BMC Medical Education

RESEARCH

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# Evaluation of the effectiveness of the medical faculty curriculum in the acquisition of a "one health" approach

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## Abstract

**Background** In this study, it was aimed to evaluate the effectiveness of the medical school curriculum in the acquisition of the concept of one health by first and sixth year students of a medical school.

**Methods** This cross-sectional study was conducted by Çukurova University Departments of Public Health and Medical Education and Informatics with 309 first-year students and 315 sixth-year students studying at the Faculty of Medicine in the summer of 2024 and autumn of 2025. Students were reached using the convenience sampling method. The questionnaire consisted of items assessing whether students were familiar with the One Health concept, their definition of the concept, sources of information, issues related to the One Health approach (antimicrobial resistance, zoonotic diseases, vector-borne diseases, foodborne diseases, environmental problems, laboratory-related issues, and other problems), as well as factors that might influence awareness of the concept (such as having a family member working in human health, animal health, or environmental/food safety). In addition, the Global Climate Change Awareness Scale was included. The impact of the medical school curriculum on the One Health approach was also evaluated.

**Results** The mean age of the students included in our study was 21.3 ± 3.44 years. Thirty per cent of the students stated that they had information about the concept of One Health. 16.5% of the students stated medical education as a source in the acquisition of the concept of One Health. It was found that the rate of those who defined the One Health approach correctly was higher in 6th grade students and the relationship between the grade level and the correct definition of the One Health approach was weak (Cramer's V = 0.195). It was found that the rate of those who stated that they had knowledge in the dimensions of zoonotic diseases, vector-borne diseases, food-borne diseases, environmental problems was higher in sixth grade students, and there was no significant difference in the sub-dimensions of antimicrobial resistance and laboratory problems. When the effect of medical school education attributed to One Health and its sub-dimensions is analysed, it is 8.1 per 100 people for general One Health concept knowledge. The topics with the lowest attributed effectiveness were antimicrobial resistance (AE = 2.8) and laboratory problems (AE = 2.7), and the topics with the highest attributed effectiveness were vector-borne diseases (AE = 11.4) and zoonotic diseases (AE = 8.8).

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**Conclusion** In our study, it was concluded that the medical faculty curriculum is not sufficient for the acquisition of the concept of one health.

**Keywords** One health, Medical education, Zoonoses, Human-animal bond, Interdisciplinary education, Environmental health

## Introduction

The idea that everything is interconnected is not new. However, in order to address the challenges faced today, a holistic perspective that recognizes the interrelationship between humans, animals, and the environment is more important than ever. This multidisciplinary collaborative approach is referred to as the One Health concept. The One Health approach contributes to the development of an understanding not only of health and disease processes but also of the identification, prevention, and control of infectious threats and other issues affecting well-being, thereby supporting efforts to promote greater equity worldwide [1].

Since 2007, the One Health approach has re-emerged on the scientific agenda in Türkiye, emphasizing the collaboration between veterinary physicians and medical doctors in this field. Numerous scientific congresses, seminars, symposia, and workshops have been organized on this topic [2].

In addition, the General Directorate of Health Promotion of the Ministry of Health has also organized "One Health Days" to raise awareness [3].

The concept of "One Health" was first defined as "One Medicine", then "One World, One Health" and finally "One Health" [4]. There is no single accepted definition of the concept of One Health. The University of California-Davis One Health Institute defines One Health as an approach to ensuring the well-being of people, animals and the environment through collaborative problem-solving at local, national and global levels. One Health is described by the Centers for Disease Control and Prevention (CDC) as a collaborative, multi-sectoral and interdisciplinary approach that recognises the interconnectedness of people, animals, plants and their shared environment, working at local, regional, national and global levels, with the ultimate goal of achieving the best health outcomes. One Health Global Network recognises the interconnectedness of human, animal and ecosystem health. It applies a collaborative cross-sectoral approach to address existing or potential risks arising from the animal-human ecosystem [5].

The concept of One Health focuses specifically on the consequences, responses and actions that occur at the animal-human-ecosystem interface [6–9]. The World Health Organization (WHO), the World Organisation for Animal Health (WOAH), the Food and Agriculture Organization (FAO) and the United Nations Environment Programme (UNEP) promote multi-sectoral responses to public health threats arising from the animal-human-environment interface. They have identified laboratory services, zoonotic disease control, tropical diseases, antimicrobial resistance, food safety, and environmental health as focal points on how to reduce risks [10].

Climate change may add challenges and uncertainties to human health issues such as emerging infectious diseases. It has a profound impact on biological systems worldwide. This impact is also experienced by human populations through multiple mechanisms, including changes in the life cycles of vectors, reservoirs, and pathogens; effects on wildlife and plant diseases; disruption of synchronization among interacting species; and habitat destruction. The rapid environmental changes driven by climate change highlight the importance of collaborative research and policymaking to protect the health of humans, animals, and the environment [11].

In addition to these topics, disciplines such as environmental and ecosystem health, social sciences, ecology, wildlife, land use and biodiversity are also included in the One Health approach. Although interdisciplinary cooperation forms the basis of the concept of One Health, the adoption of this approach in the field of medicine is progressing more slowly. To ensure greater involvement of the medical community, the One Health approach needs to be integrated into the curricula of medical schools. Within the framework of the One Health approach, it is essential that physicians continuously recognize the interconnections between humans, animals, and the environment throughout their professional careers. Through the development of multidisciplinary programs in this field, joint efforts can be undertaken to prevent potential future outbreaks, while also meeting the need for experts who can contribute to global health. The One Health concept necessitates collaboration across different disciplines, with medical doctors playing a central role within these teams. Therefore, incorporating the concept of One Health and its fundamental topics into undergraduate medical education, as well as enhancing the awareness of medical students, is of critical importance. Thus, medical students can see this concept as an essential component in the context of public health and infectious diseases [12].

