



Cătălina CROITORU

Health and climate change

Chisinau, 2024





NICOLAE TESTEMITANU STATE UNIVERSITY
OF MEDICINE AND PHARMACY
OF THE REPUBLIC OF MOLDOVA



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613/614+551.583(075.8)

Approved at the meeting of the *Quality Management Council of the „Nicolae Testemițanu” State University of Medicine and Pharmacy*, protocol no. 6 from 27.06.2024

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The course of lessons “Health and climate change” is intended for V-year students, Faculty of Medicine as didactic material for the optional course “Health and climate change”. The simplicity and accessibility of the presentation of the material allows it to be used by the general population to increase the level of knowledge in the field.

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INTRODUCTION

**„Climate change is the biggest
and most massive failure to date“**

Nicholas Stern,
Head of the Economic Service of the British Government
and former chief economist of the World Bank

Historically, the study of the atmosphere and oceans was among man's earliest scientific concerns.

Evidence of an interest in meteorological processes is present in the *Indian Vedas* and in *cuneiform tablets* discovered in the region between the Tigris and the Euphrates.

Greek philosophers also tried to explain the causes of some processes related to weather and climate. Hippocrates' *Air, Waters and Places*, published around 400 BC, is probably the first climatology, and Aristotle's *Meteorologica*, written around 350 BC, is considered one of the first treatises on meteorology.

By the end of the 19th century, the dominant attitude in science was that the main laws and directions had already been discovered. A mad courage accompanied this attitude, but also an unproductive arrogance - later called „temporal provincialism” - that settled in the great university centers. The science of the following centuries had already been charted, and the destiny of human knowledge settled. Nothing was beyond the powers of known science, armed with Newton's differential equations, the thermodynamic laws of Rankine, Clausius, and Lord Kelvin, or Maxwell's classical electrodynamic equations. The behavior of any object in the known Universe could be understood by analyzing its constituent elements.

The term climatology has its origin in Greek. For the first Greek philosophers the notion of climate (κλίμα) meant slope (inclination) and referred to the curvature of the Earth's surface. They believed that significant regional differences in weather characteristics occur only in the north-south direction, due to the curvature of the earth's surface (high in the south and low in the north) which determines the existence of torrid, temperate and cold zones.

The functioning of the climate system is ensured by solar radiation, unevenly distributed on the Earth's surface. Changes in the Earth's relative position to the Sun cause changes in the intensity and distribution of solar radiation at the Earth's surface.

Climate change and its consequences are the greatest challenge facing human health and the health care system in the 21st century. Rising air temperatures, fires, floods and droughts can directly and indirectly cause human pathologies at the physical and mental level. Extreme weather events lead to loss of human lives, life resources and cause severe mental problems.

During the 20th century, the global average surface temperature of the Earth increased by about 0.6°C. Additional warming of more than 0.14°C has been measured since 2000. Although the total increase may seem small, it represents an extraordinarily rapid rate of change compared to changes over the past 10,000 years.

The Australian Medical Association (AMA) in 2019 announced the decision of „clear scientific evidence indicating a severe impact on patients and communities, now and in the future”. The AMA indicated that the decision is in line with those taken by the American Medical Association, the United States College of Physicians and the British Medical Association, as well as the World Health Organization, in 2015. The AMA has recognized since 2004 the health risks associated with global warming. AMA President Tony Bartone said in a press release that climate change affects health by promoting the spread of infectious diseases and the negative effects of heat waves. „There is no doubt that climate change is a health emergency. AMA accepts the scientific evidence related to the climate crisis and its impact on human health and well-being.” „Climate change will cause harm and death due to the increase in severe weather events. Climate change will cause an increase in the risk of transmission of vector-borne diseases. Climate change will cause food insecurity following the decline of agricultural harvests. Climate change will cause a higher incidence of mental health problems.” A coalition of doctors’ groups, including the Royal Australian College of Physicians and the Australian Medical Students’ Association, sent an open letter to the country’s political parties in April calling attention to the „significant and profound impact” of climate change

on health and well-being. *The Guardian* mentions in an article that, in Australia, the amount of greenhouse gas emissions has increased every year since the carbon tax was canceled in 2013.

The WHO recognized in 2015 that „climate change represents one of the greatest global threats of the 21st century”.

So... With the development of all spheres of activity, advancing in evolution, man forgets more and more about what surrounds him - NATURE. It suffers, and therefore people suffer too. That is why it is very important not to neglect climate change and to understand what is really valuable.

To succeed in combining both fields, ecology and development, we need to find rational and effective solutions that will help us prevent these harmful climate changes.

Step by step for change:

RECYCLING – garbage sorting starts with each person. It’s something simple, but very useful.

THINKING – changing thinking leads to improved climate change.

PROGRESS – everything happens because of something. Each step must be thought out and implemented.

CHANGE STARTS WITH EACH OF US!

Children are the ones who will feel the consequences of what we do today!

Climate-medical literacy

**„The roots of teaching are bitter,
but the fruits are sweet!”**

Aristoteles, La Diogenes Laertius

The purpose of teaching the work:

Emphasizing the importance of awareness and increasing the level of general and specialized knowledge on a new and emerging trigger pheno-menon.

Theme structure:

- ✓ Climate – the basis of climate change
- ✓ Notions and explanations of climate literacy
- ✓ The role of climate change education
- ✓ The fee for the action
- ✓ Dimensions of climate change education
- ✓ The objective of climate change education
- ✓ Factors driving the development of education on climate change and the environment
- ✓ Climate education - mandatory in schools at all levels
- ✓ Where does climate literacy begin, where does it end?

Climate represents the dynamics of all meteorological phenomena in the atmosphere in a certain place or region on the globe, in a very large time interval. It plays an important role in the formation of water, vegetation, animal life and soils, influences the life and activity of the population, favors the development of agriculture, the normal growth of plants.

The World Meteorological Organization (WMO) defines climate, in the *Guide to climatological practices*, as: „*the synthesis of weather conditions in a given area, based on long observational series (minimum 30 reference years) of atmospheric variables*”.

Climate is an ideal interdisciplinary topic for lifelong learning about the scientific process and the ways in which humans affect and are affected by Earth systems. This rich topic can be approached at many levels, from comparing daily weather to long-term records to explore the abstract, representations of climate in computer models to examine how climate change affects people and ecosystem health.

Climate literacy encompasses essential principles of climate science involving information that is considered important for individuals and communities to know and understand about the Earth’s climate, the impacts of climate change, and approaches to adaptation and mitigation.

Climate change is a major challenge that will mark future generations.

Climate literacy constitutes essential climate education (the principles of climate science) and at the same time awareness of the impact.

Climate science education is man’s understanding of his influence on climate and the influence of climate on man and society.

Climate education is a branch of environmental education that everyone must go through in order to understand the practical aspects of a sustainable way of life, but also to deal with changes, learn how to adapt and how not to allow them to happen. aggravate.

Climate education is one of the pillars of improving the response to climate change, by changing human behavior, in order to protect nature and resources. It is recognized that climate education plays a fundamental role in the behavioral and mental adaptation of society to climate change.

Education for climate action has an important role in addressing climate change on a global scale: it informs pupils, students, the population; it eliminates climate anxiety and brings important skills. Educating young minds is the best step to take in climate action. Our young people are our future, the future of this planet. We need to leave our grandchildren and great-grandchildren a beautiful place to live in, so a sustainable way of living now is of major importance. Every small step counts and each of us is responsible for how we protect our planet.

By climate change and environmental education, we mean an education that promotes a sustainable lifestyle through the development of ecosocial skills. This type of education aims to familiarize young people with the effects of climate change on the natural and socio-economic environment, but also with the ways to improve the response to them. It aims to raise awareness of climate change and environmental issues. Children can be both bearers of a message to their families and communities, and directly involved in actions to stop environmental degradation.

Climate change and environmental education aims at orientation towards change and action, taking into account three dimensions:

- the culture of complexity,
- capacity for action,
- responsibility towards the environment.

The objective of climate change education is to develop competencies (knowledge, skills and attitudes) that enable individuals to contribute to:

- relevant actions for limiting climate changes and reducing their impact;
- climate change adaptation actions and ensuring climate change resilience models;
- protecting, restoring and promoting the sustainable use of terrestrial ecosystems, running waters, lakes, seas and marine resources and stopping the loss of biodiversity;
- ensuring sustainable consumption and production models.

Factors driving the development of education on climate change and the environment are:

- the urgency to act on climate change issues,
- the need to comply with international commitments,
- compliance with the national commitments made by the authorities,
- public pressure, demand from young people.

No one person can be expected to understand every detail about all the fundamental climate science literacy concepts. Full understanding of these interconnected concepts will require a systems thinking approach, meaning the ability to understand the complex interconnections between all components of the climate system. Furthermore, as climate science advances, and efforts to educate people about the climate's influence on them and their influence on the climate system, will lead to public understanding that continues to grow.

A climate literate: understands the essential principles of the Earth's climate system; knows how to evaluate scientifically credible climate information; is able to make informed and responsible decisions about actions that may affect the climate; behaves appropriately; communicate about climate and climate change in a meaningful way.

Climate education helps to find systemic solutions and action through: international cooperation, firm commitments from states,

the involvement of all state institutions, the involvement of the private, academic environment and, last but not least, citizens, lifestyle change: from food to the energy used to live, move, produce and consume goods and services.

The UN is calling for climate education to become compulsory in schools at all levels from 2025 to tackle future global warming.

Only a few countries currently mandate climate change studies in their education systems, despite many being signatories to this goal in the Paris Agreement.

Where does climate literacy begin, where does it end?

- state
 - ✓ from north to south and vice versa,
 - ✓ from east to west and vice versa,
- public
 - ✓ connection from high school to college and from college to university,
 - ✓ high school and college students address and serve larger communities, universities are nodes of the information network.

Climate change: a new problem for students

**„Let’s raise awareness today
to survive tomorrow!”**

World Health Organization

The purpose of teaching the work:

Highlighting the existence, actuality of the phenomenon of climate change and the need to know the characteristics of this phenomenon for young people in general and for medical professionals in particular.

Theme structure:

- ✓ The need to study the climate change phenomenon
- ✓ The challenges of climate change education
- ✓ Case study on the issue of climate change training
- ✓ Educational recommendations

Today's education is constantly changing and adapting to the new challenges and opportunities of the contemporary world. In the context of climate change and its impact on the environment, health and life, education must play an important role in promoting a culture of sustainability and a responsible attitude towards the environment, especially for the young generation, which in many sources is called the „climate generation”.

First of all, education must provide solid and up-to-date knowledge about climate change, its causes, effects on the environment and life, but also possible solutions to reduce or prevent them. This knowledge should be integrated in different subjects, from natural sciences and geography in schools to economics, social sciences, medical sciences in specialized secondary institutions and up to thematic subjects in universities.

Second, education must promote sustainable values and behaviors among pupils and students. Which can be achieved by actively involving young people in projects and activities that help them understand the importance of protecting the environment and develop skills and competences to face climate challenges, such as recycling waste, saving energy and water or reducing emissions of carbon.

Third, education must encourage innovation and research to develop new and more effective technologies and solutions to mitigate/ combat climate change. This involves fostering creativity and critical thinking among young people.

Enriching knowledge in the field of climate change must occupy an important place in the training of young specialists, who will start their work in a changing climate. As climate changes have a particular impact on the healthy population and with a strong effect on the sick, knowledge is needed that will influence the prophylaxis of the consequences.

Climate change and climate variability are the main issues facing the global community. The complex nature of the global clima-

te as an interconnected system, encompassing land and socio-ecological systems, requires critical inquiry along with reflexive and transformative educational methods.

Concepts such as education for sustainable development, as an integral component of quality education and the essential tool for sustainable development, empower people to change their thinking and approaches towards a sustainable future. This can be facilitated by increasing opportunities for quality education on sustainable development.

It is necessary to promote, social transformation by redesigning educational pedagogies and empowering people to build knowledge, skills, values and behaviors essential for sustainable development. It also emphasizes the need to integrate sustainable development themes such as climate change into the teaching and learning process (UNESCO 2020). Efforts are needed from universities around the world to develop advanced education programs, capacity building and interdisciplinary collaboration to support deeper learning on climate change.

The challenges of climate change education

Climate change education can play a critical role in promoting a just climate transition. However, educational institutions seem challenged to equip their students and future teachers with what it takes to become multipliers for climate action.

Universities around the world are increasingly recognizing their responsibility to prepare students and society to actively contribute to climate change mitigation and adaptation. One of the major roles - states that universities adopt and promote carbon neutral objectives and practices.

Instances of universities taking it upon themselves to invest in environmentally sustainable projects to achieve sustainability goals have escalated. Recent trends have resulted in a growing number of universities globally making decisions to actively manage their fossil fuel endowments.

