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The Impacts of Knowledge, Attitudes, and Actions on the Implementation of Biosecurity in the Management of Foot and Mouth Disease in Kuta Baro Subdistrict, Aceh Besar Regency

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ABSTRACT. *Foot and Mouth Disease (FMD) is an animal disease caused by a virus from the Picornaviridae family with the genus Aphthovirus. This study aimed to assess the extent of knowledge, attitudes, and actions of cattle farmers in Kuta Baro Subdistrict, Aceh Besar District, in implementing biosecurity on their farms to prevent FMD. The sample used was 45 cattle farmers in four villages in Kuta Baro Subdistrict, Aceh Besar District, namely Cut Preh, Cut Beut, Lam Seunong, and Ujong Blang. This study used a questionnaire instrument and the data were analyzed using binary logistic regression analysis. The statistics showed that the percentages of farmers with poor knowledge, attitude, and action were 71.1%, 66.7%, and 68.9%, respectively. Furthermore, the results of the analysis revealed that there was a significant relationship between the attitudes and actions of farmers towards the infection of FMD virus in livestock. Meanwhile, the farmer's knowledge did not have a significant role in handling FMD. The odds ratio showed that the odds of FMD cases decrease 0.593 times if there is an increase in farmers' attitudes towards biosecurity, and the odds of FMD cases decrease 0.666 times if there is an increase in farmers' actions towards biosecurity. The accuracy of this model reached 68.9%. Enhancements in farmers' knowledge, attitudes, and actions towards implementing biosecurity have the potential to reduce the incidence of Foot and Mouth Disease (FMD) in livestock.*

Keywords: Action, attitude, biosecurity, foot and mouth disease, odd.

INTRODUCTION

Livestock health management is closely related to efforts to prevent infection from infectious agents through biosecurity efforts, maintaining personal hygiene, livestock housing sanitation, good feed management, and increasing the immune system of livestock, as well as deworming and multivitamins (Nuraini et al., 2020). The causative agents of infectious diseases can be viruses, bacteria, parasites, and fungi (Sinaga et al., 2022). One infectious disease currently endemic to cattle in Aceh Province is the Foot and Mouth Disease (FMD). This disease is acute and highly contagious in cloven-hoofed animals (Yano et al., 2018). The causative agent of FMD is a virus of the Picornaviridae family with the genus Aphthovirus (Adjid, 2020).

FMD was first reported in Indonesia in 1887 in Malang, then spread to Sumatra, Java, Sulawesi, Kalimantan, Bali, and Nusa Tenggara. FMD eradication was carried out by continuous vaccination until Indonesia was declared free from FMD in 1986 (Soehadji & Setyaningsih, 1994). Indonesia's FMD-free status was confirmed by the World Organization for Animal Health (OIE), as stated in OIE resolution No. XI/1990. After over 32 years of FMD freedom, in early 2022, FMD re-entered and spread to various regions of Indonesia. The first case was reported by the Livestock and Animal

Health Service Office of East Java Province, where the infectious disease affected more than 1,000 cattle with typical symptoms of lesions on the mouth and hooves. The first reported case in Aceh Province was in Aceh Tamiang District. Through the Decree of the Minister of Agriculture No. 403/KPTS/PT.300/M/2022, the East Java region was designated, and No. 404/KPTS/PT.300/M/2022, the Aceh Tamiang district was designated as an outbreak area (Rahmi et al., 2022).

The first case finding in Aceh Tamiang District occurred on May 6, 2022. Two weeks after the first case was reported, seven other districts also reported FMD cases, one of which was Aceh Besar District. Based on data from the Aceh Livestock Service Office, as of October 2, 2022, Aceh Besar District had the highest FMD case in Aceh Province, with 12,253 sick animals, 12,197 recovered animals, and 33 dead animals. FMD also spread through 19 sub-districts out of 23 sub-districts in Aceh Besar district. Most cases occurred in three sub-districts, namely Montasik subdistrict (2,085 cases); Kuta Baro subdistrict (1,425 cases); and Indrapuri subdistrict (1,245 cases (Dinas Peternakan Aceh 2022).

