

Awareness Regarding the One Health Approach Among Postgraduate Residents of a Tertiary Care Hospital in Northern India: A Cross-Sectional Study

Arunima Sharma^{1*}, Prashant Barailly¹, Abhishek Sahu¹, Shivali Singh¹, Dhiraj Kumar Srivastava¹, Shushil Kumar Shukla²

Background: The One Health model recognizes the complex interrelationships among human, animal, and environmental health and has emerged as a pivotal framework for tackling zoonotic diseases, antimicrobial resistance (AMR), food safety concerns, and emerging infectious threats. However, it has global significance; the level of awareness regarding the One Health approach among medical practitioners in low- and middle-income countries (LMICs) such as India has not been thoroughly evaluated. The objective of this study was to assess the level of awareness of the One Health paradigm and its three fundamental pillars, human, animal, and environmental health, among postgraduate (PG) medical residents at a tertiary care teaching hospital.

Methods: A cross-sectional, institution-based investigation was undertaken involving 295 postgraduate medical residents at a tertiary care facility in Uttar Pradesh, India, during the period spanning November 2022 to January 2023. The methodology employed was convenience sampling. A self-administered, semi-structured, pre-validated questionnaire was utilized to evaluate the levels of awareness across three domains of One health (human health, animal health, and environmental health) and to gather sociodemographic data. The data were subjected to analysis utilizing SPSS version 25. Descriptive statistics and chi-square tests were implemented, with statistical significance established at $p < 0.05$.

Results: A total of 295 individuals participated in the study, comprising 53.9% males and 46.1% females, with 45.1% originating from para-clinical departments, 34.9% from clinical departments, and 20.0% from pre-clinical departments. A commendable level of awareness regarding the One Health framework was observed in 90.8% of participants, pertaining to the interconnectedness of human, animal, and environmental health. Domain-specific knowledge was found to be proficient in 53.9% for human health, 86.4% for animal health, and 40.3% for environmental health. A statistically significant relationship was identified between gender and awareness of human health ($\chi^2=6.284$, $p=0.012$) as well as environmental health ($\chi^2=4.451$, $p=0.035$). Furthermore, departmental affiliation exhibited a significant correlation with awareness of environmental health ($\chi^2=7.361$, $p=0.025$) and animal health ($\chi^2=21.83$, $p<0.001$).

Conclusion: Despite a high overall conceptual awareness of the One Health paradigm (90.8%), domain-specific knowledge deficiencies are evident, with human health awareness being the weakest domain (53.9% adequate knowledge), followed by environmental health (59.7%), while animal health awareness was comparatively strong (86.4%). Gender and departmental affiliation were identified as significant determinants of One Health awareness. Incorporation of One Health principles into postgraduate medical curricula and continuing professional development programmes is imperative to equip future health practitioners with the requisite interdisciplinary competencies.

Introduction

The notion of One Health embodies a synergistic, multidisciplinary, and transdisciplinary methodology aimed at attaining optimal health outcomes through the recognition of the inherent interrelation among humans, animals, plants, and their mutual environment.¹⁻³

Globally, it is estimated that roughly 60% of identified infectious diseases affecting humans are of zoonotic origin, with 75% of newly emerging infectious diseases stemming from animal reservoirs.^{4,5} According to the World Health Organization (WHO), zoonotic diseases account for an estimated one billion cases of illness and millions of fatalities globally on an annual basis.⁶

¹MD, Community Medicine, Uttar Pradesh University of Medical Sciences, Saifai, Uttar Pradesh, India

²PhD, Statistics, Uttar Pradesh University of Medical Sciences, Saifai, Uttar Pradesh, India

Correspondence to: Arunima Sharma, MD, Community Medicine, Uttar Pradesh University of Medical Sciences, Saifai, Uttar Pradesh, India. E-mail: Surabhisharma19010@gmail.com

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These threats are exacerbated by accelerating ecological disruption: rapid urbanization, deforestation, increased interactions between livestock and wildlife, alterations in agricultural methodologies, and the globalization of trade in animal products have collectively heightened the risks associated with cross-species transmission.⁷

