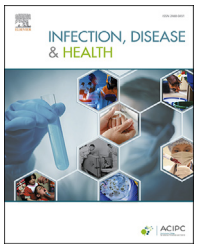
Infection, Disease & Health 29 (2024) 212–217

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: http://www.journals.elsevier.com/infection-disease-and-health/



Research paper

# Oral care practices and hospital-acquired pneumonia prevention: A national survey of Australian nurses

**Peta Ellen Tehan [a,b], Katrina Browne [b], Georgia Matterson [b], Allen C. Cheng [a,c], Sonja Dawson [b], Nicholas Graves [e], Douglas Johnson [f,g], Martin Kiernan [b,h], Auxillia Madhuvu [d], Caroline Marshall [f,g], Julee McDonagh [i,j,l], Maria Northcote [k], Jayne O'Connor [m], Liz Orr [f], Helen Rawson [d], Philip Russo [b,d,v], Jenny Sim [n], Andrew J. Stewardson [o,p], Janet Wallace [q], Nicole White [r], Rhonda Wilson [s,t], Brett G. Mitchell [b,d,t,u,*,1]**

[a] *School of Clinical Sciences, Monash University, Melbourne, Victoria, Australia*
[b] *School of Nursing and Health, Avondale University, Lake Macquarie, New South Wales, Australia*
[c] *Infectious Diseases, Monash Health, Melbourne, Australia*
[d] *Nursing and Midwifery, Monash University, Melbourne, Victoria, Australia*
[e] *Duke-NUS Medical School, Singapore*
[f] *Infection Prevention and Surveillance Service, The Royal Melbourne Hospital, Melbourne, Victoria, Australia*
[g] *Department of Infectious Diseases, The University of Melbourne, Melbourne, Victoria, Australia*
[h] *University of West London, London, UK*
[i] *University of Wollongong, Wollongong, New South Wales, Australia*
[j] *Centre for Chronic & Complex Care Research (CCCCR), Ward B37, Blacktown Hospital, New South Wales, Australia*
[k] *Research Services, Avondale University, New South Wales, Australia*
[l] *Western Sydney Local Health District, New South Wales, Australia*
[m] *Sydney Adventist Hospital, Wahroonga, New South Wales, Australia*
[n] *School of Nursing, Midwifery & Paramedicine, Australian Catholic University, North Sydney, New South Wales, Australia*
[o] *Department of Infectious Diseases, Alfred Hospital, Melbourne, Victoria, Australia*
[p] *Central Clinical School, Monash University, Melbourne, Victoria, Australia*
[q] *University of Newcastle, Newcastle, New South Wales, Australia*
[r] *Australian Centre for Health Services Innovation, School of Public Health and Social Work, Queensland University of Technology, Brisbane, Queensland, Australia*
[s] *RMIT University, Melbourne, Victoria, Australia*
[t] *Central Coast Local Health District, Gosford Hospital, Gosford, New South Wales, Australia*
[u] *Hunter Medical Research Institute, Newcastle, New South Wales, Australia*
[v] *Cabrini Health, Malvern, Victoria, Australia*

Received 19 February 2024; received in revised form 11 April 2024; accepted 11 April 2024
Available online 8 May 2024

* Corresponding author. School of Nursing and Health, Avondale University, Lake Macquarie, New South Wales, Australia.
*E-mail address:* brett.mitchell@avondale.edu.au (B.G. Mitchell).
[1] On behalf of the HAPPEN study team.

https://doi.org/10.1016/j.idh.2024.04.006
2468-0451/© 2024 The Author(s). Published by Elsevier B.V. on behalf of Australasian College for Infection Prevention and Control. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

