

Original Research

Virtual Nurse for Detecting Suicide Risk Behaviors in Adolescents



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Article Info	Abstract
Article history: Received: 19 September 2024 Accepted: 28 October 2024	<p><i>Introduction:</i> Suicide is a complex phenomenon that is intriguing to study because its causes are still not fully understood. This phenomenon often garners media attention, as the number of incidents has significantly increased. Suicidal ideation frequently occurs in teenagers, and many who seek consultation report similar thoughts or engage in self-harm. The approach to problem-solving proposed in this research is the use of a virtual nurse as an early detection service for suicide risk behavior. A Virtual Nurse is an artificial intelligence-based application or system designed to provide health services and psychological support, particularly for teenagers. The Virtual Nurse uses machine learning algorithms to analyze user behavior, speech patterns, and interactions to identify signs of suicide risk. This study aims to analyze the effectiveness of the Virtual Nurse in detecting suicide risk behavior in adolescents.</p> <p><i>Methods:</i> This research utilized a pre-experimental design with a one-shot case study approach.</p> <p><i>Results:</i> The implementation of the virtual nurse application for the detection of suicide risk behavior in adolescents over four weeks yielded favorable outcomes for 116 students (16%), while 74 students (39%) were categorized as showing poor results and the score for using virtual nurse in detecting suicide risk was 84 points. The result was that virtual nurse were classified as good in detecting suicide risk behavior in adolescents.</p> <p><i>Conclusion:</i> The virtual nurse is an artificial intelligence-based application or system designed to provide psychological services and support to its users, particularly teenagers.</p>
Keywords: adolescents, early detection, suicide behavior, virtual nurse	

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INTRODUCTION

Suicide is a complex phenomenon worth studying because its causes are still not fully understood. This issue often garners media attention due to the significant increase in cases. In Indonesia, suicide rates in 2019 reached 2.5 per 100,000 people, resulting in approximately 6,750 deaths by suicide [1]. According to data from the Central Statistics Agency (BPS), there were around 5,787 cases of suicide or attempts in Indonesia in 2021 [2].

This research focuses on the rising number of teenage suicide cases in Jembrana Regency, Bali. The Jembrana Police reported that as of September 2023, there had been 17 suicide cases. In 2022, the number of cases reached 12 [3]. Suicidal ideation frequently occurs in teenagers, and many who seek consultation also report similar thoughts or engage in self-harm. Depression, a mental disorder, is the primary cause of suicide in teenagers. The WHO notes that suicide due to depression is the third leading cause of death globally among 15- to 19-year-olds, with around 4,600 deaths each year [4].

Besides depression, several other factors can influence suicidal behavior, such as unresolved conflicts, social pressure, a lack of problem-solving skills, and unexpressed feelings of anger or sadness [5]. Triggers and risks of suicide in adolescents can also stem from behavioral patterns, emotional states, family influences, peer pressure, and external factors such as substance abuse, distorted perceptions, poor living conditions, and economic hardships [6].

This highlights the critical need for early intervention in suicide risk behavior. Early detection of suicidal behavior is a top priority in preventing suicide among adolescents. It allows individuals to receive timely psychological assistance [7]. Early detection enables proper mental health services, such as counseling or therapy, to be offered, helping individuals address their underlying issues and alleviate emotional distress. Additionally, it helps reduce the stigma associated with mental health problems, including suicide [8]. By recognizing these issues as serious but treatable, nurses can foster a more inclusive and supportive environment for adolescents experiencing these challenges. Furthermore, raising awareness of the signs and risk factors for suicide through early detection can reduce overall suicide rates. This involves educating and supporting communities to be more attuned to at-risk individuals. A holistic approach to mental health care strengthens the support system for those in need, allowing families, friends, and mental health professionals, including nurses, to provide timely help and support, ensuring individuals do not feel isolated in facing their problems [9].

The proposed solution in this research is the use of a virtual nurse as an early detection service for suicide risk behavior. A Virtual Nurse is an artificial intelligence-based application or system designed to provide health services and psychological support to users, particularly teenagers. The Virtual Nurse uses trained machine learning algorithms to analyze user behavior, speech

patterns, and interactions to detect signs of suicide risk.