Antimicrobial resistance (AMR) represents a critical area where the One Health approach is essential. The World Health Organization (WHO) has classified AMR as one of the foremost global public health challenges, AMR arises from the inappropriate utilization of antimicrobials across human healthcare, veterinary medicine, and agricultural practices, and can only be effectively mitigated through integrated One Health monitoring and responsible management.^{8,9}

India as the most populous country globally, characterized by an extensive livestock sector (the largest worldwide), intricate human-animal interactions, a substantial incidence of zoonotic diseases including rabies, brucellosis, leptospirosis, and JE, as well as a swiftly growing medical workforce, India encounters distinctive challenges pertaining to One health.¹⁰ The National Action Plan on Antimicrobial Resistance (AMR) and India's National One Health Framework, formulated in accordance with international strategies, highlight the nation's institutional dedication to this integrative approach. Nonetheless, the application of One Health principles within medical education and clinical practice continues to be markedly constrained.¹¹

Medical practitioners play an essential role within the One Health initiative, as they frequently represent the initial contact point for manifestations of zoonotic diseases and act as leading figures in public health communication within their communities. Nonetheless, the medical education framework in India remains predominantly fragmented, exhibiting a significant lack of integration of perspectives related to veterinary, environmental, or ecological health.¹² Postgraduate residents assume a crucial transitional role: they operate simultaneously as primary healthcare providers and as prospective academics, policy shapers, and specialist clinicians. Consequently, evaluating their foundational awareness of One health is not only scientifically relevant but also bears significant implications for the development of curricula and policy formulation.

Despite the growth of One Health scholarship globally, few studies have assessed awareness among Indian medical postgraduate residents. Existing research

conducted in Asia and Africa reveals considerable deficiencies in knowledge, even among healthcare practitioners who are directly engaged in the management of zoonotic diseases.^{13,14} Gaining insight into the foundational awareness, pinpointing domain-specific deficiencies, and examining the sociodemographic factors influencing One Health knowledge among postgraduate residents can yield substantial evidence base for the development of targeted educational interventions.

This study was therefore designed with the following objectives:

- To assess awareness regarding the One Health approach among postgraduate residents of a tertiary care hospital.
- To determine associations between sociodemographic profile and awareness of the One Health approach.

Methods

Study Design and Setting

This research was conducted as an institution-based, cross-sectional descriptive investigation within a tertiary care teaching hospital located in Uttar Pradesh, India. The timeframe for this study spanned from November 2022 to January 2023.

Study Population and Sampling

The study population consisted of all postgraduate medical residents enrolled at the institution during the designated study period. Convenience sampling was utilized to select participants for inclusion in the study. Residents who willingly provided informed consent and were present during the data collection interval were incorporated into the sample. There was no exclusion criteria related to the year of residency or the specific medical specialty. Ultimately, a total of 295 participants were included, forming the final analytic cohort.

Ethical Approval

The Institutional Ethics Committee granted approval for the study (Reference No. 257/RC/UPUMS/2023-24, dated 05 January 2024). All participants were required to provide written informed consent prior to their involvement in the study. The confidentiality of the data was rigorously upheld throughout the duration of the research.

Data Collection Tool

A self-administered, semi-structured, pre-designed, and pre-tested instrument was employed for the purpose

of data collection. The instrument was disseminated through Google Forms. It was composed of two distinct sections:

Section I: Sociodemographic variables encompassing age, gender, family structure, socioeconomic status, geographical location, and departmental affiliation (clinical, para-clinical, or pre-clinical).

Section II: A series of multiple-choice inquiries evaluating the awareness of One health across three critical domains as human health (encompassing diseases, lifestyle factors, and medical implications), animal health (addressing welfare, diseases, and conservation issues), and environmental health (focusing on pollution, habitat preservation, and climate change). Each question was designed with a single correct answer. Responses were categorized as 'Good Knowledge' or 'Poor Knowledge' based on the ratio of correct answers.

The instrument was subject to pre-testing among a select cohort of postgraduate residents not involved in the primary study, leading to minor adjustments for enhanced clarity and understanding.