**KEYWORDS**
Pneumonia;
Hospital acquired pneumonia;
Nursing, practical;
Oral hygiene;
Nursing

**Abstract** *Background:* Hospital-acquired pneumonia (HAP) also known as non-ventilator associated pneumonia, is one of the most common infections acquired in hospitalised patients. Improving oral hygiene appears to reduce the incidence of HAP. This study aimed to describe current practices, barriers and facilitators, knowledge and educational preferences of registered nurses performing oral health care in the Australian hospital setting, with a focus on the prevention of HAP. We present this as a short research report.
*Methods:* We undertook a cross sectional online anonymous survey of Australian registered nurses. Participants were recruited via electronic distribution through existing professional networks and social media. The survey used was modified from an existing survey on oral care practice.
*Results:* The survey was completed by 179 participants. Hand hygiene was considered a very important strategy to prevent pneumonia (n = 90, 58%), while 45% (n = 71) felt that oral care was very important. The most highly reported barriers for providing oral care included: an uncooperative patient; inadequate staffing; and a lack of oral hygiene requisite. Patients' reminders, prompts and the provision of toothbrushes were common ways believed to help facilitate improvements in oral care.
*Conclusion:* Findings from this survey will be used in conjunction with consumer feedback, to help inform a planned multi-centre randomised trial, the Hospital Acquired Pneumonia PrEveNtion (HAPPEN) study, aimed at reducing the incidence of HAP. Findings may also be useful for informing studies and quality improvement initiatives aimed at improving oral care to reduce the incidence of HAP.
© 2024 The Author(s). Published by Elsevier B.V. on behalf of Australasian College for Infection Prevention and Control. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

**Highlights**

- Dysphagia management and patient mobilisation were perceived as having greater importance on HAP prevention.
- Barriers for providing oral care included inadequate staffing; and a lack of oral hygiene requisite.
- Reminders, prompts and the provision of toothbrushes may aid oral care.

## Introduction

Hospital-acquired pneumonia (HAP), also known as non-ventilator associated pneumonia, is one of the most common infections acquired by patients in hospital [1,2]. HAP accounts for approximately 30% of all healthcare-associated infections (HAIs) in Australian public hospitals [3]. The impact of HAP is significant, and is associated with prolonged length of hospital stay, and increased morbidity and mortality [4,5]. Poor oral hygiene is an important risk factor for HAP [6]. Previous studies have also demonstrated that improving oral hygiene reduces the incidence of HAP [7—9]. However, there are no multi-centre randomised control trials examining associations between improving patients' oral care in the hospital and reducing HAP [6]. This is something the authors of this paper will be addressing in an upcoming trial, the Hospital-Acquired Pneumonia PrevEntioN (HAPPEN) study.

Oral care is currently not performed optimally in the hospital environment, and is frequently reported as a task that is not completed [10]. Nurses commonly assist with oral care, however it is currently unclear what knowledge registered nurses have about oral care and what the current practices, barriers and facilitators are towards providing care in hospital settings. Furthermore, the educational preferences of nurses in developing skills in oral care provision is also unknown. Therefore, this study aimed to describe current practices, barriers and facilitators, knowledge and educational preferences of registered nurses performing oral health care in the Australian hospital setting, with a focus on the prevention of HAP. In this short report, we present findings from a survey of Australian nurses which help answer these aims and help inform elements of the upcoming HAPPEN study.

## Methods

### Design

A cross sectional online anonymous survey of registered nurses in Australia was conducted between September and December 2023. Data were collected and managed using REDCap® electronic data capture tools hosted at Hunter Medical Research Institute [11].

### Participants

Participants were Registered nurses (registered with Australian Health Practitioner Regulation Authority) working in a patient facing role in an Australian hospital.

### Recruitment

The study used a convenience sample where participants were recruited via electronic distribution through existing professional networks and social media (Twitter, LinkedIn), as well as direct email and newsletter advertisement at three major Australian hospitals that are likely to participate in the HAPPEN trial. These included two New South Wales hospitals (regional public and large private) and a large public tertiary referral hospital in Victoria. It was anticipated that 100 participants would complete the survey, in line with previous responses in other Australian surveys of infection control practice [12].

### Data collection

The questions used in the online survey were derived from results of a literature review, engagement with consumers, previous related work and an existing survey on oral care practice [6,12,13]. This survey was chosen as it has face and content validity [13]. There were four sections within the survey: demographic information (items 1–8), current practice and barriers and facilitators of oral care (items 9–15), current knowledge about HAP and prevention strategies (items 16–19), and educational needs (items 20–24). The survey questions are outlined in the supplementary material and included a combination of Likert scale and ranking questions. To put the survey into context, we indicated to participants at the beginning of the survey that the survey was focussed on HAP, referenced as pneumonia during the survey.

### Data analysis

Descriptive statistics of the cohort were completed to establish the participants' age, sex, years of experience, work location, shift types and practice areas. Frequencies and percentages of responses were calculated per survey item. Continuous variables (age, years of experience) were summarised as medians, ranges and interquartile ranges.

