CHAPTER XX

Can Inclusive Environmental Design be Achieved in Acute Hospitals?

Sue Hignett

Loughborough University
Loughborough, UK.
S.M.Hignett@lboro.ac.uk

ABSTRACT

The effectiveness of healthcare delivery is determined, in part, by the design of the physical environment and the spatial organisation of work. This paper will consider firstly whether ergonomic input to provide recommendations for work space requirements may restrict patient autonomy and secondly, whether design developments for patient benefit may lead to difficulties in providing clinical care.

The findings from two research studies are used to discuss the impact of physical layout on work systems with respect to staff well-being (space to work), patient care (monitoring) and patient experience (privacy and dignity). Several approaches to design and ward layout are considered, including Harness, Nucleus, AEDET, Planetree and Sengetun. Finally, the involvement of both staff and patients through a participatory ergonomics framework in building design is explored. It is suggested that mapping criteria for user participation in building design briefing with the participatory ergonomics framework may offer potential to improve and enhance patient involvement in hospital design.

Keywords: inclusive design, patient safety, participatory ergonomics

1 INTRODUCTION

Although it is acknowledged that the physical environment has a significant impact on health and safety (including confidentiality, cross infection and travel time), it has been suggested that hospitals have not been designed with the explicit goal of enhancing staff and patient safety through facility design innovations (Reiling et al, 2004).

The findings from two research studies will be used to consider the impact of physical layout on work systems with respect to staff well-being (space to work), patient care (monitoring) and patient experience (privacy and dignity). It is proposed that the patient perspective in the system has received relatively little attention and that combining the theoretical concepts of participatory ergonomics and inclusive briefing for building design may offer a better framework for environmental design in care facilities.

2 DESIGN FOR STAFF: SPACE TO WORK

The space provision in hospitals has been debated since the time of Florence Nightingale when she recommended the construction of a larger ward as a long open space for approximately 30 patient beds to achieve cross-ventilation and nurse efficiency (Gesler et al, 2004). The racetrack concept was introduced after 1945, with multi-bed bays grouped around a central core of utilities (part of the Harness initiative; Francis, 1998). A variation on this theme, the Falkirk layout (1960s) used dispersed nurse stations to support a flexible response to variations of workload. The most widely used design in the UK is Nucleus, a cruciform template with six-bedded bays and single rooms, some with en-suite facilities. The response by architects and stakeholders to Nucleus is that '*it was too prescriptive, tended to stifle creativity and simply failed to address design issues such as location, legibility and sense of place*' (Francis, 1998). An alternative ward layout (bed courtyard) has been developed in Norway to improve monitoring, the '*sengetun'* (Rechel et al, 2009). The sengetuns (courtyards) are groups of 6-8 single rooms are arranged as '*pearls on a string'*. Each has a central fully operational (not dispersed) nursing workstation with sufficient space for documentation, observation, medication and storage.

All these design approaches have been influenced by government legislation and guidance. For example, in the 1990s health and safety law that required '*every room [to] have sufficient floor area, height and space for the purposes of health and safety'* (The Workplace (Health, Safety and Welfare) Regulations 1992, regulation 10). However space planning has continued to be a matter for debate and there have even been legal challenges to hospital plans (BBC, 2004). In 1996, Palmer suggested that Nightingale would now challenge design professionals to create patient bedrooms of a sufficient size to accommodate two caregivers simultaneously, as well as the visitor/patient chair, bedside locker, over-bed tray, straight-backed

chair, and washing facilities and allow a trolley, bed or wheelchair to be move in and out of the room.

In the UK an ergonomic database was developed to encourage those involved in hospital design to think in terms of the relationship between a user and a particular component and other components located within a room with respect to critical minimum space requirements (Dept. of Health and the Welsh Office, 1986). Unfortunately user data were not included due to a lack of time and resources (Stanton, 1983) so to address this deficit, Hignett and Lu (2008) investigated spatial requirements for frequent and safety critical tasks in medical, surgical and intensive care wards. Data were collected from field observations with 34 nurses and 58 tasks (Figure 1) and laboratory simulations (n=90 datasets). The results were compared with previous recommendations where a gradual increase in the recommended space can be seen from 6.96m^2 in 1961 (HBN 04) to 10.84m^2 in 2008 (Hignett and Lu, 2008). However, even though the new recommendations were based on empirical data and included user data (staff) they still failed to include patient activities and preferences.

