Hospital Ward Configuration

Determinants Influencing Single Room Provision

A Report for NHS Estates, England by the EU Health Property Network

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Executive Summary

The aim of this review of European perspectives on the determinants influencing design decisions on single room ward provision is to aid decision making on setting relevant guidelines within the NHS.

Contemporary health societies are facing new challenges, such as rapidly rising public expectations, increasing professional competencies widening the portal for care and treatment, and new opportunistic and often predatory infections.

This review looks at these characteristics of change and their impact on thinking about hospital design on mainland Europe, with specific reference to single room ratios. The study was undertaken in three stages: a desktop review of literature, peer review by a panel of experts working in the field, and the drawing together of other opinion to form a consensus view and set of conclusions.

The desktop review was extensive and wide-ranging and was cross checked for consistency with other parallel reviews undertaken by European colleagues. The findings were consistent as follows:

- HAI: 35% spread by pathogens of other patients
- Pathogens are present in the environment
- New (predatory) infectious diseases are emerging
- Patients are becoming more vulnerable
- Increase in hand hygiene compliance results in a decrease in HAI, and single room provision facilitates compliance
- The role of single rooms in preventing HAI is not proven by randomised controlled trials. However, from present knowledge and logical reasoning it is clear that single rooms play a major role in reducing some preventable diseases and beyond all doubt in other specific disease areas
- There is a lack of good studies.

The strong consensus outcome of review and discussion proposed that HAI and the following additional factors:

- Flexibility
- Dignity, privacy and confidentiality
- The patient environment and patient choice

justify strongly a ratio of single rooms of between 50% and 100% as providing a planning parameter with a high evidence-based confidence rating. It was also concluded that there were four different types of factors shaping decisions about single rooms:

- Science-based decisions relating to the clinical and nursing care of patients and overall hygiene standards
- Value-based judgements about the nature of personal services and responsiveness to local community and generational cultures
- Operational needs: for example, managing volatility in demand or changing clinical needs and priorities, and
• These should be balanced against new economic considerations in particular anticipating the shift to a payment by results system being introduced in the NHS.

In light of these variable factors it is recommended that there should not be a generalised 'one size fits all' guideline but that the above principles be applied to reflect the population profile of the hospital in question (and its local catchment area), and that the factors be applied on a graded scale representative of the type of patient risk/need. Thus for tertiary teaching hospitals with highly vulnerable patients and treatment regimes that may carry high risk factors the highest rated determinant may be HAI, which could predispose single room ratios towards the higher end of the 50% to 100% scale. For community orientated hospitals the shading may be towards factors such as dignity and the environment with a predisposition towards the lower end of the ratio scale. It is suggested that some form of scaled benchmark advisory standard might be developed to reflect the profiles of typical NHS hospitals: Tertiary Teaching, DGH and Community.

It is strongly recommended that planning strategies such as care pathway (disease framework) service design should be used to provide a systematic and reliable model for patient profiling and predictive risk/needs assessment. Furthermore, ward design models should ensure flexibility to accommodate future changes in the nature and type of service delivery, or in environmental standards.

Finally it is proposed that the nature of guidelines should be sensitive to two principles:

• High evidence-based levels of credibility with hospital professionals, patients and relatives and the wider public - and transparent and defensible decision making processes with appropriate degrees of local engagement
• The changing health landscape reflective of choice, devolution and payment systems related to quality and outcomes

It is observed that there is an absence of good science in the 'single-room' research studies so far available relating to HAI determinants - it is strongly suggested that multi-centre, multi-national collaborative action research programmes be established to improve understanding of this complex interaction of design and HAI.
Introduction

Over time there has been ongoing debate about ward design in the search for the optimum balance between open (multi-bedded) accommodation and single room provision. Although in general terms there has been a shift away from the more open configuration characterised by the ‘Nightingale’ model there has been little consensus on alternatives. Four factors are shaping opinion and growing in intensity:

- Better risk management of healthcare acquired infection
- Rising public expectation for improved quality - and associated cultural responsiveness
- Operational factors and revenue cost
- Capital cost.

The current focus on healthcare acquired infection (e.g. the report *Improving patient care by reducing the risk of hospital acquired infection: A progress report* - National Audit Office, July 2004, comments on the need for better evidence of the impact of different intervention strategies) demands a better understanding of the co-relation between infection risk and single room ratios. Additionally the need for a more informed debate about single rooms is amplified by growing public expectation of a safe, secure and high quality environment for care.

Equally important is the requirement for ward accommodation to offer flexibility in use to respond to variations in demand levels and changing clinical priorities. This report aims to set ‘confidence parameters’ for guidance on single room ratios and therefore addresses the interacting dynamics of:

- Relationships between infection rates and single room provision
- Quality standards, characterised by issues of:
  - privacy and dignity
  - confidentiality
- Flexibility.

Note that issues relating to operational and capital costs lie outside the scope of this report.

The report also sets out recommendations about how a ‘best practice’ approach can be developed within guideline parameters.
Study Methodology

The study has been based on three distinct activities:

1. a ‘desktop’ review of relevant published literature, reports and evaluations
2. an expert ‘peer-review’ of the desktop literature search, and
3. the subsequent consensus reached following peer review and other expert opinion.

The structure of the report is as follows:

- Desktop Review - the findings relevant to the study are summarised in section one of the report under the three headings above (HAI risk, quality standards, flexibility). The quality and relevance of referenced literature has been assessed on a graded scale of robustness and reliability - the NHS research ratings were not used as this was too narrow a definition for this purpose.

- Peer Review - the purpose of the peer-review process was to provide a European forum within which to assess the findings from the desktop search. The composition of the group is given in Appendix 2. The nature and outcome of discussion is represented in section two of the report.

- The consensus view of the group is given in section three; this incorporates:
  - A commentary on the important findings for each of the three main single room determinants
  - A framework and ‘confidence’ assessment for planning and design guidance
  - Case studies that demonstrate how design considerations have been influenced by the factors explored in this report.

The aim overall has been to provide a reliable and robust approach to decision making about room configuration, and well-informed guidance parameters to inform that decision.

Selection Criteria – Participants and Evidence

Some of the participants in the peer review exercise had already worked closely with EUHPN on a number of previous projects; others were new to the organisation. All, however, have acknowledged expertise in one or more of the fields thought relevant to the inquiry: medical architecture and design, health service planning and logistics, clinical management, and microbiology. NHSE representatives were present at the meeting held in Amsterdam on 13/10/04, in order to provide critical input and to ensure that discussion remained focussed on the key themes addressed in this report.

No study is ever entirely free of bias. However, in amassing the literature and references that form the desktop review, every effort was made to ensure that:
• All of the relevant thematic elements were included. This was done by cross-checking references in key papers. Where those references were cited on a number of occasions, it was assumed that they formed an important part of a particular argument or position, and that their contents should be reflected in this report.

• Dissenting views were included. While the literature often led to an emerging consensus, it was rare for there to be no challenge to established opinion. We have tried to flag those areas where orthodoxy is questioned, while at the same time indicating where the balance of opinion lies.

• Advice was also sought from a swathe of experts and EUHPN members in a number of countries, in order to give the review European breadth.
Section One – Desktop Review of Available Literature

The genesis of the desktop review lay in a series of literature searches aimed at investigating the relationship between hospital design and rates of HAI, since at the outset this seemed to be the most relevant factor in the ‘push’ towards single-bed rooms. As the study progressed, this focus was enlarged to cover a number of further factors connected with single room provision, such as the patient environment, patient choice, flexibility, dignity, privacy, and confidentiality.

Search terms included ‘hospital design’, ‘infection control’, ‘infection containment’, ‘MRSA’, ‘nosocomial infection’, ‘ward design’, ‘bed spacing’, ‘hygiene’, ‘patient privacy’, ‘patient dignity’, and ‘medical confidentiality’. Advice was also sought from EUHPN’s members in a number of countries, in order to give the review European breadth.

The sources unearthed were arranged into categories, including:

- Internet journals
- The web-pages of regulatory bodies and other institutions
- A bibliography
- Some software resources
- Academic papers and other articles arranged by search terms, by organisation, and by country of origin.

