Risk Management and Healthcare Policy

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Development and Evaluation of an ICU Nurse Training Program on Oral Mucosal Pressure Injury Prevention and Management Using the ADDIE Model

Tiantian Jia[1], Yunxia Lan[2], Jing Pang[2], Mengdan Ma[1], Zhe Ding[3], Yongting Wang[1], Enshe Jiang[4]

[1]Cardiac Surgery Intensive Care Unit, The Affiliated Chest Hospital of Zhengzhou University, Zhengzhou, 450008, People's Republic of China; [2]Department of Nursing, The Affiliated Chest Hospital of Zhengzhou University, Zhengzhou, 450008, People's Republic of China; [3]Department of Rehabilitation, The Affiliated Chest Hospital of Zhengzhou University, Zhengzhou, 450008, People's Republic of China; [4]Institute of Nursing and Health, Henan University, Kaifeng, 475004, People's Republic of China

Correspondence: Enshe Jiang, Institute of Nursing and Health, Henan University, No. 1 Jinming Road, Kaifeng, Henan, 475004, People's Republic of China, Email esjiang@gmail.com; Yongting Wang, Cardiac Surgery Intensive Care Unit, the Affiliated Chest Hospital of Zhengzhou University, No. 1 Weiwu Road, Zhengzhou, Henan, 450008, People's Republic of China, Email 2313992171@qq.com

Purpose: To construct a training course program for ICU nurses to care for oral mucosal membrane pressure injury (MMPI) and evaluate its implementation effects based on the ADDIE model.

Patients and Methods: A research team was established to construct the training course program in January 2024. According to the ADDIE model, a training course was designed and developed after the literature research and Delphi expert inquiry. The training course program was implemented in 138 ICU nurses from a tertiary A hospital in China from April to May 2024. The ICU nurses' knowledge, attitude, and practice in preventing medical device-related pressure injury in critically ill patients and the incidence of oral MMPI were compared before and after the training program.

Results: A particular training course program for the ICU nurses to care for oral MMPI was constructed in this study. It contained three aspects of particular training subjects (professional knowledge, practical skills and professional literacy) and included 16 specific training courses. One hundred and thirty-eight ICU nurses received the training course program in the hospital. The total score of MMPI knowledge-attitude-practice of the ICU nurses was (167.73±8.13) after the training, which was significantly improved compared with the score before the training (145.81±13.57) (t = 16.283, $P<0.001$). The incidence of oral MMPI after the training (5.94%) was significantly lower than that before training (22.93) ($x^2=12.034$, $P<0.001$).

Conclusion: The training course program for ICU nurses to care for oral MMPI based on the ADDIE module can effectively improve ICU nurses' comprehensive ability to prevent oral MMPI and reduce the incidence of oral MMPI. It can be applied in clinical nursing education and practice.

Keywords: ADDIE model, ICU nurses, mucosal membrane pressure injury, training course

Introduction

Mucosal membrane pressure injury (MMPI) refers to local mucosal tissue damage associated with using a medical device at the injury site. It is a specific device-related pressure injury.[1] Common medical devices that cause MMPI include endotracheal tubes, nasogastric tubes, oxygen tubes, urinary catheters, neck fixation devices, electrodes and wires, pulse oximeters, and orthopedic instruments.[2] The oral MMPI caused by endotracheal intubation is the most common one. The oral MMPI development is 2 to 13 days after intubation.[3–5] The patients staying in the intensive care unit (ICU) are in critical condition and have poor resistance. They are prone to oral MMPI in multiple parts of the oral cavity. The incidence of oral MMPI after endotracheal intubation is as high as 45%, which is much higher than that of other departments in the hospital.[6] It causes pain in patients and affects disease prognosis.

The site of oral MMPI is more hidden than traditional pressure injury. It is challenging to examine the oral mucosa during endotracheal intubation. Once the oral MMPI is found, it has already caused bleeding, rupture, and ulcers. The

Received: 15 October 2024
Accepted: 30 January 2025
Published: 7 February 2025

ICU nurses, being in close contact with patients, play a pivotal role in facilitating the prevention and effective management of oral mucosal pressure injuries In clinical practice. Thus, a key priority is developing a comprehensive, evidence-based, holistic training program for ICU nurses to manage oral mucosal pressure injuries effectively. This program should incorporate standardized professional training within the hospital, addressing the specific needs of ICU nurses with a forward-looking approach.