Furthermore, the path to climate-based education is integrative, strategic and progressively combines the goals of sustainable development.

Many universities aim to become „carbon neutral” institutions by adopting low carbon operational practices.

Universities are developing curricula and pedagogical approaches to educate students (and by extension society) about the imperatives of carbon neutrality and climate change mitigation and adaptation.

Climate change education in universities can take the form of formal, informal and non-formal approaches to learning and teaching, including field projects in nature, international case studies and graduate research.

The report “Climate change and environmental education in sustainable schools” includes topics such as: climate and environmental education program; educational resource solutions; the human resource involved in climate change and environmental education; infrastructure for sustainable schools.

Digital solutions used can be: an area dedicated to environmental events or actions; a digital library for centralizing open educational resources; an area dedicated to funding sources for educational activities; an area where partnership opportunities can be detailed.

Case Study:

A questionnaire was conducted in the northern part of country X, using the example of 80 secondary school students and 18 teachers. The results indicated that both cohorts feel inadequately prepared for their role as potential ‚agents of change’, stating that too little time is given to climate change as a topic, engagement with practical examples of climate action is inadequate and an examination superficiality of the subject.

- Students, teachers are not sufficiently supported by educational institutions to exercise their transformative potential due to the many identified challenges that must be faced at a systemic level. The results indicate that teacher training programs in particular need to increasingly focus on the professional development of future generations
- Students show a lack of information regarding the consequences of climate change.
- In order to know more information about the consequences, it is considered welcome to promote information on a large scale about the problems and their negative aspects, as an example: the distribution of informative brochures, class hours.

Educational recommendations

1. Integrating climate change education into training programs.

It is important that specific climate change content be introduced into school curricula, starting in the primary grades and continuing through to the university level. This should include learning about the effects of climate change on the environment, the economy, society and especially health.

2. Development of practical skills for sustainability.

Educational institutions should provide children and young people with opportunities to develop practical skills to reduce their carbon footprint and promote a sustainable lifestyle. These could include practical activities such as waste recycling, waste composting, alternative energies, creating vertical gardens, growing vegetables, plants and more.

3. Introduction of the topic of climate change in all subjects.

Educators should address climate change in all subjects, not just environmental science. For example, in Romanian, one can learn about ecological literature and poetry, while in history, stu-

dents can learn about the impact of industrial development on the environment and climate change. In medical universities, both the fundamental disciplines, but even more so the clinical ones, must include thematic subjects. All the consequences of climate change have an impact on health.

4. Promoting education through action.

Young people should be encouraged to use their knowledge to take measures to reduce/ mitigate the impact on the environment. These measures could include purchasing eco-friendly products, conserving energy, recycling waste and participating in volunteer events to clean up the environment.

5. Using technology to improve climate change education.

The use of digital tools in the training process. For example, educational computer games can be a fun and interactive way to learn about the impact of climate change, in the medical field – modeling the impact on the human body.

6. Introducing the topic of climate change in the continuing education of pedagogues, doctors, outdoor workers and other categories of employees.

The population must be encouraged to develop their knowledge of climate change and participate in seminars and continuing education courses. This will enable people to improve their knowledge and provide others with the best possible information about the impact of climate change on the environment, health and how they can take action to protect the planet.

The European Commission's "European Agenda for Quality Education" includes specific objectives for climate change education, including the development of key skills and critical thinking on the issue.

Education today plays a critical role in preparing young people to deal with tomorrow's climate change. In the table below are some recommendations to help young people understand the impact of climate change and to encourage a culture of sustainability.

The review of the literature in university education on climate change and sustainability reflected a gradual shift globally over the last decade away from a narrow curriculum focus on environmental protection, health impact reduction towards broader goals and creative educational approaches.

Proposed measures to mainstream climate change education among young people

<p>Developing partnerships in the fields of environmental protection, climate change with managerial structures from all areas of life (ministries, departments, teaching staff, medical workers, non-governmental organizations, local public authorities, etc.) for the development of activities that generate learning opportunities.</p>	<p>Ministry of Education, Ministry of the Environment, Ministry of Health, NGOs, Professors, Local authorities.</p>
<p>Stimulating the expansion of optional courses with an emphasis on sustainable development, environmental issues and climate change.</p>	<p>Ministry of Education, Ministry of Health, NGO sources</p>
<p>Updating and improving training programs in gymnasiums, high schools, professional schools, centers of excellence, universities, academies.</p>	<p>Ministry of Education, academic/research environment in the field</p>

Overview of climate change vs global warming

**„The warmest decade is a stark reminder
of the relentless pace of climate change,
which is destroying lives
and livelihoods across the planet”**

Antonio GUTERRES,
the secretary general of the UN

The purpose of teaching the work:

Approaching a major contemporary environmental phenomenon: climate change, following global warming.

Theme structure:

- ✓ Definitions, comparative characteristics between climate change and global warming
- ✓ The solar cycle
- ✓ The greenhouse effect
- ✓ IPCC conclusions with reference to climate change as a result of the analysis of scientific research
- ✓ Changes in precipitation, ocean and wind patterns as a result of global warming

NASA declares for the first time in the 1970s, based on satellite measurements, that we are witnessing ***a new environmental phenomenon: „global warming”***, which means that the global average annual temperature, after 1970, on the surface of land and water, exceeds the average values of the last 100 pre-industrial years (1850-1950).

Climate change is a change in the statistical distribution of weather patterns over an extended period of time (ie, decades to millions of years). Climate change can refer to a change in average weather conditions or variation in weather in the context of long-term average conditions. Climate change is any form of long-term progressive or regressive variation.

Global warming is the phenomenon of continuous increase in the average atmospheric temperatures recorded in the immediate vicinity of the ground, as well as of the water of the oceans, observed in the last two centuries, but especially in the last decades.

The United Nations Framework Convention on Climate Change provides the following definition of Climate Change: *„a change in climate attributable directly or indirectly to human activity, which results in a change in the composition of the global atmosphere and which occurs in addition to natural climate variability observed over comparable periods of time”*. Therefore, the Convention makes a distinction that climate change is determined by human activities, which lead to changes in atmospheric composition, and climate variability attributed to natural causes. At the same time, climate change is considered a natural phenomenon, which depends on the solar cycle, plate tectonics and volcanic eruptions.

Global warming is mainly considered anthropogenic (artificially influenced) phenomenon.

Climate change is a global problem, which represents changes in the planet’s climate that can essentially influence the development of humanity in the near future, having significant effects on the health of the population, the environment, society, and the global economy.

Global warming is an effect of climate change, which refers to an increase in the global average temperature.

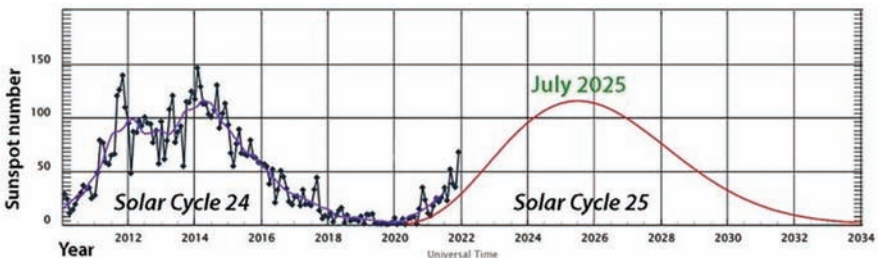
The Intergovernmental Panel Climate Change (IPCC), the international body established in 1988 by the World Meteorological Organization and the United Nations Environment Programme, which assesses the scientific basis and provides policy on climate change, defines the changes climate as „*a change in the state of the climate, which can be identified by changes in its properties, which persists for a longer period and which is due to natural variability and a result of human activity*”.

The solar cycle is the periodic variation of solar radiation that causes climate change on Earth. The average duration of a cycle is 11.2 years (solar cycles with durations between 8 and 15 years are also known)

Heating and cooling phenomena have always existed in Earth's history. Warming is associated with the cosmic solar maximum phenomenon, alternating with small terrestrial glacial phenomena associated with the solar minimum phenomenon.

The current solar cycle is the 25th, which began in December 2019 and is expected to last until 2032-33. In this cycle – the solar maximum is calculated for the years 2023-2026.

The solar cycle



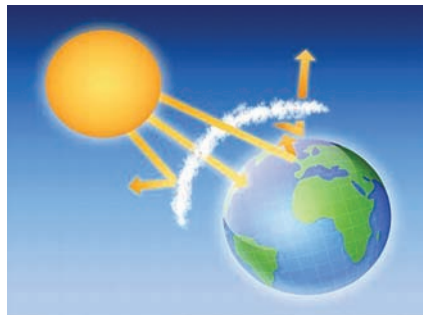
The phenomenon of global warming began to worry humanity after the 60s, of the 20th century. Massive industrial development and the increase in the concentration of greenhouse gases, which are largely considered responsible for this phenomenon, have led to climate warming. The phenomenon of global warming is believed to have contributed to an increase in the global average temperature of up to 90C over a period of about 20,000 years. The warming of the ocean water, the melting of the glaciers, the rise of the sea level, the reduction of the snow cover in the northern hemisphere, etc. are proof of the increase in the earth's temperature.

The last decade was the warmest in 125,000 years. The concentration of carbon dioxide is the highest in the last 2 million years. About 1.2 trillion tons of ice is lost every year. Coral reefs are destroyed at ~50%.

The basis of global warming is the *Greenhouse Effect*. The greenhouse effect is a process of warming the planet due to the radiation reflected from the surface of the soil, which currently takes place in the Earth's atmosphere and which is essential for maintaining a comfortable temperature for life. The effect was discovered by Joseph Fourier in 1824.

The mechanism of GHG formation

The greenhouse effect is based on the fact that while gases in the Earth's atmosphere allow solar radiation to pass through, some of them absorb heat radiation emitted at the Earth's surface or prevent some of the heat from passing back into outer space. This interaction leads to the heating of the respective gases and, as a result, they re-emit the heat in all directions. This results in an increase in the global average temperature.



Greenhouse gases

Carbon dioxide (CO ₂)	Combustion of coal, oil and natural gas, transport
Nitrogen dioxide (N ₂ O) Methane (CH ₄)	Landfills, agriculture and animal husbandry
Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) Sulfur hexafluoride (SF ₆)	Used for refrigerators, air conditioners and even shoes
Water vapor	

According to data provided by the National Oceanic and Atmospheric Administration (NOAA) in the USA, the concentration of carbon dioxide has increased by ~30%. The global average concentration of carbon dioxide in the atmosphere has increased from 316 ppm (parts per million) in 1959 to over 415 ppm in 2021.

The methane concentration information is more worrying: ~160% increase. The global average concentration of methane in the atmosphere has increased from 722 ppb (parts per billion) in 1750 to over 1,880 ppb in 2021.

Global warming at the local level

Although little time has passed since the beginning of the 21st century, average temperatures have seen a slight increase during this period. The average temperature in the Republic of Moldova has increased by approximately 0.6°C in the last 50 years. It is expected to rise by 1°C by the middle of this century.

„Planck Response” is an effective mechanism of the earth to restore its balance, regarding global warming. At the beginning of 2016, NASA specialists published a study in *the Journal of Climate*, showing how this „Planck Response” is influenced by sudden changes at the local level.

A recent study by the Australian Queensland and Griffith universities used for the first time a novel model for estimating global temperature increase, based on the idea of energy used by each person on Earth.

An example of the sudden increase in temperature can be found in India: in May 2016, an absolute temperature record of 51°C was recorded in the city of Phalodi, in northern India, which is a very populated area.

The IPCC presented the results of a series of scientific investigations and concluded that:

- ✓ The thickness and extent of the Arctic glaciers decreased by 40% in the last 30 years and there is a possibility of their complete disappearance by 2100.
- ✓ The warmest 15 years globally were recorded in the last two decades, the years 1998 and 2005 being extremely warm.
- ✓ The frequency of occurrence and intensity of extreme weather phenomena (storms, tornadoes, hurricanes) has increased.
- ✓ Europe's temperature increased by about 1°C, being 0.75°C more than the global rate.
- ✓ The concentration of greenhouse gases in the atmosphere currently exceeds the values recorded in the last 650,000 years, and forecasts indicate an unprecedented increase.
- ✓ Regional climate patterns have changed (heat waves, droughts, floods), and trends indicate a gradual increase in the coming years.

Global warming is causing increasing and, in some cases, irreversible changes in precipitation, ocean and wind patterns in all regions of the world.

