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Effect of the Self-monitoring of Calendar Documentation on the Transmission Control and Treatment Outcomes

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ABSTRACT

Tuberculosis can cause a substantial challenge to public health, especially in developing countries. The objective of this research is to determine the effect of intervention of SM-CD on the control of TB transmission in one treatment period (6 months) of TB. This Research using the quasi-experimental post-test only with control group design. The analytical unit consisted of 96 TB cases from two primary health centers as the SM-CD and 87 TB cases as the control group from two different primary health centers. The results of analysis after adjustment found that behavior of controlled taking medicine (ARR= 1.44; 95%CI: 1.22-1.70), controlled environment (ARR= 3.59; 95% CI: 2.18-5.90), and controlled droplet nuclei (ARR=4.04; 95%CI: 2.53-6.45) were found to be significantly higher in the SM-CD than the control group. The treatment outcome showed that recovery (ARR=1.95; 95%CI: 1.44-2.65), completeness (ARR= 1.65; 95%CI: 1.32-1.85), undrop out (ARR=1.25; 95%CI: 1.13-1.38), and cases no failed (ARR=1.43; 95%CI:1.24-1.65) was found to be significantly higher in the SM-CD was compared with the control group. The SM-CD intervention was effective in increasing the behavior of TB transmission control, treatment outcomes, and effective as a data collection tool that can be used to improve the surveillance system for TB transmission control.

Keywords: Tuberculosis, Self-monitoring, Calendar documentation, Tuberculosis transmission, Treatment outcome

ABSTRAK

Tuberkulosis (TB) merupakan tantangan besar terhadap kesehatan masyarakat, terutama di negara-negara berkembang yang memiliki tingkat kondisi sosial-ekonomi rendah dan lemahnya pengendalian penularan dan infeksi TB. Tujuan penelitian ini adalah untuk mengetahui pengaruh intervensi self-monitoring dokumentasi kalender (SM-DK) terhadap pengendalian penularan tuberculosis dalam satu masa pengobatan (6 bulan). Metode yang digunakan dalam penelitian ini adalah quasi-experimental post-test only with control group design. Unit analisis terdiri dari 96 kasus tuberkulosis dari dua puskesmas sebagai kelompok intervensi SM-DK dan 87 kasus TB sebagai kelompok kontrol dari dua puskesmas berbeda. Analisis dilakukan dengan menggunakan Uji RR (Risk ratio) Mantel Haenszel. Hasil analisis multivariat setelah penyesuaian menemukan perilaku minum obat terkontrol (ARR [Adjusted Risk Ratio]= 1,44; 95%CI: 1,22-1,70), lingkungan terkontrol (ARR= 3,59; 95% CI: 2,18-5,90), dan pernapasan terkontrol (ARR=4,04; 95%CI: 2,53-6,45) ditemukan secara signifikan lebih tinggi pada kelompok SM-DK dibandingkan kelompok kontrol. Kesembuhan (ARR=1,95; 95%CI: 1,44-2,65), kelengkapan (ARR= 1,65; 95%CI: 1,32-1,85), tidak drop out (ARR=1,25; 95%CI: 1,13-1,38) , dan tidak gagal kasus (ARR=1,43; 95%CI:1,24-1,65) ditemukan jauh lebih tinggi pada kelompok SM-DK dibandingkan dengan kelompok kontrol. Intervensi SM-DK efektif meningkatkan perilaku pengendalian penularan TB, outcome pengobatan, dan sebagai alat pengumpul data yang dapat digunakan untuk meningkatkan sistem surveilans perilaku pengendalian penularan TB.

