The physical environment and patients' activities and care: A comparative case study at three newly built stroke units

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The physical environment and patients' activities and care: A comparative case study at three newly built stroke units

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Abstract

Aim: To explore and compare the impact of the physical environment on patients' activities and care at three newly built stroke units.

Background: Receiving care in a stroke unit instead of in a general ward reduces the odds of death, dependency and institutionalized care. In stroke units, the design of the physical environment should support evidence-based care. Studies on patients' activities in relation to the design of the physical environment of stroke units are scarce.

Design: This work is a comparative descriptive case study.

Method: Patients (N = 55) who had a confirmed diagnosis of stroke were recruited from three newly built stroke units in Sweden. The units were examined by non-participant observation using two types of data collection: behavioural mapping analysed with descriptive statistics and field note taking analysed with deductive content analysis. Data were collected from April 2013 - December 2015.

Results: The units differed in the patients' levels of physical activity, the proportion of the day that patients spent with health professionals and family presence. Patients were more physically active in a unit with a combination of single and multi-bed room designs than in a unit with an entirely single-room design. Stroke units that were easy to navigate and offered variations in the physical environment had an impact on patients' activities and care.

Conclusions: Patients' activity levels and interactions appeared to vary with the design of the physical environments of stroke units. Stroke guidelines focused on health status assessments, avoidance of bed-rest and early rehabilitation require a supportive physical environment.

KEYWORDS
evidence-based design, nursing, physical environment, rehabilitation, stroke guidelines, stroke unit

1 | INTRODUCTION

High-quality care that is safe, efficient and person-centred requires a high standard for the physical environment (architecture or built environment) (Anåker, Heylighen, Nordin, & Elf, 2016; Clancy, 2008; Sadler et al., 2011). A recent study on a new stroke unit showed that the environment negatively affected patients' activity levels (Anåker, von Koch, Sjostrand, Bernhardt, & Elf, 2017). However, studies on how the environment has an impact on health, rehabilitation and stroke care are still scarce; thus, the environment and its importance are not addressed in Swedish or European stroke guidelines (Ringelstein et al., 2013; Socialstyrelsen, 2009). Consequently, there is a need to investigate how the physical environment influences stroke patients' activities and care in stroke units to improve the quality of stroke care and rehabilitation. There are also large global investments in new healthcare environments and requirements that design decisions should be evidence-based. In this study, we compared three newly built stroke units. Guidelines for stroke care were the starting point for investigating whether newly developed stroke units supported care and rehabilitation.

Summary Statement

Why is this research needed?

- The physical environment is important for health and recovery after a stroke and studies on patients' activities in relation to the design of the physical environment of stroke units in hospitals are scarce.
- A focus on the physical environment and patients' interactions with it after stroke may contribute to developments in the area of evidence-based design.

What are the key findings?

- A comparison of three different stroke units revealed that differences in patients' physical activity level may be related to the design of the physical environment.
- Patients in a stroke unit with a combination of single and multi-bed room designs were more physically active than patients in a unit with an entirely single-room design.
- The design of the physical environment can be a barrier to or facilitate patients' rights to preserve their personal integrity.

How should the findings be used to influence policy/practice/research/education?

- New stroke units and refurbishment of stroke units should rely on evidence-based designs and support evidence-based care as presented in contemporary guidelines.
- Architects need to collaborate with healthcare professionals in the design process of new healthcare facilities to encourage designs in accordance with guidelines to promote health and well-being for patients with stroke.
- Further research is needed to extend our knowledge in key areas of stroke care environments that have implications for patients' care and health outcomes.

2 | BACKGROUND

Research has shown an association between the physical environment and health outcomes (Malenbaum, Keefe, Williams, Ulrich, & Somers, 2008; Steinke, 2015; Steinke, Webster, & Fontaine, 2009; Ulrich et al., 2008). Patients with access to sunlight have shorter hospitalizations and use fewer analgesics (Ulrich et al., 2008). The physical environment can contribute to the risk of falls (Tilson et al., 2012; Tyson, Hanley, Chillala, Selley, & Tallis, 2006). Thus, consideration should be given to the design of patients' rooms, including layout, flooring structure, lighting and access to daylight to increase patient safety (Ulrich et al., 2008). In addition, previous research has shown a correlation between the attractiveness (e.g., nice furnishings, artwork and lighting) of the environment and patients' perceptions of quality of care (Becker & Douglass, 2008).

The physical environment can be defined as a space that includes architectural features (layout and size), interior design features (colours and layout of furnishings) and ambient environment (lightning and noise levels) (Harris, McBride, Ross, & Curtis, 2002). The environment is a core concept in nursing (Meleis, 2017). The environment forms the context where person–nurse interchanges and nursing practice occur (Kim, 2010; Meleis, 2017). In this sense, the environment is also a factor in person-centred care (McCormack & McCance, 2006). Person-centred care reinforces the demand of nursing to safeguard patient dignity and autonomy and invites and respects shared decision-making, choice and control (Edvardsson, Watt, & Pearce, 2017). The environment can influence the ability to perform person-centred care and enable patients to fully participate in their care (McCormack, McCormack, & McCance, 2010). For instance, a patient room that allows privacy, provides a supportive and functional dining area and maximizes orientation and opportunities for social interactions can facilitate person-centred care (Chaudhury, Mahmood, & Valente, 2005).

