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Characteristics of The Development of the COVID-19 Pandemic in Ukraine and Peculiarities of Epidemiologic Surveillance

In December 2019, the world faced a new challenge — an outbreak of the disease caused by the new SARS-CoV-2 coronavirus. On March 11, 2020, WHO declared the COVID-19 pandemic. In order to overcome it, previously tested strategies and measures of prevention and control were implemented, as well as the latest digital approaches, new political, diplomatic and socio-economic solutions were also applied, which, together with classical approaches, made it possible to finally overcome the spread of SARS-CoV-2 and the consequences of the COVID-19 pandemic.

Objective — to investigate the development of the pandemic of the acute respiratory disease COVID-19 caused by the new coronavirus SARS-CoV-2 in Ukraine and the organization of epidemiologic surveillance for COVID-19 in the country.

Materials and methods. An observational population study was conducted. Epidemiological, medical-statistical and bibliosemantic methods were used.

Results and discussion. The weekly morbidity rate varied from 8.28 to 371.39, mortality — from 0.26 to 11.19, lethality — from 1.29 to 5.93 %. The rate of increase/decrease of confirmed cases ranged from —60.92 to 101.21 %, deaths — from —53.66 to 131.25 %. In the age structure of those infected with COVID-19, the largest share is people aged 50—59 years old (18.3 %), among the dead — people > 70 years old (55.64 %). The highest mortality rate in the age group of ≥ 70 years old is 9.78 %. The morbidity rate by region ranged from 1.93 to 753.08, the mortality rate from 0.06 to 25.3. The Electronic Integrated Surveillance System for Infectious Diseases was launched in May 2020 to monitor COVID-19, and data exchange with the Electronic Health Care System was subsequently implemented.

Conclusions. The development and implementation of effective strategies to combat new infectious diseases, including preparedness and response plans, allow you to prepare for future epidemics and pandemics, an important role in this is played by data analysis, in particular the systematic collection, processing and interpretation of data, in order to assess the current situation and forecast and determine the effectiveness measures taken.

Keywords

COVID-19, pandemics, surveillance, morbidity, epidemiology.

In December 2019, the world faced a new serious challenge — the outbreak of the disease caused by the new SARS-CoV-2 coronavirus, which extremely quickly, compared to the previous SARS and MERS coronavirus epidemics, took on an epidemic and even pandemic character and covered most of the world's countries [5, 20].

On March 11, 2020, the World Health Organization declared a pandemic of COVID-19 [6, 11, 18]. In response to this situation, the WHO implemented a global system of surveillance for COVID-19, based on the International Health Regulations [11]. To contain the spread of the COVID-19 pandemic, many countries have introduced quarantines and

restrictions on international travel [15]. During the pandemic period (2020—2023), more than 687 million confirmed cases of this disease were registered worldwide, of which more than 6 million were fatal [10].

The dynamics and scope of the COVID-19 pandemic have affected all aspects of the health care system, including social determinants, public health, primary and specialty care, and policy decisions about resource allocation. In order to make decisions based on evidence and provide the necessary expertise, there is a significant need for modeling infectious diseases, risk assessment, and control measures [7].

Continuous improvement of preparedness and response capacity is critical to effective response to pandemics. This requires an integrated approach, covering the coordination of resources at all levels, the development of a powerful epidemiological and laboratory capacity, creating a reliable system of surveillance, early warning and rapid data analysis in order to provide timely information for making informed decisions [16].

The COVID-19 pandemic has demonstrated tangible consequences for public health and the impact on the socio-economic situation. No health care system in the world was fully prepared to deal with this crisis [12, 19].

The impact was less pronounced in some countries, but essential health services, from infection control and mental health, sexual and reproductive health, maternal and child health, to nutrition and immunization, were disrupted in countries at all income levels [19].

In order to overcome the pandemic, previously tested prevention and control strategies and measures were implemented, as well as a variety of new digital approaches, data collected regularly through electronic health systems, surveillance systems for identifying and reporting morbidity, and analysis in real time [8, 13, 17].

In the process of countering the challenges of the pandemic, new political, diplomatic and socio-economic solutions were also applied, which, together with classical approaches, made it possible to eventually overcome the spread of SARS-CoV-2 and the consequences of the COVID-19 pandemic.

