Expected impact of vaccination and active case finding as the key to tackling with the COVID-19 pandemic in areas with the high density of migrants in Thailand

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Introduction

Since late 2019, the Coronavirus Disease 2019 (COVID-19) has become the ongoing crisis and has overwhelmed health systems around the globe. The first wave of COVID-19 in Thailand was caused by local infections with local transmission in boxing stadiums, entertainment venues, and other crowded public spaces. Also, imported cases from other countries were pronounced. In December 2020, Thailand was affected by the second wave of COVID-19 and the impact was likely to be more severe than the earlier wave. The aim of this study was to estimate whether and to what extent the vaccination policy and active case finding (ACF) could mitigate the outbreak in Samut Sakhon in a timely manner.

Methods

This study used a secondary analysis of quantitative data. Most of the data were obtained from the Department of Disease Control (DDC), Ministry of Public Health (MOPH) of Thailand. Deterministic system dynamics and compartmental models were exercised. At the beginning, a basic reproductive number (R0) was estimated at 3, and vaccine efficacy against disease transmission was estimated at 50%. A total of 10,000 people were estimated as an initial population size. A further review was performed to identify key parameters to serve as inputs for the model. Opinions from the DDC experts were also inputs for model development especially for some missing interested parameters unavailable from the review literature. A compartmental susceptible-exposed-infected recovered (SEIR) model was applied to assess the impact of ACF and vaccination measures. The model relied on five key assumptions including: (i) the ACF did not operate all the time but functioned in a biweekly fashion; (ii) there was in and out-migration to and from the province; (iii) it is presumed that mass vaccination for a target population could be performed within a day; (iv) a contact between a case and each susceptible person took place at random; and (v) all infected persons were treated at health facilities. Nine policy scenarios were described in Table 1.

Table 1 Policy scenarios of the impact of vaccination and ACF coverage

Scenario	Vaccination Coverage (%)	Active Case Finding Coverage (%)
no-VAC & no-ACF	None	None
no-VAC & ACF50	None	50
no-VAC & ACF90	None	90
VAC50 & no-ACF	50	None
VAC50 & ACF50	50	50
VAC50 & ACF90	50	90
VAC90 & no-ACF	90	None
VAC90 & ACF50	90	50
VAC90 & ACF90	90	90

Abbreviations: no-VAC, no vaccination; no-ACF, no active case finding; ACF50, active case finding with 50% coverage; ACF90 = active case finding with 50% coverage; VAC50, vaccination with 50% coverage; VAC90, vaccination with 90% coverage.

