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Original Research

What's in a Building? A Descriptive Survey of Adult Inpatient Rehabilitation Facility Buildings in Victoria, Australia

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KEYWORDS
Built environment;
Evidence-based facility design;
Hospitals, rehabilitation;
Patients' rooms;
Rehabilitation;
Rehabilitation centers

Abstract *Objective:* To identify all the services that offer inpatient rehabilitation in Victoria, Australia, and to describe the buildings in which these services are housed, including their size, age, whether or not they were purpose-built, whether or not they are colocated with a tertiary hospital, the proportion of single-bed rooms, and ward layout.
Design: Cross-sectional survey of inpatient rehabilitation buildings. Data were collected via telephone questionnaire and websites.
Participants: Sixty-four rehabilitation facilities were identified and all participated in the survey (37 public, 27 private).
Results: Results revealed heterogeneity on most variables measured, including size (number of beds ranged from 2-104), age (oldest building built in 1860, and 26% built since 2010), purpose-built status (48% purpose-built), freestanding status (34% freestanding), percentage of single-bed rooms (ranged from 0%-100%), and layout. All facilities had a therapy gym, and most had a communal area (96%).
Conclusion: Since 2010, the proportion of buildings being purpose-built and colocated with a tertiary hospital has increased. The proportion of single-bed rooms has also increased and is especially high in privately funded facilities. Results suggest that rehabilitation design is influenced by norms and evidence from acute medical health care despite the purpose of care

List of abbreviations: AROC, Australasian Rehabilitation Outcomes Centre; IQR, interquartile range.

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being different: acute care (short-term, medical illness) and rehabilitation (longer-term, recovery, relearning).

The built environment can affect our behavior and well-being, and thus hospital buildings can affect clinical efficiency and outcomes.[1] The design of rehabilitation facilities has been largely overlooked in health care design research, with most research focusing on acute health care environments.[2,3] This article concerns built environment design for inpatient physical, cognitive, or occupational rehabilitation following illness or injury, not drug or alcohol rehabilitation.

Clinical priorities in rehabilitation differ from those in acute health care. While in rehabilitation, patients must balance rest with active participation in repetitive, goal-directed practice to relearn skills and abilities.[4,5] Rehabilitation patients' needs vary considerably depending on type of injury or illness, but in general, physical, cognitive, and social activities are important for regaining independence. Length of stay is usually longer in rehabilitation than in acute care. The optimal design for rehabilitation buildings may therefore be different from that of acute health care and requires detailed insight into the needs of varied rehabilitation patient groups. For example, although single-occupancy patient bedrooms are increasingly considered best practice for acute health care, there is debate about whether they are the most appropriate choice for all patients.[6,7] The demand for rehabilitation care is increasing as our population ages and acute treatment improves.[8] It is therefore timely to ask whether rehabilitation facilities are designed to meet the unique needs of rehabilitation patients.

To date, there has been no survey of rehabilitation facility buildings in Australia. Graham and Cameron conducted an Australia-wide survey to establish the availability of rehabilitation, but did not collect data regarding the buildings.[9] From 2008-2012, the Rehabilitation Services Report conducted by the Stroke Foundation included 2 questions regarding the built environment: (1) whether the facility was freestanding or part of an acute hospital; and (2) whether certain spaces were available (therapy gym, dining room, etc).[10] The Rehabilitation Services Report is an excellent summary of service performance for stroke rehabilitation in Australia, but it has provided limited information about the built environment. Knowing that there is a therapy gym available to patients does not indicate how easily accessible this gym is from the ward. Is it in a separate building? On a different floor? Participation in the Report is voluntary, specific to stroke, and dominated by public hospitals, which affects the sample. Twenty-seven Victorian rehabilitation facilities participated in the 2012 Report (25 public and 2 private),[10] which represented 47% of those currently on the national rehabilitation medicine clinical registry of Australia and New Zealand (96% of public and 7% of private).[11]

The Australian Hospital Design Guidelines does include recommendations for rehabilitation design, but these hardly differ from the Guidelines' recommendations for acute health care besides suggesting that therapy spaces should be made available.[12] There are very few evidenced-based recommendations for rehabilitation design in the Guidelines, which is understandable considering the limited literature available. Research in the area has been stymied on a number of fronts: (1) there are very few suitable theoretical frameworks to draw on,[13] (2) there are no standard checklists or measurement tools for assessing the design of rehabilitation buildings, and checklists developed for other buildings may not be appropriate,[14] and (3) there is no central repository for hospital designs, which creates a data accessibility problem. Design briefs and floor plans remain in the hands of design and construction teams—even designs for public hospitals are often not publicly available.