When assessing the contents of the desktop review, especially in the case of academic articles on HAI, it was decided to employ a rating system. The aim was not to judge the academic merits of the papers in question (the NHS already employs a system to do just this) but to establish the robustness and relevance of the article to the question in hand. The rating system was organised thus:

* Rhetorical. The source assumes that the advantages or disadvantages of single-bed provision are obvious and given. The source doesn’t reference any evidence in the form of data or other literature. Example: ‘Ministers advised to scrap NHS wards’ (http://news.bbc.co.uk/1/hi/health/2012836.stm).

** Circumstantial. The source takes its cue from other literature, but doesn’t itself contain any primary research. Such reviews are often extremely thorough and useful, but they rely on hard data produced by others. Example: ‘The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity’ (Ulrich et al, 2004).

*** Single Issue. The source contains primary research, but limited to only one aspect of single-bed provision. Typically, this would be a study into the effects of isolation on infection by a particular micro-organism, within a particular cohort of patients. Example: ‘Control of Pseudomonas aeruginosa infections in burned patients’ (McManus et al, 1992).

**** Primary. The source contains data from original research, and considers two or more factors in relation to single-bed provision. Ideally, the conclusions reached
should be applicable beyond the area of intensive care. Example: 'The effect of moving to a new hospital facility on the prevalence of methicillin-resistant *Staphylococcus aureus* (Vietri et al, 2004).

Nearly all the sources rated ** or ***, with a few, mostly newspaper articles, given *. It was extremely hard to find any sources that could be considered as a **** rating - even the example given above is somewhat doubtful, since it is based on a rather small patient sample. The conclusion is, therefore, that the literature broadly divides into two camps. The first camp (***) takes its cue from the second (**) - papers that deal with a single, fairly narrow aspect of single-bed provision - and by combining those references with 'common-sense', makes recommendations that are usually in favour of single-bed rooms.

The desktop review was used as a basis for discussion at the Single-Bed Symposium held in Amsterdam on 13th October, 2004. The expert consensus from this meeting was that the impression offered by the literature review, in respect of HAI and single-bed rooms, was correct. This is to say, there is a distinct lack of high-quality, peer-reviewed studies on the effects of ward design on rates of healthcare acquired infection. Note that this viewpoint was also expressed by colleagues from Erasmus University, who had undertaken a similar in depth review of literature.

The subsections that follow synthesise the conclusions and recommendations provided by the desktop review sources for each of the factors linked to single-bed provision.

**Healthcare Associated Infection**

The 2003 report from the Chief Medical Officer, 'Working together to reduce Healthcare Associated Infection in England', makes the following points:

- "infection of patients during their care and treatment is common and in some cases life-threatening;"
- "whilst the problem is world-wide, the NHS in England does not perform as well as some other European countries" (p. 5)

The report is chiefly concerned with the clinical measures that can be taken to combat HAI, with questions of surveillance and investigation, and with issues of management and organisation. However, it does touch upon the design of hospitals and the environment in which patients are treated, insofar as these affect rates of HAI. The report points out that: "Programmes are underway ... to modernise ward environments." (p.2) and goes on to remark that one of the factors driving the increase in HAI rates has been "... the tendency of hospitals to admit patients with a wide range of serious illnesses from a large geographical area so that different pools of patients are mixing within the care environment." (p. 7). While recognising that all countries have problems in this area, some have been more successful in controlling HAI than others. Commenting specifically on MRSA, the report states as follows:

"Notable is the experience of the Netherlands ... The Dutch have been able to set aside sufficient numbers of single rooms in modern hospitals and maintain a high healthcare worker to patient ratio. As a result, this approach has been remarkably successful." (p.11).
Our analysis of the desk-top review material shows that, where it addresses the issue of single-bed rooms and HAI, much of the available literature arrives at a consensus which coincides with the opinion of the Chief Medical Officer's 2003 report. The broad conclusions are as follows:

- Rates of cross-infection are reduced by housing patients in single rooms
- Treatment of patients with HAI is made easier and more effective when they are not in open wards or multi-bed bays
- Single-bed rooms can be effective in improving standards of hand-hygiene, and in allowing more efficient cleaning and decontamination programmes.

The large-scale literature review by Ulrich et al (2004), for example, concludes that "...findings collectively provide a strong pattern of evidence indicating that infection rates are usually lower in single-bed rooms" (p.10). Reasons suggested for this are better air quality and ventilation, ease of decontamination and cleaning compared with multi-occupancy rooms, and lower levels of spatial proximity between patients.

Or again, in Lawson and Phiri's 2004 study:

"Single rooms can make a useful contribution to the two main dimensions of the problem of hospital acquired infection:

- Airborne (nosocomial) infection.
- Hospital acquired infection by contact with shared object interfaces." (p. 11)

There are two arguments here. The first is that convection accounts for a significant percentage of nosocomial infection, and that the ventilation systems associated with single rooms can help to overcome this problem. Lawson and Phiri acknowledge, however, that "better ventilation practice and design" (p. 12), even in multi-bed wards, can lead to a reduction in rates of nosocomial infection. The second argument is that the curtains commonly used in multi-bedded rooms are a means of spreading HAI, mainly because the space around beds is not large enough to hold all necessary equipment without making contact between curtains, objects, staff, and patients (Palmer, 1999). Furthermore, the current provision for hand-hygiene is such that when staff leave a curtained enclosure (due to an emergency, for example), they have no physical reminder of the need to wash their hands.

When considering the above arguments, it is worth bearing in mind that HAI can result from a number of vectors. Lawson and Phiri cite airborne pathogens and contact with 'shared object interfaces', but a fuller list is would be:

- Person to person contact
- Contact via contaminated surfaces
- Large droplet (coughs, etc)
- Small droplet (pathogens remaining from larger droplets after evaporation: comprising most airborne infections)
- Infections carried by insects, rodents, etc
- Water and/or food contamination
- Contact with skin fragments or other small body parts that carry infection.
Lawson and Phiri argue that single-bed rooms contribute to an environment where it is easier to detect and manage infection outbreaks, because:

- Single rooms can be adapted to act as isolation units
- Deep cleaning, subject to careful monitoring, is more easily carried out
- A high percentage of single rooms means that there is a reduced chance of whole-scale ward closures in the event of an infection outbreak.

As mentioned at the beginning of this section, much of the available literature conforms to the consensus that single-bed rooms are effective in preventing HAI, and in managing outbreaks of HAI where they occur. However, it is worth noting that this consensus is not as yet based on any large-scale, longitudinal, scientifically watertight study. There is a good deal of evidence concerning the efficacy of treating patients in single rooms or isolation units, but this mainly concerns very specific categories of patient, such as those with serious burn injuries or infected by SARS(*), rather than the more general population of less vulnerable patients (see, for example, McManus et al, 1994; Thompson et al, 2002; Farquharson and Baguely, 2003; Schwarz and Dulchavsky, 2002; Shirani et al, 1986; Health Canada, 2003; McManus et al, 1992; McKendrick and Emond, 1976).

It is worth noting that at least one study contradicts the consensus cited above. Vietri et al (2004) investigated the effects on MRSA infection rates of moving from a hospital with open bay wards to a new facility with single or double rooms. There was no significant change in rates of MRSA infection, which the authors attributed to a failure to change the hand-hygiene culture among health care workers. This is an interesting study, but it covers the experience of only one hospital and includes a relatively small sample of patients.

The importance of the Vietri study may in fact lie in the recorded failure to change the hygiene culture within the hospital in question. From the point of view of HAI, single-bed rooms may be effective because they can be designed strongly to encourage culture change amongst hospital staff (including cleaners, porters, nurses, allied health clinicians, and doctors) as well as visitors and patients themselves. Without an accompanying commitment to rigorous cleaning regimes, hand-hygiene compliance, and strict protocols on screening for colonisation and infection by pathogenic microorganisms, single-bed rooms are unlikely to prove to be a panacea in relation to the problem of HAI. Studies of the pathogenic colonisation of hospital fixtures and fittings (Aygün et al, 2002; Devine, Cook, and Wright, 2001; Bures et al, 2000; Neely and Maley, 2001; Noskin et al, 2000) suggest that as the number of wall surfaces, partitions, sinks, taps, keyboards, remote controls, etc increases, so must the level of attention paid to disinfection and cleaning.