Until recently, research on the environment and health has focused more on residential care (Nordin, McKee, Wijk, & Elf, 2017) and emergency care (Steinke, 2015) than on rehabilitation environments such as stroke units. Stroke units are a geographically defined area of the hospital, and according to the Stroke Unit Trialists' Collaboration (SUTC, 2013), there is strong evidence that stroke units provide benefits for patients, such as lower mortality and morbidity. Factors contributing to the superior outcomes of care in stroke units include multiprofessional stroke expertise (e.g., physicians, nurses, physiotherapists and occupational therapists), early rehabilitation

plans, avoidance of bed-rest and early and comprehensive assessment of health status.

Stroke is an important cause of death and disability from stroke can create impaired health and increase patient dependence on daily life support, creating challenges for individual patients, caregiving and society (SUTC, 2013). Stroke is a neurological dysfunction characterized by a sudden onset of symptoms, for example, weakness or numbness in the face, arm or leg that usually occurs on one side of the body (Ringelstein et al., 2013; WHO, 2016). Physical activity positively affects health after a stroke (Oberlin et al., 2017), and individually adapted, structured rehabilitation is important in reducing the consequences of stroke to the individual. The plausible impact of the physical environment on care and outcomes after stroke until now has largely been ignored in international stroke guidelines. However, the physical environment should invite and enable mobilization, avoid extensive bed-rest, and provide support for rehabilitation and interactions.

In a stroke unit, nurses have a central role in the multiprofessional team and in all care activities (Kirkevold, 2010; Ringelstein et al., 2013; Summers et al., 2009). For nurses, together with their allied health colleagues, the focus is on maintaining function; preventing complications; integrating patients into social relations (Kirkevold, 2010); assessing patients' skin, blood pressure and temperature; and mobilizing patients (Summers et al., 2009). The physical environment has been found to influence nursing practices in stroke units, for example, limited space makes it difficult to move, use and relocate equipment; transfer patients; and interact with other stroke team members (Seneviratne, Mather, & Then, 2009).

An extensive review of international observational studies of patients' behaviour in stroke units reported that patients are alone in the room without company over 60% of the day and are inactive for long periods of the day (median 48% of the day) (West & Bernhardt, 2011). Unfortunately, none of those studies addressed the role of the physical environment. Research based on animal models (Johansson & Belichenko, 2002) has suggested that an enriched environment can promote recovery after a stroke. In addition, studies in real stroke care have shown that an enriched environment can promote both cognitive and social activities (Janssen et al., 2014; White, Bartley, Janssen, Jordan, & Spratt, 2015; White et al., 2014). The specific features of an enriched environment are access to meeting places, for example, patient lounges and the potential for individual activities, for example, access to computers, books, newspapers, games and personal hobbies (Janssen et al., 2014; Keysor, Jette, Coster, Bettger, & Haley, 2006).

Evidence-based design is the process of basing decisions about the physical environment on credible research to achieve the best possible outcomes for patients and staff (Hamilton & Watkins, 2009; Ulrich, Berry, Quan, & Parish, 2010). Decisions are often made early in the planning and design process, which is a complex process involving the management of different conditional steps and various stakeholders (Chandra & Loosemore, 2011; Elf, Frost, Lindahl, & Wijk, 2015). Ultimately, knowledge from different research disciplines is integrated in the design process to create new physical environments based on evidence.

In summary, contemporary research on components that are important for stroke unit quality has focused on medical and physiotherapy interventions rather than on the quality of the physical environment and how it supports rehabilitation and care. The literature indicates that the physical environment plays an important role in health outcomes and care performance. However, there has been a limited focus on linking the physical environment to a patient's recovery and rehabilitation in stroke units. We can further develop the area of evidence-based design by increasing our knowledge of how the patient interacts with the physical environment after a stroke.

3 | THE STUDY

3.1 | Aim

The study aimed to explore and compare the impact of the physical environment on patients' activities and care at three newly built stroke units.

3.2 | Design

A comparative descriptive case study method (Yin, 2014) with a mixed method approach (Creswell & Plano Clark, 2011) was used. The specific case consists of how the physical environment has an impact on patients' activities and care. Different independent techniques for data collection and analysis were performed with a mixed method, followed by a comparison of the results from the overall interpretation and discussion.

3.3 | Setting

The stroke units were identified through a nationwide organization of healthcare facilities in Sweden (Forum, 2015). All units were built after the establishment of the first Swedish stroke guidelines (Socialstyrelsen, 2009), which correlated with the European stroke guidelines (Ringelstein et al., 2013).

