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# Clinical knowledge, practice patterns, and educational needs on incidental lung nodules among interns, residents, and general practitioners in Palestine

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## Abstract

**Background** Incidental lung nodules (ILNs) are increasingly detected through imaging, posing clinical and psychological challenges for healthcare providers, especially when local guidelines are lacking. This study assessed knowledge and fear related to ILNs among interns, residents, and general practitioners (GPs) in Palestine.

**Methods** A cross-sectional study was conducted using an online questionnaire distributed via social media platforms to interns, residents, and GPs across Palestine. The validated tool assessed demographics, knowledge, emotional responses, clinical practices, and perceived barriers regarding ILNs. SPSS version 25 was used for statistical analysis.

**Results** The mean age was 26 ( $\pm 3.22$ ) years; 53% were female. A majority of the participants (54%) were interns, and 83% had two or fewer years of professional experience. While 68% of participants reported being aware of ILN management guidelines, only 6% rated their understanding of these guidelines as excellent, and more than half (51%) indicated that they did not utilize any guidelines. The median knowledge score was 4 out of 7 [IQR: 2]. Female participants and those who received training in Palestine achieved significantly higher scores ( $p=0.012$  and  $p<0.001$ , respectively). Common management strategies included reviewing previous imaging (44%) and referring patients to specialists (30%). The primary barriers to effective ILN management were identified as insufficient training (62%) and limited clinical exposure (50.3%).

**Conclusion** This study reveals significant deficiencies in knowledge and confidence regarding ILNs among early-career clinicians in Palestine. The findings underscore the need for targeted educational interventions, the development of local guidelines, and increased clinical exposure to enhance competence and alleviate anxiety in

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managing incidental findings. Addressing these gaps is crucial for ensuring accurate diagnosis, appropriate follow-up, and improved patient outcomes.

**Keywords** Incidental lung nodules, Medical education, Palestine, Knowledge, Practice, Management guidelines, Cross-sectional study

## Background

Incidental lung nodules (ILNs) are asymptomatic findings that are increasingly identified in clinical practice, particularly during imaging studies conducted for unrelated purposes [1]. A pulmonary nodule is characterized as a well- or poorly defined, rounded or irregular opacity with a diameter of  $\leq 3$  cm. These nodules can be further classified into small nodules ( $\leq 10$  mm) and micro-nodules ( $< 3$  mm) [2]. Although often benign, ILNs can occasionally signify early-stage lung cancer, underscoring the importance of accurate identification and appropriate management.

With the growing utilization of various chest imaging modalities, the detection of ILNs has become more prevalent. A systematic review of 8 randomized controlled trials and 13 cohort studies indicated that the average rate of nodule detection per screening round is 20%, [3] with some studies reporting higher rates, reaching approximately 30% of all chest computed tomography (CT) scans [4]. While the majority of these nodules are benign, primarily resulting from prior or active infections or non-cancerous growths such as hamartomas, a small but significant proportion may represent early malignant lesions. Studies have demonstrated that approximately 6% of ILNs may progress to lung cancer, highlighting the necessity for timely and informed clinical responses and necessitating careful evaluation and follow-up, particularly among high-risk populations such as smokers [5].

To guide the evaluation and management of ILNs, several national and international guidelines have been established, including the Fleischner Society guidelines. These guidelines incorporate both nodule characteristics—such as size, density, morphology, and growth rate—and patient-related factors, including age, smoking history, and familial risk, to estimate malignancy risk and determine appropriate follow-up intervals [7]. However, variability in adherence to these guidelines persists among healthcare providers, potentially influenced by knowledge gaps, limited formal training, and even fear regarding potential malignancy. The increased detection rate of ILNs may have adverse effects if healthcare workers lack sufficient knowledge and training in the appropriate management of these findings. These adverse effects include increasing the psychological stress of the patient, leading to unnecessary further investigations or even invasive procedures such as surgery or biopsy, or conversely, underestimating the risk and missing a fatal cancer in its early stages [8].

