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Clinical Factors Among Health-Care Providers Affecting the Diagnosis of Pulmonary Paragonimiasis in Basilan, Philippines: A 2006 Baseline Study Revisited

Norvie T. Jalani

Author Information:
Ateneo De Zamboanga University, School of Medicine, Philippines

Correspondence:
norviejalani@gmail.com

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Abstract. Basilan was identified as a new endemic focus for human paragonimiasis in 1992, yet hospital-confirmed cases declined sharply over the following decade without clarity on whether this reflected true epidemiological change or diagnostic failure. Objectives: This study, conducted in 2006 and not previously published, examined the clinical factors affecting the diagnosis of pulmonary paragonimiasis in Basilan: physician knowledge competency, medical technologists' diagnostic skills, hospital diagnostic capability, and rural health unit (RHU) recognition and referral practices. Design: Analytical, cross-sectional study. Participants and sampling: Twelve physicians, eleven medical technologists, and two RHU midwives (N = 25) enrolled through total enumeration of all eligible personnel in four major hospitals and two RHUs in paragonimiasis-endemic municipalities. Instruments: Three parallel problem-based, criterion-referenced multiple-choice examinations, validated by laboratory and public health specialists and pretested before administration. Statistical tools: Frequency and percentage, mean, standard deviation, University of Calgary item analysis against a computed Minimum Passing Level (MPL), the KR-20 coefficient, and the chi-square test with the Fisher-Freeman-Halton exact test; hospital capability was assessed against World Health Organization (WHO, 1996) laboratory standardization criteria. Results: For SOP 1, 8 of 11 medical technologists (73%) reached the MPL, but only 7 of 11 (64%) passed items requiring direct identification of Paragonimus ova. For SOP 2, only 4 of 12 physicians (33%) reached the MPL, failing most often in paraclinical test selection (10/12) and preventive medicine (9/12). For SOP 3, all four hospitals met the WHO benchmarks assessed. For SOP 4, both RHU midwives recognized and appropriately referred a simulated case and had conducted community education on raw crab consumption. Conclusion: Physician underrecognition, rather than laboratory or hospital capacity, was the most likely point of breakdown, suggesting that the apparent decline in reported paragonimiasis reflected underdiagnosis rather than disease elimination, a finding still relevant to paragonimiasis-tuberculosis surveillance in the region.

Keywords: pulmonary paragonimiasis; clinical factors; diagnosis; provider competency; Basilan, Philippines

Introduction

Paragonimiasis is a food-borne zoonosis caused by trematode flukes of the genus Paragonimus, transmitted through the consumption of raw or undercooked freshwater crabs and crayfish (World Health Organization, n.d.). Its clinical course, marked by chronic productive cough, hemoptysis, chest pain, and low-grade fever, closely mimics pulmonary tuberculosis (PTB), making it an important but frequently overlooked differential diagnosis in regions where both diseases are common.

Endemic foci of human paragonimiasis in the Philippines had long been documented in Sorsogon, Leyte, Samar, and parts of Mindanao before Infante and colleagues (1992) established Basilan province as a new endemic focus, identifying Paragonimus eggs in the sputum of 33 patients who had been initially treated, without response, for PTB. That finding challenged local clinicians to consider paragonimiasis whenever a presumed tuberculosis case failed to respond to standard anti-tuberculosis therapy. Despite this, no follow-up clinical assessment was conducted in the province for more than a decade.

Hospital records suggested that paragonimiasis cases in Basilan, concentrated mainly in the municipalities of Lantawan, Tipo-tipo, and Sumisip, fell from 33 confirmed cases in the early 1990s to only

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nine hospitalized and confirmed cases between 2000 and 2005. This apparent decline could plausibly reflect several distinct mechanisms: a behavioral shift away from raw or undercooked crab consumption, an ecological decline in the intermediate snail or crab hosts, or a clinical and diagnostic failure in which cases continued to occur but were no longer being recognized, tested for, or referred. The present study, originally completed in 2006 as a master's thesis at the Ateneo de Zamboanga University and not previously submitted for journal publication, focused specifically on the third possibility: the clinical factors potentially responsible for the apparent decline.