The three included stroke units were newly built Stroke Unit 1 (SU1) or recently renovated with a brand-new design (SU2 and SU3). Their physical environment characteristics (Table 1) and design (Figure 1) somewhat differed. All units provided acute care and rehabilitation. SU1 was built with a mix of multi-bed rooms and single rooms. SU2 and SU3 had mainly single rooms. In SU2, there were two multi-bed rooms with 24-hour staff presence in the room for patients in need of acute care and medical monitoring. All units were open for visitors 24 hours a day, but all units preferred visits in the afternoons and evenings.

3.4 | Participants

All patients who had been admitted to the stroke unit for at least 24 hours, had a confirmed diagnosis of stroke, were able to give informed consent and answer questions and were able to perform activities (e.g., stand, walk, eat, sit in bed or sit out of bed) were

TABLE 1 Physical environment characteristics of the included stroke units

	Physical environment characteristics
Stroke Unit 1 (SU1)	Spatial organization Three corridors built around a courtyard. One nursing station with the possibility of closing the door. Several so-called open workplaces in the corridor. A combination of multi-bed rooms and single rooms (23 beds).Windows with natural light, some of which face the outside garden. Bathroom in the patient room. Therapy area placed on the same floor as the unit with the door often opened to the corridor. Patient lounge/dining room placed at the entrance to the unit and windows with daylight. Interior details Contrasting colours around the doors and toilets. Large room number on the door to patients' rooms. Some handrails along the walls.
Stroke Unit 2 (SU2)	Spatial organization Two corridors built at an angle. A nursing station in one of the corridors. A nursing station (including physicians) between the two multi-bed rooms, facing both rooms with large windows. Mainly single rooms (22 beds). Two multi-bed rooms reserved for acute patients (n = 6) in need of medical monitoring. Bathroom in the patient room. Therapy area placed at the end of a corridor between two building complexes. Patient lounge/dining room placed in the middle of the unit with a large entrance, and no windows. Interior details Contrasting colours around the doors and toilets. Large room number on the door to patients' rooms. No handrails along the walls in the corridors.
Stroke Unit 3 (SU3)	Spatial organization Two parallel corridors with four nursing stations, two on each side. Separate rooms for physicians and other health professionals. Mainly single rooms (22 beds). One room reserved for acute patients (n = 3) in need of medical monitoring. Bathroom in the patient room. Therapy area on the same floor as the unit. Closed door to the therapy area. Patient lounge/dining room is placed at the end of the corridor with no noticeable entrance, and windows with daylight. Interior details Contrasting colours around the doors and toilets in patients' rooms. Handrails along the walls in the corridors.

asked to participate in the study. Patients receiving palliative care were not included. Patients who met the inclusion criteria were recruited consecutively and all patients agreed to participate. All patients were asked to participate the evening before the day of observation.

3.5 | Data collection

Data collection was conducted from April 2013 - December 2015. Patients' activities were systematically observed and recorded using established standardized behavioural mapping procedures (Bernhardt, Dewey, Thrift, & Donnan, 2004). The patients were observed on one occasion over a weekday from 8 a.m. to 5 p.m. (the most active part of the day). Observations were recorded every 10 min. During the observations, the patient's activity level (e.g., talk, eat, sit out of bed, walk or stand), the people present during the activity (e.g., nurses, physicians, therapists or family members) and the location (e.g., patients' room, corridor, therapy area or patient lounge) were recorded. Patients and staff were informed about the study's content and told not to perform any extraordinary activities on the observation day. The staffing levels were considered adequate during the period of data collection. The first and last author and two research assistants, trained and guided by a detailed manual in behavioural mapping procedures, performed all observations.

In addition, non-participant observation of the included participants was conducted according to Spradly and Bakers' (1980) nine dimensions of every social situation (space, actor, activity, object, act, event, time, goal and feeling). Descriptive and reflective field notes (Sanjek, 1990) were taken during the observations, with a focus on elements in the physical environment that facilitated or created barriers to patient activities and care. Examples of observed activities and care included patients' activities of daily living, patients' dialogue and rounds with staff, gait and balance training in the corridor or in patients' bedroom and participation in care activities, for example, medical treatment. The aim was to capture descriptions and the reflections of facilitators on barriers in the physical environment that were as detailed as possible. All included patients (N = 55) participated in one observation. The observations lasted 20–45 min.

3.6 | Ethical consideration

Approval for the study was granted by the Regional Ethical Review Board for research in Uppsala Sweden (Ref No. 2012/199). Written and verbal informed consent was obtained from all participants prior to data collection. Participants were free to withdraw their participation from the study at any time.