Previous literature suggests that enhancing physicians' knowledge and confidence in managing ILNs can promote more consistent and effective clinical decision-making, reduce unnecessary interventions, and improve patient outcomes. This study aims to assess the clinical knowledge, practice patterns, and educational needs regarding ILNs among interns, residents, and general practitioners in Palestine. Additionally, it seeks to explore the extent of fear or anxiety associated with managing such findings. Subsequently, this research will support the development of targeted educational interventions and contribute to more standardized, evidence-based care for patients with ILNs.

## Methodology

### Study design and population

This cross-sectional study was conducted from January to June 2025 in Palestine. The inclusion criteria encompassed individuals  $\geq 24$  years old who were Palestinian interns, general practitioners (GPs), or residents employed in the Palestinian healthcare sector and who voluntarily consented to participate by completing the study questionnaire in its entirety. Interns were defined as medical graduates currently undergoing their mandatory internship; residents were physicians in residency programs across various specialties; and GPs included non-specialized doctors and family physicians. Medical students and specialists were excluded from the study, and any incomplete or invalid questionnaires were omitted. Participants were invited to partake voluntarily after the study's objectives and procedures were explained, and all participants provided informed consent.

### Data collection and assessment tool

The authors utilized a sample size calculator (<https://www.calculator.net/>) to determine the appropriate sample size, with a 5% margin of error and a 95% confidence interval. Based on the estimation of the number of doctors employed in the Palestinian health sector, the calculated sample size was approximately 370. A self-administered questionnaire, developed by the research team using recent evidence, recommendations, and peer-reviewed medical resources, was employed for data collection. The questionnaire comprised several domains, each containing questions designed to assess specific aspects. The first domain included demographic and background information (age, sex, country of study, level of medical proficiency, workplace, and years of

experience). The second domain contained questions to evaluate awareness and previous experiences with managing ILNs. The third domain assessed knowledge and concerns regarding ILNs, featuring seven questions on basic knowledge about ILNs (definition, size, initial evaluation step, optimal imaging modality for nodule characterization, characteristics suggesting benign versus malignant causes, and patient age associated with a higher likelihood of a malignant cause). Participants' concerns and emotional responses (fear/anxiety) were measured by asking them to rate their level of concern about an ILN being malignant and their comfort in discussing ILNs with patients. The fourth domain included questions to assess management practices and sources of learning about ILNs, encompassing clinical decision-making, treatments, and referral behavior regarding ILNs. The questionnaire was created on Google Forms in English and distributed online via widely used social media platforms, through groups specific to participants, such as groups for interns, residents, and GPs on Facebook and WhatsApp, to facilitate its dissemination among participants throughout Palestine.

### Statistical analysis

Data analysis was conducted utilizing IBM SPSS Statistics version 25. Descriptive statistics were employed to summarize the demographic and professional characteristics of participants, as well as their clinical experience, awareness, and knowledge concerning ILNs. Categorical variables were expressed as frequencies and percentages. The Shapiro-Wilk test was applied to assess the normality

of the continuous data for the knowledge score, revealing a non-normal distribution. Participants' knowledge was evaluated through seven multiple-choice questions, with each correct response earning one point, resulting in a total possible score ranging from 0 to 7. Given the non-normal distribution of the knowledge score among different groups, medians and interquartile ranges (IQRs) were used for summarization.

Group comparisons were executed using non-parametric tests: the Mann-Whitney U test was utilized for comparing knowledge scores between two groups (e.g., sex, country of medical education), while the Kruskal-Wallis H test was applied for comparisons across three or more independent groups (e.g., current role, years of experience, place of work). In instances where the Kruskal-Wallis test yielded significant results, post hoc pairwise comparisons were conducted using the Mann-Whitney U test, with Bonferroni correction applied to account for multiple comparisons. All p-values were two-tailed, and statistical significance was set at  $p < 0.05$ .