Objective — to investigate the development of the pandemic of the acute respiratory disease COVID-19 caused by the new coronavirus SARS-CoV-2 in Ukraine and the organization of epidemiologic surveillance for COVID-19 in the country.

Materials and methods

An observational population study and a review of the literature on the topic were conducted. The object of the study: the epidemic process of the new coronavirus infection SARS-CoV-2 and the epidemiological surveillance of COVID-19.

Epidemiological, medical-statistical, and bibliosemantic research methods were used in the work, in particular, the method of graphical construction of time series, intensive and extensive indicators were calculated, and the national legislation of Ukraine on epidemiological surveillance of COVID-19 was studied. The growth rate was calculated as the ratio of the difference between the number of cases in the current week and the number of cases in the previous week to the previous number of cases in the previous week multiplied by 100 %.

Data from the Ministry of Health of Ukraine and the Public Health Center of the Ministry of Health of Ukraine were subject to study and analysis, in particular: «Operational information on the main indicators of the incidence of COVID-19 in Ukraine», «Epidemic situation regarding the spread of the coronavirus disease COVID-19 in Ukraine» and «Weekly Report on Public Health Risks» for the period from 02.11.2020 to 04.05.2023.

Data on the population for 2020—2021 were used from the website of the State Statistics Service of Ukraine. Similar data for 2022 and 2023 are not available due to the introduction of martial law in Ukraine.

Results and discussion

According to official statistics of the Ministry of Health of Ukraine, during the 2019 global pandemic of the coronavirus disease caused by SARS-CoV-2, 5,544,969 confirmed cases of COVID-19 were registered in Ukraine, of which 112,268 people died (Fig. 1).

The epidemic of COVID-19 cases was characterized by a wave-like nature, with a peak in the fifth week of 2022, when 242,942 cases of the disease were recorded. The weekly incidence rate of COVID-19 per 100,000 population ranged from 8.28 to 371.39. The growth/decrease rate ranged from –60.92 to 101.21 %.

The distribution of incidence by administrative territory showed considerable variation, with the weekly rate per 100,000 population ranging from 1.93 to 753.08 (Table).

An analysis of the age structure of persons who fell ill with COVID-19 indicates that the majority of cases (95.2 %) fell on the adult population (Fig. 2). Among people with a confirmed diagnosis of COVID-19, the largest share is people aged 50—59 (18.3 %). The age groups of 30—39, 40—49 and 60—69 years are in second place, each of which makes up 17.2 %. The third position is occupied by people over the age of 70, the share is 11.5 %, in the age group of 20—29 years — 9.9 %, and in the age

