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## Research Article

# Application Development and Content Validation of "SinoBed" for Pressure Ulcer Prevention and Monitoring

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### Abstract

**Aims:** This study aimed to describe the application development and validation of the "SinoBed" application for pressure ulcer prevention and monitoring.

**Methods:** The Delphi technique was used in this study to validate the researchers' content. Twelve specialists willing to help with this research validate the content of the SinoBed application. The experts were invited through email to participate in the study, and they were then issued an electronic form to fill out and return for evaluation. The data collecting tool was created using the Google Forms® platform and included a sociodemographic survey of the participants and an evaluative survey with seventeen closed-ended questions. We used the CVI (Content Validity Index) to check the information and modified kappa.

**Results:** The study involved twenty experts, but only twelve participated. The I-CVI ranged from 0.92 to 1.00. The summary received mostly positive expert assessments throughout the study. The SinoBed app has a collection of five unique algorithms. The topics to be discussed in this paper include: 1) Identification creation, 2) Roles as a patient or nurse, 3) Monitoring position and mobilization, 4) Nursing care plan, and 5) Education.

**Conclusion:** The content supplied in SinoBed® was validated using an expert consensus. The experts determined that the mobile application is suitable for preventing pressure ulcers.

### Keywords:

Application development, pressure ulcer prevention, monitoring, validation,

## INTRODUCTION

Stroke, as defined by the World Health Organisation (WHO), is a medical disorder characterized by the fast onset of clinical manifestations in the form of localized or widespread neurological impairments. These deficits can be severe in nature, persisting for a duration of 24 hours or longer, and may potentially lead to fatality. Importantly, strokes are distinguished by their vascular aetiology, with no discernible alternative causative factors. Stroke is a

medical condition characterized by the occlusion or rupture of cerebral blood arteries, leading to insufficient blood flow and subsequent oxygen deprivation to a specific brain region. This deprivation ultimately culminates in the death of cells and tissues within that affected area (1,2). Complications arising from stroke frequently result in impairment and immobility, hence necessitating the implementation of preventive measures and suitable therapeutic interventions to mitigate the occurrence of such

complications. Decubitus ulcers are a frequently encountered problem (3).

In 2018, the occurrence of stroke in Indonesia among individuals aged 15 years and above, as determined by medical professionals, was recorded at a prevalence rate of 10.9%, equivalent to an estimated population of 2,120,362 individuals. According to (4), in the province of West Java, the incidence of stroke in 2018 was recorded at 11.4%, corresponding to an estimated population of approximately 52,511 individuals. In West Java, the number of individuals affected by stroke was 26,448 among males and 26,063 among females. According to the (5) survey, the urban population constitutes a significant proportion of the total population, specifically 12.11% or 38,919 individuals. Conversely, the rural population accounts for a smaller percentage, specifically 9.49% or 13,592 individuals.

Decubitus ulcers, also known as pressure ulcers, are characterized by the impairment of anatomical structure and disruption of normal skin function due to prolonged external pressure exerted on areas of the body with prominent bony structures. Prolonged neglect of decubitus ulcers can lead to the development of more severe tissue damage and subsequent susceptibility to infection. In addition to pressure, decubitus ulcers may arise as a result of friction and stretching of the skin, typically observed in regions of the body characterized by bony prominences (6). The tailbone, heels, and waist are anatomical regions that exhibit a heightened susceptibility to injury or damage. In addition, it should be noted that decubitus ulcers can also affect the elbows, knees, ankle joints, and the posterior aspect of the shoulders, as stated by the Ministry of Health. Decubitus ulcers primarily arise due to the extended application of pressure, leading to the development of soft tissue ischemia. Additional factors have been found to contribute to the formation of

decubitus ulcers, including shear, friction, excessive moisture, and maybe infection (3).

Pressure ulcers can be effectively averted through the implementation of many preventive measures, one of which is proper placement. Altering one's body position is an efficacious strategy for mitigating the likelihood of acquiring pressure ulcers. By altering the position of the body, it is possible to alleviate the sustained pressure experienced in a particular body position. In addition to proper placement, the utilization of specialized items, such as specialized mattresses and pillows, can contribute to the prevention of decubitus ulcers. The prevalence of pressure sores in Indonesia is reported to be 33.3%, a much higher rate compared to the prevalence of pressure ulcers in Southeast Asia, which ranges from 2.1% to 31.3%. According to the Ministry of Health (2023), the recorded data indicates that there were 9,413 cases of decubitus patients in hospitals located in Central Java, accounting for almost 30% of the total population.

The advent of the mobile computer era has led to smartphones becoming an essential requirement for nearly everyone (7). Android-based smartphone devices are widely recognized as one of the most prevalent smartphones in contemporary society. The range of Android-based smartphone devices exhibits significant diversity, encompassing various hardware and software specs. For an application to be suitable for Android-based smartphone devices, it must possess a high degree of compatibility. This aims to ensure the application's seamless functionality across a wide range of Android-based smartphone devices. In addition, the application must possess comprehensible and pertinent material that aligns with the subject matter under consideration. This will facilitate all users' ease of use, enhancing the overall user experience. When designing an application for an Android-based

smartphone, it is imperative to consider the programme's content. The SinoBed application serves the purpose of monitoring stroke patients who are confined to prolonged bed rest.

