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Strengthening Community Readiness for a Possible Avian Influenza Resurgence

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Abstract

Avian influenza (AI) continues to pose a significant zoonotic threat in communities where close contact between humans and poultry is common. In 2024–2025, several areas, including Semarang City, Klaten, Temanggung, and Purworejo, reported simultaneous poultry deaths that were subsequently confirmed as AI through laboratory testing. This study aimed to develop and evaluate a community-based educational model to enhance readiness for a potential AI resurgence in Semarang City. A research and development (R&D) approach was employed using the ADDIE framework, encompassing needs analysis, model development, expert validation, pilot testing, and refinement. A mixed methods approach assessed knowledge, attitudes, practices, self-efficacy, and health commitment, complemented by qualitative feedback from community cadres and local leaders. Independent t-tests compared pre- and post-intervention results between intervention and control groups. The intervention included a validated educational module, cadre capacity strengthening, and community-based surveillance components. The intervention group demonstrated statistically significant improvements across all assessed variables ($p = 0.000$), whereas the control group exhibited no significant changes ($p > 0.05$). The community-based educational model, known as KONMABUR (Komunitas Masyarakat Anti Flu Burung), proved effective in enhancing community preparedness for AI and shows potential for broader application in the prevention of other zoonotic diseases.

Introduction

Emerging infectious diseases (EIDs) continue to threaten global health security due to their ability to cause widespread outbreaks, high mortality, and substantial economic disruption. This burden is especially profound in developing countries, where limited resources and weaker health systems reduce the capacity for rapid detection and effective response (Ministry of Health, 2023). Over the last two decades, several novel viral pathogens, including SARS, MERS, Ebola, and most recently COVID-19, have triggered major global health emergencies, underscoring the growing importance of strengthening preparedness and preventive measures (Djalante *et al.*, 2020).

Avian influenza (AI), caused by Influenza A subtypes (HxNy), represents one of the most persistent zoonotic threats. The virus primarily infects poultry but can spill over to humans through direct or indirect contact with infected birds. Although sustained human-to-human transmission remains uncommon, continuous viral mutation contributes to diverse clinical outcomes ranging from mild symptoms to severe and fatal disease, sustaining the possibility of future pandemic events (WHO, 2025). Indonesia is among the countries most

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heavily affected by AI, having reported 200 laboratory-confirmed human infections and 168 deaths (case fatality rate 84%) between 2005 and 2023, alongside recurrent outbreaks in poultry populations. This high burden highlights the urgent need for strengthened community-level preparedness and effective prevention strategies (Ministry of Health, 2023).

An effective community-based surveillance system for avian influenza requires careful attention to the multiple challenges that influence early detection and response. Consistent with the One Health framework, such systems depend on coordinated collaboration across medical, veterinary, and public health sectors. Robust information exchange among these sectors is essential to support early warning mechanisms and strengthen preparedness for identifying and controlling avian influenza outbreaks. The One Health approach emphasizes not only multisectoral collaboration but also meaningful engagement of local communities. Community participation has been shown to improve compliance with preventive measures and enhance collective resilience during infectious disease emergencies. Evidence from previous health crises, including the Ebola outbreak, COVID-19 pandemic, and health emergency conditions, demonstrates that communities play a decisive role when interventions are implemented through two-way, community-informed engagement rather than top-down directives (Franklin, 2023; Duan *et al.*, 2023). Other studies also developed health-related research to enhance the village's readiness and prevention (Raharja J, 2020; Raharja & Akhmad, 2020; Sulistiani *et al.*, 2021; Siyam *et al.*, 2024), quality of the community (Idris, Misnaniarti & Safriantini, 2020; Nugraha & Aprillia, 2020; Nugraha, 2020).

