RMJ

Original Article

Factors Affecting Melioidosis Prevention Behaviors Among People in the Area of Health Zone 10, Ubon Ratchathani

Sitang Philom[1, 2], Kulchaya Loyha[2*], Supaporn Chaigarun[2]

[1] Infectious Disease Control Group, Provincial Public Health Office, Amnat Charoen, Thailand

[2] Public Health Program, Faculty of Public Health, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand

Abstract

Background: The number of melioidosis cases in Thailand rose from approximately 3500 in 2022 to more than 4000 in 2023, with provinces in Health Zone 10 experiencing the highest incidence.

Objective: To investigate the factors influencing the melioidosis prevention behaviors of the population in the Health Zone 10 area of Ubon Ratchathani province.

Methods: This cross-sectional analytic study included 352 adults (≥ 45 years) selected by multistage sampling. Data were collected using a validated questionnaire and analyzed using descriptive statistics and binary logistic regression.

Results: Most of the participants were female farmers (65.9%); 66.8% had nonrisk preventive behaviors, whereas 33.2% were in the risk group. Compared with the age group of 45-55 years, it was found that those aged ≥ 66 years had a significantly lower chance of having inappropriate disease prevention behaviors (adjusted odds ratio [AOR], 0.10; P = .003). Regarding educational level, it was found that the group with completed primary education had a significantly lower chance of having inappropriate disease prevention behaviors (AOR, 0.02; P < .001) than the group with less than primary education. The group with secondary education had a significantly lower chance (AOR, 0.02; P < .001). Regarding occupation, using agriculture (rice farming and gardening) as the reference group, the animal husbandry group was significantly more likely to engage in inappropriate disease prevention behaviors (AOR, 7.91; P = .027). Other occupations also had a significantly higher chance than the reference group (AOR, 13.67; P < .001). Regarding knowledge about melioidosis, those with high knowledge were significantly less likely to engage in inappropriate disease prevention behaviors (AOR, 0.10; P < .001) than those with low knowledge.

Conclusions: Factors associated with disease prevention behaviors included age, education level, occupation, knowledge about melioidosis, and certain health literacy.

Keywords: Factors, Behavior, Melioidosis, Health Zone 10

Citation: Philom S, Loyha K, Chaigarun S. Factors affecting melioidosis prevention behaviors among people in the area of Health Zone 10, Ubon Ratchathani. *Res Med J*. 2026;49(4):e275598. doi:10.33165/rmj.2026.e275598

***Corresponding Author:** loyha2523@gmail.com

Received: 23 May 2025
Revised: 25 November 2025
Accepted: 26 November 2025
Published Online: 26 January 2026

Copyright © 2026 by the Author(s). Licensee RMJ. This article is licensed under the Creative Commons Attribution (CC BY) License.

Introduction

Melioidosis is an endemic disease found in Southeast Asian countries and northern Australia. Outbreaks have also been reported in Hong Kong, Taiwan, India, New Zealand, Thailand, and other parts of the world.[1] Melioidosis, also known as “soil fever”, is a public health issue in several countries, especially in the northeastern region of Thailand, which has the highest incidence rate in the world. The disease is of great public health importance

because of its high mortality rate and complex diagnosis; it is also a notifiable communicable disease under Thailand's Communicable Disease Act B.E. 2558 (2015).[2] Melioidosis is caused by the gram-negative bacterium *Burkholderia pseudomallei*, which infects humans and animals in tropical climates. These bacteria are commonly found in the environment, including soil, mud, and water sources.[3] Infection usually occurs through direct contact with contaminated soil or water that enters the skin, ingestion, or inhalation. After exposure, there is no vaccine, and even with treatment, the mortality rate from the disease remains at 10%-50%.[4] Symptoms of the disease range from asymptomatic to severe, such as fever, chills, muscle pain, pneumonia, liver and spleen abscesses, or bloodstream infection that spreads to all organs, which can lead to death.[5] Those with comorbidities, those with weakened immune systems, and chronic alcoholics often experience severe symptoms, which are the cause of death. The high-risk groups are farmers or those who have had prolonged contact with soil and water.[6]

