

Geographic Information System of Dental Caries Management (Sig-Mkg) to Improve the Quality of Information in Dental and Oral Health Services in Puskesmas

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Abstract

Background.

The program to reduce the development of dental caries in elementary school children has not been optimal. So far, the reporting mechanism of the inspection results is still manual so that the resulting data is inaccurate and incomplete. The dental caries management geographic information system (SIG-MKG) provides dental caries distribution data in support of effective and targeted handling.

Purpose of Study.

The purpose of this research is to produce a decent SIG-MKG and its application effectively improve the behavior of dental and oral therapists, the quality of dental caries management, and the quality of data and information.

Methods.

The methods used are Research and Development and pre-experimental design method. Respondents numbered 30 to assess the behavior (knowledge, attitude, and action) of Dental and Oral Therapists in the application of SIG-MKG, the quality of dental caries management, and the quality of data and information. Data tested using paired different tests, proportion tests, and regression tests.

Results.

Expert validation test on SIG-MKG obtained an average feasibility of 97.23%. Assessment of knowledge, attitudes, and actions after treatment increased significantly compared to before ($p < 0.001$, $p = 0.032$, and $p < 0.001$, respectively). Quality of dental caries management and Quality of data and information improved significantly after treatment ($p < 0.001$). Behavior affects Dental Caries Management Quality and Quality of data and information ($p < 0.001$).

Conclusion.

It can be concluded that The application of SIG-MKG provides a significant improvement in the behavior of Dental and Oral Therapists in the application of SIG-MKG, the quality of dental caries management, as well as the quality of data and information compared to before.

Keywords:- Dental Caries Management, Geographic Information Systems.

I. INTRODUCTION

Dental and oral health in Indonesia needs serious attention because a lot of people in Indonesia suffer from dental and oral diseases.[1] Common dental and oral health problems include dental caries and periodontal disease. School-age children are a vulnerable group of dental health disorders that need more attention.[2]

There are 35% Dental and oral health problems that occurred in elementary school children in Southeast Asia in 2015.[3] Riskesdas data in 2018 stated that 57.60% of people in Indonesia have dental and oral health problems.[4] The proportion of Indonesians according to Riskesdas in 2018 was 92.60% having dental caries problems in the five to nine year age group.[4] The Global Burden of Disease Study (2016) reports that permanent dental caries are included in one of the diseases with the largest prevalence in various countries at 95.00%.[5]

School-age children are one of the groups that are vulnerable to dental caries because they still have less knowledge of dental caries.[6] The results of the National

Dental Health Survey 2015-2016 on 3500 children there are 3410 children who need care in terms of dental health. The survey showed that about 73.90% of children have untreated dental caries.[6] The high number of dental caries in children will hinder the development of the child so as to decrease the level of intelligence of the child, even in the long term will have an impact on the quality of life of the community.[6]

The Government of Indonesia has attempted to early detect dental caries through a child health screening program to reduce the incidence of dental caries and reduce the development of dental caries in school children.[7, 8] The program goes hand in hand with dental caries management where each caries lesion is examined to determine the stage of further caries then the results of the examination are utilized in the prevention and promotion of dental caries health program.[7]

Coverage of primary school dental health networking in Temanggung District in 2018 amounted to 99.67%, but only 7,129 students received treatment from a total of 18,008 students still needing treatment.[9] It can be concluded that there is no reciprocity of health workers in the mechanism of reporting the results of the examination to the parents of the child for follow-up health services.[10]

The reporting system of children's dental health management in Cipaku Health Center is limited to there are/not cavities and wobbly teeth only.[11] This causes the quality of the examination data to be inaccurate, so the available information cannot be communicated to the parents of the student and there will be potential decision-making errors by healthcare officers/providers in preventive efforts.[12]

Improved aspects of input, process, and output are required in the quality of dental caries management with effective management through an ongoing process of early detection of dental caries, diagnosis of existing caries lesions at the dental level, and assessment of caries activity and risk. This synergizes in recording, planning, implementing, monitoring and evaluating the prevention of dental caries as early as possible.[13] This will result in complete and continuous dental caries history data in the needs of complete and comprehensive services, especially in school children.[14]

The function of Provision of health information in the web-based reporting system by puskesmas at this time, is still not optimal because the presentation of data is still semi-automatic limited in the form of tables and graphs, while the presentation of information based on regional maps has not resulted in delays in Monitoring The Local Area.[15] The description of the problem as the basis of thinking on the need for the development of geographic-based information systems to support the presentation of geographic data in conveying health information.

Utilization of Geographic Information System (GIS) in the field of health is one of the methods to present or visualize tabular data into health-related information.

Presentation of spatial data forms can effectively be used by policy makers in decision making.[16]

The model that researchers developed provides an application to monitor and evaluate the spread of dental caries events in certain regions online so that it can be accessed by policy makers and the general public anytime and anywhere. This developed system is expected to assist relevant agencies in supporting effective and more targeted handling. This system is also expected to assist and facilitate relevant agencies in conveying information related to dental caries to the general public.