In the two decades since these data were collected, no comparable clinical-competency assessment has been published for Basilan or for the wider Basilan-Sulu-Tawi-Tawi (BaSulTa) island group, even as substantially stronger evidence of the same underlying problem, diagnostic confusion between PTB and paragonimiasis, has emerged elsewhere in the Zamboanga Peninsula. An integrated surveillance study in Zamboanga del Norte found a paragonimiasis prevalence of 6.7% among patients with chronic cough, more than three times the 1.9% prevalence of bacteriologically confirmed PTB in the same population (Belizario et al., 2014). A subsequent study extended this surveillance across the wider Zamboanga Region and reported municipality-level paragonimiasis prevalences ranging from 5.2% to 22.1% (delos Trinos et al., 2020). Most recently, a molecular survey in Davao Oriental identified a previously unrecognized freshwater crab genus as a potential intermediate host of Paragonimus westermani, widening the documented transmission ecology of the parasite in Mindanao (Ricarte et al., 2025). Globally, paragonimiasis and related foodborne trematodes are now explicitly targeted for control under the World Health Organization Neglected Tropical Diseases (NTD) Roadmap 2021–2030, which identifies disease mapping, surveillance, and capacity building as the critical actions required to meet its 2030 targets (World Health Organization, 2021; Tidman et al., 2023). At the same time, a current Master of Public Health (MPH) thesis proposal is examining the same diagnostic-overlap question among clinically diagnosed PTB patients in Sulu province, for which no published paragonimiasis data of any kind currently exist. Against this backdrop, the present findings, the only clinical-factor assessment ever conducted in the BaSulTa archipelago, take on renewed significance as baseline evidence bridging the discovery reported by Infante et al. (1992) and the present decade's surveillance efforts.

Research gap. Three gaps in the evidence motivated this study. First, although Infante et al. (1992) established Basilan as an endemic focus and alerted local clinicians to it, no subsequent study had examined whether the province's physicians and laboratories were actually equipped to detect the disease. Second, the observed decline in confirmed cases had never been tested against the competing explanation of diagnostic failure, leaving the province's surveillance figures of uncertain validity. Third, and still the case at the time of writing, no clinical-competency assessment of any kind has been published for the BaSulTa island group, so the provider-level determinants of paragonimiasis detection across the archipelago remain undocumented. The present study addressed the first two gaps directly and, in being published now, begins to close the third.

Research Questions

This study therefore aimed to determine the clinical factors affecting the diagnosis of pulmonary paragonimiasis in Basilan province, assessing in turn each point at which a case could be lost: recognition and referral at the primary care level, physician decision-making in hospital, laboratory execution of the confirmatory test, and institutional capacity to support it. Specifically, it sought to;

1. Determine the knowledge and skills of medical technologists in the four major hospitals in performing diagnostic procedures and identifying parasitic eggs in sputum and stool specimens?
2. Determine the knowledge competency of physicians in the four major hospitals in diagnosing and treating pulmonary paragonimiasis?
3. Determine the capability of the four major hospitals to support diagnosis through manpower, facilities, and laboratory quality control?
4. Determine the ability of RHU personnel in two paragonimiasis-endemic municipalities to recognize and refer potential cases and to contribute to control and prevention at the primary health care level.

Scope and Delimitation of the Study

This study was limited to the clinical factors affecting the diagnosis of pulmonary paragonimiasis in Basilan province as they stood in 2006. It covered the four major hospitals of the province and the rural health units of two of the three paragonimiasis-endemic municipalities; the Lantawan rural health unit was excluded for peace-and-order reasons, so the findings do not describe that municipality. The study assessed the knowledge, skills, and institutional capability of health-care providers and facilities. It did not screen patients, did not measure the prevalence of paragonimiasis, and did not audit whether confirmatory tests were in fact ordered in routine practice; competency and capability were measured, not their exercise. Barangay health workers, private practitioners outside the four major hospitals, and personnel in the neighbouring provinces of Sulu and Tawi-Tawi were outside its scope. Because the data were collected in 2006 and are published here

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without re-survey, the findings describe that period and are offered as a baseline rather than as a current assessment of provincial capability.

Literature Review

Transmission, Distribution, and Intermediate Hosts

Paragonimiasis is transmitted through a two-host life cycle involving freshwater melaniid snails (genus Antemelania, also referred to as Jagora) as the first intermediate host and freshwater crabs, principally Sundathelphusa philippina, as the second intermediate host (Paller et al., 2021). Historically, both hosts were documented mainly in Luzon, the Bicol region, Samar, and Leyte, with scattered records in Mindanao. Blair (2022) characterises Paragonimus as an ancient parasite that is nonetheless re-emerging, with species boundaries and host associations still being resolved, which is one reason distribution records for any given region should be treated as provisional. The 2025 identification of Isolapotamon sp. carrying P. westermani DNA in Davao Oriental (Ricarte et al., 2025) indicates that the known intermediate-host range across the southern Philippines, including the broader Mindanao-Sulu island group to which Basilan belongs, is wider than previously documented and continues to be revised. The same pattern of revision is evident outside Asia: Coogle et al. (2022), reviewing autochthonous human infection with Paragonimus kellicotti in North America, note that the true prevalence and geographic distribution of the parasite there remain unknown, and that cases continue to be reported from areas not previously regarded as endemic.

