

© 2024 by the author(s).

This work is licensed under Creative Commons Attribution 4.0 International License
<https://creativecommons.org/licenses/by/4.0/>



How to cite / Як цитувати статтю: Nesterenko V, Shevchenko V. Calculation of the national need for palliative care by the refined method of trends in the conditions of a military crisis. *East Ukr Med J.* 2024;12(3):711-720

DOI: [https://doi.org/10.21272/eumj.2024;12\(3\):711-720](https://doi.org/10.21272/eumj.2024;12(3):711-720)

ABSTRACT

Valentyna Nesterenko

<https://orcid.org/0000-0002-3773-9525>

Department of Public Health and Health Care Management, Kharkiv National Medical University, Kharkiv, Ukraine

Valentina Shevchenko

<https://orcid.org/0000-0002-9557-9849>

Department of Electrical Machines, National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine

CALCULATION OF THE NATIONAL NEED FOR PALLIATIVE CARE BY THE REFINED METHOD OF TRENDS IN THE CONDITIONS OF A MILITARY CRISIS

Introduction. Palliative and Hospice Care (PHC) in Ukraine is necessary for 300,000 patients (adults and children) whose lives are coming to an end due to incurable diseases. Ukraine is improving this area of medical care due to changes in funding. The issue of reliably predicting the need for PHC in adults and children remains unresolved.

The aim. Check the forecast of the need for palliative and hospice care for 2021 and 2022, made according to the methodology of the Ukrainian Center for Public Data (2019), and determine the optimal method of refined trend forecasting to increase reliability in the conditions of a military crisis.

Materials and methods. The forecasting was carried out using Microsoft Excel, the method of a creeping trend with a constant segment of smoothing, with a detail that allows you to determine the reliability of the forecast at the expense of a 95% confidence interval. The updated forecast takes into account migration processes in Ukraine during the war, including the impossibility of collecting medical statistics data in the temporarily occupied territories.

Results. The calculation of the need for PHC for adults and children in 2021 and years has been carried out based on the available statistical data of the State Statistics Service of Ukraine, Medical Statistic Service of Ukraine, national cancer and tuberculosis registries. Significant discrepancies were found between the calculated result and the forecast made before the war. The results of the forecast made in 2021 regarding the need for PHC of adults and children of Ukraine for 2021 and 2022 by the linear trend method are also compared with the results of the forecast by the creeping trend method with a constant smoothing segment. The latter was 4.70 times more accurate for adult palliative patients, and 1.25 times more accurate among palliative patients of all age categories.

Conclusions. The tendency to decrease the need for PHC among both adults and children from the period 2018–2022 is maintained, which is associated with a decrease in the quality of data collection of medical statistics, and during the military crisis, also with significant migration processes and occupation of territories. Forecasting is necessary for further planning and financing of PHC and should be carried out on an ongoing basis. Methods for assessing the need for PHC need further improvement.

Keywords: *medical statistics, demographic statistics, creeping trend, linear trend, palliative and hospice care.*

Corresponding author: Valentyna Nesterenko, Department of Public Health and Health Care Management, Kharkiv National Medical University, Kharkiv, Ukraine
e-mail: vh.nesterenko@knmu.edu.ua

РЕЗЮМЕ

Валентина Нестеренко

<https://orcid.org/0000-0002-3773-9525>

Кафедра громадського здоров'я та управління охороною здоров'я, Харківський національний медичний університет, м. Харків, Україна

Валентина Шевченко

<https://orcid.org/0000-0002-9557-9849>

Кафедра електричних машин, Національний технічний університет «Харківський політехнічний інститут», м. Харків, Україна

РОЗРАХУНОК НАЦІОНАЛЬНОЇ ПОТРЕБИ В ПАЛІАТИВНІЙ ДОПОМОЗІ УТОЧНЕНИМ МЕТОДОМ ТРЕНДІВ В УМОВАХ ВІЙСЬКОВОЇ КРИЗИ

Вступ. Паліативна та хоспісна допомога (ПХД) в Україні необхідна для 300 тисяч хворих (дорослих і дітей), життя яких добігає кінця внаслідок невиліковних хвороб. Україна вдосконалює цей напрямок медичної допомоги за рахунок зміни фінансування. Невирішеним залишається питання надійного прогнозування потреби у ПХД у дорослих і дітей.