3.7 | Data analysis

Descriptive statistics were generated using SPSS 20.0 to present the sample's characteristics and behavioural mapping. Activities were quantified as relative numbers as a function of time with 100% referring to a full day starting at 8 a.m. and ending at 5 p.m. Activity level was categorized as follows according to Bernhardt (Bernhardt et al., 2004): no activity, minimal activity (talking, reading, eating or sitting supported in bed), low activity (sitting supported out of bed

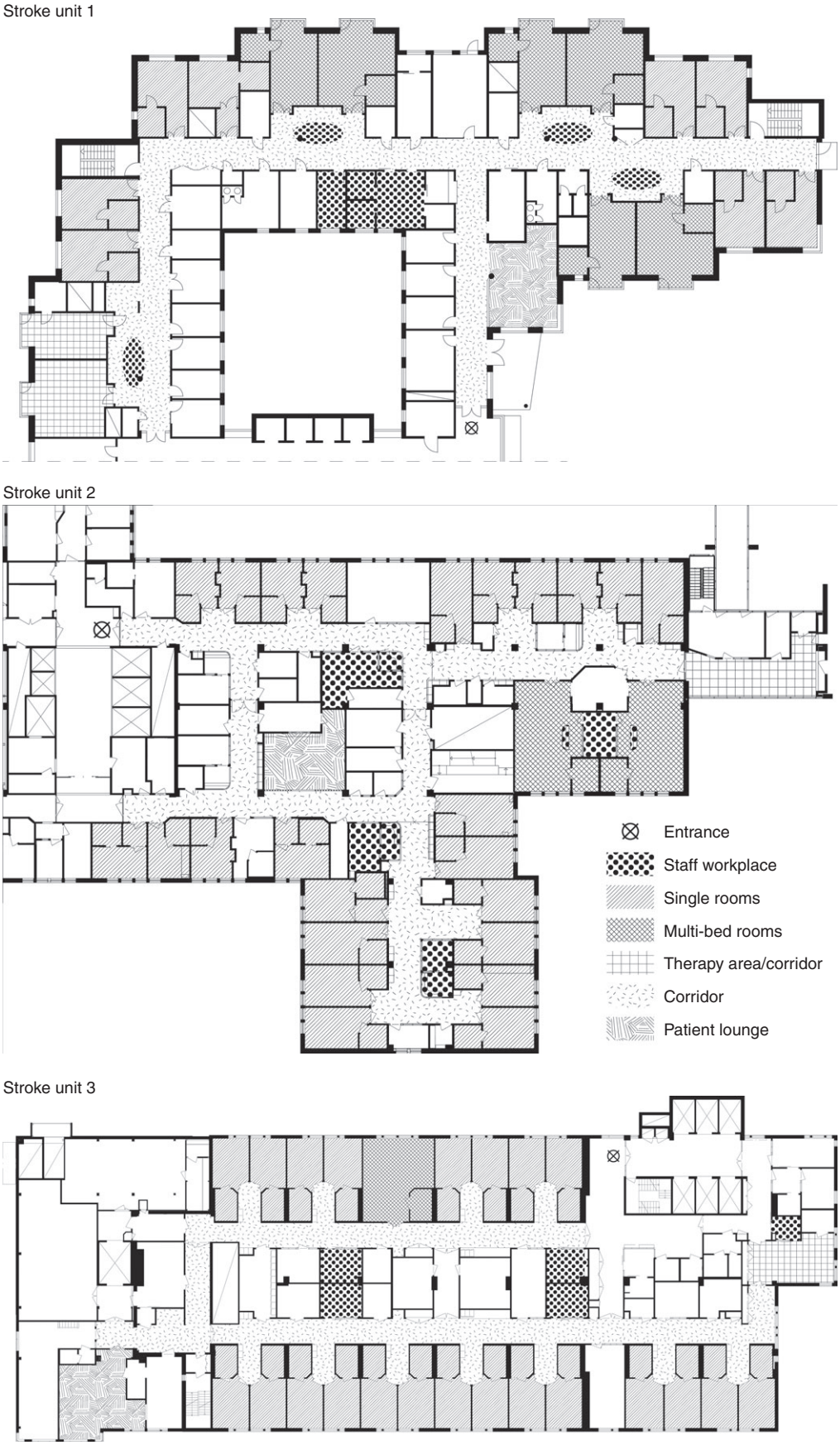

FIGURE 1 Schematic of the included stroke units

or sitting in hoist), moderate activity (rolling and sitting up, sitting unsupported or transferring feet onto floor) and high activity (standing, walking or using stairs).

Analysis of the field notes were based on Elo and Kyngäs' (2008) deductive content analysis method and guided by the question of what elements of the physical environment facilitated or created barriers for patients' activities and care. The notes were reviewed several times to obtain a general impression of their content. A categorization matrix (Elo & Kyngäs, 2008) based on facilitators and barriers was created. Descriptions of the facilitators and barriers were identified and coded (Table 2), compared based on similarities and organized into subcategories, forming three main categories.

3.8 | Rigour

The behavioural mapping technique was based on a standardized and frequently used method of quantifying patients' behaviour (Bernhardt et al., 2004) that has shown good validity (Kramer, Cumming, Churilov, & Bernhardt, 2013) and good inter-observer reliability (Bernhardt et al., 2004). Regarding the qualitative part of the study, analysis of the field notes is described in detail and examples are supplied to enhance the trustworthiness of the findings. The field notes were analysed, and coding was performed by the first author and the research group altogether. The authors' continuous discussion during the analysis ensured credibility.