Variable Definitions

The principal exposure variables were gender (male/female) and departmental affiliation (clinical, para-clinical, or pre-clinical). The outcome variables were dichotomous knowledge scores across three One Health domains: awareness of human health, awareness of environmental health, and awareness of animal health (classified as 'Good' or 'Poor' based on a predetermined cut-off like for human health is ≤ 5 , environment health is ≤ 10 and animal health is ≤ 7).

Statistical Analysis

Data were systematically entered into Microsoft Excel and subsequently analysed utilizing IBM SPSS Statistics, version 25. Descriptive statistics were articulated as frequencies and percentages for categorical variables. The chi-square (χ^2) test was employed to assess associations between sociodemographic variables and domain specific One Health awareness. Statistical significance was determined at $p < 0.05$ within a 95% confidence interval. Degrees of freedom (df) and χ^2 values are documented for all significance tests.

Reporting Standards

This investigation was executed and reported in alignment with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist applicable to cross-sectional studies.¹⁵

Table 1: Distribution of study participants regarding Sociodemographic Profile (N=295)

Sociodemographic Profile			Frequency (N=295)	
S. No.	Variables	Subgroup	Frequency (n)	Percentage (%)
1.	Gender	Male	159	53.9%
		Female	136	46.1%
2.	Department they belong to?	Clinical	103	34.9%
		Para-Clinical	133	45.1%
		Pre-Clinical	59	20.0%

Results

Sociodemographic Profile

A total of 295 postgraduate medical residents engaged in the study. The gender distribution was comprised of 159 males (53.9%) and 136 females (46.1%). In terms of departmental affiliation, the largest representation (133 participants, 45.1%) was from para-clinical departments, followed by clinical departments (103 participants, 34.9%), and pre-clinical departments (59 participants, 20.0%). The preponderance of participants was aged between 20 and 25 years, originating from urban backgrounds, and residing in nuclear family structures (Table 1).

Domain-Specific One Health Awareness

Table 2 delineates the distribution of cognizance across the three domains of One health. The awareness pertaining to animal health was found to be the most pronounced, as evidenced by 255 participants (86.4%) exhibiting proficient knowledge. A satisfactory level of awareness regarding environment health was indicated by 176 participants (59.7%). Conversely, awareness of human health was the least prevalent, with merely 159 participants (53.9%) categorized as possessing adequate knowledge, rendering it the domain exhibiting the most significant knowledge deficiency 136 participants (46.1%) exhibited inadequate awareness of human health.

A notable observation was that 268 participants (90.8%) accurately recognized the interdependence of human, animal, and environmental health as fundamental to the One Health paradigm, signifying a robust conceptual awareness even among individuals who displayed domain-specific deficiencies.

Association Between Gender and One Health Awareness

The application of the chi-square test disclosed a statistically significant correlation between gender and awareness within the human health domain ($\chi^2=6.284$,

Table 2: Distribution according to knowledge of one health [including human, environment & animal health] (N=295)

Variables	Subgroup	Frequency (N=295)	Percentage (%)
Knowledge on Human Health	Good Knowledge	159	53.9
	Poor Knowledge	136	46.1
Knowledge on Environment Health	Good Knowledge	176	59.7
	Poor Knowledge	119	40.3
Knowledge on Animal Health	Good Knowledge	255	86.4
	Poor Knowledge	40	13.6

Table 3: Association between sociodemographic factors and knowledge of one health among post graduate residents of tertiary care hospital(N=295)

S. No.	Variables	Subgroup	Poor Knowledge (%)	Good Knowledge (%)	Total	Test of Significance		
						x2	df	P
1	Human Health	Female	52	84	136	6.284	1	.012
		Male	84	75	159			
		Total	136	159	295			
2	Environment Health	Female	46	90	136	4.451	1	.035
		Male	73	86	159			
		Total	119	176	295			
3	Animal Health	Female	13	123	136	3.445	1	.063
		Male	27	132	159			
		Total	40	255	295			

df = 1, p = 0.012) as well as within the environmental health domain ($\chi^2 = 4.451$, df = 1, p = 0.035). Females exhibited a proportionately greater level of proficient knowledge in both human health (84/136, 61.8%) and environmental health (90/136, 66.2%) in comparison to their male counterparts (75/159, 47.2% and 86/159, 54.1%, respectively). No statistically significant gender-based disparity was identified concerning awareness of animal health ($\chi^2 = 3.445$, df = 1, p = 0.063) (Table 3).