Additionally, it provides educational resources for families, and its mechanism aids nurses in monitoring patient mobilization to prevent the occurrence of decubitus ulcers. Furthermore, the SinoBed application will be developed to include validated content, ensuring that users have access to information that experts have evaluated. This study aimed to describe the application development and validation of "SinoBed" application for pressure ulcer prevention and monitoring.

## METHODS

### Study design

The present study is a content validation study (8) employing the Delphi technique (9). The Delphi methodology is a decision-making procedure that incorporates the participation of multiple experts. The Delphi technique has been employed in several studies for multiple objectives and has demonstrated its utility in educational design and validation. This technique aims to achieve the most dependable agreement of opinion from a panel of experts (referred to as judges) through multiple rounds of guided evaluation questionnaires, with controlled feedback incorporated at intervals (9). The present study was conducted after obtaining ethical approval from the research committee of the PPNI West Java College of Nursing. Before the commencement of the study, all participants were provided with comprehensive guidance regarding the study's objectives and instructions on how to participate and were required to provide their informed consent by signing a consent form.

### Application development

The SinoBed application was developed by implementing a server-client architecture

that utilizes the HyperText Transfer Protocol (HTTP) and the Web API (Application Programming Interface). The database management system employed in this study was MySQL, while the server framework consisted of Apache Tomcat and the Spring Framework. The Android application utilized the Android software development kit (SDK) to configure the client. Installing the intervention programme on a personal mobile phone can be cumbersome. As a result, we have opted to provide tablets as an alternative for implementing the programme. The tablets utilized in the study were Samsung Galaxy Tab A6 models, including seven-inch screens, quad-core 1.3 GHz CPUs that supported API 21, and operating on Android Lollipop or subsequent software versions.

The development of content and animations was guided by safety procedures and protocols, as described in the literature (10). This article provides a comprehensive overview of decubitus ulcer prevention in stroke patients, with a particular emphasis on those requiring protracted bed rest. The primary purpose of creating this content is to meet the informational requirements of these patients. The author created the animation on the Canva platform, which was then published to the Sinobed application. Google Drive is then used to disseminate the application to each expert.

The SinoBed app has a collection of five unique algorithms, as depicted in Figure 1. The topics to be discussed in this paper include: 1) Identification creation, 2) Roles as a patient or nurse, 3) Monitoring position and mobilization, 4) Nursing care plan, and 5) Education. The "SinoBed" application is a novel technological solution that leverages the functionalities of the user's mobile device, independent of the need for an active internet connection. SinoBed employs User-Centered Design, along with HTML, CSS, and JavaScript, to facilitate its compilation for Android platforms, encompassing a total of three menus and twenty-five screens.



Figure 1. SinoBed

**Sample**

The inclusion criteria were those who have expertise in the field of medical surgical nursing, PhD degree or having experience at least 5 years old in clinical practices. Twelve experts who are prepared to assist with this research validate the sinobed application's content.

**Procedure**

This study was conducted online. The experts were contacted via email to participate in the study, and then they were sent the evaluation form to complete and submit electronically. The Google Form®-based data collection instrument consisted of a sociodemographic survey of the participants and an evaluation survey with seventeen closed-ended questions adapted from Souza and Turrini (2012) (Table 1). Respondents were asked to rate the survey's content, language, illustrations, layout, and motivation on a scale from one to five. A field was reserved after the digital form for the experts to record their feedback and suggestions for improvement.

**Data analysis**

The information was validated by the Content Validity Index (CVI) and modified kappa (11). The CVI can be calculated by dividing the total number of replies by the number of answers that received a score of 4 or 5. This calculation yields the percentage of items that earned a score of 4 or 5. The assessment of content validity among judges can be measured on a continuum ranging from 0 to 1, where scores below 0.80 indicate a high level of quality (11). According to previous research conducted by (12–14), the scores "4 - Agree" and "5 - Completely agree" were treated similarly, signifying a positive attitude. The first step in assessing the probability of a particular causal event is to compute the modified kappa after determining the CVI. Microsoft Corp.'s Excel for Mac and SPSS (Statistical Package for the Social Sciences) were used for the statistical analysis.

**RESULTS**

The study involved twenty experts, but only twelve participated. The majority were

females from Bandung, aged 37-45. About 41.7% held a master's degree, while 58.3% held a PhD. 66.7% of nurse nursing faculty members had over a decade of professional experience, while 33.3% had over ten years of experience as registered nurses. A significant proportion of experts were employed within educational

establishments. The evaluation procedure involved active participation from the entire panel of experts, who responded to questions using SinoBed. The study aimed to assess the quality of each of the 14 screens, including nursing assessment and diagnostic and bed position setting.

