Joan Webster
Heather Davies
Monica Stankiewicz
Lesley C. Fleming

Estimating the Time Involved in Managing the 'Unoccupied Bed:' A Time and Motion Study

Executive Summary

- Occupied bed days are often used as a demand indicator when calculating the number of nurses required to provide safe care.
- However, such calculations fail to take into account the amount of nursing time consumed by the "unoccupied bed."
- This study used direct observation time-and-motion methods to estimate the time and costs associated with a bed that is unoccupied.
- The average time taken to complete all of the activities associated with a bed that was unoccupied due to an internal transfer was 8.65 minutes, for a patient discharge 26.27 minutes, and for a patient admission 37.7 minutes.
- An average daily cost for activities surrounding these patient movements was approximately $386/day (AUD) in registered/enrolled nursing salaries alone.
- The unoccupied bed is not resource neutral and time associated with its maintenance should be considered when calculating nursing requirements to provide safe care.

In recent years, there has been a continuing focus on calculating the number of nurses required to provide a minimum, safe service in acute hospital settings (Elkhuizen, Bor, Smeenk, Klazinga, & Bakker, 2007; Gonzalez-Torre, Adenso-Diaz, & Sanchez-Molero, 2002). The imperative to "get this right" is driven by a progressive rise in the cost of health care (Halpern & Pastores, 2009) and attempts to control such cost increases by departments of health, using various payment systems (Farrar et al., 2009; Street & Maynard, 2007). However, calculating the number of nurses required per patient day is fraught with difficulty. Clinical work has become extremely complex. Patients admitted to acute hospitals are, on average, older, have higher acuity levels, and require increased nursing care; so systems for measuring staffing requirements continue to be examined and revised (Smith, Casey, Hurst, Fenton, & Scholefield, 2009; Twigg & Duffield, 2009).

One of the persistent problems associated with accurately calculating nursing staff requirements is these systems generally include a measure of bed occupancy, or the number of patients receiving inpatient care divided by the number of available beds (DeLia, 2006). Such calculations ignore the nursing work consumed by an unoccupied bed and may contribute to inappropriate staffing levels. For example, we recently completed an observational study of the nursing work required to maintain an unoccu-

JOAN WEBSTER, RN, BA, is Nursing Director for Research, Royal Brisbane and Women's Hospital, Brisbane, Australia, and holds Adjunct Professorial positions at the Griffith University, the University of Queensland, and the Queensland University of Technology, Brisbane, Australia.

HEATHER DAVIES, RN, was Research Nurse, Centre for Clinical Nursing, Royal Brisbane and Women's Hospital, Brisbane, Australia, at the time this article was written.

MONICA STANKIEWICZ, RN, M APP SCI (Research), was Research Nurse, Centre for Clinical Nursing, Royal Brisbane and Women's Hospital, Brisbane Australia, at the time this article was written. She is a Master's Student at the Queensland University of Technology, Brisbane, Australia.

LESLEY C. FLEMING, AOM, RN, BA, M (Health Services Management), is Executive Director of Nursing Services, Royal Brisbane and Women's Hospital, Brisbane, Australia, and a Doctoral Student at the Queensland University of Technology, Brisbane, Australia.

pied bed (Collins et al., 2010). Three reasons for an empty bed were identified: (a) pre-patient admission, (b) temporary transfer for provision of another health service, and (c) post-patient discharge. The nursing work, which was associated with each of the reasons for an unoccupied bed, was considerable and increased significantly after hours, when support systems were reduced (e.g., when administrative staff were off duty, catering facilities were unavailable, or senior decision makers were absent).

The assumption underpinning the use of bed occupancy as a factor in determining nursing staff levels is the unoccupied bed is "resource neutral." This is not the case. Our literature review found no empirical studies quantifying the extent of resources consumed by the unoccupied bed. Consequently, a more transparent view of nursing time, which is employed in maintaining the unoccupied bed, may be useful to nurse mangers and health care planners.

Objective

The primary objective of the proposed study was to quantify the amount of time utilized in activities related to the unoccupied bed.