(*) Note that, in the light of recent experience during an outbreak of SARS, Canadian authorities have revised upwards the need for single rooms in hospitals. See Farquharson and Baguely (2003) for the difficulties of isolating SARS patients, and Health Canada at www.sars.gc.ca for current guidelines and recommendations.
References


Quality Standards

The NHS's agenda on consumerism calls for efforts to be made to ensure that patients are not subject to undignified circumstances during a hospital stay, that their need for privacy is respected, and that patient confidentiality is given the highest priority.

A number of authors argue that single-bed rooms greatly help to ensure that these three conditions are met. Ulrich et al (2004), for example, refers to several US studies which show that in the absence of solid walls, both staff and patients feel that conversations are less 'secure', and that in some cases patients withhold some of their medical history. Ulrich quotes from a Press Ganey patient satisfaction survey, to the effect that "Greater satisfaction with privacy in single rooms was evident across all major patient categories and types of unit and across different age and gender groups." (p. 14). Note that Ulrich makes use of mainly north American sources in his study, and that the cultural and social conditions thus described may not be wholly or easily applicable to other parts of the world.

Lawson and Phiri (2004) cite a similar result from a BMRB telephone survey in the UK. Most of those questioned showed a preference for a single room, with the most common reason being given as "Privacy/more private/private person" (p. 16). Respondents also gave reasons connected with other 'social' factors, such as hygiene, sleeping patterns, security, noise, etc, but privacy was the most often cited. Lawson and Phiri also point out that the privacy of single rooms is likely to promote better sleep and rest, and allows patients to follow "individual cultural and religious practices" (p. 16). Furthermore, they quote from nursing staff who are acutely aware that curtains in multi-occupancy wards offer only a flimsy barrier when changing patients or carrying out other intimate procedures.

Not all studies reach the same conclusions regarding the need for single-bed rooms in order to provide patients with dignity, privacy, and confidentiality. Sharma and Monaghan (2003?), for example, investigated patients' feelings regarding privacy in a university hospital, and concluded that:

- A large majority of patients did not feel that privacy was an issue in communal wards
Most patients preferred a communal space to an individual one, usually citing anxiety about isolation as the reason for this.

It should be said that the sample size in the Sharma and Monaghan study was quite small, covering a total of 51 patients.

Another small scale study by Rees et al (2000), which looked specifically at the psychological effects of isolation nursing on patients infected with MRSA, Clostridium difficile, or Tuberculosis, found that mood disturbance was quite common. The paper recommends that patients treated in isolation should be provided with means of communication and entertainment, and that staff caring for them should be properly trained to recognise symptoms of anxiety and/or depression. Privacy and confidentiality, it seems, may come at a price for some patients.

The Patient Environment

What do people want from a hospital, apart from high quality clinical care? Some recent literature provides evidence that patient expectations have changed over the years, such that issues of noise, access to personal possessions, security, control over lighting and ambient temperature, and provision of en suite bathrooms have become increasingly important. These factors are examined by Ulrich (2004) and Lawson and Phiri (2004). Considered together, the consensus is that:

- Noise disturbance impairs patients' ability to recovery quickly, by increasing stress levels and disturbing sleep patterns (Barlas, 2001)
- Single rooms are quieter than multi-occupancy wards
- Rooms that can be personalised, in terms of control over lighting and temperature, lead to happier patients
- Patients value being able to keep some personal belongings with them
- Single rooms (especially those with en suite bathrooms) encourage patients to recover mobility more quickly, and give them an important sense of self-reliance
- Single rooms mean that family and friends can visit more frequently, for longer periods, and don't feel that they are disturbing others.

Put simply, a high percentage of single-bed rooms is seen by patients as an indicator of a high status hospital and, where choice is possible, may well influence the decision over which hospital to be treated at. A study of maternity care facilities and client satisfaction (Janssen et al, 2000) cited all of the above factors as reasons for choosing single-bed rooms as a birth setting, and found that only a tiny proportion of the cohort chose not to take up the offer of a single room.

References

Flexibility

The American Institute of Architects document ‘Guidelines for the Design and Construction of Hospitals and Health Care Facilities’ has recently noted that

“Universal rooms or acuity adaptable rooms are a current trend in design, especially in hospitals that are promoting patient-centered care and family participation in the patient’s healing program.”

Traditionally, UK hospitals have not been designed with a view to allowing family members or other lay visitors to take an active role in a patient’s recovery. Part of the argument in favour of single-bed rooms is that they can be used, not just to allow families to spend more time with patients, but to accommodate many diverse functions, such as:

- Patient recovery, after surgery or other procedures
- In situ medical treatment – wound dressing, physiotherapy, etc, thus freeing up communal treatment rooms
- Accommodation for many different types of patient: e.g, maternity, mental health, paediatric, etc, together with the equipment required for each speciality.
- A centre for family involvement in care and recovery
- A healing environment that can change to match the patient’s progress.

When allocating beds in multi-bed bays and open wards, hospital administrators often find that, for social or clinical reasons, certain mixes of patients are unwise or impossible. This is alluded to in the recent report by Lawson and Phiri (2004), which includes a number of key findings concerning the issue of flexibility. They find that:

“A higher percentage of single inpatient rooms enhances flexibility and simplifies the increasingly challenging and complex task of managing hospital beds and balancing demand against availability by eliminating roommate incompatibilities based on sex, gender, personalities, and so on.” (p. 3).
From the point of view of clinical management of specialities within the hospital environment, Lawson and Phiri also consider single rooms to have significant advantages. The particular needs of cancer care, paediatrics, maternity, mental health, and others are thought to be better served by rooms that can be more easily sterilised between patients and can have their physical characteristics matched to individual patient care plans. According to this study, the high status accorded to single rooms also make them of interest to third party organisations offering elective care.

If we take flexibility to encompass bed management in general, then Lawson and Phiri also argue that single rooms are advantageous, since their suitability for many different kinds of patient makes for “effective and efficient bed utilisation” (p. 10).

From an architectural standpoint, the BDP report (2004) comparing French and UK hospital design and value-for-money concludes that:

“France has used single-bed patient rooms in all new hospitals for twenty years … [and that] … firstly, bed utilization is superior and secondly patient recovery is faster.” (p. 14).

The need to accommodate changes in clinical practice and to meet the individual, specialist requirements of patients in terms of the space afforded them is also recognised in the healthcare construction sector (Langdon, 2003)
Interaction of factors that affect ratio of single-bed room provision

References

Erickson, D., (no date), 'Presentation on the Guidelines for the Design and Construction of Hospitals and Health Care Facilities'


Building Design Partnership (BDP), 2004, 'Learning from French Hospital Design', www.bdp.co.uk

Section Two – Peer Review; Discussion and Key Points

The peer review process was conducted in two ways:

- A meeting of selected experts to review the findings of the desktop review, including presentations of the analysis so far carried out:
  - EUHPN analysis
  - Erasmus University (Rotterdam) parallel review and findings
  - A Nordic perspective on design considerations

Note: the three principal bodies and organisations drawn upon for the initial review (EUHPN members, Erasmus and the Nordic group) provided multi-disciplinary contributions with significant general scientific and microbiological expertise and were chosen because of their noted prominence in this field, and their ability to make an objective contribution.

- Additional (subsequent) complementary contribution of other European members of the EU Health Property Network.

The following is a summary of the key points of discussion.

Historical Perspectives

There was convergence in the driving forces promoting the trend towards higher ratios of single rooms, in all respects:

- HAI – from the post 1980 period (an era of "emerging infections")
  - new pathogens (HIV, SARS, Legionella)
  - multi resistance (MRSA, TB)
  - more sensitive hospital populations (immunocompromised patients and an increasingly aged patient population)
  - greater mobility (global travel)

To more and different challenges in the future:
  - an ageing population (more chronic disease, frequent and longer hospital visits, greater risks of hospital acquired infections)
  - increasing multi-resistant pathogens
  - pandemics
  - increasing exotic diseases (the impact of global travel)

- Patient Privacy and Dignity – a trajectory of enlightenment and responsiveness
  - the impact of improvements in general living standards - raised expectations of quality
  - the increasing effect of cultural responsiveness
  - the needs (and expectations) of an ageing population – for those needing longer stays; the replication of home conditions – "we do not share bedrooms at home with strangers"
  - greater awareness of the benefits of social interaction
- better understanding of the changing needs of patients throughout the trajectory of their illness
- a shift away from ‘technological’ environments

- Flexibility
  - a shift from territorialism
  - new treatment modalities need ever changing co-locations of facilities
  - intensity of work pressures driving the need for greater operational efficiency - ‘every bed counts’

These were considered good examples of why there is now an evidence-based shift towards higher ratios of single room provision. No one factor has proved dominant, but this is changing.