## Results

### Participant characteristics

A total of 304 healthcare professionals completed the questionnaire and were included in the final analysis, with a mean age of 26 years ( $\pm 3.22$ ). The sample comprised 143 males (47%) and 161 females (53%). Most respondents completed their medical education in Palestine (69%), while 31% were educated abroad. Regarding professional status, the majority were interns (54%), followed by residents (23%) and general practitioners (22%). Most participants (83%) had 0–2 years of clinical experience, with 13% having 3–5 years and only 4% possessing over 5 years of experience. Regarding their workplace, 44% were employed in governmental hospitals, 35% in private hospitals, and 21% in other healthcare settings (Table 1).

### Clinical experience and awareness regarding ILNs

Encounters with ILNs were relatively infrequent, with over half of the participants (51%) reporting rare encounters, and only 1% encountering them almost daily. Residents were slightly more likely to encounter ILNs than interns or general practitioners. Previous involvement in a multidisciplinary team (MDT) discussion regarding ILNs was reported by 34% of participants, with the highest involvement among residents (47%). Pulmonologists were the most frequently selected referral destination for ILNs (48%), followed by thoracic surgeons (30%) and oncologists (16%). In terms of management approach, the most common strategy was reviewing previous imaging (44%), followed by referral to a specialist (30%). Only 19% indicated that management would vary based on nodule characteristics. Two-thirds of participants (68%) reported

**Table 1** Participant demographic and professional characteristics

Characteristic	Value
Age (mean $\pm$ standard deviation)	26 $\pm$ 3.22
Sex, n (%)	
- Male	143 (47)
- Female	161 (53)
Country of Medical Education, n (%)	
- Palestine	211 (69)
- Abroad	93 (31)
Current role, n (%)	
- Intern	165 (54)
- General Practitioner	68 (22)
- Resident	71 (23)
Years of experience, n(%)	
- 0–2 years	252 (83)
- 3–5 years	40 (13)
- >5 years	12 (4)
Place of Work, n (%)	
- Governmental Hospitals	134 (44)
- Private Clinics	106 (35)
- Others	64 (21)

awareness of different international guidelines for ILN management, though only 6% rated their understanding of those guidelines as excellent, with the majority (49%) reporting a good understanding. The most utilized guideline was the ACR Lung CT Screening Reporting and Data System (Lung-RADS) (19%), followed by the National Comprehensive Cancer Network (NCCN) guideline (17%) and the Fleischner Society Guidelines (13%). Notably, over half of the participants (51%) reported not using any formal guidelines at all (Table 2).

Regarding the perceived risk of malignancy, a majority of participants (54%) expressed moderate concern when encountering an ILN. Only 3% were extremely concerned, while 5% reported no concern. This pattern was consistent across all professional roles. When queried about their comfort level in discussing ILNs with patients, a majority (57%) expressed a neutral stance, while 28% felt uncomfortable (Table 2).

#### Knowledge assessment

Participants' knowledge concerning ILNs was quantitatively assessed through seven questions. The overall median knowledge score was 4 [IQR: 2], with a mean score of 4.23 (SD 1.41) out of a maximum of 7. The highest-performing question was the definition of an ILN, with 88% answering correctly. This was followed by the question about identifying red flags associated with lung nodules (83%) and the first step in evaluating an ILN (71%). In contrast, only 32% correctly identified the typical size range for an ILN. Other lower-scoring items included characteristics of benign nodules (47%) and patient age as a risk factor (48%). There were no substantial differences in question performance across healthcare roles (Table 3).

#### Comparison of knowledge scores across participant characteristics

Female participants had a significantly higher median knowledge score (5 [IQR: 1]) compared to males (4 [IQR: 2];  $p=0.012$ ). Participants who studied medicine in Palestine scored higher (5 [IQR: 1]) than those who studied abroad (4 [IQR: 2];  $p<0.001$ ). Knowledge scores were also significantly associated with years of experience ( $p=0.001$ ). Post hoc analysis revealed that participants with 0–2 years of experience scored significantly higher than both the 3–5 year group ( $p=0.011$ ) and the > 5 year group ( $p=0.006$ ). No statistically significant differences were observed in knowledge scores based on current role ( $p=0.6$ ) or place of work ( $p=0.9$ ) (Table 4).