The analysis, design, development, implementation, and evaluation (ADDIE) model is a systematic teaching method with five stages. The five steps of the ADDIE model are closely linked, and the output of each step provides input for the next step. It has a solid systematic feature. The course's analysis, design, and development are the core of teaching activities and can guide the construction of teaching courses; implementation and evaluation are the guarantee of feedback on training results and can guide the application of the constructed course. In recent years, domestic and foreign researchers have introduced the ADDIE model into nursing education, which has played a good role in training nurses in Neonatal Intensive care units,[7] orthopedic nurses,[8] regulated nurses,[9] and head nurse leadership.[10] This study aims to develop and evaluate an ICU Nurse Training Program for Oral Mucosal Pressure Injury Prevention and Management Using the ADDIE Model and Delphi method. The training effect on ICU nurses was also evaluated in this study. The constructed training course has specific practical significance for improving the comprehensive quality of ICU nurses.

Materials and Methods

Analysis of the Oral MMPI Nursing Training Course for ICU Nurses and the Formation of the First Draft of the Training Course

To enhance the development and implementation of the oral MMPI training course, we established a research team of seven members in January 2024. This team includes a chief nurse who oversees the entire project, manages personnel organization and coordination, and engages external experts to provide questionnaire design input. The research team will construct and apply the oral MMPI nursing training course based on the ADDIE model (Figure 1). For the training course application, informed consent was obtained from the ICU nurses before the study commenced. The Medical Ethics Committee of the Affiliated Chest Hospital of Zhengzhou University (No. 2024-5-7) approved the research project protocol.

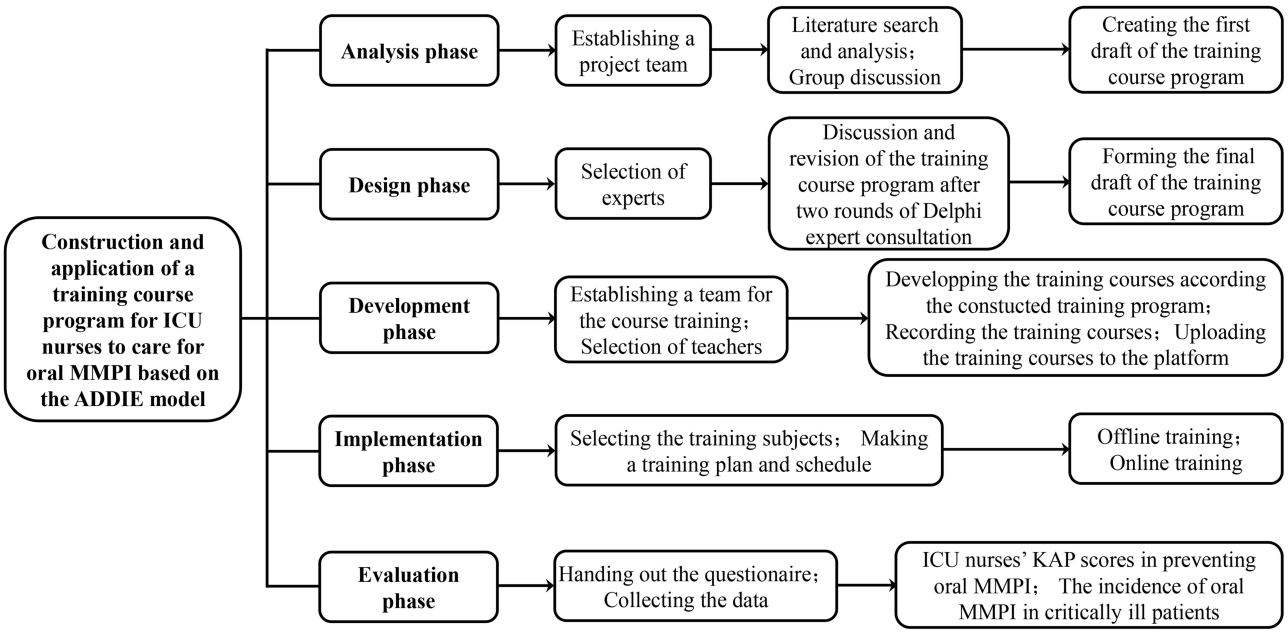

Figure 1 Flowchart of the construction and application of oral MMPI nursing training courses for ICU nurses based on the ADDIE model.
Abbreviations: MMPI, mucosal membrane pressure injury; KAP, knowledge, attitude and practice; ADDIE, analysis, design, development, implementation and evaluation; ICU, intensive care unit.