Despite ongoing national efforts to control avian influenza, community-level preparedness remains limited, particularly in settings where daily human–poultry interaction increases the risk of zoonotic spillover. Previous interventions have largely emphasized top-down approaches, often lacking community engagement, contextual adaptation, and sustained behavioral change. Moreover, few models have integrated educational strategies with community-based surveillance and cadre empowerment, even though such approaches are essential for early detection and rapid response at the grassroots level. Strengthening these community mechanisms is aligned with the One Health perspective, which emphasizes coordinated action across human, animal, and environmental health sectors to address zoonotic threats more effectively. Given these gaps, the development of a structured, community-based educational intervention is crucial to enhance readiness for potential avian influenza resurgence. Such a model can improve knowledge, attitudes, practices, self-efficacy, and health commitment, key components of effective prevention, while fostering collective vigilance and resilience within at-risk communities.

Methods

This study employed a research and development (R&D) design to develop and evaluate a community-based educational model for avian influenza (AI) prevention. The study was conducted in Kelurahan Jatirejo (intervention group) and Kelurahan Cepogo (control group), Kecamatan Gunungpati, Semarang City, Indonesia. The target population included community members, household poultry farmers, and local health cadres. Participants were selected using a multi-stage sampling technique: purposive sampling for location selection and simple random sampling for individual recruitment. Inclusion criteria were adults engaged in poultry farming, willing to participate in training sessions, and capable of providing informed consent. Exclusion criteria included individuals with physical disabilities or unwilling to participate. This study has been approved by the Health Research Ethics Committee, Faculty of Medicine, Semarang State University (Certificate No. 1035/KEPK/FK/KLE/2025). Sample size calculation followed the formula for comparing two proportions, assuming a baseline proportion of correct preventive practices of 30% and an expected increase to 60% post-intervention. With α = 0.05 and power = 80%, each group required 39 participants, rounded to 45 to account for potential dropouts. The total sample size was 90 participants (45 intervention, 45 control).

The ADDIE model (Analysis, Design, Development, Implementation, Evaluation) guided the model development. This methodology has also been used in other studies (Sulistiani *et al.*, 2021). This consists of 3 stages. Stage 1: Analysis involved a systematic literature review (SLR), quantitative survey, and qualitative interviews/FGDs to identify community knowledge, attitudes, practices, self-efficacy, and health commitment regarding AI. Stage 2: Design and development included drafting a community-based AI prevention model integrating SLR findings and field data. The model components encompassed: risk awareness and biosecurity education, self-efficacy enhancement, and health commitment reinforcement. The draft modules underwent expert validation by specialists in public health, veterinary medicine, and health communication. Revisions were made based on content relevance, clarity, and cultural suitability. A pilot test with a small group of community members and cadres assessed feasibility and comprehension. Stage 3: Implementation and evaluation. The intervention group received structured community education using the validated KONMABUR module, including practical demonstrations and simulations. The control group received standard health information. Pre- and post-intervention data were collected using structured questionnaires. Quantitative instruments measured five domains: knowledge, attitude, practice, self-efficacy, and health commitment. All scales demonstrated acceptable reliability (Cronbach's $\alpha \geq 0.70$). Qualitative data were obtained through semi-structured interviews and direct observations.

Descriptive statistics summarized participant characteristics and baseline measures. Normality was tested using the Shapiro-Wilk test; homogeneity was evaluated via the Brown-Forsythe test. Between-group differences were analyzed using independent t-tests for parametric data and the Wilcoxon signed-rank test for non-parametric data. Correlations between independent and dependent variables were assessed using Spearman's rank correlation. Statistical significance was set at $p < 0.05$.

Results and Discussion

A systematic literature review identified 672 articles across three databases (Plos One: 99, Google Scholar: 554, Springer Link: 19). After applying inclusion and exclusion criteria (English-language original research, August 2020-July 2025), 4 studies were selected for analysis. These studies highlighted risk factors contributing to avian influenza (AI) transmission: inadequate knowledge, poor attitudes and practices, insufficient risk communication, non-standard biosecurity measures, low awareness, lack of training, and limited access to personal protective equipment (PPE). The most frequently reported risk factors were knowledge, attitude, and practice deficiencies, alongside non-standard biosecurity implementation. These findings underscore the importance of targeting community-level knowledge, behavior, and biosecurity practices in AI prevention. Aligning with previous studies, improving awareness and skills in backyard poultry management can mitigate viral transmission risks.