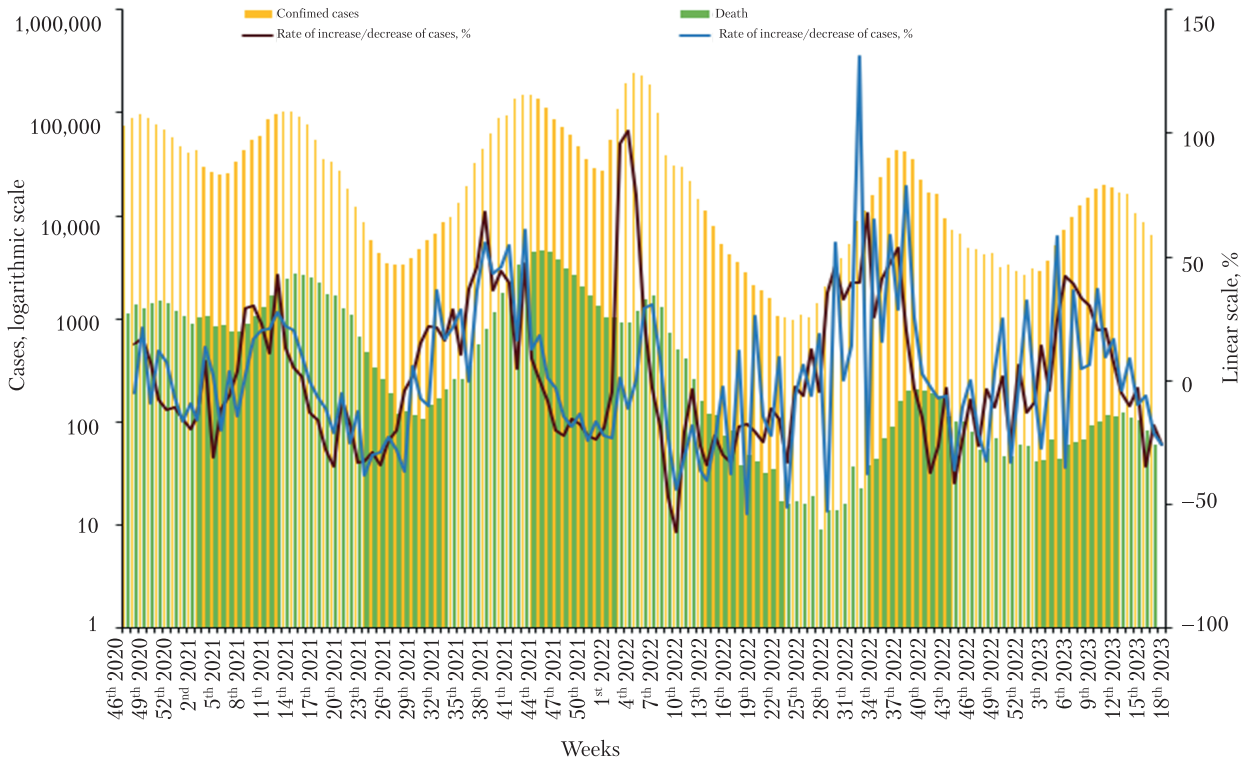

Fig. 1. **Confirmed cases of COVID-19 and deaths, Ukraine, November 02, 2020 — May 04, 2023**

Table. **Morbidity and mortality from COVID-19 by territory. Ukraine. November 02, 2020 — December 31, 2021***

Regions	Morbidity		Mortality	
	Minimum	Maximum	Minimum	Maximum
Kyiv city	34.49	371.70	0.21	12.26
Vinnytsia region	3.79	357.62	0.07	10.85
Volyn region	2.16	392.39	0.10	11.19
Dnipropetrovsk region	4.95	432.34	0.42	17.07
Donetsk region	3.76	180.28	0.12	8.11
Zhytomyr region	6.36	587.05	0.17	14.15
Transcarpathian region	1.93	307.58	0.08	8.05
Zaporizhzhia region	5.50	508.04	0.06	18.56
Ivano-Frankivsk region	2.52	379.66	0.07	11.27
Kyiv region	5.48	363.20	0.06	12.52
Kirovohrad region	2.01	148.56	0.11	7.91
Luhansk region	3.24	185.20	0.24	6.48
Lviv region	5.08	399.39	0.08	10.12
Mykolayiv region	7.42	592.24	0.18	19.25
Odesa region	8.20	543.17	0.21	13.97
Poltava region	6.92	576.37	0.15	18.37
Rivne region	3.24	492.49	0.09	11.83
Sumy region	8.90	712.09	0.10	19.74
Ternopil region	2.85	396.58	0.10	10.70
Kharkiv region	5.65	407.46	0.39	11.34
Kherson region	9.20	753.07	0.10	25.30
Khmelnytskyi region	4.00	543.87	0.16	13.14
Cherkasy region	7.86	409.83	0.09	14.09
Chernivtsi region	3.16	478.03	0.11	13.07
Chernihiv region	4.10	475.72	0.11	14.83

Note. * Data from the Autonomous Republic of Crimea and the city of Sevastopol are not available.