Association Between Departmental Affiliation and One Health Awareness

Departmental affiliation demonstrated a significant correlation with both environmental health awareness ($\chi^2=7.361$, df=2, p=0.025) and animal health awareness ($\chi^2=21.83$, df=2, p<0.001), yet no significant association was observed with human health awareness ($\chi^2=4.343$, df=2, p=0.114) (Table 4). Para-clinical residents exhibited the highest level of proficient knowledge regarding animal

Table 4: Association between departmental affiliation and one health awareness among Post Graduate Residents of Tertiary Care Hospital (N=295)

S.No.	Variables	Subgroup	Good Knowledge (%)	Poor Knowledge (%)	Total	Test of Significance		
1. Human health						X2	df	P
1	Department	Clinical	48	55	103	4.343	2	.114
		Para-Clinical	80	53	133			
		Pre-Clinical	31	28	59			
2. Environment health								
2	Department	Clinical	51	52	103	7.361	2	.025
		Para-Clinical	89	44	133			
		Pre-Clinical	36	23	59			
3. Animal health								
3	Department	Clinical	76	27	103	21.83	2	.000
		Para-Clinical	125	8	133			
		Pre-Clinical	54	5	59			

health (125/133, 94.0%), followed by pre-clinical residents (54/59, 91.5%) and clinical residents (76/103, 73.8%). In terms of environmental health awareness, para-clinical residents again demonstrated the most substantial proficient knowledge (89/133, 66.9%) in comparison to pre-clinical (36/59, 61.0%) and clinical departments (51/103, 49.5%) (Figures 1 and 2).

HUMAN HEALTH

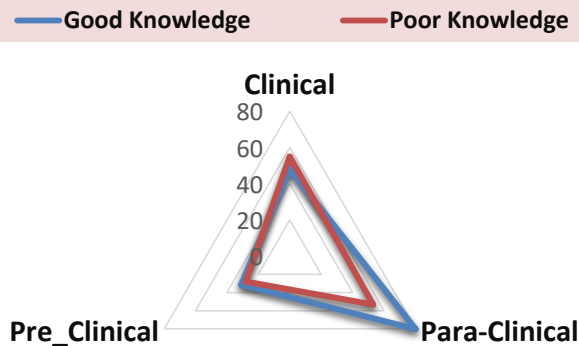


Figure 1: Human health

ANIMAL HEALTH

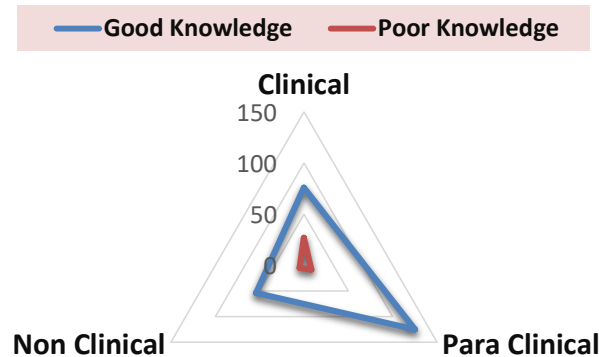


Figure 2: Animal health

ENVIRONMENT HEALTH

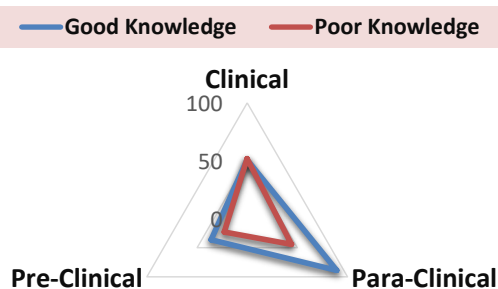


Figure 3: Environment health

Discussion

This cross-sectional investigation yields significant contributions to the understanding of domain specific One Health awareness among postgraduate medical residents at a tertiary care teaching institution located in northern India. The results elucidate a paradox that bears implications for medical education policy: while 90.8% of respondents could conceptually recognize the interdependence of human, animal, and environmental health a fundamental principle of One Health domain-specific knowledge exhibited considerable inconsistency. Notably, human health awareness (53.9%) emerged as the weakest domain, followed by environmental health (59.7%), whereas animal health awareness was comparatively robust (86.4%). This finding challenges the assumption that clinically trained practitioners inherently possess adequate awareness of all One Health pillars, particularly the human health dimensions relevant to interdisciplinary practice.

