

THE ONE HEALTH CONCEPT: A HOLISTIC APPROACH TO PROTECT HUMAN AND ENVIRONMENTAL HEALTH – HOW DOES IT WORK IN TOTAL WORKER HEALTH STRATEGY

Paulina Kaczmarek¹, Marta Wiszniewska¹, Sebastian Słomka², Jolanta Walusiak-Skorupa¹

¹ Nofer Institute of Occupational Medicine, Łódź, Poland
Department of Occupational Diseases and Environmental Health

² Wł. Biegański Regional Specialist Hospital, Łódź, Poland
Department of Internal Medicine and Geriatrics

ABSTRACT

Human well-being is affected by demographic, geographical, environmental and economic changes in the modern world. Advanced and rapid technological advances have left countries without an adequate structural framework. The One Health concept, rooted in the interconnectedness of human health, animal health and the environment, addresses today's global health challenges. These include non-communicable and zoonotic diseases, antimicrobial resistance, ecosystem degradation and food security. All of these require a holistic approach, bringing together multiple disciplines. Therefore, an exploration of the One Health concept was undertaken, which focuses on the collaboration of professionals from different disciplines, as well as looking at human health in a multi-faceted way. The aim of the study was to explore how the One Health concept could contribute to effective pandemic prevention and a broader holistic understanding of human health. It was also relevant to identify its application in occupational medicine. The narrative review was adopted as the research method of choice. The authors emphasise the importance of interdisciplinary collaboration, education and international partnerships in preparing for future health emergencies. Human health should not only be assessed from a medical perspective, but also from an environmental point of view. International cooperation is therefore essential to prepare a unified response to threats and challenges. The system of teaching medical personnel needs to be improved, returning to anthropological assumptions. With zoonotic diseases systematically emerging, health professionals should be as prepared as possible for emergencies. Qualified teams are needed to assess risks and hazards in the workplace in a multidisciplinary manner. An in-depth knowledge of zoonotic pathogen transmission is crucial. The impact of environmental degradation on the immune system must be taken into account. A holistic view of workers' health is needed, taking into account ecological, environmental, social and economic factors. *Med Pr Work Health Saf.* 2024;75(5):433–444

Key words: health promotion, occupational health, environment, sustainable agriculture, One Health, planetary health

Corresponding author: Paulina Kaczmarek, Nofer Institute of Occupational Medicine, Department of Occupational Diseases and Environmental Health, św. Teresy 8, 91-348 Łódź, Poland, e-mail: paulina.kaczmarek@imp.lodz.pl
Received: May 6, 2024, accepted: August 23, 2024

INTRODUCTION

The concept of One Health involves a collaborative approach to addressing health challenges by considering the interconnectedness of human, plant, animal and environmental health. This approach represents a shift from traditional surveillance methods and emphasizes the need for a holistic strategy. The world is currently facing issues such as food safety, antimicrobial resistance, ecosystem degradation, climate change and zoonotic diseases, all of which are influenced by factors like urbanization, agricultural practices, and ecological transformations. Many approaches focus on the link between individual well-being and the broader social system, with special attention on the impact of envi-

ronmental security on human health. One Health also explores the links between ecology, consumer behavior, the safety of food production systems [1]. The basis of the One Health approach is cooperation on numerous levels and in many areas. Health care requires comprehensive action, especially in the face of the increasingly complex health problems of the global population [2]. Furthermore, One Health idea is crucial for the preventive healthcare and health promotion, thus should be included in occupational health strategies. There are several definitions of the One Health vision, however none has been formally adopted. The most commonly used is the one stating that "One Health recognizes that the health of humans, animals and ecosystems are interconnected. It involves apply-

ing a coordinated, collaborative, multidisciplinary and cross-sectoral approach to address potential or existing risks that originate at the animal-human-ecosystems interface” [1]. One Health can be described through an acronym ECOHAB: exposure connections, comparative clinical connections, occupational health connections, human-animal-nature bond connections, agriculture and food connections, animal agriculture, biodiversity connections [3].

Study objectives included identifying global health challenges that demand urgent attention, reviewing the assumptions of the One Health approach, analyzing the institutional framework of the idea. The aim was also to highlight the potential benefits of the One Health approach in enhancing global healthcare, as well as to examine the applicability of the One Health strategy to the field of occupational health.

METHODS

To achieve the stated objectives, a narrative review was adopted as the research method. The narrative review integrates findings from various sources to offer an exhaustive analysis of the topic. To ensure the review’s relevance and quality, the authors established inclusion and exclusion criteria. Materials considered for inclusion had to be published predominantly 2019–2023, with a few exceptions for significant publications between 2007 and 2016. In total, the review includes 63 publications. In the initial phase of the study, a comprehensive search of scientific databases was carried out in order to collect as much data as possible. Publications in Polish and English were under consideration. Each article was analysed for relevance to the study being undertaken based on titles and abstracts. After applying the inclusion and exclusion criteria, 63 articles remained. A number of data sources were accessed to gather relevant literature, including online academic databases, medical journals and documents from applicable international organizations. The search strategy included the use of specific research terms and keywords to identify pertinent articles, reports and academic papers. Search terms involved “One Health,” “One Health concept,” “One Health anthropology,” “human and animal health,” “planetary health,” “workplace health,” “environment,” “sustainable agriculture,” “One Health and allergy,” “One Health and non-communicable diseases.” Boolean operators (AND, OR) were used to narrow the search results and ensure the inclusion of relevant publications.

RESULTS

Background for the One Health concept

The linkages between human health and ecosystems were noted in the 1800s by Dr. Rudolf Virchow. He was mainly involved in cellular pathology and created comparative pathology. His efforts for One Medicine, however, were not recognized back then [4]. The concept has evolved from One Medicine [1] (his disciple William Osler [1849–1919] regarded as a founder of the One Medicine concept), One World to eventually – One Health (the first international One Health Congress, Melbourne, February 2011) [5]. The latter was first used in 2003–2004. It was linked to the outbreak of the severe acute respiratory syndrome (SARS) pandemic and then the spread of highly pathogenic avian influenza H5N1 [1]. The One Health concept should be examined through anthropological context as well [6]. The existing correlation between human and animal health and the possible transmission of diseases between these species was also reflected in Babylon, the Nile Valley, China, Leviticus (Old Testament), Hippocrates in Greece (the role of a clean environment in the quality of human health was emphasized by Hippocrates already in 4th century) [7], Virgil and Galen in Rome [5]. Ancient times were the era when environment and animal health were considered intertwined. The goal of veterinary medicine was to serve human health in the first place. It was to be achieved by protecting the food supply and limiting the transfer of diseases [6]. Though losing popularity in the early 20th century, now the concept is making a comeback. It points to the usefulness of evolutionary biology and molecular analytical tools as a resources for combating zoonotic diseases [8].