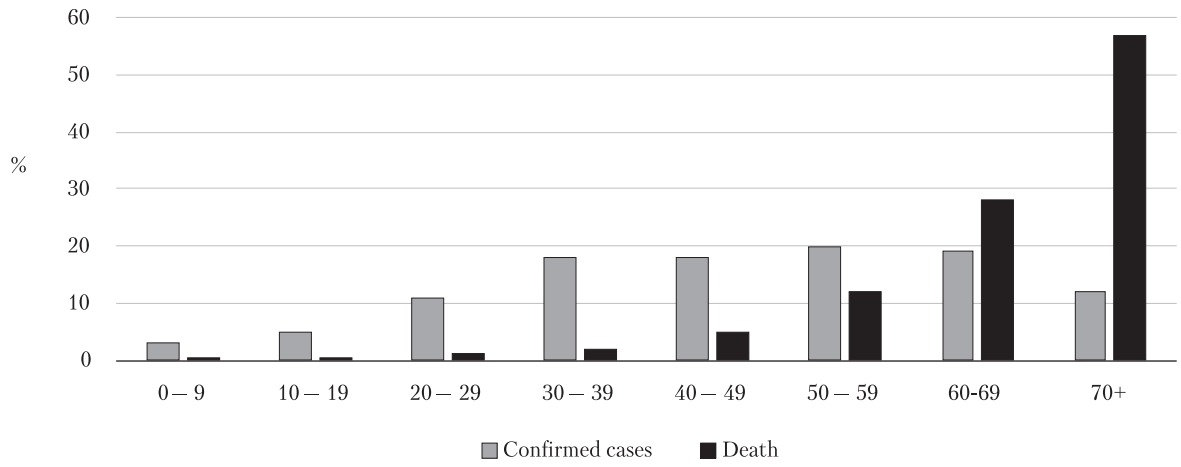

Fig. 2. **Structure of confirmed cases of COVID-19 and deaths by age, Ukraine, November 02, 2020 — May 04, 2023**

group of 10—19 years — 5.5 %. The fewest cases of the disease are observed among children under 9 years of age (3.3 %).

The incidence rate of COVID-19 per 100,000 population for different age groups showed significant fluctuations (Fig. 3). For children under 9 years old, it varied from 2.11 to 112.08, for persons aged 10—19 years — from 2.53 to 208.94, for the 20—29 year old group — from 7.35 to 359.95, for age category 30—39 years — from 8.32 to 395.09, for persons 40—49 years — from 8.73 to 427.38, for the group of 50—59 years — from 10.34 to 483.27, for persons 60—69 years old — from 10.96 to 498.58, and for people aged 70 and over — from 10.14 to 393.61.

The peak of deaths among confirmed cases of COVID-19 was recorded in week 45 of 2021, when 4,590 deaths were reported. The weekly death rate per 100,000 population varied from 0.26 to 11.19. The growth rate varied from —53.66 to 131.25 %.

According to data by administrative territory, the weekly death rate per 100,000 population varied from 0.06 to 25.3.

The share of people who died with confirmed SARS-CoV-2 infection by age group has the following distribution (Fig. 4): among people over 70 years old — 55.64 %, in the age group 60—69 years old — 27.51 %, 50—59 years old — 10.84 %, 40—49 years old — 4.04 %, 30—39 years old — 1.51 %,