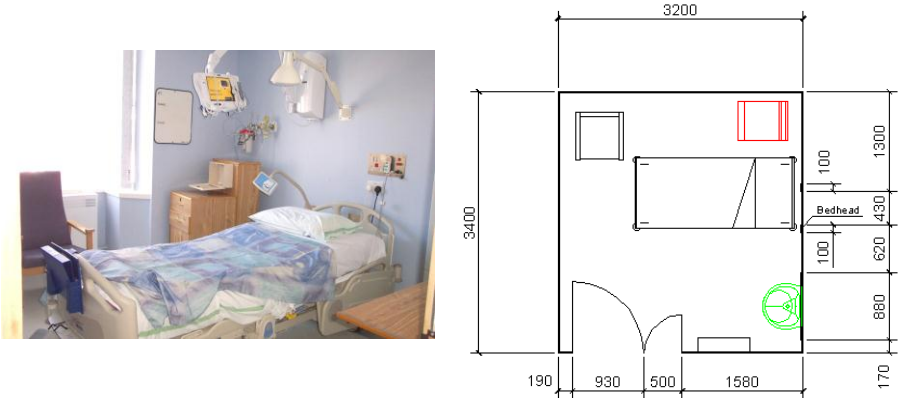

Figure 1 Field observations for spatial layout on medical wards

3 DESIGN FOR PATIENTS: SINGLE ROOMS (PRIVACY)

The bed space becomes the patient's domain during their stay in a care facility; the hub of their clinical and care experience. It provides a private space either as a single room or a cubicle with curtains or screens and will be where they store their personal belongings, receive visitors and interact with staff for many aspects of their treatment and care. Cartledge (2007) reported a divergence in privacy preferences with older people concerned about being in single rooms because they 'don't trust the staff to be there to help if they fall out of bed, and they don't like being alone and may depend on other patients in the room for assurance and safety'. In contrast, younger people are reported to prefer the privacy of a single room with the ability to have treatment and care without moving location. In UK hospitals the percentage of single bedrooms as a proportion of total available beds has increased from 22.6% in

2002/03 to 32.7% in 2009/10 (DH, 2010) as a design development for patient benefit in response to privacy requirements.

Falls in care facilities account for over 33% of reported incidents in the UK with over 70% of reported falls being un-witnessed (Healey et al, 2008). One of the interventions for managing falls is to increase the level of monitoring for at-risk patients (Hignett, 2010). The second research study (Sands et al, 2011) looked at the contributory factors of falls by collecting data in an overnight bedrail audit at 18 UK hospitals (n=1,799 beds). The level of monitoring (observation) was explored by recording bed visibility from nursing stations. The participating hospitals had more than 900 beds (n=4), 500-899 beds (n=8) and less than 499 beds (n=6). Seven were built in the 2000s, 3 were built in the 1980s/90s, 4 were built in the 1970s, and 5 were built in the 1940s and 1880s with refurbishment in the 1970s/80s.

Table 1. Profile of participating hospitals (*, †, ◊ = part of same NHS Trust, with individual hospitals in different towns)

Hospital number. Approx. opening date of current building	No. of beds	No. of single rooms with en-suite	% Beds visible	% Patients described as confused
1. Refurbished from 1940s	152	-	28%	62%
2. 1990s◊	155	7 (5%)	30%	35%
3. No date available†	255	64 (25%)	4%	28%
4. 1988◊	380	38 (10%)	0%	33%
5. 1992*	448	25 (6%)	13%	45%
6. 1970s†	451	58 (13%)	12%	36%
7. 1976*	503	24(5%)	24%	50%
8. 2010	516	40 (8%)	21%	56%
9. 1972	581	2 (<1%)	6%	64%
10. 1980s, refurbished from 1850s†	591	44 (8%)	61%	24%
11. 1970s, refurbished from 1870s†	617	56 (9%)	24%	49%
12. 2010	744	306 (41%)	58%	49%
13. 2007	809	66 (13%)	25%	53%
14. Part 1993 and part refurbished from 1800s	884	74 (8%)	29%	40%
15. 2003	900	-	16%	47%
16. 2010	1000	440 (44%)	20%	39%
17. 2009	1010	317 (31%)	2%	50%
18. 1976	1106	169 (15%)	39%	41%

[1]Dr Foster Hospital Guide (http://www.drfosterhealth.co.uk/hospital-guide/ accessed 18th May 2011). Data Source: England, qualified nursing, midwifery & health visiting staff (full time equivalent) in NHS Hospital and Community Health Services: Staff by main staff groups in England as at 30 September 2009 from the Non Medical Workforce Census. The number of beds at each hospital is published in the General and Acute (available) column of *'Bed availability and occupancy, England - KH03'* return and is for the financial year 2008/09.

It was found that only 23% (0% - 61%, median 24%) of beds were visible from a nursing station (Table 1). Most of the accommodation was provided in 4-6 bed bays, with en-suite single rooms accounting for a median of 10% (range <1% to 44%). Beds that were visible from the nursing station were significantly more likely to be a multi-bed bay with no toilet ($p<0.001$, Phi=0.230). Beds that were not visible from the nursing station were significantly more likely to be located in a single en-suite room ($p<0.001$, Phi=0.230). So there is a need for balance in environmental design to support both safe observation (monitoring) and patient privacy (Essence of Care, 2010).