The overall conceptual awareness reported in this research (90.8%) is optimistic and corresponds with findings from a multi institutional study conducted by Mableson *et al.* (2014) in East Africa and South Asia, which demonstrated that health professionals generally acknowledged the interconnectedness of human and animal health yet lacked the operational knowledge requisite for practical application.¹³ Similarly, a study in sub-Saharan Africa by Rüegg *et al.* (2017) emphasized that, despite high levels of conceptual acceptance of One health, practical interdisciplinary collaboration was infrequent, indicating a disjunction between awareness and implementation.¹⁶

The domain specific results of this investigation are particularly enlightening. Awareness pertaining to animal health was the highest (86.4%), aligning with research from veterinary centric contexts and potentially reflecting the relative prominence of zoonotic diseases such as rabies, avian influenza, and brucellosis within Indian public health discourse. A study conducted by Singh *et al.* (2020) among Indian health practitioners indicated that awareness regarding zoonotic diseases, especially rabies and leptospirosis, was considerably superior to awareness of environmental health interconnections.¹⁷ This trend likely mirrors the historical focus within Indian medical education on the management of infectious diseases, particularly within the framework of animal-to-human transmission.

Human health awareness was found to be the lowest across all domains at 53.9%, indicating that nearly

half the participants (46.1%) demonstrated inadequate knowledge of human health dimensions within the One Health framework. This finding is particularly striking given that postgraduate medical education is inherently focused on human health; it suggests that the One Health conceptualization of human health encompassing its interconnections with zoonotic diseases, environmental determinants, and lifestyle factors is insufficiently integrated into current training. This observation is analogous to findings from a Nigerian study by Fasina *et al.* (2015), which reported that 57% of medical students and residents exhibited adequate knowledge of One Health domains, with human disease recognition being more prevalent than awareness of environmental determinants.¹⁸ It may be posited that while postgraduate medical education covers pathophysiology extensively, it neglects the broader interdisciplinary dimensions of human health within the One Health paradigm, reinforcing a siloed clinical perspective rather than an integrative one.

Environmental health awareness was moderate at 59.7%, with 40.3% of participants demonstrating inadequate knowledge in this domain. While this represents a higher level of awareness than human health, the proportion with poor environmental health knowledge remains substantial and warrants attention. This pattern is consistent with international literature.

A systematic review conducted by Atlas and Maloy (2014) indicated that environmental health constituted the least integrated element of One health within health professional curricula worldwide, attributed to the historical separation of environmental science from medicine.¹⁹ In the Indian context, a study by Vanak *et al.* (2021) noted that environmental health and ecosystem services are seldom included in MBBS or MD curricula, notwithstanding their established connections to disease emergence.¹¹ The urgency of rectifying this gap is accentuated by the identification of environmental degradation including deforestation, wetland drainage, and climate change as a principal driver of zoonotic spillover events, including the COVID-19 pandemic.⁵ Regarding the substantial correlation between gender and awareness of One health, female participants exhibited superior knowledge in both human health (61.8% vs 47.2%) and environmental health (66.2% vs 54.1%) relative to their male counterparts. Although this correlation has rarely been scrutinized within the One health scholarly corpus, it aligns with broader observations in health education research. A study conducted by Krupat *et al.* (2020) revealed that female medical students demonstrate

heightened interest in holistic, patient-centered, and public health paradigms, which may predispose them to enhanced awareness in interconnected health domains.²⁰ The lack of a statistically significant gender disparity in animal health awareness ($p=0.063$) may indicate that knowledge regarding animal diseases is uniformly disseminated across gender demographics through general public health communications within India.