Between the 1950s and 1990s ward configurations around Europe tended towards single ward corridors with various permutations of multi-bedded bays. There was no consistent pattern of single room provision. Since that time design standards have shifted towards a new benchmark base line of 50% single rooms evident in current projects, and with a multiplicity of configurations. However many older hospitals remain pegged at around 20% to 30% because of spatial and practical construction limitations.

The ‘issue of the moment’ spotlight can shine on any one of the driving forces behind these changes at any time - modern media access (and opportunity for ‘campaigns’) can substantially amplify pressure for answers at the risk of distorting the balanced approach that is necessary to make wise and secure investment in change. For the moment this is clearly HAI but as this comes under control the pendulum will inevitably swing back to other considerations – as evidenced by the ‘fits and starts’ nature of design changes over time.

Another feature of discussion was the extent (or lack of extent) of formalised guidelines across Europe; there is little evidence of minimum standards being set for single room ratios. Most countries tend towards promoting good practice standards but with more specific guidelines reserved for ‘technical’ health and safety standards that need to be applied in specialised single room provision (e.g. isolation rooms which need air filtration).

The Netherlands is a good example. Until quite recently the Netherlands matched the NHS in setting formalised guidelines for new hospital building. This approach has now been dropped in favour of benchmark standards of best-practice. Several factors are noteworthy in making an assessment about this shift:

- Almost all hospitals in the Netherlands are in independent not-for-profit ownership - the highest ratio in Europe
- Hospitals are funded on a payment-by-results system with fixed tariffs - the structure is based on the so called ‘Bismark’ (Insurance Funds) principle
- The Government intends to move towards a free floating, market contestable tariff system over the next 5 years.

In essence the shift away from strict conformist guidelines reflects the need for hospitals to have the necessary freedoms to make their own judgements but with the
safety net of standards that are monitored for best practice. It is important in this context to note that the Netherlands has the lowest HAI rates in Europe.

Is there now good evidence for specific guidelines - as an alternative to 'best-practice'?

The consensus view was that there was insufficient evidence to point to a definitive guideline. There are four distinctly different types of decisions that need to be balanced in arriving at a reliable proposal:

• 'Science-based' decisions - there is good science underpinning papers that deal with the clinical dimensions of HAI, but none is conclusive enough to use as the basis for determining a specific guideline. In any event there are two different dimensions involved:
  o control of infections that are airborne - where single rooms can provide a physical barrier. The level of provision will be influenced by the prevalence of this type of risk within the hospital environment. It should recognise the wide spectrum ranging from containment of large droplet infection (coughs) to well researched studies that define need for negative or balanced pressure rooms (the latter are regarded as specialist needs supplementary to the general considerations in this report); it is noted that such rooms are useful for airborne infection but have no great advantage over well designed, easily disinfected single rooms for infections which spread by other means.
  o control of infections that are spread by contact - here single rooms are likely to have a predisposing effect(*). Single rooms can be designed in such a way as to predispose staff and relatives to stronger observance of hygiene standards and procedures (e.g. hand washing and the use of alcohol rubs). This may be particularly important in the following two circumstances:
    - where intensity of work is such that staff may be tempted to cut corners in observing hygiene standards; e.g. poor cleaning of beds and equipment in open wards during times of high levels of ward transfers
    - where there are high numbers of staff unfamiliar with hospital procedures; e.g. substantial reliance on temporary or agency staff.

(*) published evidence is not conclusive but logic, commonsense and empirical observation support this point of view.

These two factors will vary considerably hospital to hospital, locality to locality - there is no evidence that promotes a standard - 'one size fits all' formulae

• Value-based decisions. There is good evidence to suggest that issues of privacy and dignity are major factors in shaping ward configuration. There are two different dimensions:
the need for privacy where this may have an important and beneficial effect on the doctor/patient relationship – "single rooms provide more privacy than ward curtains". There is evidence to indicate that this can contribute directly to better outcomes, but there is no evidence of a measurable and quantifiable benchmark standard at present.

the need to respect local views, values and cultures. This will vary from locality to locality and from generation to generation, and is emblematic of the UK government's drive towards local responsiveness. In NHS terms incorporating decisions about these factors justify and underpin the measures taken to engage citizens in the local management of their local foundation hospital.

**Operational-based decisions.** These are mostly self evident:

- type of clinical workload, including changing (variable) patterns of care, accommodating mixed regimes of patients and the individual approaches adopted by clinicians within the same speciality – it is also necessary to think in terms of:
  - patients who may act as a source of infection (*), and
  - patients who through the nature of their treatment will be more vulnerable to infection

(*) also a major factor for hospitals introducing pre-admission screening techniques similar to those adopted in the Netherlands. In this instance the availability of single rooms for 'urgent/emergency admissions' is clear.

- managing outbreaks of infection - where the need for isolation facilities is axiomatic
- workforce availability and flexibility
- managing the dynamics of demand
- professional (hospital) management cultures
- facilitating maintenance in high intensity use facilities

Finally all these need to be set within a fourth decision framework: cost.

The NHS is moving from a mixed economy (but essentially allocation) based funding system for hospitals to a payment by results system (described in more detail later). This will be a transitional process and conversion will involve moving from:

- A cost-control ethos where the principle in making financial judgements about single rooms (revenue and capital) is affordability and cost-efficiency to
- a return on investment (and cost sensitive) regime based on cost effectiveness of capital and workforce investment.

The three factors above will need to be balanced against each other, and weighed against economic factors.

It is difficult to see in the interplay of all these factors that a 'single-bullet' target guideline will be realistic and effective. In respect of the contemporary issue of healthcare acquired infection there is simply no science-based evidence available to suggest a specific ratio that can be justified as having universal application.
Is there a risk of a double standard and can it be managed?

Reference to the Australian experience provides an interesting insight into this issue. Australia has a mixed economy of provision of ‘public’ hospital services. There are both conventional State-owned public hospitals and public private partnerships delivering public services under long-term government contracts. There are two different standards applied to single room guidance:

- Public hospital projects are generally subject to a maximum single room ratio of between 20% and 30% - the criteria is primarily one of cost containment
- Public private partnership hospitals (providing the same type of services) do not have to comply with any guideline on room ratios - most have opted for much higher ratios of between 50% and 80% (there are few that approach 100%) the level of provision is ‘at the risk’ of the PPP operator. Their decisions on ward configuration follow mainland European trends with factors such as service type (e.g. surgical, palliative care or rehabilitation service), flexibility, local expectation, local competition and potential private healthcare market.

Put simply they are all paid by results and therefore apply return on investment principles in working out the optimum configurations for design. It is to be noted that public private partnership hospitals are consistently regarded as being better and more cost-effectively designed - a distinct factor of freedom to decide and innovate.

There seems no public (or professional) disquiet over the different standards, excepting a public preference for those hospitals that can offer better choice of single room provision. This is anecdotal; there are no figures to prove the point. Public confidence in HAI risk management is generated by the benchmark standards set by the Australian Commission for Healthcare Standards (ACHS) - State governments require satisfactory accreditation of PPP hospitals as a prerequisite for granting public service contracts (this principle is now increasingly being applied to public hospitals). The ACHS does not apply conditions concerning room ratios but instead monitors hospitals on evidence of good HAI management practice e.g. clinical and hygiene standards and guidelines, observance of good practice and rates of infection.

There are important lessons in this analysis for managing the evolutionary growth of foundation hospitals - they will be very similar in nature to many Australian not-for-profit PPP hospitals. The Australian experience with PPP's suggests a flexible but effectively monitored approach.

A number of Australian States have indicated an interest in collaborative research and development based on the findings of this study to better understand the impact of single room standards and ratios.

Can the current ‘benchmark’ of 50% be justified?