Kata Kunci: Tuberculosis, Self-monitoring, Dokumentasi Kalender, Penularan Tuberkulosis, Outcome Pengobatan

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INTRODUCTION

In Indonesia, tuberculosis (TB) is still a latent infectious disease problem. According to WHO the number of TB in 2019 was 845,000 (95%CI: 770-923) cases with an incidence of 312 cases per 100,000 (95%CI: 285-341) population (WHO, 2020). Riskesdas 2019 shows the number of TB is 735,123 cases with a prevalence of 245 per 100,000 population (Kemenkes RI, 2019). According to TB-Indonesia 2019, the number of TB in Indonesia is 842,000 cases with a case notification rate (CNR) of 68 % (TB Indonesia, 2020). The number of notified TB cases in the same year was 163 cases per 100,000 population with a success rate of 85 % (WHO, 2020; Kemenkes RI, 2019).

In Simalungun Regency, the increase in the number of TB cases from 2016-2020 an average of 45 cases per year and an average CNR of 4.6 cases per 100,000 population shows that there has been TB transmission in the population (Dinkes Simalungun, 2019). The increase in new TB cases in the population is caused the chain of person-to-person transmission is not well controlled. Control of transmission in the mechanism of TB transmission can be carried out, especially in patients with active TB and MDR TB (WHO, 2020). TB transmission can occur due to poor treatment control, environment, and droplet nuclei in patients (Mathema, 2017).

Control of TB transmission is the control of risk behavior towards treatment, environment, and droplet nuclei so as to allow Mycobacterium tuberculosis not to spread to susceptible populations (WHO, 2020). Treatment, environment, and droplet nuclei control are functions of exposure probability in reproductive modeling. In an intervention program of health promotion, treatment, environment, and droplet nuclei control are behavioral outputs in the context of tuberculosis prevention. These three behavioral outputs are the basis for forming the concept of TB transmission control (Mathema, 2017).

Control of TB transmission is the output of program intervention of health promotion that are influenced by self-efficacy. Sirur found self-efficacy as a mediator of the concept of behavioral change on the desired compliance behavior (Sirur, 2016). The results of the study found a significant relationship between self-efficacy and controlled treatment (Nafradi, 2017;Purba, 2022). In self-management theory, self-monitoring affects self-efficacy and self-evaluation (Sawin, 2016). Self-monitoring is the emergence of a new behavior as a result of social or environmental demands and how individuals respond to these behaviors (Whong, 2018). Self-monitoring is the concept of a self-observation, self-recording and self-evaluation process which is a precursor to behavior change that aims to create expensive control over the identified behavior (Sawin, 2016; Whong , 2018; Hartmann, 2019).

Wang and Turk found the effect of intervention of self-monitoring using calendar documentation (SM-CD) which showed that there were significant differences in increasing physical activity, adherence and weight loss (Wang, 2012; Turk, 2013). Jorgensen in their research found that there was no significant difference in self-monitoring in mobile phone-based patient psychotherapy compared to clinical notes-based psychotherapy (calendar documentation) and found data collection through calendar documentation as a prominent aspect (Jorgensen, 2021). Todd and Mullan in their study found the effect of self-monitoring based on calendar documentation on sleep avoidance activities, avoiding anxiety and activities that trigger stress before going to bed (Todd, 2014). Maris and Mullan found a significant effect of self-monitoring based on calendar documentation on sleep time and sleep comfort (Mairs, 2015). However, no study has reported the effect of self-monitoring-calendar documentation to TB transmission control and treatment outcome. The purpose of this paper is to found the effect of intervention of SM-CD on the control of TB transmission in one treatment period (6 months) of TB.

Until now, as far as of the researcher's knowledge, no research has been found on the control of TB transmission with intervention of SM-CD. If one group of TB patients is got a set up an intervention of SM-CD with the availability of context that is in accordance with the intervention process and compared to the non-intervention group (without SM-CD), it can be seen how much SM-CD affects the control of TB transmission and outcome of treatment.

RESEARCH METHOD

Design study

This study is a test of the effectiveness of TB transmission control through an intervention of the SM-CD in cases of active tuberculosis using a quasi-experimental post-test only design with a control group. The intervention group performed a calendar documentation checklist every day and reported at the end of each follow up treatment (one time a month). The control group was not provided with calendar documentation and followed the TB card recording system in the Directly Observed Treatment Shortcourse (DOTS) program. Figure 1 presents a flow chart and details on the inclusion of patients who can be assigned as participants in this study.