Diagnostic Overlap Between Paragonimiasis and Pulmonary Tuberculosis

Because the parasite's range is wider than once assumed, the more consequential question is not where paragonimiasis occurs but whether it is recognised when it does. The clinical overlap between paragonimiasis and PTB has been documented since at least the early 1990s, when Belizario and colleagues (1994) reported confirmed paragonimiasis among patients in Sorsogon who had been treated for, but failed to respond to, anti-tuberculosis therapy. Diagnostic confusion is compounded by the limitations of routine sputum examination: while Ziehl-Neelsen (ZN) staining for acid-fast bacilli (AFB) can sometimes reveal Paragonimus ova on the same slide (Slesak et al., 2011), a later field evaluation in the Zamboanga Region found that ZN staining alone detected only about 28% of the ova-positive specimens identified by the more sensitive sodium hydroxide (NaOH) sedimentation-concentration technique, even though it produced no false positives (delos Trinos et al., 2020). This finding supports the continued use of dedicated NaOH concentration testing, rather than reliance on AFB-stained slides alone, wherever paragonimiasis is suspected. That the problem persists rather than resolves is evident from Singh et al. (2025), who reviewed 37 suspected cases presenting to three health facilities in Manipur, India, between 2011 and 2023 and found paragonimiasis still being diagnosed and treated as tuberculosis, including among children, decades after the overlap was first reported in that region.

Laboratory Diagnosis and the Skills of Medical Technologists

Given that the two diseases present so similarly, the burden of distinguishing them falls in the first instance on the laboratory. Definitive diagnosis of pulmonary paragonimiasis rests on the microscopic demonstration of Paragonimus ova in sputum or stool, a task that depends less on equipment than on whether the examining technologist knows what the ovum looks like and is actively looking for it (Garcia, 2001). The ova are golden-brown and operculated, and are readily distinguishable from other helminth eggs once seen, but they are easily overlooked in a laboratory whose routine sputum workload consists almost entirely of AFB smears. Slesak et al. (2011) showed that ZN staining performed for tuberculosis can incidentally reveal Paragonimus ova on the same slide, raising the possibility that paragonimiasis might be detected opportunistically within existing tuberculosis programmes. Field evaluation in the Zamboanga Region tempered that expectation, recovering only about 28% of ova-positive specimens by ZN staining alone (delos Trinos et al., 2020). The same study reported that newly deployed medical technologists in the region required dedicated training in paragonimiasis diagnosis, using both preserved and fresh specimens, before integrated surveillance could proceed, indicating that this competency cannot be assumed from general licensure. Lu et al. (2026) further observed that the global distribution of Paragonimus species, affecting an estimated 23 million people, remains poorly mapped in part because detection depends on precisely such locally variable laboratory practice. Serological and molecular alternatives have advanced considerably since this study was conducted and could in principle reduce the dependence on microscopy. Devi et al. (2023) identified immunoreactive excretory-secretory antigens of Paragonimus westermani type 1 and demonstrated improved diagnostic accuracy when enzyme-linked immunosorbent assay (ELISA) is combined with immunoblotting in a setting of co-existing helminth infections, while Andrade-Gomes et al. (2023) reported detection of human paragonimiasis by ELISA using a recombinant cysteine protease antigen. Blair (2024), reviewing the disease as a whole, notes that no single diagnostic method is adequate across all presentations and that ova detection, serology, and imaging are complementary rather than interchangeable. Neither serologic approach, however,

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is available in a provincial hospital laboratory in the Philippines, which continues to depend on sputum microscopy and therefore on the technologist performing it. Read together, this literature suggests that medical technologist competency is a necessary but not self-sustaining condition for diagnosis: skill in a procedure that is rarely requested decays with disuse, and no degree of skill compensates for a specimen that is never submitted for the appropriate test.

Physician Knowledge and Diagnostic Decision-Making

Because the confirmatory test must be ordered before it can be performed, the physician's index of suspicion determines whether a case enters the diagnostic pathway at all. The published case literature documents failure at this point far more often than in the laboratory. Poudyal et al. (2022) described patients whose clinical, laboratory, and radiological features had been attributed to pulmonary tuberculosis until paragonimiasis was belatedly considered, and Villanueva-Villegas et al. (2023) reported a patient who received eight months of empirical anti-tuberculosis treatment despite negative AFB smears, with Paragonimus ova found on direct sputum cytology only once the diagnosis was entertained. Resuh et al. (2024) attributed the characteristic delay to the disease's absence from the working differential, noting that in north-eastern India, where both conditions are widespread, paragonimiasis is infrequently included among the differential diagnoses of tuberculosis. Guerrero and Belizario (2025) reached the same conclusion for the Philippines, arguing from published data and the Department of Health registry that paragonimiasis in the Zamboanga Peninsula has remained hidden in plain sight within the reported tuberculosis burden, and identifying areas in which paragonimiasis is in fact more common than tuberculosis. Machrumnizar and Tan (2024) and Rodriguez and Angeles (2025), reviewing the field and its 60-year publication record respectively, both identify clinician awareness rather than diagnostic technology as the persistent constraint. Comparable assessments of provider knowledge for other neglected tropical diseases reinforce the concern. Fall et al. (2024) surveyed 187 primary health-care workers, including general practitioners, nurses, and midwives, across 24 health centres in the Dakar region of Senegal and found knowledge of skin-manifesting neglected tropical diseases to be uneven and associated with professional category and years of experience rather than with exposure to the diseases themselves. Diallo et al. (2024), studying 86 providers in the Forecariah Health District of Guinea, found that although most had heard of the more prominent neglected tropical diseases, only a minority could describe how any of them is prevented. Provider-level knowledge gaps of the kind measured in the present study are therefore neither unique to paragonimiasis nor to the Philippines. This body of work frames the central question of the present study: whether the physicians serving a documented endemic focus held the knowledge required to recognise the disease and to select the test that would confirm it.