In this study, first-year and final-year (intern) medical students were included to evaluate the impact of medical school education on the One Health approach. The aim of our study was to assess the effect of medical education

on students' knowledge and awareness regarding the One Health concept and to identify existing gaps in this area.

## Material and method

### Type and time of the study

This cross-sectional study was conducted by the Çukurova University Faculty of Medicine Public Health Department and Medical Education and Informatics Department and included first and sixth-grade students attending the Faculty of Medicine between the summer of 2024 and autumn of 2025. Ethical approval was obtained from the Çukurova University Faculty of Medicine Research Ethics Committee (at Meeting No. 145 dated 14.06.2024 with Decision No. 45). Informed consent was obtained from the participants for the data used in the study. The data collection form was sent to the students as an online survey via WhatsApp.

### Universe and sampling

The population of the study consisted of 411 first-grade students who had just started medical school at the beginning of the 2024 autumn term and 450 sixth-grade students (interns) of the 2024 summer term. The sample size analysis revealed the minimum number to be reached as 546 with $\alpha = 0.01$, $\beta = 0.8$ effect size (w) = 0.12 and degrees of freedom (d.f.) = 1 defined after a pilot study. The students were reached through WhatsApp groups created by the semester coordinators and the questionnaires were shared online. In total, 309 first-grade students and 315 sixth-grade students participated in the study. Voluntary participants were included in the study, and no additional exclusion criteria were applied.

### Data collection tools

#### *Questionnaire form*

The survey form was created by researchers using literature [10, 13]. It has not been published or used anywhere before. The questionnaire form consisted of questions about whether the students knew the concept of One Health, the definition of One Health concept, sources of information, problems related to the One Health approach (antimicrobial resistance, zoonotic diseases, vector-borne diseases, food-borne diseases, environmental issues, laboratory issues, and other issues) and factors that might be important in being informed about One Health concept like the presence of health, animal health, environmental and/or food health workers in the family (S1).

#### *Global climate change awareness scale*

The scale developed by Deniz et al. in 2020 consists of 21 items and 4 sub-dimensions. Items 1–9 constitute the Impacts on Natural and Human Environment dimension, items 10–15 constitute the Awareness of Global Organisations and Agreements dimension, items 16–18 constitute the Causative Conditions dimension, and items 19–21 constitute the Energy Consumption Relationship dimension. There are no reverse-coded items in the scale, therefore all dimensions of the scale can be added up with a resulting highest score of 105 and the lowest score of 21. Cronbach's alpha coefficient calculated to determine the internal consistency of the scale is 0.826. An increase in the scores obtained from the scale indicates a higher level of awareness [14].

**Lecture hours and contents of one health related internships in the medical school curriculum** A comprehensive document analysis was conducted to determine the course contents related to the One Health approach in the curriculum of Çukurova University Faculty of Medicine (ÇUTF). The current curriculum of the faculty was examined, and relevant courses were identified and classified according to years.

Course hours and contents of One Health-related titles in the curriculum of the Faculty of Medicine

| Year of education | Course title | Hours | Department |
|---|---|---|---|
| 1 st Grade | Contemporary health concept | 1 | Family medicine |
| | Health service provision in extraordinary situations | 2 | Public health |
| | Health measures | 1 | Public health |
| | Social Anthropology | 1 | Public health |
| | Introduction to environmental health | 1 | Public health |
| | Basic concepts in public health | 2 | Public health |
| | Social medicine | 1 | Public health |
| | Preventive medicine | 1 | Family medicine |
| | Health protection and promotion | 1 | Parasitology |
| | Protozoa | | |
| 2nd Grade | Protozoa | 5 | Parasitology |
| 3rd Grade | Health care related infections | 1 | Infectious dis. and clin. microbiology |
| | Environmental lung diseases | 2 | |
| | Antibiotic susceptibility | 4 | |
| | Vector-borne diseases | 1 | Pulmonology |
| | | | Microbiology |
| | | | Parasitology |
| 4th Grade | Basic public health | 4 | Public health |
| | Health management | 5 | Public health |
| | Fight against Infectious Diseases and Prevention | 5 | Public health |
| | Environment and public health | 4 | Public health |
| | Laboratory Practices | 8 | Public health |
| | Epidemiology | 6 | Public health |
| | Extraordinary situations and disaster management | 4 | Public health |
| | Community nutrition | 4 | Public health |
| | Zoonotic diseases | 3 | Public health |

Course hours and contents of One Health-related titles in the curriculum of the Faculty of Medicine

| Year of education | Course title | Hours | Department |
|---|---|---|---|
| 5th Grade | Basic principles of antibiotic use | 1 | Infectious dis. and clin. microbiology |
| | Infection control | 1 | Infectious dis. and clin. microbiology |
| | Health care related infections | 1 | |
| | Rational use of antibiotics | 1 | |
| | Environmental lung diseases and air pollution | 7 | Infectious dis. and clin. microbiology |
| | Health service provision in extraordinary situations | | Clinical pharmacology |
| | | | Pulmonology |
| | | | Module training |
| 6th Grade | Principles of family medicine (WONCA) | 1 | Family medicine |
| | Public health | 4 | Public health |

### Statistical analysis

SPSS 20.0 and JAMOVI softwares were used in the analysis of the data. Data were presented as numbers and percentages. Pearson's chi-square test was used in case of MEV ≥ 25 in all cells (where MEV = minimum expected value), while Fisher's Exact test was preferred if MEV in any cell was < 1 or if cells with MEV < 5 constituted more than 20% of total cells. In 2 × 2 tables, Yates' Continuity Correction was applied in case of 5 ≤ MEV < 25.