Over the past decade, there has been a noticeable increase in the incidence of melioidosis in Thailand. In 2022 and 2023, the incidence rate rose remarkably to 5.33 and 6.4 cases per 100 000 population, respectively. Although the average annual number of cases in the past ranged between 2000 and 3000, in 2022, approximately 3500 cases were reported, and in 2023, the number exceeded 4000. Two significant peaks were observed in January and between July and October 2023. In total, 4108 cases were recorded nationwide in 2023, with an incidence rate of 6.21 per 100 000 people and 101 deaths, corresponding to a case fatality rate of 2.45%.[7] Compared with 2021 and 2022, this represents a 1.86-fold increase in cases. Notably, the number of deaths reported in 2022 increased 22.29 times compared with that in 2021, from 6 deaths in 2021 to 157 in 2022. In 2023, the highest incidence rates were found in Health Zone 10, Health Zone 7, and Health Zone 8, at 27.98, 13.86, and 11.7 per 100 000 population, respectively. Within Health Zone 10, the highest rates were observed in Mukdahan (46.48), Ubon Ratchathani (25.94), Amnat Charoen (24.01), Yasothon (23.94), and Sisaket (21.32). Mukdahan also recorded the highest number of deaths at 27.[8]

Therefore, the researchers are therefore interested in studying the factors that influence preventive behaviors against melioidosis among the population in Health Zone 10, Ubon Ratchathani. This is because the majority of the population in Health Zone 10, Ubon Ratchathani, are engaged in occupations that require prolonged contact with soil and water, such as farmers, fishermen, and gardeners. Farmers working in environments with prolonged exposure to bacteria-contaminated soil, water, and dust are at high risk of contracting melioidosis. This study also examined the health literacy factors that influence the preventive behaviors against melioidosis among the population in Health Zone 10. This study revealed reveal the health literacy factors that affect melioidosis prevention behaviors, leading to changes in prevention methods to reduce the incidence of melioidosis and providing foundational data for projects addressing melioidosis-related issues.

Methods

Population and Sample

This study targeted the population aged 45 and above within Health Zone 10 (covering Ubon Ratchathani, Sisaket, Yasothon, Amnat Charoen, and Mukdahan provinces). Participants were selected from districts with the highest average melioidosis incidence rates over the past 3 years (2021-2023), including Wan Yai (Mukdahan), Na Tan (Ubon Ratchathani),

and Chanuman (Amnat Charoen). Sample size was calculated using the following equation: $n= (Np[1 - p] z^2_{1-\propto/2})/(d^2 [N - 1] + p[1 - p] z^2_{1-\propto/2})$,[9] where n is the sample size, N is the population size of 1 925 943 people,[10] $z^2_{1-\propto/2}$ is the standard value under the normal curve at a confidence level of 0.05, which is equal to 1.96, p is the prevalence proportion of melioidosis, obtained from a literature review of 0.29,[11] and d is the maximum acceptable error value, set to 0.05.

Based on a 95% confidence level and 80% power, the resulting sample size was 317 participants. To ensure normal data distribution and representativeness, a 5% dropout rate was added, bringing the total sample to 352. Sampling employed multistage sampling to the target population in each district, followed by simple random sampling based on the calculated sample size (78 from Wan Yai, 141 from Na Tan, and 132 from Chanuman).

This study received ethical approval from the Ubon Ratchathani Provincial Public Health Office (SSJ.UB 2568-01.005). All participants were fully informed of the study objectives and provided written informed consent before participation. They retained the right to withdraw without consequences. This study adhered to the ethical principles of respect for persons, beneficence, and justice. Potential risks and corresponding preventive measures were clearly communicated to the participants.

The inclusion criteria were as follows: ability to read, write, and communicate effectively; aged 45 or older; occupations with prolonged soil and water exposure, eg, farmers (rice cultivation, gardening, and fishing) and livestock raisers; presence of chronic diseases such as diabetes, hypertension, kidney disease, thalassemia, immunodeficiency, or chronic alcoholism; willingness to participate voluntarily; and cooperation and signed informed consent to join the study.

Research Instruments

Data were collected using a self-administered quantitative questionnaire assessing knowledge, attitudes, and preventive behaviors regarding melioidosis. The questionnaire was divided into 5 sections: personal characteristics, knowledge of melioidosis, attitudes toward melioidosis prevention, health literacy related to melioidosis, and preventive behaviors against melioidosis.

