

# Syllabus

## Course Title

### Climate Change Mitigation and Adaptation Strategies in healthcare

#### General Information

*General description of the required education/training, outlining the main objectives and explaining the necessity of the education/training at the organizational/country/regional level*

The course provides a systematic and applied overview of strategies for mitigating and adapting to climate change, with a special focus on the healthcare sector. It examines how global and regional climate change affects population health through mechanisms such as heat stress, changes in the dynamics of infectious diseases, air quality, mental health, and extreme weather events.

The course explores key mechanisms through which climate factors influence pathogens, vectors, reservoir hosts, and vulnerable population groups, forming the basis for the development of effective adaptation and mitigation measures in healthcare. Special attention is given to climate data analysis, health risk assessment, the development of adaptation strategies, and cross-sectoral cooperation between healthcare systems, environmental services, and climate services.

A distinctive feature of the course is the integration of practical tools such as “Knowledge Boxes,” which enable in-depth exploration of specific pathogens and risks, as well as support the development of micro-interventions at the level of healthcare facilities and communities.

#### Audience

*The main target audience of the course and any secondary audience, if it may influence decisions regarding the structure or content of the course*

*Expected level of knowledge and skills of the main audience (current or minimally required), as well as other factors (for example, cultural characteristics, level of technical training, access to the Internet) that should be considered when planning the course, as they may affect the choice of teaching methods, materials, and approaches to interaction with the audience*

- Primary: PhD students in programs on climate services, climate change adaptation/mitigation, meteorology, environmental sciences, public health, and healthcare management, working at the climate–health interface.
- Secondary: Early-career lecturers and researchers in departments of meteorology/climatology, epidemiology, and public health; specialists from public health centers and the National Health Service of Ukraine / Ministry of Health; policy analysts; local government officials in the health sector; coordinators of “green hospitals” and physician-managers; staff of national hydrometeorological services; NGO/INGO representatives (climate and health).

Entry requirements:

- basic statistical literacy and spreadsheet skills;
- skills in critical analysis of scientific sources;
- desirable: basic understanding of climate indices and scenarios (RCP/SSP), GIS or R/Python (not mandatory), knowledge of the structure of the healthcare system in Ukraine;

- English — for reading primary sources.

Prerequisites: basic knowledge of epidemiology/public health, microbiology, virology and immunology, general hygiene, infectious diseases, medical statistics, and healthcare systems; basic digital literacy is desirable.

## Competencies

*Training needs at the individual or organization/country/regional level, as well as a description of how these needs were identified and recognized as relevant.*

*Competencies targeted by the training.*

C4: Climate change impact assessment

C5: Climate communication

C6: Policy and resilience strategy development / Integrated climate impact and risk assessment

## Learning outcomes and performance criteria

*Learning outcomes and performance criteria formulated with regard to the knowledge and skills to be acquired during the training process.*

### LEARNING OUTCOMES

- Apply knowledge of basic epidemiological concepts and the epidemic chain to analyze outbreaks of infectious diseases.
- Analyze and interpret climate data to assess the potential impact of climate change on the epidemiology of infectious diseases.
- Assess the risk of emergence or changes in endemicity of infectious diseases at the local level by integrating climate projections with epidemiological information.
- Develop recommendations for monitoring and forecasting the spread of climate-sensitive infectious diseases.
- Identify healthcare sector needs for specific climate information and services to support adaptation measures.
- Propose evidence-based measures for the use of climate services to strengthen prevention and control systems for climate-sensitive infectious diseases.
- Use modern information resources and tools for data collection, analysis, and visualization of climate change impacts on health and epidemiology.

### PERFORMANCE CRITERIA

- Knowledge: The learner demonstrates a deep understanding of climate-related health risks, knowledge of climate change mitigation strategies, and the basics of healthcare sector adaptation to climate challenges.
- Analytical skills: The learner is able to analyze complex relationships between climate factors, epidemiological trends, and the effectiveness of adaptation strategies in healthcare.
- Practical competence: The learner has skills in developing and implementing adaptation measures and climate services to reduce climate-related health risks.
- Independence: The learner is able to independently research, critically evaluate information sources, and formulate practice-oriented conclusions based on current scientific evidence and policies.

