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Development of measles-rubella surveillance health information system in the working area of health center tanjung selor, bulungan district

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Abstract. The Tanjung Selor Health Center reported 2 laboratory-confirmed negative measles suspected cases that occurred in the Tanjung Selor Hilir urban village area, thus meeting the Discarded Rate target of 80% for North Kalimantan Province. This study aims to design and determine the effectiveness of measles-rubella surveillance applications based on increasing measles suspect case finding. This research used pre-experimental study design and system development with the prototype method. This study was conducted in the working area of the Tanjung Selor Health Center. Samples of research were teachers and children of kindergarten/early childhood, elementary/boarding schools, and private pediatrician health service facilities in the Tanjung Selor Hilir village. The name of the application is SICARE (*Sistem Campak Rubella/Measles-Rubella Surveillance*) and expected to facilitate monitoring reporting cases of measles rubella. Data were analyzed by univariate and bivariate t-tests on Stata and then interpreted in the form of tables and narratives. The results showed the frequency of reporting ($P=0.010$), the difference in case of reporting before and after treatment ($P=0.160$), the effectiveness of surveillance attributes in schools and private facilities after treatment ($P=0.00$), and the effectiveness of reporting on Health Center officers ($P=0.22$). Significant results from the development of the SICARE application are the frequency of reporting and the effectiveness of surveillance attributes in schools and private facilities. It is recommended for health center staff to further develop the application that has been built through optimal planning to improve early detection

and rapid response in an active measles-rubella surveillance system.

Introduction

Measles and rubella infection is an ongoing public health threat worldwide and is targeted by WHO/SEARO to achieve measles-rubella elimination by 2023 (1). Measles and rubella are infectious diseases with humans being the sole reservoir of infection. Transmission of these diseases is prevented through intensive surveillance programs and response to the emergence of cases or outbreaks as the key to elimination in the region (2).

Measles and rubella are important causes of death for children worldwide. Pre-school and elementary school-aged children are vulnerable to measles-rubella (3). World Health Organization (WHO) surveillance data for the South East Asia Regional (SEARO) region from 2017 to 2020 showed that the number of measles cases was 5.4% per 1,000,000 population, and new rubella cases were 2.3% per 1,000,000 population (4). Indonesia is one of the countries with the second highest number of measles and rubella cases for the SEARO region after India (5). The number of suspected cases and laboratory confirmations of measles-rubella fluctuated from 2014-2018 of which there were 22 deaths and as many as 89% of measles cases and 77% of rubella cases were suffered by children under 15 years of age with the distribution of cases almost throughout Indonesia (4,6,7).

Measles rubella surveillance is the continuous and systematic monitoring of measles and rubella starting from the collection, processing, analysis, and interpretation of data and dissemination of information to produce recommendations (8,9). This is useful for predicting extraordinary events (KLB/Kejadian Luar Biasa) or outbreaks by monitoring trends in the increase or increase in measles cases (10,11). In the era of technological development of documentation information systems, records made on paper have shifted to using electronic media such as computers or smartphones

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which aim to facilitate the information cycle quickly, precisely, and accurately in the health sector (12). The development of a measles-rubella health information system conducted in Kenya by Ismail (13) used an Android phone-based application to map the target population and logistics. The application is available on a laptop through a web application, the results are timely data transfer, data integrity, tracking, reporting, and analysis of factual data visualization and enable problem-solving (14,15).

Health Center Tanjung Selor is one of the only health service centers in Bulungan District that reported two laboratory-confirmed negative measles suspected cases that occurred in the Tanjung Selor Hilir urban village area, thus meeting the achievement of the Discarded Rate discovery target of 80% for North Kalimantan Province (16). The measles-rubella surveillance information system is implemented through a data recording and reporting system carried out manually from paperwork (forms) to a computer system by officers so it is not effective and passive case finding is only based on reports of daily patient visits to the Health Center. This is because there is no integrated mobile-based electronic system that supports it, resulting in low active case finding in the region and the double burden carried out by officers in carrying out their functions. Therefore, this study aims to design and determine the effectiveness of a measles-rubella surveillance-based application in increasing measles suspect case finding.