In some European countries, such as France, it has been the norm for some years to build hospitals with a very high percentage of single-bed rooms (approaching 100%) driven primarily by cultural expectation. It should be noted however that most current
schemes in planning stage have dropped back from this position (excepting for obstetrics where 100% is standard) due to concerns over cost. HAI infection is not seen as a major determinant in shaping decisions over single rooms. The USA on the other hand demonstrates an almost universal switch to 100% single rooms. In other European nations, for example:

- Finland has targeted 50% as the ‘normative’ provision although there is no explicit mandatory guideline as such.
- Sweden and Norway are demonstrating similar standards
- the Netherlands have tended to move towards 50% single bed accommodation. However for the proposed new Erasmus University Hospital, planning is predicated on the basis of 100% single rooms; HAI risk management is regarded as one of the main determinants and unless new contrary evidence emerges the hospital will hold to this line.

In the UK those adopting a more progressive view of design flexibility are tending towards higher ratios. Results here have so far been encouraging. Lawson and Phiri (2004) note that 50% single room provision at Poole General Hospital has impacted positively on bed management and occupancy levels; that the 85% level at Hexham General has been well received; and that 100% single inpatient rooms at the Kidderminster Diagnostic Treatment Centre are “crucial for this type of healthcare facility” (p10).

There is however some ambiguity elsewhere in Europe. In Germany where Rhon Klinikum (a major private hospital concern) has bought former state hospitals and is now providing services under PPP contracts the prevailing model is based mainly on double (or alternatively triple) bedrooms with a shared en-suite bathroom as the design standard. However other hospitals in Germany with this (double) model express concern that if one bed becomes ‘infected’ the other is ‘lost’ for the duration of the outbreak. Rhon Klinikum hospitals however have rigorous preadmission diagnostic strategy and this will enable them to filter out ‘risk’ patients and accommodate them in the small number of isolation rooms they provide on each site.

The question is, why 50% - 100% as a benchmark? Why not have, say, 40% as a lower bound, and 75% as the upper figure? In discussions with EUHPN members in a number of countries, it has become clear that there is no single, definitive answer to this question. Rather, it has become apparent that a lower limit of 50% has emerged in response to public expectations, changes towards more a ‘patient-focussed’ environment, as well as experience and new knowledge in regard to modern health care. Some planners now regard a minimum of 50% single room provision as justified solely in the light of emerging concerns over infection control and the possibility of new pandemics, regardless of the more ‘social’ issues, such as patient choice. However this so far has generally been a ‘rule of thumb’ decision based on the following assessment: “the role of single rooms in preventing HAI is not proven by randomised controlled trials but - obvious from present knowledge and logical reasoning that single rooms play a major role in reducing some preventable diseases and beyond all doubt in other specific disease areas.”

In those countries (again, such as France) where a high percentage of single-bed rooms has become common, there is no evidence that local, regional, or national health
authorities show any wish to return to multi-bed accommodation for patients at the cost of significant dilution of single room density - even though current financial pressures are engendering some small degree of change. In this regard, a paradigm shift to more privacy and a higher quality patient environment appears to be stable and durable.

Whatever the percentage of single-bed rooms found to be suitable for a particular hospital, it is certain that this ratio will be subject to further challenges as the nature of patient care changes, and as design standards influence issues of cost and practicality.

The need for a new planning paradigm

The clear message from the single-bed symposium, and from input provided by experts in a number of other European countries, is that hospital design and health care provision have to have flexibility built in. This is required at two levels:

• In terms of responsiveness to future developments in health care
• In terms of the current trend towards ‘universal’ spaces for treating patients.

The Dutch perspective, especially in regard to the new Erasmus MC University Hospital, is that the overall design must allow, as far as is possible within their financial restraints, for effective, low-cost conversions from open, public spaces to private treatment rooms, and for single-bed accommodation to be quickly upgraded to isolation rooms. At the same time, the design of single rooms has to be such that they are suitable for treating a very broad range of patient types, with the space and orientation necessary for installing the appropriate medical equipment.

This approach emphasises innovation in planning, looks to respond to patient choice, tries to take into account future developments in medical technology, and keeps a weather eye on newly emerging pathogens.

Our review has unearthed an important truth: health services from Australia to Finland, from the USA to Greece, are all engaged in determined efforts to understand how best to configure hospitals for the challenges of the coming decades. However, each country is essentially ‘going it alone’, in terms of standard-setting and research. While there are some clear trends across, for example, EU-15 countries (a move to 50% single room provision, patient-focused care, etc) there is little evidence of collaborative, multi-centre, multi-country research. Many of those present at the Amsterdam symposium felt that such an approach could be of great benefit to the participating nations, in terms of setting minimum standards for health care environments.

There was also a general recognition that innovation in planning also acts as a way of the overcoming or changing the mindset in many health societies that reaching the minimum standard is ‘another target achieved’.

References

Section Three – Consensus

The clear conclusion from analysis and discussion is the multi-factoral nature of cause, effect and management of HAI. There is now evidence that high HAI infection rates are also reflective of systems problems and failures. By definition therefore the resolution is both multi-factoral and concerned with systems improvement; with design considerations forming only part of the answer – but an important part. It is also clear that although effective management of HAI risk is one of the key determinants governing decisions about single room ratios, it is not the only one and should be balanced against other considerations.

This proposition needs to be set in context. No two hospitals are alike in role, function and scale. The profiles of hospitals, their range, nature, and scale of treatments and procedures, patient populations and their local catchment area will vary considerably. For this reason it would neither seem logical or reasonable to issue a blanket 'one size fits all' guidance on ward configuration and single room ratios. The government’s ‘choice’ agenda, allied to devolved ‘local’ freedoms and interaction with the local community (as given point by foundation hospitals) reinforces the more responsive approach discussed below.

The strong consensus view of the peer group (and other experts consulted) is that there is good evidence to suggest that the confidence parameters for guidance on single room ratios lies between 50% and 100%. The reason for this spread is the matrix of variables dependant upon the service range of the hospital and its local population. It also anticipates potential changes in demographic and epidemiological trends and the rapidly changing nature of medical technologies and models of care. These judgements are not easy. What is required is a systematic and reliable process that provides:

- Means by which the risks of HAI can be prospectively assessed and which relate to two considerations:
  - the clinical repertoire of the hospital which in an acute setting may range from patients undergoing by now routine procedures such as major cardiac surgery, which nevertheless carries HAI related risk for the patient because of increased vulnerability generated by the procedure itself, to the extreme end of the spectrum; total body irradiation which will point to the need for high quality specialist isolation facilities
  - the patients and their visitors themselves where it may be necessary to take into account factors such as age as presenting another form of vulnerability or where there may be an underlying infection problem endemic in the local community
- Ways of balancing the relative priorities of HAI risk management, quality and flexibility in decisions about ward layout
- Engagement of professionals and the public in decision making - transparency as a means of generating confidence
• Means of translating population (healthcare) need into measurable factors that inform hospital design considerations - over-reliance on past history or existing patient populations is unreliable because of the factors mentioned above.

It was a strong consensus view of the group that it should be possible to construct a risk scale for the patient profile and case mix of a hospital and from this determine average figures for numbers of patients in a series of risk categories ranging from high to low. A matrix (in the sense of its HAI dimension) developed for this purpose would provide the means of cross referencing the leading types of infections acquired through healthcare with the major (and by now better understood) mechanisms involved in their spread but set within the real terms context of the hospital and its associated population.

These are approaches that promote breaking the mould of incrementalism. Hospital planning has in the past tended towards an evidence-based construct, drawing on post-occupancy evaluation to inform designs for the next generation of hospitals. There are two observations:

• Hospitals can take from 4 to 7 years from concept to operational commissioning - the time lag effect
• Medicine and public expectation is moving much faster - more unforeseen (predatory) infections, more technically demanding interventions, more vulnerable patients and demands for substantially improved quality standards; notwithstanding changing economic and operational considerations

In present circumstances then it is even more necessary to get well ahead of the game.

The group then considered the practical dimensions of developing a matrix approach to planning and design. It is felt that a combination of epidemiological and demographic profiling, and care-pathway principles, could (and should) be applied to the decision-making process. Population profiling in most senses is already well developed. Care-pathways on the other hand provide the means by which potential population health needs can be translated into service language that is useful for planning and design. Care-pathways are built around casemix descriptions - the core language of disease profiling. Care-pathways describe prospectively:

• The clinical need of the patient
• The specific treatments and resources necessary to meet that need, and
• The planned outcomes.