Institutional framework

Pandemic outbreaks have become a reason to strengthen international cooperation, with the spread of H5N1 influenza as an example. United Nations System Influenza Coordination (UNSIC) and a number of international and national entities, including the World Health Organization (WHO), the Food and Agriculture Organization (FAO), the World Organization for Animal Health (WOAH), the United Nations Children’s Fund (UNICEF), the World Bank and a range of national ministries of health, worked together in order to design the International Ministerial Conference on Avian and Pandemic Influenza (IMCAPI of Hanoi, April 2010) [5]. It allowed the creation of a strategy based on One Health principles to control infectious disease [1].

Currently, institutionally, the One Health approach is handled by the so-called Quadripartite. It includes the FAO of the United Nations (UN), the United Nations Environmental Program (UNEP), the WHO and the WOAAH. The agreement of these institutions aims to encourage all countries and key stakeholders to promote and undertake priority actions. Quadripartite goals include increasing the prominence of the One Health approach on the international policy agenda, improving understanding of strengthened multi-sectoral health governance.

The One Health strategy is being promoted as a policy in the context of dealing with the threat of a pandemic. Further intentions are to support national One Health governance mechanisms and interdisciplinary coordination, situational analysis, stakeholder identification, setting up priorities and indicators for One Health monitoring and evaluation systems. It is important to build a One Health workforce with the competencies needed to prevent, detect, control and respond to health threats. To this end, strengthening joint initial and continuing education for human, animal and environmental health workers is promoted. It is crucial to prevent pandemics by getting to the source of the outbreaks and countering them based on this knowledge [9]. Already after the pandemic influenza emergency, international organizations have focused on formulating goals such as: building robust and well-managed public health and animal health systems that comply with the WHO International Health Regulations [10] and WOAAH international standards, controlling disease outbreaks through improved national and international emergency responses, addressing the concerns of poor communities more effectively. The emphasis was placed on emerging economies. Promotion of broad collaboration across sectors and disciplines, along with critical research, was advised [11].

The One Health world congresses are a venture of the One Health platform. They bring together specialists from relevant international entities, leading scientific experts and researchers in the fields of One Health. Experts in animal production and trade, food safety, animal health, human health and ecology are present. They are also attended by government representatives in the fields of public health, human health, food safety, environmental health and global health security [12]. The WHO neglected tropical disease (NTD) roadmap 2021–2030 outlines the necessity of a One Health idea to achieve the challenging control of particular diseases. The WHO envisions interdisciplinary

efforts, especially in diagnosis, monitoring and assessment. Such approach should be undertaken in the field of outreach and logistics, advocacy and funding. Taking into account interaction between livestock, humans and pathogens in their shared environment, the One Health Approach is pivotal [13,14].

Conceptual framework based on modern challenges for the world

The One Health perspective implies a shift from a system in which surveillance was carried out separately for the human, animal and environmental areas to a coordinated system of activities [15]. The One Health concept responds to the urgent problems of modern societies. Increased urbanization, expanded agricultural operations, and modified ecosystems are fostering the development of new diseases [1]. The experience of the coronavirus disease (COVID-19) pandemic has shown how the world is interconnected. A single pathogen changed people's lives and strained national systems around the world. The development of infectious diseases, the threat of malnutrition are caused because of weakened natural resources. There has been an intensification of extreme weather events. These processes affect human health, including mental well-being [16].

Infectious diseases

Technological advances have made a huge impact on smallholder farms which transformed into large-scale specialized production systems. Global marketing has developed, as well as global sourcing [17]. International trade and human travel between countries adds to the transmission of infectious diseases. Most of them are of zoonotic origin (>60% of known human pathogens and 75% of emerging pathogens) [18]. Zoonotic diseases, caused by bacterial, viral, or parasitic pathogens, are a growing concern [19]. They span a wide range, including rabies, salmonella and West Nile virus [20], Q fever (*Coxiella burnetii*), anthrax, brucellosis, Lyme disease [21] and Chikungunya virus [22]. Global Health zoonotic emergencies involved outbreaks like human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), SARS, Nipah virus, avian influenza (A)H5N1 [6], pandemic 2009 H1N1 influenza, Middle East respiratory syndrome, Ebola [23], mpox [9], Zika and eventually COVID-19 [15]. Zoonosis emerged as a result of increased agricultural practices, global trade in exotic animals [23], worldwide commerce in animals and animal products [11] and venison consumption [12]. Certain diseases become ep-

idemics, thus affecting a large number of people in a region. Others become pandemics due to the transfer of the pathogen within several countries and continents, affecting people on a large scale. It is possible to predict an increasing frequency of infection given unsustainable human habitation. Environmental changes, the ways in which food is grown, meat consumption and consequently the animal trade all point to the possibility of pandemics similar to COVID-19. Unexpected human modifications of the landscape, but also inappropriate or over-intensive use of available land, influence the development of most infectious diseases. Although complex, the link between the environment, biodiversity, people and finally infectious diseases is a reality [24]. Habitats used for irrigation and other agricultural inputs, often increase the risk of vector-borne diseases such as malaria and schistosomiasis. Due to the growing population and demand for food, the use of pesticides and fertilizers in agriculture will increase. This in turn may result in the further development of diseases [25].

