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Epizootiological and epidemiological aspects of chlamydiosis in Ukraine

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Chlamydiosis is a common infectious disease in animals that has a significant economic impact on livestock farming and poses a potential threat to human health. The pathogens *Chlamydia abortus*, *Ch. psittaci*, and *Ch. pecorum* cause abortions, infertility, encephalomyelitis, respiratory and eye lesions in various animal species. Of particular concern is the ability of these pathogens to remain latent, persist in the body, and be transmitted to humans, which makes chlamydiosis an important component of the "One Health" concept. In Ukraine, despite the availability of data on sporadic cases, systematic epizootiological assessment of the spread of chlamydiosis among animals is limited. The aim of the study was to summarize the results of the diagnosis in animals and humans in Ukraine for the period 2005–2024, to identify patterns of its spread, and to assess trends in morbidity. The study was based on data from state reports of veterinary medicine laboratories, results from the State Scientific and Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise, and statistics from the Public Health Center of the Ministry of Health of Ukraine. Descriptive statistics, Klopper–Pearson confidence intervals (95% CI), and geoinformation mapping were used for the analysis. Between 2005 and 2024, the veterinary medicine service tested 246,387 serum samples and biomaterials, of which 2,775 (BCI, 1.1–1.2%) were positive. The highest number of positive results was recorded in cattle – 1,397 (BCI, 48.5–52.2%), pigs – 883 (BCI, 30.1–33.4%), small ruminants – 472 (BCI, 15.6–18.5%), as well as in horses – 29 (BCI, 0.7–1.5%), cats – 13 (BCI, 0.2–0.8%), and dogs – 12 (BCI, 0.2–0.7%). High seropositivity rates were recorded in Vinnytsia, Cherkasy, Kharkiv, Poltava, and Chernihiv regions. Peaks in animal morbidity were observed in 2007– 2008, 2010–2011, 2016–2017, and 2020–2021. Among the human population of Ukraine, 428,177 cases of chlamydiosis were registered during the same period, with the annual number of cases decreasing almost 12-fold – from 34,149 (BCI, 7.9–8.1%) in 2005 to 2,857 (BCI, 0.6–0.7%) in 2024. Women and men aged 20–34 were more likely to get sick (with a higher number of diagnoses among women). Infection trends show that there is basically no zoonotic transmission of the pathogen from animals to humans. The results obtained indicate a stable, albeit uneven, spread of chlamydia among animals and a gradual decline in incidence among humans. Improving the effectiveness of monitoring, expanding diagnostic capabilities, and intersectoral cooperation between veterinary and medical services are key conditions for the prevention and control of this disease in Ukraine.

Keywords: *Chlamydia* spp.; epizootic and epidemic situation; humans; farm animals; serological studies; mapping.

Introduction

Chlamydia are immobile, gram-negative, very small, obligate intracellular bacteria. Their cell wall resembles that of gram-negative bacteria, but contains only traces of peptidoglycan. They undergo a characteristic development cycle and are extracellular round or oval highly infectious elementary bodies with a diameter of 0.2–0.6 μm. The latter enter cell vacuoles by endocytosis. There, they develop into vegetative, non-infectious pleomorphic reticular bodies (0.5–1.5 μm in diameter), which divide by binary fission and are metabolically active. Over time, the vacuole fills with more than 1000 intracytoplasmic inclusions, but does not fuse with cellular lysosomes due to an inhibitory mechanism produced by chlamydia. This vacuole is a characteristic morphological feature of infected cells and can be used for microscopic diagnosis. The reticular bodies then differentiate through intermediate condensing forms into mature infectious bodies, which are released when their membranes and host cell membranes rupture, thus beginning a new cycle (Tantengco, 2022; Caspe & Hill, 2024).

In 1999, representatives of the genus *Chlamydia* were divided into two genera, *Chlamydia* and *Chlamydophila*. However, the subsequently reclassified single genus *Chlamydia* included a total of 14 species (*Chlamydia trachomatis*, *Ch. pneumoniae*, *Ch. psittaci*, *Ch. abortus*, *Ch. suis*, *Ch. pecorum*, *Ch. avium*, *Ch. caviae*, *Ch. muridarum*, *Ch. felis*, *Ch. gallinacea*, *Ch. serpentis*, *Ch. poikilothermis*, and *Ch. buteonis*) (Sachse et al., 2015; Polkinghorne & Branley, 2020). Of all these species, only two (*Ch. trachomatis* and *Ch. pneumoniae*) are clinically significant to humans, and two (*Ch. psittaci* and *Ch. abortus*) are zoonotic.