## Results

### Demographics

A total of 179 participants consented and completed the survey, with some participants not completing the entire survey. The median age of participants was 32 years (range 20–74, IQR 26–41) and median years of nursing experience was 5 years (IQR 3–11). Most respondents were from New South Wales ($n$ = 88, 49%) (Table 1 and Supplementary Table 1).

**Table 1** Demographic details of participants (n = 179).

| Variable | *n* (%) |
|---|---|
| **Participant characteristics** | |
| Age | Median 32 years (range 20–74, IQR 26–41) |
| Years of experience | Median 5 years (range 0.75–51, IQR 3–11) |
| **Participant location** | |
| QLD | 13 (7) |
| NSW | 88 (49) |
| VIC | 35 (20) |
| TAS | 16 (9) |
| ACT | 7 (4) |
| SA | 9 (5) |
| WA | 7 (4) |
| NT | 4 (2) |
| **Participant profession** | |
| Registered nurse | 96 (54) |
| Clinical nurse specialist | 24 (13) |
| Nurse educator | 24 (13) |
| Clinical nurse consultant | 16 (9) |
| Nurse unit manager | 9 (5) |
| Other | 10 (6) |
| **Participant hospital** | |
| Regional public NSW hospital | 44 (25) |
| Private NSW hospital | 65 (36) |
| Tertiary public Victorian hospital | 32 (18) |
| All other Australian hospitals | 38 (21) |

### Oral care priorities, training and practice

Most participants agreed/strongly agreed (n = 135, 82%) that oral care was a high priority for their patients (Table 2). Similarly, the majority agreed/strongly agreed (n = 109, 66%) that the oral cavity was a difficult area to clean. Thirty-nine percent of participants (n = 64) agreed/strongly agreed that cleaning their patients' oral cavity was an unpleasant task. Most participants were satisfied with their oral care practices, identified that it had an impact on patient outcomes and reported they were given adequate training (Table 2). The most used oral care equipment was a manual toothbrush (n = 67, 41%) or foam swab (n = 40, 24%), and solutions of sodium bicarbonate (n = 49, 30%) followed by chlorhexidine (n = 30, 18%) and normal saline (n = 25, 15%) commonly used as part of the provision of oral care (Supplementary Table 4).

### Perceptions of pneumonia (HAP) risk and prevention strategies

Of all HAIs, participants ranked pneumonia as third in terms of frequency ($n$ = 45, 29%) and reported pneumonia as having a major impact for patients on the ward ($n$ = 54, 35%), and a major impact on the hospital ($n$ = 63, 40%) (Supplementary Table 3). Both hand hygiene and oral care were perceived as very important strategies to prevent pneumonia (n = 90, 58% and n = 71, 45% respectively) (Table 3).

### Barriers

The greatest barriers for providing oral care were an uncooperative patient ($n$ = 91, 43%), inadequate staffing ($n$ = 84, 40%) and a lack of oral toilet requisite ($n$ = 63,

**Table 2** Oral care priorities and barriers.

| Topic | Strongly disagree *n* (%) | Disagree *n* (%) | Neither agree or disagree *n* (%) | Agree *n* (%) | Strongly agree *n* (%) |
|---|---|---|---|---|---|
| **Priorities and training *n* = 164** | | | | | |
| I believe oral hygiene is a high priority for my patients | 13 (8) | 16 (10) | — | 54 (33) | 81 (49) |
| The oral cavity is a difficult area to clean | 12 (7) | 43 (26) | - | 79 (48) | 30 (18) |
| I find cleaning the oral cavity to be an unpleasant task | 21 (13) | 79 (48) | - | 43 (26) | 21 (13) |
| I believe that good oral care has a significant impact on patients clinical outcomes | 15 (9) | 15 (9) | - | 75 (46) | 59 (36) |
| I am satisfied with my oral hygiene practices | 11 (7) | 27 (17) | - | 73 (45) | 52 (32) |
| I have been given adequate training in providing oral care | 11 (7) | 40 (24) | - | 67 (41) | 46 (28) |
| I need more information on research-proven oral care standards | 10 (6) | 32 (20) | - | 82 (50) | 40 (24) |
| Attending an in-service on proper oral care is a priority for me | 9 (6) | 32(20) | - | 86 (52) | 37 (23) |
| **Barriers to providing oral care** | | | | | |
| I need better supplies and equipment | 13 (8) | 21 (13) | 27 (17) | 67 (41) | 36 (22) |
| Supplies are readily available | 5 (3) | 26 (16) | 39 (24) | 58 (36) | 35 (22) |
| I have adequate time to provide oral care | 7 (4) | 27 (17) | 32 (20) | 64 (39) | 33 (20) |
| The toothbrushes provided are suitable | 11 (7) | 24 (15) | 27 (17) | 69 (42) | 32 (20) |
| I prefer that a dental hygienist perform oral care tasks | 13 (8) | 28 (17) | 44 (27) | 45 (28) | 32 (20) |