Methods

This type of research uses two stages of research, namely pre-experimentation and system development (research and system development) using a prototype method development design that helps the identification process at each stage in the development methodology and after development an evaluation of the quality of the information produced. The research was conducted in the Tanjung Selor Health Center working area, namely Tanjung Selor Hilir village from December 2022 to April 2023. The population in this study were all kindergartens, elementary schools, and private pediatrician health service facilities in the Tanjung Selor Hilir village area as many as 38, and all members of the Rapid Motion Team was a team formed by the south coast center of whom doctors, sanitarians, epidemiologist and health analysts are on duty during extraordinary cases in the area of the Tanjung Selor Health Center. The sample of this study, namely:

1. Children were recorded in kindergartens, elementary schools, and private practice pediatrician health care facilities with a sampling technique that is simple random sampling. Sample inclusion criteria, namely aged 4 to 12 years, active students at school and/or registered as patients in private practice pediatrician services, have symptoms of illness namely fever and rash or one of them, and exclusion criteria, namely not domiciled in the Tanjung Selor working area.
2. Teachers and private pediatricians from the total population of 35 kindergartens and elementary schools/pesantren and 3 private pediatricians in Tanjung Selor Hilir village with purposive sampling technique. Withdrawal of the number of controls and treatments in a ratio of 1: 1 with the inclusion criteria of active teachers for more than 1 year of service and/or there is a letter of assignment by the leadership of

Playing Group and Primary School, doctors, or employees appointed at private pediatrician services operating for more than 1 year in the Tanjung Selor Health Center working area, able to operate Android, and willing to become respondents. Exclusion criteria, namely traveling, not being in place, sick or absent when the research was carried out, did not have the skills to operate Android, and were not willing to follow the training implementation process during the research.

3. All health or non-health workers who served in the Rapid Motion Team of Tanjung Selor Health Center with purposive sampling technique with inclusion criteria, namely having served more than 1 year and or there is a letter of assignment by the head of the health center, involved in the rapid response team for disease prevention and control, able to operate Android and willing to become respondents. Exclusion criteria, namely traveling, not being in place, sick or absent when the research was carried out, did not have the skills to operate Android, and were not willing to follow the training implementation process during the research.

Data collection was conducted by giving a pre-test on the socialization of the intervention (SICARE Application) and then a post-test after monitoring the use of the system within 48 days. The research instruments were a questionnaire and a review sheet of the measles-rubella suspect case finding report as well as an image/sound recording device for documentation of field activities. Data analysis used 2 stages, namely: 1) Univariate analysis using frequency distribution values, 2) Bivariate analysis using independent sample t-test with alpha value ($\alpha=5\%$), then presented in the form of tables and narratives.

Ethical consideration

This research has passed an ethical review issued by the Health Research Ethics Commission, Public Health Faculty, Hasanuddin University with number: 261222032387. This ethic was obtained in written form with the number-letter: 109/UN4.14.1/TP.01.02/2023.

Results

The SICARE application is a combination of tools and procedures based on an android website to manage the information cycle of sick case reports leading to suspected measles-rubella in pre-school and primary school children, designed and developed at the Tanjung Selor Health Center which is integrated online between the health center, teachers and private pediatricians. SICARE is accessed through the Play Store platform on personal Android devices using the internet network available at each place. Report data sent by teachers and private pediatricians as users through the SICARE application is carried out flexibly regardless of time and place and will be received in real-time by the main server admin at the Tanjung Selor health center as data to detect, monitor the development and increase in measles-rubella cases.

Fig. 1 shows the initial display after the user opens the SICARE application, there are 4 menu options, namely reporting, tracking, information portal, and instructions for use. Instructions for using the SICARE application for users who want to access can be done directly without a login