Variable Measurement

To ensure content validity, the questionnaire was reviewed by 5 experts, then revised according to their feedback. The item-objective congruence, was 0.93. Reliability testing was conducted through a pilot study with 30 participants from Huai Thap Than district, Amnat Charoen province, who shared demographics similar with the study population. Results were analyzed and used to refine the questionnaire and determine the reliability of the instrument by finding the Cronbach α coefficient. Knowledge, attitude, awareness, and preventive behavior questionnaires had a reliability value of 0.78, 0.74, 0.91, 0.70, respectively; the entire questionnaire had a reliability value of 0.76. This was considered acceptable; therefore, the questionnaire was used to collect data from the sample group.

Statistical Analysis

Data from the questionnaires were analyzed using statistical SPSS software version 30.0 (IBM SPSS Statistics for Windows, Version 30.0. Armonk, NY: IBM Corp; 2024) with the following procedures: descriptive statistics to summarize the characteristics of the risk groups; univariate analysis via univariable logistic regression to examine relationships between

independent variables and melioidosis preventive behaviors, reporting odds ratio (OR) with 95% confidence interval (CI); and multivariate analysis using binary logistic regression to identify independent predictors of preventive behaviors, presenting adjusted (AOR) with 95% CI. Variables with *P* values < .25 in the univariate analysis were included.[12] The best-fitting model was determined using backward elimination, removing variables sequentially based on likelihood ratio tests, with *P* < .05 considered statistically significant.

Results

Personal Factors

The majority of respondents were female (65.90%) aged 45-55 years (56.50%), with a mean (SD) age of 55.38 (7.82) years (median [range], 55 [45-87] years). Most had completed only primary education (47.70%) and were married (75.90%). The dominant occupation was agriculture, accounting for 80.10% of participants. Monthly family income was generally low (mean [SD], ฿6276.42 [฿5268.81]), with 37.80% earning less than ฿3000. The minimum income reported was ฿300, and the maximum reached ฿35 000 (Table 1).

Table 1. General Information

Variable	No. (%)
Gender	
Male	120 (34.10)
Female	232 (65.90)
Age, y	
45-55	199 (56.50)
56-65	120 (34.10)
≥ 66	33 (9.40)
Education level	
Below primary	20 (5.70)
Primary	168 (47.70)
Lower secondary/vocational	79 (22.40)
Upper secondary/technical	72 (20.50)
Bachelor's degree or higher	13 (3.70)
Marital status	
Single	34 (9.70)
Married	267 (75.90)
Widowed	34 (9.70)
Divorced	17 (4.80)

Table 1. General Information (Continued)	
Variable	**No. (%)**
Current occupation	
Agriculture (farming/gardening)	282 (80.10)
Animal husbandry	11 (3.10)
Homemaker	17 (4.80)
Business/sales	12 (3.40)
Government/state enterprise	6 (1.70)
Agriculture and animal husbandry	16 (4.50)
Others	8 (2.30)
Monthly income, ฿	
≤ 3000	133 (37.80)
3001-6000	97 (27.60)
> 6000	122 (34.70)
Chronic disease	
None	238 (67.60)
Diabetes	71 (20.20)
Kidney disease	5 (1.40)
Thalassemia	4 (1.10)
Others	34 (9.70)
Residential environment	
Standing water near house	14 (4.00)
Forested area nearby	123 (34.90)
Nearby ponds or marsh	19 (5.40)
Other	196 (55.7)

Most respondents showed high knowledge levels, totaling 248 individuals (70.50%). Those with moderate knowledge numbered 63 (17.90%), whereas 41 (11.60%) demonstrated low knowledge levels. The mean (SD) knowledge score was 12.09 (2.81).

Overall attitude scores revealed that majority (223 respondents, 63.40%) held a moderate attitude toward prevention. A notable 129 individuals (36.60%) demonstrated a high preventive attitude, with no participants exhibiting low attitude scores

Health literacy was predominantly moderate, with 258 respondents (73.30%). High health literacy was observed in 66 individuals (18.80%); only 28 (8.00%) showed low literacy levels (Figure 1).