Tuberculosis patient recruitment

Tuberculosis patients were recruited from two Public Health Community (PHC) (Tiga Runggu and Seribu Dolok) for the intervention group (100 participants; 99 units of analysis) and two PHC (Pematang Silima Kuta and Dolok Pardamean) for the control group (100 participants; 79 units of analysis) (Figure 1). The four PHC provided DOTS service with the criteria of management and the same resource qualification. The recruitment of patients was carried out when the patient

were diagnosed with new tuberculosis, both pulmonary tuberculosis bacteriological (PTB+) and clinical (PTB-) from the result of the confirmation of PHC laboratory, clinic, or hospital. The confirmed tuberculosis patients were screened based on the inclusion criteria: Pulmonary tuberculosis, new tuberculosis cases, age > 20 years, patient monitored by cadre, DOTS program patients, fixed dosage combination (FDC), and having bedroom window(s). The exclusion criteria were MDR tuberculosis, HIV/AIDS tuberculosis, Diabetes Melitus tuberculosis**,** Gestational tuberculosis, and COVID-19 tuberculosis. The recruitment of participants based on consecutive technique for five months from March to August, 2023.

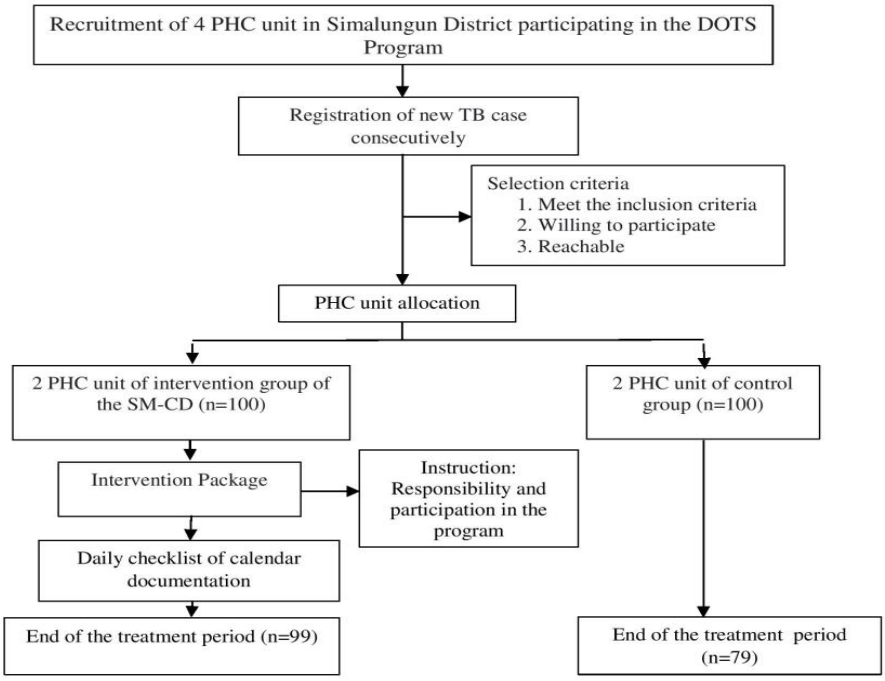

Figure 1. Sampling methodology

Training

The DOTS program officers in the two SM-CD intervention locations were trained to fill out calendar documentation in one meeting of one hour. The selected two PHC in the SM-CD intervention group found the average of 30 new tuberculosis cases per month, either they were diagnosed by the PHC laboratory or clinical doctors or they were referred by a hospital.