Describing and understanding patient needs in this manner provides all the information necessary to identify the combinations of factors that will inform design considerations. From then on it is a simple matter of applying the matrix of risks operational factors and values:

• Risks: what level of risk of HAI attaches to the clinical (casemix related) profile of potential patients as shaped by the nature of the hospital in question; thus tertiary teaching hospitals with a high ratio of clinically vulnerable patients will likely grade towards the top end of the HAI risk scale and this need may dominate other considerations
• Operational: what special considerations need to be given to the specific 'flexibility' needs of the hospital e.g. managing high and unpredictable levels of emergency admissions

• Values: how does the local population (and patient need) inform value judgements about privacy and dignity, thus:
  o hospitals with large numbers of elderly patients may grade towards the lower end of the guideline e.g. a balance between the need for single rooms for disturbed or terminally ill patients; more 'social' bed areas where local culture values this facility. However many frail elderly will remain vulnerable to infection, particularly those rehabilitating from invasive procedures such as hip replacement - these dimensions will be factored in.
  o in many instances single rooms will undeniably improve the doctor / patient relationship - resulting from the ability to discuss clinical (or social) conditions with greater privacy than that offered by curtains. This may be a highly valued consideration in some circumstances. The systematic assessment process advocated here should ensure that this often overlooked factor is given appropriate weighting.

What is proposed here is simply a robust approach to evidence-based design; one that relates more explicitly to prospectively valued and described patient need. Lest it be thought that converting the full potential requirements of a large catchment population is an onerous task, research has shown that in most circumstances just 30 HRG’s are responsible for:

- 45% of all emergency hospital episodes
- 52% of inpatient elective episodes
- 78% of day cases.

Designing for good-practice benchmark standards

The current, almost microscopic, examination of all factors that may influence the levels of HAI will almost certainly ensure that within the planning lifecycle of new hospital schemes approved in 2004 there will be a range of initiatives that will bring this problem back under better control with resultant probable reduction in overall levels of infection. Some programmes are already underway, for example:

• 'A Matron's Charter: An Action Plan for Cleaner Hospitals', the recent programme to ensure across-the-board recognition that "cleanliness is everyone’s responsibility, not just the cleaner’s".

• The measures piloted by UCLH and other hospitals, such as:
  o Wound surveillance
  o Aseptic-Non-Touch-Technique
  o Pre-surgery screening via nose swabs
  o Use of alcohol hand gel.

• Mandatory induction training on HAI for all hospital staff.

Others will follow:
• Introduction of new 'over the horizon' antibiotics
• More widespread pre-admission screening of patients
• More effective operational standards that reduce the current reliance on extremely high bed-occupancy ratios - reducing the 'intensity of work' factor that may contribute to current problems
• Better surveillance to identify new opportunistic and predatory diseases

In other words, we foresee a basket of initiatives that will have impact irrespective of planning guidance issued now; planning guidance that will take from 4 to 6 years to come into effect. This therefore places a premium on:

• Introducing a guidance framework that is predictive and anticipatory of change rather than based on current HAI experience
• Benchmarking standards against the best that can be found; the rationale of this report in reflecting European perspectives.

Valuing design in a new healthcare landscape

The guidance offered on single room ratios should also reflect the dramatically changing healthcare landscape faced by hospital management teams. Decisions about new capital investment will be influenced by factors that in themselves are new:

• The patient choice agenda - patients will have guaranteed rights and will exercise this against criteria such as:
  o speed of access
  o quality of care and environment
  o clinical outcomes
  o HAI infection rates. Hospital responses to the problem will be in the public domain and will be a major factor influencing patient choice. They will look for evidence of good practice, they are likely to interpret single room provision as indicating good practice.
• Choice will be backed up by payment by results under fixed tariff arrangements - this policy will be in full force and through its transitional stages by the time SOC approvals for 2004 come on stream. Payment by results will introduce the reality of appraising capital projects against more rigorous 'return on investment' principles
• External and independent review by the 'Monitor' in addition to ongoing review by CHAI
• Greater involvement of the local population in the management of hospitals such as promoted by the Foundation Hospital movement

All hospitals contemplating capital investment will therefore face more complex judgements and trade-offs, for example:

• A balance between designs that maximise HAI improved risk management set against potential increases in capital and / or operational costs
• A temptation to opt for the minimum standard guidance purely on cost grounds
• Investing (and designing) for change in role and configuration - the choice agenda will lead to greater diversity and contestability
• Pressure from local community interests for configurations that may be in conflict with say economic considerations.

This may be a new environment for NHS hospitals in England but is already the norm for many European hospitals. It is at this point worth amplifying the issue of cost efficiency vs cost effectiveness. The NHS has been conditioned through benchmarked targets towards placing emphasis on cost reduction; the cost efficiency model. Such has been the pressure that cost considerations may swamp arguments in favour of better and more effective design.

In the changed (and continually evolving) patient led environment, backed by the new tariff system, opportunity cost will become much more important. Successful hospitals in Europe providing public healthcare but working in a competitive 'public service' market - whether they are not-for-profit institutions (Netherlands) or PPPs (Rhon Klinikum, Germany) - have adopted the cost-effectiveness model of investment appraisal. They weigh the gains made through providing better quality and potentially lower risk hospital facilities against the risk of losing market share or losing income through the quarantine impact of managing outbreaks of infection. This has led for example to greater consideration of establishing improved preadmission screening systems and diagnostic facilities and brought clarity to the thinking behind ward design, as in the case of Erasmus Hospital.

The economic considerations are given point by the assessments described in the two case studies below; Erasmus and St Olav’s. Both project lower lengths of stay through emphasising single room provision, in the case of St Olav the financial projections assess and describe the economic benefit of 'investing in design.'

Whilst the public service ethos of commitment to quality is still a prominent feature it is nevertheless tempered by the harsh reality of an increasingly competitive healthcare market. Hospitals in this position are also mindful of the difficulty of regaining public confidence if things go wrong; the salutary side of informed and effective patient choice.

This now resonates strongly with the introduction of fixed tariff systems in the NHS. The tariff is based on average lengths of stay; the case presented by St Olav’s will apply. Any prolongation of stay as may be triggered by HAI will place the Trust at financial risk. Therefore measures which enable the hospital to minimise this risk will have a material payback that should be taken into account at design and investment appraisal stage. Equally important is investment to ensure effective management of outbreaks, single rooms enable patients to be isolated to avoid losing the availability of beds in multi-bed settings. Furthermore seen in the context of the Netherlands (and Rhon Klinikum) should steps be taken to introduce pre-admission screening higher ratios of single beds anticipate the practical workflow/urgent admission need.

Such considerations have therefore influenced this report in the direction of 'confidence parameters' and decision making guidance. In terms of practical support for those hospitals contemplating this changing scenario, organisations with a pan-European perspective and expertise in this field (such as NHS Estates and EUHPN) can provide a reference point for support and a means of collaborative development of new matrix planning techniques.
The ‘bell-curve’ impact of design considerations

The following case studies reflect a shift towards complete 100% provision of single rooms for the two hospitals in question. The rationale is explained but in part is indicative of the bell-curve effect of cost and practicality of bed ratios pitched between 50% and 100%. At 50% there seems evidence of a cost-equilibrium – a good balance between all the factors in play. As single bed ratios are increased costs will rise; factors of design, spatial allocation, workforce impact and environmental service costs. A point can be reached however beyond which the philosophy of care and operational management may change. Single rooms may become multi-purpose, for example, used for family-centred care. This may start to eliminate the need for separate ancillary spaces such as day-rooms, treatment rooms, etc. At this ‘tipping point,’ cost (capital and operational) should reduce. A study by the NHS Estates architectural advisory team would seem to imply this projection. This tipping point will vary according to the care and treatment philosophy of the hospital concerned matched against the profiled needs of its patients. A typical bell curve is shown below as a means of illustrating this point.

European experience in establishing design standards

Two case studies are presented as examples of the interaction of design considerations with overall hospital function, role and cost – and issues such as HAI risk management –
in shaping new hospital projects. The two illustrations taken from the experiences of Erasmus University Hospital, Rotterdam and St. Olav’s Hospital, Trondheim.