**Table 3** Pneumonia prevention: How important do you think these interventions are at preventing pneumonia? (*n* = 156).

| Topic | Not important *n* (%) | Slightly important *n* (%) | Moderately important *n* (%) | Very important *n* (%) |
|---|---|---|---|---|
| Hand hygiene | 3 (2) | 23 (15) | 40 (26) | 90 (58) |
| Patient mobilisation | 3 (2) | 19 (12) | 49 (31) | 85 (55) |
| Environmental cleanliness | 8 (5) | 24 (15) | 43 (28) | 81 (52) |
| Correct use of PPE | 9 (6) | 28 (18) | 40 (26) | 79 (51) |
| Dysphagia management | 3 (2) | 20 (13) | 56 (36) | 77 (49) |
| Oral care | 7 (5) | 31 (20) | 47 (30) | 71 (45) |

30%) (Supplementary Table 2). The need for better supplies and equipment was also an identified barrier, with 63% (*n* = 103) of participants agreeing/strongly agreeing with this statement. Approximately one-fifth (*n* = 34, 21%) of participants indicated they did not have sufficient time to perform oral care (Table 2).

## Education & support

Participants were asked to indicate their preferences for education on oral care. In-services were the most common preference of oral care education (*n* = 46, 30%), followed by a website (*n* = 21, 14%) and interactive resources such as videos (*n* = 19, 12%) (Supplementary Table 4). There was a preference to receive digital education on a smart phone (*n* = 52, 34%), followed by website (*n* = 37, 24%) (Supplementary Table 4). Most participants were agreeable to all options presented for education content, with the highest rated content including practical elements of oral care (*n* = 134, 87% important/very important) and why oral care is important in pneumonia prevention (n = 131, 86%) (Supplementary Table 5).

Participants ranked patient reminders (n = 102, 77%), tracking of oral care for self-monitoring and prompting (n = 116, 76%) and provision of high-quality toothbrushes (n = 112, 73%) as the top three methods (somewhat and very helpful) to support oral care provision in hospital. Games (n = 42, 34%), chatbots (n = 66, 43%) and apps (n = 76, 50%) were ranked the least useful (Supplementary Table 4).

## Discussion

Oral hygiene has been identified as an important factor in the prevention of pneumonia, and nurses play a critical role in assisting patients with this personal care task whilst in hospital [6]. Our cross-sectional survey is the first Australian study to explore the oral care practices of nurses, as they relate to pneumonia prevention. Results from our study on oral care priorities, including that oral care was important for patient outcomes and that the oral cavity is difficult to clean, is consistent with a previous study conducted in Singapore [13]. However, in terms of pneumonia prevention, interventions such as dysphagia management and patient mobilisation were perceived as having greater importance. Both dysphagia and patient immobility are recognised as either predictive or risk factors for non-ventilator associated HAP [14]. A recent meta-analysis

exploring risk factors predicting non-ventilator HAP demonstrated that dysphagia was associated with a 3.27 increased odds of HAP, and patient immobility was also shown to be associated with increased HAP risk (1.83—2.83 increased odds) [14]. It is therefore logical that nurses would perceive these factors as important when caring for patients.