Intervention

All TB patients in intervention group of the SM-CD received the explanation on how to fill out calendar documentation by the PHC of TB program officer. The calendar documentation intervention for treatment control was carried out for 6 months (follow up 1-6 treatments) while intervention of the environmental and droplet nuclei control were carried out for 6 months (follow up 1-6 treatments). During the intervention a TB case received 6 time calendar documentation sheets and 6 ball points given at each follow-up treatment, a box of masks containing 50 sheet for follow-up 1-6, and one handkerchief for follow-up 1-6. Calendar documentation will be filled in by the patient at home (preferably at night before going to bed) by putting a check mark every time he takes medication, opening the bedroom window every morning, removing sputum in a closed container, using a mask, and covering his mouth with a handkerchief when coughing and sneezing every day.

The Calendar documentation is given to TB patients when they come to the PHC to take medication at the initial follow-up treatment and are returned when taking medication at the next follow-up. The PHC of TB program officer confirms every day to remind TB cases through the WhatsApp group to take medication and fill out calendar documentation. At the end of follow-up, data were compiled and confirmed by a patient compliance list questionnaire.

Bias control

Calendar documentation has fulfilled the validity content by consulting three pulmonary specialists and four senior staffs of DOTS program. External validity for treatment cards of DOTS tuberculosis program and pilot study for 20 patients of DOTS tuberculosis program with the very strong agreement value (Kappa = 0.7-1). Keeping balance between intervention group and control group was done by 1) distributing self-monitoring modules of tuberculosis transmission, masks, and handkerchiefs to the SM-CD group and the control group, 2) performing restriction with inclusion and

exclusion criteria, and 3) making adjustment in the data analysis. The validity of information was done by 1) instruction of participation and responsibility, instruction of filling out calendar documentation, reminding of WhatsApp group, and recalling information about 30 SM-DK intervention patients with very strong agreement values (Kappa=0.7-1).

Data collection

The calendar documentation has fulfilled the validity content of 3 medicine of the pulmonary specialists, external validity of the DOTS TB treatment card, and a pilot study of 20 TB patients with the DOTS program with a statistical value of Kappa = 0.87.

Data on the characteristics of TB patients were collected when the patient was registered and confirmed with a TB patient card at the PHC. The data of TB transmission of control group were collected through a questionnaire of adherence list that confirmed from calendar documentation (intervention group) and interviews (control group). The patient compliance list consists of 1 question of medication control, 2 question of environmental and droplet nuclei control that consist of 2 answer categories: 1 (controlled), 2 (uncontrolled). The response of questionnaire of environmental and droplet nuclei control were included in the variables of environmental and droplet nuclei control with the response criteria that if both answers were controlled then they were given category 1 (controlled) and if one of the answers to questions was not controlled or both were given category 2 (uncontrolled).

Statistical analysis

Data was entered, checked, cleaned and analyzed using STATA. Analysis of proportions, risk ratio (RR) and MH-Chi-square test were performed to compare the differences between of the intervention and the control group with 95% confidence intervals. Data analysis to determine the effect of self-monitoring on the control of tuberculosis transmission and confounding factors was carried out by multivariate stratification analysis and decision of statistically significant if the p-value <0.05.

RESULTS AND DISCUSSION

As shown in table 1, the number of participants included in the analysis was 183 patients (response rate = 91.5%). Drop out as many as 17 participants consisting of 4 intervention groups and 13 from the control group. The average age of the TB patient was 43.3 years with a standard deviation of 15.1 years and the most aged 40-49 years was 24.0%. Most of the TB patient were 56.3% male, 86.3% marital status and 82% education ≤ 9 years of schooling. In terms of association with TB transmission, most of the participants had no history of BCG immunization of 80.9%, TB status of patients was 60.1% BTA+, and household contacts of 3-5 people were 71.2%. Work and family income of TB patient, mostly with low physical activity category 69.9% and family income < 3 million rupiah per month 71.6%.