On noticing the lack of information available on rehabilitation facility buildings, we decided to conduct a survey of these buildings in the state of Victoria, Australia. The aim of this survey was to describe the buildings that house the rehabilitation facilities, including how many beds they provide, whether they are freestanding or part of a tertiary hospital, when they were built, whether they were purpose-built, whether key services such as a gym are easily accessible from the ward, and the extent to which communal spaces and single-bed rooms are available. By describing these buildings, we hope to show the current state of rehabilitation facility design and inform future research priorities.

Methods

This survey was a descriptive study. Data were collected via telephone questionnaire and publicly available websites between January and July 2017. Ethics approval was received from the Architecture, Building, and Planning Ethics Advisory Group at The University of Melbourne (no. 1749537).

Defining the sample

We aimed to include all public and private inpatient facilities that provide inpatient physical, cognitive, and/or occupational rehabilitation services to adults in Victoria, Australia. This included neurologic, spinal injury, orthopedic, cardiac, acquired brain injury, and musculoskeletal rehabilitation among others. The included facilities could be specialist hospitals dedicated only to rehabilitation, large tertiary hospitals with dedicated rehabilitation wards,

Table 1 Information that was collected for each rehabilitation facility in the sample

Variable	Description
Location	
Postcode	Australian postcode of the facility
Remoteness	According to the Accessibility and Remoteness Index of Australia, accessed from the Australian Bureau of Statistics (http://www.abs.gov.au/websitedbs/D3310114.nsf/home/remoteness+structure)
Funding	
Funding status	Whether the facility is public or private
Size	
No. of buildings	No. of buildings that the rehabilitation facility is housed in
No. of wards	No. of wards dedicated to rehabilitation
No. of beds	No. of beds dedicated to rehabilitation patients
Freestanding	
Freestanding status	Whether the building is freestanding or attached to a larger hospital
Age	
Year built	Year that the rehabilitation building was completed
Year renovated	Year that the rehabilitation building was last renovated (if applicable)
Purpose-built	
Purpose-built status	Whether the building was originally built as a rehabilitation facility
Original purpose	If it was not purpose-built, specify what it was original built for
Layout	
Therapy location	Where the therapy area is located in relation to the rehabilitation ward(s)
Floors	No. of floors/levels in the building allocated to rehabilitation services
Ward layout	Brief description of the ward layout including location of nurses' station
Communal areas	Whether indoor and/or outdoor communal areas are available to patients
Single-bed rooms	The number of single-bed rooms on the ward
Comments	Any other volunteered information about the design of the building

or smaller facilities where rehabilitation patients were placed in mixed wards (ie, wards providing more than 1 service). Facilities with mixed wards were only included if they had beds permanently dedicated to rehabilitation. Mixed wards reflect the reality of some smaller health care services in Australia, especially in rural areas, and so are an important consideration in any health care survey in this country. Facilities providing exclusively drug and alcohol rehabilitation, only geriatric evaluation and management, only transitional care, only acute care, or only outpatient/community rehabilitation were excluded. Residential aged care facilities were also excluded. For convenience, the included facilities will be referred to in the remainder of this article as rehabilitation facilities, even though some also provide other services besides rehabilitation.

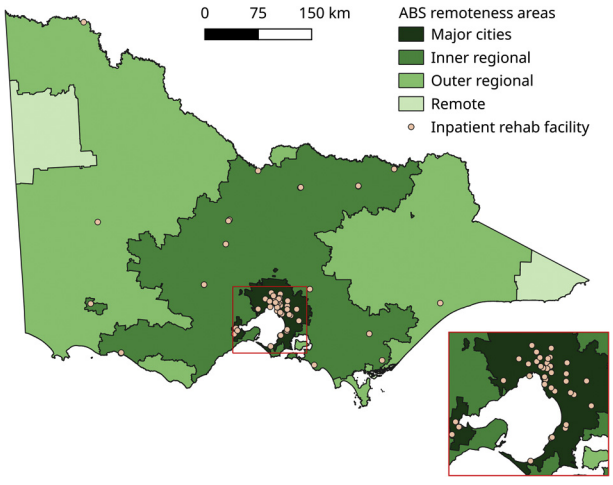

Fig 1 The location of the facilities that provide inpatient rehabilitation in Victoria, Australia, that were included in this survey. The remoteness areas are defined by the Accessibility and Remoteness Index of Australia, accessed from the Australian Bureau of Statistics. Abbreviation: ABS, Australian Bureau of Statistics.