One way to break the chain of FMD spread is by implementing biosecurity. According to Pinardi et al. (2019), biosecurity is an essential and strategic measure to prevent the entry or exit of a disease in a livestock area. The essential elements of biosecurity are isolation, sanitation, and regulation of livestock traffic. A factor influencing the increase in FMD incidence is the lack of awareness among farmers about the need to maintain the sanitation and cleanliness of livestock pens. Success in implementing biosecurity is based on the knowledge, attitudes, and actions of farmers. Human behavior is a form of all forms of experience and human interaction with the environment that results in knowledge, attitudes, and actions. An individual's response to a stimulus that comes from outside or from within can be active (taking action) or passive (no action) (Soemarti & Kundrat, 2022).

Kuta Baro sub district is one of the three sub districts with the highest number of FMD cases in Aceh Besar district. Therefore, research is necessary to provide an overview of the extent of farmers' knowledge, attitudes, and actions regarding the application of biosecurity in handling Foot and Mouth Disease (FMD) in Kuta Baro subdistrict, Aceh Besar Regency.

MATERIALS AND METHODS

This research was conducted directly by visiting livestock pens in Kuta Baro Subdistrict, Aceh Besar Regency, from February to March 2023. The population in this study was 157 cattle farmers spread across four villages from a total of 47 villages in Kuta Baro Sub-district, Aceh Besar Regency, namely Cot Preh Village, Cot Beut Village, Lamseunong Village, and Ujong Blang Village. The sample determination used the proportional method, and 45 cattle farmers were obtained. The sample calculation was obtained using the proportional sample formula as follows (Alam et al., 2015):

$$\frac{Number\ of\ breeders\ in\ one\ village}{Total\ number\ of\ farmers\ in\ four\ villages}\ x\ 100\%$$

This study used the cross-sectional method, where the survey was conducted only once at a particular time (Armandita et al., 2017). Data were collected using questionnaire sheets, and interviews were conducted directly with randomly selected cattle farmers. Data sources were: 1) Primary data, which is data obtained directly from respondents using questionnaire sheets, and 2) Secondary data, which is supporting data obtained from the local animal health center related to this study.

Research Variables

This study used two variables, namely the independent variable (X) and the dependent variable (Y). The independent variable (X) is seen as the cause of the dependent variable.

Meanwhile, the dependent variable (Y) is the effect variable predicted as a result of the independent variable. The variables observed in this study are described in Table 1.

Table 1. Variables in the study

Variable	Description	Measurement scale
X1	Farmer knowledge towards biosecurity	Continuous
X2	Farmer attitude towards biosecurity	Continuous
X3	Farmer action towards biosecurity	Continuous
Y	FMD case	Categorical (0: Negative, 1: Positive)

Operational Definitions

Operational definitions or limitations in this study are: 1) Farmers are cattle farmers in Kuta Baro Sub-district, Aceh Besar District (Cot Preh Village, Cot Beut Village, Lamseunong Village, and Ujong Blang Village). 2) Sick cattle are cattle infected with FMD. 3) Puskeswan is an animal health center located in Kuta Baro Sub-district, Aceh Besar District. 4) Biosecurity is management done to reduce the potential spread of disease.

Research Instruments

This study used a questionnaire instrument containing structured questions with closed-answer options using a Guttman scale. According to Pranatawijaya et al. (2019), the Guttman scale is used to determine the respondent's response to two alternative answers, for example, yes or no, good or bad, ever or never, and others. Based on the number of scores obtained by respondents, the results of the level of knowledge, attitudes, and actions are said to be "good" if the respondent scores more than half the maximum points. In contrast, respondents who score less than half the maximum points are declared "not good" (Tomia, 2020).

Research Procedure

Data on the number of cattle farmers in four villages in Kuta Baro Sub-district, Aceh Besar District, was collected from the Animal Health Center (Puskeswan). Then, the number of respondents or samples to be interviewed was calculated. Then, questions were compiled in the form of a questionnaire, followed by validity and reliability tests. The results of valid and reliable question instruments were used as a tool to measure the application of biosecurity in farmers handling FMD by conducting interviews with respondents.

Validity and Reliability Test of Questionnaire

The validity test is carried out to measure whether a questionnaire is valid or not. The measurement uses SPSS software. The questionnaire is valid if the r table value is smaller than the r count. Meanwhile, the reliability test measures the extent to which the instrument provides stable and consistent results (Amanda et al., 2019). The questions asked in the questionnaire are said to be reliable if Cronbach alpha exceeds 0.6.