Table 1
Characteristics of TB Patients Between SM-CD and Control Groups

Characteristics	Total	SM-CD	Control	*P*-value
	N=183 (%)	n= 96 (%)	n= 87 (%)	
	Overal	Care as usual (control)	SM-DK (intervention)	p-value
Sample characteristic				
N (PHC unit)	4	2	2	
N (provider)	200	100	100	
Drop-out, n (%)	22 (11,0)	1 (0,5)	21 (10,5)	
Age, mean (SD)	45,1 (15,2)	44,69 (14,8)	45,68 (13,4)	0,64[a]
	N=178 (%)	n= 99 (%)	n= 79 (%)	
Age group (years)				
≤ 45	93 (52,2)	52 (52,5)	41 (51,9)	
> 45	85 (47,8)	47 (47,5)	38 (48,1)	1,00
Sex				
male	124 (69,7)	74 (74,7)	50 (63,3)	
female	54 (30,3)	25 (25,3)	29 (36,7)	0.13
Marital stats				
married	166 (93,3)	90 (90,9)	76 (96,2)	
no married	12 (6,7)	9 (9,1)	3 (3,8)	0.27
Education				
≤ 9 years of school	123 (69,1)	70 (70,7)	53 (67,1)	

> 9 years of school	55 (30,9)	29 (29,3)	26 (32,9)	0,72
History of immunization				
No BCG	129 (72,5)	76 (76,8)	53 (67,1)	
BCG	49 (27,5)	23 (23,2)	26 (32,9)	0.20
TB status				
BTA+	105 (59,0)	53 (53,5)	52 (65,8)	
BTA-	73 (41,0)	46 (46,5)	27 (34,2)	0,13
Household contac				
≤ 3	73 (41,0)	34 (34,3)	39 (49,4)	
> 3	105 (59,0)	65 (65,7)	40 (50,6)	0,06
Occupation				
low physical activity	103 (57,9)	56 (56,6)	47 (59,5)	
high physical activity	75 (42,1)	43 (43,4)	32 (40,5)	0.81
Household income, million rupiah				
≤ 3	127 (71,8)	63 (64,3)	64 (81,0)	
> 3	50 (28,2)	35 (35.7)	15 (19,0)	0.02

For all question categories, figure 2 shows that the control of tuberculosis transmission was higher in the SM-CD group compared to the control group at follow-up 1-3 treatment. At follow-up 1 treatment, the mean comparison of TB transmission control in the SM-CD intervention with the control group was 87.5% versus 65.6%, follow-up 2 treatments was 81,7% versus 49.8%. At follow-up 3 treatment the comparison of TB transmission control in the SM-CD intervention with the control group was 78.4% versus 34.1%. Figure 2 also showed that recovery of treatment between the SM-CD versus control on follow-up 1,2,3 was 97.8% versus 50.0%, completeness was 94.0% versus 60.0%, drop out was 1 % versus 21%, and filed was 4.0% versus 33.0%.

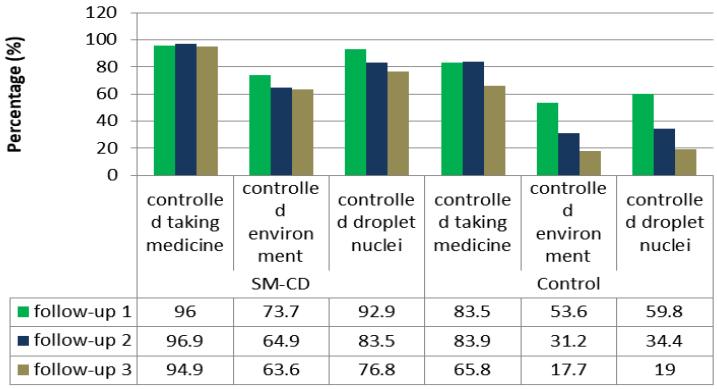

Figure 2
Characteristic of the TB Transmission Control and Outcome Treatment Between SM-CD and Control Groups

The results of multivariate analysis after adjustment found that behavior of controlled taking medicine (ARR= 1.44; 95% CI: 1.22-1.70), controlled environment (ARR= 3.59; 95% CI: 2.18-5.90), controlled droplet nuclei (ARR=4.04; 95% CI: 2.53-6.45) were found to be significantly higher in the SM-CD than the control group. The treatment outcome after adjustment showed that recovery (ARR=1.95; 95%CI: 1.44-2.65), completeness (ARR= 1.56; 95%CI: 1.32-1.85), undrop out (ARR=1.1.25; 95%CI: 1.13-1.38), and cases no failed (ARR=1.43; 95%CI:1.24-1.65) was found to be significantly higher in the SM-CD was compared with the control group.