Dam construction, flooding, ecosystem disruption and agricultural monocultures are clear threats in the context of transmission of threatening pathogens. Both rural areas through the above practices are a source of infectious disease development, but large metropolitan areas, the so-called “megacities,” should not be forgotten. Webster et. al [26] show this with the example of simian immunodeficiency virus transmission, which could have occurred earlier, but the HIV pandemic came about precisely in the 20th century with the processes of urbanisation and intensification of global transport. The environment is constantly transforming through efforts to control infectious agents, including vaccination and drug development. One Health strategy to understand the ecological and evolutionary determinants of zoonotic diseases is needed. Developing effective methods to respond to and deal with diseases transmitted by multiple hosts requires knowledge of these processes and a holistic scientific approach [26]. The 2030 Sustainable Development Goals (SDGs) and the Global Health Security Agenda (GHS), set out the actions that should be taken to address the threats that infectious diseases present to the world. Among them is the development of strong interdisciplinary, multi-sectoral collaboration [16].

A problem with significant implications for global health is the maintenance of ecosystem diversity. Only such remain resilient to change and threats, so biodiversity (less change in the ecology of hosts and pathogens) reduces the risk of developing infectious diseases.

The most effective One Health activities for surveillance but also prevention of infectious diseases include vaccination, environmental sanitation (access to treated water, refuse collection, sewerage and wastewater treatment), vector control, urbanisation monitoring, promotion of safe intercourse and treatment of sexually and vertically transmitted infections. The challenge for the modern world is also to eradicate poverty, increase access to contraception, gender equality in order to effectively control overpopulation. In addition, promoting personal hygiene care practices is indispensable [12].

Non-communicable diseases

One Health does not solely address zoonotic diseases; it extends its reach to non-communicable diseases (NCDs) such as cancer, allergy, developmental abnormalities and neuropsychiatric disorders [27]. As Kabir et al. [28] point out, NCDs are responsible for 41 million deaths (71% of all deaths) annually worldwide, and 77% occur in low- and middle-income countries. There are 4 main NCDs with the highest incidence rates: apart from above mentioned diabetes mellitus and cancer, these include chronic respiratory disease and cardiovascular disease [28]. In humans, NCDs are associated with factors such as poverty, gender, race, limited nutrition or risk of violence in their close environment [27]. Such diseases are a great concern and challenge for modern medicine, mainly due to the high death statistics caused by these pathologies. These are risks assigned by researchers to categories such as lifestyle, genetic, environmental, medical and socio-demographic factors. A key aspect is to highlight humanity's nutritional problems and see them as one of the sources of high mortality rates. They are a great concern and challenge for modern medicine. The One Health concept is gaining popularity due to the recognition of the multifaceted drivers of NCDs. Therefore, a sector-wide approach is an opportunity for better health prevention. Actions are needed at international and national level to raise awareness of health and healthy lifestyles, changes in national health prevention. The solution that deserves the most attention is to promote dietary modification, as well as physical activity and abandoning harmful habits. Increased control of human metabolic disorders is an indispensable aspect. Given the above, a unified approach that integrates medical and environmental aspects may be the answer to the threats posed by NCDs to today's population. Budreviciute et al. [29] mention lung cancer as an example of the most common cancer in the world and

caused by multifaceted factors. Thus, smoking is considered to contribute to the likelihood of contracting the disease, but so is an inadequate intake of vitamins and nutrients provided by fruit and vegetables. In the context of breast cancer in women, on the other hand, obesity and endocrine dysfunction have been linked to each other. The authors point to links between dietary habits and the development of colorectal cancer. In this case, a high consumption of meat and fat and an inadequate intake of fruit and vegetables, vitamins and minerals, and dietary fibre may contribute to the development and progression of the disease [29].

The difficulty in overcoming NCDs is that while infectious diseases are controlled with vaccines and drugs, NCDs are too complex to manage effectively. A way of dealing with NCDs is the idea of taking a broader view of the problem and incorporating the socio-economic context into considerations. Actions with potential for success include the organisation of public health campaigns, upgraded health monitoring systems and international cooperation [30]. Tackling this phenomenon requires long-term healthcare provision, adequate prevention, a slant on the psychosocial sphere of health, management of the individual in terms of people's personal life behavior [29].

Neglected tropical diseases

The WHO classifies 17 tropical diseases as neglected [31]. Neglected tropical diseases are devastating for human health. They often turn into chronic infectious diseases. More than a billion people in nearly 150 countries are impacted [32]. The combat against NTDs will require innovative approaches that link health, agriculture and development activities; NTDs transmission is impacted directly and indirectly by socio-cultural, economic, anthropological and ecological determinants. Collaboration between health care services, veterinary public health providers and environmental programs, should be promoted [13].

Antimicrobial drug resistance

A significant health concern in the modern world is drug resistance. Antimicrobial resistance is the resistance of a microorganism to an antimicrobial drug to which it was previously sensitive. Microorganism mutates or acquires a resistance gene. Bacteria, viruses, fungi, protozoa and worms are able to withstand the attack of antimicrobial drugs. These involve antibiotics, antivirals and antimalarials [33]. The microbial generation period can be 20 min. It takes about

10 years to generate new antimicrobial agents. Intestinal flora and urogenital flora significantly overlap, which promotes interspecies transfer of drug-resistant agents [8]. Between 2016–2020, the number of infections and deaths because of antimicrobial resistance increased significantly in the European Union/European Economic Area (EU/EEA). The 2017–2021 period also marked a higher note of the reported invasive *Klebsiella pneumoniae* and *Acinetobacter* spp. infections. These are resistant to carbapenems – a group of antibiotics often used as a last resort. Antimicrobial resistance is ranked by the Health Emergency Preparedness and Response Authority among the top 3 health threats. The European Center for Disease Prevention and Control states that >35 000 people die each year in the EU, Iceland and Norway from infections caused by antibiotic resistant microorganisms [34]. It is predicted that by 2050, 10 million lives a year and a total value of USD 100 trillion will be at jeopardy from the rise of drug-resistant infections. In a situation where antibiotics, as a special group of antimicrobial drugs, will lose their potency significantly, surgical medicine will suffer the consequences. Without adequate antibiotics, procedures such as intestinal surgery, cesarean sections, joint replacements and chemotherapy may become too dangerous. The negative effects of drug resistance will affect poor countries and communities the most [35].