- ✓ One of the major impacts visible at the moment is the melting of glaciers, parallel to the rise of the sea level. Thus integrated, these two actions lead to the flooding and erosion of coastal and low-lying areas
- ✓ The effects are visible, for example, in the Ocean in the tropics where we have vast coral meadows of incredible color. Due to the warming of the ocean, these corals discolor and die.
- ✓ In the Arctic Ocean, due to high temperatures, the glaciers are melting, leaving the polar bears stranded, destroying their natural habitat where they fed and multiplied, causing their death.
- ✓ Permafrost is melting at an accelerated rate. As the ground thaws, it causes disruption of the physical and chemical components of the ecosystem.

Global warming and winter weather

- ✓ Increase in global average temperature will almost certainly lead to an increase in the incidence of record temperatures,
- ✓ Global warming also leads to an increase in atmospheric water vapor, which increases the likelihood of more abundant precipitation events that can cause flooding,
- ✓ Global warming could disrupt the polar vortex in a way that makes the flow around it more wavy, leading to an increased incidence of both extreme heat and extreme cold in temperate latitudes,
- ✓ The loss of Arctic sea ice can influence the atmospheric circulation at mid-latitudes during the summer. Losses of sea ice in late summer can indeed lead to regional changes in the Arctic climate,

- ✓ Summertime sea ice extent in the Arctic has been remarkably low since 2007, and the years that followed were marked by several notable cold air bursts. It was this coincidence that led Francis JA, Vavrus SJ to link cold air outbreaks with global warming,
- ✓ Research linking summer Arctic ice with winter climate in temperate latitudes deserves a proper hearing. But making it the centerpiece of the public discourse on global warming is inappropriate and a distraction.

The environmental vulnerability index is made up of the following indicators:

- Share of eroded land;
- Share of homes with access to sanitation services;
- Share of unauthorized landfills;
- Share of land surface contaminated with pesticides.

The assessment of these indicators shows a clustering of vulnerabilities in certain regions, generally interconnected.

There are districts in the central and northern parts with high levels of environmental vulnerability and a group of districts in the southwestern part that are highly vulnerable to climate change. Seven districts in the north (where very heavy and erratic rainfall, including flooding, is expected in the coming decades) and several districts in the south (where heat stress is expected to have a major impact on agriculture, lives and livelihoods) have documented high levels of environmental vulnerability and will suffer the greatest damage (socio-economically and on health).

The major global economic consequences of global warming

Average global losses could be 1-5% of Gross Domestic Product (GDP) for every 4oC of warming. This ranges from significant but bearable to truly burdensome. Economists are “virtually certain”,

however, that whatever the global climate costs, not everyone will bear them equally.

Because such events related to geography, climate and economy make some groups particularly vulnerable, climate change will hinder progress towards achieving the Millennium Development Goals,

Some people will be exposed to more climate change than others. Some will be more sensitive to it. These people could live in countries that are at low latitudes, where drought will prevail. Their economies are probably based largely on agriculture which is susceptible to drought.

Although the report highlights the vulnerability of poorer, developing countries, it does not predict any real winners. Every population has vulnerable segments, the European heat wave of 2003 killed 30,000 people, especially the elderly.

The actuality of global warming and how likely is global cooling?

The more we increase global warming, the more the chances of global cooling decrease.

Humanity's irrational use of the sources that cause this warming (especially in developing countries such as the Republic of Moldova) will continue to lead to its increase and to much more serious consequences.

The causes and consequences of climate change

**„If you think the environment is less important
than the economy, try to hold your breath
while counting the money!”**

Guy McPherson,
American scientist, professor emeritus
at the University of Arizona

The purpose of teaching the work:

Description of the causes and consequences of climate change.

Theme structure:

- ✓ Causes of climate change
- ✓ Consequences of climate change

CAUSE

Changes in solar activity

The Sun's activity provides the primary energy for Earth's climate system, contributing to the planet's energy balance. Solar activity and the solar cycle cause variations in the amount of energy absorbed by the Earth.

A study published in the journal *Environmental Research Letters* shows that variations in solar activity contributed no more than 10% to global warming in the 20th century.

Research by Professor *Terry Sloan* of Lancaster University and Professor *Sir Arnold Wolfendale* of Durham University has highlighted that variations in solar activity, or its influence on stopping cosmic rays, cannot be a significant contributing factor to global warming.

Even during the period of solar minimum, the average global temperature would follow an increasing trend, because the warming of the planet caused by greenhouse gas emissions is about six times greater than the possible cooling due to a prolonged solar minimum.

The Sun will not change the Earth's climate system on its own. In the past, changes in solar activity influenced the climate only to a small extent, and today, the impact of a possible solar minimum would be counteracted by the anthropogenic causes of global warming.

Volcanic eruptions are *partly* responsible for global warming and contribute to global warming in two ways:

- through the greenhouse gases (especially CO₂) that are in the magma;
- through volcanic ash, and sulphurous aerosols that stop solar radiation.

Conflicting views: until now climatologists have ignored the cooling effect produced by volcanoes.

But some scientists are of the opinion that volcanic eruptions stop the development of the global warming process, because following volcanic eruptions, sulfur particles are released into the atmosphere that reflect the Sun's light and prevent the heat from reaching the Earth's surface.

It is too difficult to assess the impact of the less significant volcanic eruptions that have occurred recently. But according to the researchers, they are responsible for 15% of the gap between predicted and recorded temperatures between 1998 and 2012.

More detailed observations on the properties of volcanic aerosols and a more effective representation of this phenomenon in climate model simulations are needed.

A newer hypothesis - global warming causes new volcanic eruptions - a study carried out by two universities in Great Britain and Iceland warns that the melting of the ice caps, determined by global warming, considerably increases both the frequency of volcanic eruptions and the risk of their occurrence in unpredictable areas. Volcanoes will erupt once every 30 years, and new eruptions will appear in several areas.

Greenhouse gases

The 5th Assessment Report of the Intergovernmental Panel on Climate Change (GISC/IPCC), the leading international organization for assessing climate change, determined that anthropogenic greenhouse gas emissions are the dominant cause of global warming. They have a much more important impact than changes in solar activity and volcanic eruptions.

The causes of the increase in GHG emissions:

- Burning coal, oil and gas generates carbon dioxide and nitrous oxide.

- Cutting down forests (land clearing) – trees contribute to the regulation of climatic conditions by absorbing carbon dioxide from the atmosphere. When trees are cut, this beneficial effect is lost and the carbon dioxide stored by the trees is released back into the atmosphere, increasing the greenhouse effect. Due to the decrease in forested areas worldwide, there is a decrease in the concentration of oxygen vs. an increase in the concentration of carbon dioxide. This happens because there is a very high demand for wood as a raw material and because in some areas more agricultural land is needed.
- Intensification of animal husbandry – cattle and sheep produce large amounts of methane during digestion.
- Nitrogen-containing fertilizers generate nitrous oxide emissions.
- Fluorinated gases are emitted by equipment and products that use such gases. Their warming effect is very strong – up to 23,000 times greater than the effect of carbon dioxide.
- Waste.

CONSEQUENCES

Extremely high temperatures

One of the major consequences is the very high temperatures in the form of heat waves and heat waves, which are more frequent and more intense in recent years.

Heat waves combined with high relative humidity and high night temperatures can have serious consequences on human health, even causing death.

A *heat wave* is the maintenance of hot weather for five consecutive days.

A *heat wave/canícula (dog-days)* is when maximum temperatures reach or exceed 35°C during the day and are around 20°C or above this threshold during the night.

The term *canícula (dog-days)* comes from the Latin language and refers to the constellation Canis Major (the Big Dog). In general, the heatwave can be considered as a natural phenomenon, but its effects can be amplified and exacerbated by human activities. This term is especially used to describe the hottest periods of summer, when the sun is strongest and temperatures reach their highest values.

Higher temperatures can result in increased mortality, reduced productivity and damage to infrastructure. The most vulnerable categories of the population.

- babies,
- elderly people,
- chronic patients,
- outdoor workers,
- pregnant women.

Higher temperatures are expected to cause a shift in the geographic distribution of climate zones. These changes alter the distribution and numbers of many plant and animal species, which are already under pressure from habitat loss and pollution, and may also influence phenology – the behavior and life cycles of animal and plant species, so it is possible that the number of pests and invasive species to increase, as does the incidence of certain human diseases.

Extremely low temperatures

Low temperatures also have serious consequences for human health. Cold waves are usually more specific to temperate and subtropical areas. They are characteristic in the winter period, but can also be found in autumn, spring.

A cold wave is defined according to the study *The impact of heat waves and cold spells on mortality rates in the dutch population*, cited by the European Commission as „a period of at least 9 consecutive days in which the lowest temperature reaches 5°C and below, the interval including at least 6 days in which the lowest temperature reaches -10°C or lower”.

Example: in 2010, there was a cold wave that affected the states of central and eastern Europe. Statistical data record the fact that 200 deaths were recorded due to frosty weather in Poland, in Slovakia – 122 deaths, in Romania – 52 deaths, in the Russian Federation with two frosty weather events – 24 deaths.

Drought

Many European regions are already experiencing more frequent, severe and longer droughts.

Drought is an unusual and temporary shortage of water availability caused by a combination of lack of precipitation and greater evaporation (due to high temperatures). It differs from water scarcity, which means the structural lack of fresh water throughout the year as a result of excessive water consumption. In extreme conditions of high temperatures and low precipitation, the phenomenon of drought sets in.

Meteorological drought is established after 10 consecutive days without precipitation (in the warm season). The persistence of the meteorological drought is assessed according to the number of days without precipitation and the number of days with precipitation below the multiannual average of the period for which the analysis is made. From an agricultural point of view, drought is defined by parameters that affect crop development and production.

Droughts often have domino effects, for example – on transport infrastructure, agriculture, forestry, water and biodiversity. They reduce the water level of rivers and water tables, slow the growth of trees and crops, lead to increased pest attacks and promote forest fires.

Torrential rains

Torrential rains are characterized by a large amount of water falling in a very short time, which implies a high intensity and can cause soil erosion and washing of nutrients, often causing a wide range of discharge processes, destroying pastures and agricultural crops. Rain showers are almost always accompanied by electrical discharges, and sometimes by blizzards and hail.

The destructive effect of heavy torrential rains is due to the duration, intensity and quantity of falling water, which are their characteristic parameters, but this effect is amplified by many other characteristics of the active surface such as: the slope, the lithological substrate, the lack of vegetation, the time of year when it rains etc.

Acid rain

Acid rain occurs when gases (nitrogen oxides, sulfur oxides, etc.) enter the atmosphere and mix with water droplets. Acid rain has destructive effects affecting everything around us. Acid rain has negative effects on people's health and life, causing certain diseases, including respiratory (asthma, bronchitis, emphysema), eye and skin diseases and indirectly, through the consumption of contaminated food, digestive and nervous system diseases.

Acid rain leads to soil acidification, which increases the exchange of hydrogen ions and nutrients such as potassium (K), magnesium (Mg) and calcium (Ca) from the soil. Acid rain also affects the aquatic world to some extent. Acid rain that falls on the ground removes nutrients from the soil and carries toxic metals released from the soil into lakes, causing aquatic vegetation to become acidic.

Trees can be damaged by acid rain even if the soil is well protected. Forests in high mountain regions are often exposed to higher amounts of acid than other forests because they tend to be surrounded by acidic clouds and fog, which are more acidic than rain.

Floods

Floods represent increased risks for the population located in their production areas, as they cause drowning, bodily injury, interruption of the provision of medical services, etc.

Floods occur as a result of phenomena such as – tropical and extratropical cyclones, storms, melting snow or even due to the melting of glaciers. Coastal areas can also occasionally be flooded in the context of sea level rise, due to the strong winds that accompany storms, or tsunami-type waves that arise after a strong submarine earthquake.

Examples:

- In 2002, in Germany, extreme rainfall produced serious floods as a result of which 330,108 people were affected, 27 people lost their lives, and the material damage was estimated at 11.6 million. USD.
- In the year 2007, in the United Kingdom of Great Britain and Northern Ireland, in the months of June-July, abundant precipitations fell, which were followed by serious floods. Between June 25 and July 3, the floods resulted in 30,000 affected people, 6 deaths and damages worth 4 million. USD.
- In 2008, in Ukraine, heavy rainfall caused severe floods, the balance of which resulted in 224,725 affected people, 38 dead people and material destruction worth 1 mill. USD.
- In 2013, extreme rainfall in the Czech Republic caused serious floods, as a result of which 1.3 million people were affected, 15 people lost their lives, and material damage amounted to 828 million USD .

The air pollution

Pollution is the contamination of the environment with materials that interfere with human health, quality of life, or the natural function of ecosystems (living organisms and the environment in

which we live). Even though sometimes environmental pollution is a result of natural causes, most pollutants originates from human activities.