4 | FINDINGS

The findings from the behavioural mapping are based on a total of 2,970 observations ($N = 55$ patients). Twenty-four patients were observed at SU1, 15 at SU2 and 16 at SU3, and their characteristics are shown in Table 3.

4.1 | Patients' interactions and activities

In all three stroke units, the patients spent more than 80% of the day in their rooms (Table 4). Patients at SU1 spent more time in the therapy area than patients at SU2 and SU3. There were also differences in how much time patients spent in the patient lounge. Patients in SU3 spent more time in the patient lounge than patients in SU1.

The time that patients spent alone differed between the three units; patients at SU3 spent more time alone than patients at SU1 and SU2 (Table 5). Patients spent more time with family members at SU1 and SU2 than patients at SU3. Furthermore, patients at SU1 were observed to interact with therapists more frequently (physiotherapist, occupational therapist, and speech and language therapist) than patients at SU2 and SU3.

When comparing the three units, SU2's design was different regarding the structure of two patients' rooms (Figure 1). SU2 had two multi-bed rooms with staff in the room for 24-hour patient monitoring. Three patients were observed in those rooms and when those three patients were excluded from the analysis of SU2, the proportion of the day that patients were alone increased (Table 5).

The proportion of the day when patients were not involved in any physical activity was lowest at SU1 (Table 6). The time patients spent in moderate- and high-level activities (e.g., roll and sit up, sit unsupported or transfer feet onto floor) and high-level activities (stand, walk or use stairs) represented a larger proportion of the day at SU1 than at the other two units. Generally, patients seemed to be more active and less alone at SU1 than at SU2 and SU3 (Tables 5 & 6).

TABLE 2 Example of coding the data into the categorization matrix

	Facilitators	Barriers
What elements of the physical environment in stroke units facilitate or create barriers for patients' activities and care?	Privacy	Many items
	Large windows	Closed doors
	Sound level is low	No chairs in the stairwell during training
	Spacious	Dark

4.2 | The impact of the physical environment on patients' activities and care

Analysis of the field notes resulted in the formation of the following three categories describing how the physical environment had an impact on the patients' activities and care: (1) Easy to navigate support patients' activities; (2) Responsiveness, flexibility and variety in how the physical environment has an impact on patients' activities and care; and (3) Privacy and respect for personal integrity as opposed to publicness (Table 7).

4.2.1 | Category 1: Easy to navigate support patients' activities

Activities in the patient's room, for example, practising walking and activities of daily living, at the three stroke units seemed to be facilitated by natural light from large windows. Natural and artificial light provided good views of access to furniture and made it easy to navigate the room, for example, during training with the physiotherapist. All included stroke units had a contrasting colour on the wall behind the hand basin, the wall behind the bed and the doorframe surrounding the doors. This contrasting colour helped patients notice where, for example, the door to the bathroom was located and the passageway to the corridor. At SU1 and SU2, patients were guided to and from their room, with room numbers both on top of the door and on the wall close to the door to the room. At SU1, several so-called open workplaces in the corridor helped patients to find their way by highlighted coloured pillars next to the workplaces.

In all three units, patients spent a small part of their time in lounges. Lounges were in different areas of the units (centrally placed or at the end of the corridor). The lounge at SU2 was designed without windows, which made it dark and unwelcoming.

TABLE 3 Patients' demographic characteristics

Variable	SU1	N (%)	SU2	N (%)	SU3	N (%)
N	24		15		16	
Age, mean (*SD*)	66.1 (17.3)		70.8 (23.0)		75.9 (12.6)	
Sex, male		14 (58.3)		8 (53.3)		11 (68.8)
Stroke history						
First stroke		18 (75.0)		10 (66.7)		12 (75.0)
Time since stroke in days, median (IQR)	6.0 (12.3)		2.0 (1.0)		9.5 (20.5)	
Stroke type						
Infarct		21 (87.5)		13 (86.7)		15 (93.7)
Haemorrhage		2 (8.3)		2 (13.3)		1 (6.3)
Missing		1 (4.2)		0 (0.0)		0 (0.0)
NIHSS score, median (IQR)	6.0 (8.0)		4.0 (8.0)		4.5 (9.5)	
Mild (0–7)	2.0 (4.0)	15 (62.5)	3.0 (2.0)	9 (60.0)	3.0 (3.0)	11 (68.7)
Moderate (8–16)	10.5 (4.5)	8 (33.3)	8.0 (8–10[a])	3 (20.0)	13.0 (4.5)	5 (31.3)
Severe (>16)	18.0 (18.0)	1 (4.2)	21.0 (17–26[a])	3 (20.0)	0.0 (0.0)	0.0 (0.0)

IQR, interquartile range; NIHSS, National Institutes of Health Stroke Scale.
Day of arrival in the unit.
[a]Range.