Methods

Design. The study was designed to answer questions related to cost of managing the unoccupied bed and to identify the levels of nursing staff involved in the process. Because we were more interested in the actual time spent on activities, rather than the proportion of time, we used a direct observation time-and-motion method to document the activities nurses perform in relation to the unoccupied bed.

Definition. An unoccupied bed is defined as one that is "open" and available but currently unoccupied (Damiani, Propper & Dixon, 1995).

Setting. The study site is an Australian, tertiary referral teaching hospital, which provides services to patients throughout the State of Queensland, Northern New South Wales, and the Northern Territory. It incorporates all major health specialties including medicine, surgery, psychiatry, oncology, women's and newborn services, trauma services, and more than 30 subspecialties. Four units in this 950-bed hospital were included. The units — one medical, one surgical, one oncology, and one maternity — represent the complex nature of the organization and provided a comprehensive assessment of the study objective.

Participants. All nursing staff working on the targeted units during the study period were eligible for participation. This included direct care registered nurses and midwives, enrolled nurses, and assistants in nursing. It also included bed managers and nurse unit managers, if they participated in activities related to the unoccupied bed. Participation in the study was voluntary and written consent was obtained before observations commenced. Approval for the study was obtained from the hospital's human research ethics committee.

Observation instrument. Observational methods are valid and reliable in assessing nursing work activity (Capuano, Bokovoy, Halkins, & Hitchings, 2004; Herdman et al., 2009; Williams, Harris, & Turner-Stokes, 2009) and in comparing activities performed by different levels of nurses (Chaboyer et al., 2008). This method has also been tested against self-reports of time spent on nursing activities, and shown to be more acceptable and efficient (Ampt, Westbrook, Creswick, & Mallock, 2007). A number of observational instruments for classifying nursing activity are available (Capuano et al., 2004; Herdman et al., 2009; Urden & Roode, 1997) but most of these systems classify activities into the following activities: direct care, indirect care, unit related, documentation, professional, and personal time (Capuano et al., 2004; Herdman et al., 2009; Weigl, Muller, Zupanc, & Angerer, 2009; Williams et al., 2009). For our purposes, a more focused instrument was required; one built around the three, broad activity areas identified in our preliminary study. Consequently, we developed a new instrument, based on our previous observations, which was pilot tested for usability and applicability before the main study began.

Data collection. Leading up to the start date, posters were developed and displayed and staff education folders prepared to promote the study. Several staff in-service sessions were also held in each participating ward, to provide an opportunity to explain the study and respond to any questions. Data collection covered a 9-week period between April and June 2010 and involved two research nurses working independently. Periods of observation were not uniformly predetermined but directed by notification of an imminent admission, transfer, or discharge. It was not possible to follow every patient transfer, but a representative sample of admissions, discharges, and intra-hospital transfers were selected by convenience. Research nurses remained in one ward at a time and focussed on one bed at a time. They observed and recorded the type of activity and time consumed on each activity, using the precoded activity sheet. Any uncertainty about the nature of an activity was clarified with the nurse performing the activity (e.g., if a phone call was being made, it may have been necessary to establish if it was related to the unoccupied bed). Data collection occurred between 0700 hours and 1900 hours, as these are the busiest times for patient movements. A stopwatch was used by research nurses to record times accurately. Demand for beds in this busy hospital is constant so every effort is made to limit turnaround times.

Sample size. In other time and motion studies, adequate samples have ranged between 324 and 980 observations (Elganzouri, Standish, & Androwich, 2009; Van de Werf,

Table 1.
The Proportion of Individual Activities Surrounding an Unoccupied Bed Associated with Admissions, Discharges, and Transfers in an Acute Hospital

	One Activity n (%)	Two Activities n (%)	Three Activities n (%)	Four Activities n (%)	Five Activities n (%)	> Five Activities n (%)
Discharges	63 (45.7)	33 (23.9)	14 (10.1)	13 (9.4)	3 (2.2)	12 (8.7)
Admissions	70 (68.6)	19 (18.6)	5 (4.9)	4 (3.9)	3 (2.9)	1 (1.0)
Transfers	196 (70.8)	52 (18.8)	20 (7.2)	4 (1.4)	4 (1.4)	1 (0.4)

Lievens, Verstraete, Pauwels, & Van den Bogaert, 2009). We believed it would have been possible for two research nurses to observe approximately 10 activities each day. This would allow 200 observations to be recorded each week. We aimed to observe approximately 800 activities (admissions, discharges, and inter-hospital transfers) to provide sufficient detail to answer the research question.