Hospital and Primary Health Care Capability

Competent clinicians and technologists nonetheless depend on institutions able to support them, and on a primary-care tier able to bring patients to those institutions in the first place. The tests needed to confirm pulmonary paragonimiasis are inexpensive and technically undemanding, so institutional capability is assessed against basic laboratory standards rather than specialised capacity (World Health Organization, 1996). Whether that baseline is met in practice across Philippine endemic areas is less certain. Abrazaldo et al. (2026), synthesising Field Health Services Information System data for 2020 to 2024, reported that Paragonimus westermani has been documented in at least 12 provinces with local prevalences ranging from 0.7% to 52%, and identified geographically isolated and disadvantaged areas as those least served by existing neglected tropical disease programmes, a description that fits the island municipalities of Basilan. At the primary care level, the rural health unit is the first point of contact and therefore the first opportunity for recognition and referral. Guerrero and Belizario (2026) found in Sorsogon that tuberculosis prevalence rose by 49% between 2016 and 2024, that clinically diagnosed rather than bacteriologically confirmed cases again predominated by 2024 despite widespread GeneXpert availability, and that among 883 tuberculosis suspects screened in August 2025, 81 of the 172 actually tested were positive for paragonimiasis. Their recommendation, that paragonimiasis surveillance be integrated into existing tuberculosis programmes, places the burden of first recognition squarely on primary-level personnel. Tenorio and Molina (2021) and the World Health Organization (2021) likewise locate foodborne trematodiasis control within routine primary care and health promotion rather than specialist services. The capability of hospitals and the capability of rural health units are therefore properly treated as two distinct variables, as they are in this study.

Assessment of Clinical Knowledge and Competency

Measuring the competencies described in the preceding subsections requires an instrument suited to clinical reasoning rather than factual recall. The examination instruments used in this study followed the criterion-referenced, problem-based multiple-choice format described by Cristobal (1999), in which item choices are weighted as “must-know” or “may-know” correct and incorrect responses, and a Minimum Passing Level is computed from these weights prior to administration. This approach evaluates clinical reasoning and

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judgment rather than isolated factual recall (Harasym, 1998), making it appropriate for assessing whether physicians and medical technologists could apply paragonimiasis-relevant knowledge to a realistic clinical scenario rather than simply recognize textbook facts.

Methodology

Research Design

This study used an analytical, cross-sectional design. All data were collected at a single point in time, in 2006, from health-care providers and health facilities in Basilan province; there was no follow-up period and no intervention. The design was chosen because the research question concerned the state of diagnostic capability at the time of the apparent decline in reported cases, rather than change in that capability over time. It is analytical rather than purely descriptive in that provider performance was evaluated against a criterion computed in advance, the Minimum Passing Level, and compared across three respondent groups occupying different positions in the diagnostic pathway.

Research Locale

The study was conducted in the four major hospitals of Basilan province, namely Infante Hospital, Basilan Community Hospital (BASCOM), Basilan General Hospital (BGH), and Juan S. Alano Hospital, and in the two Rural Health Units (RHUs) serving the municipalities of Tipo-tipo and Sumisip. These two municipalities, along with Lantawan, had previously been identified as paragonimiasis-endemic; Lantawan was excluded from data collection because of peace-and-order conditions in the province at the time of the study. Basilan is an island province in the southwestern Philippines, separated from the Zamboanga Peninsula by the Basilan Strait and forming, with Sulu and Tawi-Tawi, the BaSulTa island group. Its population at the time of the study was largely rural and dependent on farming and fishing, and freshwater crabs from inland streams formed part of the local diet. The consumption of raw or undercooked freshwater crabs is the established transmission route for paragonimiasis in the Philippines (Paller et al., 2021; Tenorio & Molina, 2021), and Infante et al. (1992) attributed the Basilan focus to this practice. The province's health system was organised around the four major hospitals named above, which together served as the referral destinations for the municipal rural health units; none of the four functioned as a tertiary referral centre, and cases requiring higher-level care were referred off-island to Zamboanga City. Tipo-tipo and Sumisip are interior municipalities with the stream-and-crab ecology associated with Paragonimus transmission, and both had been among the sites from which confirmed cases were reported in the early 1990s. These conditions, remote and geographically dispersed facilities, an at-risk dietary practice, and a diagnostic pathway that terminates within the province, define the setting in which the clinical factors examined here operated.