Phi coefficients for 2 × 2 tables and Cramér's V coefficients for m×n tables were used to evaluate the strength of the relationship between categorical variables. The Phi coefficient (Φ) value range was interpreted as follows: The relationship strength was defined as positively "very strong" in the case of Φ≥0.70, "strong" if 0.70 >Φ≥0.40, "medium" if 0.40 >Φ≥0.30, "weak" if 0.30 >Φ≥0.20, "negligible" if 0.20 >Φ≥0.01 and "none" if Φ < 0.01, while negatively if all the figures were negative [15]. Cramer's V coefficient ($\Phi_c$) measures the relationship between two variables in an m×n table, independent of the number of rows and columns. It varies between 0 and 1. It is interpreted as follows: "very strong" if $\Phi_c \geq 0.25$, "strong" if $0.25 > \Phi_c \geq 0.15$, "medium" if $0.15 > \Phi_c \geq 0.10$, "weak" if $0.10 > \Phi_c \geq 0.05$ and "very weak" if $0.05 > \Phi_c > 0$ and "none" if $\Phi_c = 0$ [10].

The effectiveness of medical school education on the One Health concept was measured with "Attributed effectiveness" and "prevalence ratio" formulas:

> Attributed effectiveness (AE) = (Rate (prevalence) of knowledge of One Health concept in sixth-grade students) – (Rate (prevalence) of knowledge of One Health concept in first-grade students).

$$\text{Prevalence Ratio (PR)} = \frac{\text{Rate (prevalence) of knowledge of One Health concept in sixth grade students}}{\text{Rate (prevalence) of knowledge of One Health concept in first grade students}}.$$

**Table 1** Distribution of the students according to sociodemographic characteristics and information about one health

| Characteristics | Mean ± S.D. (min–max) | |
|---|---|---|
| **Age** | 21.3 ± 3.44 (17–52) | |
| **Sex** | ***n*** | **%** |
| Female | 309 | 49.5 |
| Male | 315 | 50.5 |
| **Grade** | | |
| First | 309 | 49.5 |
| Sixth | 315 | 50.5 |
| **Household income** | | |
| ≤17,000.2 | 370 | 59.3 |
| 17,000.3–34,000.4 | 176 | 28.2 |
| ≥34,000.5 | 78 | 12.5 |
| **Health worker in the family** | | |
| Yes | 199 | 31.9 |
| No | 425 | 68.1 |
| **Animal health worker in the family** | | |
| Yes | 15 | 2.4 |
| No | 609 | 97.6 |
| **Food/environmental health worker in the family** | | |
| Yes | 17 | 2.7 |
| No | 607 | 97.3 |
| **Informed on the One Health approach** | | |
| No | 437 | 70.0 |
| Yes | 187 | 30.0 |
| **Information Source*** | | |
| Social Media | 44 | 7.1 |
| Peers | 12 | 1.9 |
| As part of medical education | 103 | 16.5 |
| Publications | 28 | 4.5 |

* Percentage calculations were made over the whole group

Interpretation of the Prevalence Ratio: PR = 1 indicates no relationship, PR > 1 indicates that education increases the probability of knowing the One Health concept, and PR < 1 indicates that education reduces the probability of knowing the One Health concept.

## Results

The mean age of the students included in our study was 21.3 ± 3.44 years. The first-year students constituted 49.5% and those of the sixth-year 50.5% of the participants. A total of 30% of the students stated that they had information about the One Health concept, indicating the medical curriculum being the most important source (16.5%) followed by social media sources as the second rank (Table 1).

Different definitions of the One Health concept were presented to first-year and sixth-year students, and they were asked to select the correct definition. When the correct definition of the One Health approach was compared based on the grade, a statistically significant difference was found between the groups: the rate of those who defined it correctly was higher in sixth-grade students, and the relationship between the grade level and the correct definition of the One Health approach was found to be weak ($\Phi_c = 0.195$) (Table 2).

When it was questioned whether they knew the concept of One Health and its sub-dimensions the rate of those who reported that they knew was 30% in the whole group. The sixth-grade students were found to have a significantly higher rate of knowledge in the sub-dimensions of general knowledge level, zoonotic diseases, vector-borne diseases, food-borne diseases, and environmental issues, while there was no significant difference in the sub-dimensions of antimicrobial resistance and laboratory problems between grades. It was found that the strength of the relationship between grade level and general knowledge level, zoonotic diseases, vector-borne diseases, food-borne diseases, and environmental issues dimensions was very weak. When the effect of medical school curriculum attributed to One Health and its sub-dimensions was analysed, the general knowledge of the One Health concept per 100 people was calculated to be 8.1; i.e., if 100 students were educated in medical school, 8.1 students would have information about the One Health. The topics with the lowest attributed effectiveness were antimicrobial resistance (AE = 2.8) and laboratory issues (AE = 2.7), while the topics with the highest attributed effectiveness were vector-borne diseases (AE = 11.4) and zoonotic diseases (AE = 8.8). At the end of medical education, the probability of having knowledge about the concept of One Health was found to increase by 31%. When One Health concept information sources were compared according to grade levels, it was found that social media was more prevalent in first-grade students, while medical faculty education was more prevalent in sixth-grade students. Among the 80 first-year students who reported being familiar with the One Health concept, 41.3% indicated that their source of information was social media, whereas 77% of the 107 sixth-year students stated that their source of information was medical education (Table 3).