Environmental degradation

Populations are falling prey to diseases caused by environmental factors and illnesses associated with deteriorating environmental quality. Food systems lead to both malnutrition and over-nutrition [23]. On account of advanced agricultural production, large-scale use of natural resources, intensified extraction, and climate change [36], biodiversity is gradually being reduced [37]. The global village is causing intercontinental ecosystem exchange and geospatial unification. Biodiversity is essential for pollination, sustainable climate, flood control. Soil fertility and the production of food, fuel, fibers and medicines strongly depend on it [36]. Forbidden diseases are transmitted by the contact between wild and farmed animals, deforestation and the consistently broadening human presence in previously untamed areas [38]. When examining the relationship between environmental changes and the incidence of allergic diseases, asthma, allergic rhinitis, atopic dermatitis and food allergies appear above all. It is argued that today's condition may have the appearance of an epidemic, and this situation indicates a link between neg-

ative environmental processes and the human immune system [39]. New species of plants and animals are being identified in completely different areas than before. More severe exposure to allergens is associated with polluted air and climate change, as well as widespread use of cosmetics and chemicals. People have contact with contaminated natural resources (e.g., soil or water) [7]. Being exposed to polluted air for long periods of time can cause serious health damage. Among them are inflammation, bone demineralization, kidney calcification, respiratory acidosis, physiological changes, and oxidative stress [40]. One Health strategy is an answer to immunological challenges in the modern world. Immunology investigates the cause-and-effect relationships associated with urbanization and environmental degradation and decrease in resistance. It studies stress as well. Therefore, cooperation along the lines of allergology and immunology, internal medicine, laryngology, pediatrics, dermatology, dietetics, ecology, biology, agriculture, aerobiology, among others, is indispensable [7]. A polluted environment and climate change have a proven negative impact on many chronic NCDs, diseases of civilization, allergic diseases. On a societal level, the consequences of these diseases translate in terms of productivity, mental health and economic level. Increased health care expenditure and reduced productivity have a direct impact on economic wealth. Specific risk groups are identified: children, pregnant women, people with comorbidities, the disabled and the elderly. Naturally, countries and communities with limited resources are at particular risk.

Over the past 23 years, there has been a trend towards food allergy and anaphylaxis, eosinophilic oesophagitis and drug-induced anaphylaxis, which began in the United States of America (USA) and has been transferred to the Western world. An increase in diabetes, rheumatoid arthritis, multiple sclerosis and coeliac disease is also noted. Pawankar and Akdis [38] stresses that chemical compounds used in toothpaste, shampoo, detergents and processed foods, among others, damage key epithelial barriers in the respiratory and gastrointestinal tracts and skin. Through this, it is possible for bacteria, toxins, pollutants and allergens to enter the human body more efficiently. Researchers in the Asia-Pacific regions have singled out the impact of Western lifestyle (including diet) urbanization, air pollution and climate change on the formation of various interactions with the human immune system and allergens, respiratory allergies in urban dwellers but also on changes in the gut microbiome. Thus, One Health

focuses on the damage being done to the environment and emphasises the importance of taking care of sustainable development [39].

Mental health

It is important to stress that mental health in the modern world is linked to environmental issues as well. In order to provide support in this area, it is necessary to link efforts from various fields, including the environment [40].

The recent research indicate a high incidence of mental health disorders. The study's authors conclude that as much as 50% of the population will suffer from mental health problems <75 years, with depressive and anxiety disorders among the most common conditions. The researchers recommend investing in basic neuroscience research and medical support for mental health (including young people, given that the age of first incidence peaked at 15 years of age) [41].

The need for intervention in this area also reflects the current understanding of mental health in a much broader way than just the fact of having a mental illness. Examples include how a broad perspective contains the emotional deficit disorder of nature, eco-paralysis and topophilia [42].

Learning about the relationship between humans and nature and its impact on the well-being of people around the world is of great importance today. Not only does this demand find its place in the One Health concept, but also in clinical ecology and the goals of the UN. The important link between the environment, biodiversity and well-being should be highlighted. Furthermore, environmental issues also need to be taken into account in the pursuit of well-being in the working environment. As the use of simulated natural scenes, among other things, is evidenced to be effective in anxiety and stress therapy, this shows how human contact with nature can have a beneficial therapeutic effect.

An important step will be research to learn more about the relationship between humans and nature, which in turn will allow corrective measures to be implemented. These can include all kinds of curricula, green infrastructure, as well as appropriate urban planning. Brymer et al. [40] suggests bringing together, in a holistic approach, artists, planners, designers and researchers. Still, there is a need to improve knowledge on how climate change affects people's mental health. It is not only air pollution, the successive reduction of green spaces available for regeneration, but also sudden climatic events such as floods, tornadoes and landslides

that contribute to depression and anxiety. The latter also have an associated risk of post-traumatic stress disorder [43]. Interference caused by changes in the environment and land use can also lead to displacement and conflict, which is not indifferent to mental health [44], as is economic disruption [42].

The term solastalgia, used by Australian philosopher Glenn Albrecht, refers to emotional detrimental reactions to mental health due to the threat of losing inhabited ecological zones. The knowledge that future generations may not have the opportunity to observe certain natural phenomena or animal species can place a significant strain on a person's mind and emotional balance, as indicated by considerations of psychiatric epidemiology [44].

It is worth noting that the study of well-being is a complex process due to its subjective nature. In this situation, it is important to recognise context such as social, economic, cultural and religious factors as part of the variability of the impact of mental health on different communities. Research in this area should therefore take into account certain demographic and population data [42].