- Communication: The learner can clearly and convincingly present results of complex analyses and justify proposals for climate change mitigation and adaptation in written forms (essays, case studies, reports).

## Course Content

Provide a content outline that corresponds to the learning objectives and outcomes. This may be a course outline as it will be presented to students, but not necessarily a complete curriculum.

Include a general list of all topics that you consider necessary to cover. If you believe it would help clarify the scope, indicate what will NOT be covered.

Distribution of activities (fully asynchronous):

- Video lectures (14 × 15–20 min) — 6 academic hours
- Module tests (3 × 10–12 tasks with explanations) — 3 academic hours
- Independent study (reading, glossary work, review of additional materials) — 5 academic hours
- Practical assignment (mini-project) — 4 academic hours
- Final test — 1 academic hour

Module 1. Fundamentals of Epidemiology and Methodological Approaches

- Key topics: Fundamentals of infectious disease epidemiology: epidemic chain and process; driving forces of global change and infectious disease risk; concepts of causality in the study of the impact of climate on infectious diseases.
- Video for each topic: 15–20 min.
- Self-test M1: 25 questions (mandatory completion, with answers). Practical tasks.

Module 2. Climate Change and Infectious Disease Dynamics

- Key topics: Interconnected global threats: climate change, biodiversity loss, and infectious diseases; impact of climate-related population migration on infectious diseases; climate change and cascading risks of infectious diseases; prospects of climate change impacts on infectious disease outbreaks: is there evidence?; impact of anthropogenic climate change on pediatric viral diseases.
- Video for each lecture: 15–20 min.
- Self-test M2: 50 questions (mandatory completion, with answers). Practical tasks.

Module 3. Climate-Sensitive Infectious Diseases

- Key topics: Cholera paradigm; climate-sensitive infectious diseases: waterborne infections; climate-sensitive infectious diseases: foodborne infections; climate-sensitive infectious diseases: soil- and dust-related infections; climate-sensitive infectious diseases: zoonotic infections; climate-sensitive infectious diseases: vector-borne infections.
- Video: 15–20 min.
- Self-test M3: 60 questions (mandatory completion, with explanations). Practical tasks.

## Learning Solutions and Methods of Implementation

List the learning solutions (teaching methods) that will be used and explain why they were chosen. For example: classroom learning, online learning, blended learning, workplace learning, online resources for self-study, coaching or mentoring, etc.

**Learning format:**

The course is delivered in a blended learning format, combining traditional classroom-based teaching with online methods. This approach provides flexibility, supports better acquisition of theoretical knowledge, and develops practical skills relevant to healthcare in the context of climate change.

**Practical classes:**

- Conducted in person under the guidance of the lecturer in classrooms, where participants can discuss complex issues, receive individual consultations, and analyze real case studies and examples of implementing adaptation and mitigation strategies.
- Ensure direct interaction with lecturers, contributing to a deeper understanding of the material and the development of decision-making skills in cross-sectoral contexts.

**Lectures (online format):**

- Provide access to lecture materials at any convenient time and from any location, expanding learning opportunities for a broad audience, including students from different regions.
- Promote the development of skills in independent search, processing, and analysis of up-to-date information in the field of climate change and public health.
- Enhance inclusivity by allowing learners with different needs to access knowledge without time and geographic limitations.

**Independent learning:**

- Implemented through studying lecture materials, completing practical tasks, working with climate and epidemiological data, and preparing analytical presentations and case studies.
- Develops critical thinking, the ability to work with large datasets, and the formulation of evidence-based conclusions.
- Includes the preparation of recommendations for adapting healthcare practices in response to climate change, contributing to the development of practical competencies.

**Role of the lecturer:**

- The lecturer acts as a mentor and facilitator, supporting students in mastering the material, helping them apply knowledge in practice, coordinating discussions, and providing professional guidance during practical tasks.