The logistic regression analysis conducted to estimate the predictor factors for being knowledgeable about the One Health concept was found to be significant (omnibus test, $p < 0.001$; accuracy rate, 70%). The dependent variable of the model was the status of being knowledgeable about the One Health concept. The independent variables included class level, gender, presence of a healthcare professional in the family, family member working in animal health, and family member working in environmental/food health. Among the variables included in the model, class level was found to contribute significantly. Compared to first-year students, sixth-year students were 1.5 times (50%) more likely to be knowledgeable about the One Health concept (Table 4).

When the sub-dimensions of global climate change awareness were compared according to the status of being knowledgeable about the One Health concept, it was found that only in the sub-dimension related to energy consumption did those who reported being knowledgeable about One Health achieve significantly higher scores (Table 5).

**Table 2** Comparison of the definition of the One Health approach according to grades

| One Health approach meant… | Grades*n* (%) | | Statistical evaluation |
|---|---|---|---|
| | First | Sixth | |
| "Not explained" | $3_a$ (1) | $1_a$ (0.3) | $p < 0.001$ |
| Separate assessment of human, animal and environmental health | $1_a$ (0.3) | $0_a$ | **$\Phi_c = 0.195$** |
| Animal and environmental health | $3_a$ (1) | $2_a$ (0.6) | |
| Human and environmental health | $48_a$(15.6) | $17_b$ (5.4) | |
| Human and animal health | $11_a$ (3.6) | $8_a$ (2.5) | |
| Human, animal and environmental health | $240_a$ (77.9) | $287_b$ (91.1) | |
| A common concept of health | $1_a$ (0.3) | $0_a$ (0) | |
| Only one living creature | $1_a$ (0.3) | $0_a$ (0) | |

$\Phi_c$, Cramer's V; symbols a, b denote cells that are different in the post-hoc analyses. If two cells contain different symbols, there is a statistically significant difference between them

## Discussion

One Health is an emerging concept that emphasises the links between human, animal and environmental health. It highlights the need for interdisciplinary communication and collaboration to address health challenges such as zoonotic diseases, the effects of climate change and the human-animal bond. This approach promotes the solution of complex problems using a systematic framework that considers the interactions between humans, animals and the environment they share. Although many medical educators are not yet familiar with the concept, the One Health approach has been endorsed by many major medical and public health organisations and is being implemented in some medical schools [12]. In this study, we evaluated the impact of a medical school curriculum on the acquisition of the concept of one health. Among the participating students, 30% stated that they had knowledge about the concept of one health, and 16.5% indicated medical school education as the source of information. Among sixth-year students, compared to first-year students, the proportion of those who correctly

**Table 3** The relationship between grade level and knowledge about the concept of one Health, the effectiveness attributed to medical education, and information sources

| Information Type | Grades *n* (%) | | *p* | Φ | AE (%) | PR |
|---|---|---|---|---|---|---|
| | First (*n* = 309) | Sixth (*n* = 315) | | | | |
| **Having knowledge about One Health approach** | 80 (25.9) | 107 (34.0) | 0.028* | 0.088 | 8.1 | 1.31 |
| **Having knowledge on the focal topics of One Health approach** | | | | | | |
| Antimicrobial resistance | 276 (89.3) | 290 (92.1) | 0.238 | 0.047 | 2.8 | 1.03 |
| Zoonotic diseases | 273 (88.3) | 306 (97.1) | < 0.001* | 0.170 | 8.8 | 1.09 |
| Vector-borne diseases | 261 (84.5) | 302 (95.9) | < 0.001* | 0.192 | 11.4 | 1.13 |
| Food-borne diseases | 286 (92.9) | 308 (97.8) | 0.002* | 0.122 | 4.9 | 1.05 |
| Environmental issues | 291 (94.2) | 309 (98.1) | 0.019* | 0.102 | 3.9 | 1.04 |
| Laboratory issues | 231 (74.8) | 244 (77.5) | 0.428 | 0.032 | 2.7 | 1.03 |
| Other | 53 (17.2) | 50 (15.9) | 0.667 | 0.017 | −1.3 | 0.92 |
| **One Health approach information resource** | **First** (*n* = 80) | **Sixth** (*n* = 107) | | | | |
| Social media | $33_a$ (41.3) | $11_b$ (10.3) | < 0.001* | | | |
| Circle of friends | $7_a$ (8.8) | $5_a$(4.7) | | | | |
| Medical education | $26_a$ (32.5) | $77_b$ (72.0) | | | | |
| Scientific publications | $14_a$(17.5) | $14_a$ (13.1) | | | | |

*, statistically significant differences; Φ, Phi coefficients for 2 × 2 evaluation; symbols a, b denote cells that are different in the post-hoc analyses. If two cells contain different symbols, there is a statistically significant difference between them