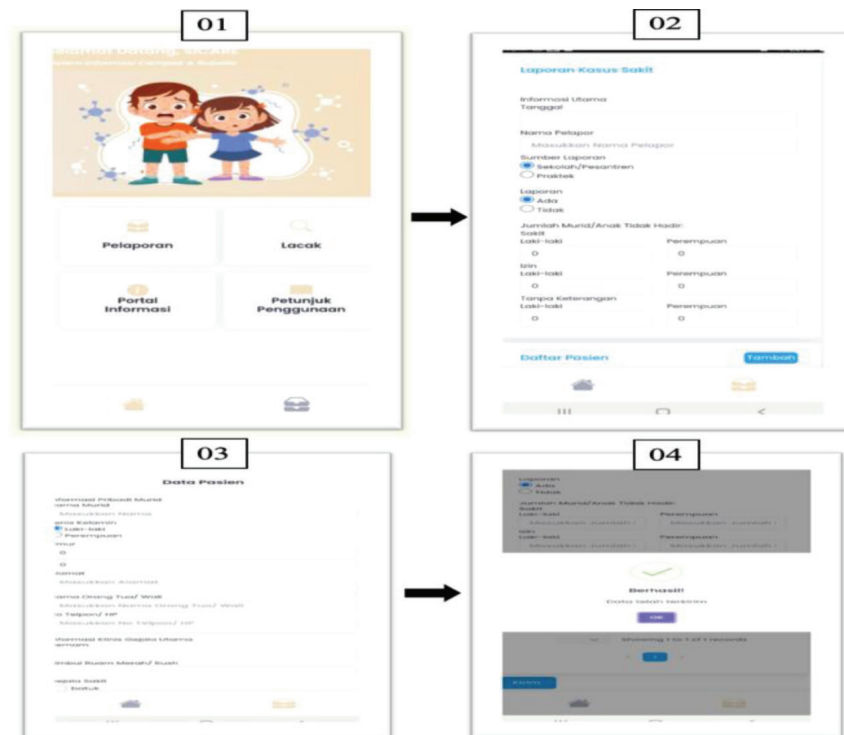


Figure 1. SICARE application dashboard via mobile phone.

username and password. The following are instructions and pictures of how to use it:

1. SICARE application is downloaded and opened, users can report by clicking the reporting menu on the application and filling in the main information then click Add (number 1).
2. Users fill in Patient Data (number 2) and patient symptoms completely then click Save. The last stage after completing filling in the student/patient data (number 3) is to make sure the data that appears in the SICARE application is correct and then click Submit.

3. After all, stages have been completed, information on reporting student/patient sick data will be sent to the SICARE Application website database (number 4) to be verified and followed up by the Tanjung Selor Health Center.

Table I shows the distribution of respondent characteristics in this study by group. Most respondents in the female group were 92.11% with the largest proportion in the treatment group 18 (94.74), then in the employment group who worked as non-permanent employees than civil servants, namely 26 (68.34%) were more in the control group, namely 16 (84.21). As for the frequency of reporting, the 0-7 day report is the largest frequency compared to other reporting frequencies. The highest frequency of 0-7 days was 17 (89.47) in the control group.

Table II shows the acceptance of users (teachers and doctors) before and after the intervention based on the treatment group on surveillance attributes. Acceptance of surveillance attributes with very agree answers before the intervention was a very small proportion but after the intervention, there was an increase in each surveillance attribute. Users who answered in the affirmative after the intervention also showed an increase in the intervention group (see Table II).

Table III shows health worker acceptance of the application based on aspects of surveillance attributes. The number of acceptance before the intervention who chose strongly agree was almost none but after the intervention, there was a huge increase. Similarly, agreed answer shows a greater increase in acceptance of health workers after the use of the application.

Analysis of differences between intervention and control groups before and after is presented in Table IV. The analysis showed that there was a difference between groups in the frequency of reporting after the intervention where the mean value in the intervention group was higher than the control group, namely 8.42 ± 7.61 and 1.63 ± 4.03 , $P\text{-value} = <0.000$. Likewise, the surveillance attributes after treatment showed that the mean in the intervention group was higher than the control group, namely 11 ± 3.62 and 7.31 ± 3.49 .

Discussion

Evaluation of measles-rubella case reporting frequency.

The results of the study with the design of this android-based application showed that there was a significant difference in reporting frequency between the treatment group that was given the treatment using the android-based electronic application SICARE and the control group. The highest frequency of the 19 treatment groups showed that the reporters routinely reported measles-rubella case data for 28 days of the study period compared to the control group who only reported routinely for 15 days. The use of the electronic application was shown to increase the frequency of reporters sending case reports to health officials promptly.

The results of the above research are in line with research conducted by Salsabila, 2019 (17) who developed an android-based recording system as one of the innovations to

Table I. Frequency distribution of respondents' characteristics.

Characteristics	Control		Treatment		Total	
	n	%	n	%	n	%
Sex						
Male	2	10.53	1	5.26	3	7.89
Female	17	89.47	18	94.74	35	92.11
Age						
21-30 years	9	47.37	6	31.58	15	39.47
31-40 years	6	31.58	9	47.37	15	39.47
41-50 years	4	21.05	4	21.05	8	21.05
Occupation						
Non-permanent employees	16	84.21	10	52.63	26	68.34
Public servant	3	15.8	9	47.37	12	31.58
Education level						
High senior	3	15.79	0	0	3	7.89
Diploma	0	0	3	15.80	3	7.89
Bachelor	16	84.21	16	84.21	32	84.21
Reporting frequency						
0-7 days	17	89.47	11	57.89	28	73.68
8-15 days	2	10.53	3	15.79	5	13.16
16-23 days	0	-	5	26.32	5	13.16
Case classification						
Not measles	111	100	690	97.87	801	98.16
Measles suspect	0	-	14	1.99	14	1.72
Clinical measles	0	-	1	0.14	1	0.12

