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Noise levels in in-patient hospital wards

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ABSTRACT

There is a growing body of research into the acoustic environment in hospitals with increasing evidence of the detrimental effects of noise on the well being and comfort of hospital patients, and of a significant rise in hospital noise levels over the past 40 years. However most of the evidence concerning the impact of noise on patients has focused on specific areas within hospitals such as critical care units; furthermore there have been few studies carried out within UK hospital environments.

Current UK guidance on the acoustic design of hospitals in the UK is mainly concerned with speech privacy for patients. Other issues that need to be considered in the acoustic design include overall noise levels and possible disturbance to patients, plus potential noise control measures. An additional challenge in addressing acoustic concerns in hospitals is that non-acoustic factors also need to be considered, for example the need for all construction materials to be compatible with control of infection requirements.

A project is currently being undertaken to investigate, through objective and subjective surveys, the effects of factors such as building design and materials, and ward size and geometry on the acoustic environment in hospitals.

1. INTRODUCTION

Concern about noise in healthcare is not a recent phenomenon. In her book 'Notes on Nursing', first published in 1860, Florence Nightingale[1] devoted an entire chapter to noise and its negative effects. She warns… 'Unnecessary noise, then, is the most cruel absence of care which can be inflicted on the sick and well.'

The subject area of hospital noise is a diverse one. Ulrich *et al* [2] cite no less than 130 studies focusing on the subject of noise in hospitals and the research seems to be gathering momentum. The published research appears to fall into a number of

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distinct groups – the measurement of noise levels; the effects of noise on staff; the effects of noise on patients; the effects of physical or behavioral modifications on the noise climate; and sleep studies.

Without exception, all the noise measurement studies reviewed by the authors found that noise levels exceeded the World Health Organization (WHO) guidelines[3] and the relevant standards set within the country of study. Busch-Vishniac *et al* [4] have shown that a clear trend exists for rising hospital noise since the 1960's, with average noise levels increasing by 0.38 dB per year for daytime levels and 0.42 dB for night time levels. It certainly appears that the problem of noise in hospitals is universal in its nature.

The source of much of the published research on hospital noise is healthcare journals rather than acoustic journals, many of the studies having been undertaken by healthcare professionals with little knowledge of acoustics. This has led to inconsistencies in the acoustic parameters used. Interpretation and comparison of many studies is also difficult owing to factors such as short or incomplete measurements periods, no information regarding microphone positions, and a lack of statistical robustness.

There appears to be increasing evidence of the detrimental effects of noise on patient wellbeing and on staff, with noise induced stress being linked to burnout of critical care nurses[5]. Studies have also linked noise levels to patient recovery rates[6] and have associated improvements in acoustic design with patient re-admission rates[7]. It should be noted, however, that much of the evidence concerning the impact of noise on patients and staff is focused on a small number of regularly cited studies.

A review of the literature also indicates that a large percentage of the research has been carried out in specific area types within hospitals such as critical care units and operating theatres – those areas that are generally perceived as noisy. Little research has been carried out in general in-patient care facilities, and few studies have built up an extensive picture of hospital noise. Studies rarely consider the frequency content of the noise measured; furthermore there have been few studies carried out within UK hospital environments

2. CURRENT ISSUES AFFECTING ACOUSTIC DESIGN OF HOSPITALS IN UK

The current UK guidance, Health Technical Memorandum (HTM) 08-01[8], provides guidance on the acoustic design of hospitals in the UK. However, the document is mainly concerned with the acoustic impact of mechanical and electrical services and room sound insulation for the purposes of patient speech privacy. Other current issues that need to be considered in the acoustic design are:

- Design for Control of Infection
- Building and room design
- Sustainability
- Increased numbers of noise sources
    - Medical Equipment
    - Patient entertainment / communication consoles
    - Mobile phones

A. Design for control of infection

How compatible is design for control of infection purposes and design for acoustic comfort? In recent years Healthcare-Associated Infection (HCAI) has received a great deal of negative press coverage. Has pressure on hospitals to reduce the number of HCAI cases, led to a knee-jerk reaction regarding the type of materials used in design?

There is limited guidance available regarding the use of sound absorbing finishes in hospitals. HBN (Health Building Note) 30[9] specifies that suspended ceilings should be avoided in operating theatres, isolation rooms and treatment rooms. HTM 08-01 specifies that sound-absorbent treatment should be provided in all areas where cleaning, infection control, patient safety, clinical and maintenance requirements allow. This guidance also states that the absorbent treatment will normally be a ceiling, but floor finishes or wall panels may also be considered. The National Standards of Cleanliness[10] lists possible cleaning regimes and types of cleaning for different finishes, but this is purely guidance and each hospital is responsible for its own cleaning procedures.

Control of Infection teams have now been set up at each hospital. The teams interpret the guidance in different ways. Many people are not aware that there are acoustic products available that are washable and can withstand disinfectants; hence the acoustic comfort of a building may be compromised.