**Role of the learner:**

- Learners are actively involved in the educational process, independently study materials, participate in practical sessions and discussions, and complete analytical tasks aimed at developing competencies for adapting healthcare systems to climate challenges.

### *Learning Strategies*

*Consider which learning strategies you will use. Provide justification for why you intend to apply them, including reasons why they will help participants achieve the planned learning outcomes.*

*Combine different learning strategies to create a diverse learning environment that accommodates different learning styles of participants. This will increase the effectiveness of learning and help achieve the planned learning outcomes. This section does not require a detailed description of specific activities.*

### **1. Flipped Classroom**

Participants review theoretical materials in advance (short micro-lectures, reading guides with key terms). This allows in-class sessions to focus on discussion, case analysis, and solving complex problems, promoting deeper understanding and the development of practical skills for healthcare adaptation.

### **2. Lectures and Readings**

Structured online materials and curated reading lists are provided for independent acquisition of core concepts and current research, helping participants build a solid theoretical foundation.

### **3. Discussion Strategies**

Active discussion of problematic topics and case studies during practical sessions enhances critical thinking, promotes experience sharing, and supports collaborative solution development in the context of climate-related health challenges.

### **4. Case-Based Learning**

Analysis of real or simulated situations related to climate impacts (e.g., consequences of heatwaves, infectious disease risks after floods) helps integrate theory with practice and develop analytical and decision-making skills.

### **5. Project-Based Learning**

Individual or group projects focused on developing adaptation strategies and interventions provide practical experience while fostering interdisciplinary collaboration and critical thinking.

### **6. AI Guidance**

The use of artificial intelligence tools for information retrieval and data analysis improves learning efficiency and introduces an innovative approach to data processing, while ensuring ethical standards and academic integrity.

This combination of strategies creates a diverse and flexible learning environment that accommodates different learning styles, supports course objectives, and develops practical competencies in climate change mitigation and healthcare adaptation.

## *Learning Activities*

*Describe the main learning activities that will be included, such as lectures, readings, case studies, discussions, exercises, practical assignments, simulations, role-playing games, etc.*

*Also describe the roles of instructors and students during these activities.*

All activities are completed asynchronously in the LMS with clear deadlines and templates.

**1. Micro-lectures and guided notes:** viewing 14 micro-lectures (15–20 minutes each) with a guide (prompt questions) and completion of structured notes using a template.

- **Role of the lecturer:** records micro-lectures; provides the guide and note template; publishes a list of recommended sources and a self-check checklist.

- **Role of the learner:** watches the videos; completes the notes; formulates at least one clarifying question/note in the LMS.

**2. Concept map “climate → health”:** development of a cause-and-effect map (climate factor → risk → health outcome → indicator/action).

- **Role of the lecturer:** provides glossary, sample format, instructions for map construction, and list

of sources.

- **Role of the learner:** creates the map and uploads the file.

**3. Case analysis “Climate and healthcare”:** analysis of a case for an outpatient clinic/hospital (vulnerable groups, communication channels, preparedness indicators) with answers to guiding questions.

- **Role of the lecturer:** provides case description, input data (e.g., heat stress index, admission rates), questions, and rubric.
- **Role of the learner:** analyzes the case; provides answers (250–300 words) with references; proposes 1–2 actions for the healthcare facility.

**4. Scenario planning (M2):** climate change, biodiversity loss, climate-induced migration, cascading risks, and impacts on pediatric viral diseases.

- **Role of the lecturer:** prepares case studies and supervises task completion.
- **Role of the learner:** investigates, analyzes, and proposes adaptation solutions.

**Module self-tests:** five tests of 10 questions each with explanations and retake attempts.

- **Role of the lecturer:** designs the question bank; sets the passing threshold ( $\geq 60\%$ ) and number of attempts; provides correct answers.
- **Role of the learner:** takes tests until the threshold is achieved; reviews explanations; revisits materials if needed.