Several previous studies provide support for the foundation of this research. Research on "Digital Suicide Prevention: Can Technology Be a Transformer?" highlights recent international studies on digital suicide prevention, including the use of machine learning, smartphone applications, and sensor-based systems [10]. Another study, "Artificial Intelligence and Suicide Prevention: A Systematic Review," found that artificial intelligence shows high potential for identifying patients at risk of suicide. However, appropriate use of these algorithms in clinical settings, as well as the ethical considerations they raise, requires further clarification [11]. A separate study, "Application of Artificial Intelligence to Psychological Intervention and Diagnosis: A Review," shows promising results in the use of artificial intelligence in clinical practice, with significant potential for personalized treatment in mental health care. Future research could be enhanced by larger sample sizes and greater focus on ethical approval and compliance in online therapy [12].

These prior studies suggest that developing a Virtual Nurse to detect suicide risk behavior in adolescents can be a valuable tool in preventing suicide and improving mental well-being. Therefore, this research introduces an innovation in the early detection of suicide risk behavior among teenagers in Indonesia using artificial intelligence in the form of a virtual nurse—something that has not been studied before. This study aims to analyze the effectiveness of the Virtual Nurse in detecting suicide risk

behavior in adolescents. Future innovations may involve the development of applications capable of providing real-time, accurate predictions of mental health conditions in teenagers through systematic data analysis, pattern detection, risk evaluation, and intervention.

METHODS

Research Design

This study employed a pre-experimental design with a one-shot case study approach. This design was chosen to align with the research objective of analyzing the effectiveness of the Virtual Nurse in detecting suicide risk behavior in adolescents.

Population and Sample

The research was conducted in 2024 at high schools located in Jembrana Regency, Bali. The population for this study consisted of high school students in Jembrana Regency, Bali. Purposive sampling was used to select participants based on specific criteria: students aged 13-18 years old who were able to read, write, communicate verbally, and were cooperative. The total population was 328 students, of which 190 respondents met the inclusion criteria and were selected for the study.

Research Variables

The variables analyzed in this study were categorized as follows: 1) The dependent variable was adolescent suicide risk behavior, which was measured using a suicide risk

behavior questionnaire designed for adolescents; and 2) The independent variable was the Virtual Nurse, which was provided as an intervention for 4 weeks.

X	O ₁
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X = Treatment (Dependent Variable)

O₁ = Observation (Dependent Variable)

Data Collection

The data collection process began with the principal researcher applying for ethical approval to conduct the health research. Once approval was obtained, the necessary research permits were secured from the Bali Provincial Government, the Jembrana Regency Government, and the respective high schools in Jembrana Regency where the study was to take place.

Following approval, the principal researcher identified participants who met the inclusion criteria: high school students aged 13-18 years who could read, write, communicate verbally, and were willing to participate. Upon identifying eligible participants, the research team visited each school and provided detailed information about the study to potential respondents. Participants were given a clear explanation of the research objectives, methods, and their role in the study. After ensuring that the respondents understood the purpose and procedures, they were asked to provide informed consent to participate. Once participants agreed, both they and the researchers, along with a witness, signed the informed consent forms.

With the consent process complete, the Virtual Nurse intervention was introduced to

participants for a duration of four weeks. During this period, the Virtual Nurse—a system based on artificial intelligence—monitored and provided psychological support to participants, analyzing their behavior, speech patterns, and interactions to detect signs of suicide risk.

After the four-week intervention, data on participants' suicide risk behaviors were collected using a structured questionnaire designed to assess adolescent suicide risk. This data was then processed and analyzed to evaluate the impact of the Virtual Nurse intervention.