Chlamydia trachomatis is the most common bacterial cause of sexually transmitted diseases (STDs) in humans and also causes trachoma (keratoconjunctivitis). Chronic and recurrent infections can lead to irreversible damage, including tubal infertility in women and blindness (trachoma) after infection of the eyes. Complications may include reactive arthritis, probably related to the immune response to infection. *Chlamydia pneumoniae* can cause irreversible damage, including tubal infertility in women and blindness. It is a recognized causative agent of community-acquired pneumonia. It causes infection in the upper and lower respiratory tract. Repeated or prolonged exposure to *Ch. pneumoniae* is associated with symptoms of asthma and chronic infection, which can lead to the development of airway obstruction in non-atopic bronchial asthma. In animals and birds, *Ch. psittaci* (in birds), *Ch. abortus* (in rats), and *Ch. felis* (in cats) are found. The primary host of *Ch. pneumoniae* is humans, but sporadic cases of the disease have been reported in koalas, horses, snakes, turtles, iguanas, chameleons, and frogs. However, these isolates have been found to be specific to animal biovars; therefore, *Ch. pneumoniae* is not considered a zoonotic bacterium (Sachse et al., 2018; Cheong et al., 2019).

Psittacosis in humans (also known as ornithosis or parrot fever) is an important zoonosis caused by *Ch. psittaci*. The reservoirs of *Ch. psittaci* are birds (including parrots, poultry, pigeons, and other ornamental birds) and even mammals (Hogerwerf et al., 2017). Direct contact with infected birds and mammals, exposure to their feces and respiratory secretions, and inhalation of contaminated aerosols can lead to psittacosis in humans (Gu et al., 2020). Human-to-human transmission of this pathogen is rare (Balsamo et al., 2017).

Outbreaks of the disease have been reported in wild birds. *Ch. psittaci* can infect mammals, including humans who have been in contact with birds or have been in a contaminated environment. Some infections in humans are subclinical; however, both mild and severe forms of the disease have been observed. In pregnant women, infection can lead to fetal death. Researchers note that *Ch. psittaci* infections may be underdiagnosed in some populations and in humans. For example, poultry farm workers may be exposed to this pathogen on a regular basis. It has also been reported that the causative agent of avian chlamydiosis can cause reproductive losses, eye disease, or respiratory lesions in ruminants, horses, and domestic animals. *Ch. avium* and *Ch. gallinacea* have not yet been sufficiently studied. *Ch. avium* has been detected in pigeons, with some birds of this species showing no clinical signs of disease though the pathogen was isolated from these birds. This pathogen is often isolated from parrots. *Ch. gallinacea* was first detected in domestic poultry flocks associated with chlamydiosis in humans, and it is suspected that this pathogen is primarily adapted to the human body. *Ch. gallinacea* can also infect humans. There are reports in the literature of cases of atypical pneumonia in slaughterhouse workers who processed poultry. There have been no reports of *Ch. avium* infecting humans. *Ch. psittaci* is found worldwide. *Ch. gallinacea* has been described in Europe, China, and Australia, and *Ch. avium* – in Europe (Tantengco, 2022; Caspe & Hill, 2024).

In recent years, between 70 and 200 annual outbreaks of psittacosis in parrots and approximately 10 to >100 cases of psittacosis / ornithosis in other species have been officially registered. Strains isolated from parrots are particularly virulent to humans. People usually become infected through direct contact with infected birds or from the environment when they inhale contaminated dust, small feathers, and aerosolized secretions. Human-to-human transmission is rare, but such cases have been described in the literature. There have been reports of the pathogen spreading within families when an infected person (who was a hospital worker) coughed (via aerosol). There have also been reports of patients becoming infected after sharing a room with an infected person. There is also evidence of *Ch. psittaci* transmission through egg consumption (Vanrompay et al., 1995; Caspe & Hill, 2024).

The leading source of *Ch. abortus* for healthy sheep and humans is abortive biomaterials from sheep. Significant amounts of chlamydia can be detected in vaginal secretions (Pospischil et al., 2002; Essig & Longbottom, 2015). In humans, *Ch. abortus* can cause flu-like syndromes with thrombocytopenia and coagulopathies, conjunctivitis, chronic genital tract infections, septicemia with impaired lung, liver, and kidney function (Pospischil et al., 2002; Knittler & Sachse, 2015). People with psittacosis may experience a variety of clinical manifestations, including subclinical or flu-like symptoms (mild psittacosis), pneumonia (moderate psittacosis), severe pneumonia (severe psittacosis), and severe pneumonia complicated by multiple organ dysfunction syndrome (MODS, fulminant psittacosis) (Gu et al., 2021; Su et al., 2021; Wang et al., 2024). *Ch. psittaci* can affect organs other than the respiratory system, leading to myocarditis, endocarditis, hepatitis, encephalitis, or meningitis. Renal and neurological complications may also occur. Very young and elderly people, as well as people with weakened immune systems, are most at risk of severe consequences of infection (Collina et al., 2012; Vande et al., 2018).