identify and develop information systems for recording and reporting mobile health service activities. The results of this study presented the use of Android-based mobile phones as a tool for collecting data on the implementation of recording and reporting on maternal and child activities. It can be carried out more efficiently in terms of time, sending data to the server makes the data more secure, making it easier for recording officers to later input data as reporting material (8). Another similar study was conducted by Young-ji, 2022 (18) through the Ghana health service on the launch of an electronic health management information system, namely a mobile health-based HMIS (Health Mobile Information System) called the e-Tracker system (14) in 2 regions in Ghana. E-tracker is an Android-based tracker capture application that electronically manages maternal and child health data. The results of the pre-post comparison analysis showed a significant increase in the capacity of health workers, with higher levels of knowledge and practice after using the e-Tracker system thus providing empirical evidence that the e-Tracker system is conducive to improving capacity in MCH (Management Care Health) data management to provide the necessary MCH services (19,20).

The frequency of reporting measles-rubella cases as an indicator of timeliness in completing data was also conducted by Hayu 2019 (21) who measured the completeness and accuracy of measles case reports from reporting units calculated based on the number of health centers in each district and in

the province and automatically calculated by software applications (21). Each village midwife unit or health center uses SMS to report weekly data and the results showed an increase in completeness of reports after treatment to 100%. The use of the SICARE application in the timeliness of report completeness as an alternative is evidenced by measurable results in improving the timeliness and completeness of data through indicators of the frequency of reports sent by teachers and private pediatricians, but the obstacles in completing reports promptly were not carried out during the research period of application implementation and manual implementation, namely 48 (forty-eight) days due to the implementation of the main task in supervising student learning and supervising patient examinations by both control and treatment groups.

Evaluation of surveillance attributes on the use of the SICARE application. In this measles-rubella health surveillance system research, a comparison was made between the use of the official Ministry of Health system, namely manual reporting, and the development of the SICARE application which involves teachers and pediatricians in private practice as active reporters in stages reporting to the Tanjung Selor Health Center surveillance officer. This surveillance system provides accurate data and is by conditions in schools and private healthcare facilities in the Tanjung Selor Working area within 48 (Forty-Eight) days of implementation.

Table II. Distribution of pre-post user answers to surveillance attributes.

Surveillance attributes	Strongly agree, n (%)		Agree, n (%)		Disagree, n (%)		Strongly disagree, n (%)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Simplicity								
Intervention	0	12 (63.16)	4 (21.05)	7 (36.84)	15 (78.95)	0	0	0
Control	4 (21.05)	3 (15.79)	10 (52.63)	14 (73.68)	5 (26.32)	2 (10.53)	0	0
Reception								
Intervention	0	13 (68.42)	13 (68.42)	6 (31.58)	6 (31.58)	0	0	0
Control	2 (10.53)	0	10 (52.63)	11 (57.89)	7 (36.84)	8 (42.11)	0	0
Stability								
Intervention	0	12 (63.16)	6 (31.58)	7 (36.84)	13 (68.42)	0	0	0
Control	2 (10.53)	0	9 (47.37)	6 (31.58)	8 (42.11)	13 (68.42)	0	0
Timeliness								
Intervention	0	7 (36.84)	2 (10.53)	8 (42.11)	17 (89.47)	4 (21.05)	0	0
Control	0	0	8 (42.11)	8 (42.11)	11 (57.89)	11 (57.89)	0	0
Flexibility								
Intervention	0	13 (68.42)	12 (63.14)	6 (31.58)	7 (36.84)	0	0	0
Control	0	0	16 (84.21)	13 (68.42)	3 (15.79)	6 (31.58)	0	0

Table III. Distribution of health workers' acceptance of surveillance attributes.