Air quality is influenced by human activity, transport, industrial production and natural sources of pollutants, and the historical trend is that air pollution has increased over time, especially in densely populated and industrial areas.

Sources of atmospheric pollution can be:

- evaporation from fuel tanks;
- smoke from boilers;
- evaporation for the preservation of volatile liquids;
- ammonia and freon leaks from cooling systems;
- sulfurous anhydride from sulfiting processes;
- means of transportation;
- incineration of waste;
- fan exhausts from the fermentation tanks;
- emissions of harmful substances from batteries and welding, etc.

Polluting substances contain up to 20 ingredients: carbon monoxide, nitrogen dioxide, sulfur dioxide, suspensions, vanadium pentoxide, benz- α -pyrene, cement dust, inorganic dust, wood dust, hydrocarbons, lead compounds, acetone, butanol, ethanol, butylacetin, ethylcellosols, iron oxides, manganese and others.

Photochemical smog

Photochemical smog is one of the negative effects of the concentration of greenhouse gases in cities.

It is about air pollution that negatively affects health due to the accumulation of harmful gases in the city's atmosphere. Smog is the result of a large amount of air pollutants, especially smoke caused by burning coal, although it is also caused by emissions from industry or factories and automobiles.

The influence of climate change

„Climate change, which influences climate and the environment, will affect human health both directly and indirectly. Heat waves will be more frequent and people will die from heart disease associated with hyperthermia, more people will die in droughts without access to clean water, or in storms, more will die from zoonotic or other mosquito-borne diseases, or diseases that are transmitted through contaminated water“

World Health Organization, 2023

The purpose of teaching the work:

Emphasizing the importance of awareness and increasing the level of general and specialized knowledge on a new and emerging trigger phenomenon.

Theme structure:

- ✓ The positive effects of climate change
- ✓ The negative effects of climate change
- ✓ The ways in which extreme weather phenomena affect human health
- ✓ The repercussions of global warming from different perspectives
- ✓ The effects of climate change on the Republic of Moldova

Climate change is certainly an alarming situation that has a significant impact on life. Both flora and fauna are directly influenced positively and negatively affected by climate change. The effects are widely seen this decade, but they won't stop there. Thus, man is influenced by the consequences of climate change and in the future, he will be influenced even more strongly.

The positive effects are for a limited time.

Profesorul Richard Tol de la Universitatea Sussex, după ce a revizuit 14 studii diferite despre efectele viitoarelor tendințe climatice, a ajuns la concluzia că impactul pozitiv va fi pînă în jurul anului 2080.

✓ *Milder winter*

- fewer deaths caused by freezing in winter,
- lower energy costs,
- low risk of myocardial infarction and stroke.

The latest studies show that cold winters cause a much greater increase in heart failure deaths than during heat waves. Cold, not heat, is the biggest killer. Over the past decade, Britons have died from the cold at an average rate of 29,000 excess deaths each winter.

✓ *The sun will be able to be used as an energy source*

Reducing GHG emissions by switching to cleaner forms of energy

- will help slow down global warming,
- improve air quality, reducing cases of asthma and other respiratory diseases resulting from high levels of ozone and other harmful particles in the air.

✓ *Increases the resistance of the body*

- Exposure to the sun increases the level of vitamin D in the body. Vitamin D can provide higher energy levels, boost immunity, prevent cancer, decrease the incidence of rickets and other diseases associated with vitamin D deficiency or deficiency.

- Advantages for agriculture and solving the problem of undernutrition (short term). In the short term, farmers in some regions may benefit from an earlier spring start and a longer warm season suitable for growing crops. Up to a point, crops and other plants grow better in the presence of higher levels of carbon dioxide.

The negative effects of climate change on health

- Heat stress and cardiovascular failure due to excessive heat.
- Malnutrition, diarrheal diseases as a result of the disruption of sanitation and hygiene infrastructures and the reduction of food and water intake.
- Impact on respiratory systems (ex: asthma), cardiovascular and cancer associated with air pollution.
- Infectious diseases related to changes in temperature, precipitation and humidity, including vector-borne diseases (ex: Zika).
- Infectious diseases associated with flooding, inadequate shelters and reduced water supplies (eg diarrheal and respiratory diseases).
- Anxiety, despair, depression and stress disorders associated with climate disasters, forced migration and related conflicts.
- Damage caused by extreme weather events such as heat waves or floods.
- Chemical exposure and antimicrobial resistance.

Modurile în care fenomenele meteorologice extreme afectează sănătatea umană

- ✓ Calea directă a impactului încălzirii globale asupra sănătății
- Se referă la boala directă și decesul cauzat de expunerea frecventă la evenimente meteorologice extreme.

- Inundațiile și furtunile duc la decese (prin înec), răni, hipotermie, boli infecțioase și afectarea sănătății mintale (stres psihologic, anxietate și depresie).
- Radiații ultraviolete cresc incidența cancerului de piele, afectează ochii (ex: cataractă oculară ce duce la pierderea vederii).
- Efecte ale căldurii excesive sunt „epuizare termică”, „soc termic”.

Correlations between *factor* and *phenomenon*:

Heat and cold: increase in deaths caused by heat, decrease in deaths caused by cold.

- ✓ The ecosystem-mediated pathway
- Applies to disease and death caused by events such as changes in disease tolerance of some vertebrates, mosquitoes and ticks.
- Increase in the number of water-borne diseases, caused by atmospheric warming, precipitation or slow-onset climate effects (eg: salt water intrusion from rising sea levels).
- Worsening air quality in general (air pollution) as a result of rising temperatures and fires.

Effects:

Vector-borne and other infectious diseases: increase in mosquito- and tick-borne infections (ex: Lyme disease, malaria, dengue fever, tick-borne encephalitis).

Foodborne and waterborne infections: increased incidence of waterborne infections and pathogens (eg cholera-causing vibrios), parasites and enteric viruses from foodborne and rotavirus infections.

Air quality: increase in premature deaths associated with high levels of ozone exposure, increase in deaths attributed to toxic air pollution (result of fires).

✓ Pathway mediated by social systems/human institutions (through economic and social disruptions).

- Includes death and disease caused by human-made systems (agriculture, production and distribution, urban environments and food insecurity, stress and malnutrition, numerous challenges related to massive population displacement, deterioration of infrastructure and health services, economic losses due to the widespread impact of warming on the workforce, etc).

Consequences at different levels:

Nutrition: increasing conditions associated with chronic under-nutrition and acute undernutrition.

Occupational health: increased risks for outdoor workers depending on climate and occupation (eg dehydration, heat stress, vector-borne diseases).

Mental health: increased stress and mental illness following climate disasters (eg post-traumatic stress, generalized anxiety disorder, depression), increased psychological stress around slower climate events such as drought (can lead to higher frequency of suicides).

Violence and conflict: increasing number of deaths and injuries caused by conflicts in the population (causes: lack of access to food, water or shelter).

Repercussions of global warming from different perspectives

Climate change is a major threat to human existence.

The following aspects lead to impact on people:

- Temperature
- Nutrition and food security
- Population movement
- Vulnerable populations
- Infectious diseases

Temperature

- The average human body temperature is 36.6°C (the range in which it can oscillate to maintain physiological functions: 33.2°C - 38.2°C).
- Extreme deviations – a drop below 27.0°C (hypothermia) or an increase above 42.0°C (hyperthermia) can be fatal.
- Climate change is resulting in high exposure to intense heat in many regions of the world.
- With the increase in temperature, physiological reactions occur in humans that reduce yield and increase the risk of morbidity and mortality (eg: reduced work performance and productivity, behavioral changes, heat exhaustion, sunstroke, respiratory failure, myocardial infarction, stroke and death).
- In the US, there are approximately 1,500 heat-related deaths each year.
- The European heat wave in the summer of 2003 caused around 70,000 deaths.

Nutrition and food security

- Climate change is leading to significant water and food shortages.
- Exposure to high concentrations of salt in drinking water, food and bathing leads to health problems (hypertension and skin diseases) in the absence of adequate desalination. The cause of increasing salinity is rising sea levels (especially in low-income countries).
- 1°C increase in nighttime temperature can reduce rice production by 10% (Philippines International Rice Research Institute).
- Rising ocean temperatures are causing fish populations to move latitudinally, which affects the human supply of animal protein.

- 7.5 million children are expected to be stunted by 2030 due to global warming. The WHO estimates that this number will increase with climate change to 10 million additional children by 2050.

Population movement occurs because

- Schimbările climatice crează condiții de viață necorespunzătoare (ex: deșertificare).
- Creșterea nivelului mării duce la scăderea disponibilității apei dulci, penuria de alimente, probleme de sănătate.
- The major consequence is forced displacement, planned relocation, migration.
- It is estimated that by 2050, several hundred million people will migrate.
- Population movement will expose countries to multiple challenges (eg social, financial consequences and violent conflicts).

Vulnerable populations

- Climate change disproportionately affects children, pregnant women, the elderly, indigenous groups, the poor, outdoor workers, remote populations and subjects with pre-existing conditions. According to the WHO, global mortality in 2004 as a result of climate change was approximately 141,000 (85% of which were children). The European heat wave of 2003 mainly caused the death of the elderly.
- Low-income and geographically vulnerable countries will be most affected by the health consequences of climate change.
- In higher income countries (eg USA) there is high vulnerability in some ethnic and socio-economic groups, as demonstrated by the heat wave in Chicago in 1995 and Hurricane Katrina in New Orleans in 2005.

Infectious diseases

- Climate change could increase the burden of diarrhea by up to 10% by 2030 in sensitive regions such as Southeast Asia.
- Globally, it is estimated that warming of 2-3°C could increase the number of people at risk of malaria by up to 5%, or more than 150 million people.
- Elevated environmental temperatures allow the parasite that causes theileriosis (east coast fever) in animals to become infectious more quickly.
- The most common infectious diseases involved are: Malaria, Dengue fever and Lyme disease.

The effects of climate change on the Republic of Moldova:

- Extreme weather phenomena have a great impact on the quality and consumption of water in the Republic of Moldova.
- Floods can contaminate water sources, and water shortages due to extended droughts increase exposure to dehydration and unsafe water use. Result: high chances of getting an enteric disease.
- The safety and availability of water is essential for human survival, as disease outbreaks caused by water contamination, water-borne and vector-borne diseases, and physical ailments are highly dependent on water.
- Deprivation of water and sewage is high in the northern region and in the districts of Leova and Dubăsari. The region along the western border with Romania is also underserved with water and sewage services.
- The eastern border of the northern region is the least served by water.
- These regions also face a high deprivation of healthcare services.

The lack of precipitation, followed by increased dependence on depleting groundwater has an impact on food security, affects the physical development and well-being of the population, especially children.

Extreme temperatures – danger to the health of the population

**„Illnesses caused by heat are predictable
and can be prevented!”**

Intergovernmental Panel on Climate Change (IPCC), 2022

The purpose of teaching the work:

Explaining the relationships between high air temperature and mortality at global, regional and local levels.

Theme structure:

- ✓ The relationship between high air temperature and mortality rate in some countries of the world
- ✓ The effects of high air temperature in some Eastern European states
- ✓ The effects of air temperature on the mortality of patients with cardiovascular diseases and diabetes

Global warming leads to increased mortality related to high air temperature. The impact of global warming on human health can occur through multiple pathways. In addition to indirect mediated effects, for example, the spread of disease vectors, migration and conflict, direct effects are characterized by an increase in extreme weather phenomena such as floods, droughts, heat waves.

Global warming presents the biggest problem of contemporary society, so it becomes a cause of continuous increase in air temperature in a short period of time. As heat waves become more frequent, more severe, and longer, more heat-related illnesses and deaths are being seen, especially among children, the elderly, those with chronic conditions, and poor or underserved communities.

Each year, a large number of hospitalizations and deaths are associated with exposure to high ambient temperatures. The WHO estimates that the global warming process is responsible for the annual death of 150,000 people and the illness of another 5 million, due to heat waves or various natural calamities triggered by this process.

Thus, exposure to extreme heat has been associated with increased mortality and morbidity, consequently many studies have been conducted to emphasize the relationship between air temperature and mortality in populations.

The relationship between high air temperature and the mortality rate in some countries of the world

At the global level, the average air temperature has increased in the last century by $0.74 \pm 0.18^\circ\text{C}$ and by the year 2100 it is estimated that the global temperature will increase by 1-6.3°C. These events indicate that with climate change, the air temperature becomes unfavorable both for the environment and for the entire population in different parts of the world, resulting in health problems and even deaths. Many epidemiological studies have provided evidence for the association between ambient temperature and mortality. Stud-

ies show that air temperature is substantially responsible for the number of deaths in several countries such as USA, Greece, Australia, Canada, Spain, etc. Most of the deaths were caused by very cold days and very hot days. The main results show that 7.71% of the deaths are fully related to the extreme temperatures present in these regions.