TABLE 4 Proportion (%) of day spent in different locations in the stroke unit

	Proportion of the day (%)		
Location	Stroke Unit 1	Stroke Unit 2	Stroke Unit 3
Bathroom	3.6	1.6	2.3
Patient's room	82.4	88.9	83.1
Corridor	3.5	2.3	3.4
Therapy area	2.8	0.2	0.6
Patient lounge	4.3	5.8	8.6
Physicians room	0.3	0.0	0.6
Off ward	0.9	1.2	1.2
Other (e.g., meeting room)	2.0	0.0	0.0
Missing	0.2	0.0	0.2

TABLE 5 Proportion (%) of day with people present

	Proportion of the day (%)			
People present	Stroke Unit 1	Stroke Unit 2		Stroke Unit 3
Alone	61.6	55.6	64.7[a]	82.8
Physicians	1.0	2.6	1.5[a]	0.4
Nurses	5.1	17.0	6.8[a]	2.4
Nurse assistants	7.1	17.9	13.2[a]	5.3
Physiotherapist	3.5	2.8	2.7[a]	2.2
Occupational therapist	4.5	1.0	0.9[a]	1.2
Speech and language therapist	1.4	0.0	0.0[a]	0.2
Family	13.8	13.5	14.6[a]	6.3
Other team member	0.5	0.9	0.5[a]	0.6
Interpreter	0.8	0.0	0.0[a]	0.0
Other (e.g., priest, librarian)	1.5	0.4	0.5[a]	0.0
≥Two staff and/or family members at the same time	4.6	13.46	6.36[a]	1.9

[a]Results when excluding three patients from a multi-bed room with 24-hr staff and patient monitoring.

On the other hand, the lounge at SU2 was easy to find because it was centrally located (Figure 1). In the lounges, we observed patients eating, watching television and reading books and magazines.

The use of the therapy room for physical activities differed among the three stroke units. SU3 had a distant training facility with a closed door and was not easy to find. SU1 had a therapy room that was easily accessible from an open door to the corridor.

4.2.2 | Category 2: Responsiveness, flexibility and variety in how the physical environment has an impact on patients' activities and care

Patient care was influenced by ambient features in the physical environment. All three stroke units had many items in the corridors that were observed to both facilitate activities and act as barriers for the patients. Products and technological objects for personal indoor mobility and transportation in the form of walking frames, wheelchairs and beds were placed along the walls in the corridors. These objects, along with the medication carts, sampling trolleys and cleaning materials that were also placed in the corridors all day, created barriers in the physical environment for patients, for example, in their therapy activities and walks in the corridors to the patient lounge. However, the physiotherapists used the many items in the corridor when patients practised walking in the

TABLE 6 Patients' physical activities as a proportion (%) of the day spent in different activity categories

	Proportion of the day (%)					
Activity level[a]	No activity	Minimal activity	Low activity	Moderate activity	High activity	Missing
Stroke Unit 1	31.6	19.0	8.8	28.6	8.0	4.0
Stroke Unit 2	54.4	14.6	7.8	17.3	4.6	1.3
Stroke Unit 3	54.1	8.1	30.9	0.5	4.0	2.4

[a]No activity (no motor activity), minimal activity (talk, read, eat, use arms or sit supported in bed), low activity (sit supported out of bed, sit in hoist or transfer), moderate activity (roll and sit up, sit unsupported or transfer feet onto floor) and high activity (stand, walk or use stairs).

TABLE 7 Content areas, subcategories and categories

Content areas	Examples of codes	Subcategories	Categories with examples of field note quotations
Physical environment facilitators	Many items allowing natural mobilization Privacy Confidentiality Natural light Adequate space Sound level is low Large room number on the door Strong artificial light Contrasting colour on the wall behind the hand basin and around the door Inherent training area Folding chairs Closeness to patients Spacious Adjustable tables and chairs Large entrance to patients' lounge Flexibility Obvious colour around the doors Handrails in the corridors	Increased availability for patients when the patient lounge has large, visible entrances Single rooms have adequate spaces for care regarding acoustic sounds and large surfaces The corridor is used as a natural training area Large windows create bright rooms for care Easily accessible and bright training facilities Contrasting colours around the doors and behind toilets Centrally located and easily accessible workstations in the corridor	**Easy to navigate support patients' activities** "Contrasting colour on the door frame surrounding the doors made it easy to find the way to the bathroom in the patients' room." **Responsiveness, flexibility and variety in how the physical environment has an impact on patients' activities and care** "Gait training in the corridors to getting such a natural mobilization as possible. Many obstacles for the patient to get around" **Privacy and respect for personal integrity as opposed to publicness** "Open workplaces directly connected to patients' bedrooms. The workplaces consist of a low desk that you can see straight down, all papers, notes and computers are visible for all"
Physical environment barriers	Lack of privacy High sound level Limited space Open workspaces Many items Dark Stressful environment No confidentiality Invisible patients Closed doors to patients' room Only artificial light Poor sound proofing Walk-through therapy room Screens between beds Few windows Invisible entrance to patients' lounge Handrails are blocked by items	Patients in multi-bed rooms interfering with each other through noises and simultaneous activities, affecting health care Patient care is publicly performed due to an open floor plan and a nursing station located in the corridors Doors to patient rooms are closed all day Corridor handrail blocked by many objects Patients have limited space in multi-bed rooms No visible entrance to patient lounge reduces availability	

corridor. The items acted as natural barriers in the environment and created variation, flexibility and a good training environment for the patient.