Sampling Technique

Total enumeration, or complete enumeration, was used in place of probability sampling. The population of interest was finite and small, comprising all physicians and medical technologists on duty in the province's four major hospitals together with the two midwives heading the accessible endemic-municipality rural health units, so every eligible individual was approached and no sample was drawn. This approach removes sampling error for the population as defined, but it also means that findings generalise only to that population, a limitation acknowledged in the interpretation of the results.

Research Participants

A total of 25 respondents participated, comprising 12 physicians, 11 medical technologists, and 2 rural health unit midwives, drawn from an eligible population of 31. Inclusion criteria were: (a) currently licensed and actively practising as a physician or medical technologist in one of the four major hospitals of Basilan province, or serving as midwife-in-charge of the Tipo-tipo or Sumisip RHU; (b) on duty at the facility during the data-collection period; and (c) willing to give informed consent. Exclusion criteria were: (a) refusal or withdrawal of consent; (b) absence from the facility throughout the data-collection period, including leave of absence; and (c) assignment to a facility that could not be reached safely, which excluded the Lantawan RHU. Of the 16 eligible physicians on duty across the four hospitals, 12 participated and 4 were excluded after declining consent. Of the 13 eligible medical technologists, 11 participated and 2 were excluded for being on leave of absence during data collection. Both midwives heading the Tipo-tipo and Sumisip RHUs participated. All physician and medical technologist participants were licensed practitioners; specializations among the physician group included pediatrics, internal medicine, family medicine, and general practice.

Research Instrument

Three parallel evaluation tools were developed for physicians, medical technologists, and RHU midwives respectively. Each combined a brief demographic and experience survey with a problem-based, vignette-style multiple-choice examination. The physicians' examination contained 15 items spanning five

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competency domains: pathology, parasitology, paraclinical test selection, pharmacology, and preventive medicine. The medical technologists' examination contained 14 items, including four items in Objective Structured Clinical Examination (OSCE) format assessing specimen-handling and identification skills. The RHU instrument used an abbreviated, single case-based scenario appropriate to midwife-level training. Hospital diagnostic capability was assessed separately using a structured checklist based on World Health Organization (1996) laboratory standardization guidelines covering microscopy equipment, reagents, quality control, and trained manpower. All instruments were validated by laboratory and public health specialists at the Department of Health-Zamboanga City and Zamboanga City Medical Center (ZCMC), then pretested with internal medicine residents and medical technologist interns at ZCMC before finalization. Each instrument was constructed to address one specific objective of the study. The medical technologists' examination, including its OSCE-format items, addressed the first objective on knowledge and skills in performing diagnostic procedures and identifying parasitic eggs in sputum and stool specimens. The physicians' examination, spanning pathology, parasitology, paraclinical test selection, pharmacology, and preventive medicine, addressed the second objective on knowledge competency in diagnosing and treating pulmonary paragonimiasis. The WHO-based facility checklist addressed the third objective on hospital capability in manpower, facilities, and laboratory quality control. The abbreviated case-based scenario for RHU midwives addressed the fourth objective on the ability to recognise and refer potential cases and to contribute to control and prevention at the primary health care level.

Data Gathering Procedure

Data were gathered through a systematic sequence of steps. First, permission to conduct the study was secured from the Provincial Health Officer of Basilan, the chief of hospital or medical director of each of the four major hospitals, and the municipal health officers of Tipo-tipo and Sumisip. The three evaluation instruments and the facility checklist were then validated by laboratory and public health specialists from the Department of Health–Zamboanga City and Zamboanga City Medical Center, and the Minimum Passing Level for each examination was determined by the panel of evaluators prior to administration. The instruments were pretested with internal medicine residents and medical technologist interns at ZCMC and subsequently revised based on the results. Eligible physicians, medical technologists, and RHU midwives were identified from duty rosters and approached individually, with the study's purpose, voluntary participation, and confidentiality clearly explained. Informed consent was obtained, and those who declined participation were recorded as non-participants and not approached again. The demographic and experience survey, along with the corresponding examination, was administered on-site in a single sitting lasting approximately 30 to 60 minutes per respondent, without the use of reference materials or discussion. Hospital diagnostic capability was assessed separately using a structured WHO-based checklist through facility inspection and interviews with laboratory heads. Finally, completed instruments were coded using respondent numbers instead of names, checked for completeness, and encoded for analysis.

Results and Discussions

Table 1 summarizes examination performance across the three respondent groups. Only 4 of 12 physicians (33%) scored at or above the MPL, compared with 8 of 11 medical technologists (73%) and both RHU midwives (100%). The difference in satisfactory performance across the three groups approached but did not reach statistical significance, $\chi^2(2) = 5.32$, $p = .070$ (Fisher-Freeman-Halton exact $p = .065$); the physician-medical technologist contrast alone yielded $\chi^2(1) = 3.57$, $p = .059$ (Fisher exact $p = .100$). Given the small number of respondents in each group, and particularly the two RHU midwives, these tests are underpowered, and the interpretation that follows rests on the magnitude of the observed differences rather than on statistical significance.