There are undiscovered species of chlamydia in nature. New species of chlamydia have been isolated from wild roe deer (*Capreolus capreolus*) and sick Siamese crocodiles raised on farms (*Crocodylus siamensis*). A new species, *Ch. sanzinia*, has also been isolated from snakes. Although *Ch. trachomatis* is the main cause of sexually transmitted bacterial diseases in humans, other species such as *Ch. abortus*, *Ch. pneumoniae*, *Ch. felis*, *Ch. suis*, and *Ch. psittaci* are also significant zoonotic pathogens (Pichon et al., 2020; Gong et al., 2023; Wolff et al., 2023).

At least 32 species of mammals, including ruminants, horses, cats, dogs, pigs, and guinea pigs, shed chlamydia that is pathogenic to humans. Human infection occurs infrequently, as a result of contact with infected animals and their excrement. The literature describes cases of disease caused by *Ch. abortus* in humans, all of which were associated with contact with small ruminants. *Ch. felis*, *Ch. suis*, and *Ch. pecorum* can also cause disease in humans. *Ch. suis* has also been detected by PCR or cell culture in swabs or materials from the eyes, nose, and throat, fecal samples from pig farmers, and the conjunctiva of pig slaughterhouse workers. *Ch. caviae* has been detected by PCR in materials from the eyes of a person who worked with infected guinea pigs. *Ch. pneumoniae* can persist in both humans and animals (koalas). *Ch. felis*, *Ch. pneumoniae*, *Ch. pecorum*, and *Ch. suis* are found worldwide. *Ch. abortus* has been described in almost all countries where sheep are kept. However, there are no reports of the pathogen being registered in Australia or New Zealand. There is no information in the specialized literature on the distribution of *Ch. caviae* or *Ch. muridarum*, but they are probably quite widespread (Pospischil, 2009; Tantengco, 2022). In general, *Ch. psittaci* and *Ch. abortus* are well-known zoonotic pathogens (Szymańska-Czerwińska & Niemczuk, 2016; Borel et al., 2018; Turin et al., 2022), other species, such as *Ch. felis*, *Ch. caviae*, *Ch. gallinacea*, and *Ch. suis*, have also been identified as possible zoonotic agents capable of causing respiratory and ocular infections in humans (De Puysseleyr et al., 2014; Kieckens et al., 2018). *Ch. abortus* infections have been associated with close contact between pregnant farm workers and small ruminants. Clinical symptoms include fever, headache, dry cough, septic shock, severe thrombocytopenia, and abortion (Reid et al., 2017; Burgener et al., 2022). Lesions found in human placentas are very similar to those seen in typical chlamydiosis in sheep, particularly purulent necrotic placentitis (Johnson et al., 1985; Walder et al., 2003).

Based on the above, the task of this research was studying the epizootic and epidemiological situation with chlamydia in animals and humans in Ukraine and identifying possible zoonotic aspects of this dangerous disease. The epizootic and epidemiological situation with *Chlamydia* in Ukraine was studied over a 20-year period (from 2005 to 2024).

Materials and methods

The authors conducted a retrospective analysis of the epizootic and epidemiological situation regarding chlamydiosis in animals and humans in Ukraine for the period 2005–2024. For this purpose, reports from regional laboratories of the State Service of Ukraine for Food Safety and Consumer Protection and data obtained from the State Scientific and Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise (SSRILDVSE, Kyiv) (report form 2-vet.) for a period of 20 years were studied, analyzed, and systematized. A retrospective analysis of the epidemiological situation of chlamydiosis among people in Ukraine for 2005–2024 was also conducted. For this purpose, data from reports of the Public Health Center of the Ministry of Health of Ukraine were analyzed.

Numerical data presented without taking into account the occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol, and part of the temporarily occupied territories of Donetsk and Luhansk regions. In our work, we focused on analyzing the possible zoonotic component of this disease (the possibility of transmission of the chlamydia pathogen from animals and birds to humans). The diagnosis of chlamydiosis (ornithosis) in animals (cattle, sheep, pigs, horses, etc.) was confirmed by serological methods using CFT and ELISA, and the diagnosis in humans was confirmed using

ELISA and PCR. Information about the total number of susceptible animals was obtained from the State Statistics Service of Ukraine (http://ukrstat.gov.ua). Statistical data were performed by the binomial confidence intervals (BCI) that were calculated to assess a seroprevalence using the Clopper-Pearson exact method with a confidence level of 0.95 using the R epitools software package (Ausvet, version 2020, Australia) (https://epitools.ausvet.com.au). Mapping was presented in the software Quantum GIS 3.16.0 (International Quantum GIS Project, 2020, Germany), which is free on the website (www.qgis.org/ru/site/forusers/download.html). The vector layers for the borders of Ukraine's regions were downloaded from the site www.diva-gis.org/Data. Quantile classification with 5 classes of the data was chosen. With this classification, an equal count of oblasts fall into each class.

