture during their first year as a result of moisture trapped within materials: fresh concrete, green lumber and wet-applied insulations. For an "average" building, it has been estimated that the lumber used at 19 % moisture content can release a total of about 200 litres of moisture as it dries to average conditions. Most framing materials for construction are kiln dried; however, dry materials do get wet prior to and during construction. Piles of materials are often covered on top to shed rain, but not placed on top of vapour retarders to restrict ground source moisture from condensing under the rain cover during cool nights [4].

Building assemblies need to be protected from wetting through rainwater, groundwater and air transport and vapour diffusion [24]. The typical strategies use drainage planes, air barriers, air pressure control, vapour retarders and control of interior moisture levels through ventilation and dehumidification. Climate location and season determine the location of air barriers and vapour retarders, and ventilation versus dehumidification [24].

Moisture usually moves from warm to cold and from more to less. In hot climates, moisture from the exterior flows towards the cooled interior by passing through the building enclosure. The most important sources of moisture requiring control are rainwater, groundwater, and air transport, vapour diffusion [24].

Mould prevention is the joint responsibility of the three key stakeholders in a building project, designers, builders, and operators or owners. The failure of any stakeholder to exercise due care can result in a mould-contaminated facility, with the inherent loss of use, costly remediation, and possible long-term litigation [16].

Builders must be aware of the importance of proper HVAC design, architectural detailing, and the selection of suitable systems and materials in the prevention of mould in a building. Designers are duty-bound to provide proper detailing, systems design, and material selection to prevent water intrusion or condensation that results in mould growth and contamination. Project or construction managers, whether they are part of the design team, should consider the timing and scheduling of the project, and advise the owner of any increased risks due to accelerated schedules. It is critical to acknowledge that construction during damp or rainy seasons may result in the exposure of building materials to moisture [19].

Even with a weather-tight completed building envelope, concrete floor curing or plastering processes can release excess moisture within a building. Where suitable ventilation or drying process is not specified, drywall surfaces and wood structures that are particularly sensitive to moisture absorption are likely to facilitate mould growth [10].

Designers who recognize the risks of exposing materials to moisture during construction or during building operation can make appropriate material choices to reduce the risk of mould.

## 2. Methodology

For the purpose of this study, the random method was employed in obtaining data to achieve the set objectives. The procedure was as follows: Questionnaire, Review of articles and architectural journal on related work, Textbooks of architecture, building and environmental sciences were read, Oral interviews with healthcare professionals, Internet-based research and Encyclopedia Britannica, and Personal observations in visited Health care facilities.

The collection of data for this study was based on the primary and secondary system of data collection in the sense that; the primary data collection method are the physical observations and questionnaire administer to the healthcare workers, while the secondary system of data collection has to do with surfing the internet, reading through journals, papers of architectural essence and reviews.

### 3. Result and Discussion

A total of 45 questionnaires were administered in Specialist Hospital Yola, Adamawa State. There were 34 valid questionnaires returned from the Hospital. The characteristics of these respondents are summarized below and in Table 1. Of the respondents, 7 were Medical Doctor's (5 male and 2 female) and 14 were Nurses (3 male and 11 female) while 13 Industrial Training Students learning to become professional nurses and lab scientists (7 female and 5 male) and participated in the questionnaire.

Table 1: Characteristics of Respondents

Variable	Category	Frequency	Percentage (%)
Sex	Male	13	38.2%
	Female	21	61.8%
Medical Personnel	Medical Doctors	7	20.6%
	Nurses	14	41.2%
	I.T Students	13	38.2%

Figure 1 reveals that 47.1% of the medical personnel have a clear understanding of M.C.M.P while 20.6% do not have the slightest idea on M.C.M.P.

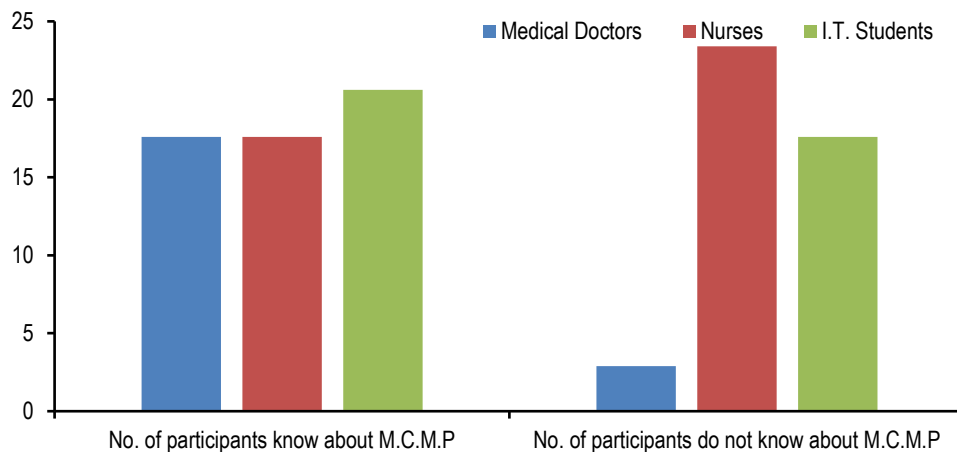


Figure 1; Analysis on M.C.M.P knowledge in the Medical Sector.