B. Building and room design

Health Building Note (HBN) 04-01[11] provides evidenced based guidance for planning and design of in-patient facilities for adults. This document recommends a move towards a much higher percentage of single patient rooms (at least 50%). Recommendations for increased bed spacing, the design and positioning of ensuite facilities and the use of large glazed areas for patient observation are also made. All these types of design factors will obviously affect the acoustic properties of a space.

C. Sustainability

Sustainability is another key influencing factor which is leading to many innovative design solutions for new buildings, some of which are incompatible with improved acoustic design. The use of exposed soffits is one example. By providing a large thermal mass to absorb and therefore reduce heat buildup in rooms, the efficiency of cooling systems can be maximized. With acoustic absorbency generally provided by acoustic ceiling tiles, the use of exposed soffits raises questions regarding the provision of acoustic absorbent in the future.

D. Increased numbers of noise sources

Continuous technological and medical advances have led over the years to increasing numbers of automated machines in all hospital environments, leading to increases in background and ambient noise levels. Edworthy and Hellier[12] found that the alarms generated by medical equipment ‘are frequently too loud, irritating, confusing, badly designed, and too numerous, resulting in them often being turned off and hindering, rather than enhancing, task performance’.

Patient choice and the desire to improve the comfort of patients in hospital also leads to an increasing number of noise sources in hospital wards. Many hospitals now provide radio/television/telephone consoles for patients’ use. Some hospitals provide headsets for watching television and listening to the radio, but there are some facilities where headsets are not provided, possibly due to control of infection policies.

'Using mobile phones in NHS hospitals' was published in 2009[13]. The document concludes that …'patients will be allowed the widest possible use of mobile phones in hospitals, including on wards, where local risk assessment indicates that this would not represent a threat to patients' own safety or that of others….'

3. ACOUSTIC DESIGN FOR IN-PATIENT FACILITIES IN HOSPITALS

A collaborative study is currently being undertaken at London South Bank University between the Medical Architecture Research Unit (MARU) and the Acoustics Group, funded by the Engineering and Physical Sciences Research Council (EPSRC) and Arup.

The research aims to build up a comprehensive picture of the noise climate within general in-patient care by undertaking a series of robust short and long term noise measurement studies. The data captured will include average, peak and background noise levels and the identification of the most commonly occurring and predominant noise sources.

Hospitals included in the study have been chosen to reflect a broad range of building designs, different types of in-patient care and a mix of ward types. Buildings undergoing refurbishment are of special interest for pre and post intervention studies.

Careful consideration will be given to room design and how the design for control of infection affects the acoustic comfort within the space. The impact of medical equipment, entertainment consoles and mobile phone usage will also be examined where appropriate.

In particular the following factors and their impact on noise levels and room acoustics will be investigated:

- space geometry
- configuration of facilities (in-board / out-board ensuite in single rooms)
- ventilation of space (natural / mechanical)
- ceiling finishes (exposed soffits / suspended ceilings)
- glazing (including use of glazed doors and observation panels)
- floor finishes (carpet / vinyl flooring)
- soft furnishings (curtains / blinds / any other absorbent materials)
- bed spacing
- occupied / unoccupied
- medical equipment used
- mobile phones / patient entertainment consoles

In addition to noise measurements, other room acoustic parameters such as reverberation times, speech privacy and speech intelligibility will be measured. Where measurement is not possible for practical / hygiene / privacy or other reasons, acoustic modelling of the environment may be carried out to predict the values of the required parameters.

The data captured during the objective studies will be invaluable in understanding the key elements of the noise climate in in-patient care and link directly into the following areas:

- understanding of the physical and behavioral factors that significantly affect the noise climate
- the effects of acoustic design changes on the acoustic comfort of a space
- exploration of the conflicts between design for infection control and acoustic comfort

In addition to objective studies of noise and room acoustics subjective studies will be carried out to investigate the staff and patients' perceptions of noise; these will be investigated by means of semi structured interviews and possibly questionnaire surveys.

The objective and subjective data captured in the study will be used for the following:

- comparison studies of room types (single / multi-bed)
- comparison studies of building types (PFI / nucleus / 1960's tower / building designed for infection control purposes)
- examination of the effects of the acoustic environment on patient and staff wellbeing and comfort by analysing relationships between objective data and subjective responses
- identification of the dominant / most annoying / most disturbing noise sources
- investigation of the cost benefit associated with improving acoustic design in inpatient facilities
- analysis of noise, acoustic and subjective data in order to suggest methods of noise control, particularly in the areas of equipment / human interface

4. CONCLUSIONS

Although an area of concern for many years, there is relatively little information regarding noise levels and acoustic conditions in general in-patient hospital wards, and their impact on patient and staff well-being. The current research project aims to address some of the gaps in knowledge in this area in order to provide better understanding of the importance of the acoustic design of hospitals, and its relationship with current issues in hospital management and building design.

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