ABSTRACT

Malaysia is situated near the equator of earth where the weather is hot and humid. The vulnerable environment has induced many Indoor Air Quality (IAQ) concerns in hospitals by health professions in many countries. There is mounting evidence on IAQ exposure leading to excessive morbidity and mortality. Many extensive studies have been conducted but there is not many IAQ standard to-date. The objective of the study is to present the finding of the source of indoor air quality in a new hospital in Malaysia. The study also presents the solution to overcome the IAQ problem faced by the hospital.

KEYWORDS

IAQ, Mould growth, assessment, hospital.

INTRODUCTION

As we are moving into the new millennium, we have witnessed numerous changes such as technological advancement, demographic epidemiological and climate changes. Many new hospitals are built in line with emerging changes and to the local needs where acute population growth has become the driving factor in the developing country (Abu Bakar, 1992). Despite of health care cost is burdening on Government's financial capacity, Malaysia spent more than 3% of GDP on health services. Many large scale hospitals are built in the 8th Malaysia Plan (Abu Bakar, 1996). One of them is the subject hospital with more than 700 beds under this pilot study.

The hospital was completed at the end of 2003 and handed over to healthcare provider by early 2004. Sign of visible mould growth was reported widespread in the entire 10 storey buildings. A study was conducted on the building perceived to have Indoor Air Quality (IAQ) problem.

MATERIAL & METHOD

A preliminary assessment was conducted immediately after the complaint to evaluate and assess the extent of contamination. Initial information from existing personnel was gathered. This process helped in subsequent investigation such as formation of expert team, preparation of building and HVAC layout/drawings, duration of investigation and testing equipment for the investigation if necessary. Hansen (1991) suggested ascertaining if there is any abnormal operation condition prior to the problem would narrow the range of possible sources.

A systematic and thorough walk-through investigation was conducted on the following week. Temperature and Relative Humidity data logging in several locations was recorded in relation to the
study of air-conditioning system design. Sampling for airborne microbes was collected for incubation and analysis. Further questionnaire was asked during this state. After the walk through, diagnostic or analysis procedures can be either conducted at hospital area or back to office.

BACKGROUND

The subject hospital is a 704 bed healthcare facility, which was scheduled to commission and begin operations in March 2004. Visible mould growth was reported at level 2 and 3 initially and quickly widespread to the whole building. It had been reported that patches of mould found on the ceiling board, wall surface, floor and furniture. Due to the concerns for the safety of the public and staff of the hospital, an IAQ investigation was put in place. The operation of the hospital had been partially suspended in order to facilitate the IAQ investigation.

FINDINGS

In the preliminary walk through to the building, a strong smell presence which is a tell tale of the mould contamination. Surface stains and visible microbial growth are found on wall surfaces, ceiling boards, floor and furniture. Moisture condensation is quite prevalent on various surfaces like glass panes, metal door frames and walls. Water is found dripping down from the soaked ceiling boards through the wall onto the floor at many locations.

During the actual assessment on the following week, the extent of mould infestation is widespread. Roof defect reveals after removing of ceiling boards, allows rain water entering the building. The indoor moisture of all floors is fairy high and is conducive to mould growth. Condensation is noted on several glass panes, metal door frames and wall surfaces.

As the occupancy rate is low, temperature recorded is marginally above the bottom limit of the designed level. High relative humidity is recorded way beyond the upper limit of 60%. The reading further confirms the high level of indoor moisture content in the building which providing conducive condition for mould growth.
SOURCES OF IAQ PROBLEMS

Defect in the roof structure has caused the rain water to enter the building. The leak is leading to water soaking to porous material such as ceiling boards and partition wall. The rain water is also causing visible dampness on the painted brick wall. The prevailing high moisture condition promotes the growth of microbes. Mould spores at the landscape in the central courtyard become the most probable ready source of the mould growth problem.

Despite of the early low occupancy in the building, air-conditioning system is fully turned on. The differential temperature between rooms has induced condensation to glass panel and metal door frame. The improper operation of air-conditioning system is not reported and adjusted to meet the low occupancy requirement. Airborne spores are transmitted by the air-conditioning system to the whole building causing the widespread of the mould growth.

It is learnt that excessive rain water absorption in the existing building components can be the possible cause of mould infestation during prolonged construction period. Also, there is a grey period between the practical completion and the building handing over period. The mould growth is recurrent during the grey period.

RECOMMENDATIONS

Immediate Actions

The subject hospital should be closed at once. Mould remover and mitigation solution should be conducted immediately to prevent cross contamination and spread of mould and spores. Precautionary measures to be developed for the cleaning workers before work starts. Interior landscapes in the central courtyard to be eliminated or relocated to a new position outside.
Subsequently, de-humidified strategy should be implemented. This step will prevent the recurrent of the mould growth.

Long Term Strategy

A comprehensive assessment to the building and air-conditioning design/defect should be carried out. Indoor parameter levels as per design specification should be closely monitored. Building and air-conditioning system maintenance manual should be reviewed and executed as per schedule. IAQ audit plan should be prepared to prevent the possibility of any indoor contaminants.

DISCUSSION

There are many recent reports on new and existing hospitals encounter the mould growth problems. Even though hospitals have used increasingly innovative air conditioning system and air filters, the incidence of mold-based incidents has grown steadily for more than 20 years, according to an article in the journal Infection Control and Hospital Epidemiology (2006). Million of dollars has been spent to rectify the problem and each problem is leading to closure of hospital, either in partial or totality. Instead of providing essential good indoor air to the occupants, air-conditioning systems have become 'highway' for deadly disease to travel to the whole hospitals. (Kecha, 2004)

Why are we spending more money and time in rectifying the problem? We should have spent a little effort in mitigating and preventing the occurrence of the same incidents.

CONCLUSION:

The study concludes that mould growth has reached critical level. The source of mould growth is due to the high moisture contents in the building owing to the inherited defects/problems. A comprehensive short term and long term solutions are recommended to overcome the IAQ problem. With the recommended action plan put in place, the mould growth problem of the subject hospital has been remedied and put in operation in 2006.

REFERENCES


2. Abu Bakar Suleiman (1996), The Future of Health Services In Malaysia (keynote address), Seminar on the Future of Health Services in Malaysia, 19-20 October, Kuala Lumpur