Statele Unite

In the United States, extreme air temperatures cause more deaths than other weather-related hazards, for example, cold weather, hurricanes, tornadoes, or even floods. Annually, the number of deaths associated with extreme heat in the US is about 1500 cases. In the summer of 1995, more than 700 deaths were recorded in Chicago. In this context, approximately 65,000 patients with acute heat-related illnesses go to the emergency room each summer in this state.

In a study by Kalkstein and Green, it is assumed that climate change would have a significant impact on the mortality of the population of 44 cities: they estimated that the mortality rate dependent on extreme heat will vary from 70% to >100% in 2050, relative as and summer mortality rate 1964-1991. Rising heat-related death rates are also in other U.S. cities. Heat-related mortality in Los Angeles by the 2090s was projected to increase two- to threefold in the B1 high-emissions A1FI scenario, and five- to sevenfold in the 1961–1990 comparison scenario. In the New York City metropolitan region, heat-related mortality increases are projected to range from 47% to 95% by the 2050s, an average of 70% higher than in the 1990s.

Spain

Studies have also been initiated in Spain. The relationship between high air temperature and mortality rate was significant in 9 of the 13 cities analyzed, including the most populated. Tempera-

ture associated with minimum mortality (MMM) in the context of total mortality varied from city to city (from 14°C in Vigo to 23°C in Seville) and tended to increase with mean temperature. The temperature associated with minimum mortality was slightly higher for cardiorespiratory deaths and the largest difference from total mortality was about 2°C.

In other countries and cities, variable results were obtained depending on the climate. For example, the temperature associated with minimum mortality was about 14°C in southern Finland, 16.5°C in the Netherlands, 18°C in England, 21°C in Boston, 27°C in Florida, and 28°C in Taiwan. In this regard, a different structure of temperature-dependent mortality rate can be observed in different cities of the world. Various studies have shown that the variation in mortality related to air temperature is greater in southern countries than in northern ones. Even within several countries, important differences were found: in England and Wales, there were up to 41% variations in ischemic heart disease mortality between cities, depending on different ambient temperature, rainfall and socio-economic differences. But in Spain, a bigger impact was seen in hotter cities.

Several hypotheses have been formulated to explain these phenomena. On the one hand, there could be a physical process that would allow people to adapt to the more common temperatures in an area. On the other hand, city dwellers can sometimes adopt, in a secular way, preventive measures to mitigate the impact of temperature variations. These measures are related to the type of housing, the clothes used or the activities carried out in different seasons. In general, the effect of heat outweighed that of cold. The only exceptions were for Valencia with a high cardio-respiratory mortality rate and Oviedo with mortality among the population under 70.

The effect of low air temperature was greater in warmer cities, showing a *correlation coefficient* of about 40% with the average city

temperature. The effect of high air temperature was also positively correlated with city temperature for specific causes of mortality among the elderly population. A greater effect of temperature, especially the impact of cold, has been reported on mortality from cardiorespiratory causes than on total mortality. Various hypotheses have been suggested to explain the high mortality from cardiovascular problems in the cold months. Among the most plausible is the association between exposure to cold air temperatures and a physical reaction resulting in decreased blood supply to the skin in an attempt to prevent heat loss. This involves an increase in blood volume in the central organs, with subsequent cardiac overload and increased blood concentration with higher blood viscosity. To some extent, the increase in mortality from respiratory causes could be due to the impact of certain infectious diseases such as influenza or pneumonia, which have a higher incidence during the cold months, and to the increase in fibrinogen concentration related to respiratory infections. Regarding the increase in cardiovascular mortality due to high temperatures, this has been shown in epidemiological studies and correlated with arterial thrombosis.

Greece

In Athens, Greece, the highest daily mortality was observed on days characterized by southerly air temperature flow conditions for both the cold and warm periods. Northeasterly air temperature flow is associated with the lowest mortality. When the specific causes of mortality are analyzed, it can be observed that respiratory and cardiovascular diseases in the elderly are particularly involved in the winter and summer mortality increase. Taking into account the effect of the time lag of the examined parameters on mortality, it was found that the significant effects of the lag of 3 days in the cold period occur compared to the lag of 1 day in the warm period. The relationship is U-shaped, indicating that both cold and warm components account for increased daily mortality, but cold

conditions affect daily mortality frequencies more than warm conditions. However, when the daily air temperature exceeds the region-specific thresholds ($T_{\min} > 23.4^{\circ}\text{C}$, $T_{\max} > 33^{\circ}\text{C}$), mortality increases sharply. Another significant finding is that the daily range of temperature contributes more to the frequency of mortality in the warm period than in the cold period of the year.

Effects of high air temperature on population mortality in some Eastern European states

In recent decades, the number of heat waves has increased worldwide. Extreme temperatures were observed in Central Europe in June and August of 2003, in June and July of 2006, in the summer of 2015. An extreme heat wave occurred in July and August of 2010 in Eastern Europe, as well as Russia of West. The Central European heat wave in the summer of 1994 was the most devastating in some Central European stations. For many stations, the longest and strongest heat wave occurred from late July to mid-August 2010, for example, during the extremely severe heat wave in Western Russia.

Excess mortality due to weather shocks is primarily explained by hypothermia and hyperthermia. According to epidemiological literature, the most comfortable winter temperature is between 20 and 23.3°C, and the summer temperature is between 22.3 and 25.6°C. Ambient air temperatures that exceed the optimal limits are perceived by the human body as thermal stress and induce physiological adjustment and thermoregulation through changes in blood pressure, viscosity, heart rate, bronchoconstriction, chills, cellular and humoral immunity. This increases the likelihood of cardiovascular and respiratory diseases and leads to higher risks of death.

Russia

Recently, Otrachshenko and other researchers found that in Russia, days when the air temperature exceeds 25°C, increases to-

tal mortality by 0.06%, while a cold day with a temperature range between -30°C and -25°C increases mortality by 0.08%. The literature also documents a phenomenon defined as mortality displacement or 'harvesting'. This effect implies an increasing probability of death on extreme temperature days for the elderly and people with diseases, i.e. people with a higher risk of death compared to the general population. Such an effect may explain the estimated increase in mortality of up to 50% during high air temperatures.

The research looked at age-specific mortality statistics for women and men, showing the impact of days with temperatures above 25°C on mortality for men and women.

Revich and Shaposhnikov investigated the relationship between air temperature and mortality throughout the year in Moscow, Russia. They concluded that the relative increase in mortality from all non-accidental causes for each 1°C decrease in mean daily temperature increases from 0.49% ($p < 0.001$) in the -10°C temperature range; $+18^{\circ}\text{C}$ to 0.65% ($p = 0.007$) in temperature range -20°C and -10°C . The same non-linear effect of increased mortality was observed at very high temperatures. If in the temperature range $18^{\circ}\text{C} < T < 25^{\circ}\text{C}$, non-accidental mortality increased on average by 2.8% for every 1°C ($p < 0.001$), then at temperatures above 25°C this increase of was up to 11.2% for every 1°C , $p = 0.001$.

Republic of Moldova

Apart from the influence of the air temperature on the mortality of populations in various states in Eastern Europe, the effects were also felt in the Republic of Moldova. The worst consequences of global warming were recorded in 2007. The very hot summer of that year was specified as the warmest period in the history of instrumental observations up to that time, when multi-year air temperature records were broken not only in summer, but also in winter and spring. In the summer of 2007, on the territory of the Republic of Moldova, the number of extremely hot days, determined

by the apparent temperature, was very high and increased during the July-August period up to 20 days. Apparent temperature values in the summer of 2007 reached the first degree of caution, when, with exposure to the sun and prolonged physical activity, fatigue may occur, and continued activity in such conditions could lead to heat cramps.

The direct effect of the heat during the summer of 2007 led to about 200 excess deaths in Chisinau alone. In order to estimate the dynamics of deaths during the warm period of this year, the daily rate of additional deaths was calculated. Following the analysis, it was determined that in four studied territories of the country, 587 cases of excess deaths were registered, which is 12.1% more compared to the reference period, and in the municipality of Chisinau there were a share of 32.5% of excess deaths from the total of these cases in all the territories studied. Deaths predominated in urban areas. Several women and people over 60 years of age died, and cardiovascular diseases predominated according to the nosological forms. Excess deaths were recorded on most days, with the daily maximum being three times the reference period (for the same day) during the most severe heat wave in late July 2007. During the warm period of this year there were several peaks in excess deaths. Out of their total number, in the municipality of Chisinau, the highest was observed between July 20 and 26. Regarding the structure of excess deaths, during this period the most frequent were chronic morbid conditions. Diseases of the circulatory system constituted 75% of all excess deaths. They were followed by tumors and endocrine, nutritional and metabolic diseases (9% and 8%, respectively).

In the context of the effects of air temperature on the mortality of the population in the Republic of Moldova, it can be stated that with the increase in heat, the number of daily deaths among the population suffering from chronic or cardiovascular diseases also increases. High air temperatures during the summer have in-

creased the number of deaths in the last 15 years (2001-2015) in the municipality of Chisinau. Mortality (per 100 thousand inhabitants) of the population of Chisinau in the summer months, when high air temperatures are recorded, for the main nosological groups of non-communicable diseases – neoplasms (C00-D48), diseases of the respiratory system (J00-J99), diseases of the circulatory system (I00-I99) and diseases of the digestive system (K00-K93) constituted in total more than 70% of the causes of death.

It can be seen that diseases of the circulatory system have the largest contribution to total mortality (~50%). On their account, the number of deaths also increased in the unbearably hot year 2007, while other causes of death did not exceed normal fluctuations, that is, they were not influenced by high temperatures. Diseases of the circulatory system, which require the heart's ability to increase cardiac output, increase the body's vulnerability to sunstroke and increased atmospheric air temperatures.

The long-term variation of the maximum air temperature, with absolute maximum temperatures in the summer months of the year and the number of absolute deaths due to diseases of the circulatory system recorded in Chisinau demonstrates the coincidence of the hot air temperatures of 2007, with the increase in the number of deaths.

2012 was also very warm, surpassing the 2007 record for absolute maximum air temperature (42.4°C versus 41.5°C).

Effects of air temperature on mortality in patients with cardiovascular disease and diabetes mellitus

Climate change and diabetes could be interconnected both directly and indirectly. It is known that people suffering from diabetes are more prone to dehydration and cardiovascular events during extreme heat. Scientific researchers analyzed the impact of increased air temperature on cause-specific mortality. As a result of the studies, they observed a significant increase in the mortal-

ity rate among patients with cardiovascular diseases and diabetes during summers with an extremely high air temperature. In the same vein, it is highlighted that the number of patients most affected by heat stress are the elderly.

There were an estimated 160,062 deaths in Wayne County, Michigan among people aged 65 years and older, and mortality in patients with diabetes was found to predominate on hot days compared to patients in other age groups. Also, other studies have been initiated in the context of the effects of ambient temperature on the mortality of elderly people. The study regions were centered on Europe, Asia, North America and South America, where the increase in the risk of death from cardiovascular and cerebrovascular diseases, including cerebral infarction, cerebral haemorrhages, ischemic heart diseases, is highlighted following the exposure of the elderly to temperatures high and low air. An increase in temperature by 1oC increased the risk of mortality from cardiovascular diseases by 3.44%, respiratory by 3.60%, and cerebrovascular by 1.40%, and a decrease in temperature by 1oC increased mortality among the elderly, which they had cardiovascular diseases, with 1.66% and respiratory diseases with 2.90%.

Chronic diseases – consequences of climate change

**„The world will not be destroyed by those who do evil,
but by those who watch them from the sidelines,
doing nothing”**

Albert Einstein

The purpose of teaching the work:

Discussing the interrelationships between chronic non-communicable diseases and weather events associated with climate change.

Theme structure:

- ✓ Diseases of the circulatory system
- ✓ Diseases of the respiratory system
- ✓ Mental health
- ✓ Renal diseases
- ✓ Allergies
- ✓ Risk of skin cancer

Human health is closely related to the environment in which it lives, so a constantly changing climate already has a negative impact on safety and well-being. Without intervention, climate change will have catastrophic and far-reaching consequences.

Chronic disease and climate change are major public policy challenges facing governments around the world.

It has been scientifically proven that the dangers related to climate change bring the worst chronic diseases!

Diseases of the circulatory system

Heat stress results in physiological responses to changes in core body temperature, resulting in increased sweating, increased respiratory and heart rates, vasodilation, and changes in coagulation function. These changes can cause imbalances in the autonomic control of the heart, increase local blood pressure, and induce systemic inflammation. Subsequently, these homeostasis disturbances potentially predispose vulnerable individuals to atherosclerotic plaque rupture and myocardial infarction.