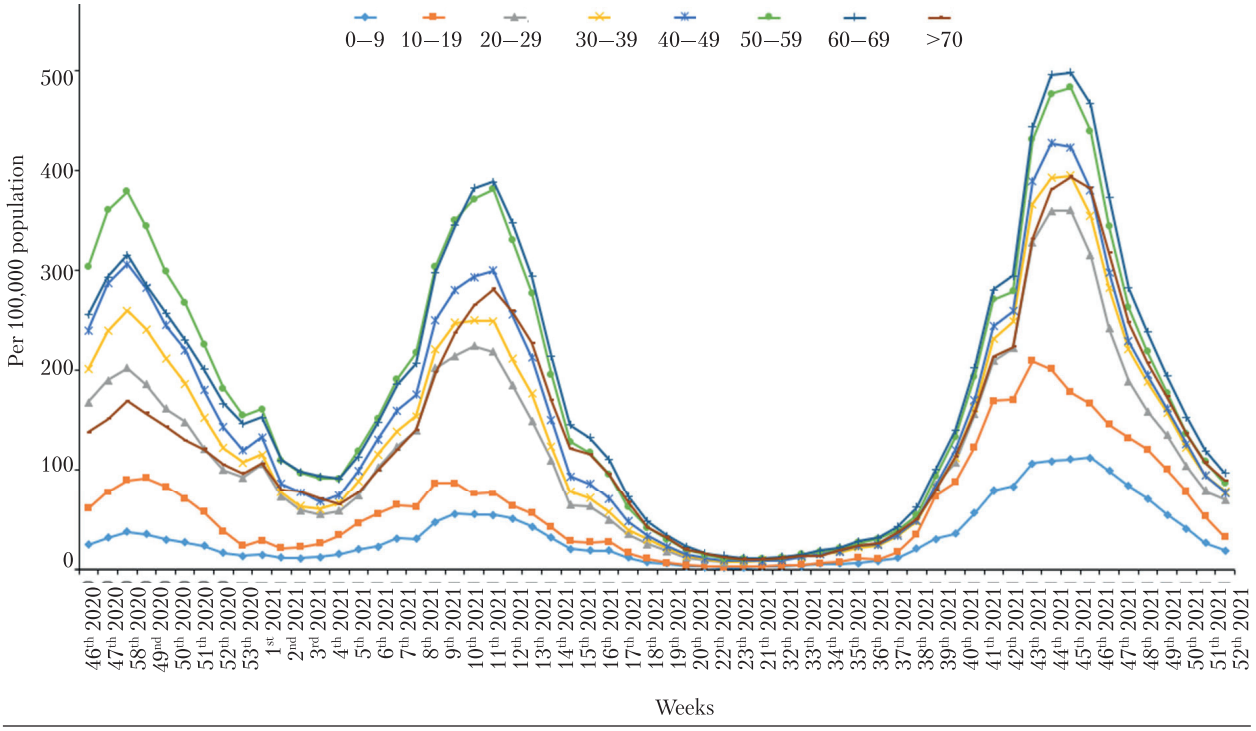

Fig. 3. **Incidence of COVID-19 by age, Ukraine, November 02, 2020 — December 31, 2021**

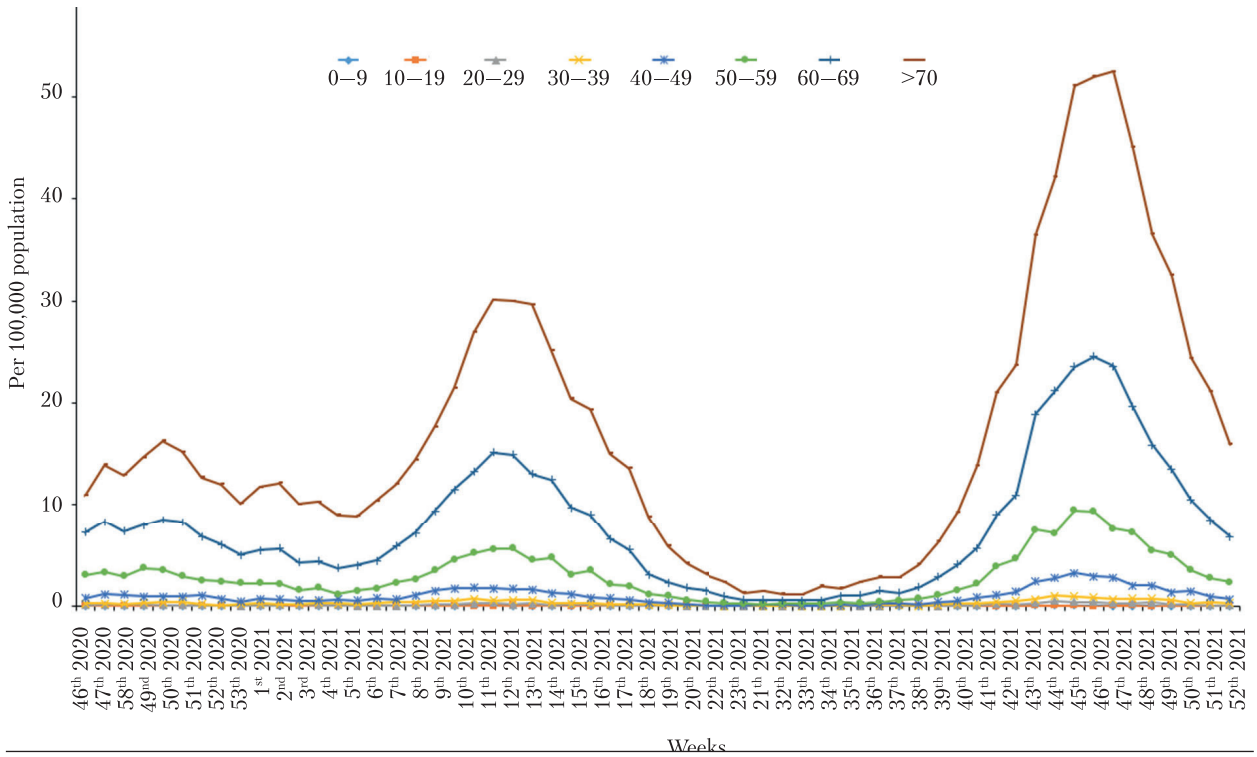

Fig. 4. **Mortality from COVID-19 by age, Ukraine, 02, 2020 — December 31, 2021**

20—29 years — 0.36 %, 10—19 years — 0.06 %, 0—9 years — 0.04 %.