**Table 1. Content validation in the first round**

Fitur	Expert	Mean	SD	Score 4 to 5	I-CVI <sup>1</sup>	Kappa <sup>2</sup>	Criteria <sup>3</sup>
1	12	4.57	1.08	12	0.92	1.00	Excellent
2	12	4.60	0.78	10	0.90	0.93	Excellent
3	12	4.26	0.66	12	1.00	1.00	Excellent
4	12	4.38	0.75	11	0.90	0.91	Excellent
5	12	4.45	0.50	11	1.00	0.87	Excellent
6	12	4.49	0.63	11	0.93	0.90	Excellent
7	12	4.45	0.43	11	1.00	0.90	Excellent
8	12	4.49	0.71	10	0.92	0.92	Excellent
9	12	4.57	0.45	11	0.90	0.90	Excellent
10	12	4.66	1.32	12	1.00	1.00	Excellent
11	12	4.38	0.43	11	0.90	0.90	Excellent
12	12	4.45	0.50	12	1.00	1.00	Excellent
13	12	4.49	0.63	11	0.93	0.93	Excellent
14	12	4.57	0.66	11	1.00	1.00	Excellent

Note:

<sup>1</sup>I-CVI, item-content validity index.

<sup>2</sup> Modified kappa:  $k = (i\text{-CVI} - pc) / (1 - pc)$ .

<sup>3</sup> The following definitions apply to the k statistic: Poor = k between 0.40 and 0.59, Good = k between 0.60 and 0.74, and Excellent = k > 0.74.

The expert ratings for the summary were predominantly positive throughout the study. Many comments acknowledged the approach's significance, the materials' quality, and the potential inspiration they may provide to the intended audience of the study. However, some suggestions were provided by the experts as follows:

*"The programme for adjusting the slant of the right and left components can be incorporated during the configuration process. It is important to determine the number of rotations required for the programme. Currently, the only variable that can be manipulated is time. For example: Rotate clockwise and anticlockwise by two complete revolutions." (expert 3)*

*"The proposed schedule involves allocating 15 minutes for the MiKa position, followed by 15 minutes in the supine position, and concluding with another 15 minutes in the MiKi position.*

*"Perhaps it would be beneficial to implement a note menu for nurses to allocate specific attention to noteworthy cases. For instance, by including descriptors like "tension intolerant patient" in the notes, nurses and family members would be promptly alerted to the presence of s"ch information." (expert 5)*

*"This application is beneficial for individuals who are currently afflicted with pressure ulcers, regardless of whether they are classified as grade 1 or not. This assertion is based on the student's previous statement, which indicated that the purpose of the application is to avoid the occurrence of pressure ulcers." (expert 10)*

The content validation approach was efficiently conducted in a limited number of iterations due to the scarcity of novel suggestions for enhancements, hence enabling the panel of judges to achieve a comprehensive consensus. The SinoBed®

has undergone modernization to incorporate all of the recommendations that were offered.

## DISCUSSION

Experts have reached consensus on the appropriateness of the SinoBed ® images in establishing a semantic relationship between the textual content and the accompanying images. Experts praised the layout, sources, and aesthetics of the screen, praised the visually appealing structure, number of displays, and comprehensive design. Our findings support the notion that the use of visually appealing and pedagogically effective images can serve as an instructional strategy to improve the integration of previously acquired knowledge and the formation of new associations for associative learning (15,16). According to (17) study conducted in Brazil, it was hypothesized that the use of technology would stimulate an increased level of curiosity among the participants in relation to the topic being discussed. The panel of experts reached a unanimous consensus in recognizing the admirable potential of technology to excite the intended audience. Modifying humans' beliefs and behaviours has been a central topic of investigation and discussion in persuasive technology, as highlighted by (18).

A consensus was achieved among specialists about the appropriateness of utilizing the SinoBed ® to prevent pressure ulcers. (19) introduce the concept of educational technology validity as a method for evaluating the adequacy of developing technologies by systematically employing established knowledge. During the initial and subsequent iterations of evaluation, it was observed that the experts' comprehension of the subject matter improved. Seventeen of the second-round concerns received the highest attainable score (four or five) from the expert evaluation. In the study conducted by (20), the researchers demonstrated their

consideration for the needs and preferences of the intended recipients during the development of their instructional technology framework. The presence of a consensus among experts was observed by analyzing the language used in the presentation of the subject matter. This study focused on the extent to which the language aligned with the target audience, the amount of engagement it generated, its clarity, and its objectivity. The incorporation of appropriate language for educational purposes is a fundamental element of the learning process (14,20,21).

One of the disadvantages of this research was the lack of semantic confirmation obtained from the targeted demographic. Further investigation is necessary to examine the semantic comprehension of the target audience, cognitive aspect, and other outcomes. The introduction of SinoBed® is expected to foster a paradigm change in the prevention of pressure ulcer, prompting a perspective on mobilization and monitoring (22).

## CONCLUSION

The content supplied in SinoBed® was validated using an expert consensus. The experts determined that the mobile application is suitable for preventing pressure ulcers.

## ACKNOWLEDGMENT

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