The respondent profile shows a predominantly female, working-age population with moderate education levels and varied occupations, largely concentrated in informal work (Table 1). Small-scale poultry ownership is common in the community. These characteristics suggest that prevention programs should be tailored to adult households with diverse employment backgrounds and frequent contact with poultry. Before the intervention, there were no significant differences between the intervention and control groups for all variables ($p > 0.05$) (Table 2). After the educational program, the intervention group showed marked increases in knowledge, attitude, practice, self-efficacy, and health commitment, while the control group showed little to no improvement. All post-test comparisons yielded significant results ($p = 0.000$), indicating that the intervention effectively improved all measured outcomes.

In-depth interviews with 5 purposively selected stakeholders and poultry owners revealed insights into factors influencing AI prevention. Poultry management practices included: proper cage placement, separation of sick poultry, and regular cleaning were

TABLE 1. Respondents' Characteristics (N = 90)

Characteristics	Respondents (n=90)	%	Characteristics	Respondents (n=90)	%
Gender			**Income**		
Male	33	36.7	Below min wage	29	32.2
Female	57	63.3	Above min wage	61	67.8
Age			**Number of poultry kept**		
Adolescent	8	8.9	None	15	16.7
Young Adult	39	43.3	<50 bird	74	82.2
Adult	43	47.8	50-100 bird	1	1.1
Education			**Occupation**		
Did not complete primary school	2	2.2	Civil servant / Military / Police	12	13.3
Primary school	12	13.3	Private employee	15	16.7
Junior high school	30	33.3	Self-employed	29	32.2
Senior high school	30	33.3	Laborer	9	10
Higher education	16	17.8	Unemployed / Housewife	23	25.6
			Poultry farmer	2	2.2

Primary Data (2025).

TABLE 2. Bivariate Analysis of Factors Associated with Avian Influenza Prevention Before and After Intervention

Variable	Mean Rank				*p* value	
	Intervention		Control			
	Before	After	Before	After	Before	After
Knowledge	46.43	67.91	44.57	23.09	0.729	0.000
Attitude	46.37	62.23	15.63	28.77	0.961	0.000
Practice	48.92	61.22	42.08	29.78	0.212	0.000
Self-efficacy	46.81	63.86	44.19	27.14	0.629	0.000
Health commitment	48.19	64.27	42.81	26.73	0.325	0.000

Primary Data (2025).

common preventive practices. Self-efficacy included: informants expressed confidence in implementing hygiene and handling measures to prevent AI. Health commitment included: respondents demonstrated strong commitment to safe poultry handling, personal hygiene, and responsible sourcing of poultry. Qualitative data complements quantitative findings, highlighting that high self-efficacy and commitment facilitate the adoption of preventive behaviors. Community engagement and practical knowledge are crucial for successful AI control programs.

Pilot testing of the developed module "KONMABUR" demonstrated significant improvements in all outcomes (paired t-test, $p < 0.05$). Mean posttest scores increased substantially for knowledge (13.9 - 21.8), attitude (12.5 - 17.8), practice (18.2 - 23.6), self-efficacy (12.6 - 14.8), and health commitment (15.6 - 18.4) (Table 3). Pilot testing confirmed the feasibility and effectiveness of the KONMABUR module as a community-based educational tool. Incorporating locally relevant examples, practical exercises, and stakeholder engagement likely enhanced learning outcomes.

The KONMABUR module was implemented in 45 intervention and 45

TABLE 3. Pilot Test Results

Variable	Pretest (Mean – SD)	Postest (Mean – SD)	p	Note
Knowledge	13.90 – 1.449	21.80 – 7.554	0.010	Significant
Attitude	12.50 – 1.841	17.80 – 5.308	0.010	Significant
Practice	18.20 – 2.530	23.60 – 3.273	0.011	Significant
Self-efficacy	12.60 – 1.713	14.80 – 2.348	0.032	Significant
Health commitment	15.60 – 1.430	18.40 – 2.119	0.007	Significant

Primary Data, 2025

TABLE 4. Paired Analysis of Pretest Posttest Changes in Knowledge, Attitudes, Practices, Self-Efficacy, and Health Commitment Within the Intervention and Control Group.