One Health and Total Worker Health

Traditional occupational safety and health programmes, i.e., programmes that have not been integrated with other activities have proven to be successful. However, in the face of a wide complex spectrum of employee problems, it is worth considering a change in approach. Total Worker Health (TWH) assuming a connected effort for occupational safety and health improvement in work environment can be a better direction for action [45]. The U.S. National Institute in 2011 created the term TWH which formulated a set of company policies, programs and practices. These policies integrated workplace safety with the promotion of employee health. Di Prinzio et al. [46] emphasize the importance of workplace health promotion for public health. The authors list the benefits of TWH in the workplace. In addition to health benefits, the improved productivity, nullified presenteeism and reduced absenteeism were emphasised [46]. The U.S. Centers for Disease Control and Prevention National Institute for Occupational Safety and Health has released the Future of Work Initiative. This program implements TWH's objectives. It postulates modifications to improve physical, organizational and psychosocial factors and identifies potential risks in the work environment [45]. The TWH strategy was the first to adopt a holistic approach, rec-

ognizing the significance of factors outside the workplace. It closely aligns with the One Health approach, which emphasizes the importance of environmental issues. Good practices involving collaboration between occupational health services and other professionals to protect the health and well-being of employees are highlighted. Di Prinzio et al. [46] show an example of a campaign for occupational health services. The initiative focused on smoking as part of a lifestyle. It included a holistic view of the problem. It was pointed out that smoking affects physical health, mental health, but also the environment. Tobacco affects air quality, which in turn has an impact on people's health and well-being. Similarly, mental health risks of employees can be detected by linking the activities of employers, the human resources department and psychologists in the workplace [46]. A group of specialists should bring together infection control or biosafety experts and an industrial hygienist. Such an arrangement will ensure adequate engineering controls, training, vaccination, post-exposure protocols and surveillance [47].

In order to take the One Health concept into account for the TWH strategy, several key elements need to be considered. These include both environmental, workplace and personal health factors. By applying such synergies, the TWH strategy can take even more effective care of the health and wellbeing of employees.

Above all, in such a composite approach, constant environmental monitoring should be taken into account, which allows for the control of environmental conditions both inside and outside the workplace. This includes occupational exposure, but also air and water quality and environmental pollution, among others. It is also particularly important to address the mental health of workers.

Action on human wellbeing cannot do without effective management of stress related to environmental and workplace factors. One Health introduces elements related to nutrition and food safety into the TWH concept. Central to this aspect is ensuring that workers have access to safe and nutritious food combined with active health-promoting education in this area [48].

Cross-sectoral collaboration is extremely important for addressing complex health issues. By bringing together different disciplines, such as public health, environmental science and occupational safety, it is possible to respond even more effectively to health challenges [49].

An additional strategy is also to expand health programmes to go beyond the workplace to include family and community health initiatives [48]. Awareness of the

impact of climate change on the health of the workforce is also important, so organisations need to prepare for its effects, such as heat stress or increased incidence of certain diseases [50].

The TWH strategy may find it valuable to implement the recommendations of the One Health snapshot on the critical importance of education and training on the links between human, animal and ecosystem health. This is an important part of modern health promotion and prevention [48].

Recommendations

As Elnaiem et al. [51] points out, it is necessary to include environmental health specialists, wildlife biologists, economists, social scientists, also legal experts when approaching health issues. It is crucial that experts from low-income countries and marginalised communities are involved [51].

There are several dominant considerations among researchers of the One Health approach. These largely include environmental care advocacy, prevention and health promotion, and international collaboration on ways to address pressing global health and social problems. The idea behind the One Health concept is to obtain more comprehensive education and science, better information exchange between different research areas/science disciplines, increased preparedness for the prevention of infectious and chronic diseases and the development of new treatments [52]. The following is proposed:

1. Comparative medicine as a potential combination of medical and veterinary education. It studies host-pathogen interactions in infectious diseases and their pathogenesis [6].
2. More sufficient education on ecosystems and environmental health for health professionals. A societal benefit would be institutional facilities to provide integrated preventive and primary health care [53].
3. A global public awareness campaign about the problem of drug resistance, especially for children and adolescents. The supply problem needs to be addressed because of the need for new drugs to replace those that no longer work due to resistance. A new class of antibiotics needs to be introduced. More transparency is being called for from food producers regarding production processes and the supply chain [35].
4. Tackling food-borne diseases. They are transmitted through the consumption of animal products or contaminated vegetables [54]. Health professionals must remain vigilant to these conditions, especial-

ly in migrants and travellers [35]. It is important for countries to cooperate in reporting and undertaking other health-oriented activities [22]. A properly prepared workforce in all sectors is essential: medical specialists, health professionals, wildlife experts, environmental health specialists, agricultural specialists [15], horticulturalists, chemical, engineering and social scientists [52].

5. Ensuring there is enough laboratory scientists, biostatisticians and field epidemiologists. Cross-sectoral coordination at the local level is recommended. The GHSA highlights the need to support the workforce to fight infectious diseases. The direction of development is to support the education and professional development of One Health employees [16].
6. Actions for sustainable agriculture and healthy aquaculture [55]. It is crucial to provide the world's population with healthy, nutritious, pollution-free food. Responsibly managed aquaculture is a solution, though environmentally challenging [56]. The One Health approach supports efforts to provide safe water and basic sanitation [57].

What is needed most of all is to build up facilities, infrastructure and preparedness to deal with sudden challenges, rather than just emergency response. Initially, One Health raised the importance of health, welfare and well-being and socio-cultural determinants including material and ecological. However, the recommended practice is to disentangle aspects that the One Health approach can address such as human behaviour, interactions with the environment and ecosystem stability. It may be necessary to involve experts dealing with marginalisation. While One Health implies a unified approach, this does not mean that certain problems cannot be approached locally. There are regions that share similar economic, geographic and environmental circumstances. Action to ensure global sustainability and health security should be complemented by managing costs at a regional level and focusing attention on the problems that are appropriate and most specific to the region [51]. Rapid industrial change makes it necessary to implement new solutions into the work environment. The fast pace of development and its impact on worker safety, health and well-being must be considered [45]. Building on the USA experience, the initiatives towards One Health revolve around academic training on this strategy. A certificate programme for graduates is implemented. There are courses at the undergraduate level as well [58].