Analysis. Data were analyzed using SPSS Version 18.0. Data are presented as means and standard deviations (SD) and ranges or proportions. Descriptive statistics, with their 95% confidence intervals, were calculated for each activity and the amount of time spent by each category of staff on each activity. In addition, the hospital employs four full-time bed managers and three full-time administration officers to coordinate patient admissions. Because all of their time is involved in finding an unoccupied bed, a calculation was made to account for this time. This was based on the number of hospital admissions and discharges during a 4-week period divided by the salary of the bed managers and the administration officers. Consequently, the total time for an admission was calculated by summing the mean activity time recorded by the research nurse and the mean bed manager and administration officer time.

Results

Individual activities. The number of individual nurses contributing to the data was not calculated; we were interested only in the activities they undertook. Consequently, it is likely the same nurse may have been involved in a number of activities over the study period. Overall, a total of 916 individual activities associated with an unoccupied bed were recorded: 304 (33.3%) in the medical ward, 254 (27.7%) in the surgical ward, 201 (21.9%) in the oncology ward, and 157 (17.1%) in the maternity ward. Of the 916 activities, 412 (45%) were associated with 277 temporary transfers, 342 (37.3%) with 138 patient discharges, and 162 (17.7%) with 102 patient admissions. Patient discharges were the most complex processes associated with an unoccupied bed with a mean of 2.48 (*SD* 2.17) individual activities (range 1-14). Patient admissions were the next most complex (mean 1.59; *SD* 1.38; range 1-6 individual activities) with internal transfers the least complicated (mean 1.49; *SD* 1.20, range 1-7); Table 1 contains further details. Times for individual activities are shown in Table 2. Registered nurses were involved in the majority of individual activities associated with an unoccupied bed (584; 63.8%).

Total time and cost for each patient movement (all staff included). The average time taken to complete all of the activities associated with a bed that was unoccupied due to an internal transfer was 8.65 (*SD* 11.17) minutes and for a patient discharge 26.27 (*SD* 34.23) minutes. Activities occurring in preparation for a patient admission took on average 6.3 (*SD* 8.9) minutes of observed time plus an estimated 23.1 minutes of the bed manager's time and 8.3 minutes of the bed allocation administration officer's time (total 37.7 minutes), for each admitted patient. Time spent by individual categories of staff varied by the type of patient movement. For example, a RN spent about 9 minutes managing an unoccupied bed that was associated with a transfer but approximately 27 minutes on activities around an unoccupied bed associated with a patient discharge (see Table 3). Assuming an average day in an average ward consisted of five admissions, five discharges, and 15 internal transfers to operating theaters, x-ray, etc., the activities surrounding these movements would cost approximately $386/day (AUD) in registered/enrolled nursing salaries alone (see Table 4). On a broader scale, the hospital admits approximately 865 patients each week. For the unoccupied bed component for these patients and based on calculations in Table 4, activities undertaken by registered nurse/enrolled nurses would amount to around $53,000 (AUD) each week or approximately $2.75 million each year.

Discussion

The main aim of this study was to quantify the time consumed by an unoccupied bed. To our knowledge, this is the first such report and provides information that may be of use to nurse managers when arguing for resources. A pending

Table 2.
Average Time Spent on Individual Activities Associated with an Unoccupied Bed in Relation to Transfers, Discharges, and Admissions in an Acute Hospital