Data Analysis

The data were analyzed using binary logistic regression analysis. This analysis method was used to see the relationship between the independent variable and the dependent variable, with the dependent variable being dichotomous, which means that it is in the form of two events, namely positive and negative FMD cases. The form of logistic regression, according to Hosmer and Lemeshow (2000), is as follows:

$$\pi = \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3}}{1+e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3}}$$

Where π is the probability that a livestock is positive of FMD.

RESULT AND DISCUSSION

Validity and Reliability Test of Questionnaire

Before being used to interview respondents, the questionnaire was first tested for validity and reliability. The results of the validity and reliability tests are shown in Table 2. A validity test is a test of the content of a questionnaire instrument used in research (Cahyani et al., 2016). Each questionnaire variable is said to be valid if it has an r value greater than 0.514. Reliability is related to the issue of trust. A high level of trust in a test can provide consistent results. If the Cronbach alpha value is >0.60, the questionnaire is declared reliable or consistent (Tahitu & Wattimena, 2023). All the variables were tested and declared to be valid and reliable.

Table 2. Test results of validity and reliability of variables

Variable	Validity test: r table (0.514) 5%	Reliability test: *Cronbach alpha* ≥ 0.6
Knowledge	≥ 0.596	0.905
Attitude	≥ 0.573	0.822
Action	≥ 0.575	0.866

Characteristics of Breeders

The demographic features of the 45 interviewed breeders are shown in Table 3. Most farmers are between 41 and 60 years old (62.2%). Based on education level, thirty-six farmers (80%) are senior high school graduates, and only two farmers graduated from college. Furthermore, only one breeder is female, while 44 breeders are male.

Table 3. Characteristics of breeders in Kuta Baro District, Aceh Besar Regency

Features	Category	Number of respondents	Percentage (%)
Age (years)	21-40	15	33.3
	41-60	28	62.2
	61-80	2	4.4
Gender	Male	44	97.8
	Female	1	2.2
Education	Elementary school	2	4.4
	Junior high school	5	11.1
	Senior high school	36	80.0
	University	2	4.4

Analysis of Farmer's Knowledge, Attitudes, and Actions

The results of Table 4 show the results of interviews using questionnaires on farmers' knowledge of biosecurity in handling Foot and Mouth Disease in Kuta Baro District, Aceh Besar Regency.

A total of 42 respondents (93.3%) were aware of FMD, while 41 respondents (91.1%) were knowledgeable about the symptoms of cattle infected with FMD virus. However, 33 respondents (73.3%) were not familiar with biosecurity practices. According to Pasi (2017), knowledge is everything that is known and related to what has been seen or information that has been heard throughout life. The results of an individual's knowledge will have a positive impact if the individual uses his knowledge well. Farmers' ignorance about how to implement cage biosecurity resulted in as many as 28 farmers (62.2%) of their livestock having been infected with the FMD virus.

Table 4. Analysis of farmers' level of knowledge about biosecurity in Kuta Baro District, Aceh Besar Regency

No.	Questionnaire	Respondents' answers			
		Yes	%	No	%
1.	Have you ever heard of FMD?	42.0	93.3	3.0	6.7
2.	Do you know the symptoms of cows infected with FMD?	41.0	91.1	4.0	8.9
3.	Has your livestock ever been infected with the FMD virus?	28.0	62.2	17.0	37.8
4.	Do you know about biosecurity?	12.0	26.7	33.0	73.3
5.	Do you know the biosecurity component, namely isolation?	2.0	4.4	43.0	95.6
6.	Do you know the biosecurity component, namely sanitation?	12.0	26.7	33.0	73.3
7.	Do you know the biosecurity component, namely traffic control?	0.0	0.0	45.0	100.0

After determining farmers' levels of knowledge of biosecurity, this study also examined the percentage differences in respondents' attitudes towards biosecurity, as shown in Table 5. As many as 32 respondents (71.1%) agreed that buying cattle included with a health certificate can reduce FMD virus transmission. In line with the report of Nuriski et al. (2020), One way to supervise livestock entering an area is in addition to providing checkpoint facilities at each district entrance; every new livestock must be accompanied by an animal health certificate.