The research team first conducted a literature retrieval on the research of oral MMPI nursing and intervention by searching the Chinese literature databases (China National Knowledge Infrastructure (CNKI), WanFang Database, VIP Database, China Biomedical Database (CBM)) and the English literature databases (PubMed, Web of Science, Embase, Cochrane Library). The keywords for the literature retrieval include ICU nurses, oral mucosa/mucosal membrane pressure injuries, Medical device-related pressure injuries, mucosal injury nursing, intervention, nursing measures, nursing program, nursing training, Delphi, and the different keywords combination. The type of literature includes all the MMPI-related guidelines, expert consensus, systematic reviews, randomized controlled studies, quasi-experimental studies, and qualitative studies. Two thousand seven hundred and sixty-one pieces of literature were retrieved from the databases. We finally got 14 full-text articles after removing the repeated literature and non-related articles by reading the title and abstract of each article. The research team reviewed and analyzed the included literature to initially form the first draft of the oral MMPI nursing training course based on relevant domestic and international standards and guidelines.

Design and Development of the Final Draft of the ICU Nurse Training Program on Oral Mucosal Pressure Injury Prevention and Management

The Delphi expert consultation was used to design and form the oral MMPI nursing training course program (Table 1). First, the inquiry experts were selected, and the selection of experts followed the principles of representativeness, universality, and authority. Inclusion criteria for experts: ① Affiliated with a tertiary A-level comprehensive hospital; ② The educational requirements are that nurses have a bachelor's degree or above, and doctors have a master's degree or above; ③ Must have an intermediate or higher professional title; ④ At least 10 years of experience in critical care nursing or critical care management; ⑤ Willing to participate voluntarily in this study. Experts' exclusion criteria: ① Those who did not respond within the specified period of the expert inquiry stage; ② Those with an expert authority coefficient (Cr) of <0.7. The final draft of the oral MMPI nursing training course for ICU nurses was formed through two rounds of Delphi expert consultation. The score of importance and coefficient of variation of expert consultation on oral MMPI nursing training course for ICU nurses in the secondary round of Delphi expert consultation were calculated as the result of the expert consultation (Supplementary Table 1).

Development of the Oral MMPI Nursing Training Course for ICU Nurses

A development team for the oral MMPI nursing training course was established. The teaching staff included 1 physician, 1 head nurse in the critical care department and 2 nursing graduates. The head nurses were responsible for organizing nurses' training and designing assessment methods and the examination contents. All course training teachers were familiar with the training content and requirements per the training program's objectives, content, processes and course requirements. Both theoretical and practical training courses were taught online or offline.

Table 1 The Content of the Questionnaire for the Delphi Expert Consultation

The Topic	The Content of the Topic
Instructions of the questionnaire	① Introducing the purpose, the background and current status of the study on oral MMPI were introduced to the experts. ② Elaborating the ADDIE model theory. ③ Explaining the scoring method of the items in the questionnaire and the requirements for filling out the form to the consultation experts.
The profile of experts	Including the information of the experts such as the gender, age, education, specialty, the years of experience in the profession, and job title et al.
The form of expert's evaluation on the training courses	① The experts using the Likert 5-level scoring method to evaluate each item in this study. ② The evaluation criteria mainly based on the importance of the items to ensure the results of the inquiry had practical value. ③ Adding an expert suggestion column to collect suggestions on addition, deletion and adjustment of items, et al.
The form using to investigate the authority of the experts	Using the questionnaire to investigate experts' judgment criteria and their familiarity with each item.

https://doi.org/10.2147/RMHP.S499606

To achieve training objectives, the oral MMPI nursing training course was developed according to the constructed training program for oral MMPI nursing for ICU nurses. The relevant theoretical knowledge of the training course about tracheal intubation and oral care can be recorded, and the videos are open for the ICU nurses to learn. The practical part of the training course is about the demonstration of oral MMPI standardized assessment, the fixation methods of tracheal intubation, and the standardized cases of oral care, which can be recorded and uploaded to the internet APP teaching platform. This platform can perform data statistics (information on the course learning) and user management (changing passwords, problem feedback, etc).

Implementation of Oral MMPI Nursing Training Course for ICU Nurses

The training subjects are first selected. The ICU nurses from 5 ICU wards in a tertiary A hospital were selected using convenience sampling. Inclusion criteria: ① Nurses who had worked in the ICU for ≥1 year and were willing to receive training; ② Nurses who had obtained a nurse's professional qualification certificate and were within the registration validity period; Exclusion criteria: ① Nurses who came to the hospital for further study from other hospitals; ② Nurses who were not on duty during the training. The oral MMPI nursing courses for ICU nurses include three training modules: professional knowledge, practical skills and professional literacy. The course will be held from April to May 2024, with a training duration of 16 hours for 8 weeks, 2 training sessions per week, 1 hour each time. The course training can be conducted online or offline. Each theoretical course can be learned online on the 317 Nursing APP, and the course can be completed at any time within 1 week. The final course training schedule is shown in Table 2.

