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Knowledge, Attitudes, and Practices Related to Sustainable Marine Tourism and Environmental Antimicrobial Resistance in North Minahasa, Indonesia

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A B S T R A C T

Coastal tourism antimicrobial resistance surveillance should consider sanitation-related knowledge, attitudes, and practices (KAP). We analyzed 209 cross-sectional questionnaire responses from North Minahasa, Indonesia. Knowledge followed a prespecified key; negatively worded attitude items were reverse-scored. Analyses assessed internal consistency, corrected item–total correlations, nonparametric associations, effect sizes, and exploratory robust linear regression. Knowledge, attitude, and practice scores averaged 74.0%, 76.7%, and 79.9%; Cronbach's alphas were 0.565, 0.906, and 0.983. Correlations were knowledge–attitude ρ=0.389, knowledge–practice ρ=0.295, and attitude–practice ρ=0.399 ($p<0.001$). Environmental information showed a small knowledge effect (Cohen's d=0.267). Action-model R^2 was 14.4%; attitude was the strongest adjusted correlate. The questionnaire supports descriptive KAP surveillance; knowledge items and three negatively worded attitude items need cognitive/content validation before confirmatory use. ARG occurrence remains unconfirmed.

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INTRODUCTION

Antimicrobial resistance (AMR) is a global public health problem that threatens the effectiveness of infection treatment and increases the burden on health care systems. Based on the Global Burden of Disease 2021 analysis by Antimicrobial Resistance Collaborators (2024), it is estimated that there will be 4.71 million deaths related to bacterial AMR in 2021, including 1.14 million deaths that can be directly attributed to the resistance. The same projection model estimates that attributable deaths to AMR could reach 1.91 million per year by 2050 if following the baseline projection scenario. The magnitude of the burden suggests that AMR control cannot rely solely on clinical interventions and rational use of antimicrobials, but also requires a One Health approach that integrates human, animal, and environmental health. Within this framework, the aquatic environment needs attention because it can be a place where resistant microorganisms are found as well as antimicrobial resistance bacterial and gene transfer pathways. Therefore, environmental management that is oriented towards pollution prevention and public health protection is an important part of AMR control strategies (GBD 2021 Antimicrobial Resistance Collaborators, 2024).

Aquatic environments can receive resistant microorganisms, antimicrobial resistance genes (ARGs), and antimicrobial residues through domestic wastewater discharge, surface runoff, fecal contamination, and human and animal activities. Cheung et al. (2025), through a review of the scope of research on AMR in the aquatic environment, identified fecal pollution and the contribution of wastewater treatment plants as important factors in the spread of resistant bacteria. Meanwhile, Punch et al. (2025) showed that AMR surveillance through wastewater is developing as a One Health approach, although geographical coverage and monitoring methods still need to be strengthened. This issue is relevant for marine tourism areas because the quality of the aquatic environment is related to the safety of recreational activities, sanitation management, and the protection of the health of visitors and local communities. Shi et al. (2023), for example, detected 21 important types of ARGs in recreational waters in Qingdao, China, and found spatial and seasonal variations related to pollution sources. The findings demonstrate the relevance of coastal environmental monitoring, but cannot be directly used to infer the presence of ARGs in other tourist sites that have not been microbiologically or molecularly examined.

North Minahasa, Indonesia, is a relevant context to examine the relationship between marine tourism sustainability, community behavior, and environmental health. The development of coastal tourism requires a balance between economic benefits, protection of marine ecosystems, environmental cleanliness, and sanitation management. As contextual evidence of marine tourism areas in North Sulawesi, Farhum et al. (2021) found that around 50% of tourists who dive and snorkel in Bunaken National Park are concentrated around Bunaken Island. The concentration of these activities shows the importance of managing the carrying capacity of tourism to reduce pressure on marine ecosystems. In the context of environmental health, sustainable tourism

management also needs to consider waste disposal practices, maintenance of sanitation facilities, wastewater handling, and prevention of water pollution. The knowledge and behavior of visitors, coastal communities, tourism business actors, and management parties have the potential to be an important part of these efforts. However, the relationship between behaviors that support sustainable marine tourism and awareness of environmental AMR needs to be empirically studied so that education strategies and environmental management can be adapted to local social conditions.