The scientific literature points to the relationship between One Health and Digital Health and this is

important to consider strategies to ensure the use of artificial intelligence (AI) in the planetary health approach [59]. A unified approach to medical care may also involve the use of cutting-edge technology. Thong et al. [60] highlights the importance of AI in modern medicine; AI is currently being applied to allergy research in asthma, atopic dermatitis, rhinitis, adverse drug and vaccine reactions, food allergy, anaphylaxis, urticaria and eosinophilic gastrointestinal disorders. The ability to create extensive databases supports improved understanding of patient profiles, disease mechanisms, risk analysis. It allows for more precise diagnosis and is intended to help compose more effective treatments. Digital technologies are largely unexploited [39] due to many legislation and ethical doubts, nevertheless they present a possibility for tackling global medical issues [60]. Back in 2017 the UN convened a global meeting to discuss the potential of using AI in order to reduce poverty and work toward solving social problems. A UN meeting was also held to consider how AI can contribute to the SDGs. In poor areas and with their limited resources, AI is being used to predict and respond to disease. Wahl et al. [61] demonstrate that machine learning was used to spot weather and land-use patterns in Manila to control dengue fever.

Natural language processing, on the other hand, is being used in health care in marginalized communities through the use of electronic medical records and online media. Worth noting in this context are tools such as Global Health Monitor. Based on an algorithm, it is able to manage infectious disease outbreaks based on English-language news. In areas such as Thailand, China and India, the aforementioned tools are used to support cancer treatment [61]. Recommendations in the context of One Health involve raising and developing education. Therefore, the utility of AI in the context of monitoring pathogen vectors and better understanding both in terms of genotypes and how animal pathogens are transmitted is important [59].

CONCLUSIONS

There is a need to join forces to address global health challenges. The One Health strategy should become part of global programmes. It should be a component part for agendas implementing actions for sustainable development and biodiversity conservation [62]. The One Health approach should also be applied in preventive care for employees. A holistic perspective on health, encompassing all its aspects, is crucial. This comprehen-

siveness, considering environmental factors and health influencers, should be the key element of occupational health services' actions.

Author contributions

Research concept: Paulina Kaczmarek, Jolanta Walusiak-Skorupa

Research methodology: Paulina Kaczmarek, Jolanta Walusiak-Skorupa

Collecting material: Paulina Kaczmarek, Jolanta Walusiak-Skorupa, Marta Wiszniewska, Sebastian Słomka

Interpretation of results: Paulina Kaczmarek, Jolanta Walusiak-Skorupa, Marta Wiszniewska, Sebastian Słomka

References: Paulina Kaczmarek, Jolanta Walusiak-Skorupa, Marta Wiszniewska, Sebastian Słomka

REFERENCES

1. Mackenzie JS, Jeggo M. The One Health Approach – Why Is It So Important? *Trop Med Infect Dis.* 2019;4(2):88. <https://doi.org/10.3390/tropicalmed4020088>.
2. Dinis-Oliveira RJ. No Boundaries for Toxicology in Clinical Medicine: One Health, One Society and One Planet for All of Us. *J Clin Med.* 2023;12:2808. <https://doi.org/10.3390/jcm12082808>.
3. Center for One Health Research [Internet]. Washington: The Organization [cited 2023 Nov 23]. What is One Health? Available from: <https://deohs.washington.edu/cohr/what-one-health>.
4. Schultz MG. Photo Quiz. *Emerg Infect Dis.* 2008;14(9):1479–1481. <https://doi.org/10.3201/eid1409.086672>.
5. One Health Global Network [Internet]. The Organization; 2012–2015 [cited 2023 Nov 18]. Timeline. Available from: <https://www.onehealthglobal.net/sample-page/>.
6. Kahn L, Kaplan B, Monath T, Steele J. Teaching “One Medicine, One Health”. *Am J Med.* 2008;121(3):169–170. <https://doi.org/10.1016/j.amjmed.2007.09.023>.
7. Pali-Schöll I, Roth-Walter F, Jensen-Jarolim E. One Health in allergology: A concept that connects humans, animals, plants, and the environment. *Allergy.* 2021;76:2630–2633. <https://doi.org/10.1111/all.14804>.
8. Currier RW, Steele JH. One Health – One Medicine: unifying human and animal medicine within an evolutionary paradigm. *Ann NY Acad Sci.* 2011;1230:4–11. <https://doi.org/10.1111/j.1749-6632.2011.06138.x>.
9. World Health Organization [Internet]. Geneva: The Organization; 2023 [cited 2023 Nov 23]. Quadripartite call to action for One Health for a safer world. Available from:

- <https://www.who.int/news/item/27-03-2023-quadrupar-tite-call-to-action-for-one-health-for-a-safer-world>.
10. World Health Organization [Internet]. Geneva: The Organization; 2016 [cited 2023 Nov 23]. International Health Regulations. Third edition. Available from: <https://iris.who.int/bitstream/handle/10665/246107/9789241580496-eng.pdf>.
 11. Food and Agriculture Organization of the United Nations [Internet]. Rome: The Organization; 2008 [cited 2023 Nov 23]. Contributing to One World, One Health. A Strategic Framework for Reducing Risks of Infectious Diseases at the Animal–Human–Ecosystems Interface. Available from: <https://www.fao.org/3/aj137e/aj137e00.pdf>.
 12. Ellwanger JH, Veiga ABG, Kaminski VL, Valverde-Villegas JM, Freitas AWQ, Chies JAB. Control and prevention of infectious diseases from a One Health perspective. *Genet Mol Biol.* 2021;44(1 Suppl 1):e20200256. <https://doi.org/10.1590/1678-4685-GMB-2020-0256>.
 13. Mwelecele NM, Ducker C. A road map for neglected tropical diseases 2021–2030. *Trans R Soc Trop Med Hyg.* 2021; 115(2):121–123. <https://doi.org/10.1093/trstmh/trab002>.
 14. Souza AA, Ducker C, Argaw D, King JD, Solomon AW, Biamonte MA, et al. Diagnostics and the neglected tropical diseases roadmap: setting the agenda for 2030. *Trans R Soc Trop Med Hyg.* 2021;115(2):129–135. <https://doi.org/10.1093/trstmh/traa118>.
 15. Behravesh CB. One Health: A Crucial Collaborative Tool for Early Disease Surveillance. *Medscape* [Internet]. 2023 [cited 2023 Nov 20]. Available from: <https://www.medscape.com/viewarticle/987525>.
 16. Togami E, Behravesh CB, Dutcher TV, Hansen GR, King LJ, Pelican KM, et al. Characterizing the One Health workforce to promote interdisciplinary, multisectoral approaches in global health problem-solving. *PLoS ONE.* 2023;18(5):e0285705. <https://doi.org/10.1371/journal.pone.0285705>.
 17. Liverani M, Waage J, Barnett T, Pfeiffer DU, Rushton J, Rudge JW, et al. Understanding and managing zoonotic risk in the new livestock industries. *Environ Health Perspect.* 2013;121(8):873–877. <https://doi.org/10.1289/ehp.1206001>.
 18. Council of Foreign Relations [Internet]. New York: The Organization; 2023 [cited 2023 Nov 18]. The Global Governance of Emerging Zoonotic Diseases. Challenges and Proposed Reforms. Available from: <https://www.cfr.org/report/global-governance-emerging-zoonotic-diseases>.
 19. World Health Organization [Internet]. Geneva: The Organization; 2020 [cited 2023 Nov 23]. Zoonoses. Available from: <https://www.who.int/news-room/fact-sheets/detail/zoonoses>.
 20. Centers for Disease Control and Prevention [Internet]. Atlanta: The Organization; 2023 [cited 2023 Nov 23]. Working Together for One Health. Available from: <https://www.cdc.gov/onehealth/in-action/working-together-for-one-health.html>.
 21. Centers for Disease Control and Prevention [Internet]. Atlanta: The Organization; 2023 [cited 2023 Nov 23]. One Health Basics. Available from: <https://www.cdc.gov/onehealth/basics/index.html>.
 22. Arguin PM, Marano N, Freedman DO. Globally mobile populations and the spread of emerging pathogens. *Emerg Infect Dis.* 2009;15(11):1713–1714. <https://doi.org/10.3201/eid1511.091426>.
 23. Rabinowitz PM, Natterson-Horowitz BJ, Kahn LH, Kock R, Pappaioanou M. Incorporating one health into medical education. *BMC Med Educ.* 2017;17:45. <https://doi.org/10.1186/s12909-017-0883-6>.
 24. United Nations Environment Programme and International Livestock Research Institute [Internet]. Nairobi; 2020 [cited 2023 Nov 1]. Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission. Available from: <https://unsdg.un.org/sites/default/files/2020-07/UNEP-Preventing-the-next-pandemic.pdf>.
 25. Rohr JR, Barrett CB, Civitello DJ, Craft ME, Delius B, DeLeo GA, et al. Emerging human infectious diseases and the links to global food production. *Nat Sustain.* 2019;2: 445–456. <https://doi.org/10.1038/s41893-019-0293-3>.
 26. Webster JP, Gower CM, Knowles SCL, Molyneux DH, Fenton A. One health – an ecological and evolutionary framework for tackling Neglected Zoonotic Diseases. *Evol Appl.* 2016;9:313–333. <https://doi.org/10.1111/eva.12341>.
 27. Natterson-Horowitz B, Desmarchelier M, Winkler AS, Carabin H. Beyond Zoonoses in One Health: Non-communicable Diseases Across the Animal Kingdom. *Front Public Health.* 2022;9. <https://doi.org/10.3389/fpubh.2021.807186>.
 28. Kabir A, Karim MN, Islam RM, Romero L, Billah B. Health system readiness for non-communicable diseases at the primary care level: a systematic review. *BMJ Open.* 2022;12(2): e060387. <https://doi.org/10.1136/bmjopen-2021-060387>.
 29. Budreviciute A, Damiati S, Sabir DK, Onder K, Schuller-Goetzburg P, Plakys G, et al. Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. *Front Public Health.* 2020;8:574111. <https://doi.org/10.3389/fpubh.2020.574111>.
 30. Wang Y, Wang J. Modelling and prediction of global non-communicable diseases. *BMC Public Health.* 2020; 20:822. <https://doi.org/10.1186/s12889-020-08890-4>.
 31. Peterson JK, Bakuza J, Standley CJ. One Health and Neglected Tropical Diseases – Multisectoral Solutions to Endemic Challenges. *Trop Med Infect Dis.* 2021;6(4). <https://doi.org/10.3390/tropicalmed6010004>.