The doors to patients' bedrooms gave the patients an opportunity to choose whether they wanted a closed or opened way into the room. However, we could not determine whether the patients had a

choice in deciding whether the doors to their rooms were open or not. During the observations, many doors into the patients' rooms were closed at all units. When the staff left a patient's room, they closed the door and the doors remained closed for the whole day.

In comparison with multi-bed rooms, single rooms had adequate space for the patient to practise walking and moving between the bed and wheelchair/walker. Single rooms included a varied environment for different care situations, for example, opportunities for the patients to choose whether a dialogue with the nurses should occur by the bed or by a table at the window. At one unit (SU1), some care conversations between the patient and the staff were performed in a meeting room outside of the patient's room.

4.2.3 | Category 3: Privacy and respect for personal integrity as opposed to publicness

In the multi-bed accommodation unit, the space between the patients' beds was shielded by a portable screen. All activities in the room, for example, activities of daily living, rounds, training with physiotherapists and nursing care, were carried out with several patients simultaneously. In multi-bed rooms, as in SU1, several staff members and patients talked simultaneously, which made it difficult for patients to hear what the staff said, and the patients constantly asked the nurse, "What did you say?"

In single rooms, the sound level was low, with no disturbances from other patients and staff and the staff was able to speak to the patient during a care situation while maintaining privacy. For example, when the nurse gave instructions for a newly prescribed drug, the instructions could be heard clearly.

Several observations showed an obvious tension between the staff's open workspaces in the corridors (SU1) with the staffs' closeness to patients and the ability to uphold patient privacy. The workspaces consisted of low desks that made notes and computers visible to anyone who passed the workspace. In these workspaces, patients and staff were moving around and staff planned and reviewed patients' care and rehabilitation. The patients' rooms were directly connected to the workspaces and inside the patients' rooms, conversations about patients' care plans were easy to hear. When staff's workplaces were hidden behind doors and/or windows (as in SU2 and SU3), discussions regarding patients' care could not be heard by non-authorized persons.

The training room for SU2 was located in a passage to another ward, which made it difficult for patients to practise undisturbed. The therapy area was located at the far end of a corridor, which was a passage to another ward at the hospital. There were no doors, creating an environment without privacy, where other people could interfere with the ongoing activity.

5 | DISCUSSION

This study explored the impact of the physical environment at stroke units on patients' activities and care. The findings showed that patients spent most of their day alone in their rooms and that very few patients visited other areas of the units. These findings confirm the results from several studies that have shown that patients at stroke units are inactive and alone (Bernhardt et al., 2004; De Weerdt et al., 2000; West & Bernhardt, 2011). The present study explored the environment in greater detail, providing an opportunity for us to consider factors in the environment that have an impact on care and added a discussion on whether these results can at least partly be explained by differences in stroke unit design.

Notably, the data showed that the patients were inactive, which can have consequences for patient recovery. A comparison of the three different stroke units revealed differences in patients' activity levels and the proportion of the day that they had people in their rooms. Patients in the unit with a combination of single and multi-bed rooms (SU1) were more active than patients at SU3, which was designed with exclusively single rooms. Contemporary guidelines state that patients with a stroke should start mobilization and rehabilitation as soon as they enter the stroke unit (Ringelstein et al., 2013). Patients need to get out of bed and sit or stand to avoid serious complications. In addition, more and more data show that activities need to be adapted to individual patient needs (Kristensen, Tistad, Koch, & Ytterberg, 2016; Morris, Oliver, Kroll, Joice, & Williams, 2017).

The data also showed that patients spent a limited part of the day in the patient lounge and therapy areas. We do not know whether this resulted from the locations of the lounge and therapy area, which made it impossible to invite patients to visit those rooms, or whether it was a result of the room design, which was not sufficiently stimulating or attractive. Studies have shown that patients are more likely to be engaged in activities in enriched environments than in non-enriched environments (Janssen et al., 2014; White et al., 2014). Modern stroke units need to consider the evidence for enriched environments and design lounges and therapy areas that support activities and social interactions. This aim could easily be accomplished by including access to games, books, computers and social interaction areas. The physical environment also needs a design that is easy to navigate. Hence, when designing new stroke units, there is a need to reflect on how corridors and communal areas should be designed as a way to naturally support mobilization and encourage patients to use spaces and rooms other than their own.