**5. Mini-project (Practical assignment):** development of adaptation measures or a risk communication plan.

- **Role of the lecturer:** provides a brief template (1–2 pages), presentation template (3–5 slides), and assessment rubric; answers questions in the forum.
- **Role of the learner:** selects an option; completes the brief (problem, data, solution, SMART indicators); prepares a presentation; participates in peer assessment if required.

**6. Final test:** integrated assessment of learning outcomes. 20 tasks of different formats; one attempt; time-limited.

- **Role of the lecturer:** creates the test; sets timing and threshold; provides technical support.
- **Role of the learner:** completes the test within the allotted time; adheres to academic integrity.

**7. Forum reflection and peer assessment (optional):** one short reflection post (100–150 words) + one constructive comment on a peer’s mini-project draft using a rubric.

- **Role of the lecturer:** moderates discussions; provides examples of high-quality feedback; ensures ethical and academic integrity standards.
- **Role of the learner:** posts reflection; provides one rubric-based comment.

## Assessment of Learning

*Describe the assessment plan for participants before, during, and/or after the course, including tests, exercises, activities, and projects that will be assessed. Indicate whether self-assessment or peer assessment will be used.*

*Explain how the assessment is linked to the learning outcomes.*

Ongoing tests after each module – 40%  
Mini-project (practical assignment) – 20%  
Final test – 40%

## Storyboard of Learning (Learning Storyboard)

Use this to create a visual scenario of your blended learning activity

### Learning resources and tools

List the available resources that will be used for different types of learning activities and recommended to students.

Describe the technologies that will be used to implement learning solutions, including educational technologies and operational equipment (hardware, software, collaboration tools).

Lecture texts (6,000–8,000 characters each) in .html / .pdf format.  
Presentation slides for each lecture in .pptx / .pdf format (searchable).  
Video lectures of 15–20 minutes (.mp4) with full captions/transcripts.  
Course glossary (minimum 12–15 terms, up to 20 for more advanced topics).  
Practical assignment (description, sources, optional .xlsx worksheet, assessment criteria).  
Recommended literature:

1. Барер, М. Р. (2021). Медична мікробіологія, вірусологія та імунологія. Медицина.
2. Грузєва, Т. С. (Ред.). (2021). Громадське здоров'я. Книга-плюс.
3. Виноград, Н. О., та ін. (2021). Загальна епідеміологія (5-е вид.). ВСВ «Медицина».
4. Tarasov, Y. (2025). Biostatistics in Health (1st ed.). Allied Health Press.
5. Tarasov, Y. (2025). Epidemiology (1st ed.). Allied Health Press.
6. OpenStax College. (2016). Microbiology. OpenStax CNX. <https://openstax.org/details/books/microbiology>
7. Gordis, L. (2014). Epidemiology (5th ed.). Elsevier Saunders.
8. Heymann, D. L. (Ed.). (2015). Control of communicable diseases manual (20th ed.). American Public Health Association.

Additional (key articles and reports):

9. Awad, D. A., Masoud, H. A., & Hamad, A. (2024). Climate changes and food-borne pathogens: the impact on human health and mitigation strategy. *Climatic Change*, 177, 92. <https://doi.org/10.1007/s10584-024-03748-9>
10. Baker, R. E., Mahmud, A. S., Miller, I. F., Hay, S. I., & Grenfell, B. T. (2022). Infectious disease in an era of global change. *Nature Reviews Microbiology*, 20(4), 193–205. <https://doi.org/10.1038/s41579-021-00648-9>
11. Baker-Austin, C., Oliver, J. D., Alam, M., Ali, A., Waldor, M. K., Qadri, F., & Martinez-Urtaza, J. (2018). *Vibrio* spp. infections. *Nature Reviews Disease Primers*, 4(1), 8. <https://doi.org/10.1038/s41572-018-0005-8>
12. Barrero Guevara, L. A., Kramer, S. C., Kurth, T., & Domenech de Cellès, M. (2024). Causal inference concepts can guide research into the effects of climate on infectious