#### Perceived barriers to ILN management and knowledge acquisition

The most frequently reported barrier to effective ILN management was insufficient training, reported by 62%

of participants. Other reported challenges included limited access to resources (17.7%), uncertainty in decision-making (9.2%), lack of clear protocols (6.9%), and financial issues (4.3%). When asked about barriers to gaining knowledge, the most common reason was that ILNs are rarely encountered in practice (50.3%). Additional barriers included lack of formal training (22.4%), time constraints (13.3%), perception that the topic is not a priority (10.5%), lack of reliable resources (2.9%), and lack of follow-up (0.3%).

#### Discussion

This cross-sectional study assessed the knowledge and fear related to ILNs among 304 Palestinian medical trainees and practitioners. Overall, the knowledge level was suboptimal, with a median score of 4 out of 7 (IQR: 2). Although there was no statistically significant difference in knowledge between interns, residents, and general practitioners ( $p=0.6$ ), further analysis revealed significantly higher knowledge scores among females ( $p=0.012$ ), graduates of local medical institutions ( $p=0.001$ ), and those with less than two years of clinical experience ( $p=0.001$ ). These findings suggest that demographic and educational factors may influence ILN-related competence more strongly than clinical rank or duration in practice.

Despite 68.1% of participants reporting awareness of ILN management guidelines, only 6% rated their understanding as excellent, and 51% indicated that they do not apply any formal guidelines in clinical settings. Substantial knowledge gaps were observed in core clinical concepts: only 32% correctly identified the typical size of ILNs, 48% recognized appropriate risk factors for malignancy, and 47% could differentiate benign radiographic features. This highlights a disconnect between superficial awareness and applied clinical knowledge, underscoring the need for targeted training on radiologic incidental findings.

Fear associated with ILNs was prevalent and inversely related to knowledge. Over half of participants (54%) expressed moderate concern, and 28% reported feeling uncomfortable discussing ILNs with patients. Interns were particularly affected, indicating that lack of knowledge may contribute to clinical hesitation or anxiety. While residents had greater exposure to multidisciplinary case discussions (47%), this did not correspond to significantly higher knowledge scores, suggesting that observational exposure alone may be insufficient to build clinical confidence. Together, these findings reflect a combination of cognitive and emotional challenges in managing ILNs among early-career physicians.

A comparative analysis with a recent study by Cheng et al. (2024) on Chinese adults underscores similarities and differences in knowledge and attitudes toward