Data analysis

Logistic regression was used to analyze the data, as it is suitable for testing predictors with dichotomous data scales [13]. Logistic regression is a technique for modeling the probability of an event occurring, based on its suitability. The value of the dependent variable (Y) can be categorized as Y=1 (success) and Y=0 (failure) and it follows a distribution for each observation. The logistic regression equation is as follows:

$$\pi(x) = \frac{\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)}{1 + \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)}$$

where $\pi(x)$ is the probability of the event, β_1 is the parameter value, x is the independent variable. The value $\pi(x)$ is the probability of a success event $P(Y=1)$. Since $\pi(x)$ is a non-linear function, a logit transformation is necessary to obtain a linear function, allowing the relationship between the independent and dependent variables to be observed. The

Y value follows a Bernoulli distribution with a mean of $\pi(x)$ and variance $(Y) = \pi(x) \cdot [1 - \pi(x)]$. The normality assumption does not apply in the multiple logistic regression test, because Y is a dichotomous variable. Homogeneous variance in the use of linear regression models also cannot be applied to logistic regression, because the variance (Y) value is not constant. Maximum Likelihood Estimation is used to obtain the estimator β through an iterative process.

Ethical considerations

This research adhered to ethical guidelines for health research, following the principles of respect for persons, beneficence, non-maleficence, and justice. Ethical approval was obtained from the Research Ethics Committee of Triatma Mulya University, with research permission granted on September 10, 2024, under letter number 053-KEPK. Informed consent was obtained from all participants, who were fully informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time. Participant confidentiality and anonymity were maintained throughout the research process.

RESULTS

Based on Table 1, a total of 190 respondents participated in the study. The results show the age distribution of the respondents as follows: 3 participants (2%) were 13 years old, 17 participants (9%) were 14 years old, 27 participants (14%) were 15 years old, 73 participants (38%) were 16 years old, 39

participants (21%) were 17 years old, and 31 participants (16%) were 18 years old. The average age of the respondents was 16.66 years, with an age range of 13 to 18 years.

According to Table 2, the majority of respondents were female, with 114 participants (65.2%), while 76 participants (34.8%) were male.

Based on Table 3, the results of the suicide risk behavior questionnaire administered to adolescents before the implementation of the Virtual Nurse showed that 127 students (67%) were categorized as being at risk for suicide, while 63 students (33%) fell into the good (low risk) category.

Table 4 indicates that after the implementation of the Virtual Nurse application for the detection of suicide risk behaviors over a four-week period, 116 students (61%) showed improvement, while 74 students (39%) remained in the high-risk category.

Table 5 explains that 190 respondents filled out the suicidal behavior questionnaire. After collecting the data, the researcher summarized all the assessments and obtained a total of 84 scores with a Good classification. This table also explains that the virtual nurse has a Good classification for detecting the risk of suicide in adolescents.

The stages of model formation are as shown in Table 6. From the results of the likelihood ratio test, it was found that the G2 value was 82.597 which was significant at the test level $\alpha=5\%$, So it can be concluded that the model that includes all variables is the best model. At this stage a new model was formed by removing the respondent's age variable. From the results of the likelihood

test, a G2 value of -0.002 is obtained, which is not significant with a p-value 0.966, so it can be concluded that the model without including the respondent's age is the best model. With the same steps, for stage 3 the

variable that was excluded was gender with a G2 value of -0.075 which was not significant with a p-value 0.78, so it was concluded that the model without including gender was the best model.

Table 1

Overview of Age Category Respondents

Category	Frequency	Percentage (%)	Mean	Min-Max
13 years old	0	0		
14 years old	17	9.0		
15 years old	27	14.0	16.66	13-18
16 years old	73	38.0		
17 years old	42	23.0		
18 years old	31	16.0		
Total	190	100		

Table 2

Overview of Respondents in Gender Category

Blood Pressure	Before Intervention	After Intervention	t	p value
Systolic (mmHg)	152.03 (± 8.78)	138.13 (± 11.53)	15.70	0.00
Diastolic (mmHg)	94.71 (± 3.18)	83.66 (± 6.58)	10.78	0.00

Table 3

Overview of the results of the Suicidal Behavior Questionnaire in Adolescents

Category	Frequency	Percentage (%)
Bad	127	67
Good	63	33
Total	190	100

Table 4

SBQ-R - Scoring Virtual Nurse Application for Detection of Suicide Risk Behaviors in Adolescents