Teachers could conduct classroom teaching during the course training to teach the essential knowledge. The theoretical knowledge, such as the current status and research progress of oral MMPI nursing, could be uploaded to the 317 Nursing APP, and the ICU nurses could study and watch online. If the nurses encounter complex problems in the course learning, they could raise them in time in the WeChat (a popular communication APP in China) group, and the training teachers were responsible for answering the questions. The practical teaching courses, such as the operation techniques for standardized assessment of oral MMPI and standardized cases of oral care, will be demonstrated offline. The on-site answers will be given to difficult points. Nurses needed to complete the training tasks within the required time. Teachers could monitor the course learning situation of nurses through the monitoring system of the 317 Nursing APP. After the course training, nurses could communicate and learn online with the teachers through the WeChat group

Table 2 Content and Schedule of Oral MMPI Nursing Training Course

Training Module	Contents of Training Course	Training Location	Training Length	Teaching Methods
Professional knowledge	The course mainly focuses on professional knowledge such as the definition and classification of medical device-related pressure injuries, the current status and research progress of oral MMPI, the influencing factors of oral MMPI in patients with endotracheal intubation, and the bundled management strategy for patients with endotracheal intubation.	Online: 317 Nursing APP; Offline: Academic Lecture Hall.	8 hours	Theoretical teaching; Participatory teaching
Practical skills	Assessment content, operation purpose and precautions of oral care, and fixation method of endotracheal intubation.	Online: 317 Nursing APP; Offline: Clinical Skills Training Center.	4 hours	Nursing ward rounds; Technical demonstration and drills in the training room.
Specialty literacy	Methods and techniques of literature retrieval, application of critical thinking in clinical practice, and communication strategies for multidisciplinary teams.	Online: 317 Nursing APP; Offline: Academic Lecture Hall.	4 hours	Theoretical teaching; Simulation exercises.

Abbreviations: MMPI, mucosal membrane pressure injury; APP, application.

about problems found during the course training. Teachers in the WeChat group encouraged nurses to upload videos or pictures of their practice results to the 317 nursing APP.

Evaluation of the Training Effects of Oral MMPI Nursing Training Course for ICU Nurses

The training effect of ICU nurses' knowledge, attitude and practice level of preventing medical device-related pressure injuries in critically ill patients and the incidence of oral MMPI were evaluated before and after the course training to determine the improvement of ICU nurses' theoretical knowledge and practical ability to the oral MMPI nursing after training.

The Method of Data Collection

An anonymous survey was conducted in the form of a paper questionnaire. Before the formal survey, the purpose and some precautions were explained to the ICU nurses. Questionnaires with the same answer to all items in the survey were eliminated. Clinical nurses' knowledge, attitude and practice scale to prevent medical device-related pressure injuries in critically ill patients was handed out one week before and one week after the course training.

Knowledge, Attitude and Practice Level of Clinical Nurses in Preventing Medical Device-Related Pressure Injuries in Critically Ill Patients

The knowledge, attitude and practice scale of clinical nurses in preventing medical device-related pressure injuries in critically ill patients were compiled by Hu Yuding in 2017. It includes three dimensions of nurses' knowledge, attitude and practice in preventing medical device-related pressure injuries, with 38 items.[11] The questionnaire was completed using the self-assessment method and scored using the Likert 5-level scoring method. The higher the score, the higher the knowledge, attitude and practice level in preventing medical device-related pressure injuries. Wei Xiaojing et al[12] tested the reliability and validity of the scale. The Cronbach's α coefficient of the scale was 0.955. The split-half reliability was 0.856, and the content validity was 0.957, indicating good reliability and validity.

The Incidence of Oral MMPI

The three-level statistical data reporting system with the department-quality management office-nursing department was adopted. The hospital data for the number of oral MMPI in patients was collected before (March 2024) and after (June 2024) the training through the "adverse event reporting system" and "Yihui mobile nursing system" in the hospital. The incidence of oral MMPI = the number of cases of oral MMPI/total number of cases × 100%.

Statistical Analysis

IBM SPSS Statistics 22.0 software was used to conduct statistical analysis. The quantitative data were expressed by mean ± SD. The paired *t*-test was used to compare clinical nurses' knowledge, attitude and practice in preventing critically ill patients with medical device-related pressure injuries before and after the course training. The Chi-square test was conducted to compare the incidence of oral MMPI before and after course training. The rejection criterion for all statistical tests was set at the conventional value of 0.05.