To identify the eligible facilities, we cross-referenced the list of Australasian Rehabilitation Outcomes Centre (AROC) members with the hospitals listed as providing rehabilitation services on the Australian government MyHospitals website. AROC is the rehabilitation medicine clinical registry of Australia and New Zealand. The MyHospitals website provides the public with locations of hospitals, the services they offer, and hospital performance information. We checked these lists against the Victorian health care facilities listed in Schedule 1 of the Victorian Health Services Act 1988.[15] Each facility's eligibility was confirmed via telephone when we called the facility to administer the survey. We verified the completeness of the sample by asking each facility to list the other rehabilitation facilities in their area.

Data collection

Once we had a list of the rehabilitation facilities in Victoria, author R.L.S. conducted online searches and telephoned

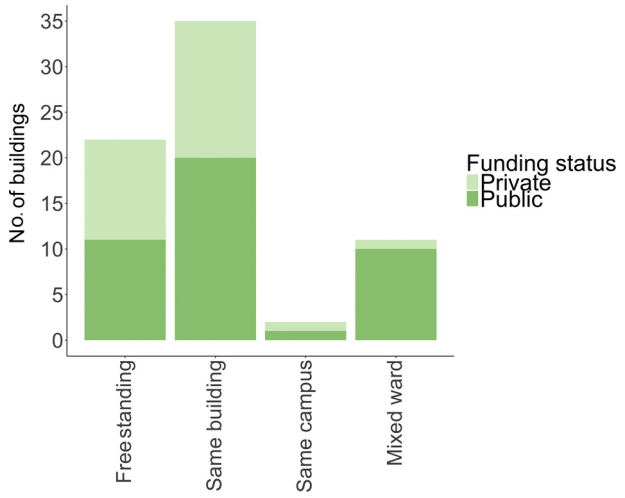

Fig 2 The proximity between buildings that house rehabilitation services and other medical buildings/services. Bars are stacked according to the funding type of the services (public or private). Buildings that housed rehabilitation services were classified as one of the following: freestanding rehabilitation services (ie, not on the same campus as a tertiary hospital), tertiary hospital buildings that included rehabilitation services (ie, in the same building), buildings adjacent to a tertiary hospital building (ie, on the same campus), or buildings that housed rehabilitation beds in a mixed ward.

each facility to collect targeted information about the building (table 1).

Information about new or notable buildings was sometimes included on facility's websites. We also searched Australian health care architecture firms' websites to find rehabilitation facilities in their past projects (Bates Smart, Billard Leece, HSPC Health Architects, Lyons, Silver Thomas Hanley, Team2, Tectura).

To contact each facility, R.L.S. rang the hospital's main switchboard, explained the purpose of the survey, and asked to be transferred to any staff member (administrative or clinical) in the rehabilitation facility. The respondent was asked to provide the information outlined in table 1. If the initial respondent could not provide the information, R.L.S. asked to be transferred to another staff member who might know more about the building. The final respondent's role at the hospital was noted (ie, receptionist, nurse, etc), but no other identifying information was recorded.

Analysis

All data were analyzed descriptively as counts, percentages, medians, or interquartile ranges (IQRs) using R software.[a] All missing data are specified below.

Results

Cross-referencing the AROC members list, the MyHospitals website, and the Victorian Health Services Act revealed 62 rehabilitation facilities. Two further facilities were identified through recommendations by respondents, making a total of 64 inpatient rehabilitation facilities in Victoria, Australia (37 public, 27 private). These 64 facilities are located in 70 buildings (42 public, 28 private) because some facilities are housed across 2 buildings. The deidentified individual facility data, publicly available photographs of the facilities, and an infographic summary of the results are included in supplemental appendixes S1-S3 respectively (available online only at http://www.archives-pmr.org/).