Activity	N	Mean (*SD*) Number of Minutes	95% Confidence Intervals	Minimum Number of Minutes	Maximum Number of Minutes
Communicating with shift coordinator	55	1.75 (1.72)	1.27; 2.21	1.00	10.00
Communicating with bed manager	52	3.54 (5.69)	1.95; 5.12	1.00	30.00
Liaising with treating team	52	1.83 (1.06)	1.53; 2.12	1.00	5.00
Liaising with allied health	33	1.88 (1.24)	1.43; 2.31	1.00	7.00
Requesting or returning equipment	23	3.30 (5.53)	0.91; 5.69	1.00	27.00
Collecting medications	21	4.40 (3.51)	2.78; 5.98	1.00	12.00
Documentation	47	2.60 (2.70)	1.80; 3.39	1.00	18.00
Data entry	35	1.77 (1.28)	1.32; 2.21	1.00	7.00
Preparing bed/room	256	10.40 (7.28)	9.50; 11.29	1.00	39.00
Nurse escort	94	13.81 (9.71)	11.83; 15.80	1.00	72.00
Searching for a patient	14	6.92 (8.36)	2.10; 11.75	1.00	30.00
Communicating with relatives	58	3.36 (4.58)	2.15; 4.56	1.00	30.00
Medical record delivery	14	3.93 (3.02)	2.18; 5.67	1.00	10.00
Liaising with other departments	110	1.90 (2.12)	1.50; 2.31	1.00	15.00
VRE clean	14	101.50 (53.87)	70.39; 132.60	31	215.00

Table 3.
Average Time Spent on Combined Activities Associated with an Unoccupied Bed in Relation to Transfers, Discharges, or Admissions by Nursing Staff

Category of Staff	Mean (*SD*) Number of Minutes	95% Confidence Intervals	Minimum Number of Minutes	Maximum Number of Minutes
Admissions				
Registered or enrolled nurse	5.68 (8.91)	3.25; 8.11	1.00	60.00
NUM/Shift coordinator	3.98 (6.61)	2.16; 5.80	1.00	30.00
Bed manager (estimate)*	23.15 (N/A)			
Discharges				
Registered or enrolled nurse	24.39 (31.86)	17.51; 31.26	1.00	134.00
NUM/Shift coordinator	6.28 (8.04)	2.27; 10.28	1.00	25.00
Transfers				
Registered or enrolled nurse	8.31 (10.44)	7.00; 9.62	1.00	74.00
NUM/Shift coordinator	4.39 (6.90)	2.06; 6.72	1.00	30.00

* Based on an average of 864 overnight admissions per week.

Table 4.
Managing an Unoccupied Bed: Average Daily Ward-Based Cost of the Nursing Component (Based on an Assumed Five Admissions, Five Discharges, and 15 Transfers)

	Minutes	Cost per Minute AUD $	Total per Movement AUD $	Daily Total AUD $
Admissions X 5	32.81 (9.66 observed plus 23.15 bed manager)	0.815	21.08	105.5
Discharges X 5	30.67	0.815	25.0	125.0
Transfers X 15	12.70	0.815	15.58	155.26
Total				**385.76**

admission requires the coordination and completion of numerous tasks such as preparing the bed, liaising with bed managers, requesting equipment, and communicating with shift coordinators and others in the health care team. Discharges are similarly complex, requiring data entry, cleaning and preparation of the area, escorting patients, collecting discharge medications, returning equipment, and liaising with bed managers. For infectious or isolated patients, the cleaning process may be complex and prolonged. These tasks are repeated many times each day and use up a considerable amount of nursing time that is not accounted for when resource use is calculated based on the number of "occupied" beds.

The study also provides a tested methodology for collecting data about detailed nursing work that moves away from the traditional classifications of direct care, indirect care, unit related, documentation, professional, and personal time (Capuano et al., 2004; Herdman et al., 2009; Weigl et al., 2009; Williams et al., 2009). Although these classifications may include time spent on activities related to the unoccupied bed, they fail to bundle such activities into quantifiable and usable time estimates. In addition, the methodology may be useful for other purposes, such as costing the admission or discharge components of high patient turnover areas, such as medical assessment and planning units. The methodology could also help in assessing a hospital's surge capacity by estimating the time required to rotate a bed from discharge to readiness for admission.