- diseases. *Nature Ecology & Evolution*, 9(2), 349–363. <https://doi.org/10.1038/s41559-024-02594-3>
13. Bartlow, A. W., Manore, C., Xu, C., Kaufeld, K. A., Del Valle, S., Ziemann, A., Fairchild, G., & Fair, J. M. (2019). Forecasting Zoonotic Infectious Disease Response to Climate Change: Mosquito Vectors and a Changing Environment. *Veterinary Sciences*, 6(2), 40. <https://doi.org/10.3390/vetsci6020040>
  14. Carlson, C. J., Albery, G. F., Merow, C., Trisos, C. H., Zipfel, C. M., Eskew, E. A., Olival, K. J., Ross, N., & Bansal, S. (2022). Climate change increases cross-species viral transmission risk. *Nature*, 607(7919), 555–562. <https://doi.org/10.1038/s41586-022-04788-w>
  15. Castonguay, A. C., Chowdhury, S., Shanta, I. S., Schrijver, B., Schrijver, R., Wang, S., Fazil, A., Gachon, P., Ogden, N. H., & Leighton, P. A. (2024). A Generalizable Prioritization Protocol for Climate-Sensitive Zoonotic Diseases. *Tropical Medicine and Infectious Disease*, 9(8), 188. <https://doi.org/10.3390/tropicalmed9080188>
  16. Charnley, G. E. C., & Kelman, I. (2024). Perspectives on climate change and infectious disease outbreaks: is the evidence there?. *npj Climate Action*, 3, 61. <https://doi.org/10.1038/s44168-024-00115-3>
  17. Chitre, S. D., Crews, C. M., Tessema, M. T., Plėštytė-Būtienė, I., Coffee, M., & Richardson, E. T. (2024). The impact of anthropogenic climate change on pediatric viral diseases. *Pediatric Research*, 95(2), 496–507. <https://doi.org/10.1038/s41390-023-02929-z>
  18. Colwell, R. R. (1996). Global climate and infectious disease: the cholera paradigm. *Science*, 274(5295), 2025–2031. <https://doi.org/10.1126/science.274.5295.2025>
  19. Grobusch, L. C., & Grobusch, M. P. (2022). A hot topic at the environment-health nexus: investigating the impact of climate change on infectious diseases. *International Journal of Infectious Diseases*, 116, 7–9. <https://doi.org/10.1016/j.ijid.2021.12.350>
  20. Gurevitch, J., Koricheva, J., Nakagawa, S., & Stewart, G. (2018). Meta-analysis and the science of research synthesis. *Nature*, 555(7695), 175–182. <https://doi.org/10.1038/nature25753>
  21. Haque, S., Mengersen, K., Barr, I., Loughnan, M., & Soares Magalhaes, R. J. (2024). Towards development of functional climate-driven early warning systems for climate-sensitive infectious diseases: Statistical models and recommendations. *Environmental Research*, 249, 118568. <https://doi.org/10.1016/j.envres.2024.118568>
  22. Lake, I. R., & Barker, G. C. (2018). Climate Change, Foodborne Pathogens and Illness in Higher-Income Countries. *Current Environmental Health Reports*, 5(1), 187–196. <https://doi.org/10.1007/s40572-018-0189-9>
  23. Levy, K., Smith, S. M., & Carlton, E. J. (2018). Climate Change Impacts on Waterborne Diseases: Moving Toward Designing Interventions. *Current Environmental Health Reports*, 5(2), 272–282. <https://doi.org/10.1007/s40572-018-0199-7>
  24. Mahon, M. B., Sack, A., Aleuy, O. A., Rohr, J. R., et al. (2024). A meta-analysis on global change drivers and the risk of infectious disease. *Nature*, 629(8013), 830–836. <https://doi.org/10.1038/s41586-024-07380-6>
  25. McIntyre, K. M., Setzkorn, C., Hepworth, P. J., Morand, S., Morse, A. P., & Baylis, M. (2017). Systematic Assessment of the Climate Sensitivity of Important Human and Domestic Animals Pathogens in Europe. *Scientific Reports*, 7, 7134. <https://doi.org/10.1038/s41598-017-06948-9>