4 COMPLEXITY OF DESIGN

The evolution of design approaches have been described as changing focus from designers (1960s), to design for healthcare planners, and finally design for service delivery (Glanville, 2006). In the USA, the Planetree philosophy of patient-centred care is gaining momentum for emphasising 'trust, intimacy, dignity, security and confidence, holistic care and treatment, information, participation in decision-making, health promoting physical surroundings, and network support' (Jenso and Haugen, 2005). The involvement of patients in the hospital design process has been discussed for many years. Ronco (1972) offered 3 reasons why patients were not involved, including the need to prioritise functional efficiency before habitability, and the lack of data relating physical environment to behaviour. The challenge of including patient input continues, for example the Achieving Excellence Design Evaluation Toolkit (AEDET) was developed to assess new healthcare buildings for functionality (user, space, access), impact (character and innovation) and build standard (performance, engineering, construction). But its effectiveness has been questioned as it requires stakeholders (including staff and patients) to translate quite complex qualitative judgements about several discrete questions into single scores (Gesler et al, 2004).

Attaianese and Duca (2010) suggested, in a theoretical discussion of human factors in building design that many of the methods (in particular task analysis and participatory methods) in offer benefits for (1) environment design and sustainability, (2) functionality (effectiveness and efficiency) and user satisfaction, (3) accessibility including way finding, emergency response and inclusive design, and (4) value creation through design management (economic). Their model is an excellent step forward but limited in terms of hospital design to physical impairments (mobility, vision, hearing) with only fear of falling as a cognitive impairment. This excludes many of the in-patient population particularly confused patients (dementia and delirium). The difficulties for researchers to deliver empirical data on hospital design may be due to the *'inherent logistic difficulties in performing or interpreting studies in care homes or hospitals associated with population, setting, design, and outcome measurement. Getting consent from or randomising frail, confused, unwell elderly people, who are often in the institution for only a short stay, is challenging*' (Oliver et al. 2007).

5 PARTICIPATORY ERGONOMICS

One theoretical model that offers potential for future patient involvement is Participatory Ergonomics (PE). PE can be very simply described as a concept involving the use of participative techniques and various forms of participation in the [*work*]place (Vink and Wilson, 2003). Wilson (1995) defined participation in ergonomics projects as *'the involvement of people in planning and controlling a significant amount of their own [work] activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals*'. This is being explored in building design, for example Jensen (2011) suggesting that user participation in briefing should be a continuous process before and during the design and construction activities. He reflects that the view of buildings has changed '*from seeing buildings as mainly architectural expressions or passive physical constructions to….. facilities that must support the needs of an organisation'* and describes this as 'inclusive briefing' rather than the traditional model of where users were mainly involved as data sources. This involvement has been mapped onto the dimensions of the Participatory Ergonomics Framework (Table 2).

Table 2. Participatory Ergonomics Framework mapped with selected elements of inclusive design criteria and user building design briefing (modified from Haines et al, 2002; Jensen, 2011)

PEF Dimension (*range and/or scope*)	User participation in briefing
Decision-making (*group to individual*)	The result is acceptance of solutions based on a brief
Mix of participants (*operators to management*)	Concerns all client/user needs in developing facilities
Remit (*problem to solution*)	A guided learning and dialogue process
Role of ergonomics specialist (*initiate and guide to consultation*)	
Involvement (*full direct to representative*)	
Focus (*equipment/job design to strategy)*	A continuous process with changing focus in different phases
Level of influence (*organisation to work group)*	Users actively involved as part of a corporate change process
Requirement (*compulsory to voluntary)*	
Permanence (*on-going to temporary)*	

6 CONCLUSION

Healthcare is a complex system with multiple users of equipment, products and treatment/care environments. Whether inclusive environmental design can be achieved remains to be seen but the indications are positive with building designers exploring human factors methodologies including user-needs analysis, task analysis and participatory ergonomics.

The challenge for clinicians, designers and researchers is to work together using robust high quality research methods to analyse the activities of all the user groups. This should be used at all stages of the briefing (design) process to achieve inclusive facilities that provide both functionality and habitability including autonomy, privacy (where appropriate) and safety.

ACKNOWLEDGMENTS

The author would like to acknowledge all her collaborators in the studies: Jun Lu, Gina Sands, Paula Griffiths, Jane Youde, Frances Healey, Mike Fray, Penny Xanthopoulou.