Results

Expert Consultation and Development of an Oral Mucosal Pressure Injury Nursing Training Program for ICU Nurses

There were 12 experts from critical care medicine, critical care nursing, nursing management, and nursing education who received the expert inquiry in this study. There are 5 males and 7 females. The average age of the experts was (35.56 ±2.15) years old. The average working years was (19.31±2.16) years. The educational background for the 12 experts was 6 bachelor's, 4 master's, and 2 doctorates. There were 2 intermediate professional titles, 4 associate professional titles, and 6 professional titles for the 12 experts. The effective rate of return for the two inquiry questionnaires was 100%. The average assignment of the importance of each indicator by experts is more significant than 3.5. The variation coefficient of the mean values of the importance assignment of each indicator was less than 0.25, indicating that the experts' opinions were relatively concentrated. The expert authority coefficient was 0.89, and the Kendall harmony coefficient of

the expert opinions was 0.229 (P<0.001), indicating that the expert's views on the training course program were relatively consistent, and the inquiry results were reliable. The final draft of the oral MMPI nursing training course program for ICU nurses was formed after two rounds of expert consultation. The oral MMPI nursing training course program includes 3 primary indicators, 16 secondary indicators and 26 tertiary indicators (Table 3).

Table 3 The Final Draft of the Oral MMPI Nursing Training Courses for ICU Nurses

Primary Indicators	Secondary Indicators	Tertiary Indicators
I-1 Professional Knowledge	II-1 Definition and classification of medical device-related pressure injuries	III-1 Diagnostic criteria and common causes of medical device-related pressure injuries.
		III-2 Clinical staging and evaluation methods of oral MMPI.
	II-2 Selection and use of medical devices	III-3 Evaluate the purpose and function of the device and select the appropriate type, material and model of medical device.
		III-4 Select and use preventive dressings.
		III-5 Correctly wear and fix the medical device with appropriate tightness to avoid excessive pressure.
	II-3 Current status and research progress of oral MMPI at home and abroad	III-6 Interpretation of the updated skin management guidelines.
		III-7 Interpretation of the management standards for oral MMPI in patients with endotracheal intubation.
		III-8 Incidence and common sites of oral MMPI.
		III-9 Analysis of high-risk populations and influencing factors for oral MMPI.
	II-4 Medication management strategy for patients with endotracheal intubation.	III-10 Strategies for using sedatives, anticoagulants and vasoactive drugs in patients with endotracheal intubation.
	II-5 Nutrition management strategy for patients with endotracheal intubation.	III-11 Assessment of nutritional status and implementation in patients with endotracheal intubation.
	II-6 Posture management strategy for patients with endotracheal intubation.	III-12 Strategies for preventing oral MMPI in patients with endotracheal intubation during ventilation in a prone position.
	II-7 Early withdrawal of mechanical ventilation strategy for patients with endotracheal intubation.	III-13 Regularly assess the necessity of ventilators and endotracheal intubation, and wean and extubate as soon as possible.
	II-8 humanistic care strategy for patients with endotracheal intubation.	III-14 Effective communication and psychological support for patients with endotracheal intubation.
I-2 Practical Skills	II-9 Assessment content, operation purpose and precautions in oral care.	III-15 Master the standard operation process of oral care.
	II-10 Selection and function of oral care solution.	III-16 Be familiar with the role and application of oral care solutions.
		III-17 Correctly select and use oral cleaning utensils.
	II-11 Material and size selection of endotracheal tube	III-18 Measurement method of endotracheal tube length and material selection.
	II-12 Methods of securing the endotracheal tube	III-19 Tips for fixing the endotracheal tube with a modified dental pad.
		III-20 Regularly adjust the endotracheal tube position and dental pad in the oral cavity.

(*Continued*)

Table 3 (Continued).

Primary Indicators	Secondary Indicators	Tertiary Indicators
I-3 Professionalism	II-13 Methods and techniques of literature retrieval.	III-21 Master the search methods of commonly used Chinese and English databases.
		III-22 Understand the commonly used Chinese and English databases in nursing and their characteristics.
		III-23 Be familiar with the purpose, function, and method of literature retrieval.
	II-14 Ways to obtain the latest guidelines and expert consensus.	III-24 Search strategy for Yimaitong Guideline.
	II-15 Application of critical thinking in clinical practice.	III-25 Critical thinking helps ICU nurses make effective decisions.
	II-16 Communication strategies for multidisciplinary teams.	III-26 ICU nurses' Roles and functions in the multidisciplinary skin management team.

Abbreviations: MMPI, mucosal membrane pressure injury; ICU, intensive care unit.

Demographic and Professional Profile of ICU Nurses Participating in the Oral MMPI Nursing Training Program

One hundred and thirty-eight ICU nurses completed the training course and submitted valid questionnaires, including 24 males (17.4%) and 114 females (82.6%). The average age of the nurses was (32.67±5.24) years; the average years of ICU work experience were (9.13±5.85) years; the educational backgrounds were 8 master's (5.8%), 119 bachelors (86.2%), and 11 college degrees (8.0%); the professional titles were 23 nurses (16.7%), 41 nurse technicians (29.7%), 72 head nurses (52.2%), and 2 deputy chief nurses (1.4%).