II. METHODS

This type of research is Research and Development. R &D steps with reference to Borg &Gall (1983) by Sugiyono (2013) among others first collect information on the resource person as material to design the model build, design a model using the method Rappid Application Development (RAD) then in the validation test experts by IT experts, health promotion experts, and dental and oral health management experts, the next step is product trials using pre-experimental design methods with the design of One Group Pre -Post Test.

This research was conducted at the puskesmas work area of the Temanggung health office in December 2020 until January 2021. Respondents numbered 30 Dental and Oral Therapists to assess the behavior (knowledge, attitudes, and actions) of dental and oral therapists as well as the quality of data and information. Model test result data is tested using paired different tests, proportion tests, and regression tests.

III. RESULTS

Validation of experts against three people, namely dental and oral health promotion experts, dental and oral health management experts, and information technology experts Validation test results as follows:

Table 1. SIG-MKG Expert Validation Results

No.	Expert	Score	p-Value*
1.	information technology experts	92.90%	0.012
2.	dental and oral health promotion experts	98.80%	
3.	dental and oral health management experts	100.0%	

**Interclass Correlation Coefficient*

The results of the system feasibility assessment of the expert validator known p-Value of 0.012 show that SIG-MKG is relevant and feasible as a geographic-based information system in the system of recording and reporting dental caries incidents of elementary school children.

Table 2. Data Normality Test Results Before and After SIG-MKG Administration

Variable	p-Value*
Pretest Knowledge	0.100
Posttest Knowledge	0.022
Pretest attitude	0.072
Posttest attitude	<0.001
Pretest action	0.003
Posttest action	<0.001
Pretest Quality of data and information	<0.001
Posttest Quality of data and information	0.043
Pretest Quality of dental caries management	<0.001
Posttest Quality of dental caries management	0.018

**Shapiro-Wilk*

Normality test results based on the table above show pretest and posttest data of each variable is not normally distributed ($p < 0.005$), then the next analysis test using Non-Parametric analysis is Wilcoxon test.

Table 3. Results of Knowledge Analysis Before and After SIG-MKG Implementation

Variable	Mean±SD	Delta (Δ)±SD	p-Value*
Knowledge			
<i>Pretest</i>	3.67±1.45	4.23±2.89	<0.001
<i>Posttest</i>	7.90±1.58		

**Wilcoxon*

Wilcoxon test results in the table above show the application of SIG-MKG effectively improves knowledge from before as evidenced by the significance value of < 0.05 . The average result showed that the value after the application of SIG-MKG was greater than before the application of SIG-MKG with an increase of 4.23. This suggests that the application of SIG-MKG provides benefits that further enhance knowledge in the behavior of Dental and Oral Therapists.

The effectiveness of information systems is closely related to the increasing competence of human resources because the use of information technology encourages one in understanding a thing where knowing and understanding a particular object is the output of the process of one's sensing [17, 18].

Table 4. Results of Attitude Analysis Before and After SIG-MKG Implementation

Variable	Mean±SD	Delta (Δ)±SD	p-Value*
Attitude			
<i>Pretest</i>	15.33±1,81	1.44±2.21	0.032
<i>Posttest</i>	16.77±2,27		

**Wilcoxon*

The table shows that the p-value in the attitude before and after the application of SIG-MKG is 0.032 which is smaller than 0.05. This shows there is a difference in attitude improvement before and after the administration of SIG-MKG. The average value showed an attitude after the

application of SIG-MKG was greater than before the application of SIG-MKG with an increase of 1.44. Thus it can be concluded that SIG-MKG provides benefits that further improve attitudes in the behavior of Dental and Oral Therapists.

Utilization of geographic-based information systems is believed to be useful and assist users in obtaining information. Trust in information technology that users provide high value due to the inherent characteristics of the system and assessment of the extent to which the system is trusted to meet the needs according to their duties [19].

Table 5. Results of Actions Analysis Before And After The Application of SIG-MKG

Variable	Mean±SD	Delta (Δ)±SD	p-Value*
Action			
<i>Pretest</i>	4.27±1.05	2.36±1.90	<0.001
<i>Posttest</i>	6.63±0.61		

**Wilcoxon*

The results of the analysis of actions before and after the application of SIG-MKG showed the application of SIG-MKG effectively improved the action than before. This is proven by a significance value of less than 0.001. Based on the average value is also known that the value of action after the application of SIG-MKG is greater than before the application of SIG-MKG with an increase of 2.36. So it can be concluded that the application of SIG-MKG effectively improves the action in the performance of Dental and Oral Therapists.

These results support research by Puri (2017) that utilizing information technology can facilitate human resources in improving performance effectiveness [20]. In this case, the utilization of information technology in its implementation is able to change the way employees view in all work that was done manually while now can be done automatically [21].