Erasmus University Hospital

Hospitals in the Netherlands are nearly all run as private, not-for-profit organisations, although heavily regulated by government agencies. The 10% of hospitals that are not in private hands are the university hospitals, such as Erasmus. As a percentage of GDP, 2001 data show that the Netherlands’ expenditure on health was almost exactly the same as the EU average, at 8.9% (some 1.3% above the UK spend). The trend in health care expenditure for the Netherlands has recently been increasing, at least up to 2002 (European Observatory, Health Care Systems in Transition).

The new Erasmus MC university hospital is still in the planning stage, but the clinicians, administrators, architects and designers responsible for the new building have already reached a consensus that they will offer 100% single-bed rooms to most of their patient population. The considerations that led to this decision are as follows:

• Patient care is becoming more complex, and more demanding (not least because of HAI)
• Both patients and staff expect higher levels of privacy
• There is an increased need for isolation facilities
• Patients increasingly ask for ‘rooming-in’ facilities
• Patient care now requires more flexibility in terms of room space and equipment configuration
• The number of rooms required may change according to the nature of care.

Erasmus MC recognises that for some patients - e.g. those treated as day cases, or where ‘joint care’ is appropriate - multi-bed wards may be more appropriate, but considers that for the general patient population, single rooms are the answer.

This strategy is not without complications, however. Money allocated to a hospital build in the Netherlands is directly related to the number of beds, and there is a fixed minimum area required for each bed. In the case of the Erasmus hospital, the authorities are planning on the basis of 1000 beds and 95 m² per bed. Given the Dutch view that single-bed rooms require more space, they were faced with the question of how to fit an adequate number of beds into the total area available. The answer, according to the chief architect for the project, is that the greater patient throughput in single rooms (thanks to shorter stays and greater flexibility of use) means that fewer beds are required to serve the same patient population. Fewer beds has also meant that there has been room to expand outpatient facilities, in line with the government’s ‘hospital care improvement’ programme. A reduction in bed numbers is in line with the trend in the Netherlands since the 1980’s, such that, by 2001, the figure for acute hospitals was just 3.1 per 1000 population: well below the EU-15 average. The occupancy rate for acute care beds is also extremely low, at just 58.4% (European Observatory, Health Care Systems in Transition).

Two important tests are currently taking place. Firstly, the single room layout is being carefully and rigorously examined by means of a mock-up, to define the room plan, equipment configuration, lighting, etc. Secondly, the Dutch consider the issue of
staffing levels to be one of the most important imponderables. In order to reach a firm conclusion here, the existing hospital will be renovated and have alterations to its floor plan. During the 10 year build cycle of the new hospital, the existing structure will be used to evaluate the optimum number of staff needed to cope with the change to 100% single rooms. The results of the above tests could be of great interest to NHS planners who wish to make comparisons with similar studies in the UK.

It is worth bearing in mind that Erasmus MC is a university hospital, serving a large, highly mobile, urban population, and that the staff see a relatively high number of immunocompromised patients, as well as many clinically challenging cases. This may help to explain why, although the Netherlands has a relatively low rate of HAI, infection control has clearly been a key factor in determining the choice of a high proportion of single-bed rooms.

St. Olav’s Hospital

The public health system in Norway is perhaps more similar to the UK’s than that of the Netherlands, in that it features “tax-financed public provision together with limited out-of-pocket payments” (European Observatory HiT summary, Norway, 2002). As of 2002, Norway’s health care expenditure as a percentage of GDP was somewhat above the EU average, and the number of acute beds per 1000 population was holding steady at around 3.5.

St. Olav’s hospital and the Faculty of Medicine together comprise the University Hospital in Trondheim. Work to replace the existing University Hospital with a series of new structures, devoted to “improved resource utilization and shorter hospital stays” (Aslaksen, 2003) began in 2002, with the first phase of what will eventually be a series of clinical modules integrated into the structure of Trondheim’s city centre. The vision is of changing the hospital’s focus from staff needs to patient requirements, and to use environmental psychology as well as aesthetics and Nordic design principles to achieve this.

Trondheim’s new hospital will serve both as a local hospital for the 250,000 inhabitants of the city, and as a regional hospital for central Norway (population approximately 650,000). With that population base, and as a teaching hospital, the patient profile is at least similar to that of Erasmus MC. The Norwegian designers also opted for 100% single-bed rooms, and the factors leading to this decision are ostensibly similar to those taken into consideration in the Netherlands:

- Lowering rates of HAI
- Patient privacy and control
- Greater family involvement in care
- Wider range of treatment options in situ
- Better facilities for medical students

However, close examination reveals a rather different mix of priorities. The Norwegian emphasis on patient-focused care has led to extensive participation by patient organisations in the design of Trondheim hospital, and it has been the patient organisations that have driven the demand for single-bed rooms. From 1997 onwards, the hospital’s architects and designers have seen patient satisfaction, patient transfers,
issues of privacy and confidentiality, and flexibility of use as the key drivers in the decision to offer 100% single rooms, with infection prevention only gradually emerging as an important factor. A further consideration has been the increasing proportion of the elderly in the Norwegian population, a trend that will continue at least up to 2020.

Although the influence of HAI concerns on ward design has not always been as important to the Trondheim hospital as it has been to Erasmus MC, data from Norway certainly indicate that it has been given serious consideration. The average rate of HAI in Trondheim has been around 8% (of all patients) since 1985. With 45,000 hospitalisations per year, this translates to 3,600 HAI cases annually. Such patients average hospital stays are 4 days longer than would otherwise be the case. The Norwegian estimate is that the effect of single rooms will be a 10% reduction in HAI rates, reducing the overall figure by 360 per year and generating a saving of NOK 5.4 million. (Data supplied by Trondheim hospital's chief architect.)

References


European Collaboration

A surprising outcome of the study was the lack of good ‘science’ on the subject: very few studies were considered robust and reliable in tackling the links between HAI and ward design. This was a view shared by all participants in the peer review group, and subsequent contributors. There was a strong declaration of interest in establishing a forum to explore the prospects of a pan-European (and Australian) research project. This was endorsed at a full plenary session of the EUHPN bi-annual member workshop held in Edinburgh (November 2004). It is proposed that relevant members of the initial peer review group should prepare a supplementary paper for urgent discussion.

In the wider sense the Workshop, attended by representatives and observers (including the WHO) from fourteen countries, provided an opportunity to present and discuss this report in draft form. There was strong and clear support for the findings, the consensus views expressed and the conclusions and recommendations – it was in effect an opportunity to apply the EU principles of Open Method Coordination (OMC) to an issue that affects hospitals throughout Europe.
Section Four – Conclusions

The purpose of this review is to provide a European perspective to aid decision-making about guidance on single room ratios as a design feature of new hospital developments and as a benchmark standard for existing hospital refurbishment within physical and resource constraints.

The nature and substance of guidance should take account of two factors:

1. The guidance on room ratios must be based on evidence that is credible to:
   - clinical, nursing staff and other health professionals delivering the frontline service to patients
   - patients and their relatives
   - the wider public

   The evidence should be interpreted and applied in a manner that is open, defensible, reliable and robust. It must add value to the drive against HAI through contributing to a safer environment for care and should aid better clinical outcomes.

2. The guidance must also take account of the changing public service ethos and changing healthcare landscape. It must therefore endorse and apply key principles:
   - the government’s choice agenda
   - the devolved freedoms to innovate and tune services responsively to local needs
   - engage the local communities in decisions about local healthcare services
   - recognise the changes in hospital funding (payment by results tariffs) to support the above principles

The findings from this review therefore commend:

- Single room ratios within the 'confidence parameters' of 50% to 100%
- That there is the freedom for local determination within these guidelines but against evidence of a robust and systematic assessment of risk and justification of ultimate design decisions
- That a set of benchmark 'illustrative' guidelines be developed covering the principle types of hospitals in evidence within the NHS e.g. Tertiary Teaching, DGH, Community Hospital etc
- That predictive risk analysis allied to hospital population and local community profiling should be recommended as a means of implementing satisfactory risk management design strategies
- That steps be taken to establish a multi-centred, multi-national longitudinal action research programme on the subject of design / HAI interaction
- That steps be taken to develop expertise and knowledge development support for staff working in this field
There is notable convergence between English NHS hospital services and those on the continent:

- Increasing concerns about the growing risks of HAI
- Increasing awareness of the need for more responsive and personal services to patients
- The need for continuous improvement in operational efficiency
- Increasing financial pressures; the effect of choice and contestability and payment systems that place a premium on quality and outcomes
- High degrees of devolution and local freedoms

For all these reasons the European viewpoints and experience embedded in this report are considered relevant to the NHS.