Variable	Rank	Mean Rank		Sum of Rank		p	
		Intervention	Control	Intervention	Control	Inter-vention	Control
Knowledge	Negative	0	3.5	0	7	0.000	0.414
	Positive	23.00	3.50	1035	14.0		
Attitude	Negative	0	8.0	0	7.0	0.000	0.796
	Positive	21.50	8.0	903	64.0		
Practice	Negative	0	4.0	0	12.0	0.000	0.190
	Positive	20.00	5.5	780	33.0		
Self-efficacy	Negative	0	2.5	0	2.5	0.000	0.317
	Positive	20.00	2.5	780	7.5		
Health commitment	Negative	0	0	0	0	0.000	0.157
	Positive	22.50	1.50	990	3.0		

control respondents. The results indicate that the intervention group experienced a significant improvement across all variables: knowledge, attitude, practice, self-efficacy, and health commitment. This is reflected in the substantially higher mean ranks in the positive category and the p-value of 0.000, confirming meaningful differences after the intervention. In contrast, the control group showed no statistically significant changes. All p-values were above 0.05 (knowledge p = 0.414; attitude p = 0.796; practice p = 0.190; self-efficacy p = 0.317; health commitment p = 0.157), indicating that improvements did not occur in the absence of the intervention (Table 4). Overall, these findings demonstrate that the community-based educational intervention effectively enhanced knowledge, attitudes, practices, self-efficacy, and health commitment compared to the control group.

Independent t-test results showed that the intervention group demonstrated significant improvements in mean scores of knowledge, attitude, practice, self-efficacy, and health commitment ($p < 0.05$; $p = 0.000$), whereas no significant changes were observed in the control group ($p > 0.05$) (Table 5). These findings indicate a meaningful difference between the intervention and control groups across all variables.

The study demonstrated a strong positive correlation among knowledge, attitudes, practices, self-efficacy, and health commitment in preventing avian influenza within the intervention group ($p < 0.001$). In contrast, no significant associations were found

Table 5. Independent Test of Knowledge, Attitude, Practice, Self-Efficacy, and Health Commitment in Pre and Post-Test between the Intervention and Control Groups.

Variable	Intervention			Control		
	Pretest		Posttest	Pretest		Posttest
Knowledge						
Mean	15.04		19.80	14.80		14.84
Std. Deviation	1.833		1.307	1.471		1.429
P value		0.000			0.885	
Attitude						
Mean	10.89		14.04	10.93		10.91
Std. Deviation	2.156		1.758	2.093		1.987
P value		0.000			0.959	
Practice						
Mean	17.42		20.82	16.53		16.67
Std. Deviation	3.381		2.807	2.982		2.812
P value		0.000			0.828	
Self-efficacy						
Mean	13.11		16.18	12.89		12.93
Std. Deviation	1.945		1.336	2.091		1.970
P value		0.000			0.918	
Health commitment						
Mean	15.89		19.80	2.433		1.424
Std. Deviation	2.433		1.424	2.618		2.551
P value		0.000			0.935	

Primary Data (2025)

in the control group ($p > 0.05$). These results are consistent with Alsulami *et al.* (2025), who reported that nurses possessing greater infection control knowledge and positive attitudes toward protocols exhibited higher adherence, an effect further supported by self-efficacy, which reinforces comprehension of procedures and strengthens the perceived importance of protocols, ultimately enhancing compliance and commitment (Alsulami *et al.*, 2025). Similarly, Wang *et al.* (2023) found that individuals with higher knowledge, favorable attitudes, and strong self-efficacy demonstrated improved health behaviors, including oral hygiene practices, among Chinese university students (Wang *et al.*, 2023). Additionally, Elhadi *et al.* (2021) highlighted that knowledge and attitudes significantly influenced preventive behaviors against COVID-19, including vaccine acceptance and adherence (Elhadi *et al.*, 2021).