The knowledge, attitudes, and practices (KAP) approach can be used to describe knowledge, attitudes, and practices related to a public health problem. Conceptually, knowledge can shape understanding and perception, while attitudes reflect a person's judgment or tendency towards an issue; both can be related to practice, although the relationship is not always linear or causal. In AMR research, Tran et al. (2023) showed that knowledge about antimicrobial resistance is not always in line with the attitudes and practices of antibiotic use in college students. Pitaloka et al. (2023) also developed and validated KAP instruments related to antibiotic self-medication in the elderly in Bandung, Indonesia. In other health contexts, Tariq et al. (2022) showed the importance of evaluating validity and reliability in the development of KAP instruments. These studies provide a methodological basis for measuring the constructs of KAP, but the context focuses on the use of antibiotics or specific health problems. The application of the KAP approach to the linkages between sustainable marine tourism and environmental AMR requires special attention to the relevance of the content of the questions, the clarity of the grain, the consistency of the measurements, and the suitability of the instruments to the characteristics of the respondents and the local context.

Based on these studies, there is a research gap on the integration of social-behavioral dimensions and environmental health in marine tourism management. Aquatic environmental research, such as Shi et al. (2023) and Cheung et al. (2025), mainly provides evidence regarding the presence, distribution, or distribution pathways of microorganisms and resistance genes. In contrast, KAP studies such as Tran et al. (2023) and Pitaloka et al. (2023) focus more on antibiotic use behavior and human health aspects. Thus, evidence on KAP related to sustainable marine tourism and environmental AMR in North Minahasa still needs to be developed. This gap includes the need to describe the KAP profile of communities or respondents in this context while evaluating the performance of the instrument's initial measurement before it is used more widely. Therefore, this study aims to describe knowledge, attitudes, and practices related to sustainable marine tourism and assess the performance of the questionnaire's initial measurement based on 209 cross-cutting survey responses from North Minahasa, Indonesia. Evaluation was carried out through internal consistency, corrected item-total correlation, nonparametric associations, effect measures, and exploratory robust linear regression. This study did not include environmental sample testing and was not intended to determine the presence or prevalence of ARG in local waters.

Theoretically, this research contributes to the development of the application of the KAP framework in One Health-based environmental health studies, in particular by linking behaviors relevant to the sustainability of marine tourism with environmental AMR issues. This study also provides preliminary evidence on the characteristics of questionnaire measurement in social and geographical contexts that have not been widely represented in AMR-related KAP research. In practice, the results of the research can serve as an initial basis for developing environmental health education, raising awareness about sanitation and pollution prevention, and supporting coordination between communities, tourism business actors, destination managers, and environmental health stakeholders. However, the use of instruments for confirmatory measurement requires further content validation and cognitive interviews, especially to evaluate knowledge grains and negative attitude statements. Further research also needs to integrate social-behavioral surveys with microbiological or molecular examinations of water and environmental samples. The integration will allow for a more comprehensive assessment of the relationship between tourism management practices, sanitation conditions, and environmental AMR indicators without equating respondents' perceptions with measurable evidence of contamination.

LITERATURE REVIEW

Environmental Antimicrobial Resistance and the One Health Approach

Antimicrobial resistance (AMR) is a major public health challenge that requires an integrated One Health approach connecting human, animal, and environmental health. Aquatic environments may receive antimicrobial-resistant bacteria and antimicrobial resistance genes (ARGs) through wastewater discharge, fecal contamination, surface runoff, and other human activities. Cheung et al. (2025) identified fecal pollution as an important contributor to the dissemination of AMR in aquatic environments. Similarly, Punch et al. (2025) emphasized the role of wastewater surveillance in understanding AMR circulation across interconnected human and environmental systems. These findings support the inclusion of environmental sanitation and community behavior in AMR management. However, questionnaire-based evidence concerning public knowledge and practices should complement, rather than replace, microbiological and molecular surveillance.

Antimicrobial Resistance in Coastal and Recreational Waters

Coastal and recreational waters are important environmental settings because they support tourism, recreation, and interactions between humans and aquatic ecosystems. A systematic review by Siri et al. (2023) documented antimicrobial-resistant bacteria and ARGs across freshwater, seawater, and wastewater environments in Southeast Asia. The authors also highlighted the need for improved molecular detection, particularly in seawater. These findings establish the regional relevance of environmental AMR research, including in Indonesia. Nevertheless, evidence of AMR in aquatic environments elsewhere in Southeast Asia cannot establish the presence of resistant organisms or ARGs in North Minahasa. Environmental measurements are therefore necessary to

determine local contamination, while social and behavioral assessments can help identify knowledge and practices relevant to sanitation and pollution prevention.