Recommendations

Although this report was commissioned as an observational study, the unanimity of view suggests it is appropriate to make a number of specific recommendations. They are:

1. Guidelines should promote a good practice range of between 50% and 100% single rooms - there is a strong ‘confidence’ base for this judgement.

2. Design decisions on HAI risk and other single room determinants should relate to the profile of the hospital and its local catchment population - not on the evidence of currently observed rates of infections or standards but on a predictive model that translates population need and infection risk into a service language that is useful for planning and design.

3. That a practical risk matrix scale be developed as an aid to profile analysis.

4. There should be support for hospitals in changing focus towards a cost effectiveness model of capital investment and design (in particular relating to judgements about HAI) and that advantage be taken of the expertise currently available within NHS Estates and its European alliance through the European Health Property Network.

5. The prospect of establishing a pan-European multi-centred study into the links between HAI and hospital design be vigorously pursued
Postcript

It is noted that the NHS is well positioned to promote new principles and concepts in healthcare during its Presidency of the EU during 2005. HAI is a European (and global) issue and patient safety is high on the agenda of all countries. Whilst this report does not deal with manpower issues there is scope to align this report with other initiatives. For example; linking good nursing practice developments in this field with the practical design modelling programme being developed by Erasmus hospital.
### Appendix One – Single Room Provision by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>History</th>
<th>Trend</th>
<th>Reasons / Notes</th>
</tr>
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<tbody>
<tr>
<td>Finland</td>
<td>50’s - 1990, 21 hospitals for ‘specialised care’, built with 1, 3, 6-bed rooms, later with 2 and 4-bed rooms. Local hospitals: same model, but smaller-scale. No tradition of open wards.</td>
<td>New hospitals (acute/teaching) built with 50% single, 50% double rooms - e.g. University Hospital in Helsinki; Turku University Hospital; Oulu City Hospital (acute primary care) 60% single, 40% double. Health Centre Hospital (Hanko City) - 20 single, 11 double.</td>
<td>Patients’ preference. For general hospitals, the priorities are hygiene, flexibility, privacy. For long-term hospitals, priorities are privacy, dignity, hygiene.</td>
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<td>Netherlands</td>
<td>Historically, Dutch hospitals have been designed with 4-bed bays, with no differentiation between teaching, university, acute, or general. Guidelines issued in 1995 suggest a mix of 4 single, 4 double, and 2x4-bed on a 20-bed unit.</td>
<td>In the last 3 years the trend towards single and double rooms has grown. Apart from Erasmus MC, one other new-build hospital has been constructed with 100% single rooms, while others have seen varying ratios, from 25% - 30% upwards.</td>
<td>Dutch hospitals have great freedom to choose their own distribution of beds, as long as the gross area stays in govt. defined limits. Most recent guidelines (2003) don’t suggest any distribution; even those of 1987 only mentioned the overall number of beds.</td>
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<td>Norway</td>
<td>Low proportion of single rooms in general hospitals - mostly 2 or 4-bed bays. Rikshospitalet state hospital has 25% single rooms.</td>
<td>Trend is towards more single-bed rooms. Apart from Trondheim (100%), the Nye Ahus hospital in Oslo is being constructed with 50% single rooms, the rest in double room accommodation.</td>
<td>Patient-driven requirement for single rooms (esp. in Trondheim) via patient organisations. ‘Social’ aspects of single room provision have been important since the mid 90’s, HAI emerging now as a priority.</td>
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<td>Australia</td>
<td>Publicly-funded hospitals have traditionally had a ratio of around 20%-30% single-bed rooms.</td>
<td>No change in the state sector. However, PPP hospitals are built with a ratio of 50% single rooms where most of their caseload is public sector; a higher percentage where they do a significant amount of private work.</td>
<td>Australian health authorities monitor policies on hygiene, bed occupancy, patient satisfaction, etc, rather than putting in place requirements for single room provision. State hospitals regard cost as the issue preventing a higher single room percentage.</td>
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<tr>
<td>Country</td>
<td>Description</td>
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<td>Ireland</td>
<td>Ireland has a relatively old stock of hospital buildings, many still with open or multi-bed bays and only a low ratio of single rooms</td>
<td>In the geriatric care sector, PPP/PFI projects are currently planning for 50% single room accommodation.</td>
<td>Dignity; family-oriented care. Financial restraints make change difficult for other health care sectors. Under current health service reforms in Ireland, the DoH will become a policy/strategy unit, with a Health Service Executive to run health services.</td>
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<tr>
<td>Switzerland</td>
<td>Many Swiss hospitals are privately run, but there is also a significant public sector. From the 20's to the 90's hospitals were built with 1, 2, and 4-bed rooms, in varying proportions</td>
<td>From the 90's onwards, hospitals (especially in the private sector) are built with 1 and 2-bed rooms, 50% each. Public hospitals still have some 4-bed bays</td>
<td>The mix of single and double rooms in private hospitals matches the requirements of Swiss health insurance. Fully insured patients usually opt for single rooms; 'semi-insured' patients are offered doubles. Public hospitals cater for all patient types.</td>
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</tbody>
</table>
| Canada | Update: Canada’s response to recent SARS outbreaks has been a review of existing healthcare facilities, and new recommendations regarding the accommodation of patients with febrile respiratory disorders during SARS outbreaks anywhere in the world. These recommendations clearly increase the need for provision of negative pressure rooms, HEPA filtered single rooms, single rooms generally, and 'semi-private' rooms. | | Infection Control.
Appendix Two – Contributors, Commentators, Observers

The EU Health Property Network has active members and contacts not only within each of the EU-15 countries, but also across a number of non-EU European states and, increasingly, within the recent accession countries. The expertise and knowledge provided by many of the representatives of these countries has been invaluable in preparing this report.

Peer Review Symposium – Amsterdam, 13th October 2004

The following people were present as contributors or commentators at the single-bed room peer review symposium:

- Marinus Verweij, EUHPN Chair, Deputy General Director of the Netherlands Board for Hospital Facilities
- Barrie Dowdeswell, EUHPN Executive Director
- Chris Farrah, Head of Design, NHS Estates, UK
- Peter Sellars, Project Director, NHS Estates, UK
- Nigel Tomlinson, Scientific Advisor, NHS Estates, UK
- Dr M. C. Vos, MD, Head of Infection Control Department, Erasmus University Medical Centre, Netherlands
- Myra Behrendt, Infection Control Department, Erasmus University Medical Centre, Netherlands
- Wim van Dorp, MD, Netherlands Board for Hospital Development
- Arie Mol, Engineer, Netherlands Board for Hospital Development
- Professor Bas Molenaar, Architect, EGM, Netherlands
- Richard O’Keeffe, Chief Architectural Advisor, Department of Health and Children, Ireland
- Helina Kotilainen, Architect, STAKES National Research and Development Center for Welfare and Health, Finland

Further Support and Advice

Following the peer review meeting, a number of individuals (EUHPN members or otherwise) were involved in provision of supporting information and opinion. Much important insight was gained during the course of the 7th EUHPN Conference, held in Edinburgh from 15th - 17th November, 2004. The following list covers some (but by no means all) of those who have provided valuable input:

- Asmund Myrbostad, Senior Advisor, SINTEF Unimed Innovation, Norway
- Taralde Rohde, Senior Advisor, Norwegian Health Department
- Simona Agger, Evaluation of Investments Group, Ministry of Health, Italy
- Maria Paola di Martino, Director General, Evaluation of Investments Group, Ministry of Health, Italy
- Paul deFreine, Deputy Chief Architectural Advisor, Department of Health and Children, Ireland
We would also like to mention the presence as an observer, at the 7th EUHPN Conference presentation on single room provision, of Dr Rafael Bengoa, Director, Health System Policies and Operations for the World Health Organisation (WHO).