**Table 4** Logistic regression analysis of the likelihood of having one health information

| | | | | 95% C.I. for O.*R.* | |
|---|---|---|---|---|---|
| **Predictor** | **β** | ***p*** | **O.*R.*** | **Lower** | **Upper** |
| **Constant** | −1.122 | < 0.001 | 0.326 | 0.233 | 0.456 |
| **Grades** | | | | | |
| 6 vs. 1(ref) | 0.405 | 0.023* | 1.500 | 1.057 | 2.129 |
| **Sex** | | | | | |
| Male vs. Female(ref) | 0.149 | 0.398 | 1.161 | 0.821 | 1.642 |
| **Health worker present in the family** | | | | | |
| Yes vs. No (ref) | −0.108 | 0.572 | 0.898 | 0.618 | 1.305 |
| **Animal health worker present in the family** | | | | | |
| Yes vs. No(ref) | 0.300 | 0.583 | 1.349 | 0.463 | 3.936 |
| **Environmental/food health worker present in the family** | | | | | |
| Yes vs. No(ref) | 0.941 | 0.258 | 2.563 | 0.502 | 13.090 |

*, statistically significant differences; vs., versus; ref, reference item; O.R., odds ratio; C.I., confidence interval

**Table 5** Comparison of global climate change awareness scale scores according to the having one health information

| Information Type | Having knowledge about the concept of One Health | | *p* |
|---|---|---|---|
| | Yes | No | |
| | Mean ± S.D. | Mean ± S.D. | |
| Impacts on Natural and Human Environment | 36.24±9.75 | 34.71±9.76 | 0.073 |
| Awareness of Global Organisations and Agreements | 17.74±8.02 | 18.70±7.47 | 0.161 |
| Causative Conditions | 8.81±3.96 | 9.23±3.51 | 0.213 |
| Energy Consumption Relationship | 12.08 ± 3.45 | 11.41 ± 3.41 | 0.025* |
| **Total score** | 74.87 ± 20.36 | 74.05 ± 20.81 | 0.647 |

*, statistically significant differences; S.D., standard deviation

defined the One Health approach and reported being knowledgeable in the sub-dimensions of zoonotic diseases, vector-borne diseases, foodborne diseases, and environmental issues was higher. No significant differences were observed in the sub-dimensions of antimicrobial resistance and laboratory-related issues. The association between class level and knowledge level was found to be very weak. The strength of the relationship between grade and knowledge level was very weak. When the effect of medical school education attributed to One Health and its sub-dimensions was analysed, it was found as 8.1 per 100 persons in the context of general One Health concept knowledge; meaning that 8.1 out of 100 students attending the medical faculty would have sufficient knowledge about One Health. The topics with the lowest attributed effectiveness were antimicrobial resistance and laboratory issues, while the topics with the highest attributed effectiveness were vector-borne diseases and zoonotic diseases. Laboratory services are a fundamental component in the diagnosis of infectious diseases, as they enable the identification of the causal organism and the determination of appropriate treatment options [16].

Laboratory services also play a key role in the surveillance of infectious diseases. Data on microorganisms are routinely collected in countries, and some diseases are

classified as "notifiable," with notification criteria typically requiring laboratory confirmation of the diagnosis. In addition, laboratory services are critical for the reporting and diagnosis of animal diseases. The expertise of diagnostic laboratory professionals is essential for performing diagnostic tests, developing sampling and testing protocols, and designing new methods. Although laboratories are indispensable for monitoring health and the environment, they can also be a significant source of waste. Considering all these factors, laboratory services are important within the One Health framework, as approaches that ensure the careful use of limited resources should be adopted [17]. In this context, increasing the number of laboratory courses in medical school curricula and designing course content based on the One Health approach could enhance efficiency for future physicians.

When the curriculum content was examined, it was seen that topics related to the components of the One Health approach were included in all years of education, but these topics were handled within the scope of independent, stand-alone courses. It is known that medical students have difficulty integrating subjects of an interdisciplinary curriculum if the subject is not covered in an integrated format within a context [18]. In the context of 'One Health', this can be translated as understanding the real importance of the interactions between human, animal and environmental health and health problems such as zoonotic diseases, the effects of climate change and human-animal interactions by a preventive medicine point of vision and developing a holistic health perspective in this direction, rather than simply memorising them.

The biopsychosocial model for teaching systems approaches in medical education is a systems approach that considers the patient as part of a larger system and takes into account the increasing hierarchy from the molecular level to the cellular, organ, individual, community and global levels [19, 20]. Patient-centred care addressed at the individual, community and global levels and the consideration of social determinants of health are among the most recent efforts to integrate biopsychosocial approaches into patient-healthcare provider interactions [21]. In today's rapidly changing global environment, it is seen that the biopsychosocial model should be adapted and updated to the "One Health" framework as an approach that adopts systematic thinking in the fight against diseases [12]. Academic medical institutions are called to adopt One Health interdisciplinary approaches in both research and education. In many medical faculties, student groups interested in "One Health" have been constituted and some academic health centres have reorganised their existing programmes and started new programmes within the framework of "One Health" principles [22]. The findings of our study also showed that the One Health approach should be integrated into the 6-year medical education curriculum using different teaching methods. There was no significant difference between students who had received this information through medical education and those who had never, and the contribution of medical education to the One Health approach was very low.

In the study conducted by Akpınar et al. in 2020, 40.2% of the interns stated that they had not heard of the concept of One Health before. There were only three students who declared that they had gotten an education on One Health. The study revealed that the awareness of medical school interns towards the concept of "One Health" was limited, but they generally had a positive attitude. It was emphasised that "One Health"-focused courses should be added to the curriculum of the last year in medical faculties and related programmes [23].