Results

Between 2005 and 2024, the veterinary medicine service examined 246,387 serum samples and biological materials. The largest number of tests on chlamydia were conducted in Poltava (54,954 samples), Cherkasy (38236), Kharkiv (22755), Vinnytsia (17,840 samples), Dnipropetrovsk (12,315), and Odesa (11,318) regions. By year, as shown on Figure 1, the vast majority of biological materials were tested in the periods from 2005 to 2008 and from 2010 to 2014. At the same time, over the last 4 years of the analyzed period (2021–2024), the minimum number of samples was tested, namely 5459, 4397, 2804, and 1949, respectively. In total, out of 246,387 tests, 2,775 or 1.1% (BCI, 1.1–1.2%) were positive. The minimum number of positive samples (within 10) was found in 2015, 2022, and 2024. At the same time, a significant number of positively reacting animals were registered in 2008 (602 samples – BCI, 20.1–23.3%), 2010 (341 – BCI, 11.1–13.6%), 2007 (271 – BCI, 8.7–10.9%), 2017 (253 samples – BCI, 8.1–10.2%), 2011 (242 – BCI, 7.7–9.8%), and 2006 (188 – BCI, 5.9–7.8%) (Fig. 1). Thus, the peaks of seropositivity occurred in 2007–2008, 2010–2011, 2016–2017, 2020–2021, and 2023. The graph shows jagged trends in the number of samples tested, i.e., sporadic outbreaks are observed.

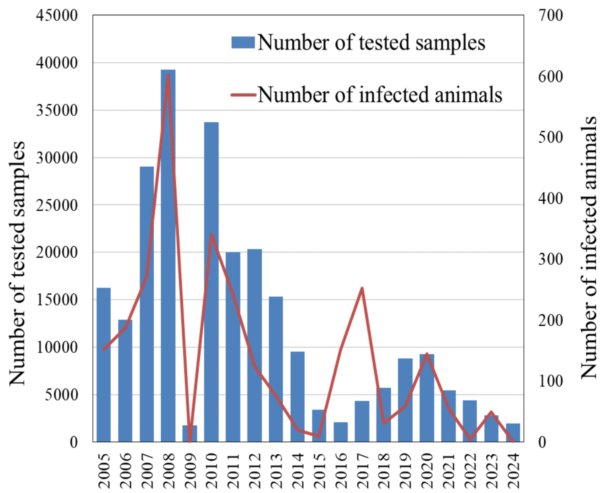

Fig. 1. Dynamics of the number of tested samples from animals on chlamydiosis and number of infected animals in Ukraine (2005–2024 years)

As for the regions, the vast majority of positive responses from the number of respondents surveyed in the region were from Kyiv – 28.4% (BCI, 27.9–28.5%), Kharkiv – 4.6% (BCI, 4.4–4.9%), Cherkasy – 2.1% (BCI, 1.9–2.2%), Chernihiv – 1.8% (BCI, 1.6–2.0%), Sumy – 1.2% (BCI, 1.2–1.3%), Khmelnytskyi – 1.2% (BCI, 1.1–1.2%), Kirovohrad – 1.1% (BCI, 0.9–1.2%), Kherson – 1.1% (BCI, 1.0–1.1%), Vinnytsia – 0.7% (BCI, 0.6–0.9%), and Poltava – 0.2% (BCI, 0.2–0.3%) regions (Fig. 2).

Of the 2,775 positive samples detected over the entire study period 2005–2024, 1,397 were detected in cattle (50%, BCI 48.5–52.2%), 883 in pigs (31%, BCI 30.1–33.4%), 472 in small ruminants (17%, BCI 15.6–18.5%), 29 in horses (1%, BCI 0.7–1.5%), 13 in cats (0.5%, BCI 0.2–0.8%), and 12 positives in dogs (0.4%, BCI 0.2–0.7%) (Fig. 3).