We noted that the doors to the patient rooms were closed for most of the day. The closed doors may have prevented infection from spreading (Loveday, Pellowe, Jones, & Pratt, 2006; Teltsch et al., 2011; van de Glind, de Roode, & Goossensen, 2007), but they may also have contributed to the fact that patients were invisible to the staff. In stroke care, it is very important that the staff and nurses can frequently assess health status; the nurses must observe and communicate with the patient, which is impossible without patient contact, and there is a risk that assessments will be left undone. In addition, the closed doors may have given the patients a signal that they are not allowed to get out of the room, and thus, it was best to

stay in the room and not visit other places in the environment, such as the lounge. A single room may also be comfortable for patients and may make them more sedentary, which does not encourage activities outside of the room. In this case, it is a serious issue because the single-room design does not support the recommended early mobilization mentioned in stroke guidelines (Ringelstein et al., 2013; Socialstyrelsen, 2009).

In a recent study by Maben et al. (2015), patients were more invisible and less observed in single rooms than in multi-bed rooms; thus, patient safety was threatened in single rooms. Patients expressed anxiety about isolation and that no one (staff or other patients) would notice if they fell. In another study, patients in single rooms reported that they experienced security because they could create a personal and private environment without a disruptive element while they simultaneously felt lonely (Persson, Anderberg, & Ekwall, 2015). In our study, the data showed that multi-bed rooms did not support patients' full privacy because the staff often conducted activities with all patients in the room at the same time. Furthermore, it was often noisy in these patients' multi-bed rooms, which could threaten an accurate assessment. Research has also shown that reduced noise levels increase speech perception between patients and staff (Ulrich et al., 2008). We also noticed that it was difficult to balance privacy and publicness in multi-bed rooms. Care mostly occurred with more than one patient in the room simultaneously, creating clear risks for violating personal integrity.

The data also revealed a tension between patients' need for privacy and nurses' need to be available to patients. In SU1, the staff's open workplaces in the middle of the corridor (right outside the patients' bedrooms) were not harmonious with patients' right to preserve their personal integrity. The staff might speak openly about the patients in these workplaces. Respecting privacy in a complex organization is one of the core duties of healthcare practice and challenges. On the other hand, having staff workplaces in the middle of the corridor could help patients find their way, enabling a more direct relationship between the patients and the staff that gave the staff a chance to walk and talk with the patients, build relationships, assess patient health and better involve the patients in their own care.

Quality of the environment is a multifaceted construct that is difficult to define. However, it is essential to be clear on the meaning of quality in each building project. Quality involves, for example, supporting participation and social interaction (Anåker et al., 2016). This example highlights a need to emphasize the trend towards mainly single rooms in newly built hospitals without options for social interactions with other patients. In the design process of new stroke units, designs that promote social interaction are needed, and this design needs to be enacted in places other than in the patient's own room.

From an evidence-based design perspective, this study contributes data that relate to the complex interaction among health, care and the physical environment that must be understood and considered when designing healthcare environments (Andrews, 2006; Elf et al., 2015).

From a nursing perspective, the study findings contribute to knowledge of the environmental metaparadigm of nursing. Creating and maintaining environments to facilitate health and well-being have been central to nursing for a long time due to the interconnectedness of people, health and their environments, as described by, for example, Florence Nightingale (Nightingale & Rosenberg, 1988). Following up on the work of Kirkevold (Kirkevold, 2010), one role of nursing is to help integrate patients into social relationships. We suggest that more emphasis should be placed on an awareness and understanding of which parts of the physical environment can support social relationships. Furthermore, studies should focus on which part of the physical environment affects care and, consequently, the way that care affects patients. A well-designed physical environment can increase patients' participation in their care.

5.1 | Strengths and limitations

The use of a mixed method design strengthened the study by combining two different types of data and letting them interact equally in the overall interpretation and discussion. The large number of observations contributed to the strength of the study results due to the frequency of observations and their occurrence throughout the day. A challenge of observations is observers' influence on participants' behaviours. However, research has shown (McDonald, 2005) that after just a few minutes, participants in observational studies behave normally and the observer becomes a subordinate. Qualitative observations were performed using a semi-structured observation guide to minimize the risk of excessive pre-understanding. The first and last authors performed parallel observations of the same activity and care along with parallel analyses to increase trustworthiness and reliability. The differences between the healthcare organizations and their impact on activities and care in stroke units have not been fully evaluated in this study, which is a limitation. We did not explore where (in which places) patients were (more) active; this information could have helped explain the differences between the included units. Some data were also missing, mainly because patients were not in the ward; however, only a small amount of data were missing, and the same trends were observed regardless the missing data.

6 | CONCLUSION

Understanding complex interactions between the physical environment and care is important, as these interactions are likely to influence rehabilitation and care in stroke units. Stroke guidelines, which focus on health status assessments, avoidance of bed-rest and early rehabilitation, require a supportive environment. Environmental factors, such as access to communal areas and patient room designs that respect privacy, are important for stroke care and should be considered early in the planning and design process as a central part of evidence-based design. A future challenge is to involve both healthcare professionals and patients in evidence-based design work.

Further empirical studies should continue to explore this field and, therefore, contribute to designing physical environments based on evidence.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

All authors have agreed on the final version and meet at least one of the following criteria (recommended by the ICMJE [http://www.icmje.org/recommendations/]):

- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

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