Multi-disciplinary and multi-sectoral approaches, such as One Health and related concepts, offer opportunities for synergistic use of specialised areas of expertise to address complex health threats. Collaboration across sectors is needed to comprehensively understand and mitigate risks and consequences for health and welfare, and the interconnections between humans, animals and the environment. "One Health" approaches are increasingly emphasised in national and international plans and strategies on zoonotic diseases, food safety, antimicrobial resistance and climate change. However, to date, their potential use in clinical practice and benefits to human health have been largely lacking [24]. At the "2018 Application of the One Health Approach to Global Health Centers Conference", four objectives were identified: (a) to improve One Health resource sharing in global health and medical education, (b) to create pathways for information flow in clinical medicine and global health practice, (c) to develop innovative partnerships to improve outcomes in the health sector, and (d) to inform and strengthen health through public awareness-raising efforts. These objectives provide opportunities for medical schools to engage in and benefit from "One Health". They can lead to more efficient use of available resources and more holistic and effective service delivery, and enhance the ability to better manage the determinants of poor health. Medical and global health educators, practitioners and students need to explore how One Health can add value to their work on a local and global scale [24].

One of the important results of our study was revealing the low impact of medical faculty education on antimicrobial resistance. Antimicrobial resistance (AMR) is one of the study topics that best reflects the principles of "One Health". AMR is directly related to each component of human, animal, and environmental health. The use of antibiotics in animal production often at low doses and

with prolonged exposure can lead bacteria to develop resistance genes, which can then be passed on to human-adapted pathogens or the human gut microbiota through direct contact, contaminated food or the environment. Adopting a true "One Health" approach to tackling AMR, covering all areas, will depend on understanding their relative importance in the evolution of bacteria and genetic markers, how they interact, and the pathways and mechanisms by which resistance genes spread [25]. In the study conducted by Akpınar et al., antibiotic resistance was found to be the topic with the lowest positive attitude of students [23]. In medical faculties, there is more focus on the misuse, unnecessary and inappropriate use of antibiotics. A broader perspective is only possible with a One Health approach. Recognising other risk factors related to animal and environmental health and understanding their clinical value will also contribute to these studies. Integrating joint sessions on antimicrobial resistance, involving veterinarians, environmental health professionals, and physicians, into the curriculum starting from the first year could be beneficial in raising awareness. Additionally, the results of our study indicate that social media is an important source of information, particularly for students newly admitted to medical school. Therefore, sharing content related to One Health during medical school orientation week and on the faculty's social media accounts could further contribute to raising awareness. Just as systems biology focuses on the interactions between proteins and molecules, the health in social-ecological systems approach involves the interdisciplinary examination of complex interactions in all health-related fields. This approach aims to identify new determinants of health that may emerge at scales ranging from the molecular level to the ecological and sociocultural context, as well as characteristics arising from a systemic perspective [26]. In our study, it was observed that living in a family with workers in one of the One Health fields was not effective in gaining this perspective. In terms of knowing the concept of "One Health", it was seen that the contribution of medical faculty education was important and this understanding should be strengthened.

In terms of zoonotic and vector-borne diseases, medical education appears to provide more links to One Health than other fields [27]. While addressing zoonotic diseases and other emerging disease threats, the "One Health" approach also emphasises the importance of considering factors that affect the sustainability of the balance of ecosystems. These factors include climate change, agricultural intensification, destruction of food systems and wildlife habitats [28]. It is seen that students are unable to establish the connection between the concept of One Health and global warming and climate change, which are the most important problems of today and the future. Climate change awareness was not reported to differ according to the level of One Health knowledge. "Evaluation on the Inclusion of Climate Change and Air Pollution in the Medical Curriculum" surveys performed by 2817 medical faculties from 112 countries revealed that, in only 15% of the schools, climate change and health were included in medical curricula. The proportion of medical schools where student-led climate-related activities were carried out was 12%. This study pointed out that environmental health issues such as climate change were largely neglected in medical education. Recognising these shortcomings in the medical curriculum and actively involving students in the curriculum change process is vital to prepare future health professionals for these critical issues [29, 30].

As the climate changes due to global warming, the frequency and geographic distribution of existing zoonoses are expected to shift, and increased contact with organisms found solely in wildlife may facilitate the emergence of new zoonoses. Considering transmission routes and the mechanisms that maintain the continuity of organisms in populations and the environment, zoonotic diseases have been classified into different categories known as "epitypes." All major animal diseases and zoonoses of global significance can be assigned to one of these epitypes, and in some cases, to multiple epitypes from an epidemiological perspective. As a result of climate change, significant variations in the spatial and temporal distribution of zoonoses are anticipated, which may be associated both with increases in cases within endemic regions and with their spread to new areas. Increased direct contact between wildlife and humans, or more frequent indirect contacts via bridge hosts and vectors, has led to the regular identification of new zoonoses. Recent examples, such as the three SARS coronaviruses and H5N1 avian influenza, illustrate the potential for zoonotic diseases emerging in the future to cause serious social and economic consequences. To minimize the risks posed by new or evolving zoonotic pathogens that could trigger regional outbreaks or global pandemics, investment in surveillance systems and strengthening response capacities is of critical importance. Achieving this goal requires a holistic strategy based on the One Health approach, in which countries collaborate to develop knowledge and capacity [31].

At present, One Health education in medical faculties is in its infancy and lags behind veterinary faculties in this respect. Veterinary faculties have made the "One Health" approach a central part of their curricula [32]. Recent initiatives include interprofessional training programmes between human health and veterinary medicine educational institutions focusing on common issues such as access to clean water [33]. In addition, the Council for Education in Public Health (CEPH) has established

the "One Health" qualification for Master's and Doctoral programmes in public health. Such educational initiatives aim to further integrate the One Health approach into medical education and promote interdisciplinary collaboration of health professionals [34]. We believe that a similar integration of the One Health approach should be ensured in the curricula of medical faculties in Türkiye.