Мета. Перевірити прогноз потреби у паліативній та хоспісній допомозі на 2021 та 2022 роки, зроблений за методикою Українським центром суспільних даних (2019), та визначити оптимальний методу уточненого прогнозу трендів для підвищення достовірності в умовах воєнної кризи.

Матеріали та методи. Прогнозування проведено з використанням Microsoft Excel, методом повзучого тренду з постійним сегментом згладжування, з деталізацією, яка дозволяє визначити достовірність прогнозу за рахунок 95 % довірчого інтервалу. Уточнений прогноз враховує міграційні процеси в Україні під час війни, у тому числі неможливість збору даних медичної статистики на тимчасово окупованих територіях.

Результати. Виконано розрахунок потреби у ПХД дорослих і дітей у 2021 та роках за наявними статистичними даними Держстату України, Медстату України, національних реєстрів раку та туберкульозу. Виявлено значні розбіжності між розрахованим результатом та проведеним до війни прогнозом. Результати прогнозу, виконаного у 2021 щодо потреби у ПХД дорослих і дітей України на 2021 та 2022 роки методом лінійного тренду, також порівняні з результатами прогнозу методом повзучого тренду з постійним сегментом згладжування. Останній виявився в 4,70 більш точним для дорослих паліативних пацієнтів, та в 1,25 рази більшим точним серед паліативних пацієнтів всіх вікових категорій.

Висновки. Зберігається тенденція до зниження потреби у ПХД як серед дорослих, так і серед дітей з період 2018–2022 років, що пов'язано із зниженням якості збору даних медичної статистики, а під час воєнної кризи ще й зі значними міграційними процесами та окупацією територій. Прогнозування є необхідним для подальшого

планування та фінансування ПХД, має проводитися на постійній основі. Методи оцінки потреби у ПХД потребують подальшого вдосконалення.

Ключові слова: медична статистика, демографічна статистика, повзучий тренд, лінійний тренд, паліативна та хоспісна допомога.

Автор, відповідальний за листування: Валентина Нестеренко, кафедра громадського здоров'я та управління охороною здоров'я, Харківський національний медичний університет, м. Харків, Україна
e-mail: vh.nesterenko@knu.edu.ua

ABBREVIATIONS

PHC – palliative and hospice care

INTRODUCTION / ВСТУП

Palliative and hospice care (PHC) in Ukraine is provided according to a limited list of diseases of adults and children, which needs to be expanded according to the model of countries classified as category 4b according to the classification of Lynch T., Wright M. & Clark D. [1]. In these countries, the PHC system is best integrated into the health care system; palliative patients with chronic pain have free access to opiates; health professionals, local communities and society as a whole are well aware of PHC issues; significantly developed educational centers; national palliative care associations have significant influence on public palliative care policy. In recent years, the procedure for providing PHC in Ukraine has changed significantly: package financing of palliative care for children and adults was started by the National Health Service of Ukraine under the Medical guarantee program (the program and service have been in existence since 2017); PHC tariffs are gradually increasing; in 2023, the reimbursement of painkillers for palliative patients under the "Affordable Medicines" program began. As a result of these reforms, the number of PHC service providers increased by an order of magnitude. But the issues of free access of palliative patients to narcotic painkillers and the safety of palliative patients with limited mobility in the frontline regions of Ukraine remain unresolved. There is a stable shortage of doctors, mid-level and junior medical staff in palliative care departments and hospices. There is no public, state-recognized calculation of the need for PHC among adults and children with a list of diagnoses with which patients will be able to receive palliative care in the early, pre-terminal stages of their incurable diseases, with a calculation of the number of beds and medical personnel for a certain number of palliative patients [2, 3].