Despite the inclusion of oral care for patients as part of Australian Safety and Quality Standards, the association of good oral care and the prevention of HAP may not be widely recognised by bedside nurses. Our findings suggest that nurses believe hand hygiene to be the most important strategy for HAP prevention. Hand hygiene is a fundamental component of infection prevention and control education and is regularly audited in healthcare facilities. This may be one reason why nurses are more likely to rationalise and prioritise hand hygiene compliance for HAP prevention. As the oral microbiome and flora may play an important role in subsequent infection of the respiratory tract [15,16], the role of hands and air in colonising the mouth present potentially important horizontal infection control strategies for HAP prevention. The correct use of personal protective equipment was ranked higher than oral care as a HAP prevention strategy. This presents an opportunity for nurse educators, clinical nurse consultants and infection control professionals to raise the profile of oral care and HAP prevention in education and training. This is particularly pertinent, as previous research has indicated that a large proportion of nurses' oral care knowledge was learned during their initial education [13] Similarly, other research has identified that nurses need knowledge of the benefits of oral care, as well as the skills related to assessment and approaches to oral care [17]. The current study reinforced that hospital nurses prefer education delivered as traditional in-services, consistent with previous literature exploring educational needs of hospital-based nurses in the United States of America [18]. Nurses also are seeking evidence-based information to inform their practice quickly and easily, which was reflected in the participants desire to access information on their smart phones [18].

Despite the importance of oral care in HAP prevention, it remains a poorly met aspect of care during hospital stays [17,19]. The current study described the common barriers to providing oral care to patients including an uncooperative patient, inadequate staffing, a lack of adequate oral care requisite and access to equipment. Staffing and workload are often cited as challenges to implementing clinical care. These factors have been shown to play a role in safe care and nurse-sensitive outcomes. Previous research suggests higher levels of staffing are associated with a decreased risk of infection [20,21]. Participants also identified opportunities to improve oral care including patient reminders, prompts and the provision of high-quality toothbrushes.

Our research is limited by being a cross-sectional design and the response rate. Whilst we used questions from an existing survey, some questions could be perceived as leading towards a positive response. The survey was anonymous but cannot discount the possibility of response bias or acquiescence bias. We did not capture the demographic data of participants, therefore a more granular analysis of data was not possible. Future research should consider exploring why the potential barriers to oral care exist. Our paper is presented as a short report to help acknowledge these limitations, as well as not overreach in interpretation of the findings.

Findings that are relevant to the design of our proposed clinical trial include: i) support to deliver the intervention, thus improving fidelity and overcoming workload challenges; ii) education and training for ward staff (in-service) supported by a website with interactive resources accessible via smart devices; iii) the opportunity to engage patients (consumers) in this topic, including reminders or prompts or nudges; and iv) the provision of suitable high-quality equipment, such as toothbrushes. In an upcoming multi-centre randomised control trial evaluating the impact of improving oral care on the incidence of HAP (the HAPPEN study), we will use findings from this research to inform our intervention. In addition, we have undertaken focus groups of nurses around Australia exploring oral care and HAP prevention in more detail, informed by the findings of this survey. We will report the findings of the focus group research in a future publication. In the HAPPEN study, we have consumers involved in co-design of the intervention. Suggestions and findings from this survey will be taken to our consumers to seek their views and input before finalising the intervention for the HAPPEN study. Findings from this study may also be useful for informing other studies and quality improvement initiatives which aim to improve the quality and or frequency of oral care in hospitalised patients.

## Ethics

Ethics approval was granted from the Hunter New England Local Health District Human Research Ethics Committee (2023/ETH1380), with all participants providing consent prior to participation in the survey.

## Authorship statement

BM conceived this research. BM and PT designed the survey and took responsibility for recruitment and data collection. PT was primarily responsible for data analysis and drafting the initial paper. All authors contributed to interpretation of the work, provided critical input, and approved the final version.

## Conflict of interest

Five of the authors have an editorial affiliation with the journal. They had no role in the peer review process or any editorial decisions relating to this paper.

## Funding

This research was supported by a Medical Research Future Fund research grant (MRF2022645), administered by Avondale University. BM is a recipient of a National Health and Medical Research Council Emerging Leadership Investigator grant (GNT2008392) administered by Avondale University.

## Provenance and peer review

Not commissioned; externally peer reviewed.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.idh.2024.04.006.