Analysis of the age structure shows significant fluctuations in the mortality rate from COVID-19 per 100,000 population among different age groups. For people aged 0—9 years, this indicator varied from 0.03 to 0.08, for the age group 10—19 years — from 0.02 to 0.07, for 20—29 years old — from 0.02 to 0, 51, for 30—39-year-olds — from 0.01 to 1.02, for 40—49-year-olds — from 0.07 to 3.24, for 50—59-year-olds — from 0.2 to 9.38, for 60—69-year-olds — from 0.56 to 24.53, and for people aged 70 and over — from 1.12 to 52.55.

The weekly fatality rate ranged from 1.29 to 5.93 %, and in different administrative regions this indicator varied from 0.05 to 50 %.

The highest mortality rate was observed in the age group of 70 years and older, where it was 9.78 %. The second place was taken by the group of 60—69 years with a mortality rate of 3.24 %. The third position was occupied by the age group of 50—59 years, where the mortality rate was 1.18 %. For the age groups 40—49 years, 30—39 years, 20—29 years, 0—9 years, and 10—19 years, the mortality rates were 0.48 %, 0.18 %, 0.07 %, 0.03 %, respectively and 0.02 %.

Epidemic surveillance (surveillance) is a systematic and continuous collection, recording, compilation and analysis, interpretation, dissemination of data for medical and sanitary purpose, epidemic well-being of the population and indicators of the living environment for the assessment and adoption of the necessary appropriate measures in the field of public health [3].

The definition of a case of the disease with COVID-19, which includes clinical, epidemiological and laboratory criteria, was approved by the order of the Ministry of Health of Ukraine dated March 28, 2020 No. 722. A three-stage system for determining the case of the disease is used: suspected case, probable and confirmed. The order also defines a repeated case [1].

Epidemiological surveillance for COVID-19 was carried out at three levels: local, regional and national. Both individual accounting of COVID-19 cases and reporting, including cumulative data, were also carried out [1, 3].

The Electronic Integrated Infectious Disease Surveillance System (EIIDSS) was launched in May 2020 to monitor COVID-19, and later data exchange with the Electronic Health Care System was implemented for prompt information transfer [14].

The functionality of the EIIDSS provided comprehensive collection of information on suspicions, confirmed cases and outbreaks of infectious diseases. This system provided an opportunity to manage data on individual cases of diseases, as well as to aggregate information with relevant samples and laboratory results related to these cases. EIIDSS collected data, informed about events in a mode close to real time [4].

In accordance with the resolution of the CMU dated December 9, 2020 No. 1236, indicators of epidemic danger levels were determined [2].

The overall approach to surveillance of COVID-19 has changed during the pandemic. Initially, the main indicator was the number of cases, but later the emphasis was placed on such criteria as the occupancy of hospitals and intensive care units [9].

On February 24, 2022, the Russian Federation carried out a large-scale invasion of the territory of Ukraine, but epidemiological surveillance and anti-epidemic measures continued.

In May 2023, WHO announced that COVID-19 is no longer a public health emergency of international concern (PHEIC). Resolution No. 383 of the Cabinet of Ministers of Ukraine dated April 25, 2023 made the latest amendments to Resolution No. 1236 of the Cabinet of Ministers of Ukraine dated December 9, 2020 [2] regarding the continuation of quarantine in Ukraine, which, accordingly, ended on June 30, 2023.

The introduction of epidemiologic surveillance made it possible to ensure prompt receipt of information for management decisions, development of new policies, and socio-economic interventions. This made it possible to prevent the further spread of COVID-19, reduce morbidity and mortality rates.

Conclusions

The epidemic of COVID-19 cases and deaths was characterized by a wave-like nature. The weekly rate of the incidence of COVID-19 per 100,000 population varied from 8.28 to 371.39, mortality — from 0.26 to 11.19, lethality — from 1.29 to 5.93 %. The growth rate of confirmed cases ranged from –60.92 to 101.21 %, deaths — from –53.66 % to 131.25. In the age structure of persons who fell ill with COVID-19, the largest share is people aged 50—59 years — 18.3 %, among the dead people over 70 years old prevail — 55.64 %. The highest mortality rate in the age group of 70 years and older is 9.78 %. The distribution of morbidity by administrative territories showed fluctuations from 1.93 to 753.08, mortality — from 0.06 to 25.3.