Table 5. Analysis of farmers' attitudes in implementing biosecurity in Kuta Baro District, Aceh Besar Regency.

No.	Questionnaire	Respondents' answers			
		Yes	%	No	%
1.	Do you agree that buying cows accompanied by an animal health certificate can reduce the transmission of FMD virus?	32.0	71.1	13.0	28.9
2.	Do you agree that buying cows from FMD-free areas can reduce FMD virus transmission?	23.0	51.1	22.0	48.9
3.	Do you agree that not keeping other animals around the cowshed can reduce FMD virus transmission?	18.0	40.0	27.0	60.0
4.	Do you agree that having a hand and foot washing station in the cage area can reduce the transmission of FMD virus?	13.0	28.9	32.0	71.1
5.	Do you agree that having a fence around the enclosure and one entrance can reduce FMD virus transmission?	17.0	37.8	28.0	62.2
6.	Do you agree that cleaning feed storage regularly can reduce FMD virus transmission?	12.0	26.7	33.0	73.3
7.	Do you agree that accommodating waste in the form of feces in a particular place can reduce the transmission of the FMD virus?	21.0	46.7	24.0	53.3

Twenty-three respondents (51.1%) stated that purchasing livestock from areas declared free of Foot and Mouth Disease (FMD) can help reduce the risk of virus transmission. This statement should be distinguished from the previous one regarding animal health certificates. While health certificates confirm that an individual animal is clinically healthy at the time of inspection, they do not guarantee that the animal originated from an area free of FMD. Therefore, relying solely on health certificates without considering the geographic origin of the livestock may lead to a false sense of security. Animal sources from endemic or high-risk areas have been linked to disease transmission, with studies showing that animal movement contributes significantly to its spread (Iriarte et al., 2023; Mirzaie et al., 2023).

Twenty-seven respondents (60%) stated that keeping other animals around the cowshed could not reduce the transmission of the FMD virus. Thirty-two respondents (71.1%) stated that

having hand and foot washing stations in the cage area could not reduce FMD virus transmission. Twenty-eight respondents (62.2%) stated that having a fence around the enclosure and one entrance could not reduce FMD virus transmission. A total of 33 respondents (73.3%) stated that cleaning feed storage areas regularly could not reduce FMD virus transmission. As many as 24 respondents (53.3%) stated that accommodating waste in the form of feces in unique places could not reduce FMD virus transmission.

Several factors can influence a person's attitude, including the influence of others who are considered essential and personal experience (Azwar, 2007). Susanti et al. (2018) explained that the personal experience of farmers can be assessed from the length and experience in raising livestock; the longer a person's experience in raising livestock, the more attitude in raising livestock will form. However, in this study, although the age of farmers is primarily productive, with the last level of education in high school, they did not show a good attitude toward raising livestock, especially in implementing cage biosecurity.

Further analysis was conducted to see the relationship between farmers' demographic characteristics, especially age and education, and their attitudes towards biosecurity implementation. The results showed that farmers with higher levels of education (high school and university graduates) tended to have more positive attitudes than farmers with only primary or junior high school education.

Based on age, farmers aged 21-40 showed slightly better attitudes towards implementing biosecurity than older groups. This may be due to greater access to information and openness to change. These findings suggest the importance of special educational interventions for older and less educated farmers to improve overall biosecurity awareness and practices.

Table 6. Analysis of farmers' actions in implementing biosecurity in Kuta Baro District, Aceh Besar Regency.

No	Questionnaire	Respondents' answers			
		Yes	%	No	%
1.	Do you disinfect new livestock?	0.0	0.0	45.0	100
2.	Do you isolate livestock that have just entered the cage area?	3.0	6.7	42.0	93.3
3.	Do you clean the cage by spraying the cage floor thoroughly?	21.0	46.7	24.0	53.3
4.	Do you wash your hands before entering the cattle shed?	29.0	64.4	16.0	35.6
5.	Are sick fathers' cattle sold to the market?	0.0	0.0	45.0	100
6.	Are sick fathers/mothers' cattle slaughtered?	0.0	0.0	45.0	100
7.	Do you wear unique clothes when you enter the cage?	6.0	13.3	39.0	86.7
8.	Do you isolate sick and healthy livestock?	18.0	40.0	27.0	60.0
9.	Do you clean the floor of the cage regularly and thoroughly?	13.0	28.9	32.0	71.1
10.	Do you clean and disinfect feed and drinking places?	6.0	13.3	39.0	86.7
11.	Do you clean and disinfect cage equipment?	13.0	28.9	32.0	71.1