ICU Nurses' Knowledge, Attitude and Practice Scores in Preventing Medical Device-Related Pressure Injuries in Critically Ill Patients

The clinical nurses' knowledge, attitude and practice Scale for preventing medical device-related pressure injury in critically ill patients were used to evaluate 138 ICU nurses during the period of 1 week before and 1 week after the training course on oral MMPI nursing. The results showed that the scores of ICU nurses in the three dimensions of knowledge, attitude and practice after the course training on oral MMPI nursing were significantly improved (Table 4).

Incidence of Oral MMPI in Critically Ill Patients

Before the training, oral MMPI was detected in 25 of 109 critically ill patients in the ICU of the hospital's five inpatient wards within a month, with an incidence rate of 22.94%. After the training, oral MMPI was detected in 6 of 101 critically ill patients in the ICU of the hospital's five inpatient wards within a month, with an incidence rate of 5.94%. Statistical analysis showed a significant difference in the incidence of oral MMPI in the ICU in the hospital before and after course training ($x^2 = 12.034$, $P < 0.001$).

Table 4 Knowledge, Attitude and Practice Level of ICU Nurses in Preventing Medical Device-Related Pressure Injuries in Critically Ill Patients Before and After Training (Score, mean±SD)

Grouping	Number of Cases	Knowledge Dimension	Attitude Dimension	Behavior Dimension	Total Score
1 week before the training	138	53.03±8.55	37.86±4.58	55.10±8.13	145.81±13.57
1 week after the training	138	65.42±5.14	41.47±3.04	60.83±6.23	167.73±8.13
t value		14.575	7.713	6.574	16.283
P value		<0.001	<0.001	<0.001	<0.001

https://doi.org/10.2147/RMHP.S499606

Discussion

The Oral MMPI Nursing Training Course Improves the Knowledge, Attitude and Practice Level of ICU Nurses

The lack of clinical nurses' awareness of preventing oral MMPI, the difficulty in early identification of oral MMPI, and the lack of assessment tools will increase patients' risk of oral MMPI.[13] The current domestic data on skin management of critically ill patients focus on pressure injury.[14] The oral MMPI is the ICU's most common mucosal pressure injury.[15] There is no special study report on oral MMPI with a large sample size. The current group standards for "Oral Care for Adult Patients with Orotracheal Intubation and Mechanical Ventilation" were issued by the Chinese Nursing Association in year 2021.[16] It states that oral care for adult patients with orotracheal intubation and mechanical ventilation includes two methods: flushing combined with brushing and flushing combined with wiping. The method of flushing combined with brushing is limited in its promotion and application due to the high cost of negative-pressure suction toothbrushes. On the other hand, there is much oral dirt left by flushing combined with wiping. The training program in this study adopted the modified oral care method. The dirt and plaque are first wiped and then flushed with negative pressure. The residue is reduced, which improves the quality of care and shortens the care time.

ICU nurses are the primary implementers of skin assessment and protection strategies for critically ill patients. Oral MMPI's cognition and behavior level directly affect the patient's skincare quality. The results of this study showed that the total score of knowledge, attitude and practice of ICU nurses on oral MMPI after course training was significantly improved compared with the score before training. It has been proved that oral MMPI nursing training based on the ADDIE model improved ICU nurses' knowledge, attitude, and behavior, similar to the findings of Jin Lihong et al[17] and Wang Huiying et al.[18] The oral MMPI Nursing Training Course, designed using the ADDIE Model, demonstrated good practicality and scientific rigor. After training, this study expanded and enriched the knowledge of oral MMPI in ICU nurses. In clinical work, they could apply the latest guidelines to practice for skin management, skin management details for critically ill patients, and selection and use of preventive dressings in the knowledge training module. The management behavior of oral MMPI in patients with endotracheal intubation is much standardized. In the future, multidisciplinary team cooperation can be strengthened. Classified management can incorporate oral MMPI into the pressure injury quality control system to form a closed-loop management system, ranging from risk assessment to hierarchical management, problem handling, monitoring, reporting, and tracking.[19] So, achieving the purpose of reducing the incidence of oral MMPI, improving the quality of nursing, and improving the level of nursing services can be achieved in clinical practice.