There are also implications from this study for nurse managers and administrators, whose responsibility it is to provide a safe level of care, by ensuring sufficient staff are available to manage patient needs. For example, a number of reports, from diverse care settings and countries, have shown a positive relationship between adequate staffing levels and improved patient outcomes (Cho, Hwang, & Kim, 2008; Frith et al., 2010; Van den Heede et al., 2010). One of the most recent studies investigated the impact of a new model for calculating nursing hours per patient day (NHPPD) on nursing-sensitive indicators. The model included a number of measures such as patient complexity, presence of high-dependency beds, and the ratio of emergency to elective patients. A reduction in rates for nine indicators provided strong support for the model (Twigg, Duffield, Bremner, Rapley, & Finn, 2010). An interesting feature of this model was the inclusion of a measure for turnover, calculated by the equation admissions plus transfers plus discharges divided by bed number. Turnover was classified as "high" where turnover was greater than 50% and moderate where turnover was greater than 35% (Twigg & Duffield, 2009). However, the relative weight of turnover in the overall model for calculating NHPPD was unclear. Data from the current study may help to close this gap by quantifying, more accurately, the amount of time each day nurses spend on admissions, discharges, and transfers. In addition, it may be possible to develop costing models, based on different levels of nursing.

For many hospitals however, calculating nursing requirements is frequently based on clinical judgement or historical data (Arthur & James, 1994) and modified by bed occupancy (DeLia, 2006). However, as we have shown, bed occupancy fails to account for the considerable time taken to prepare a bed and its environment for re-occupancy.

Strengths and Limitations

The main strength of the study is the number of observations recorded and the inclusion of a variety of practice settings. It was limited by an inability to observe all of the activities that may have been associated with the empty bed. We tried to overcome this by estimating the time involved by those outside the viewing area, such as bed managers, but this estimate excluded others who were also involved with the unoccupied bed (e.g., the director and assistant director of the patient flow unit). In addition, although the overall number of individual observations was large, there were relatively few observations for some categories of staff (e.g., patient support officers and assistants in nursing for admissions). This resulted in wide confidence intervals so results for these groups require further validation. The length of time taken by individual nurses to perform the same task may have varied but this was not monitored or adjusted during the study.

Conclusion

Funding for nursing resources within the health care system is usually based on a formula that calculates and dictates how many nurses can be employed within a hospital or health care setting. One of the variables in this formula is occupancy, that is, the proportion of available beds occupied by patients at a given time. In simple terms, if a patient is not in a bed that is available, it means occupancy is reduced; reduced occupancy equates to less nursing staff being funded. In this study, the nursing work surrounding an unoccupied bed was explored. Results indicate nursing work, and therefore nursing hours, are required to manage a bed that is unoccupied. Consequently, this time needs to be included in any calculations of required resources.

The profession has undertaken a great deal of research aimed at understanding the nursing resources required to care for a patient once he/she occupies a hospital bed. Findings from the current study will supplement this knowledge by providing nursing administrators with a tool that will assist them to calculate the additional resources required to manage an unoccupied bed. The current work shows the unoccupied bed is not resource neutral and will augment the growing knowledge we have regarding NHPPD and thus the nursing resources required to deliver safe nursing care. **$**

REFERENCES

Ampt, A., Westbrook, J., Creswick, N., & Mallock, N. (2007). A comparison of self-reported and observational work sampling techniques for measuring time in nursing tasks. *Journal of Health Services Research and Policy, 12*(1), 18-24.

Arthur, T., & James, N. (1994). Determining nurse staffing levels: A critical review of the literature. *Journal of Advanced Nursing, 19*(3), 558-565.

Capuano, T., Bokovoy, J., Halkins, D., & Hitchings, K. (2004). Work flow analysis: Eliminating non-value-added work. *Journal of Nursing Administration, 34*(5), 246-256.

Chaboyer, W., Wallis, M., Duffield, C., Courtney, M., Seaton, P., Holzhauser, K., … Bost, N. (2008). A comparison of activities undertaken by enrolled and registered nurses on medical wards in Australia: An observational study. *International Journal of Nursing Studies, 45*(9), 1274-1284.

Cho, S.H., Hwang, J.H., & Kim, J. (2008). Nurse staffing and patient mortality in intensive care units. *Nursing Research, 57*(5), 322-330.

Collins, B., Fleming, L., Hine, B., Stephenson, J., Veach, K., Anderson, S., … Webster, J. (2010). Nursing rescource implications of the unoccupied bed. *Australian Journal of Advanced Nursing, 27*(4), 13-17.