Results

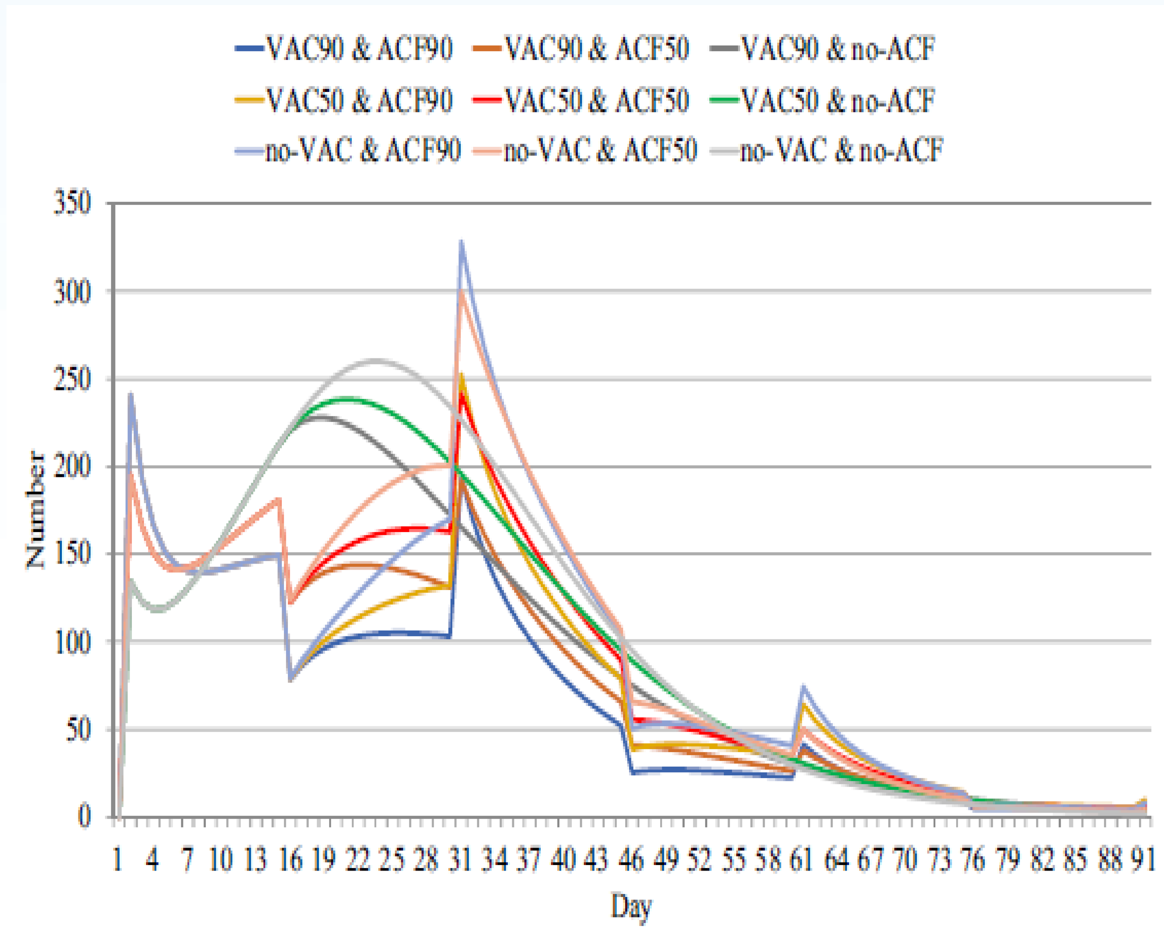

Figure 1 Daily incident cases by policy scenarios

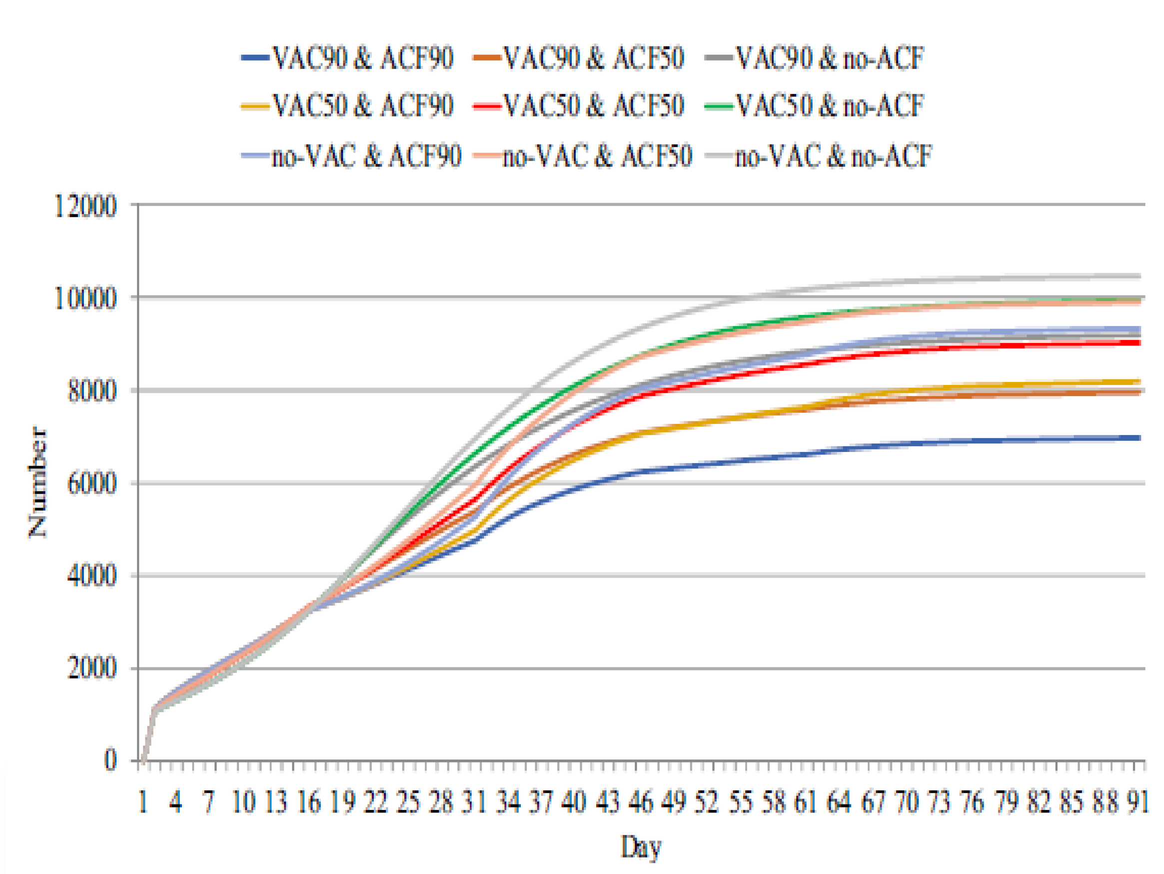

Figure 2 Cumulative cases by policy scenarios

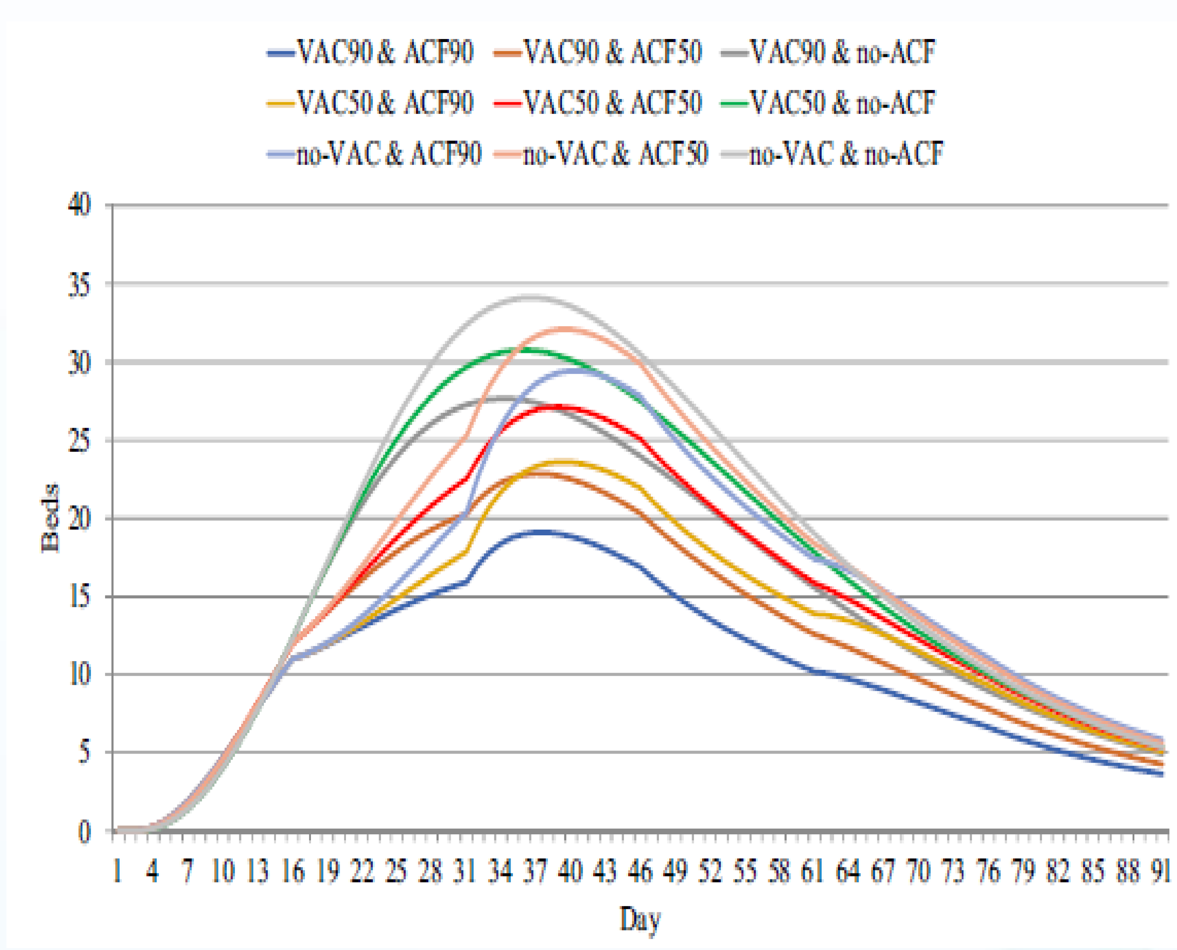

Figure 3 Prevalence cases needing intensive care beds

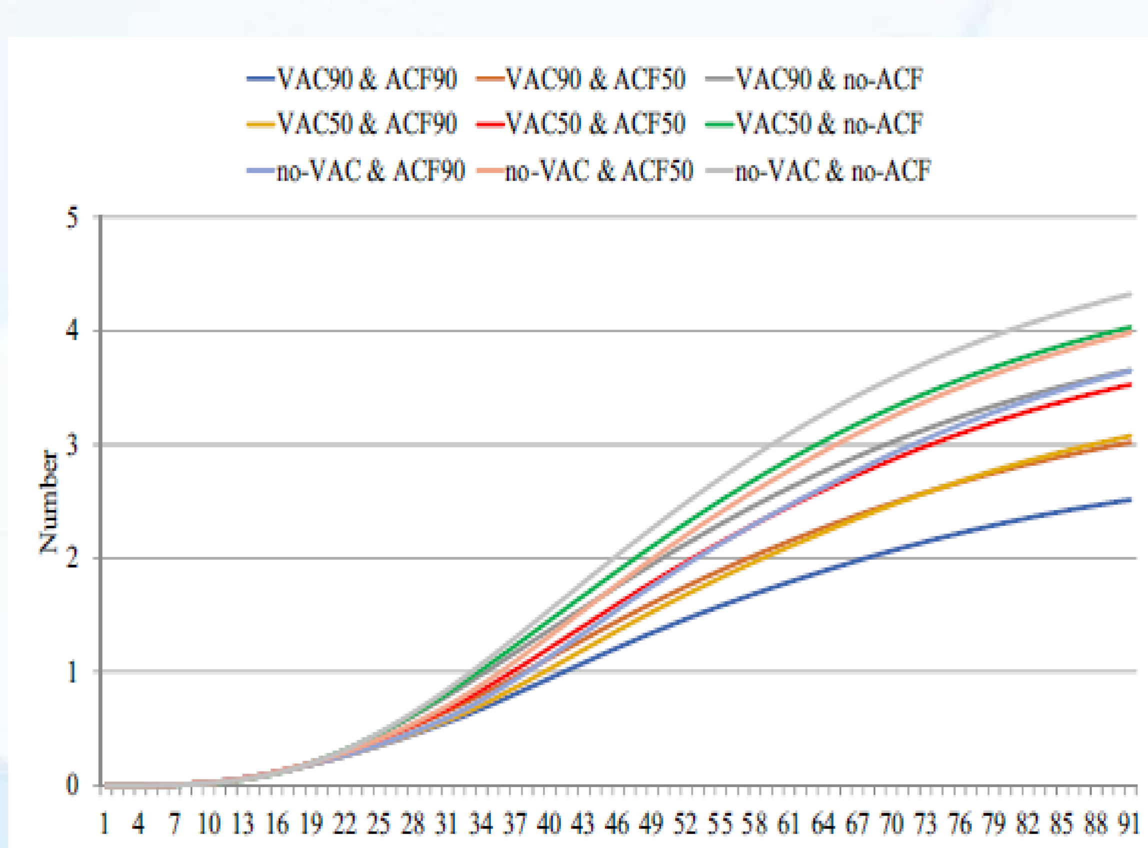

Figure 4 Cumulative deaths by policy scenarios

Table 2 Reduction of Cumulative Cases by Day 90 Between Each Policy and "No-VAC & No-ACF" Policy

Policy scenarios	Volume			Percent Reduction		
	Ro = 1.5	Ro = 2	Ro = 3	Ro = 1.5	Ro = 2	Ro = 3
no-VAC & no-ACF	9132	7337	10,457	Reference	Reference	Reference
no-VAC & ACF50	7755	5579	9895	-15%	-24%	-5%
no-VAC & ACF90	6616	4525	9330	-28%	-38%	-11%
VAC50 & no-ACF	7993	6022	9935	-13%	-18%	-5%
VAC50 & ACF50	6363	4556	9024	-30%	-38%	-14%
VAC50 & ACF90	5290	3812	8188	-42%	-48%	-22%
VAC90 & no-ACF	6793	5084	9187	-26%	-31%	-12%
VAC90 & ACF50	5318	3980	7960	-42%	-46%	-24%