Knowledge can be understood as an individual's understanding or belief that is both true and properly justified, meeting epistemological criteria so that it may be regarded as something genuinely known (Ling, 2025). In this study, the intervention group demonstrated a significant increase in knowledge after the educational intervention ($p < 0.001$). This supports the findings of Jiang *et al.* (2025), who showed that targeted health education significantly improves knowledge, fosters positive attitudes, and strengthens preventive practices. The overall mean scores for knowledge, attitude, and practice reached 32.97 ± 7.95, representing 51.5% of the maximum score, reflecting an optimal level. Knowledge directly influenced preventive practices (standardized coefficient = 0.183) and indirectly through attitude (0.056), while attitude directly influenced behavior =0.181 (Y. Jiang *et al.*, 2025).

The study also observed significant improvements in attitude ($p < 0.001$), practice ($p < 0.001$), self-efficacy ($p < 0.001$), and health commitment ($p < 0.001$) in the intervention group. These findings are consistent with Jiang *et al.* (2025), who emphasized the mediating role of attitude between knowledge and preventive behavior. Educational interventions that target knowledge can simultaneously influence attitudes and, consequently, preventive practices (Y. Jiang *et al.*, 2025). Stel & Banach (2023) similarly found that brief, risk-based educational messages effectively enhance preventive intentions and behaviors without inducing excessive fear (Stel & Banach, 2023). Continuous education has also been shown to improve compliance with preventive practices among veterinary professionals and increase vaccine acceptance in elderly populations (Habib & Alshehhi, 2021; M. Jiang *et al.*, 2022).

Self-efficacy was identified as a crucial predictor of protective behavior, as reported by Cui *et al.* (2017) and reinforced in this study, where post-intervention scores for self-efficacy in the intervention group increased significantly, with $p < 0.001$ (Cui *et al.*, 2017). Effective educational interventions enhance self-efficacy, which promotes the adoption of preventive behaviors, including biosecurity practices in poultry management (Liang *et al.*, 2024; Fahim *et al.*, 2025). Similarly, Mohebi *et al.* (2018) demonstrated that education-based interventions significantly improved attitudes, subjective norms, supportive factors, perceived self-efficacy, and health-promoting behaviors (Mohebi *et al.*, 2018). Health commitment also improved significantly after the intervention ($p < 0.001$), consistent with the Health Belief Model framework, which emphasizes the role of knowledge, perception, and compliance in adopting preventive practices (Nasiri *et al.*, 2022). Comparable outcomes were reported by Ghugey *et al.* (2022), where health education interventions significantly increased knowledge, risk perception, and adoption of preventive behaviors against zoonotic diseases (Ghugey *et al.*, 2022).

The implementation of the KONMABUR model, developed through this study, successfully enhanced knowledge, attitude, practice, self-efficacy, and health commitment in the community for avian influenza prevention. Positive changes in knowledge correlated with improved attitudes and practices, as well as stronger self-efficacy and health commitment. This suggests that targeted education can serve as an effective tool to enhance awareness and promote sustainable preventive behaviors within the community. Supporting evidence includes Gao *et al.* (2024), who reported positive correlations between self-efficacy, health literacy, and quality of life in patients with non-communicable diseases (Gao *et al.*, 2024). Taheri *et al.* (2025) demonstrated that educational interventions significantly enhanced knowledge, attitude, self-efficacy, and oral hygiene practices among students. Community-based educational programs were also shown to increase awareness, positive attitudes toward vaccination, and preventive behaviors (Taheri *et al.*, 2025; Nasiri *et al.*, 2022; Taheri *et al.*, 2025).

Conclusion

The KONMABUR model intervention led to significant improvements in knowledge, attitudes, practices, self-efficacy, and health commitment regarding avian influenza prevention ($p < 0.05$). Participants in the intervention group demonstrated substantial gains across all measured variables, whereas the control group showed no significant changes. These findings suggest that structured, theory-based educational interventions can effectively boost community awareness, foster positive attitudes, and encourage practical preventive behaviors. Using an educational module as a tool for learning and information delivery proved particularly effective in promoting safe poultry handling practices. Overall, the KONMABUR model represents a promising strategy for sustaining long-term community engagement in zoonotic disease prevention.

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