**Table 2** Participants' clinical experience and awareness of incidental lung nodule management

Variable	Interns (no.= 165)	General Practitioners (no. = 68)	Residents (no. = 71)	Total (no. = 304)
Frequency of encountering ILNs, n (%)				
- Almost daily	0 (0)	1 (2)	1 (1)	2 (1)
- Weekly	4 (2)	3 (4)	2 (3)	9 (3)
- Monthly	18 (11)	7 (10)	11 (16)	36 (12)
- A few times every year	58 (35)	13 (19)	32 (45)	103 (34)
- Rarely	85 (52)	44 (65)	25 (35)	154 (51)
Previous involvement in MDT discussion about ILN, n (%)				
- Yes	47 (29)	23 (34)	33 (47)	103 (34)
- No	118 (71)	45 (66)	38 (53)	201 (66)
Referral Destination, n (%)				
- No need for referral	1 (1)	1 (2)	0 (0)	2 (1)
- Internist	0 (0)	1 (2)	0 (0)	1 (0)
- Pulmonologist	83 (50)	32 (47)	32 (47)	151 (48)
- Thoracic surgeon	52 (32)	19 (28)	20 (28)	91 (30)
- Oncologist	24 (15)	13 (14)	12 (17)	49 (16)
- Radiologist	5 (3)	2 (3)	3 (4)	10 (3)
Management approach, n (%)				
- Ask for a previous X-ray	88 (53)	28 (41)	18 (25)	134 (44)
- Management differs according to nodule characteristics	30 (18)	10 (15)	18 (25)	58 (19)
- Recommend follow-up imaging	12 (7)	6 (9)	4 (6)	22 (7)
- Refer to a specialist	35 (21)	24 (35)	31 (44)	90 (30)
Awareness of the presence of guidelines, n (%)				
- Yes	115 (70)	40 (59)	52 (73)	207 (68)
- no	50 (30)	28 (41)	19 (27)	97 (32)
Guideline understanding, n (%)				
- Excellent	6 (4)	6 (9)	6 (9)	18 (6)
- Good	76 (46)	34 (50)	39 (55)	149 (49)
- Fair	61 (37)	17 (25)	19 (27)	97 (32)
- poor	22 (13)	11 (16)	7 (10)	40 (13)
Guideline or risk assessment tool used, n (%)				
- I don't use any guidelines	95 (57)	39 (57)	21 (30)	155 (51)
- ACR lung-RADS	26 (16)	17 (25)	14 (20)	57 (19)
- Fleischner Society Guidelines	16 (10)	6 (9)	17 (24)	39 (13)
- NCCN Guidelines	28 (17)	6 (9)	19 (27)	53 (17)
Concern about malignancy, n (%)				
- Extremely concerned	7 (4)	1 (2)	2 (3)	10 (3)
- Very concerned	29 (18)	16 (24)	6 (9)	51 (17)
- Moderately concerned	90 (55)	37 (54)	36 (51)	163 (54)
- slightly concerned	34 (21)	10 (15)	21 (30)	65 (21)
-Not concerned	5 (3)	4 (6)	6 (9)	15 (5)
Comfort discussing lung nodules with patients, n (%)				
- Very comfortable	1 (0)	2 (3)	4 (6)	7 (2)

**Table 2** (continued)

Variable	Interns (no.= 165)	General Practitioners (no. = 68)	Residents (no. = 71)	Total (no. = 304)
- Comfortable	15 (9)	14 (21)	6 (9)	35 (12)
- Neutral	91 (55)	38 (56)	43 (61)	172 (57)
- Uncomfortable	56 (34)	13 (19)	17 (24)	86 (28)
- Very Uncomfortable	2 (1)	1 (2)	1 (1)	4 (1)

ACR Lung-RADS ACR Lung CT Screening Reporting and Data System

NCCN The National Comprehensive Cancer Network

**Table 3** Knowledge assessment on incidental lung nodule management: correct and incorrect response rates by healthcare role

Question	Interns (no.= 165)	General Practitioners (no. = 68)	Residents (no. = 71)	Total (no. = 304)
Q1: Which of the following best describes an incidental lung nodule? n (%)				
- Correct answer	146 (88)	61 (90)	60 (84)	267 (88)
- Incorrect answer	19 (12)	7 (10)	11 (16)	37 (12)
Q2: What is the typical size range for a lung nodule to be considered 'incidental'? n (%)				
- Correct answer	47 (29)	20 (29)	29 (41)	96 (32)
- Incorrect answer	118 (72)	48 (71)	42 (59)	208 (68)
Q3: What is the first step in evaluating an incidental lung nodule discovered on imaging? n (%)				
- Correct answer	130 (79)	47 (69)	40 (56)	217 (71)
- Incorrect answer	35 (21)	21 (31)	31 (44)	87 (29)
Q4: Which imaging modality is the most commonly used to follow up an incidental lung nodule? n (%)				
- Correct answer	83 (50)	34 (50)	46 (69)	166 (55)
- Incorrect answer	82 (50)	34 (50)	22 (31)	138 (45)
Q5: Which of the following is not a characteristic of benign lung nodules? n (%)				
- Correct answer	77 (47)	30 (44)	35 (49)	142 (47)
- Incorrect answer	88 (53)	38 (56)	36 (51)	162 (53)
Q6: Which of the following patient ages increases the risk of malignancy? n (%)				
- Correct answer	86 (52)	31 (46)	30 (42)	147 (48)
- Incorrect answer	79 (48)	37 (54)	41 (58)	157 (52)
Q7: Which of the following are considered red flags for lung nodules? n (%)				
- Correct answer	141 (86)	55 (81)	55 (78)	251 (83)
- Incorrect answer	24 (14)	13 (19)	16 (22)	53 (17)