Oral MMPI Nursing Training Course Can Effectively Reduce the Incidence of Oral MMPI in Critically Ill Patients

Oral care and endotracheal intubation management are critical in preventing and managing oral MMPI. When the endotracheal tube is selected or fixed improperly, the risk of oral MMPI is greater. If the size of the trachea cannula is unsuitable, it has a hard toughness, or it is fixed too tightly, the trachea cannula will have consequences similar to a "tourniquet blocking blood flow" and hindering local tissue blood circulation.[20] Studies have reported that the incidence of oral MMPI after intubation is 2.59% to 49.20%.[5,21] The oral MMPI caused by oral endotracheal intubation may cause pain, infection, tissue adhesion, and swallowing dysfunction. It increases the pain of critically ill patients, prolongs hospitalization time, increases the economic burden of the patients, and leads to an increase in complaints to the CU nurses and the hospitals. The 2020 guideline for prevention of device-related pressure injury points out that all patients undergoing oral endotracheal intubation should be considered at high risk for oral MMPI, and the potential risk factors should be identified from the three aspects of patients, equipment, and nursing after the evaluation.[22] Therefore, ICU nurses should identify risk factors and take predictive nursing measures to prevent or reduce such high-risk factors. The guidelines for the management of tracheal intubation in critically ill adults recommend that medical staff should be regularly trained and supervised to improve the team members' awareness and execution of preventing oral MMPI.[23] This study showed that the incidence of oral MMPI was 22.93% (25/109) before the training and was reduced to 5.94% (6/101) after the training, with a significant decrease in the incidence rate. The reasons for decreasing the incidence of

oral MMPI after training were as follows. The ICU nurses were familiar with the timing of oral care and the standard methods of fixing endotracheal tubes. For example, immediate oral care was conducted before the endotracheal intubation and after the removal of the intubation. Oral care is also required when reintubating. The electric negative pressure toothbrush flushing was recommended. It can be rotated 2 to 3 cycles in the frenulum when fixing the oral endotracheal tube to make it at the height of the nose. The oral endotracheal tube can have the same angle as the cartilage on the top of the ear without pulling to reduce local pressure on the lips. The professional and systematic course training normalized the operational procedures for ICU nurses to implement measures to prevent oral MMPI. In addition, the training program also provided a platform for ICU nurses to communicate across multidisciplinary. The oral MMPI nursing training course based on the ADDIE model positively impacts ICU nurses' behavior to a certain extent.

Conclusion

This study designed and developed a training program for ICU nurses on oral MMPI (Mucosal Membrane Pressure Injury) prevention following the ADDIE model. The program aims to enhance nurses' professional competencies by focusing on knowledge, practical skills, and professional standards in oral MMPI prevention. Findings indicate that the training effectively improves ICU nurses' knowledge, attitudes, and practices regarding oral MMPI, reducing the incidence of these injuries in critically ill patients. The program shows potential for broader application in ICU nurse training. However, there are limitations, including a small sample size of 138 nurses from five ICUs within a single tertiary hospital, potentially impacting the representativeness of the results. Future research should consider a large-sample, multi-center approach to validate the program's effectiveness further and support advancements in oral MMPI prevention and management among ICU nurses.

Acknowledgments

We thank the support from Henan Province 2023 Medical Science and Technology Research Project [No. LHGJ20230119] for this study.

Funding

Henan Province 2023 Medical Science and Technology Research Project supported this study [No. LHGJ20230119].

Disclosure

The authors report no conflicts of interest in this work.

References

1. Wanli C, Daifeng H. Interpretation of pressure injury's definition and staging system of National Pressure Ulcer Advisory Panel in 2016. *Chin J Injury Repair Wound Heal*. 2018;13(1). doi:10.3877/cma.j.issn.1673-9450.2018.01.014
2. Zhang N, Li Y, Li X, et al. Incidence of medical device-related pressure injuries: a meta-analysis. *Eur J Med Res*. 2024;29(1):425. doi:10.1186/s40001-024-01986-2
3. Coyer FM, Stotts NA, Blackman VS. A prospective window into medical device-related pressure ulcers in intensive care. *Int Wound J*. 2014;11(6):656–664. doi:10.1111/iwj.12026
4. Kim CH, Kim MS, Kang MJ, Kim HH, Park NJ, Jung HK. Oral mucosa pressure ulcers in intensive care unit patients: a preliminary observational study of incidence and risk factors. *J Tissue Viability*. 2019;28(1):27–34. doi:10.1016/j.jtv.2018.11.002
5. Hampson J, Green C, Stewart J, et al. Impact of the introduction of an endotracheal tube attachment device on the incidence and severity of oral pressure injuries in the intensive care unit: a retrospective observational study. *BMC Nurs*. 2018;17:4. doi:10.1186/s12912-018-0274-2
6. Amrani G, Gefen A. Which endotracheal tube location minimises the device-related pressure ulcer risk: the centre or a corner of the mouth? *Int Wound J*. 2020;17(2):268–276. doi:10.1111/iwj.13267
7. Xinrui Z. *Establishment and Application of Position Management for Premature Infants Training Program Based on ADDIE Model for NICU Nurses*. Shandong University of Traditional Chinese Medicine; 2023 doi:10.27282/d.cnki.gsdzu.2023.000425
8. Jia T. *Construction and Application of Pre-Rehabilitation Training Program for Orthopedic Nurses in Lumbar Degenerative Diseases on ADDIE Model*. Henan University; 2022 doi:10.27114/d.cnki.ghnau.2022.000730
9. Li S, Lihong J, Xia C, Ning Z, Tieying S. Construction and implementation of homogeneity training program of intravenous therapy for trained nurse. Chinese nursing management. *Chin Nurs Manage*. 2022;22(9). doi:10.3969/j.issn.1672-1756.2022.09.004
10. Shiyu Y, Hui W, Yu L, et al. Transformational leadership training program based on ADDIE model for head nurses working in comprehensive hospital. *J Nurs Sci*. 2023;38(19). doi:10.3870/j.issn.1001-4152.2023.19.062