The 64 facilities together provide 2524 rehabilitation beds (not including beds that respondents identified as closed because of funding restrictions). The majority of inpatient rehabilitation facility buildings are located in a major city (69%, n=48), 27% (n=19) are in an inner regional area, and 4% (n=3) are in an outer regional area as defined by the Australian Bureau of Statistics (fig 1). The ratio of public to private varied by region:

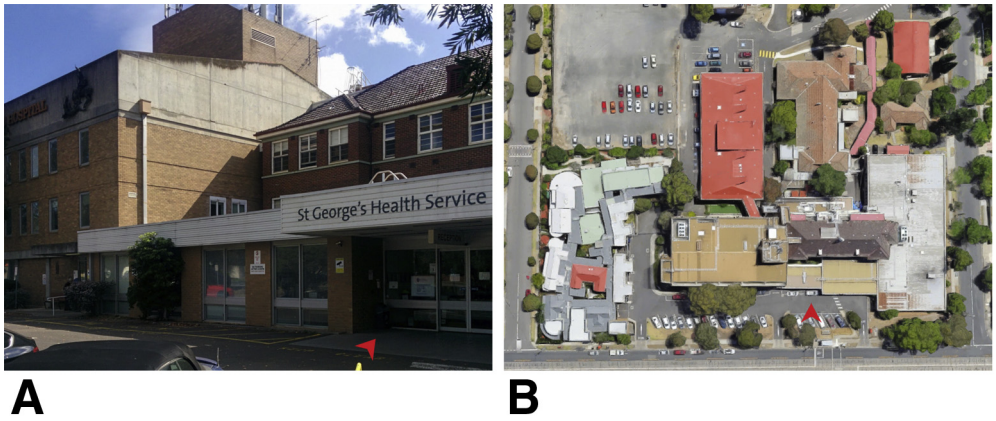

Fig 3 A rehabilitation facility that is freestanding: St George's Health, St Vincent's Hospital Melbourne, Victoria. Figure 3 **(A)** (by author R.L.S.) shows the street view, and fig 3 **(B)** shows an aerial view (from Google Earth). The red arrow indicates the front entrance of the hospital in both images. This building houses a rehabilitation ward, a geriatric evaluation and management ward, outpatient rehabilitation, transitional care units, and a general medical day service, but no emergency or acute services. The scale of fig 3 **(B)** is the same as the scale of fig 4 **(B)**.

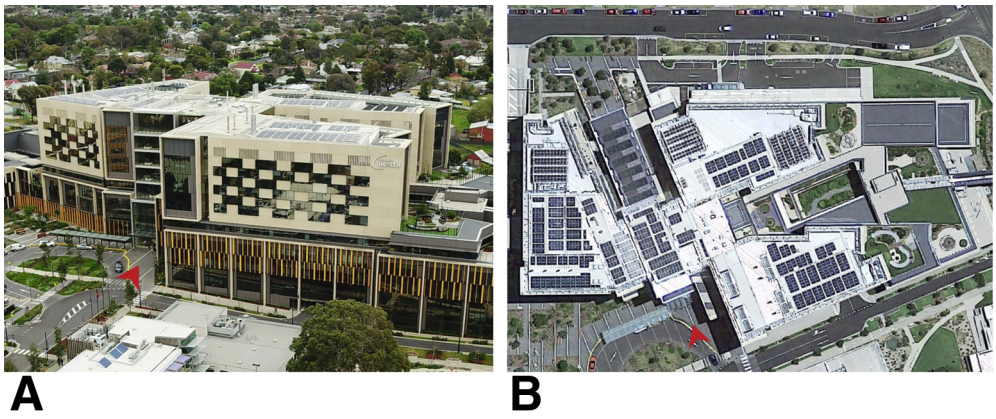

Fig 4 An example of a rehabilitation facility that is in the same building as a large tertiary hospital (ie, not freestanding): Bendigo Hospital, Victoria. Fig 4 **(A)** shows the street view (https://vhhsba.vic.gov.au/health-infrastructure/bendigo-hospital), and fig 4 **(B)** shows an aerial view (from Google Earth). The red arrow indicates the front entrance of the hospital in both images. This hospital provides emergency, acute, outpatient, and general medical services to the region. The rehabilitation ward is on the sixth floor. The scale of fig 4 **(B)** is the same as the scale of fig 3 **(B)**.

54% of rehabilitation buildings in a major city are public (n=26), 68% of inner regional buildings are public (n=13), and 100% of outer regional buildings are public (n=3).

Freestanding status

Freestanding status was collected for all 70 of the buildings that house inpatient rehabilitation services (fig 2). A total of 31% of these buildings were freestanding rehabilitation facilities, not on the same campus as a tertiary hospital (n=22). Half were tertiary hospital buildings that included rehabilitation services (n=35), 3% were adjacent to a tertiary hospital building (ie, on the same campus but a separate building, n=2), and 16% of the buildings housed rehabilitation beds in a mixed ward (n=11).