The increase in body temperature contributes to the acceleration of the respiratory rate, which also implies an increased cardiac contraction, which in turn has an impact on the dilation of blood vessels that regulate blood pressure and blood clotting mechanisms. These imbalances can trigger heat-related heart attacks and strokes, especially among people with pre-existing health conditions.

Individuals with heart failure and reduced left ventricular ejection fraction are likely to be unable to compensate for the increased circulatory demand induced by heat exposure.

The body, and especially the cardiovascular system, is sensitive to changes in humidity.

Epidemiological studies have consistently demonstrated an increased risk of cardiovascular disease at low temperatures.

Low temperatures have a direct impact on BP. People who suffer from hypertension throughout the year may notice that their condition worsens in the cold season and that the values rise more than normal. This happens because cold temperatures constrict the blood vessels, which means the heart will have to work harder to pump blood into the arteries. Summer lowering of BP is important for the management of elderly patients with hypertension or heart failure. It may favor the symptoms of orthostatic hypotension and may increase the risk of malaise.

Example

Based on scientific studies seasonal variations of blood pressure in 20 healthy subjects and in 219 chronically ill subjects (most of the patients being ambulatory) – BP was measured repetitively during twelve months. In healthy subjects, BP decreased starting in June and reached its lowest value in August, then returned to winter values starting in October. The average BP of the three winter months was 130/79 mmHg, and the seasonal drop is on average 5 +/- 5/5 +/- 6 mmHg.

Deaths from diseases of the circulatory system account for 50-60% of all deaths. Of them, ischemic heart diseases are the main cause of death, and stroke remains the second most important cause of death.

The increasingly aging population, as indicated by future demographic projections, also means increasing population vulnerability.

In the EU, the total cost of cardiovascular diseases together with respiratory diseases was estimated at €600 billion (with a cardiovascular disease mortality rate of 60% in Eastern Europe in 2016).

Diseases of the respiratory system

In most cases, the impact of extreme weather events on diseases of the respiratory system accompany the manifestations of the circulatory system (described above). One might speculate that the

observed association between heat exposure and increased respiratory disease mortality is also mediated by the underlying pathophysiological effect of heat exposure on right ventricular heart failure.

Climate change can lead to increased levels of air pollutants (such as ozone and fine particulate matter). Thus, as a result, respiratory problems may occur, bronchial asthma develops more frequently. In the context of climate change, it is estimated that the rate of asthma will continue to increase in the coming years. According to WHO data, in 2016, asthma affected more than 339 million people worldwide. In recent years, an increase in the rate of asthma has been observed in many parts of the world. In the United States, for example, the rate of asthma has increased by about 15%.

Allergic rhinitis, chronic obstructive pulmonary disease (COPD), lower respiratory tract infections are also influenced by extreme weather events.

Mental health

Mental disorders develop in people forced to move to live in other localities due to the effects of climate change. In these people, the manifestations of depression and disorders such as post-traumatic stress increase, the number of hospitalizations with psychiatric conditions increases. Increased rates of suicide, psychological distress, worsening mental health and higher mortality have been reported among people with pre-existing mental health conditions.

Kidney diseases

The kidney has a unique role not only in protecting the host from heat and dehydration, but is also an important site of heat-related illness. High air temperatures can lead to increased core body temperature, dehydration and blood hyperosmolality. Heatstroke (both clinical and subclinical whole-body hyperthermia) may play a major role in exacerbating chronic kidney disease, leading to

an increased risk of acute kidney injury from rhabdomyolysis or heat-induced inflammatory kidney injury. Heat stress and dehydration play a role in kidney stone formation, and poor hydration habits can increase the risk of recurrent urinary tract infections.

Allergies

Climate change leads to an increase in the amount of pollen, concentrations of outdoor ozone and particles at ground level, and the proliferation of mold. As a result, the number and intensity of cases of allergic diseases increases.

The increased level of carbon emissions in the atmosphere can also cause more intensive plant growth and the production of more pollen, which in 20% of cases is the main cause of allergic reactions.

With the increase in air temperature, the pollen reproduction period in plants is longer which intensifies and prolongs the allergy season.

There is also the possibility of extending the season and duration of „hay fever” type allergies.

People who already suffer from chronic respiratory conditions such as asthma or chronic obstructive pulmonary disease will be at particularly high risk.

Risk of skin cancer

An indirect effect of climate change on health is determined by changes in ultraviolet radiation. Skin cancer is the most common type of cancer in fair-skinned populations that are exposed to large amounts of UV rays. The incidence and prevalence of skin cancer are increasing, therefore, it represents a major public health problem.

UV radiation is classified as a „complete carcinogen” because it is both a mutagen and a nonspecific damaging agent and has both tumor-initiating and tumor-promoting properties.

Excessive exposure to UV rays poses major health risks, including atrophy, pigmentary changes, wrinkling, and malignancy.

The amount of UV rays that reach the earth's surface is influenced by several factors, such as:

- o depletion of the ozone layer,
- o altitude,
- o latitude,
- o meteorological conditions.

All the consequences also have effects on the direct costs of medical care and medicines, as well as on the working hours of medical workers.

Infectious diseases – consequences of climate change

**„We cannot burn the paths to the future.
We can't pretend the danger doesn't exist or ignore
it just because it affects someone else”**

Ban Ki-moon,
South Korean politician and diplomat,
Minister of Foreign Affairs and Trade between 2004 and 2006
the eighth Secretary-General of the United Nations between
2007 and 2016

The purpose of teaching the work:

The characteristic of communicable diseases accentuated by climate change.

Theme structure:

- ✓ Classification of vector insects depending on the mode of damage
- ✓ Outbreaks of insects and diseases
- ✓ Ticks – transmission vector
- ✓ The impact of ticks of the Ixodes species
- ✓ Tropical diseases

IPCC notes that climate change will cause changes in the transmission of infectious diseases by vectors such as mosquitoes, ticks as a result of changes in their geographic range, seasons of activity and population numbers; land use changes and socio-economic factors such as human behaviour, movement of people and goods.

Climate change has an indirect impact on human health. The indirect consequences are the increase in the number of carriers of infections, which swarm near flooded areas and spread diseases. Climate change may increase the number of insect vectors by increasing their population density and extending the disease transmission season.

In addition to damage to plants and animals, according to WHO data, vector-borne diseases account for more than 17% of all infectious diseases, causing more than 700,000 deaths annually.

Infectious agents carried by arthropods are transmitted by cutting the skin, stings, inoculations, their excrement.

Classification of insects depending on the mode of damage:

- dangerous species for human and animal health (15 species)
- species with ecological danger for the functioning of natural biocenoses (15 species)
- dangerous species for household items and stored products (17 species)
- species with phytosanitary danger for agroecosystems (53 species).

The Republic of Moldova has more than 16,500 species of insects, with which humans establish relationships of mutualism, commensalism and even parasitism. Their intense proliferation, in certain favorable climatic conditions and territories form *insect foci*.

Examples:

malaria and yellow fever are transmitted through the bite of mosquitoes and other arthropods;

hemorrhagic fever - from cockroaches, flies, fleas, lice, mosquitoes.

Ticks – transmission vector

Seemingly harmless, ticks are a real problem for both pets and humans. About 907 species of ticks have been identified and classified so far.

Example:

- ***Arachnida*** class
- ***Acari*** subclass
- ***Parasitiformes*** order
- ***Ixodida*** suborder

Ixodes ricinus species

Ixodes ricinus is the most common species found in humans and is also known as the sheep or deer tick.

Characteristics:

- can reach up to 11 mm,
- are parasitic insects (ectoparasites),
- inhabit shady and humid forests, pastures, swampy areas, urban parks, public gardens, grassy glades, open fields with shrubs, water bodies with abundant vegetation, etc.,
- predominates in Europe, North Africa and the Middle East,
- the limit of the area of distribution of ticks moves to the north and to higher altitudes,
- milder winters could cause the tick population to expand
- the number of eggs exceeds 3,000 pieces
- they are very active between May and July

- can transmit bacterial diseases, the most frequently attested being *Lyme disease (Lyme borreliosis)*.
- can also expose people to *Q fever, encephalitis*.

There is always the risk that the Ixodids will not survive the winter, due to temperatures lower than -30°C, but since the majority of the European area is not characterized by such low temperatures, many ticks survive.

The impact of ticks of the *Ixodes species*

Although several *species of Ixodes* ticks carry the disease, only the following are known to transmit *Lyme disease* to humans:

1. *Ixodes scapularis* (deer tick) – predominates in the North-East of the USA, being also present in Europe
2. *Ixodes pacificus* – predominates in the western US, but is also found in Europe
3. *Ixodes ricinus* – predominates in Europe
4. *Ixodes persulcatus* – responsible for disease cases in Asia

Following a study by collecting ticks, carried out at the National Agency for Public Health of the Republic of Moldova, under laboratory conditions, it was observed that, when the temperature in the room is constantly increased, the frozen ticks recover very easily, but freeze harder, which suggests the evolution and acceleration of the level of adaptation to climatic conditions. Data from the National Agency for Public Health attests that, in Chisinau, in green spaces, many ticks are carriers of the bacteria that cause the disease. In 2012, this institution examined 116 tick specimens, and *Borrelia* was identified in 16 of them. The pathogen was detected::

- o to 2 out of 8 ticks - collected from the Vadul lui Vodă forest strip;
- o at 7 out of 20 - collected from “La izvor” park;
- o at 7 out of 16 - collected from the “Dendrariu” park.

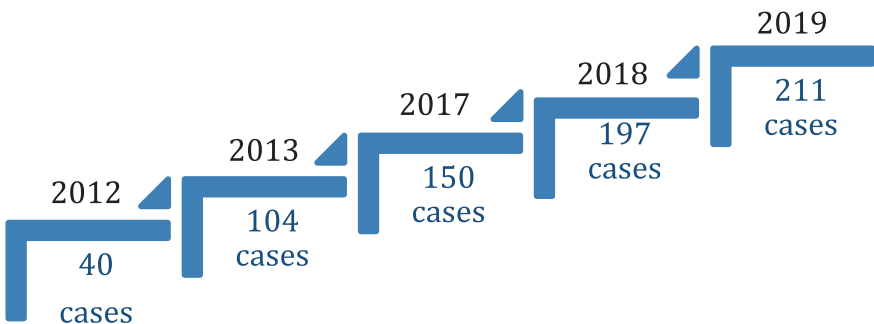
Ticks, feeding on the blood of carriers of bacteria, viruses (mammals, reptiles, birds), also steal the causative agents of these diseases, being later transmitted to humans. At the moment of the bite, the tick secretes saliva containing biologically active anesthetic substances, which makes the sting painless and practically, remains unnoticed. The life cycle of ticks (egg - larva - nymph - adult) lasts two years, with hosts: mice, birds, deer, humans. Nymphs are responsible for over 90% of cases of spread, the size of a nymph is extremely small (1-2mm), being difficult to visualize, but as it feeds on blood, its size increases considerably. The longer a tick stays attached to the skin and feeds (72 hours), the higher the risk of transmitting the infection to humans. At the same time, only 1-3% of all tick bites are followed by the appearance of *Lyme disease*.

In our country, ticks are present, both in rural and urban areas. On average, approximately 30-35%, i.e. a third of the ticks in the Republic of Moldova, are carriers of borreliosis. The risk of transmission from a sting is 10-15%.

Lyme disease is an infectious disease with multisystem manifestations (cutaneous, joint, neurological, cardiac) caused by the spirochete belonging to the genus *Borrelia*.

According to the official data of the National Public Health Agency, the number of *Lyme disease* cases increases annually.

Dynamics of *Lyme Disease* cases



Tropical diseases

Climate change/global warming favors the spread of infectious diseases, especially in tropical climates. Worldwide, the most common diseases associated with international tourism in tropical areas are malaria, Dengue fever, yellow fever.

Recently, more and more Europeans have returned from vacation with a tropical (infectious) disease. Neglected tropical diseases affect more than a billion people and endanger the health of others, causing illness and death. In 2012, 1,400 tourists were diagnosed with malaria after traveling to Africa, South America or Asia.

The causes of the spread of tropical diseases are global warming; lack of time and costs of vaccinations; tourists' disinterest in their own health.

Malaria

Malaria is a common infectious disease and a priority public health problem, ranking among the top five diseases with the highest impact on global mortality. It is the most widespread disease in tropical areas and the most common imported disease in non-endemic areas. In the absence of appropriate preventive and treatment measures, malaria can lead to death..

The *Anopheles-Plasmodium* mosquito is part of the group of protozoa-parasites, it can be transmitted through blood transfusion from people with latent malaria, through contaminated needles and syringes.