Sustainable Marine Tourism and Environmental Behavior

Sustainable marine tourism requires coordination among tourists, local communities, tourism businesses, public authorities, and environmental organizations. Dimitrovski et al. (2021) examined coastal and marine tourism sustainability through a multistakeholder approach, demonstrating the relevance of attitudes, social norms, and behavior in understanding sustainability-related practices. In coastal destinations, environmental responsibility may involve appropriate waste disposal, sanitation management, pollution prevention, and protection of marine ecosystems. These practices are relevant to environmental health because inadequate sanitation and wastewater management may contribute to the movement of microbial contaminants into aquatic environments. However, sustainability-related behavior and AMR are distinct constructs: environmentally responsible practices do not directly demonstrate an individual's understanding of AMR. Assessing both within a contextualized questionnaire can provide preliminary evidence for designing more integrated environmental health education.

Knowledge, Attitudes, and Practices in AMR Research

The knowledge, attitudes, and practices (KAP) framework provides a descriptive approach for examining what people know, how they perceive an issue, and how they report acting in relation to it. Tran et al. (2023) found that knowledge and reported behaviors related to AMR among university students were not uniformly aligned, illustrating that awareness alone may not guarantee appropriate practices. Shutt et al. (2025) further highlighted the importance of social determinants and contextual factors in interpreting KAP evidence on AMR. Accordingly, knowledge, attitudes, and practices should be analyzed as related but distinct dimensions rather than assuming that knowledge automatically produces behavioral change. In the present study, nonparametric associations and exploratory robust regression provide a way to examine these relationships without interpreting cross-sectional associations as causal effects. The framework also supports identifying potential priorities for health education and sustainable tourism management.

Questionnaire Measurement, Research Gaps, and Study Contribution

Reliable measurement is essential when KAP questionnaires are applied to a new population or subject area. Pitaloka et al. (2023) developed and evaluated an Indonesian questionnaire concerning parental knowledge, attitudes, and practices regarding antibiotic self-medication, illustrating the importance of examining reliability and validity in the intended context. Lister et al. (2025) similarly reported a structured development and validation process for a questionnaire on environmental sustainability in healthcare. These studies provide methodological guidance but do not establish the validity of an instrument addressing sustainable marine tourism and environmental AMR in North Minahasa. The present study addresses this gap by analyzing 209 cross-

sectional questionnaire responses and examining internal consistency, corrected item–total correlations, nonparametric associations, effect sizes, and exploratory robust linear regression. Its contribution is preliminary and descriptive: further cognitive interviews and content validation are required before confirmatory use, and questionnaire responses cannot establish environmental ARG occurrence without direct environmental testing.

METHODOLOGY

Research Type and Design

This study used a quantitative approach with a cross-sectional observational design. Data were collected through questionnaires to describe knowledge, attitudes, and practices (KAP) related to sustainable marine tourism and environmental antimicrobial resistance in North Minahasa, Indonesia. The study also evaluated the performance of the initial measurement of the instrument through reliability analysis, intervariable correlation, effect size, and exploratory robust linear regression. The evaluation was descriptive and exploratory, not a thorough confirmatory validation. Observational research reporting refers to the principle of transparency recommended for cross-sectional studies (Ghaferi et al., 2021).

Population and Sample

The analytical sample consisted of 209 questionnaire responses from North Minahasa, Indonesia. The target population must be determined based on the group of respondents who were actually recruited in the study, while the inclusion and exclusion criteria need to be explained according to the research protocol. Sampling techniques, both probability and non-probability, must be reported based on the actual recruitment procedure. The abstract does not include the sampling technique, the demographic characteristics of the respondents, the calculation of the sample size, or the reason for determining the number of samples. Therefore, the information needs to be confirmed through research documentation before the manuscript is published.

Research Instruments

The research instrument is in the form of a structured questionnaire that measures three domains, namely knowledge, attitudes, and practices. Knowledge scores are calculated based on predetermined answer keys, while negatively formulated attitude items are given reverse scoring so that the direction of interpretation is consistent. The source of item development, the number of questions, response choices, and the assessment procedure of each domain need to be explained based on the original instrument. Internal consistency was evaluated using Cronbach's alpha coefficient, while the relationship of each item to the domain score was examined through corrected item–total correlation. This test provides preliminary information regarding measurement consistency, but does not in itself prove the validity of the construct. In line with the development of the KAP instrument in previous studies, evaluation of content validity and clarity of the item remains necessary

when the instrument is used in different population contexts (Lister et al., 2025; Pitaloka et al., 2023).