Figure 3 shows an example of a freestanding rehabilitation facility and fig 4 shows a tertiary hospital building that provides many services including inpatient rehabilitation.

Size of facility

The number of buildings, wards, and beds allocated to rehabilitation services was collected for all 64 facilities (see supplemental appendix S1, available online only at http://www.archives-pmr.org/). The number of beds allocated to rehabilitation at each facility varied between 2 and 104. The median number of rehabilitation beds per ward was 26 (IQR, 20-30; range, 2-42) and 30 (IQR, 21.1-30.6; range, 6-46) for public and private facilities, respectively.

Most of the 11 mixed wards held a combination of rehabilitation and geriatric evaluation and management beds (46%, n=5 wards). The other mixed wards combined rehabilitation beds with general medical and acute (27%, n=3 wards), palliative (8%, n=1 ward), alcohol and other drug (8%, n=1 ward), and sleep assessment (8%, n=1 ward). On average, 54% of the beds on these wards were dedicated to rehabilitation (range, 14%-88%).

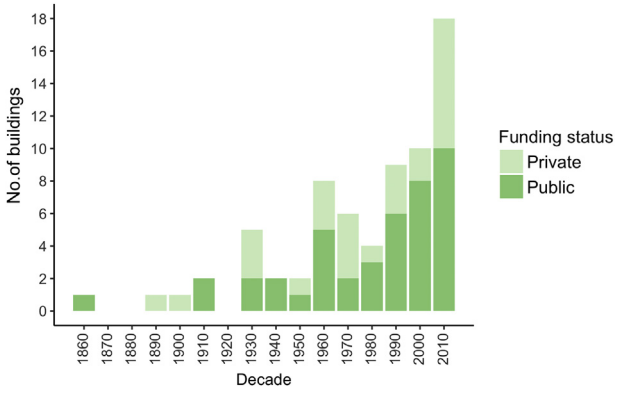

Fig 5 The number of buildings built each decade that currently house public or private inpatient rehabilitation services. Bars are stacked according to the funding type of the services (public or private).

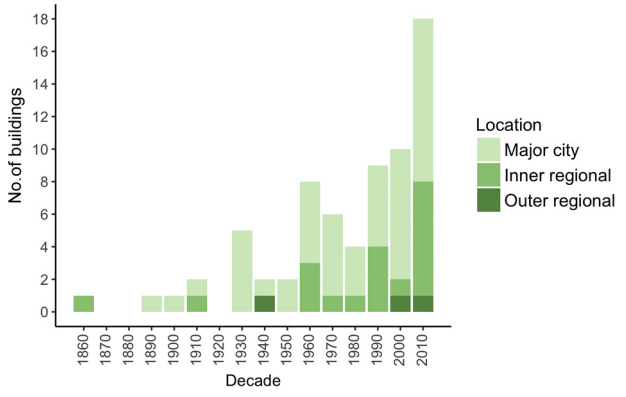

Fig 6 The number and location of buildings built each decade that currently house inpatient rehabilitation services. Bars are stacked according to the location of the services (major city, inner regional, outer regional).

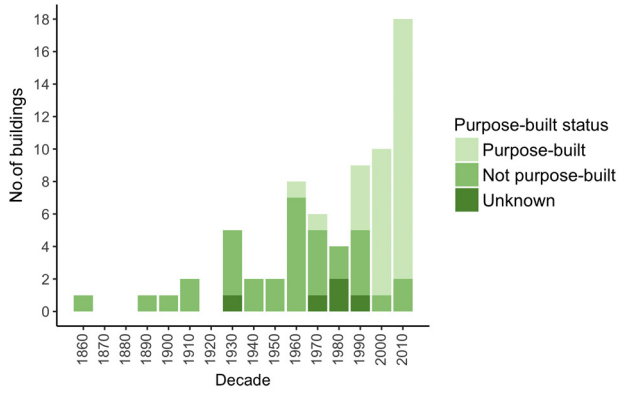

Fig 7 The number of buildings built each decade that currently house inpatient rehabilitation services. Bars are stacked according to whether or not the buildings were purpose-built for rehabilitation.