A total of 117 participants (33.20%) displayed risky behaviors, whereas the majority — 235 participants (66.80%) — demonstrated nonrisky preventive behaviors

The results of binary logistic regression analysis studying factors related to melioidosis prevention behaviors among the population in Health Zone 10, Ubon Ratchathani province, found that many factors were significantly related to disease prevention behavior at the 0.05 level. Regarding age, it was found that those aged ≥ 66 years had a significantly lower chance of having inappropriate disease prevention behaviors (AOR, 0.10; 95% CI, 0.021-0.454; P = .003) than those aged 45-55 years (reference group). Regarding education level,

the group that completed primary school had a significantly lower chance of having inappropriate disease prevention behavior (AOR, 0.02; 95% CI, 0.003-0.075; *P* < .001) compared with the group with education lower than primary school (reference group). The secondary school group had significantly lower chance (AOR, 0.02; 95% CI, 0.004-0.100; *P* < .001). The group with bachelor's degree or higher the least likely and significant difference was observed. Regarding occupation, using agriculture (rice farming and gardening) as the reference group, the animal husbandry group was significantly more likely to engage in inappropriate disease prevention behaviors (AOR, 7.91; 95% CI, 1.258-49.765; *P* = .027). Other occupations were also significantly more likely than the reference group (AOR, 13.67; 95% CI, 3.441-54.271; *P* < .001). Residential environmental factors, such as living near forests, swamps, or other areas, were not significantly associated with disease prevention behaviors (*P* > .05). Regarding knowledge about melioidosis, those with high knowledge were significantly less likely to engage in inappropriate disease prevention behaviors (AOR, 0.10; 95% CI, 0.036-0.263; *P* < .001) than those with low knowledge (the reference group). Those with moderate knowledge showed no significant difference (*P* = .236). Health literacy and access to health information and services, both at moderate and high levels, showed no significant relationship with disease prevention behaviors (*P* > .05). Health literacy and understanding health information and services at either moderate or high levels showed no significant relationship with disease prevention behaviors (*P* > .05) (Table 2).

Figure 1. Percentage of Knowledge, Attitude, and Perception

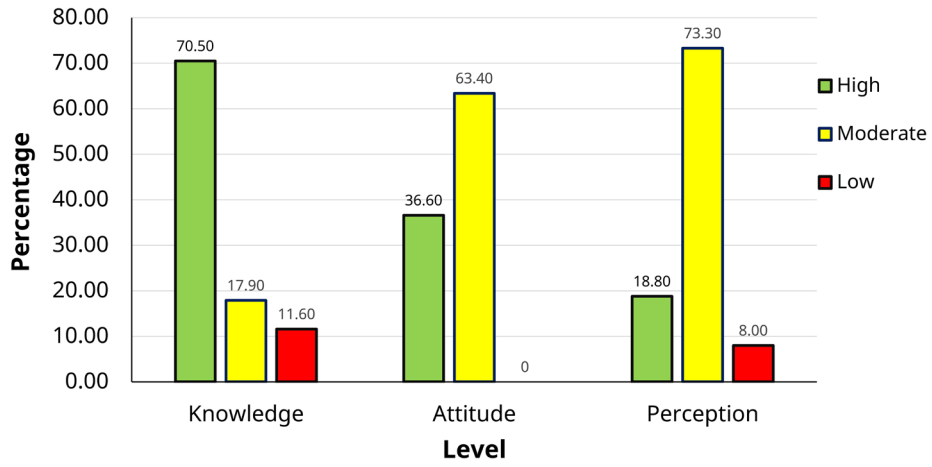


Table 2. Binary Logistic Regression Analysis to Identify Factors Influencing Melioidosis Prevention Behaviors Among the Population in Health Zone 10, Ubon Ratchathani Province

Variable	No. of Participants (n = 117)	Regression Coefficient	AOR	95% CI	*P* Value
Age, y					
45-55	69	0	1 [Reference]	NA	NA
56-65	44	0.47	0.847-3.049	1.61	.147
≥ 66	4	-2.32	0.021-0.454	0.10	.003

Table 2. Binary Logistic Regression Analysis to Identify Factors Influencing Melioidosis Prevention Behaviors Among the Population in Health Zone 10, Ubon Ratchathani Province (Continued)