## References

[1] Magill SS, Edwards JR, Bamberg W, Beldavs ZG, Dumyati G, Kainer MA, et al. Multistate point-prevalence survey of health care-associated infections. N Engl J Med 2014;370(13): 1198—208.
[2] Russo PL, Stewardson AJ, Cheng AC, Bucknall T, Mitchell BG. The prevalence of healthcare associated infections among adult inpatients at nineteen large Australian acute-care public hospitals: a point prevalence survey. Antimicrob Resist Infect Control 2019;8(1):114.
[3] Lydeamore MJ, Mitchell BG, Bucknall T, Cheng AC, Russo PL, Stewardson AJ. Burden of five healthcare associated infections in Australia. Antimicrob Resist Infect Control 2022; 11(1):69.
[4] Zhong X, Wang D-L, Xiao L-H. Research on the economic loss of hospital-acquired pneumonia caused by Klebsiella pneumonia base on propensity score matching. Medicine 2021;100(15).
[5] Davis J, Finley E, Pennsylvania Patient Safety Authority. The breadth of hospital-acquired pneumonia: nonventilated versus ventilated patients in Pennsylvania. Pa Patient Saf Advis 2012;9(3):99—105.
[6] Mitchell BG, Russo PL, Cheng AC, Stewardson AJ, Rosebrock H, Curtis SJ, et al. Strategies to reduce non-ventilator-associated hospital-acquired pneumonia: a systematic review. Infect Dis Health 2019;24(4):229—39.
[7] Robertson T, Carter D. Oral intensity: reducing non-ventilator-associated hospital-acquired pneumonia in care-dependent, neurologically impaired patients. Can J Neurosci Nurs 2013; 35(2):10—7.
[8] Munro S, Baker D. Reducing missed oral care opportunities to prevent non-ventilator associated hospital acquired pneumonia at the Department of Veterans Affairs. Appl Nurs Res 2018;44:48—53.
[9] Giuliano KK, Penoyer D, Middleton A, Baker D. Oral care as prevention for nonventilator hospital-acquired pneumonia: a four-unit cluster randomized study. Am J Nurs 2021;121(6): 24—33.
[10] McNally E, Krisciunas GP, Langmore SE, Crimlisk JT, Pisegna JM, Massaro J. Oral care clinical trial to reduce non -intensive care unit, hospital-acquired pneumonia: lessons for future research. J Healthc Qual (JHQ) 2019;41(1):1—9.
[11] Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) — a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009;42(2):377—81.
[12] Mitchell BG, Russo PL, Kiernan M, Curryer C. Nurses' and midwives' cleaning knowledge, attitudes and practices: an Australian study. Infect Dis Health 2021;26(1):55—62.
[13] Chan EY, Hui-Ling Ng I. Oral care practices among critical care nurses in Singapore: a questionnaire survey. Appl Nurs Res 2012;25(3):197—204.
[14] Lukasewicz Ferreira SA, Hubner Dalmora C, Anziliero F, de Souza Kuchenbecker R, Klarmann Ziegelmann P. Factors predicting non-ventilated hospital-acquired pneumonia: systematic review and meta-analysis. J Hosp Infect 2022;119:64—76.
[15] Rathbun KP, Bourgault AM, Sole ML. Oral microbes in hospital-acquired pneumonia: practice and research implications. Crit Care Nurse 2022;42(3):47—54.
[16] Ewan VC, Sails AD, Walls AW, Rushton S, Newton JL. Dental and microbiological risk factors for hospital-acquired pneumonia in non-ventilated older patients. PLoS One 2015;10(4): e0123622.
[17] Coker E, Ploeg J, Kaasalainen S, Carter N. Nurses' oral hygiene care practices with hospitalised older adults in postacute settings. Int J Older People Nurs 2017;12(1).
[18] Lindsay JM, Oelschlegel S, Earl M. Surveying hospital nurses to discover educational needs and preferences. J Med Libr Assoc 2017;105(3):226—32.
[19] Kalisch BJ, Landstrom GL, Hinshaw AS. Missed nursing care: a concept analysis. J Adv Nurs 2009;65(7):1509—17.
[20] Jansson MM, Syrjälä HP, Ala-Kokko TI. Association of nurse staffing and nursing workload with ventilator-associated pneumonia and mortality: a prospective, single-center cohort study. J Hosp Infect 2019;101(3):257—63.
[21] Mitchell BG, Gardner A, Stone PW, Hall L, Pogorzelska-Maziarz M. Hospital staffing and health care-associated infections: a systematic review of the literature. Jt Comm J Qual Patient Saf 2018;44(10):613—22.