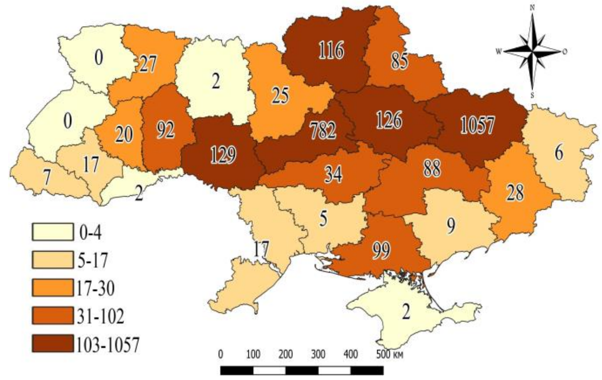

Fig. 2. Map of the distribution of animal chlamydiosis cases in Ukraine (2005–2024 years)

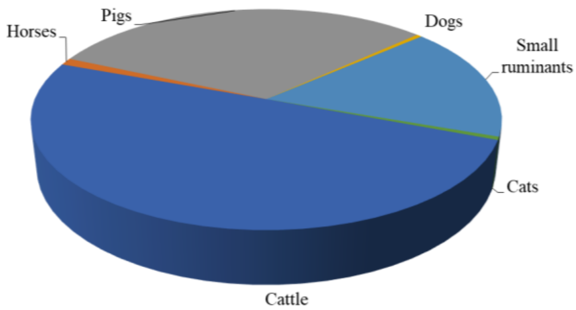

Fig. 3. Nosological structure of animal chlamydiosis in Ukraine (2005–2024 years)

The authors also conducted a retrospective analysis of the epidemiological situation regarding chlamydiosis among people in Ukraine for the period 2005–2024. According to data from the Public Health Center of the Ministry of Health of Ukraine, diagnoses of chlamydia among people during the aforementioned period were registered in all regions of Ukraine. For convenience, we combined the registration of chlamydia outbreaks in men and women. It was found that 428,177 cases of this pathology were registered in humans during the period 2005–2024. High incidence rates were recorded mainly in the eastern and southern regions of the country. At the same time, this indicator is slightly lower in the western and northern regions. In particular, 67,952 cases were registered in Dnipropetrovsk region (BCI 15.8–16.0%), 49395 in Kharkiv region (BCI 11.4–11.6%), 46261 in Odesa region (BCI 10.7–10.9%), Kyiv region – 45,159 (BCI 10.4–10.6%), Kherson region – 38,401 (BCI 8.9–9.1%), AR Crimea – 18,651 (BCI 4.3–4.4%), Poltava – 18,524 (BCI 4.3–4.4%), Khmelnytskyi – 18,331 (BCI 4.2–4.3%), Donetsk – 17,708 (BCI 4.1–4.2%), Mykolaiv – 15,746 (BCI 3.6–3.7%), Rivne – 12,171 (BCI 2.8–2.9%) and Volyn regions – 11,881 cases (BCI 2.7–2.8%, Fig. 4).

The number of infected people is decreasing annually, indicating a trend toward improvement in the epidemiological situation regarding this disease. Thus, while 34,149 cases (BCI, 7.9–8.1%) were registered in 2005, only 2,857 cases (BCI, 0.6–0.7%) were registered in 2024. Overall, there has been a 12-fold decrease in incidence, but among women this figure has decreased 13.8-fold over the corresponding years, and among men – 11.4-fold (Fig. 5).

At the same time, age-related characteristics were observed. In particular, Fig. 6 and 7 show that the highest number of people with chlamydia is registered in the age groups 20–24 (BCI, 18.5–18.8%), 25–29 (BCI, 20.4–20.6%), and 30–34 (BCI, 16.8–17.1%) years of age, which is most likely related to the sexual activity of this age group. A slightly smaller number of patients were registered in the 35–39 (BCI, 11.9–12.1%) and 40–59 (BCI, 10.9–11.0%) age groups, and a negligible number of patients in the 15–19 (BCI, 3.5–3.6%) and

60 years and older (BCI, 1.4–1.5%) age groups. The data correlate for both female and male infections.

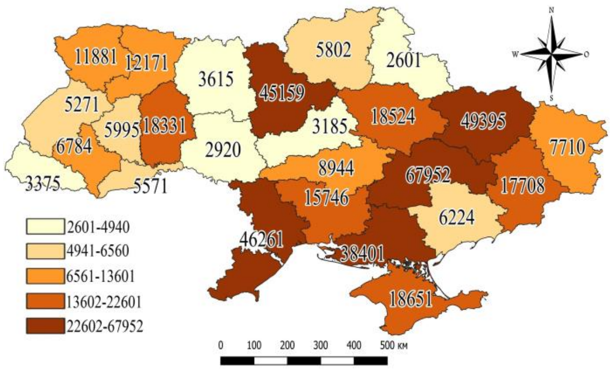

Fig. 4. Map of the distribution of chlamydiosis cases in humans in Ukraine (2005–2024)