The development and implementation of effective strategies to combat new infectious diseases, in particular preparedness and response plans, allows you to prepare for future epidemics and pandemics, an important role in this is played by data analysis, in particular the systematic collection, processing and interpretation of data, in order to assess the current situation and forecast and determine the effectiveness measures taken. Accurate data analysis makes it possible to quickly adapt response strategies, ensure rational use of resources and make informed decisions at all stages of infection control.

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References

1. Організація надання медичної допомоги хворим на коронавірусну хворобу (COVID-19). Наказ Міністерства охорони здоров'я України № 722 від 28.03.2020. https://zakon.rada.gov.ua/rada/show/v0722282-20.
2. Про встановлення карантину та запровадження обмежувальних протиепідемічних заходів з метою запобігання поширенню на території України гострої респіраторної хвороби COVID-19, спричиненої коронавірусом SARS-CoV-2. Постанова Кабінету Міністрів України від 9 грудня 2020 р. № 1236. Київ. https://zakon.rada.gov.ua/laws/show/1236-2020-%D0%BF#Text.
3. Про затвердження Порядку ведення обліку, звітності та епідеміологічного нагляду (спостереження) за інфекційними хворобами та Переліку інфекційних хвороб, що підлягають реєстрації. Наказ Міністерства охорони здоров'я України № 1726 від 30.07.2020. https://zakon.rada.gov.ua/laws/show/z1332-20#Text.
4. Про затвердження Порядку збирання та передачі інформації про випадки гострих та хронічних професійних захворювань (отруєнь) для автоматизованої системи обліку та аналізу гострих та хронічних професійних захворювань (отруєнь). Наказ Міністерства охорони здоров'я України № 2020 від 10.11.2022. https://zakon.rada.gov.ua/laws/show/z1479-22#Text.
5. Abdelrahman Z, Li M, Wang X. Comparative Review of SARS-CoV-2, SARS-CoV, MERS-CoV, and Influenza A Respiratory Viruses. Frontiers in immunology. 2020;11:552909. doi: 10.3389/fimmu.2020.552909.
6. Allan M, Lièvre M, Laurenson-Schafer H, et al. The World Health Organization COVID-19 surveillance database. Int J Equity Health. 2022;21(Suppl 3):167. doi: 10.1186/s12939-022-01767-5.
7. Bowsher G, Sullivan R. Why we need an intelligence-led approach to pandemics: supporting science and public health during COVID-19 and beyond. J R Soc Med. 2021;114(1):12-4. doi: 10.1177/0141076820947052.
8. Chen F, Liu Y, Ya B et al. Latest Effective Measures to Combat COVID-19: A Review. Iran J Public Health. 2021 Apr;50(4):640-648. doi: 10.18502/ijph.v50i4.5989.
9. Clark EC, Neumann S, Hopkins S, et al. Changes to public health surveillance methods due to the COVID-19 pandemic: Scoping Review. JMIR Public Health Surveill. 2024 Jan 19:10:e49185. doi: 10.2196/49185.
10. Coronavirus (COVID-19) Cases. 2024. Our World in Data. [Internet]. https://ourworldindata.org/covid-cases.
11. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta Biomed. 2020;91(1):157-60. doi: 10.23750/abm.v91i1.9397.
12. Filip R, Gheorghita Puscaselu R, Anchidin-Norocel L, et al. Global challenges to public health care systems during the COVID-19 pandemic: A review of pandemic measures and problems. J Pers Med. 2022 Aug 7;12(8):1295. doi: 10.3390/jpm12081295.
13. Francombe J, Ali GC, Gloinson ER, et al. Assessing the imple-

mentation of digital innovations in response to the COVID-19 pandemic to address key public health functions: Scoping review of academic and nonacademic literature. JMIR Public Health Surveill. 2022;8(7):e34605. https://doi.org/10.2196/34605.