Table 3
Results of Multivariate Stratification Analysis of SM-CD Against TB Transmission Control and Treatment Outcomes After Adjustment

TB transmission kontrol follow up 2 treatment	**SM-CD**	**Control**	**RR (95% CI)**	**ARR (95% CI)**
	n= 99 (%)	n=79 (%)		
Taking medicine control				
Controlled	94 (94.9)	52 (65.8)		
uncontrolled	5 (5.1)	27 (34.2)	1.15 (1.05-1.27)	1.44 (1.22-1.70)
Environment control				

controlled	63 (63.6)	14 (17.7)		
uncontrolled	36 (36.4)	65 (82.3)	2.08 (1.84-2.91)	3.59 (2.18-5.90)
Droplet nuclei control				
controlled	76 (76.8)	15 (19.0)		
uncontrolled	23 (23.3)	64 (81.0)	2.08 (1.84-2.91)	4.04 (2.53-6.45)
Treatment outcome				
Recovery	n= 46	n= 42		
cured	45 (97.8)	21 (50.0)		
uncured	1 (2.2)	21 (50.0)	1.33 (1.11-1.59)	1.95 (1.44-2.65)
Completeness	n=100	n=100		
completed	94 (94.0)	60 (60.0)		
uncompleted	6 (6.0)	40 (40.0)	1.23 (1.10-1.37)	1.56 (1.32-1.85)
Drop out				
undrop out	99 (99.0)	79 (79.0)		
drop out	1 (1.0)	21 (21.0)	1.10 (1.01-1.20)	1.25 (1.13-1.38)
Cases filed				
unfiled	96 (96.0)	67 (67.0)		
filed	4 (4.0)	33 (33.0)	1.23 (1.10-1.37)	1.43 (1.24-1.65)

DISCUSSION

As indicated from the results of the study, the control of TB transmission in behavior of controlled taking medicine was 94.9 % (follow-up 3), Indonesia 85.5% (Kemenkes RI, 2019). This result is in higher than with the TB compliance of medication in 2020 of 84.6 percent in Simalungun District (Dinkes Simalungun, 2019). Control of taking medicine requires consistency to achieve the desired treatment outcome (CDC, 2014). The results of this study show the consistency of the effect of SM-CD on control of taking medicine from follow-up 3 of treatment with the highest difference between the intervention of SM-CD and the control group 29.1% and the smallest difference occurred at follow-up 3 treatments of 12.5% (figure 2).

The influence of the SM-CD intervention on the control of taking medicine cannot be separated from the role of the calendar documentation intervention which is able to increase attention, adherence to action of taking medicine controlled, and increase the internal capacity of tuberculosis patients (Sargeant, 2008). This is in line with behavior change theory which states that SM probably work by change of habitual behavior into awareness behavior(Hartmann, 2019).

Furthermore, the highest difference in controlled environmental behavior reached 45.9% and droplet nucleus was 57.8% at follow-up 3 of treatments (figure 2). Environment and controlled droplet nuclei in this study were evaluated only at follow-up 1,3 and 2 because tuberculosis treatment interventions that had been carried out in the DOTS program in Indonesia did not involve environmental and droplet nuclei control (Cardoso, 2017). Further research on environmental and droplet nuclei control may have to be more focused in the future because until now comparative references to environmental and droplet nuclei control in the literature are still very rare found.