Table 1. Summary of Examination Performance by Respondent Group

Indicator	Medtechs (n=11)	Physicians (n=12)	RHU midwives (n=2)
MPL (%)	50.43	58.80	75.00
Highest score (%)	97.67	76.46	100
Lowest score (%)	34.57	44.00	82.00
Mean (%)	63.27	55.73	91.00
Std. dev.	18.27	11.39	11.74
Items	14	15	2
Satisfactory	8	4	2
Unsatisfactory	3	8	0

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Table 1 shows the three respondent groups performing at markedly different levels relative to their respective criteria. RHU midwives exceeded their MPL by a wide margin (mean 91.00% against an MPL of 75.00%), medical technologists exceeded theirs modestly (63.27% against 50.43%), and physicians fell below theirs (55.73% against 58.80%). The physician group was also the most homogeneous, with the smallest standard deviation (11.39) and the lowest maximum score (76.46%), indicating that weak performance was general rather than confined to a few individuals. This pattern is the inverse of what the diagnostic pathway requires. Physicians, who alone can order the confirmatory test, were the only group performing below criterion, while the two groups whose contribution is contingent on a physician's request performed at or above criterion. The uniformity of the physician scores is analytically important: a low mean produced by a wide spread would suggest variable individual preparation, whereas a low mean with a narrow spread points to a shared gap in training or exposure rather than to individual deficiency. Because the weakest link sits at the point of test selection, strengthening laboratory capacity or primary-level awareness would not by itself raise case detection. Interventions directed at physician recognition are the ones with the potential to change diagnostic yield in this setting. The criterion-referenced framework and the computation of the MPL follow Cristobal (1999) and Harasym (1998). The combination of adequate laboratory-side competency with weak clinical-side recognition is consistent with delos Trinos et al. (2020) and with the conclusions of Guerrero and Belizario (2025) for the wider Zamboanga Peninsula.

Research Question 1: What are the knowledge and skills of the medical technologists in the four major hospitals in performing diagnostic procedures and identifying parasitic eggs in sputum and stool specimens?

Medical technologists performed comparatively well overall, with 9 of 11 (82%) satisfactory in basic parasitology knowledge, though only 7 of 11 (64%) reached the MPL on the OSCE-format paraclinical items assessing direct identification of Paragonimus ova. This weaker performance was consistent with the technologists' own reported experience: the majority indicated they had rarely or never been asked, over the preceding decade, to examine sputum or stool specimens specifically for Paragonimus ova, with most who had received such requests examining no more than five specimens per year. Diagnostic skill in a low-frequency procedure is difficult to sustain without practice, and this pattern points toward the same bottleneck identified among physicians: without a request for the relevant test, no specimen ever reaches the laboratory for a technologist to examine, however competent that technologist might be.

Research Question 2: What is the knowledge competency of the physicians in the four major hospitals in diagnosing and treating pulmonary paragonimiasis?

Table 2 breaks down physician performance by competency domain. All twelve physicians (100%) demonstrated satisfactory knowledge of Paragonimus-related pathology, and ten of twelve (83%) were satisfactory in parasitology, indicating that the underlying biology of the disease was generally well understood. Performance fell sharply, however, in the domains most directly tied to clinical action: only 2 of 12 physicians (17%) correctly identified the appropriate paraclinical tests to confirm a suspected case, 6 of 12 (50%) demonstrated adequate pharmacologic management knowledge, and only 3 of 12 (25%) showed satisfactory knowledge of prevention and control measures.

Table 2. Physician Performance by Knowledge Category

Knowledge category	Satisfactory (n=12)	Unsatisfactory (n=12)
Pathology	12 (100%)	0 (0%)
Parasitology	10 (83%)	2 (17%)
Paraclinical	2 (17%)	10 (83%)
Pharmacology	6 (50%)	6 (50%)
Preventive medicine	3 (25%)	9 (75%)

Table 2 shows performance falling steadily from knowledge of disease biology to knowledge of clinical action. Pathology was universally satisfactory (12 of 12, 100%) and parasitology nearly so (10 of 12, 83%), but paraclinical test selection was satisfactory in only 2 of 12 (17%), pharmacologic management in 6 of 12 (50%), and preventive medicine in 3 of 12 (25%). The gradient locates the deficit precisely. These physicians knew what paragonimiasis is; what they did not know was which test would confirm it, how to treat it once confirmed, and what to advise patients in order to prevent it. Knowledge of pathology and parasitology is what medical

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education delivers and what is retained; test selection, drug choice, and counselling are what clinical exposure maintains, and exposure had been minimal for a decade. Paraclinical test selection, the single weakest domain, is also the one on which every subsequent step in the diagnostic pathway depends. Continuing professional development for this population should target paraclinical test selection and preventive counselling specifically. A general parasitology refresher would address the domains in which performance was already satisfactory and leave the operative gaps untouched. The same displacement of paragonimiasis from the working differential has been reported by Resuh et al. (2024) for north-eastern India, and by Poudyal et al. (2022) and Villanueva-Villegas et al. (2023) in patients for whom anti-tuberculosis treatment was continued for months before the correct diagnosis was reached. Fall et al. (2024) and Diallo et al. (2024) report comparably uneven provider knowledge of other neglected tropical diseases, with prevention the weakest domain in both settings.