14. Hrynzovskyi AM, Bielai SV, Volkov IM, et al. Public management of public healthcare under the COVID-19 outbreak: experience of Ukraine. Wiad Lek. 2024;77(1):94-104. doi: 10.36740/WLek202401112.
15. Li Z, Yang B, Wang J, et al. Global border restrictions in 2020-2021: Adherence and the effectiveness in long-term COVID-19 epidemic control. Travel Med Infect Dis. 2023 Mar-Apr:52:102556. doi: 10.1016/j.tmaid.2023.102556.
16. Narain JP, Dawa N, Bhatia R. Health System Response to COVID-19 and Future Pandemics. Journal of Health Management. 2020;22(2):138-145. doi: 10.1177/0972063420935538.
17. Price JR, Mookerjee S, Dyakova E, et al. Development and delivery of a Real-time Hospital-onset COVID-19 Surveillance System using network analysis. Clin Infect Dis. 2021 Jan 23;72(1):82-89. doi: 10.1093/cid/ciaa892.
18. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. World Health Organization (WHO). [Internet]. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.
19. World Health Organization. Pulse survey on continuity of essential health services during the COVID-19 pandemic: interim report, 27 August 2020. Geneva: World Health Organization. https://www.who.int/publications/i/item/WHO-2019-nCoV-EHS_continuity-survey-2020.1.
20. Zhang Y, Xu J, Li H, Cao B. A novel coronavirus (COVID-19) outbreak: A call for action. Chest. 2020;157(4):e99-e101. doi: 10.1016/j.chest.2020.02.014.

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Характеристика розвитку пандемії COVID-19 в Україні та особливості епідеміологічного нагляду

У грудні 2019 р. світ зіштовхнувся з новим викликом — спалахом захворювання, спричиненого новим коронавірусом SARS-CoV-2. 11 березня 2020 р. ВООЗ оголосила пандемію коронавірусної хвороби-2019 (COVID-19). З метою її подолання були впроваджені апробовані раніше стратегії та заходи профілактики й контролю, а також новітні цифрові підходи, застосовано також нові політичні, дипломатичні та соціально-економічні рішення, які разом з класичними підходами дали змогу подолати поширення SARS-CoV-2 та наслідки пандемії COVID-19.

Мета роботи — дослідити розвиток пандемії COVID-19 в Україні та організацію в країні епідеміологічного нагляду.

Матеріали та методи. Проведено спостережне популяційне дослідження. Використано епідеміологічний, медико-статистичний та бібліосемантичний методи.

Результати та обговорення. Тижневий показник захворюваності варіював від 8,28 до 371,39, смертності — від 0,26 до 11,19, летальності — від 1,29 до 5,93 %. Темп приросту/зниження підтверджених випадків становив від — 60,92 до 101,21 %, померлих — від –53,66 до 131,25 %. У віковій структурі хворих на COVID-19 найбільша частка припадала на осіб віком 50—59 років (18,3 %), серед померлих — на осіб віком понад 70 років (55,64 %). Найвища летальність — у віковій групі ≥ 70 років (9,78 %). Показник захворюваності в регіонах України варіював від 1,93 до 753,08, смертності — від 0,06 до 25,3. Для моніторингу COVID-19 у травні 2020 р. була впроваджена Електронна інтегрована система нагляду за інфекційними захворюваннями, згодом — обмін даними з Електронною системою охорони здоров'я.

Висновки. Розробка та впровадження ефективних стратегій протидії новим інфекційним хворобам, зокрема планів готовності та реагування, дає змогу підготуватися до майбутніх епідемій і пандемій, важливу роль у цьому відіграє аналіз даних, зокрема систематичний збір, обробка та інтерпретація даних, для оцінки поточної ситуації та прогнозування, а також визначення ефективності вжитих заходів.

Ключові слова: COVID-19, пандемія, епіднагляд, захворюваність, епідеміологія.

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ДЛЯ ЦИТУВАННЯ

- Korolenko VV, Mokhort HA, Petrusevych TV, Korolenko VV. Characteristics of The Development of the COVID-19 Pandemic in Ukraine and Peculiarities of Epidemiologic Surveillance. Туберкульоз, легеневі хвороби, ВІЛ-інфекція. 2024;4:100-106. doi: 10.30978/TB2024-4-100.
- Korolenko VV, Mokhort HA, Petrusevych TV, Korolenko VV. Characteristics of The Development of the COVID-19 Pandemic in Ukraine and Peculiarities of Epidemiologic Surveillance. Tuberculosis, Lung Diseases, HIV Infection (Ukraine). 2024;4:100-106. http://doi.org/10.30978/TB2024-4-100.