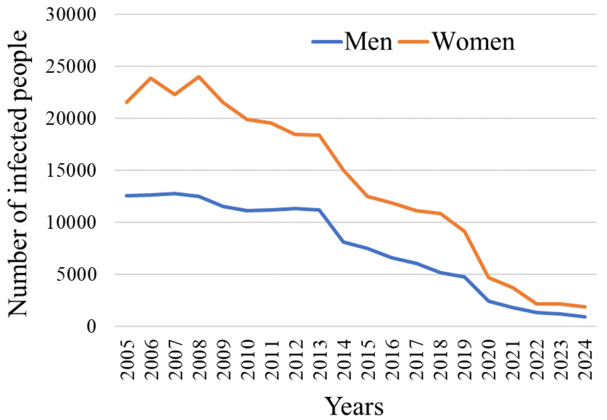

Fig. 5. Dynamics of the number of men and women infected with chlamydia in Ukraine (2005–2024 years)

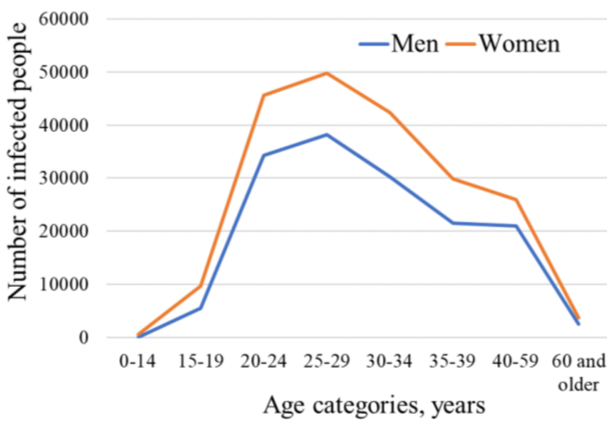

Fig. 6. Age-related characteristics of chlamydiosis among men and women in Ukraine (2005–2024)

Comparing the graphical trends of systematized data on the disease among animals and humans, we see that the incidence rates among animals are characterized by instability, since during the analyzed period there are four declines in trends to practically zero and five peaks in the incidence rate (Fig. 8). To compare the trend lines, the incidence among animals was multiplied by a conditional coefficient of 100, as the incidence of chlamydiosis among animals is indeed insignificant. We note the fact that there is practically no zoonotic transmission of the infectious agent from animals to humans. That is, in animal husbandry, we mainly register chlamydia specific to these species, while in humans, only human species of the pathogen are isolated. For example, during the period under review, 398 cases of ornithosis were registered in poultry, with positive cases detected in 2006 (17 cases), 2007 (2), 2008 (263), 2010 (82), 2012 (11), 2013 (2), 2016 (1), and 2020 (20). At the same time, among the humans, this species of chlamydia (*Ch. psittaci*)has been registered in only one patient from Donetsk region (in 2018) over the past 10 years.

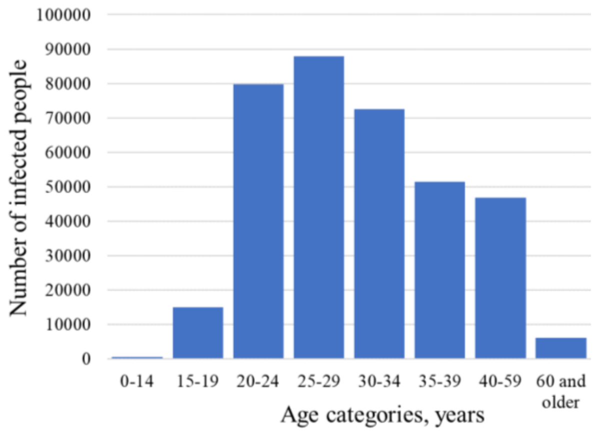

Fig. 7. Age-related characteristics of chlamydiosis among people in Ukraine (2005–2024)

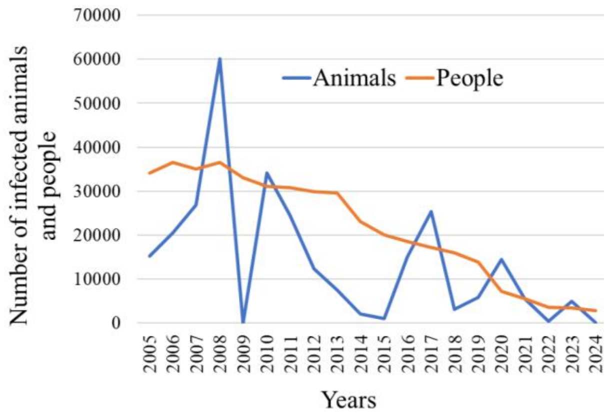

Fig. 8. Dynamics of the number of animals and people infected with chlamydia in Ukraine (2005–2024 years)

Discussion

The genus *Chlamydia* includes numerous obligate intracellular zoonotic pathogens that infect humans, vertebrates, including mammals, birds, and reptiles (Marti & Jelocnik, 2022). The species of *Chlamydia* is no exception to this trend. Recently, many new species of chlamydia and cases of interspecies transmission have been discovered. These infections are often associated with non-native animal species, occupational exposure, or ownership of exotic pets. Environments such as zoos, pet markets, and food markets, where animals from different ecosystems are kept in close proximity, further contribute to the spread of these pathogens. In addition, the global commercialization of wildlife and improved connectivity have accelerated the potential risk of chlamydiosis spread.