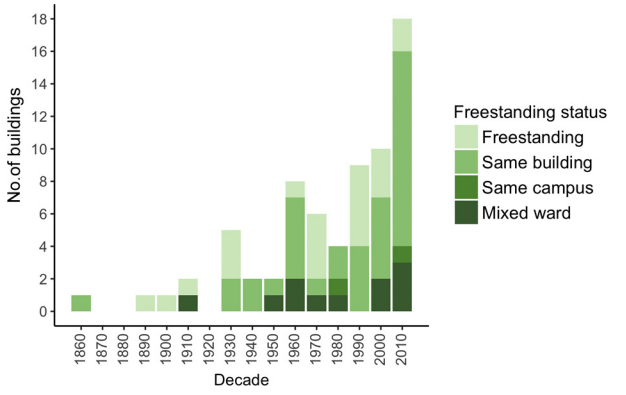

Fig 8 The number of buildings built each decade that currently house inpatient rehabilitation services. The bars are stacked according to the proximity of these buildings to other medical buildings/services. Buildings that housed rehabilitation services were classified as one of the following: freestanding rehabilitation facilities (ie, not on the same campus as a tertiary hospital), tertiary hospital buildings that included rehabilitation services (ie, in the same building), buildings adjacent to a tertiary hospital building (ie, on the same campus), or buildings that housed rehabilitation beds in a mixed ward.

Age of building

The building's age was obtained for 69 of the 70 buildings. The number of rehabilitation buildings being built has increased over time, with 26% of the buildings having been built since 2010 (n=18), including 6 between 2016-2017. The oldest rehabilitation facility building in Victoria was originally built in 1860 as a psychiatric facility. Figures 5-8 show the number of buildings built each decade that now house rehabilitation services, whether they are public or private, their location (major city, inner regional, outer regional), whether they were originally purpose-built for rehabilitation, and their freestanding status.

For 68 of the 70 buildings, we could determine whether or not the building had been renovated since being built (97%). Of these 68 buildings, 60% had been renovated at least once (n=41). Of the 49 buildings built before 2010, 80% had been renovated at least once (n=39). Of the 39 buildings built before 2000, 92% had been renovated at least once (n=36). The extent of the renovations varied widely, with some buildings having only bathroom remodeling or new flooring, while other renovations involved a complete overhaul of the ward or gym. In their comments, some staff mentioned a need for renovation of outdated facilities, especially a need for more storage space. However, other staff mentioned that a renovation would be of no use; the building would need to be remade from scratch to suit their needs. The barriers to renovation were largely financial but not exclusively. For example, 4 of the private facilities are located in buildings that were once notable private houses, some of which are heritage listed.

Purpose-built status

We defined buildings as purpose-built if they were originally designed and built specifically to house rehabilitation services. Purpose-built is therefore defined by design intent, and the purpose-built buildings in our sample may be heterogeneous in their designs and features. We were able to determine whether the building had been purpose-built for rehabilitation for 65 of the 70 buildings (93%). Half of these 65 buildings had not been purpose-built for rehabilitation (52%, n=34). Figure 9 shows that a higher proportion of private facilities were not purpose-built (61%, n=17) compared with public (46%, n=17). The majority of the rehabilitation facilities built since 2010 were purpose-built (89%, n=16) (see fig 7). The 2 built since 2010 that were not purpose-built were both designed to be identical to the general medical wards in the same building.

The original purpose of the 34 nonpurpose-built buildings was acute medical (50%, n=17), maternity (15%, n=5), aged care (12%, n=4), private residence or stately home (12%, n=4), psychiatric or mental health (6%, n=2), and a trade union training college (3%, n=1). The original purpose of 1 building could not be determined (3%).

Layout of building

The layout of the buildings varied widely. Some wards followed a standard single corridor design, others followed a U-shaped corridor design, others followed a triangle or race-track design, and some had entirely unique layouts, for example, those that were previously private residences. The percentage of single-bed rooms was collected for 68 of the 70 buildings (97%). In these 68 buildings, the median percentage of rehabilitation beds located in a single-bed room is 55% (IQR, 29%-80%). The median percentage was higher in purpose-built buildings (74%; IQR, 33%-97%) and in buildings built since 2010 (77%; IQR, 73%-100%). Figure 10 shows the proportion of single-bed rooms in public and private facilities that were purpose-built and those that were not.