26. Mojahed, N., Mohammadkhani, M. A., & Mohamadkhani, A. (2022). Climate Crises and Developing Vector-Borne Diseases: A Narrative Review. *Iranian Journal of Public Health*, 51(12), 2664–2673. <https://doi.org/10.18502/ijph.v51i12.11457>
27. Nova, N., Athni, T. S., Childs, M. L., Mandle, L., & Mordecai, E. A. (2022). Global Change and Emerging Infectious Diseases. *Annual Review of Resource Economics*, 14, 333–354. <https://doi.org/10.1146/annurev-resource-111820-024214>
28. Omazic, A., Bylund, H., Boqvist, S., Häsler, B., & Lindberg, A. (2019). Identifying climate-sensitive infectious diseases in animals and humans in Northern regions. *Acta Veterinaria Scandinavica*, 61, 53. <https://doi.org/10.1186/s13028-019-0490-0>
29. Pfenning-Butterworth, A., Buckley, L. B., Drake, J. M., et al. (2024). Interconnecting global threats: climate change, biodiversity loss, and infectious diseases. *The Lancet Planetary Health*, 8(4), e270–e283. [https://doi.org/10.1016/S2542-5196\(24\)00021-4](https://doi.org/10.1016/S2542-5196(24)00021-4)
30. Salje, H., Lessler, J., Paul, K. K., et al. (2016). How social structures, space, and behaviors shape the spread of infectious diseases using chikungunya as a case study. *Proceedings of the National Academy of Sciences of the United States of America*, 113(47), 13420–13425. <https://doi.org/10.1073/pnas.1611391113>
31. Semenza, J. C., & Ko, A. I. (2023). Waterborne Diseases That Are Sensitive to Climate Variability and Climate Change. *The New England Journal of Medicine*, 389(23), 2175–2187. <https://doi.org/10.1056/NEJMra2300794>
32. Semenza, J. C., Rocklöv, J., & Ebi, K. L. (2022). Climate Change and Cascading Risks from Infectious Disease. *Infectious Diseases and Therapy*, 11(4), 1371–1390. <https://doi.org/10.1007/s40121-022-00647-3>
33. Sokolow, S. H., Nova, N., Jones, I. J., et al. (2022). Ecological and socioeconomic factors associated with the human burden of environmentally mediated pathogens: a global analysis. *The Lancet Planetary Health*, 6(11), e870–e879. [https://doi.org/10.1016/S2542-5196\(22\)00248-0](https://doi.org/10.1016/S2542-5196(22)00248-0)
34. Thomson, M. C., & Stanberry, L. R. (2022). Climate Change and Vectorborne Diseases. *The New England Journal of Medicine*, 387(21), 1969–1978. <https://doi.org/10.1056/NEJMra2200092>
35. Trebski, A., Gourlay, L., Gibb, R., Imirzian, N., & Redding, D. W. (2024). Sensitivity to climate change is widespread across zoonotic diseases [Preprint]. medRxiv. <https://doi.org/10.1101/2024.11.18.24317483>
36. Tsui, J. L.-H., Pena, R. E., Moir, M., et al. (2024). Impacts of climate change-related human migration on infectious diseases. *Nature Climate Change*. Advance online publication. <https://doi.org/10.1038/s41558-024-02078-z>
37. Wesolowski, A., Qureshi, T., Boni, M. F., et al. (2015). Impact of human mobility on the emergence of dengue epidemics in Pakistan. *Proceedings of the National Academy of Sciences of the United States of America*, 112(38), 11887–11892. <https://doi.org/10.1073/pnas.1504964112>
38. National Research Council (US) Committee on Climate, Ecosystems, Infectious Diseases, and Human Health. (2001). *Under the Weather: Climate, Ecosystems, and Infectious Disease*. National Academies Press (US).
39. Intergovernmental Panel on Climate Change (IPCC). *Climate Change Reports* (e.g., AR6). <https://www.ipcc.ch>
40. World Health Organization (WHO). *Climate change and health*. <https://www.who.int/health-topics/climate-change>