Variable	No. of Participants (n = 117)	Regression Coefficient	AOR	95% CI	*P* Value
Education level					
Less than primary education	15	0	1 [Reference]	NA	NA
Primary education	47	-4.14	0.003-0.075	0.02	< .001
Secondary education	53	-3.89	0.004-0.100	0.02	< .001
Bachelor's degree or higher	2	-5.60	0-0.059	0	< .001
Current occupation					
Agriculture (farming and gardening)	87	0	1 [Reference]	NA	NA
Animal husbandry (cattle, pig, etc)	9	2.07	1.258-49.765	7.91	.027
Homemaker	4	0.27	0.297-5.749	1.31	.724
Self-employed/trader	4	1.52	0.997-21.1	4.59	.050
Government / state enterprise	1	0.69	0.153-26.178	2.00	.597
Agriculture and animal husbandry	11	-0.84	0.046-4.036	0.43	.461
Others	1	2.62	3.441-54.271	13.67	< .001
Residential environment					
Water stagnation near house	5	0	1 [Reference]	NA	NA
Forest near house	43	-0.86	0.086-2.066	0.42	.287
Pond/lake near house	12	1.38	0.615-25.557	3.97	.147
Others	57	-0.49	0.135-2.776	0.61	.525
Knowledge about melioidosis					
Low	30	0	1 [Reference]	NA	NA
Moderate	31	-0.66	0.174-1.539	0.52	.236
High	56	-2.33	0.036-0.263	0.10	< .001
Health literacy: accessing health information and services					
Low	35	0	1 [Reference]	NA	NA
Moderate	64	-0.62	0.258-1.115	0.54	.095
High	18	-0.88	0.157-1.099	0.42	.077
Health literacy: understanding health information and services					
Low	43	0	1 [Reference]	NA	NA
Moderate	49	-0.10	0.449-1.833	0.91	.785
High	25	0.41	0.599-3.823	1.51	.381
Health literacy: communication and questioning for better understanding					
Low	23	0	1 [Reference]	NA	NA
Moderate	49	-1.38	0.072-0.879	0.25	.031
High	45	-1.41	0.065-0.923	0.25	.038
Health literacy: health decision-making					
Low	21	0	1 [Reference]	NA	NA
Moderate	64	0.94	0.955-6.818	2.55	.062
High	32	-0.07	0.28-3.104	0.93	.909

Table 2. Binary Logistic Regression Analysis to Identify Factors Influencing Melioidosis Prevention Behaviors Among the Population in Health Zone 10, Ubon Ratchathani Province (Continued)

Variable	No. of Participants (n = 117)	Regression Coefficient	AOR	95% CI	*P* Value
Health literacy: self-health behavior modification					
Low	16	0	1 [Reference]	NA	NA
Moderate	44	-1.33	0.062-1.143	0.27	.075
High	57	-1.52	0.05-0.961	0.22	.044
Health literacy: sharing health information					
Low	19	0	1 [Reference]	NA	NA
Moderate	66	0.20	0.439-3.414	1.23	.698
High	32	0.09	0.341-3.476	1.09	.886

Abbreviations: AOR, adjusted odds ratio; NA, not applicable.

The predictive equation can be written as follows: Logit (y) = 2.83 – 1.17Know + 0.75Atti – 0.60HL. From the aforementioned equation, the probability of the public's behavior in preventing melioidosis in Health Zone 10, Ubon Ratchathani, can be predicted as follows: P (preventive behavior) = $e^{2.83 - 1.17Know + 0.75Atti - 0.60HL}/1\text{-}e^{2.83 - 1.17Know + 0.75Atti - 0.60HL}$), If P < 0.5, it is concluded that there is no effect on the preventive behavior against melioidosis. If P ≥ 0.5, it is concluded that there is an effect on the preventive behavior against melioidosis.

The analysis results showed that the variables significantly influencing preventive behavior against melioidosis ($P < .05$) are knowledge about melioidosis and health literacy. Insufficient knowledge is associated with a decrease in preventive behavior (OR, 0.309; $P < .001$), whereas good health literacy tends to increase the likelihood of exhibiting preventive behavior against melioidosis (OR, 2.020; $P = .030$).