Table 6 shows the level of action farmers take in implementing biosecurity as an effort to prevent FMD in Kuta Baro District, Aceh Besar Regency. It can be seen that all breeders (100%) do not disinfect animals that have just entered the farm. A total of 42 respondents did not isolate new livestock, and 100% of respondents did not restrict guests from entering the cage area. A total of 24 respondents (53.3%) did not clean the floor of the cage thoroughly, no sick animals were sold to the market or slaughtered. Farmers do not wear unique clothes to the cage as much

as 86.7%. Do not isolate sick livestock as much as 60%. However, 64.4% of farmers wash their hands before and after entering the cage.

Logistic Regression Model

The analysis of logistic regression was conducted to find out the relationship among observed variables. The results of the analysis are presented in Table 7.

Table 7. Results of multivariable logistic regression of the FMD cases in Kuta Baro District, Aceh Besar Regency

Variable	Parameter β	p-value	Odds Ratio (CI 95%)	Significance
Constant	1.750	0.014	-	-
Knowledge	0.469	0.137	1.5991 (0.8397; 3.0453)	Insignificant
Attitude	-0.522	0.021	0.5934 (0.3719; 0.9471)	Significant
Action	-0.406	0.034	0.6663 (0.4454; 0.9966)	Significant

Based on the value of β parameter, the logistic regression model for all independent variables is obtained as follows.

$$P(Y=1) = \pi = \frac{e^{(1.75+0.469X1-0.522X2-0.406X3)}}{1+e^{(1.75+0.469X1-0.522X2-0.406X3)}}$$

The π (x) function above is non-linear, so after the transformation is carried out, the logit model below is obtained.

$$\text{Log } \frac{\pi}{(1-\pi)} = 1.75 + 0.469X_1 - 0.522X_2 - 0.406X_3$$ ……. *equation 1*

The interpretation of the model coefficients shows the following equation.

$$\frac{\pi}{(1-\pi)} = 5.754 + 1.598X1 + 0.593X2 + 0.666X3$$ ……. *equation 2*

Test Prediction and Calculation of Classification Accuracy

After the logit logistic regression model is obtained, prediction tests can be carried out to determine the relationship between farmers' biosecurity attitudes towards FMD cases. This is to find out whether farmers who apply good biosecurity attitudes can prevent their farms from FMD cases.

Case Illustration: Based on seven questions about knowledge of biosecurity (X1), farmers answered three questions correctly (score 3). Out of 7 questions regarding biosecurity attitudes (X2), farmers managed to answer three questions correctly (score 3). While out of 11 questions about biosecurity actions (X3), farmers answered two questions correctly (score 2). The scores are then entered into the logit model (equation 1) with the following calculations.

$$\text{Log } \frac{\pi}{(1-\pi)} = 1.75 + 0.469X_1 - 0.522X_2 - 0.406X_3$$

$$= 1.75 + 0.469(3) - 0.522(3) - 0.406(2) = 0.779$$

$$\text{Exp } (0.779) = 2.179$$

$$\pi = \frac{2.179}{3.179} = 0.685$$

Where π is the chance of a positive case, and 1-π is the chance of a negative case.

So, from the illustration of the case above, the interpretation is the chance of farmers being infected with positive FMD cases is 0.685, while the chances of farmers being negative for FMD cases are 1 - 0.685 = 0.315. This means that FMD cases in these farmers are suspected to be positive if the farmer's knowledge, attitude, and action in implementing biosecurity are not good.

Classification Accuracy calculations are also performed to find the ratio of the number of observations classified precisely by the classification function of the total number of observations. The accuracy of the classification of the model that was calculated is 68.9% (Table 8).