REFERENCES

Attaianese, E., Duca, G. 2010. Human Factors and ergonomics principles in building design for life and work activities: an applied methodology. *Theoretical Issues in Ergonomic Science.* 13: 2, 187-202

BBC. 2004. *Legal bid on hospital bed spaces.*

http://news.bbc.co.uk/1/hi/health/4013509.stm Accessed 14th February 2012

BS 7000-6. 2005. *Guide to Managing Inclusive Design*. London: British Standards Institution

Cartledge, S. 2007. Planning for Patient-Centred Care. *Hospital & Healthcare* December 25-26.

Department of Health and the Welsh Office. 1986. *Health Building Note 40, Common Activity Spaces Vol. 1 – Example layouts: Common components*. London, HMSO.

Dept. of Health. 2010. Accessed 29 Dec 2010, from *Hospital Estates and Facilities Statistics 2009-10. Main Findings* http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_120811.pdf

Essence of Care. 2010. *Benchmarks for the Fundamental Aspects of Care. Benchmarks for Safety (Ref. 14641)*. Norwich: The Stationary Office.

Francis, S., 1998. A golden record, but is planning past caring? *Hospital Development*. June, 14-18.

Gesler, W., Bell, M, Curtis, S., Hubbard, P., Francis, S. 2004. Therapy by Design; Evaluating the UK Hospital Building Programme *Health and Place*, 10: 117-128.

Glanville, R., 2006, HD/MARU Forum. *Hospital Development*. 12-16.

Haines, H.M., Wilson, J.R., Vink, P. and Koningsveld, E. 2002. Validating a framework for participatory ergonomics. *Ergonomics*. 45: 4, 309-327

Healey F, Scobie S, Oliver D, et al. 2008. Falls in English and Welsh hospitals: a national observational study based on retrospective analysis of 12 months of patient safety incident reports. *Quality and Safety in Healthcare*;17: 424-430.

Hignett, S. Lu, J. 2008, Ensuring bed space is right first time *Health Estate Journal.* February *http://www.healthestatejournal.com/Story.aspx?Story=3395* Accessed 11-11-2011.

Hignett, S. 2010. Technology and Building Design initiatives in interventions to reduce the incidence and injuries of Elderly In-Patient Falls. *Healthcare Environments Research and Design Journal* 3: 4, 62-84

Jensen, P.A. 2011. Inclusive Briefing and User Involvement: Case Study of a Media Centre in Denmark, *Architectural Engineering and Design Management*, 7:1, 38-49

Jenso, M., Haugen, T. 2005 Usability of hospital buildings Is patient focus leading to usability in hospital buildings? *Proceedings of the 11th Joint CIB International Symposium.* Accessed 19 February 2012 http://www.metamorfose.ntnu.no/dok/050708UsabilityHelsinkipaperMJ.pdf

Oliver, D., Connelly, J.B., Victor, C.R.. et al. 2007. Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analyses. *BMJ* 334: 82-7.

Palmer, I.S. 1996. What Florence Nightingale would tell us today. *Journal of Healthcare Design*. 8: 19-22.

Reiling, J.G., Knutzen, B.L., Wallen, T.K. et al. 2004. Enhancing the traditional hospital design process: a focus on patient safety. *Joint Commission Journal of Quality and Safety*. 30: 3, 115-124.

Rechel, B., Erskine, J., Dowdeswell, B. et al. 2009. Capital investment for health. Case studies from Europe. *European Observatory on Health Systems and Policies.* 168-9.

Ronco, P. 1972. Human Factors applied to Hospital Patient Care. *Human Factors* 14: 5, 461-470.

Sands, G., Hignett, S., Fray, M. et al. 2011. An overnight bedrail audit in UK hospitals exploring the relationships between environmental factors and patient characteristics. In Albolino, S. et al. (Eds.) *Proceedings of the 3rd Healthcare Ergonomics and Patient Safety Conference.* June 22-24, 2011. Oviedo, Spain. 446-450

Stanton, G. 1983. The Development of Ergonomics Data for Health Building Design Guidance. Ergonomics, 26, 3, 785-801.

Vink, P., Wilson, J.R. 2003. Participatory Ergonomics. *Proceedings of the XVth Triennial Congress of the International Ergonomics Association and The 7th Joint conference of the Ergonomics Society of Korea/Japan Ergonomics Society. 'Ergonomics in the Digital Age'.* August 24-29, 2003. Seoul, Korea

Wilson, J.R. 1995. Ergonomics and participation. *In Evaluation of Human Work: A Practical Ergonomics Methodology* (2nd Ed.) J.R. Wilson & E.N. Corlett (Eds.) London: Taylor & Francis. 1071-1096

Workplace (Health, Safety and Welfare) Regulations. 1992. [S.1.1992 No. 3004] Accessed 14th February 2012 www.legislation.hmso.gov.uk/si/si1992/Uksi_19923004_en_1.htm.