Discussion

This study revealed that melioidosis prevention behaviors among the sample in Health Zone 10 were influenced by several key factors, including age, education level, occupation, living environment, disease knowledge, and specific dimensions of health literacy.

Those aged 66 and over had a significantly lower incidence of inappropriate disease prevention behaviors than the reference group, aged 45-55 years. This suggests that older adults are more prone to disease prevention practices. These findings are consistent with existing health behavior models across the lifespan.[13, 14]

Regarding education level, those with primary and secondary education were significantly less likely to engage in inappropriate disease prevention behaviors than those with less than primary education. Those with a bachelor's degree or higher were significantly less likely to engage in inappropriate disease prevention behaviors, and this difference was also significant. These results suggest a relationship between higher education and a greater likelihood of engaging in appropriate disease prevention behaviors.[15]

Regarding occupational factors, using agriculture as the reference group, animal farmers were significantly more likely to engage in inappropriate disease prevention behaviors, as were other occupations not categorized as specific. This suggests that certain

occupations are more likely to engage in inadequate disease prevention behaviors than the reference group.[13, 16, 17]

Regarding living environment No significant relationship was found between living near forests, standing water, swamps, or other areas and disease prevention behaviors. The analysis showed no statistically significant differences across all groups.[3, 11, 16]

Regarding knowledge about melioidosis, those with high knowledge were significantly less likely to engage in inappropriate disease prevention behaviors than those with low knowledge. However, those with moderate knowledge showed no significant differences from the reference group.[8, 16]

Finally, health literacy, including access to health information and services and understanding health information and services, showed no statistically significant relationship with disease prevention behaviors. The values at each health literacy level did not differ significantly from the reference group.

In future studies, the sample population should be expanded to include other areas within Health Zone 10 or different regions with varying contexts. This would allow for comparative analysis, enhance the diversity of influencing factors on melioidosis prevention behavior, and improve the generalizability and applicability of research findings on a broader scale.

Although this study primarily employed a quantitative approach, future research should consider incorporating qualitative methods, such as in-depth interviews or focus group discussions. These methods would provide deeper insights into attitudes, motivations, and constraints affecting individuals' preventive behaviors, thereby contributing to a more comprehensive understanding of the issue.

Such qualitative insights could support the development of community-contextualized health promotion programs aimed at improving melioidosis prevention behaviors. Moreover, future studies should include intervention trials to implement and evaluate the effectiveness of such programs in targeted populations.

Conclusions

This study demonstrated that melioidosis prevention behaviors among individuals in Health Zone 10 were significantly associated with selected sociodemographic characteristics and disease-related knowledge. Older adults aged ≥ 66 years were less likely to exhibit inappropriate prevention behaviors than younger age groups. Higher educational attainment was consistently associated with more appropriate preventive practices. Occupational differences were evident, with animal farmers and other nonagricultural occupations showing a higher likelihood of inappropriate prevention behaviors. Knowledge of melioidosis played an important role, as individuals with high knowledge levels demonstrated better preventive behaviors. In contrast, living environment factors and dimensions of health literacy related to access and understanding of health information were not significantly associated with prevention behaviors. Overall, the findings highlight the importance of demographic characteristics and disease-specific knowledge in shaping melioidosis prevention behaviors.

Additional Information

Acknowledgments: The researchers would like to thank the provincial public health doctors of Mukdahan, Amnat Charoen, and Ubon Ratchathani for facilitating the trial use of the instruments and data collection in this study. Thank you to all the participants who answered the questionnaires and provided valuable information for this research. The researchers also extend their gratitude to their supervisors and colleagues for their continuous support and encouragement. This work was conducted as part of a master's thesis in the Public Health Program, Faculty of Public Health, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand.

Ethics Approval: This study received ethical approval for human research from the Ubon Ratchathani Provincial Public Health Office (SSJ.UB 2568-01.005 on 30 January 2025).

Clinical Trial Consideration: This study does not report on a clinical trial.

Financial Support: No financial support was provided for this study.

Conflict of Interest: The authors declare no conflict of interest.