Research Question 3: What is the capability of the four major hospitals to support diagnosis through manpower, facilities, and laboratory quality control?

All four major hospitals met the WHO (1996) benchmarks assessed, including functioning microscopy equipment, centrifuges, radiologic services, documented quality-control procedures for laboratory reagents, and licensed, periodically trained staff. Diagnosing pulmonary paragonimiasis does not require sophisticated infrastructure; the relevant tests, complete blood count, chest radiography, sputum AFB smear, and sputum or stool examination for Paragonimus ova, are routine and inexpensive (Infante et al., 1992). Hospital capacity is therefore unlikely to explain the apparent decline in reported cases.

Table 3. Compliance of the Four Major Hospitals with WHO (1996) Laboratory Standardization Criteria

Criterion assessed	Infante	BASCOM	BGH	Juan S. Alano
Functioning microscopy equipment	Met	Met	Met	Met
Centrifuge available	Met	Met	Met	Met
Radiologic services available	Met	Met	Met	Met
Documented quality-control procedures for laboratory reagents	Met	Met	Met	Met
Licensed laboratory staff receiving periodic training	Met	Met	Met	Met

Table 3 shows uniform compliance: each of the four major hospitals satisfied all five World Health Organization (1996) criteria assessed, covering microscopy equipment, centrifuge availability, radiologic services, documented reagent quality control, and licensed staff receiving periodic training. No facility was deficient on any criterion, and no criterion was deficient across facilities. Uniform compliance allows institutional capacity to be excluded as the limiting factor in the diagnostic pathway. This is the analytically decisive negative finding of the study: had one or more hospitals lacked functioning microscopy or trained laboratory staff, the decline in reported cases could have been attributed to infrastructure. Because none did, the explanation must lie upstream, in whether the confirmatory examination was ever requested. The assessment does, however, measure the presence of capability rather than its routine use; a laboratory equipped to examine sputum for Paragonimus ova is not necessarily one that does so. Resources directed at equipment or facility upgrading in this setting would not be expected to increase paragonimiasis case detection. The binding constraint is clinical decision-making, and that is where investment should be directed. The criteria are those of the World Health Organization (1996). The finding that basic facility capability is present but underused parallels delos Trinos et al. (2020), who found that laboratory staff in the Zamboanga Region required dedicated paragonimiasis training despite working in functioning laboratories, and it sits against Abrazaldo et al. (2026), who identify geographically isolated and disadvantaged areas as those least served by neglected tropical disease programmes even where basic services exist.

Research Question 4: What is the ability of the rural health unit personnel in the two paragonimiasis-endemic municipalities to recognise and refer potential cases and to contribute to control and prevention at the primary health care level?

Both RHU midwives correctly identified a simulated case as suggestive of paragonimiasis and selected the appropriate next steps, ordering a sputum smear and referring the patient to a higher-level facility. Both health centers had previously conducted house-to-house health education on the sanitary preparation and

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avoidance of raw crab consumption, suggesting that primary-level recognition and preventive messaging were not the limiting factors in this pathway.

Table 4: Recognition, Referral, and Preventive Activity of Rural Health Unit Personnel

Indicator	Tipo-tipo RHU	Sumisip RHU
Simulated case correctly identified as suggestive of paragonimiasis	Yes	Yes
Sputum examination ordered as the next step	Yes	Yes
Referral to a higher-level facility made	Yes	Yes
House-to-house health education on sanitary preparation and avoidance of raw crab consumption previously conducted	Yes	Yes

Table 4 shows that both rural health unit midwives responded affirmatively on all four indicators. Each correctly identified the simulated case as suggestive of paragonimiasis, selected sputum examination as the next step, referred the patient to a higher-level facility, and had previously conducted house-to-house health education on the sanitary preparation and avoidance of raw crab consumption. Recognition and referral at the primary level were therefore intact, as was preventive activity in the community. Two qualifications apply. First, with only two respondents, the result establishes that these two midwives were competent rather than that primary-level competency was general across the province. Second, correct performance on a simulated case demonstrates recognition capability, not that such cases were in fact being identified and referred in routine practice at the volume the endemic history would predict. What the finding does establish is that the pathway was not failing at its point of entry: cases recognised at the rural health unit were being sent onward to the hospitals, which Table 3 shows were equipped to test them. Efforts to improve detection should build on rather than replace primary-level capability. The rural health unit is a viable entry point for the integrated screening model now recommended for co-endemic settings, and midwife-level personnel can be relied upon to recognise and refer. Guerrero and Belizario (2026) reached the same conclusion for Sorsogon, recommending that paragonimiasis surveillance be integrated into existing tuberculosis programmes and thereby placing first recognition with primary-level personnel. Tenorio and Molina (2021) and the World Health Organization (2021) similarly locate foodborne trematodiasis control within routine primary care and health promotion rather than specialist services.