32. World Health Organization [Internet]. Geneva: The Organization [cited 2023 Nov 18]. Antimicrobial resistance. Available from: <https://www.who.int/health-topics/anti-microbial-resistance>.
33. Komisja Europejska. Przedstawicielstwo Polskie [Internet]. Warsaw: The Organization; 2022 [cited 2023 Nov 23]. Jedno zdrowie. Available from: https://poland.representation.ec.europa.eu/news/jedno-zdrowie-2022-11-17_pl.
34. Jim O'Neill [chaired]. Tackling drug-resistant infections globally: final report and recommendations [Internet]. Melbourne: Government of the United Kingdom; 2016 [cited 2024 May 9]. Available from: <https://apo.org.au/node/63983>.
35. European Environment Agency [Internet]. Copenhagen: The Organization; 2020 [cited 2023 Nov 23]. Biodiversity-ecosystems. Available from: <https://www.eea.europa.eu/pl/themes/biodiversity/intro>.
36. European Environment Agency [Internet]. Copenhagen: The Organization; 2020 [cited 2023 Nov 23]. Why do we need decisive action today to protect nature? What is at stake and how can we face the biodiversity crisis? Available from: <https://www.eea.europa.eu/pl/themes/biodiversity/>.
37. FAO. Forests for a better world [Internet]. Rome: Unasylva. 2022;253(73) [cited 2023 Nov 23]. <https://doi.org/10.4060/cc3427en>.
38. Pawankar R, Akdis CA. Climate change and the epithelial barrier theory in allergic diseases: A One Health approach to a green environment. *Allergy*. 2023;78:2829–2834. <https://doi.org/10.1111/all.15885>.
39. Brymer E, Freeman E, Richardson M. Editorial: One Health: The Well-being Impacts of Human-Nature Relationships. *Front Psychol*. 2019;10:1611. <https://doi.org/10.3389/fpsyg.2019.01611>.
40. Queensland Brain Institute [Internet]. Queensland: The Organization; 2023 [cited 2024 Apr 27]. Half the population to have a mental health disorder by 75. Available from: <https://qbi.uq.edu.au/article/2023/07/half-population-have-mental-health-disorder-75>.
41. Weatherly C, Carag J, Zohdy S, Morrison M. The mental health impacts of human-ecosystem-animal relationships: A systematic scoping review of Eco-, Planetary, and One Health approaches. *One Health*. 2023;17:100621. <https://doi.org/10.1016/j.onehlt.2023.100621>.
42. Kumar P, Brander L, Kumar M, Cuijpers P. Planetary Health and Mental Health Nexus: Benefit of Environmental Management. *Ann Glob Health*. 2023;89(1):49. <https://doi.org/10.5334/aogh.4079>.
43. Myers SS. Planetary health: protecting human health on a rapidly changing planet. *Lancet*. 2017;390(10114):2860–2868. [https://doi.org/10.1016/S0140-6736\(17\)32846-5](https://doi.org/10.1016/S0140-6736(17)32846-5).
44. Agache I, Sampath V, Aguilera J, Akdis CA, Akdis M, Barry M, et al. Climate change and global health: A call to more research and more action. *Allergy*. 2022;77:1389–1407. <https://doi.org/10.1111/all.15229>.
45. Tamers SL, Chosewood LC, Childress A, Hudson H, Nigam J, Chang C, et al. Total Worker Health® 2014–2018: The Novel Approach to Worker Safety, Health, and Well-Being Evolves. *Int J Environ Res Public Health*. 2019;16(3):321. <https://doi.org/10.3390/ijerph16030321>.
46. Di Prinzio RR, Cicchetti A, Marazza M, Magnavita N, Rossi P, Chirico P, et al. Return-on-Investment of Workplace Health Promotion programs: New Total Worker Health® strategies in the framework of the “One Health” approach. *J Health Soc Sci*. 2022;7(4):355–362. <https://doi.org/10.19204/2022/RTRN1>.
47. Mobo BHP, Rabinowitz PM, Conti LA, Taiwo OA. Occupational Health of Animal Workers. *Hum Anim Med*. 2010;343–371. <https://doi.org/10.1016/B978-1-4160-6837-2.00012-9>.
48. Lee MP, Hudson H, Richards R, Chang CC, Chosewood LC, Schill AL, et al. Fundamentals of total worker health approaches: essential elements for advancing worker safety, health, and well-being [Internet]. Cincinnati: OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 2016 [cited 2024 May 9]. Available from: https://www.cdc.gov/niosh/docs/2017-112/pdfs/2017_112.pdf?id=10.26616/NIOSH PUB2017112.
49. Harvard T.H. Chan School of Public Health. Center for Work, Health and Well-being [Internet]. Boston: The Organization [cited 2024 Apr 22]. NIOSH Centers of Excellence for Total Worker Health. Available from: <https://centerforworkhealth.sph.harvard.edu/resources/niosh-centers-excellence-total-worker-health>.
50. John P, Jha V. Heat Stress: A Hazardous Occupational Risk for Vulnerable Workers. *Kidney Int Rep*. 2023;8(7):1283–1286. <https://doi.org/10.1016/j.ekir.2023.05.024>.
51. Elnaiem A, Mohamed-Ahmed O, Zumla A, Mecaskey J, Charron N, Abakar MF, et al. Global and regional governance of One Health and implications for global health security. *Lancet*. 2023;401(10377):688–704. [https://doi.org/10.1016/S0140-6736\(22\)01597-5](https://doi.org/10.1016/S0140-6736(22)01597-5).
52. One Health Commission [Internet]. Apex: The Organization [cited 2023 Nov 23]. What is One Health? Available from: https://www.onehealthcommission.org/en/why_one_health/what_is_one_health/.
53. Chaddock M. Academic veterinary medicine and One Health education: it is more than clinical applications. *J Vet Med Educ*. 2012;39(3):241–246. <https://doi.org/10.3138/jvme.0612-062>.

54. Jato-Espino D, Mayor-Vitoria F, Moscardó V, Capra-Ribeiro F, Bartolomé del Pino LE. Toward One Health: a spatial indicator system to model the facilitation of the spread of zoonotic diseases. *Front Public Health*. 2023;11:1215574. <https://doi.org/10.3389/fpubh.2023.1215574>.
55. Food and Agriculture Organization of the United Nations [Internet]. Rome: The Organization [cited 2023 Nov 23]. One Health. Available from: <https://www.fao.org/one-health/en>.
56. The Ocean Foundation [Internet]. Washington: The Organization [cited 2023 Nov 18]. Sustainable aquaculture. Available from: <https://oceanfdn.org/pl/sustainable-aquaculture/>.
57. Laing G, Vigilato MAN, Cleaveland S, Thumbi SM, Blumberg L, Salahuddin N, et al. One Health for neglected tropical diseases. *Trans R Soc Trop Med Hyg*. 2021;115(2):182–184. <https://doi.org/10.1093/trstmh/traa117>.
58. Center for One Health Research [Internet]. Washington: The Organization [cited 2023 Nov 23]. Education and Training. Available from: <https://deohs.washington.edu/cohr/training>.
59. Wai-Loon HC. Operationalizing “One Health” as “One Digital Health” Through a Global Framework That Emphasizes Fair and Equitable Sharing of Benefits From the Use of Artificial Intelligence and Related Digital Technologies. *Front Public Health*. 2022;10. <https://doi.org/10.3389/fpubh.2022.768977>.
60. Thong BY, Pawankar R. APAAACI 2023 International Conference: The innovation revolution in allergy, asthma, and immunology. *Asia Pac. Allergy*. 2023;13(4):139–141. <https://doi.org/10.5415/apallergy.000000000000130>.
61. Wahl B, Cossy-Gantner A, Germann S, Schwalbe NR. Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings? *BMJ Glob Health*. 2018;3:e000798. <https://doi.org/10.1136/bmjgh-2018-000798>.
62. Caceres-Escobar H, Maiorano L, Rondinini C, Cimatti M, Morand S, Zambrana-Torrel C, et al. Operationalizing One Health: Environmental Solutions for Pandemic Prevention. *EcoHealth*. 2023;20:156–164. <https://doi.org/10.1007/s10393-023-01644-9>.