It is important to recognize that chlamydiosis in animals ranges from asymptomatic infection to severe disease, making detection difficult. Asymptomatic animals in endemic areas can transmit infections to other species, leading to serious or fatal disease. The discovery of new chlamydia species and the expansion of host ranges may create new zoonotic risks. For example, the detection of *Ch. abortus* in various bird species (avian *Ch. abortus*) raises concerns about its potential evolution in new epidemiological contexts. In addition, the ability of many chlamydia species to overcome host barriers highlights the need for improved diagnostic tools, surveillance, and control measures (Kasimov et al., 2023). Monitoring of chlamydiosis cases among animals in our country suggests that such work is being carried out on an ongoing basis. During the period under review (2005–2024), 246,387 blood serum samples and biological materials were tested from animals in Ukraine. The number of positive samples was 1.1% or 2,775 samples. A significant proportion of positive samples were found in the Kyiv, Vinnytsia, Poltava, Kharkiv, Cherkasy, Chernihiv, Kirovohrad, Sumy, Kherson, and Khmelnytskyi regions.

In total, during the research period from 2005 to 2024, we obtained 2,775 (BCI, 1.1–1.2%) positive results among animals, distributed as follows: 1,397 were detected in cattle (50%, BCI 48.5–52.2%), 883 in pigs (31%, BCI 30.1–33.4%), 472 in small ruminants (17%, BCI 15.6–18.5%), 29 in horses (1%, BCI 0.7–1.5%), 13 in cats (0.5%, BCI 0.2–0.8%), and 12 positive cases in dogs (0.4%, BCI 0.2–0.7%). In addition to the species of chlamydia that affect farm animals, the zoonotic potential of *Ch. felis* should be taken into account. Therefore, dogs and cats that are carriers of these microorganisms can pose a significant danger to humans. In our case, 12 and 13 positive cases were found in these species, respectively. However, these were selective studies of these animal species, only when the disease was suspected, since routine monitoring studies of these animal species are not conducted in our country. For comparison, in Hungary, researchers showed that the positivity rate was 33.3% (26/78) in cats and 40.0% (6/15) in dogs. In addition, 37.2% (16/43) of cats from a cat shelter, 42.4% (14/33) from a veterinary clinic, and 11.7% (2/17) of domestic pets were found to be positive (Ulbert et al., 2024). Domestic cats are becoming more popular as companion animals, but they are quite dangerous sources of chlamydia for humans. Zoonotic transmission is rarely confirmed, but the risk of infection in such situations is always present (Ulbert et al., 2024). In one study, *Ch. felis* was detected in three patients with clinical signs of conjunctivitis who had close contact with their cats. The data obtained demonstrate that zoonotic infections in atypical conjunctivitis require more sophisticated diagnostic methods (Hughes et al., 2024).

Conjunctivitis in cats and dogs can be caused by other types of chlamydia, namely *Ch. psittaci* and *Ch. pneumoniae* (Sanderson et al., 2021). According to several recent studies conducted in different countries (using PCR, DNA microchips, isolation, or immunofluorescence analysis), the prevalence of chlamydiosis among domestic cats ranges from 10% in asymptomatic animals to 6% to 31% in cats with conjunctivitis. It is precisely the asymptomatic course in these species that distracts our specialists from this problem. However, as monitoring studies of these species in other countries show, this species poses a significant danger to humans and the pathogen is quite common among cats. For example, in stray cat populations, the prevalence is generally higher: the overall positivity rate ranges from 24.4% to 35.7%, but in subgroups with conjunctivitis, it can reach 65.8% (Bressan et al., 2021). In recent studies conducted in China, the positivity rate was 11.8% in symptomatic stray cats (higher in the Jiading area: 23.5%) and 11.6% in symptomatic domestic cats (Chen et al., 2024; Yang et al., 2024). Although *Ch. pneumoniae* is primarily a common respiratory pathogen in humans, it can also infect many animals, including horses, cattle, cats, dogs, and various reptiles and amphibians (Ciuria et al., 2021). In animals, chlamydiosis can cause atypical pneumonia, enteritis, conjunctivitis, and endocarditis, with *Ch. abortus* and *Ch. psittaci* particularly common causes of intrauterine fetal death in mammals and birds (Wu et al., 2013; Ulbert et al., 2024). Further research, including parallel studies in humans and animals, is needed to better understand the risk of zoonoses.