A therapy gym was accessible in all facilities. The location of the gym in relation to the ward was reported for all buildings. A total of 44% (n=31) of the buildings had a gym colocated on the rehabilitation ward, although some of

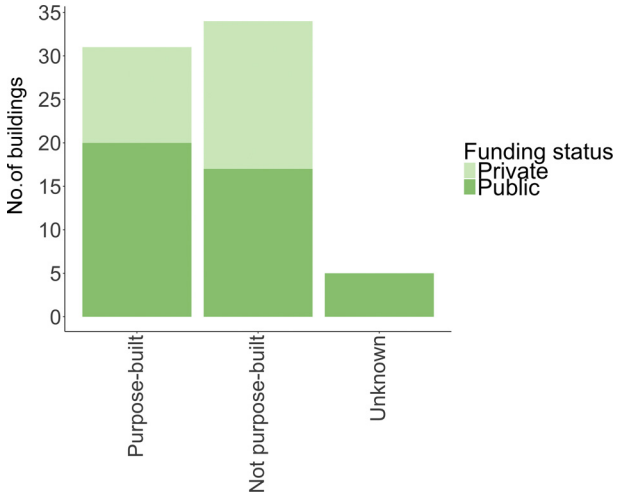

Fig 9 The purpose-built status of buildings that house rehabilitation services. Bars are stacked by the funding type of the services (public or private).

these had other therapy services located off ward (such as hydrotherapy, occupational therapy kitchen, additional larger gym). In 56% of the buildings, the gym was located on a separate floor to the rehabilitation ward, a separate section of the building, or in a separate building altogether (n=39); this was also the case for 42% of the purpose-built facilities (n=13).

Information regarding indoor communal spaces was collected for all buildings, and information regarding outdoor communal spaces was collected for 99% of the buildings (n=69). A total of 96% of the buildings had either an indoor or outdoor communal space for patients on all rehabilitation wards (n=67). Most of the buildings had an indoor communal space, such as a lounge or dining room (93%, n=65). Of the 5 buildings that did not have an indoor communal space, 4 were private, 1 was public, 1 was purpose-built for rehabilitation, and all were built prior to 2010. A total of 61% of the buildings had an outdoor communal space, such as a courtyard, garden, or balcony (n=42), and a further 5 buildings had an outdoor communal space available on some but not all rehabilitation wards (7%). About half of the buildings that had no outdoor communal space on any of the rehabilitation wards were public (59%, n=13); most were built prior to 2010 (73%, n=16) and were not purpose-built (64%, n=14). Some respondents noted that their indoor or outdoor communal spaces were rarely or never used by patients.

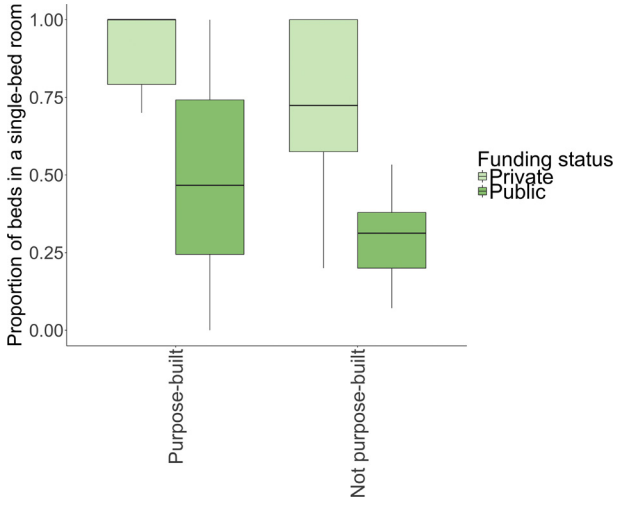

Fig 10 The proportion of public and private rehabilitation beds that are located in a single-bed room in buildings that were purpose-built and those that were not purpose-built.

Discussion

This study provides the first description of inpatient rehabilitation facility buildings in Australia.

Implications

The survey revealed notable heterogeneity in the rehabilitation facility buildings on most of the variables measured, including size, age, purpose-built status, freestanding status, proportion of single-bed rooms, and layout. The only consistency was that most facilities have a communal area and all have a therapy gym, which is in line with current Australian Healthcare Design Guidelines.[12] The variation in the location of the gym in relation to the ward suggests that it may be more accessible in some buildings than others, which could affect patients' activity levels.[16]

It may be that the heterogeneity in rehabilitation facility design reflects the heterogeneity of rehabilitation patients' needs and capacities. However, many rehabilitation facilities are not specialized and so must accommodate all patients.[17] Patient outcomes vary between rehabilitation facilities,[17] and there is growing recognition of the interaction between the health care environment and clinical outcomes.[1,18] It would be timely to investigate whether there are relationships between the variations in rehabilitation facility design and patient outcomes.