11. Yuding H. *Construction and Application of the Clinical Nurses Prevention Medical Device Related Pressure Injury of Critically Ill Patients for the Knowledge, Attitude, Practice Assessment Scale [Master]*. North China University of Science and Technology; 2018.
12. Xiaojing W, Fan Y, Mengjuan J, Liming L, Zhixia W. Nurses' knowledge, attitudes and practice towards prevention of medical device related pressure injury in intensive care units: a cross-sectional study. *Chin J Nurs*. 2020;55(1). doi:10.3761/j.issn.0254-1769.2020.01.007
13. Choi BK, Kim MS, Kim SH. Risk prediction models for the development of oral-mucosal pressure injuries in intubated patients in intensive care units: a prospective observational study. *J Tissue Viability*. 2020;29(4):252–257. doi:10.1016/j.jtv.2020.06.002
14. Barakat-Johnson M, Barnett C, Wand T, White K. Medical device-related pressure injuries: an exploratory descriptive study in an acute tertiary hospital in Australia. *J Tissue Viability*. 2017;26(4):246–253. doi:10.1016/j.jtv.2017.09.008
15. Xiangping C, Xiaoyan G, Linfang Z, et al. Qualitative research on ICU nurses' cognitive experience of acute skin failure. *Chin J Emerg Crit Care*. 2024;5(3). doi:10.3761/j.issn.2096-7446.2024.03.002
16. Yang L. Interpretation of "oral care for adult patients with orotracheal intubation and mechanical ventilation". 2021. Available from: http://www.zhhlxh.org.cn/cnaWebcn/article/3247. Accessed February 03, 2025.
17. Lihong J, Yuanyuan C, Jihua Z, et al. Pressure injury care homogeneous training for liaison nurses in secondary hospitals participating in the hospital alliance program. *J Nurs Sci*. 2022;37(15). doi:10.3870/j.issn.1001-4152.2022.15.065
18. Huiying W, Wanmin Q, Yang W, Xuan Y. Application of training based on ADDIE model in prevention of central line-associated bloodstream infection. *Chin Nurs Manage*. 2022;22(6). doi:10.3969/j.issn.1672-1756.2022.06.006
19. Qian L, Lizhu W, Yirong Z, Fan F. Research progress of oral mucosal pressure injury in ICU patients with oral tracheal intubation. *Chin J Emerg Crit Care*. 2023;4(5). doi:10.3761/j.issn.2096-7446.2023.05.019
20. Yingying Z, Bo X, Cheng C, et al. Summary of best evidence for the prevention and management of oral mucosal pressure injury in severe neurological patients with tracheal intubation. *Chin J Mod Nurs*. 2024;30(12). doi:10.3760/cma.j.cn115682-20230802-00314
21. Erbay Dalli O, Ceylan I, Kelebek Girgin N. Incidence, characteristics and risk factors of medical device-related pressure injuries: an observational cohort study. *Intensive Crit Care Nurs*. 2022;69:103180. doi:10.1016/j.iccn.2021.103180
22. Stoma, Wound, and Incontinence Nursing Committee of Chinese Nursing Association. 2020 Guideline for prevention of device-related pressure injury. *Chin J Nurs*. 2020;55(supplement):115–121. doi:10.3761/j.issn.0254-1769.2020.S2.024
23. Higgs A, McGrath BA, Goddard C, et al. Guidelines for the management of tracheal intubation in critically ill adults. *Br J Anaesth*. 2018;120(2):323–352. doi:10.1016/j.bja.2017.10.021