As a zoonotic agent, *Ch. psittaci* is transmitted primarily through inhalation of contaminated aerosols of urine, dried feces, respiratory and ocular secretions from infected animals. At the same time, contact with the feathers and tissues of infected birds, as well as mouth-to-beak contact and bites from infected birds, also contribute to chlamydiosis infection. In addition, human-to-human transmission is a new and significant zoonotic risk (Wang et al., 2024). As the reported incidence of *Ch. psittaci* in birds worldwide is increasing (Yehia et al., 2023; Zhai et al., 2023)and there are a significant number of laboratory-confirmed cases of psittacosis in humans in many countries (Zhang et al., 2022; Liu et al., 2023), it is very important to draw the attention of the global community to this zoonotic pathogen and the potential risks it poses to public health. In our country, over a period of almost 10 years of observation, only one case of ornithosis among humans has been detected, which to some extent demonstrates the significant preventive effect of anti-epizootic and anti-epidemic measures and inter-sectoral cooperation between veterinary and medical services.

During the period we analyzed, human chlamydia infections were registered annually in all regions of Ukraine. In total, 428,177 cases of these pathologies were registered in humans during this period. Significant morbidity among humans was found in Dnipropetrovsk, Kharkiv, Odesa, Kyiv, Kherson, AR Crimea, Poltava, Khmelnytskyi, Donetsk, Mykolaiv, Rivne, and Volyn regions. There is a positive trend towards a decrease in the number of chlamydiosis cases among humans. Thus, between 2005 and 2024, the incidence of chlamydia in humans decreased almost 12-fold (cases of venereal lymphogranuloma decreased 13.8-fold in women and 11.4-fold in men). In our opinion, it is encouraging that zoonotic chlamydia pathogens are practically not isolated from infected humans. Zoonotic species worldwide, such as *Ch. felis*, *Ch. caviae*, *Ch. gallinacean*, and *Ch. suis*, usually cause conjunctivitis and atypical pneumonia in humans. *Ch. felis* infections have been reported in cat owners who have been in contact with cats with conjunctivitis and rhinitis (Halánová et al., 2019; Jazi et al., 2020), and in rare cases, they have been associated with glomerulonephritis and endocarditis (Regan et al., 1979). *Ch. caviae* infections have been detected in pet owners, although no clinical signs were observed in their pets (Ramakers et al., 2017; van Grootveld et al., 2018). In addition, *Ch. gallinacea* and *Ch. suis* cause infections in farmers and slaughterhouse workers (Donati et al., 2018; De Meyst et al., 2022; Marchino et al., 2022).

Therefore, active surveillance of chlamydial infections in animals and humans may be key to environmental sustainability. By applying a One Health approach, veterinarians, researchers, healthcare professionals, and policymakers can develop interdisciplinary (cross-sectoral) strategies to combat emerging and re-emerging diseases, using wildlife health as an important component of global disease prevention. This collaborative approach is vital for creating a more resilient and sustainable global health system (Caspe & Hill, 2024). Over the past decade, the One Health concept has become a globally accepted approach to identifying and combating zoonoses. The concept supports cross-sectoral collaboration between medical and veterinary professionals and the development of action plans to prevent zoonotic infections. Indeed, the World Health Organization (WHO) notes that many human infections are of zoonotic origin, posing significant public health challenges worldwide. In addition to direct contact with animals, zoonoses can also pose a serious risk to international trade and the production of animal products (Ahmed et al., 2019; van Herten et al., 2019; Origlia et al., 2023).

Conclusions

Between 2005 and 2024, the veterinary service in Ukraine tested 246,387 serum samples and biological materials from various animal species for chlamydia, of which 2,775 samples (1.1%) were positive. A significant number of sick animals were found in Vinnytsia, Poltava, Kharkiv, Cherkasy, Chernihiv, Kirovohrad, Sumy, Kherson, and Khmelnytskyi regions and in the city of Kyiv. Among animals, the largest number of cases was found among cattle (50%), pigs (31%), small ruminants (17%), and fewer among horses (1%), dogs (0.4%), and cats (0.5%).

Chlamydiosis in humans was registered in all regions of Ukraine during the specified period. It was established that over the past 15 years, 428,177 cases of these diseases have been detected in humans. The highest incidence among humans was registered in Dnipropetrovsk, Kharkiv, Odesa, and Kyiv regions (more than 40,000 cases in each). There is a trend of annual decrease in incidence among humans, as this indicator has decreased almost 12 times. At the same time, during the analyzed period, there were practically no cases of zoonotic chlamydiosis in Ukraine. Thus, in 2018, only one case of ornithosis in humans was confirmed.

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