Figure 2 shows clearly that 82.3% Medical personnel have high aspirations for quality buildings and healthcare facility that would be healthy and friendly to patients and to the public in their private home therefore reducing the cases

of people coming in to the healthcare facility to seek for medical attention/care and end up going home sicker than ever.

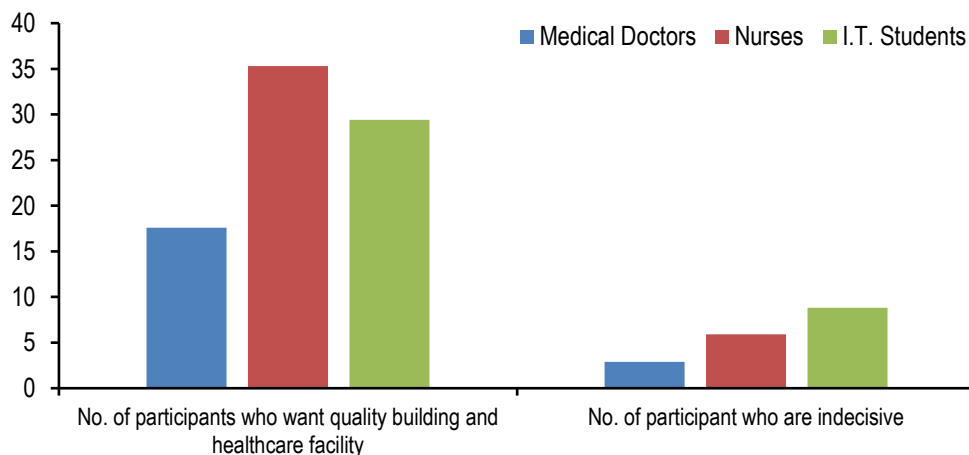


Figure 2: Distribution of Respondents who want quality building & healthcare facility

The result of the field survey using Questionnaire, Interview, Observation shows that majority of the respondents (82.3%) have a high aspiration for quality houses and healthcare facility, building that are Moisture and Mould free. Reading of articles and architectural journal, one on one interview with healthcare work or specialists, also confirms that houses, healthcare facilities represent one of the best indicators of the living status of a person in the society. This research finding indicates that 17.6% which

represent Six (6) medical Doctors have a clear understanding of what "Moisture Control and Mould Prevention", meanwhile 2.9% representing just One (1) Medical Doctor do not have an idea of what M.C.M.P stands for. "The Nurses and the IT Students" training to become professionals in the field of Nursing. Six (6) Nurses and Seven (7) IT student represent 17.6% and 20.6% shows that they understand M.C.M.P meanwhile Eight (8) "Nurses and Six (6) IT Students" representing 23.4% and 17.6% do not



have clear understanding of the term M.C.M.P and the harm it could cause to one's health. It is said by many scholars of different discipline around the world that ignorance is one of the biggest diseases of all time in the world and it's the killer of men. For that reason alone, it would be suggested that a massive awareness campaign be carried out by the government and professionals in the health sector.

#### 4. Conclusion

In conclusion, Healthy indoor air is recognized as a basic right. People spend a large part of their time each day indoors: in homes, offices, schools, health care facilities, or other private or public buildings. The quality of the air they breathe in those buildings is an important determinant of their health and well-being. The inadequate control of indoor air quality therefore creates a considerable health burden.

#### Recommendations

Knowledge of mould prevention, its health significance and the factors that cause mould growth is key to enabling action by relevant stakeholders including building owners, developers, users and occupants – to maintain clean indoor air. Many of these actions are beyond the power of the individual building user and must be taken by public authorities through the relevant regulatory measures concerning building design, construction and materials, and through adequate housing and occupancy policies.

The criteria for what constitute healthy indoor air quality are provided for in "The WHO guidelines on indoor air quality: dampness and mould", 2009. The WHO guidelines on indoor air quality: dampness and mould offer guidance to public health and other authorities planning or formulating regulations, action and policies to increase safety and ensure healthy conditions of buildings. These guidelines are therefore essential to prevent disease related to indoor air pollution [4].

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