Category	Frequency	Percentage (%)
Bad	74	39
Good	116	61
Total	190	100

Table 5

Tabulation of research questionnaire results on the dependent variable using Virtual Nurse

Respondent	Suicide ideation and/or suicide attempts				Suicidal ideation over the past 12 months					Suicide attempt			Suicidal behavior in the future							Score
	P1	P2	P3	P4	P1	P2	P3	P4	P5	P1	P2	P3	P1	P2	P3	P4	P5	P6	P7	
1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
2	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
3	1	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	4
4	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
5	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
6	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
187	0	2	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
188	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	4
189	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	4
190	0	2	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	4
Total																				84

Classification:

Excellent = 90-1.0

Good = 80-90

Fair = 70-80

Poor = 60-70

Table 6Statistical Values of Likelihood Ratio (G^2), Degrees of Freedom, and p-value tests at each stage of suicide risk detection evaluation

Stage	variables that come out of the model	-2Log Likelihood	G^2	db	$X^2(v;0,05)$	p-value
1	-	3598,614	82,597	8	15,50	0,00
2	respondent's age category	3598,616	-0,002	1	3,84	0,97
3	respondent's gender category	3598,691	-0,075	1	3,84	0,78

DISCUSSIONS

The results of the study show that there is an influence on virtual nurses as a service to detect suicidal behavior in adolescents. This study is in line with previous research on "A

Systematic Assessment of Smartphone Tools for Suicide Prevention" which showed the findings of many suicide prevention apps available, some of which provide elements of best practice, but none of which provide

comprehensive evidence-based support. Apps with potentially harmful content were also identified. Regardless of the number of apps available, and their diverse goals, there is a clear need to develop useful, pragmatic, and diverse mobile resources for the adolescent population [15]. Another study on "Hope Box Virtual Smartphone App as a Therapeutic Accessory: A Proof of Concept in a Veteran Clinical Sample" found results that the "Hope Box" is a therapeutic tool used by physicians with adolescents who have difficulty coping with negative thoughts and stress, including adolescents who may be at risk of suicide or self-harm without suicide. The researcher conducted a proof-of-concept test of the "Virtual" Hope Box (VHB) smartphone application that provides coping tools tailored to the needs of adolescents [16].

Virtual nurse as a service for detecting suicidal behavior in adolescents is an application approach given to students with a process of 4 weeks. The study conducted by [17] explained that the implementation of research on "The effectiveness of a suicide prevention app for indigenous Australian youths" requires a 5-week process and good validity, especially among general practice patient groups aged 15 to 24 years. The innovation in this study is shown in the development of early detection of suicide risk behaviors in adolescents in Indonesia using artificial intelligence in the form of virtual nurses, which has never been researched before. Future innovations will gradually develop applications that provide accurate predictions in real-time on the mental state of adolescents that will systematically work in

functions such as data analysis, pattern detection, risk evaluation, and intervention.

Study Limitations

The measurement of independent and dependent variables was carried out using an online questionnaire using google form media and virtual nurse media which were filled in directly by the respondents, this can be subjective so that the level of truth and accuracy of the data summarized is highly dependent on the honesty of the respondents in filling out the questionnaire answers. During data collection, technical issues were encountered, such as students' smartphones not functioning properly and limited internet access in certain research locations.

Implications

Nearly half of the adolescent population has been detected to have a higher risk of suicide in adolescents. In addition, in this study there is a questionnaire that functions for screening depression and suicide risk in adolescents, virtual nurses can be used and adopted in services both in hospitals and in the community, especially in adolescents. The results of this study can be used as a reference or foundation, study material and reading material to develop further research on suicide risk.

CONCLUSION

This study found that there was an influence on the implementation of virtual nurse as a suicidal behavior detection service in adolescents. Virtual nurse is an artificial

intelligence-based application or system designed to provide psychological services and support to its users, especially teenagers. Virtual nurses use trained machine learning algorithms to analyze their users' behaviors, speech patterns and interactions to identify signs of suicide risk.

CONFLICT OF INTEREST

We declare that there is no conflict of interest in this study. Funding was solely provided by the researchers without any institutional support.

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