Ethical Considerations

This study was conducted in 2006, prior to the establishment of a formal institutional ethics review board at Ateneo de Zamboanga University. At that time, only approximately half of Philippine research institutions maintained a functioning ethics review committee, and the national Philippine Health Research Ethics Board itself had only been created earlier that same year. The study protocol was reviewed and approved by the Oral Examination Committee of the ADZU Graduate School. Participation was voluntary; four prospective physician-respondents were excluded after declining consent, and all respondent data were anonymized using code numbers rather than names throughout data collection and analysis. Risk and harm. Participation carried no physical risk. The principal foreseeable harm was professional: respondents were asked to demonstrate clinical knowledge, and disclosure of individual performance could have caused embarrassment or affected standing with employers. This risk was managed by assigning each respondent a code number at the point of data collection, reporting results only in aggregate, and never disclosing individual scores to hospital administrators, colleagues, or the local health office. No respondent is identified by name, facility, or specialisation in any output of the study, and the same protection is maintained in reporting the study now. Benefits. Respondents received no payment or other material inducement, and were informed at the point of consent that the study offered no direct personal benefit. The anticipated benefits were indirect and collective: identification of the specific competency domains in which support was needed, evidence with which to argue for continuing professional development in the province, and a documented baseline against which paragonimiasis diagnostic capability in the BaSulTa island group could later be measured. Plagiarism. All literature drawn upon in this study is cited in the text and listed in the reference list. Where the examination instruments adapted an existing format, that of the criterion-referenced problem-based multiple-choice examination, the source is attributed to Cristobal (1999) and Harasym (1998) rather than presented as original work. The manuscript has been checked for unattributed reuse of text, including reuse of the author's own 2006 master's thesis, which is disclosed here as the origin of the data and is not reproduced verbatim. Honesty and integrity. The findings are reported as obtained. No respondent was excluded after data collection in order to alter the results; the six non-participants were excluded before data collection for the reasons stated in the methodology. All examination scores obtained are reflected in the tables presented, including those of

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respondents who performed below the Minimum Passing Level. Where the analysis rests on inference rather than direct measurement, and where the inferential tests are underpowered, this is stated in the text. The interval between data collection in 2006 and publication is disclosed, as is the fact that the study has not been published previously in any form.

Conclusion

The study concludes that medical technologists in the four major hospitals generally possessed adequate knowledge and skills for the required diagnostic procedures, with 8 out of 11 meeting the Minimum Passing Level, although weaker performance in the direct identification of *Paragonimus* ova was noted, likely due to limited recent exposure. Among physicians, the findings indicate underrecognition of pulmonary paragonimiasis rather than a lack of clinical competence, as only 4 out of 12 reached the Minimum Passing Level, with deficiencies primarily in paraclinical test selection and preventive medicine rather than disease knowledge. The four major hospitals were found to be fully capable of supporting diagnosis, meeting all assessed World Health Organization (1996) criteria in terms of manpower, facilities, and laboratory quality control. Additionally, rural health unit personnel in the two accessible endemic municipalities demonstrated the ability to recognize and appropriately refer potential cases and had already implemented preventive health education at the primary care level. Overall, the results suggest that physician-level underrecognition, rather than limitations in laboratory or hospital capacity, represents the most probable breakdown in the diagnostic pathway for pulmonary paragonimiasis in Basilan Province, and that the observed decline in reported cases during the early 2000s is more likely due to underdiagnosis than an actual reduction in disease transmission.

Recommendations

The study recommends that the Department of Health and the Basilan Provincial Health Office actively reinstate paragonimiasis as a standard differential diagnosis in the clinical evaluation of presumed pulmonary tuberculosis (PTB) cases that do not respond to anti-tuberculosis therapy, particularly in the BaSulTa island group and other historically endemic areas of Mindanao. Furthermore, specialty societies, hospital training officers, and medical schools in the Zamboanga Peninsula should strengthen continuing professional development and undergraduate medical education by focusing on paraclinical test selection and preventive counseling for paragonimiasis, as these were identified as the primary areas of competency gaps rather than general parasitology knowledge. In addition, researchers, the Neglected Tropical Diseases program of the Department of Health, and graduate research institutions in the region are encouraged to expand the integrated tuberculosis–paragonimiasis active surveillance model, previously validated in Zamboanga del Norte and the wider Zamboanga Region, to Basilan and the still undocumented province of Sulu. This initiative is consistent with the WHO NTD Roadmap 2021–2030, which emphasizes the control of foodborne trematodes such as paragonimiasis through strengthened disease mapping, surveillance, and capacity building. Notably, despite being conducted two decades ago, this assessment remains the only clinical-factor study of its kind in the BaSulTa archipelago, highlighting a significant research gap that this paper seeks to bring to attention.

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