Table 6. Results of Quality Data and information Analysis before and after the implementation of SIG-MKG

Variable	Mean±SD	Delta (Δ)±SD	p-Value*
Quality of data and information			
<i>Pretest</i>	46.83±2.20	7.37±6.63	<0.001
<i>Posttest</i>	54.20±5.11		

**Wilcoxon*

The results showed that the p-value of data quality and information before and after the application of SIG-MKG amounted to less than < 0.001 less than 0.05. This means that there are differences in the effectiveness of data and information quality before and after the provision of SIG-MKG. The average value also shows that the value of data quality and information after the implementation of SIG-MKG is greater than before the implementation of SIG-MKG with an increase of 7.37. This means that the implementation of SIG-MKG provides more effective and efficient benefits in the presentation of data and information compared to previous systems. The use of this new system presents data

and information that can be utilized by users.

The utilization of information technology significantly affects the reliability of reporting to produce quality reports, the quality of employees involved in the preparation of reports must understand and understand about the processes and implementation carried out in accordance with applicable guidelines[22].

Table 7. Effect of Behavior on Data and Information Quality

Variable	p-Value*
Knowledge Attitude Action	<0.001

** linear regression*

The above results show that partially or individually knowledge, attitudes, and actions affect the quality of data and information. This is proven by a p-value smaller than 0.05.

It proves that a person's behavior and the use of information technology have a positive effect on the quality of the report [23]. In this case, the underlying human resource competency of a person achieves high performance [24].

Quality report results are relevant, reliable, comparable, and understandable depending on competent human resources judging by educational background, skills, and training [25]. The higher the quality of an apparatus in terms of educational background, understanding its roles and responsibilities, participating in training skills related to tasks will improve the reliability of reports in providing information[26].

Table 8. Quality Analysis of Dental Caries Management Before and After The Implementation of SIG-MKG

Variable	Mean±SD	Delta (Δ)±SD	p-Value*
Quality of data and information Pretest	31.67±3.04 37.60±3.36	5.93±5.64	<0.001
Posttest			

**Wilcoxon*

Overall, the p-value on the questionnaire's before and after total score was less than 0.001 < 0.05. This indicates that there is a more effective application of SIG-MKG to the quality of dental caries management. Overall the score showed that the value after SIG-MKG administration was higher than before sig-mkg administration with an increase of 5.93 which means that SIG-MKG provides more effective and efficient benefits to the quality of dental caries management.

Management information system has the benefit of providing information to support the planning, control, evaluation and continuous improvement process.[27] In this case, dental caries management information system can support the recording and reporting of dental caries on dental

health networking and child health. Dental caries management consists of early detection of dental caries, diagnosis of dental caries, and risk assessment of dental caries.

Detection of dental caries is one way to know the early signs of the occurrence of dental caries. The use of an automated code system based on an information system can make it easier for medical personnel to plan people's dental needs.[28]

The use of information technology in the diagnosis of dental caries can facilitate officers in decision making. This is in line with research by Arfajsyah, et al (2018) that mobile-based dental caries diagnosis application as a tool for early diagnosis of dental and oral diseases.[29] In this case, the utilization of information systems plays an important role in the decision-making process so that it needs relevant information according to the needs of an organization.[30]

Dental caries risk assessment based on information system is effective in the delivery of information because the information system can provide benefits and understanding of the picture of dental caries risk factors so that the resulting information can be used by the user to support the right decision making.[31]

Table 9. Effect of Behavior on Dental Caries Management

Variable	p-Value*
Knowledge Attitude Action	<0.001

** linear regression*

The results of the influence test showed that partially or individually knowledge, attitude, and actions influenced the quality of dental caries management. This is evidenced by a p-value smaller than 0.05.

These results show that with high knowledge, good attitude, and good action is able to improve the management of dental caries. this is because the performance management system will succeed if the human resource capacity is able to understand, analyze, and utilize the available information so as to encourage their spirit of work.[32]

Product.

The result product is one of the innovations to overcome the problems faced by health workers, especially Dental and Oral Therapists in monitoring and evaluating the incidence of dental caries and optimizing the reporting of dental caries data in a particular region.



Figure 1. Results of Dental Caries Data Distribution from SIG-MKG

SIG-MKG displays a map of the area with location coordinate points along with a pop up showing student details (student data and dental caries test results). SIG-MKG can support the acceleration of the receipt of information on puskesmas and school reports in reporting the results of recapitulation of records in stages and can map the incidence of dental caries in the region so that the level of problems can be detected as early as possible.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the results of the research SIG-MKG is feasible and its application effectively improves the Behavior of Dental and Oral Therapists, improves the quality of data and information, and improves the quality of dental caries management in dental and oral health services in puskesmas.

The advice that the author can convey is that further research needs to be done by using different research designs and variables to add more ideas and research development.

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