VAC90 & ACF90	4473	3446	6971	-51%	-53%	-33%

Discussion

The findings showed that the greater the vaccination coverage, the smaller the size of incident and cumulative cases. When comparing the scenarios without vaccination and ACF, the greatest impact was found when applying 90%-vaccination coverage combined with 90%-ACF coverage. As a result, it contributed to a reduction of cumulative cases by 33%. The case reduction benefit would be greater when R0 was smaller (~53% and ~51% when R0 equated 2 and 1.5, respectively). The results supported the idea that ACF is key to suppress the epidemic. However, interpreting the findings should be made with caution as different models almost always rely on different assumptions, structures and parameters. Moreover, the model applied a deterministic approach as it is more convenient to communicate with policy makers rather than using a stochastic approach. This is because most parameters in the model lacked information on the distribution characteristics, which is a prerequisite for stochastic analysis.

Conclusion

A combination vaccination and ACF measures provides better results in decreased number of COVID-19 cases and deaths. The greater the vaccination and ACF coverage, the greater the volume of cases saved. Over a three-month period of operation, a provision on vaccination and ACF with 90% coverage contributed to a reduction in the case toll by 33% compared with the scenario where no measures were implemented. Policy makers should consider the readiness of health resources and the issue of social acceptability of COVID-19 vaccination in targeted areas. Further studies aiming to explore the policy feasibility and prioritization of COVID-19 vaccination will be of great value. More research on empirical studies is required with the studies using the secondary data analysis.