Prophylaxis: vaccination at least 3 weeks before travel, respective medicines.

Avoiding mosquito bites, especially between dusk and dawn, using protection methods.

Vector

- the *Anopheles - Plasmodium* mosquito

Spread

- tropical and subtropical areas

Symptoms

- fever, chills, headache, muscle pain, weakness, vomiting, cough, diarrhea, abdominal pain, acute renal failure, convulsions, circulatory collapse

Dengue fever

Dengue fever is an infectious disease caused by the Dengue virus and is transmitted by infected mosquitoes. Under conditions of high temperature and increased rainfall, mosquitoes can reproduce faster and live longer, which leads to an increase in the mosquito population and by extension the spread of the Dengue virus. Climate change may also alter the geographic areas where mosquitoes can survive and breed

According to the WHO, hundreds of millions of people are infected annually, and the disease is now present in over 100 countries, compared to only 9 countries in 1960, the number of cases increased during this period from 15 thousand to 390 million per year.

Often, the symptoms can be confused with those of a cold. Clinical suspicion is based on the patient's symptoms and travel history. The diagnosis of certainty is established on the basis of medical laboratory analyses.

Vector

- the *Aedes* mosquito

Spread

- tropical and subtropical regions (*Southeast Asia, Pacific, Africa, Central and South America, Caribbean etc.*)

Symptoms

- fever, nausea, rash, headache, eye pain, bone pain, muscle joint pain, convulsions, hepatomegaly, circulatory failure, severe bleeding

Yellow fever

Yellow fever is an acute viral hemorrhagic disease. The virus causes degeneration of liver and kidney tissues. There is no specific treatment.

The WHO warns that 50% of yellow fever patients who do not receive treatment die.

It is a disease that can be prevented by vaccination. In order to enter the countries in the geographical risk areas - vaccination is mandatory, and at the border points the vaccination certificate obtained from the specialist doctor in the country must be presented.

Vector

- mosquitoes, the species *Aedes* or *Haemagogus* spp.

Spread

- tropical regions of Africa and America

Symptoms

- fever, chills, headache, back and limb pain, jaundice (yellowing of the skin or eyes), constipation, decreased urine output, vomiting blood, bleeding in the mouth, nose, eyes or stomach, liver failure, relapsing, breathing, coma

Zika virus infection

Zika virus is an RNA virus. The infection causes flu-like symptoms lasting 2-7 days. The *Zika* virus can also be transmitted through unprotected sexual contact. There is no treatment for Zika virus infection.

Zika virus infection during pregnancy is a common cause of microcephaly.

The WHO announces that the *Zika* virus can cause, in rare cases, Guillan-Barré syndrome (acute inflammatory demyelinating polyradiculoneuritis), which is manifested by weakness and diminished reflexes.

Vector

- infected *Aedes* mosquito

Spread

- first identified in the rainforest of Uganda

Symptoms

- fever, skin rashes, joint pain, conjunctivitis, muscle pain, headache

Traveler's diarrhea

Traveller's diarrhea is a disease of the digestive tract, which can be prevented by:

- frequent hand washing, especially before eating! If this is not possible, an alcohol-based hand sanitizer must be used,
- food must be properly prepared thermally and not cooked in „blood” or raw,
- carefully consume seafood or shellfish,
- use bottled water to brush your teeth and keep your mouth closed during the shower.

Vector

- occurs as a result of the consumption of food or water contaminated with microorganisms from faecal matter (viruses, bacteria and parasites) (The most common etiological agent involved is *Escherichia coli*)

Spread

- the more exposed areas are countries in Latin America, Africa, the Middle East, Asia and some countries in Europe

Symptoms

- > 3 watery stools a day, abdominal cramps, nausea, vomiting, fever

Typhoid fever

Typhoid fever is a severe infectious disease, widespread in all exotic countries with a warm climate. In most cases, up to 75%, the disease is contracted during trips abroad. There are two vaccines approved to prevent typhoid fever. Vaccination is especially recommended for people who intend to travel to a tropical country.

The pathogen is found in contaminated water or food, it is transmitted by consuming liquids, contaminated food, from sick to healthy people.

Pathogenic agent

- *Salmonella typhi* or *paratyphi*

Spread

- Mexico, South America, India, Pakistan, Egypt

Symptoms

- states of weakness, insomnia, headache, muscle pain, dry cough, fever, chills, profuse sweating, abdominal pain, lack of appetite, inflammation of the spleen, delirium, erosions of the intestinal wall, immobility - *typhoid state*

West Nile virus infection

West Nile virus is an RNA virus. The main hosts of *WNV* are birds, in nature it is maintained in a cycle involving transmission between birds and mosquitoes.

The incubation period is between 2-14 days after the sting.

Treatment is supportive for patients with neuro-invasive *West Nile* virus, often involving hospitalization, intravenous fluids, respiratory support, and prevention of secondary infections. No vaccine is available for humans.

Vector

- infected *Culex* mosquitoes

Spread

- Africa, Europe, Middle East, North America and Middle Asia

Symptoms

- often asymptomatic
- in 15-20% of cases – symptoms similar to a mild flu (fever, headache, myalgia, malaise, anorexia, nausea, vomiting). Sometimes patients can present eruptive phenomena: maculopapular erythema affecting the neck, trunk, lower or upper limbs

Lymphatic filariasis

Lymphatic filariasis (elephantiasis) is a parasitic disease caused by infection with parasitic worms. The disease occurs when the worms grow in the lymph vessels of the infected person, causing these vessels to become blocked so that the fluid in the tissues cannot drain. Swelling and damage to the lymph glands occur.

It is estimated that around 120 million people are infected.

Vector

- mosquito infected with *W. bancrofti*

Spread

- South East Africa

Symptoms

- often asymptomatic
- acute infection manifests as acute adenolymphangitis, acute dermatolymphoangioadenitis, and pulmonary eosinophilia. Chronic manifestations include: lymphedema (which may progress to elephantiasis) and hydrocele (uni- or bilateral)

African trypanosomiasis (sleeping sickness)

African trypanosomiasis is a parasitic disease that affects humans and animals. Annually, specialists report about 25,000 new cases, but it seems that the figure is much higher in reality (50,000-70,000 new cases).

The disease is currently considered endemic in Africa and affects more than 60 million people in 36 countries.

Vector

- infected *Ţeţe* flies

Spread

- Africa

Symptoms

- chancre, intermittent fever, myalgia, altralgia, headache, urticaria, erythematous rash, facial oedema, lymphadenopathy, tachycardia, splenomegaly, somnolence, nyctemeral rhythm change, tremor

The impact of climate change on human infection patterns illustrated in the scientific literature

“Global warming and the possible emergence of new arboviral diseases” (Weaver et al., 2010)

This article examines how rising global temperatures may expand the range of vector-borne diseases such as Zika virus or West Nile virus.

„Climate change and infectious diseases” (Schär et al., 2016)

Acest articol examinează impactul schimbărilor climatice asupra bolilor transmise prin vectori, cum ar fi malaria și febra Denge, și al bolilor transmise prin apă și alimente.

“Climate change and infectious diseases” (Schär et al., 2016)

This article examines the impact of climate change on vector-borne diseases such as malaria and dengue, and water- and food-borne diseases.

„Impact of climate change on human infectious diseases: Empirical evidence and human adaptation” (Huang et al., 2017)

This article examines the impact of climate change, which affects the prevalence and modes of transmission of many infectious diseases, and the impact of these changes on human health will become more pronounced in the future. Understanding impacts is critical to developing effective adaptation strategies.

“Climate change and infectious diseases in North America: The road ahead” (Ostfeld et al., 2018)

This article examines the possibilities for reducing the impact of climate change on infectious diseases. Mitigation can reduce the magnitude of future climate impacts on human health and ecosystems, while adaptation can reduce the severity of impacts that cannot be avoided.

The consequences of the heat wave on the human body

“Humanity is sitting on a time bomb. If the vast majority of the world’s scientists are right, we have just ten years to avert a major catastrophe that could send our entire planet’s climate system into a tail-spin of epic destruction involving extreme weather, floods, droughts, epidemics and killer heat waves beyond anything we have ever experienced - a catastrophe of our own making.”

Al Gore
american politician, businessman and activist

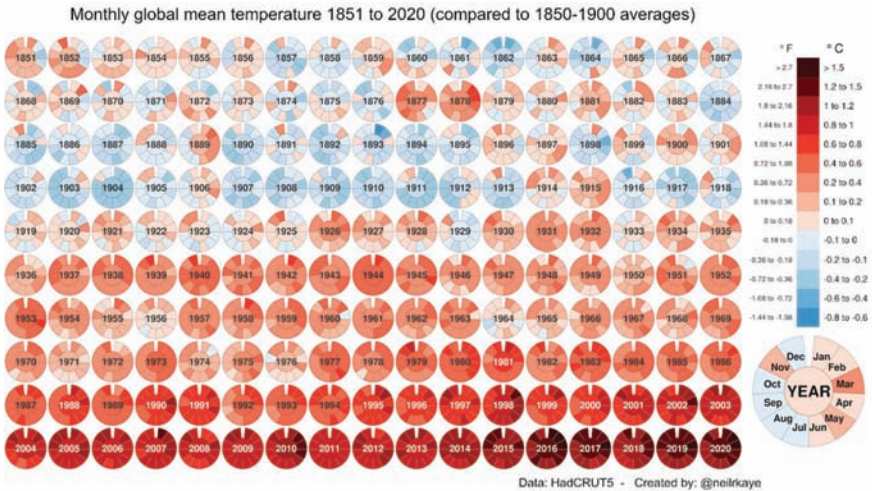
The purpose of teaching the work:

Highlighting the effects of the heat wave on the human body.

Theme structure:

- ✓ Thermal stress of the human body
- ✓ Ultraviolet radiation during the heat wave

Heat wave is defined as an increase in the daily temperature by more than 10oC compared to the average temperature of the respective area. High air temperature leads to heat stress, so the human body receives a large amount of heat, which can be lethal.



Global average monthly temperature for the period 1851-2020
(compared to the average of the years 1850-1900)

Thermal stress

Thermal stress is an alarm reaction of the body occurring at temperatures higher than its ability to withstand.

The mechanism of thermal stress development:

1. increase in body temperature above the norm,
2. the body's compensation mechanisms appear:
 - heart rate increases, cardiac output increases,
 - sweat appears, sweat evaporates,
- lowers blood pressure, dilates blood vessels,

3. during the normal operation of these mechanisms, the temperature of the human body stabilizes at a safe level ($\approx 37^{\circ}\text{C}$),

4. when these mechanisms are deregulated, the temperature rises above 38°C , as a result of this deregulation the human body is subjected to thermal stress.

The factors involved in the development of thermal stress:

Environmental factors:

- ❖ radiant heat
- ❖ high humidity
- ❖ air movement

Work environment factors:

- ❖ personal clothing and equipment
- ❖ workload

Classification of the factors involved in the development of thermal stress according to their nature:

External factors:

- ❖ high air temperature,
- ❖ high air humidity,
- ❖ irrational clothing,

Internal factors:

- ❖ physical effort,
- ❖ the functional position of the body,
- ❖ individual characteristics of the body.

Personal factors on which the development of thermal stress depends:

- body mass: heat loss is less efficient in overweight people,
- poor physical conditions,

- previous pathologies related to high temperature: these people are much more sensitive to temperature variations,
- age: as the body ages, the sweat glands become less efficient,
- heart disease and high blood pressure,
- recurrent ailments (diarrhea, vomiting, fever), because they have an increased risk of dehydration,
- alcohol consumption leads to dehydration and increased risk of heat stress,
- some medicines can cause heat intolerance,
- insufficient acclimatization possibilities.

Among the effects of heat stress are:

- ✓ dehydration – excessive loss of fluids from the body can lead to dry mouth, dizziness, confusion, nausea, vomiting and constipation,
- ✓ thermal exhaustion - occurs after prolonged exposure to high temperatures,
- ✓ heatstroke – a more severe form of heat exhaustion and occurs when the body temperature exceeds 40°C,
- ✓ hypothermia - occurs after prolonged exposure to low temperatures,
- ✓ skin lesions – such as sunburns, rashes,
- ✓ respiratory problems – high temperatures can lead to breathing difficulties and can aggravate existing respiratory conditions,
- ✓ cardiovascular problems – increased blood pressure, which can increase the risk of stroke or myocardial infarction,
- ✓ neurological problems – dizziness, weakness, headache, confusion or even loss of consciousness.

Heat stress is the condition in which the human body cannot escape from excess heat.