**Table 4** Mean knowledge scores by participant demographic and professional characteristics

Variable	Knowledge score median(interquartile range)	Mean rank	P-value
Sex			
- Male	4 (2)	139.41	0.012
- Female	5 (1)	164.12	
Country of Medical Education			
- Palestine	5 (1)	164.36	< 0.001
- Abroad	4 (2)	125.60	
Current role			
- Intern	4 (1)	156.87	0.6
- General Practitioner	4 (2)	145.14	
- Resident	4 (2)	149.40	
Years of experience			
- 0–2 years	4 (1)	160.12	0.001
- 3–5 years	4 (2)	123.91	
- >5 years	2 (3.50)	87.88	
Place of Work			
- Governmental	5 (2)	160.94	0.9
Hospitals			
- Private Clinics	4 (1)	153.90	
- Others	4 (2)	132.51	

pulmonary nodules [9]. Cheng and colleagues identified significant knowledge deficits but moderate attitudes and practices among general populations, demonstrating that knowledge directly influences clinical behavior. Similarly, our study suggests that healthcare providers have gaps in knowledge that could adversely affect their clinical decision-making and patient management, but we uniquely emphasize the element of professional anxiety and fear related to incidental findings. The elevated fear levels noted, especially among interns, may be related to insufficient training and unclear management guidelines, leading to psychological distress and potentially suboptimal clinical decisions.

The psychological distress associated with incidental nodule detection, described as significant in longitudinal studies, highlights the importance of effective communication strategies in clinical practice [10]. Research by Sullivan et al. (2015) indicates that inadequate patient-provider communication and uncertainty about nodules

often lead to prolonged distress, further emphasizing the need for better educational interventions and clear communication strategies [11]. Similarly, Slatore et al. (2018) stress that patient-centered communication significantly mitigates anxiety and distress, emphasizing that clear, empathetic communication strategies are crucial for optimal patient care and reducing unnecessary psychological burdens [12].

Multiple studies have underscored the complexity of managing ILNs. The review by Schmid-Bindert et al. (2022) emphasized that although the majority of ILNs are benign, a small but clinically significant proportion are malignant [13]. They advocated for improved patient-tracking systems, multidisciplinary management, and

risk stratification models to distinguish benign from malignant nodules effectively. Similarly, Gould et al. (2015) highlighted that while the rate of nodule detection has increased with improved imaging technologies, many nodules are not followed up adequately [14]. They stressed the role of decision support systems and standardized reporting to mitigate these shortcomings.

The American College of Chest Physicians (ACCP), Fleischner Society, and British Thoracic Society (BTS) have all proposed detailed guidelines for the management of IPNs. For example, the BTS guidelines emphasize volumetric analysis and malignancy risk models like the Brock and Herder models, which are supported by evidence to guide follow-up and intervention [15]. The study by MacMahon et al. (2017), on behalf of the Fleischner Society, further elaborated on size-based surveillance protocols and the need for individualized management strategies [7]. In contrast, the Asian consensus guidelines, as discussed by Bai et al. (2016), propose longer follow-up periods and a more conservative approach, reflecting regional disease patterns such as tuberculosis and non-smoking related adenocarcinoma [16].

The Palestinian healthcare setting presents unique contextual challenges. Access to advanced imaging modalities such as positron emission tomography-CT (PET-CT) and high-resolution CT is inconsistent and often centralized in urban centers, limiting equitable diagnostic services [17]. Additionally, the lack of national clinical guidelines or structured surveillance protocols for pulmonary nodules complicates uniform care delivery. This fragmented approach may contribute to uncertainty and fear among healthcare professionals who are unsure of appropriate next steps following incidental findings [18]. Institutional efforts to create context-appropriate management pathways and facilitate access to continuing medical education are critically needed.