Damiani, M., Propper, C., & Dixon, J. (2005). Mapping choice in the NHS: Cross sectional study of routinely collected data. *British Medical Journal, 330*(7486), 284.

DeLia, D. (2006). Annual bed statistics give a misleading picture of hospital surge capacity. *Annals of Emergency Medicine, 48*(4), 384-388, 388, e381-382.

Elganzouri, E.S., Standish, C.A., & Androwich, I. (2009). Medication Administration Time Study (MATS): Nursing staff performance of medication administration. *Journal of Nursing Administration, 39*(5), 204-210.

Elkhuizen, S.G., Bor, G., Smeenk, M., Klazinga, N.S., & Bakker, P.J. (2007). Capacity management of nursing staff as a vehicle for organizational improvement. *BMC Health Services Research, 7*, 196.

Farrar, S., Yi, D., Sutton, M., Chalkley, M., Sussex, J., & Scott, A. (2009). Has payment by results affected the way that English hospitals provide care? Difference-in-differences analysis. *British Medical Journal, 339*, b3047.

Frith, K.H., Anderson, E.F., Caspers, B., Tseng, F., Sanford, K., Hoyt, N.G., … Moore, K. (2010). Effects of nurse staffing on hospital-acquired conditions and length of stay in community hospitals. *Quality Management in Health Care, 19*(2), 147-155.

Gonzalez-Torre, P.L., Adenso-Diaz, B., & Sanchez-Molero, O. (2002). Capacity planning in hospital nursing: A model for minimum staff calculation. *Nursing Economic$, 20*(1), 28-36.

Halpern, N.A., & Pastores, S.M. (2009). Critical care medicine in the United States 2000-2005: An analysis of bed numbers, occupancy rates, payer mix, and costs. *Critical Care Medicine, 38*(1), 65-71.

Herdman, T.H., Burgess, L.P., Ebright, P.R., Paulson, S.S., Powell-Cope, G., Hancock, H., … Cadman, E.C. (2009). Impact of continuous vigilance monitoring on nursing workflow. *Journal of Nursing Administration, 39*(3), 123-129.

Smith, S., Casey, A., Hurst, K., Fenton, K., & Scholefield, H. (2009). Developing, testing and applying instruments for measuring rising dependency-acuity's impact on ward staffing and quality. *International Journal of Health Care and Quality Assurance, 22*(1), 30-39.

Street, A., & Maynard, A. (2007). Activity based financing in England: The need for continual refinement of payment by results. *Health Economics Policy and Law, 2*(Pt 4), 419-427.

Twigg, D., & Duffield, C. (2009). A review of workload measures: A context for a new staffing methodology in Western Australia. *International Journal of Nursing Studies, 46*(1), 131-139.

Twigg, D., Duffield, C., Bremner, A., Rapley, P., & Finn, J. (2010). The impact of the nursing hours per patient day (NHPPD) staffing method on patient outcomes: A retrospective analysis of patient and staffing data. *International Journal of Nursing Studies, 48*(5), 540-548.

Urden, L.D., & Roode, J.I. (1997). Work sampling. A decision-making tool for determining resources and work redesign. *Journal of Nursing Administration, 27*(9), 34-41.

Van den Heede, K., Simoens, S., Diya, L., Lesaffre, E., Vleugels, A., & Sermeus, W. (2010). Increasing nurse staffing levels in Belgian cardiac surgery centres: A cost-effective patient safety intervention? *Journal of Advanced Nursing, 66*(6), 1291-1296.

Van de Werf, E., Lievens, Y., Verstraete, J., Pauwels, K., & Van den Bogaert, W. (2009). Time and motion study of radiotherapy delivery: Economic burden of increased quality assurance and IMRT. *Radiotherapy and Oncology, 93*(1), 137-140.

Weigl, M., Muller, A., Zupanc, A., & Angerer, P. (2009). Participant observation of time allocation, direct patient contact and simultaneous activities in hospital physicians. *BMC Health Services Research, 9*, 110. doi: 10.1186/1472-6963-9-110.

Williams, H., Harris, R., & Turner-Stokes, L. (2009). Work sampling: A quantitative analysis of nursing activity in a neuro-rehabilitation setting. *Journal of Advanced Nursing, 65*(10), 2097-2107.