### Limitations and strengths

In our study, the fact that the level of One Health knowledge was measured based on the students' declaration, the first and sixth-year cohorts were not available in the same periods and the questionnaire form was conducted online may have led to information bias. However, the fact that it is one of the few studies conducted in terms of evaluating the contribution of the medical school curriculum to the concept of One Health is determined as our strength.

## Conclusion

According to the results of our study, medical students' level of knowledge regarding the One Health concept is low, and the impact of medical school education on fostering understanding of this concept is not at the desired level. The effectiveness of the medical school curriculum in providing a One Health concept on the topics of zoonotic diseases, vector-borne diseases, food-borne diseases, environmental issues, antimicrobial resistance and laboratory issues is low.

### Recommendations

We believe that it would be appropriate to integrate a One Health understanding from the first year to the end of the sixth year in the medical faculty curriculum, to increase the relevant course hours in the relevant branches or to introduce new course hours, to increase the emphasis on the One Health perspective in existing courses and to enrich the curriculum with integrated sessions and module. We recommend planning integrated sessions on health and one health in the first year, addressing the concept of one health within the context of social determinants of health in the second year, developing projects on one health in the third year, increasing course hours in relevant internships in the fourth and fifth years, and strengthening the one health perspective in the context of community-based medical practices in the sixth year. We believe that future health professionals should be trained to understand the link between health and ecosystems in order to meet the needs of their patients and their communities.

#### Abbreviations

| | |
|---|---|
| AE | Attributed effectiveness |
| AMR | Antimicrobial resistance |
| CDC | Centers for disease control and prevention |
| FAO | Food and agriculture organization |
| PR | Prevalence ratio |
| UNEP | United nations environment programme |
| WHO | World health organization |
| WOAH | World organisation for animal health |

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-025-08066-x.

Supplementary Material 1.

#### Acknowledgements

N/A.

#### Authors' contributions

B.M., H.D. and Ç.O. wrote the article, B.M. made the analyses, H.D. and F.T. made critical critiques, A.İ and B.M. designed the study, A.B. prepared the tables and figures.

#### Funding

there is no funding.

#### 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

Ethical approval was obtained from the Çukurova University Faculty of Medicine Research Ethics Committee (at Meeting No. 145 dated 14.06.2024 with Decision No. 45). Informed consent was obtained from the participants for the data used in the study. The study was conducted in accordance with the Declaration of Helsinki.

#### Consent for publication

N/A.

#### Competing interests

The authors declare no competing interests.

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Received: 28 May 2025 / Accepted: 25 September 2025
Published online: 21 October 2025

#### References

1. Schneider MC, Munoz-Zanzi C, Min K, duk AS. One Health From Concept to Application in the Global World. Oxford Res Encycl Glob Public Heal [Internet]. 2019 Apr 26 [cited 2025 Sep 4]; Available from: https://oxfordre.com/publichealth/publichealth/view/https://doi.org/10.1093/acrefore/9780190632366.001.0001/acrefore-9780190632366-e-29
2. Serpen A. One Health the Origins of the Approach: The World and Current Situation in Turkey. J One Heal Res [Internet]. 2023 Oct 17 [cited 2025 Sep 4];1(3):1–33. Available from: https://onehealthjournal.com/index.php/pub/article/view/17
3. Sağlığın Geliştirilmesi Genel Müdürlüğü. World One Health Day Program [Internet]. 2021 [cited 2025 Sep 4]. Available from: https://sggm.saglik.gov.tr/EN-86130/world-one-health-day-program.html
4. Atlas RM. One Health: Its Origins and Future. 2012 [cited 2025 Mar 12];1–13. Available from: https://link.springer.com/chapter/10.1007/82_2012_223