Clinically, our results underscore an urgent need for targeted educational initiatives. Educational programs emphasizing ILN management should be integrated systematically into medical curricula, residency training

programs, and continuous professional development sessions for general practitioners. Effective interventions could include interactive workshops, guideline dissemination, structured mentorship programs, and clinical case discussions emphasizing real-world management scenarios. Simulation-based training modules and access to multidisciplinary discussions could further enhance practical competencies [19].

This study has several strengths. It employs a comprehensive evaluation across three distinct healthcare provider groups, offering robust comparative data. The questionnaire was developed based on validated tools and pilot-tested, which supports the reliability of the findings. Moreover, the focus on both knowledge and fear provides a multidimensional view that has been largely unexplored in similar studies. However, the study also has important limitations. First, its cross-sectional design limits the ability to establish causality between knowledge levels and clinical behaviors. Second, reliance on self-reported data introduces potential biases, including social desirability bias. Third, the use of convenience sampling may limit the generalizability of findings to the broader healthcare population. Fourth, because the survey link was voluntary and the overall response rate was not recorded, non-response bias cannot be ruled out; likewise, the exclusion of incomplete questionnaires (Y of X total responses) may have introduced attrition bias. Fifth, the self-developed questionnaire—although pilot-tested—may carry instrumentation bias, and the subjective fear items may not fully capture emotional nuance. Sixth, unmeasured confounders such as specialty (e.g., radiology vs. internal medicine) and years since graduation were not adjusted for in multivariable analyses, leaving residual confounding possible. Lastly, conducting the study in Palestine adds regional specificity that, while valuable, may restrict direct comparisons with data from more resource-rich healthcare systems.

Future research should adopt longitudinal and interventional study designs to evaluate how knowledge and emotional responses evolve over time and whether targeted training interventions produce sustained improvements. Additionally, qualitative investigations are warranted to explore the lived experiences of healthcare providers managing incidental findings. Understanding the nuances of provider anxiety, perceived barriers to effective management, and institutional support structures could enrich current understanding and inform policy development. Multi-center and cross-national studies could help elucidate regional differences and guide the creation of adaptable, evidence-based protocols [20].

## Conclusion

This study provides a comprehensive evaluation of the knowledge and emotional responses of healthcare providers toward ILNs in a Palestinian context. The findings reveal substantial knowledge deficits and varying levels of fear, particularly among interns, which can adversely impact clinical decision-making and patient care. The absence of national guidelines, inconsistent access to diagnostic tools, and limited educational support further exacerbate these challenges. Addressing these gaps through targeted education, structured communication strategies, and system-level reforms is essential to empower clinicians, improve patient outcomes, and standardize care. This research underscores the urgent need for context-specific training programs and policy interventions to bridge the gap between knowledge and practice while promoting emotional resilience and clinical confidence among healthcare professionals.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-025-08242-z>.

Supplementary Material 1.

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None.

## Authors' contributions

Alhareth M. Amro, Osama J. Makhameh, and Raghad Sweity contributed equally to the study's conception, data analysis, and drafting and editing of the manuscript. Tala Dweik, Sandra S. Hnaihien, Marah Ghassan Shareef, and Khaled Dawabsha were responsible for data collection. Yousef Abu Asbeh supervised the project and contributed to the critical editing and revision of the manuscript. All authors read and approved the final version.

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## Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

All procedures performed in this study involving human participants complied with the institutional and/or national research committee ethical standards and the 1964 Helsinki declaration and subsequent amendments or equivalent ethical standards. The study was designed and conducted in accordance with the ethical principles established by Al-Quds University. Therefore, ethical approval was obtained from the Institutional Review Board Committee, Al-Quds University. Written informed consent was obtained from all the participants for the participation of this study and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

### Consent for publication

The manuscript contains no images or videos—not applicable.

### Competing interests

The authors declare no competing interests.

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