The notable association between departmental affiliation and awareness particularly concerning animal and environmental health is conceptually sound. Para clinical residents (encompassing microbiology, pharmacology, pathology, and community medicine) exhibited the highest level of awareness across various domains, which is logically anticipated due to their educational exposure to epidemiology, infectious disease ecology, and environmental health determinants. Pre-clinical residents likewise surpassed clinical residents in terms of animal health awareness, potentially reflecting recent engagement with foundational biomedical sciences, including comparative physiology and microbiology. Despite their direct engagement with disease, clinical residents appear to possess comparatively lower One Health awareness related to environmental and animal health domains, a phenomenon corroborated by research conducted in Thailand by Wongkalasin *et al.* (2019), which indicated that practicing clinicians often exhibit limited familiarity with the interconnections between environmental and animal health due to their focused specialty training.¹⁴

Particularly noteworthy is the lack of a significant departmental association regarding human health knowledge ($p=0.114$), suggesting that knowledge of human diseases is distributed evenly across all three departmental categories possibly because human pathophysiology and clinical medicine are covered in all medical curricula, regardless of specialization.

These findings carry direct ramifications for the medical education policy landscape in India. The Medical Council of India (now recognized as the National Medical Commission) instituted competency-based medical education (CBME) in 2019 and has accentuated the importance of interdisciplinary learning. Nonetheless, formal modules pertaining to One health remain conspicuously absent from standardized educational curricula.¹² The outcomes of this study reinforce the arguments put forth by scholars such as Calistri *et al.* (2013) advocating for the integration of One Health competencies including environmental health literacy, management of zoonotic diseases, and antimicrobial

stewardship across all stages of medical training. The incorporation of One Health principles into postgraduate curricula, internship initiatives, and continuing medical education (CME) would better prepare Indian medical practitioners to operate effectively as integral members of interdisciplinary One Health teams, in alignment with national action plans addressing antimicrobial resistance and the global One Health Joint Plan of Action 2022–2026.²

Finally, it is imperative to recognize that elevated conceptual awareness does not inherently lead to One Health-informed clinical practices or interprofessional collaboration.

Future research should evaluate not only awareness but also the attitudes, practices, and obstacles to the integration of One health among medical practitioners in India, employing validated instruments such as the One Health Competency Framework.

Conclusion

This investigation elucidates that although the conceptual cognizance of the One Health framework is notably elevated among postgraduate medical residents (90.8%), substantial domain specific deficiencies in knowledge persist. Human health awareness within the One Health context was identified as the weakest domain, with only 53.9% of participants demonstrating adequate knowledge a finding that is counterintuitive given the clinical training background of participants and underscores the gap between clinical medical education and integrated One Health perspectives. Environmental health awareness was moderate (59.7% adequate knowledge), while awareness of animal health was comparatively robust (86.4%). Gender and departmental affiliation emerged as significant predictors of One Health awareness, with female residents and those affiliated with para-clinical departments exhibiting heightened awareness across multiple domains.

These results accentuate the pressing necessity to formally incorporate the principles of One health encompassing its human, animal, and environmental health dimensions into postgraduate medical curricula within India, with particular emphasis on the One Health conceptualization of human health and its interdisciplinary interconnections. Structured educational interventions, including One Health modules, interdisciplinary workshops, collaborative training programmes with veterinary and environmental professionals, and online learning platforms, should be implemented to bridge existing knowledge gaps. As India advances its national One Health framework and antimicrobial resistance (AMR) action plans, equipping its medical workforce with comprehensive One Health

competencies is not merely an academic priority but a critical public health imperative.

Strengths and Limitations

Strengths

- The research employed a systematically structured and pre-tested questionnaire, facilitating the assessment of awareness across three distinct domains of One health, which allows for domain-specific analytical insights.
- A sufficiently sizeable sample (N=295) along with the inclusion of both clinical and para clinical as well as pre-clinical departments enhances the breadth and representativeness of the findings.
- Ethical considerations, including the acquisition of informed consent and the assurance of data confidentiality, were diligently upheld throughout the study.

Limitations

- The employment of a convenience sampling methodology constrains the generalizability of the findings to the broader population of postgraduate residents in India.
- The reliance on self-reported data may introduce potential biases related to social desirability and recall.
- The cross-sectional nature of the study inhibits the possibility of causal inferences regarding the determinants of One Health awareness.

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Conflict of Interest

None disclosed.

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