Author Contributions:
Conceptualization: All authors
Formal Analysis: All authors
Methodology: Sitang Philom, Kulchaya Loyha
Visualization: Sitang Philom
Writing – Original Draft: Sitang Philom
Writing – Review & Editing: Sitang Philom

References

1. Ministry of Public Health. *Communicable Disease Act, B.E. 2558 (2015)*. Royal Thai Government Gazette. 2015;132(86A):26-44. Published 8 September 2015. Accessed 25 November 2025. http://www.ratchakitcha.soc.go.th/DATA/PDF/2558/A/086/26.PDF
2. Department of Disease Control, Ministry of Public Health. *Operational Guidelines for Disease and Health Hazard Prevention and Control, Fiscal Year 2025*. Ministry of Public Health; 2024. Accessed 25 November 2025. https://online.fliphtml5.com/wkqqv/ngku/#p=1
3. Kanjaras P, Bumrerraj S, Seng R, Noradee S, Nithikathkul C. Melioidosis in Si Sa Ket model: risk factors with prevention and control. *Am J Biomed Sci & Res*. 2022;17(4):AJBSR.MS.ID.002374. doi:10.34297/AJBSR.2022.17.002374
4. Chantratita N, Phunpang R, Yarasai A, et al. Characteristics and one year outcomes of melioidosis patients in northeastern Thailand: a prospective, multicenter cohort study. *Lancet Reg Health Southeast Asia*. 2023;9:100118. doi:10.1016/j.lansea.2022.100118
5. Savelkoel J, Dance DAB. Alfred Whitmore and the discovery of melioidosis. *Emerg Infect Dis*. 2024;30(4):752-756. doi:10.3201/eid3004.230693
6. Sampheothong T, Prasertsang A, Kraikirat C, Taweewikayakarn P. Weekly outbreak news verification, week 17, April 23-29, 2023. *Weekly Epidemiological Surveillance Report*. 2023;54(17):265-266.
7. Doungboobpa C, Chaigarun S, Loiha K. Factor associating the occurrence of melioidosis in Mukdahan province. *UBRU Journal for Public Health Research*. 2023;12(3):59-70.
8. Department of Disease Control, Ministry of Public Health. Thailand National Disease Surveillance (Report 506). Accessed 25 November 2025. https://dvis3.ddc.moph.go.th/t/DDC_CENTER_DOE/views/DDS2/sheet33

9. Daniel WW, Cross CL. Biostatistics: A Foundation of Analysis in the Health Sciences. 10th ed. John Wiley & Sons; 2013. Accessed 25 November 2025. https://faculty.ksu.edu.sa/sites/default/files/145_stat_-_textbook.pdf
10. Bureau of Registration Administration. Population in Health Zone 10. Accessed 2 October 2024. https://www.bora.dopa.go.th
11. Muangjaiphet P, Suggaravetsiri P. Prevalence and factors associated with melioidosis in Ubon Ratchathani province. *J Off Dis Prev Control 7*. 2019;26(2):1-13.
12. Hosmer DW, Lemeshow S. *Applied Logistic Regression*. 2nd ed. John Wiley & Sons; 2000. doi:10.1002/0471722146
13. Limmathurotsakul D, Kanoksil M, Wuthiekanun V, et al. Activities of daily living associated with acquisition of melioidosis in northeast Thailand: a matched case-control study. *PLoS Negl Trop Dis*. 2013;7(2):e2072. doi:10.1371/journal.pntd.0002072
14. Sujuritphong P, Suggaravetsiri P, Vaeteewootachan K. Factors associated with patients suffering from melioidosis at the Khok Sri Suphan Hospital, Sakonnakhon province. *KKU Journal for Public Health Research*. 2014;7(1):80-86.
15. Limmathurotsakul D, Wongratanacheewin S, Teerawattanasook N, et al. Increasing incidence of human melioidosis in northeast Thailand. *Am J Trop Med Hyg*. 2010;82(6):1113-1117. doi:10.4269/ajtmh.2010.10-0038
16. Kanjaras P, Bumrerraj S, Seng R, Noradee S, Nithikathkul C. Geospatial analysis and modeling of melioidosis prevention and control in Si Sa Ket province, Thailand. *International Journal of Geoinformatics*. 2023;19(1):57-65. doi:10.52939/ijg.v19i1.2501
17. Pediatric Infectious Disease Society of Thailand. Melioidosis. Accessed 25 November 2025. https://www.pidst.or.th/A247.html