The effect of the SM-CD intervention on increasing of environmental control is independent after the confounding variables were removed. This increase is occurred because of process of SM-CD is a recording intervention as a conscious behavior that opening the bedroom window in the morning and removing sputum in a closed container can break the chain of tuberculosis transmission. The controlled behavior of the patient recording calendar documentation will be a reminder perform the same action and repeat in next day within the recommended treatment duration (Bornstein, 2019). However, whether the recording was done consciously or under pressure from the cadres or officers who collected the calendar documentation will be one of the research questions in the future. Although the recording probable occur, it does not have too many implications toward the use of calendar documentation as a data collection tool of the tuberculosis cases. This is due to the fact that the behavioral change model in the intervention of tuberculosis eradication have been conducted still tends to be coercive, even though the desired expectation is in the form of awareness.(Wang , 2012; Fritz, 2012)

The effect of SM-CD on increasing of droplet nuclei control in this study is consistent with the results of previous studies (Martin, 2005). The cause of the differences in the behavior of the controlled droplet nuclei is due to the identification, record, evaluation, and analysis processes in the SM-CD that affect the conscious behavior of tuberculosis cases (Wang, 2012; Seng, 2018; McGrievy, 2019). However, a little uniqueness toward the influence of SM-CD on droplet nuclei control in this discussion is the involvement of self-presentation which can affect the results of the SM-CD intervention on droplet nuclei control (Whong , 2018).

In addition to having an effect on the control of tuberculosis transmission, the SM-CD intervention has an effect on the outcome of tuberculosis treatment. Theoretically, control of tuberculosis transmission is an intervening variable on the outcome of tuberculosis treatment (Samuel B, 2016). However, this study proved that there was no effect of control of tuberculosis transmission, either taking medicine, environmental, and droplet nuclei control on treatment outcome. The absence of the influence of control of tuberculosis transmission on treatment outcomes may be due to the difference in controlled taking medicine between the SM-CD and the control group not too large. The effect of the small difference

between the SM-CD intervention on treatment outcomes between the intervention group and the control group proves that the effect of the DOTS program on treatment outcomes still dominates (Gebrezgabiher, 2016).

However, the effect of the SM intervention-calendar documentation on treatment outcomes has been enough to prove that calendar documentation is quite feasible to be used as a data collection instrument in future tuberculosis treatment programs. The results of this study have shown that SM-documentation has a double effect in the tuberculosis treatment program, namely contributing to the control of tuberculosis transmission and the outcome of tuberculosis treatment (CDC, 2014).

Almost all behavioral research in assessing the effectiveness of the tuberculosis program measures the effect of behavioral interventions on outputs as behavioral goals to be changed and treatment outcomes as an integral part of the tuberculosis program's goals (Sirur, 2016; Gebrezgabiher, 2016). If a given intervention program is able to change compliance as the intended behavior and is able to change the outcome of the treatment, the program is quite effective to implement (Sirur, 2016).

Research limitations

Data feedback (calendar documentation) was filled in by tuberculosis cases manually. This condition has the potential to cause bias if the patient is forced to fill out calendar documentation. To overcome the bias, Whatsapp (WA) groups were developed to remind patients to taking medicine, open room windows, dispose of sputum in closed containers, use masks and handkerchiefs. However, from the results of the study it was found that only 56.8 % of cases had Android. Research on the effectiveness of calendar documentation as a data collection tool for groups of Android users compared to non-Android users (manual) needs to be developed in the future. The results showed that calendar documentation was effective as a data collection tool for the surveillance model of behavior in control tuberculosis transmission based on google earth. Testing the effectiveness of SM-CD compared to self-monitoring of android applications or other electronic applications needs to be developed in the future.

CONCLUSION

The SM-CD intervention was effective in increasing the behavior of tuberculosis transmission, especially on the control of taking medicine, the environment, and droplet nuclei. In terms of treatment outcomes, the SM-CD intervention also contributed to increased cure, completeness, decreased dropout rates and treatment failure cases. Another important finding in this study is that SM-CD is effective as a data collection tool that can be used to improve the surveillance system for controlling behavior of tuberculosis transmission in health center.

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DECLARATION

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Conflict of Interest Disclaimer

The authors declare that there is no conflict of interest in publishing this article in Jurnal Aisyah

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