5. Mackenzie JS, Jeggo M. The one health Approach—Why is it so important? Trop Med Infect Dis. 2019;4(2):88.
6. Cleaveland S, Sharp J, Abela-Ridder B, Allan KJ, Buza J, Crump JA, et al. One health contributions towards more effective and equitable approaches to health in low- and middle-income countries. Philos Trans R Soc B Biol Sci. 2017;372(1725):20160168.
7. Welburn SC, Beange I, Ducrotoy MJ, Okello AL. The neglected zoonoses—the case for integrated control and advocacy. Clin Microbiol Infect. 2015;21(5):433–43.
8. Garcia SN, Osburn BI, Cullor JS. A one health perspective on dairy production and dairy food safety. One Heal. 2019;7:100086.
9. Boqvist S, Söderqvist K, Vågsholm I. Food safety challenges and one health within Europe. Acta Vet Scand. 2018;60(1):1.
10. Pitt SJ, Gunn A. The one health concept. Br J Biomed Sci. 2024;81:12366.
11. Patz JA, Hahn MB. Climate Change and Human Health: A One Health Approach. Curr Top Microbiol Immunol [Internet]. 2012 [cited 2025 Sep 4];366:141–71. Available from: https://link.springer.com/chapter/10.1007/82_2012_274
12. Rabinowitz PM, Natterson-Horowitz BJ, Kahn LH, Kock R, Pappaioanou M. Incorporating one health into medical education. BMC Med Educ. 2017;17(1):45.
13. WHO. One health [Internet]. 2025 [cited 2025 Sep 4]. Available from: https://www.who.int/health-topics/one-health#tab=tab_1
14. Deniz M, İnel Y, Sezer A. Awareness scale of university students about global climate change. Int J Geogr Geogr Educ [Internet]. 2021 [cited 2025 Mar 12];43:252–64. Available from: https://dergipark.org.tr/en/pub/igge/article/818561
15. Njuka DA, Phiri J. Factors influencing social media in managing corporate reputation for a Christian organisation in developing countries based on the VT4 model. Technol Invest. 2021;12(02):66–81.
16. United Nations. The 17 Goals| Sustainable Development [Internet]. 2025 [cited 2025 Sep 4]. Available from: https://sdgs.un.org/goals
17. Hueth KD, Prinzi AM, Timbrook TT. Diagnostic Stewardship as a Team Sport: Interdisciplinary Perspectives on Improved Implementation of Interventions and Effect Measurement. Antibiot 2022, Vol 11, Page 250 [Internet]. 2022 Feb 15 [cited 2025 Sep 5];11(2):250. Available from:https://www.mdpi.com/2079-6382/11/2/250/htm.
18. Wijnen-Meijer M, van den Broek S, Koens F, ten Cate O. Vertical integration in medical education: the broader perspective. BMC Med Educ. 2020;20(1):509.
19. Engel GL. The clinical application of the biopsychosocial model. Am J Psychiatry [Internet]. 1980 [cited 2025 Mar 12];137(5):535–44. Available from: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=b547c17f6c9bedf931fe0d7bad14e2acc670c382
20. Engel GL. The need for a new medical model: A challenge for biomedicine. Sci (80-). 1977;196(4286):129–36.
21. Smith RC, Fortin AH, Dwamena F, Frankel RM. An evidence-based patient-centered method makes the biopsychosocial model scientific. Patient Educ Couns. 2013;91(3):265–70.
22. Commission OH. One Health Commission [Internet]. 2025 [cited 2025 May 14]. Available from: https://www.onehealthcommission.org/
23. Varer Akpinar C, Durmaz S. Medical interns' attitudes towards one health approach. Turkish J Biochem. 2022;47(1):137–44.
24. Machalaba C, Raufman J, Anyamba A, Berrian AM, Berthe FCJ, Gray GC, et al. Applying a one health approach in global health and medicine: enhancing involvement of medical schools and global health centers. Ann Glob Heal. 2021;87(1):30.
25. Robinson TP, Bu DP, Carrique-Mas J, Fèvre EM, Gilbert M, Grace D et al. Antibiotic resistance is the quintessential One Health issue. Trans R Soc Trop Med Hyg [Internet]. 2016 Jul 1 [cited 2025 Mar 31];110(7):377–80. Available from: https://doi.org/10.1093/trstmh/trw048
26. Zinsstag J, Schelling E, Waltner-Toews D, Tanner M. From one medicine to one health and systemic approaches to health and well-being. Prev Vet Med. 2011;101(3–4):148–56.
27. Karesh WB, Dobson A, Lloyd-Smith JO, Lubroth J, Dixon MA, Bennett M et al. Ecology of zoonoses: Natural and unnatural histories. Lancet [Internet]. 2012 Dec 1 [cited 2025 Mar 31];380(9857):1936–45. Available from: https://www.thelancet.com/action/showFullText?pii=S014067361261678X
28. Wallace RG, Bergmann L, Kock R, Gilbert M, Hogerwerf L, Wallace R, et al. The dawn of structural one health: A new science tracking disease emergence along circuits of capital. Soc Sci Med. 2015;129:68–77.
29. Omrani O, El DA, Paniello Castillo B, Amaro BQRC, Taneja S, Amzil M et al. Envisioning planetary health in every medical curriculum: An international medical student organization's perspective. Med Teach [Internet]. 2020 Oct 2 [cited 2025 Mar 31];42(10):1107–11. Available from: https://doi.org/10.1080/0142159X.2020.1796949
30. Morse SS, Mazet JAK, Woolhouse M, Parrish CR, Carroll D, Karesh WB et al. Prediction and prevention of the next pandemic zoonosis. Lancet [Internet]. 2012 Dec 1 [cited 2025 Mar 31];380(9857):1956–65. Available from: https://www.thelancet.com/action/showFullText?pii=S0140673612616845
31. Morris RS, Wada M. The Effect of Climate Change on Emergence and Evolution of Zoonotic Diseases in Asia. Zoonoses Public Health [Internet]. 2025 [cited 2025 Sep 5]; Available from: https://pubmed.ncbi.nlm.nih.gov/40888029/
32. Courtenay M, Sweeney J, Zielinska P, Brown Blake S, La Ragione R. One Health: An opportunity for an interprofessional approach to healthcare. J Interprof Care [Internet]. 2015 Nov 3 [cited 2025 Mar 31];29(6):641–2. Available from: https://doi.org/10.3109/13561820.2015.1041584
33. Haxton E, Lindberg A, Troell K, Redican KJ. One Health education meets science. Infect Ecol Epidemiol [Internet]. 2015 [cited 2025 Mar 31];5(1):30264. Available from:https://doi.org/10.3402/iee.v5.30264
34. CEPH (Council on Education for Public Health). Accreditation criteria: school of public health & public health programs (CEPH) [Internet], Maryland, U.S.A. ; 2016 [cited 2025 Mar 12]. pp. 1–52. Available from: https://media.ceph.org/wp_assets/2016.Criteria.pdf


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