The average numbers of beds per building and per ward were similar for public and private rehabilitation facilities. However, the proportion of publicly funded rehabilitation facilities compared with private is higher in rural areas, with all outer regional rehabilitation facilities being publicly funded. A higher proportion of publicly funded rehabilitation facilities are purpose-built compared with private facilities, and privately funded buildings are more likely to be freestanding. It is not uncommon for patients in rehabilitation to require transfer to an acute facility for short-term care for an acute-onset illness, and earlier transfers are associated with lower mortality.[19] Proximity of rehabilitation and acute facilities may be an important design consideration for rehabilitation.

Our survey showed that many new rehabilitation facilities have been built in the last 10 years and that most older buildings have been renovated. New health care facilities and renovations require significant financial investment. Acute health care building designs that follow the latest evidence-based design research have been shown to improve clinical outcomes and provide return on investment.[18,20,21] Half of the rehabilitation facilities in our

survey were not purpose-built for rehabilitation and were refurbished as clinical demands changed over time. Evidentially, as well as being purpose-built for their intended purpose, health care buildings should also be designed to be adaptable should their purpose change.

Design intent was central to our definition of what constitutes purpose-built, but rehabilitation facilities are currently being built and refurbished with little to no rehabilitation-specific evidence base behind the design. This raises the question of what purpose-built really means in the context of contemporary rehabilitation facility design. How are the designs of purpose-built rehabilitation facilities different from rehabilitation facilities that were not purpose-built? And what informed these design choices? Future research could address these questions by analyzing the design briefs of purpose-built and nonpurpose-built facilities or by interviewing architects and hospital planners to understand the rationales behind their choices.[22] A detailed survey of renovations in nonpurpose-built facilities, including any planned renovations, would indicate the relative priority of different design features.

The results of this survey suggest that there is a high proportion of single-bed rooms in rehabilitation buildings, particularly in private facilities and especially in those that were recently built or purpose-built. There is evidence that single-bed rooms are beneficial for infection control, clinician/patient communication, patient perception of care, and sleep quality in acute medical settings.[3] However, clinical priorities in rehabilitation may be different from priorities in an acute medical environment. Multibed rooms may be better at meeting some of these priorities, such as reducing falls risk[23] and promoting social connection.[24] The growing proportion of single-bed rooms suggests that rehabilitation facility design is influenced by evidence from acute medical settings and current design trends.

Study limitations

We acknowledge that this study considered only the rehabilitation facilities in Victoria, Australia. While Victoria is the second most populous state in Australia, it has fewer remote regions than the rest of the country, and the results of this study may not be generalizable to the whole of Australia. There would be value in interrogating all the rehabilitation facilities in Australia to compare differences between states and regions.

The data collection method used in this study produced an excellent response rate but may have had drawbacks in terms of the reliability of the data because the role and expertise of the respondent varied between facilities. Some respondents were incredibly knowledgeable about the building and generously provided additional information, such as leaflets about the history of the building, while other respondents were less confident in their responses. This led to missing data for some variables where information could not be obtained through publicly available websites. Individual site visits could produce more detailed and complete data. Future surveys could be supported by standardized collection of data about important design features; however, no rehabilitation-specific built environment audit tool currently exists.

This study highlights current gaps in knowledge about rehabilitation facility design. Although we selected variables that we believed important to survey, the relative importance of these or other built environment features on patient outcomes and staff outcomes is unknown. Research completed after this survey was conducted has begun to address this issue.[25] Future built environment surveys could link to clinical registry data to investigate whether the presence of particular design features affects patient outcomes. Understanding how patients and staff behave within a rehabilitation environment in response to building features would also be valuable. Here, qualitative data collection and analysis methodologies or spatial analysis tools, such as space syntax, may be the best research option.[26] Future research would benefit from considering the perspectives of the users of the facilities—patients, staff, and visitors. Ready access to floor plans and design briefs would also help facilitate research. This is not currently the norm in Australia.

Conclusions

Without research into rehabilitation facility buildings, it is difficult for health care planners and architects to produce evidence-based designs. This study represents the first step in a series of projects to investigate rehabilitation environments and suggests critical questions for a wider survey of rehabilitation buildings that could be linked to patient outcomes data. We need to understand the current state of these buildings before we can optimize them for rehabilitation.

Supplier

a. R software; R Foundation for Statistical Computing.

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