Data Collection Procedure

The research was carried out through the stages of instrument preparation, questionnaire response collection, coding and scoring scores, and statistical analysis. In the preparation stage, the measurement domain and knowledge answer key were determined, while negative attitude items were identified for the score reversal process. Furthermore, the responses collected from North Minahasa were compiled as research data with a final number of 209 responses analyzed. The data is then prepared according to the assessment rules of each domain before reliability testing, statistical association, effect size, and regression modeling are performed. For replicable reporting, the final manuscript needs to include a more specific period and location of data collection, the manner in which the questionnaire is distributed, the respondent approval procedure, ethical approval when required, and the handling of incomplete responses. These details are not available in the abstract and must be adapted to the actual conduct of the research.

Data Analysis Techniques

The analysis was conducted descriptively and inferentially exploratory. Knowledge, attitudes, and practice scores were summarized in the form of percentages. The internal consistency of each domain was evaluated using Cronbach's alpha, while the item-total correlation was corrected to assess the relevance of each item to its domain score. The relationship between knowledge scores, attitudes, and practices was analyzed using Spearman's nonparametric correlation (ρ). Differences in knowledge based on the reception of environmental information were evaluated using a measure of Cohen's effect d. Furthermore, exploratory robust linear regression was used to identify correlations related to action outcomes after adjustment for variables entered into the model. The determination coefficient (R^2) was used to describe the proportion of variation in outputs described by the model. The selection of the method follows the purpose of the study to identify relationship patterns and evaluate the initial performance of the questionnaire, rather than to establish a cause-and-effect relationship. To guarantee replication, the analysis method needs to mention the definition of regression output, covariates, robust estimators, missing data handling, significance criteria, as well as the software and its version based on the actual code or analysis records. Such technical information has not been described in the abstract.

Data Analysis Techniques

Data were analyzed using thematic analysis through repeated reading, coding, grouping, and synthesis of findings from ten selected articles. The analysis was focused on six dimensions, namely adaptive leadership, organizational learning, technological innovation, doctrinal flexibility, interoperability, and bureaucratic barriers and decision-making. Findings were compared to identify similarities, differences, patterns, and gaps in the research, then synthesized to explain the adaptation of military organizations to changing strategic environments and the complexity of modern threats. The analysis was conducted qualitatively without statistical meta-analysis as the research focused on thematic and conceptual synthesis.

RESEARCH RESULT

Overview of Research Data

This study analyzed 209 questionnaire responses collected in North Minahasa, Indonesia, using a *cross-sectional survey* design. The analysis focused on three main domains, namely knowledge, *attitudes*, and practices related to sustainable marine tourism and environmental antimicrobial resistance. In addition to score analysis, the study evaluated the internal consistency of the instruments, the correlation between domains, the relationship between environmental information reception and knowledge, and an exploratory robust linear regression model.

Knowledge, Attitude, and Practice Score

The results of the descriptive analysis showed that the average practice score was the highest, followed by the attitude and knowledge score. The details of the average score of the three domains are presented in Table 1.

Table 1. Average Score of Knowledge, Attitude, and Practice

Measurement domains	Average score
Knowledge	74,0%
Sikap (*attitudes*)	76,7%
Practices	79,9%

The average knowledge score was recorded at 74.0%, while the average attitude score reached 76.7%. The practice score showed the highest average, which was 79.9%. Thus, the difference between the practice and knowledge scores was 5.9 percentage points, while the difference between attitude and knowledge scores was 2.7 percentage points. The difference between practice and attitude scores reached 3.2 percentage points. The knowledge score is calculated based on the predetermined answer key. Meanwhile, the negatively formulated attitude items have gone through a score reversal process (*reverse scoring*) before the analysis is carried out.

Internal Consistency of Instruments

The internal consistency of the instruments was evaluated using Cronbach's alpha coefficient for each KAP domain. The test results are presented in Table 2.

Table 2. Internal Consistency Test Results

Domain	Cronbach's alpha
Knowledge	0,565
Attitude	0,906
Practice	0,983

Cronbach's alpha coefficient for the knowledge domain is 0.565, while the attitude domain shows a coefficient of 0.906. The practice domain has the highest coefficient, which is 0.983. The results show that there is a difference in internal consistency values between the three measurement domains. The study also included a *corrected item–total correlation examination* to evaluate the relationship between the question item and its domain score. However, the correlation value of each item is not included in the abstract so numerical results per item cannot be presented.