Surveillance attribute aspects	Strongly agree		Agree		Disagree		Strongly disagree	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Simplicity	1 (5)	7 (35)	9 (45)	13 (65)	10 (50)	0	0	0
Receipt	0	16 (80)	13 (65)	4 (20)	7 (35)	0	0	0
Stability	0	10 (50)	16 (80)	10 (50)	4 (20)	0	0	0
Flexibility	0	10 (50)	14 (70)	10 (50)	6 (30)	0	0	0
Representation	0	18 (90)	7 (35)	1 (5)	13 (65)	1 (5)	0	0
Data quality	0	9 (45)	8 (40)	10 (50)	12 (60)	1 (5)	0	0

The results of this study related to differences in surveillance attributes on reporting measles-rubella in teachers and doctors, namely there is a significant difference between the control and treatment groups after the use of the application. These three things indicate that surveillance attributes are characteristics inherent in this study including simplicity, acceptance, stability, flexibility, representativeness, timeliness, and quality of data used can be used as parameters of feasibility in continuing the development of measles-rubella surveillance information systems that are more stable, extensive and sustainable (22,23). This is in line with research conducted by Wahyuningsih 2021 (24) in developing a website-based Certainty Factor method in detecting measles-rubella disease. In its development, the research focuses on the application and implementation of an expert system to diagnose measles-rubella disease in

children that can be accessed online using a website, where the results of this study will be a reference for the feasibility of using an expert system application in diagnosing website-based measles-rubella disease (25). Other research that is in line with the results of this study was conducted by Afdal 2020 who made an android-based expert system using the Forward Chaining method with user acceptance test testing, the results showed a user application acceptance rate of 91% (26). Riska's research, 2020 is also in line with this, which conducts an evaluation assessment on a web-based infectious disease risk factor surveillance system with data sources for infectious disease integrated coaching post activities, the results are considered simple, acceptable, have high sensitivity and stability and are timely to facilitate the implementation of non-communicable disease surveillance (21).

Table IV. Differences between groups on report frequency and surveillance attributes.

Parameters	Group		Changes	P
	Intervention (19)	Control (38)		
Reporting frequency				
Pretest	n/a	n/a	-	-
Posttest	8.42±7.61	1.63±4.03	6.78	0.000
Surveillance attributes				
Pretest	7.73±3.73	7.89±2.81	-0.16	0.870
Posttest	11±3.62	7.31±3.49	3.69	0.000

n/a, not applicable.

In collecting information on disease incidence and risk factors, various methods can be used, but in determining the appropriate data collection method, it is important to consider the objectives and data desired, the mechanism must be mutually supportive and balanced in its implementation, and there must be a good commitment among the people involved, both field actors, data analyzers and policy-makers who use surveillance data (23,27,28). However, the problems encountered in the implementation of these two systems are the low commitment of teachers and private pediatricians to actively participate, limited facilities and infrastructure, limited system operational budgets, the double burden of duties and responsibilities of teachers and private pediatricians, and health workers who still do not understand the definition of measles suspect cases, resulting in unresponsive responses and follow-up to reports (29). Early detection of measles-rubella using digital health technology through mobile phones can be used as an alternative method to support the improvement of the effectiveness of community, family, and individual health services as a social networking (30).

Based on the comparison of the use of manual systems and application systems in measles reporting in this study, it shows that the Android and website-based SICARE application has been tested to contribute to improving early detection, case report data and is effective in the prevention and control of measles-rubella in kindergartens, elementary schools/boarding schools and private health service facilities in the Tanjung Selor Health Center working area. So that along with the development of technology and information, the development of this application needs to be utilized through broader planning and implementation sustainably and comprehensively and balanced with capacity building and commitment to cooperation and guidance across sectors/programs involved in the measles-rubella surveillance system to further optimize the performance of the surveillance system to provide accurate, fast and precise data information and follow-up.

Limitation

This research was only conducted for one month, therefore it is a recommendation for further research to evaluate the implementation of this application.

Conclusions

The results showed that there were differences in the frequency of reporting days before and after the use of the SICARE application between the treatment and control groups, there were differences in surveillance attributes after treatment between the treatment and control groups, and there were differences in the effectiveness of surveillance attributes on officers before and after using the SICARE application. The Tanjung Selor Health Center is expected to further develop the application that has been built through optimal planning in improving early detection and rapid response in the measles-rubella surveillance system actively and widely throughout the community both across sectors/across programs to the community.

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Authors' contribution

ACP: conceptualized, designed, and prepared the initial draft and framework, interpreted the data, data curated, formal analysis, methodology, supervision, writing original draft, review & editing.

IL: designed and prepared the initial draft and framework and interpreted the data, writing-the original draft.

RA: conceptualized, designed, data collection and prepared the initial draft and framework, and interpreted the data.

WA: conceptualized, designed, and prepared the initial draft and framework and interpreted the data, data curated formal analysis, and methodology.

SU: conceptualized, designed, data curated, and prepared the initial draft and framework and interpreted the data.

SY: data collection, prepared the initial draft, interpreted the data.

Conflict of interest

The author declares that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

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