As a result of thermal stress, the frequency of breathing increases, the human body sweats intensely. Excessive sweating leads to dehydration. During heatwaves, dehydration can appear suddenly. When the temperatures are very high, water and mineral salts are eliminated from the body through perspiration. They must be constantly replaced by an adequate intake of fluids. The accelerated frequency of breathing contributes to. Both dehydration and increased elimination of carbon dioxide lead to acid-base imbalance.

The Centers for Disease Control and Prevention (CDC) describes that heat stress can be dangerous and lead to serious health consequences such as heat cramps, heat exhaustion, stroke, multiple organ dysfunction syndrome, collapse, and even death.

Statistics show an alarming increase in deaths caused by heat waves in the last 10-15 years.

Exemplu

A longitudinal study conducted over a 20-year period (2000-2020) in 43 cities in the United States of America, which aimed to investigate the effects attributed to the intensity, duration, and incidence of heatwave temperatures in a season, demonstrated that:

- the mortality rate increased by 3.74% during hot periods than during those with an optimal temperature for the human body,
- heatwave mortality increases by 2.49% for each additional degree Fahrenheit in each heatwave day.
- mortality increased by 5.04% during the first heat wave, versus a 2.49% increase during subsequent heat waves, compared to non-heatwave days.

Thermal stress is also a common problem in dental practice, especially during procedures that involve the use of rotating instruments, such as dental burs or piezotomes. In these situations, the heat generated can lead to thermal stress in the dental pulp, which can lead to pain or even the need for endodontic treatment.

Exemplu

The study published in the *Journal of Dental Hygiene* aimed to assess the effects of excessive heat exposure on cognitive performance and attention among dental staff. For this, 29 dental nurses and dental hygienists were recruited and underwent cognitive tests before and after a 4-hour work period in a high-temperature environment. Study participants underwent cognitive and attention tests before and after working for one hour in an environment where the temperature was artificially raised to 30°C. The results showed a significant decrease in cognitive performance and attention among the participants after exposure to excessive heat.

Heat stress can lead to fatigue and dehydration, which can negatively affect concentration and cognitive performance. This can lead to errors during professional activities and risks to patients.

The human body is able to regulate internal temperature through the thermoregulatory system, which involves sweating, vasodilation and vasoconstriction.

Ultraviolet (UV) radiation during heatwaves

Classification of ultraviolet radiation according to the impact on biological objects:

- destructive character – heating of the skin and tissues
- photochemical character – influences the DNA structure.

The impact of ultraviolet radiation can be:

- biogenic (favorable)

UVRs from the A spectrum contributes to the formation of vitamin D, which is the most important way to provide the body with vitamin D. The B spectrum contributes to the formation of the melanin pigment, the C spectrum - increases the resistance of cells and in the environment they serve as an air disinfectant, the spectrum D – increases muscle tone.

- abiogenic (unfavorable)

The abiogenic impact leads to the inhibition of DNA synthesis processes, hypertrophy of the cells of the fascicular and reticular zones of the adrenal cortex, disorders of vitamin metabolism, oncogenesis intensifies.

RUVs can have action:

- carcinogenic, manifested by burns, dermatitis, ulcers,
- phototoxic, there is damage to the skin by visible radiation,
- photoallergic, which represents the skin's acquired ability to respond to visible radiation.

UV radiation is the part of the solar spectrum that is most biologically active. An auxiliary source of heat is the skin and clothing of a person heated under ultraviolet rays.

Notions of mitigation and adaptation to climate change from a health system perspective

„We are the first generation to feel the sting of climate change, and we are also the last to make a difference”

Jay Robert Inslee,
American politician, lawyer and economist,
23rd Governor of Washington since 2013

The purpose of teaching the work:

Information about the general notions of reducing the consequences of extreme weather events and adapting to climate change from the perspective of the health system.

Theme structure:

- ✓ Important actions to adapt human health to climate change
- ✓ Reducing the risk of infectious diseases in relation to climate change
- ✓ Recommended measures in case of floods and drought
- ✓ General recommendations for behavior during the heat wave
- ✓ Recommended measures in case of heat wave and frost waves

Important actions to adapt human health to climate change

Intensification of epidemiological surveillance actions, targeting specific territories, as a result of the expected expansion of the distribution of endemic infections and the emergence of some diseases in new areas. This would be guided by information from up-scaled climate scenarios for specific regions and their implications for disease cycles.

Development of early warning systems for epidemics, especially after extreme hydrometeorological events such as storms and floods. Outbreaks of water-associated, water-borne and mosquito-borne infections are frequently reported after these events.

In the area of health systems, strategies to facilitate access to health care services would contribute to the early detection and treatment of infections and thus potential outbreaks. This should preferably be targeted at the most vulnerable populations and territories.

Important adaptation actions are also those that focus on specific disease and vector control programs, including entomological surveillance. The aim of these actions would be to reduce the risk of infection, by reducing the populations of pathogens, vectors and animal reservoirs of infection.

Functions of the health system	Necessary measures
Good governance and health policies	<p>Clear establishment of roles and delegation of tasks between SPCSE (Civil Protection and Emergency Situations Service), health authorities, SHS (State Hydrometeorological Service), including for risk assessment and communication</p> <p>Assessment and improvement of water reserves, digging of artesian wells in coordination with AGRM (Agency for Geology and Mineral Resources), sustainable supply of safe drinking water in rural areas</p>
Human resources for health	<p>Training of health specialists in the field of public health emergency management (taking into account gender specificity)</p> <p>Ensuring an institutional link between the SPCSE and the health sector, including a clear description of the delegation of competences from the health sector</p> <p>Creation of a working group for health risk assessment and communication</p>
Information systems	<p>Strengthening the structures for the epidemiological surveillance of infectious diseases</p> <p>Designation of a public health specialist responsible for maintaining permanent liaison with meteorological and geological services for early notification of drought risks</p> <p>Securing and deploying stocks for humanitarian aid in municipalities subject to the risks of floods and landslides</p>

Essential products and technologies	Provision of ceramic filters for water purification in domestic conditions
	Ensuring the drinking water supply chain through 19-liter bottles or containers with a volume of 1m ³
Provision of services	Ensuring reserves of solutions for rehydration and medicines for gastrointestinal diseases in municipalities exposed to risks

General recommendations for behavior during heatwave

- Prolonged exposure to the sun between 12:00 and 17:00 is avoided.
- If exposure to the sun during hot weather is unavoidable:
 - the head must be covered (sun hats, umbrellas);
 - clothing must be thin, made of natural fabric, light-colored;
 - eyes must be protected with sunglasses;
 - it is necessary to have a reserve of water with you;
 - it will go in the shade.
- It is necessary to use a body lotion based on coconut oil and carrot extract to keep the skin hydrated, protected from ultraviolet rays.
- Air conditioners are adjusted so that the temperature is 5oC lower than the outside air temperature.
- Avoid outdoor activities that require high energy consumption.
- Elderly people, children, people with disabilities must be offered liquids regularly, even if they do not ask for them.
- Residential spaces must be well ventilated and cooled (by opening the windows late in the evening, at night and ear-

ly in the morning, to cause air currents, during the period when the outside temperature is lower than the one in the house).

- Air conditioning in residential and occupational spaces is favorable. If there are no air-conditioned devices at home or at work, you can spend 2-3 hours a day in air-conditioned spaces (cinemas, public spaces, shops). Fans do not work if the air temperature exceeds 32°C (they will not prevent heat illness).
- During the day, frequent showers with water at a moderate temperature are recommended, without wiping the body of water.
- Situations where children and disabled people are left to wait for a long time inside cars parked in the sun will be avoided.
- People suffering from certain ailments will continue their treatment according to medical indications. It is very useful that, during these periods, people with chronic conditions: cardiovascular, hepatic, renal, pulmonary, circulatory, mental or with hypertension consult the doctor in order to adapt the therapeutic scheme to the existing conditions.

Healthy foods that must be included in the diet to reduce body temperature:

- watermelon (watermelon) and cantaloupe (juicy) are fruits rich in water and very effective in reducing body heat and keeping the body hydrated. During the summer, these products must not be missing from the food ration;
- cucumber is the summer vegetable, very rich in water and effective in providing a cooling effect to the body. A cucumber eaten daily helps reduce body heat naturally;
- radish, apart from being rich in water, is a rich source of vitamin C, it is a good antioxidant that can reduce body tem-

perature. Radishes also have anti-inflammatory properties, which are quite effective for combating heat stress;

- consuming sesame seeds (20-30 g/day during heatwave) is one of the main remedies for reducing body heat, while also contributing to increasing vitamin D levels;
- a handful of poppy seeds with a glass of water before going to bed regulates and induces sleep, keeping the body temperature within normal limits;
- cold liquids, such as milk or lemon juice, can be very effective in reducing body heat. A glass of cold milk with a spoonful of honey is delicious and keeps the body in shape on hot days.

For a healthy life, it is very important to cover the body's requirements in all essential amino acids, substances from which all the proteins in the human body are formed.

In the conditions of psychological and thermal stress, in the current meteorological conditions, the human body endures sudden changes in temperatures from one day to the next (in 6 months it endures temperature differences greater than 50oC, which means enormous stress) and the adoption a purely vegetarian diet, which brings all the indispensable amino acids within optimal limits, is almost impossible.

Recommended measures in case of heat wave and frost waves

Functions of the health system	Necessary measures
Governance and health policies	Awareness campaign on healthy behaviors during the heat wave (day and night), lifestyle, nutrition and alcohol abuse during the cold waves (with gender-specific needs in mind).
Human resources for the health system	<p>Training of health professionals on the management of emergency cases during heatwaves (taking into account gender-specific needs);</p> <p>Health professionals specially trained and designated for public awareness and risk communication.</p>
Information systems	<p>Consolidation of the health information system by assigning a well-identified entity the obligation to analyze and report data on:</p> <ul style="list-style-type: none"> - Morbidity and mortality from respiratory diseases, with a special focus on tuberculosis and population groups such as workers and the elderly (over 65); - Infant mortality in children aged 1-5, by causes; - Epidemiological surveillance of specific diseases, such as asthma; - External causes of mortality by age groups, with an emphasis.

Basic products and technologies	Fully functional emergency departments for cardiovascular diseases in all major hospitals in towns and village;
	Diagnostic capabilities and drugs to deal with infectious diseases such as Lyme disease, West Nile, Chikungunya fever;
	Increasing the general accessibility of health services, especially for disadvantaged families, for early diagnosis and prevention.
The provision of services	The availability and checking of the stock of food, fuel, stoves, blankets, etc. in rural areas to cope with frost waves in remote and/or dispersed localities.
Financing	Increasing general accessibility to health services, mainly for disadvantaged families;
	Analysis of the effectiveness of the health insurance system/funds in the field of public health, also considering the significant reduction in the share of "out-of-pocket" costs for health services.
Governance and health policies	Awareness campaign on healthy behaviors in case of spread of infectious diseases and mainly in case of outbreaks caused by sudden spread of parasites and insects.
	Compliance with international quality standards regarding animal husbandry and agricultural products

Human resources for the health system	Educating healthcare professionals about new potential future threats;
	Health professionals specially trained and assigned to sensitize the population (with a focus on gender-specific needs) on the spread of infection, hygiene practices and safety behavior in case of insect outbreaks.
Information systems	Review/strengthen the national research agenda on the spread of infectious diseases and the risk of morbidity;
	Review/strengthen the national research agenda on pollen and mold health risk;
	Review, identify and update risks to adjust epidemiological surveillance according to specific / changing threats, as appropriate.

Reducing the impact is based on measures to reduce the carbon footprint, by adopting sustainable practices, such as recycling waste, using renewable energy sources, improving the energy efficiency of buildings and equipment used.

On August 30, 2023, the Government of the Republic of Moldova approved the ***National Climate Change Adaptation Program*** until 2030 and the ***Action Plan for its implementation***.

The National Climate Change Adaptation Program sets objectives aimed at increasing the climate resilience of six key sectors:

- ✓ agriculture,
- ✓ health,
- ✓ transportation,
- ✓ energy,
- ✓ water,
- ✓ forester

→ In the health sector it is to be

- adjusted the existing clinical protocols
- new protocols developed

for the prevention and treatment of diseases caused or exacerbated by climate change.

and is accompanied by an action plan to prevent and overcome the risks and vulnerabilities caused by climate change.

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Descrierea CIP a Camerei Naționale a Cărții din Republica Moldova

Croitoru, Cătălina.

Health and climate change / Cătălina Croitoru ; Nicolae Testemitanu State University of Medicine and Pharmacy of the Republic of Moldova. – Chișinău : Print-Caro, 2024. – 120 p.

With the support of the Agence Universitaire de la Francophonie. – Referințe bibliogr.: p. 118-119 (16 tit.)

[30] ex.

ISBN 978-9975-180-97-9.

613/614+551.583(075.8)

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