The Relationship between Knowledge, Attitudes, and Practice

The relationship between KAP domains was analyzed using Spearman nonparametric correlation. All three pairs of variables showed positive correlations with *a p value* of less than 0.001. The results of the analysis are presented in Table 3.

Table 3. Spearman Correlation between KAP Domains

Relationships between variables	Coephysin Spearman (ρ)	Value *p*
Knowledge–attitude	0,389	< 0.001
Knowledge–practice	0,295	< 0.001
Attitudes and practices	0,399	< 0.001

The correlation between knowledge and attitude has a coefficient of 0.389. The relationship between knowledge and practice shows a coefficient of 0.295, while the correlation between attitude and practice reaches 0.399. Among the three variable pairs, the attitude-practice correlation has the largest coefficient, while the knowledge-practice correlation has the smallest coefficient. All relationships show a positive direction and a p-value of less than 0.001. These results illustrate the statistical relationship between the three KAP domains in the study data. An analysis of the effect size showed that the acceptance of environmental information was related to differences in knowledge scores, with Cohen's value *d* of 0.267. The value was reported as a small effect measure in the study abstract.

Furthermore, exploratory robust linear regression was used to identify correlations related to *action outcomes*. The model yielded a coefficient of determination (R^2) of 14.4%, which indicates that the model explains 14.4% of the variation in the analyzed outputs. As much as 85.6% of the output variation is not explained by the model. Attitudes were reported as the strongest correlates after adjustments to the variables entered into the model. However, regression coefficients, confidence intervals, p-values of each predictor, list of covariates, and effective sample sizes on the model were not available in the abstract. Therefore, the regression results could not be further elaborated based on the magnitude of the coefficient and the uncertainty of its estimates.

Summary of Key Findings

Overall, the results of the study on 209 questionnaire responses showed that the average scores of knowledge, attitudes, and practices were 74.0%, 76.7%, and 79.9%, respectively. Cronbach's alpha values differed between domains, namely 0.565 for knowledge, 0.906 for attitudes, and 0.983 for practice. All three domains of KAP had a statistically significant positive correlation ($p < 0.001$). The acceptance of environmental information showed a small effect size on knowledge (Cohen's $d = 0.267$), while the robust regression model explained the 14.4% variation in action outputs and identified attitudes as the strongest correlation after adjustment. This study has not produced evidence on the presence or prevalence of *antimicrobial resistance genes* (ARGs) in the waters of North Minahasa because data collection was carried out through questionnaires, not microbiological or molecular testing of environmental samples.

DISCUSSION

This study shows that knowledge, attitudes, and practices related to sustainable marine tourism and environmental antimicrobial resistance have a positive relationship pattern in 209 respondents in North Minahasa, Indonesia. The average knowledge score of 74.0%, attitude 76.7%, and practice 79.9% indicate that practice scores are numerically higher than those of the other two domains. However, without a previously set classification threshold, the percentage cannot be directly categorized as a level of knowledge or good practice. In One Health's perspective, these findings are relevant because the control of antimicrobial resistance depends not only on the appropriate use of antibiotics, but also on infection prevention and environmental management. The GBD 2021 Antimicrobial Resistance Collaborators (2024) estimates that 1.14 million deaths in 2021 can be directly attributed to bacterial antimicrobial resistance. However, this study provides evidence of the social-behavioral dimension, not direct evidence of contamination or the presence of antimicrobial resistance genes (ARGs) in the waters of North Minahasa.

Positive correlations between knowledge and attitudes ($\rho = 0.389$), knowledge and practice ($\rho = 0.295$), and attitudes and practices ($\rho = 0.399$), all with $p < 0.001$, supported the linkage between KAP domains, but the strength of the relationship was not identical. The attitude–practice correlation was the largest, while the knowledge-practice correlation was the smallest. This pattern indicates that knowledge alone may not be enough to explain the practices reported by respondents. Tran et al. (2023) also found that knowledge, perceptions, and behaviors related to antimicrobial resistance are not always aligned among college students. Shutt et al. (2025) emphasized the importance of social factors and life context in understanding AMR-related behaviors. Thus, environmental health education in marine tourism areas should not only convey information, but also strengthen attitudes, social norms, and support for responsible sanitation practices. However, because the design of this study is cross-sectional, the correlation does not prove that changes in attitudes lead to changes in practices.