Table 8. Model classification accuracy

Observations		Predictions		(%)
		0	1	
Negative cases	0	8	9	47.1
Positive cases	1	5	23	82.1
Total				68.9

The Relationship Between Knowledge, Attitudes, and Actions of Farmers Towards The Increase in FMD Cases

Logistic regression analysis was conducted to see the relationship between the increase in FMD cases based on the application of biosecurity to the three variables tested, namely knowledge, attitudes, and actions. There were two significant variables, namely attitude and action. The results of multivariable analysis using logistic regression are presented in Table 7. The value of the β parameter obtained is used to create a logit model, which is then proceeded to the interpretation of the model coefficients (Equation 2). This equation can be used to analyze the odds value between farmers' biosecurity attitudes towards FMD cases. Odds Ratio results are often applied in medical research. It is a statistical measure that compares the chance of success of an event to the chance of failure of that event. If the Odds Ratio coefficient is positive (+), then the Odds Ratio value will be greater than one, which means the chance of an event occurring is greater than the chance of failure. On the other hand, if the coefficient is negative (-), then the Odds Ratio value will be smaller than one, which means the chance of success is smaller than the chance of failure (Safitri et al., 2022).

The knowledge variable was declared insignificant because the *p-value* > 0.05, which is 0.137 with *an Odds Ratio* (OR) value of 1.59 against the increase in FMD cases. If farmers have better knowledge about biosecurity, this will result in positive attitudes towards biosecurity measures and better practices (Chowdhury et al., 2023). However, farmers' perceptions of biosecurity can evolve and change and may not be consistent over time. This can cause the knowledge factor not always to have an impact on attitudes and actions.

The results of the logistic regression equation of attitudes towards the increase in FMD cases showed significant results, namely with a *p-value* of <0.05. The attitude variable shows a *p-value* of 0.021 with odds of 0.593. This shows that the odds of FMD cases decrease 0.593 times if there is an increase in farmers' attitudes towards biosecurity. The high incidence of FMD in farmers who have a bad attitude may be caused by a lack of awareness from breeders about maintaining sanitation and cleanliness of cages. Toha et al. (2022) state that better attitudes are in line with improved practices, and changes in good attitudes will lead to good actions as well.

According to Pakpahan (2017), there are three domains of human behavior, namely knowledge, attitudes, and actions. This means that someone who knows must take it into action. In this context, the knowledge a person possesses can influence his attitude towards something, and that attitude can then encourage appropriate action. Based on the results of logistic regression testing, the action variable against the increase in FMD cases also showed significant results with a p-value of <0.05, which is 0.034, and an odds value of 0.666. This means that the odds of FMD cases decrease by 0.666 times if there is an increase in farmer actions on biosecurity. The high incidence of FMD in farmers who take bad actions may be due to the lack of biosecurity implementation, especially in terms of disinfection and isolation of livestock. Disease infections would be straightforward to enter and transmit in livestock areas if the application of biosecurity is not good (Bulu et al., 2013). Youssef et al. (2021) added

that biosecurity interventions can also help reduce transmission of disease from livestock to humans.

Given the low level of knowledge on biosecurity among farmers, it is recommended that extension services and relevant authorities provide targeted training and practical demonstrations to improve farmers' understanding and implementation of biosecurity measures, including proper disinfection practices and livestock isolation. This can effectively transform knowledge into attitudes and actions that can reduce the risk of FMD transmission.

CONCLUSION

Based on the results of the study, it can be concluded that the level of knowledge, attitudes, and actions of farmers towards the implementation of biosecurity in four villages in Kuta Baro District, Aceh Besar Regency, is not good. As many as 71.1% of farmers have been classified as having bad knowledge of biosecurity, 66.7% of farmers have a bad attitude towards biosecurity, and 68.9% of farmers are classified as having bad actions in implementing biosecurity. The logistic regression model for all variables is log π (x) = 5.754 + 1.598X1 + 0.593X2 + 0.666X3. Meanwhile, the *odds ratio* shows that the odds of FMD cases decrease 0.593 times if there is an increase in farmers' attitudes towards biosecurity, and the odds of FMD cases decrease 0.666 times if there is an increase in farmers' actions towards biosecurity. Improving farmers' knowledge, attitudes, and actions towards implementing biosecurity have the potential to reduce the incidence of Foot and Mouth Disease (FMD) in livestock.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare. All authors have seen and agree with the contents of the manuscript.

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