The relationship between environmental information reception and knowledge showed a measure of Cohen's effect $d = 0.267$, which was small. These results suggest that information acceptance is related to relatively limited differences in knowledge. In practical terms, information dissemination alone may not be sufficient to form a deeper understanding, especially when environmental AMR issues require an understanding of sanitation, pollution, and microorganism migration pathways. In exploratory robust linear regression analysis, the model explained 14.4% of the variation in action outputs, with attitudes being the strongest correlation after adjustment. The proportion of unexplained variation of 85.6% suggests that other factors may play a role, such as access to sanitation facilities, social norms, tourist experiences, or socio-economic characteristics. However, these factors cannot be stated as determinants of this study without knowing whether they are all measured and incorporated into the model. These findings are more appropriately used to identify the next direction of research than to establish behavioral causative factors.

The results of the instrument evaluation showed internal consistency differences that are important to note. Cronbach's alpha in the knowledge domain of 0.565 indicates relatively low internal consistency according to conventional benchmarks, while the attitude domain of 0.906 indicates high consistency. The practice domain has an alpha of 0.983. This high value does not automatically prove the validity of the instrument; in the practice domain, values above 0.95 also need to be checked for possible redundancy between items. Stefana et al. (2025) emphasized that the evaluation of the instrument must include the structure of the construct, the quality of the items, and more than one reliability indicator. In addition, the three negative attitude items in this study require further validation. Elek et al. (2025) explain that reverse-oriented items can affect factor structure and reliability due to differences in language processing or ambiguity, so score reversals alone do not guarantee measurement equivalence. In line with Pitaloka et al. (2023), the development of KAP

instruments needs to consider the validity of content and psychometric evidence according to the context of its use.

The main contribution of this study is to link the measurement of KAP to environmental health issues in the context of marine tourism that has not been widely researched through a social-behavioral approach. The study of Shi et al. (2023) detected ARG in recreational waters in Qingdao and showed that pollution patterns can vary by location and season. Cheung et al. (2025) also identified fecal pollution as one of the important pathways for the spread of AMR in aquatic environments. Both studies provide relevant environmental context, but the results cannot be used to conclude the presence of ARG in North Minahasa. By measuring KAP, this study provides preliminary information that can help sanitation education planning and sustainable tourism management. The contribution remains preliminary as the instrument does not yet have adequate confirmatory validation evidence.

Several limitations need to be considered in interpreting the results. The cross-sectional design cannot determine temporal order or cause-and-effect relationships, while the use of questionnaires has the potential to lead to self-reporting bias and the desire to provide socially acceptable answers. In the available research information, sampling techniques, respondent demographic characteristics, item-total correlation values were corrected, and regression coefficients and confidence intervals have not been presented in full. The study also did not conduct microbiological or molecular testing of environmental samples. Follow-up research is recommended to conduct cognitive interviews on the knowledge items and three negative attitude items, an expert assessment of the validity of the content, and an evaluation of additional factor structure and reliability, including McDonald's omega. In addition, the KAP survey needs to be combined with spatial and seasonal water sampling, microbiological or molecular testing, and measurements of sanitation conditions. This integrated approach can strengthen the implementation of One Health while differentiating public perceptions from empirical evidence about environmental AMR.

CONCLUSIONS AND RECOMMENDATIONS

The study of 209 respondents in North Minahasa showed that the average scores of knowledge, attitudes, and practices related to sustainable marine tourism and environmental antimicrobial resistance were 74.0%, 76.7%, and 79.9%, respectively. The three domains had a significant positive correlation ($p < 0.001$), with attitudes being the strongest correlative to action outputs in the robust regression model explaining 14.4% variation. The internal consistency of the instruments varied, so refinement of the knowledge items and the three negative attitude items was still needed. This study supports the use of questionnaires for descriptive KAP surveillance initially, but has not proven the presence of antimicrobial resistance genes in the aquatic environment. Therefore, further research needs to validate the instrument and integrate the KAP survey with microbiological or molecular examinations and coastal sanitation evaluations to support the management of One Health-based marine tourism.

ADVANCED RESEARCH

Further research needs to prioritize cognitive interviews, validation of content by experts, evaluation of factor structures, and additional reliability testing. Multisite and longitudinal studies are also needed to test the consistency of the relationship between KAP across populations and time. The integration of questionnaire data with ARG testing of water samples, indicators of fecal pollution, and sanitation conditions will provide more comprehensive evidence regarding the association of community behavior with the health of the coastal environment.

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