In 2018, the Ukrainian Center for Public Data calculated the need for PHC in Ukraine in 2018 [4], which contained a much larger list of palliative diagnoses for adults and children compared to the standard practice

of providing palliative care mainly to patients with a neurological and oncological profile. According to this calculation, more than 324,000 Ukrainians needed PHC, including more than 258,000 adults and almost 66,000 children. Using this methodology, in 2021 we calculated the need for PHC in Ukraine for 2019 and 2020 and forecasted by the linear trend method for 2021 and 2022 [5]. Over the period from 2018 to 2020, the number of adults in need for PHC decreased by approximately 17% (from 258.2 to 213.7 thousand), the number of children also decreased by approximately 26% (from 65.9 to 49.0 thousand). Accordingly, the forecast of the need for PHC, executed for 2021 and 2022 using the linear trend method, was also associated with a decrease in the demand for PHC. To increase the accuracy of the forecast, we considered adaptive forecasting models: the model of the square of the average values between the indicators of linear and logarithmic trends, the method of moving averages and the method of the creeping trend with a constant smoothing segment. Previously, we made a choice in favor of the last method. Its accuracy for future years depends on the choice of the forecast adaptation model, which can affect the adequacy of package financing of PHC in conditions of shortage of military economy resources. The persuasiveness of the forecast depends on its detail, which is high in cases of calculating average values, deviations, dispersion, excesses and coefficients of variation. The study of the specialized literature of PubMed and GoogleScholar with the depth of the retrospective search until 2000 inclusive showed the absence of special studies on the choice of a universal method for predicting the need for PHC.

THE AIM OF THE STUDY

The study was conducted to verify the forecast of the need for palliative and hospice care among adults and children in Ukraine for 2021 and 2022, and to determine the optimal refined method of trends to increase the reliability of the forecast in the conditions of a military crisis.

MATERIAL AND METHODS

A retrospective analysis of the need for PHC among adults and children of Ukraine was conducted by us at the preliminary stage of the study in depth up to 2018 inclusive. Data on the need for PHC for 2018 were calculated by the Ukrainian Center for Public Data in 2019 [4] using data from the official medical statistics of Ukraine (the State Statistics Service of Ukraine, ukrstat.gov.ua; and the Medical Statistics Service of the Public Health Center of the Ministry of Health of Ukraine, medstat.gov.ua; National Cancer Registry, ncr.uinf.ua; National Tuberculosis Registry, tbc.gov.ua) and expertly established qualitative coefficients for the main palliative diagnoses of adults and children [5]. Expertly determined coefficients (multiples of 1/10, 1/5, 1/4 or 1/3 of the total number of patients with palliative diagnoses) show exactly what part of patients with a corresponding diagnosis with a severe course is incurable and requires palliative care. State forms of statistical reporting on forms No.No.10, 19 and 20 were used for the calculation, on the number of deceased, discharged from the hospital or newly registered patients with the corresponding diagnoses.

In 2021, we calculated the need for PHC based on the list of diagnoses and the methodology proposed by the Ukrainian Center for Public Data for 2019 and 2020. Forecasting was also carried out using the linear trend method for 2021 and 2022. When calculating for 2019 and 2020, we identified categories of patients with regard to which there are difficulties: dementia in adults (F00–F07 according to the 10th revision of International Statistical Classification of Diseases and Related Health Problems, hereinafter – ICD-10) and severe and profound mental retardation in children (F70–F79 according to ICD-10). These difficulties were due to the lack of government statistics on these diagnoses in adults and children as of 2019. Data for these categories of patients

were expertly calculated. It was also difficult to calculate the PHC requirement of adult patients with chronic obstructive pulmonary disease, due to the need to calculate the number of patients with severe bronchial obstruction during the COVID-19 pandemic. Data of state medical statistics were officially collected without taking into account lung lesions due to coronavirus infection, but a significant increase in the number of such patients in comparison with statistical data for the previous 10 years indicated the mixing of these groups of patients. The forecast for 2021 and 2022 was made using the linear trend method using the statistical calculation operator "TREND" of the Excel 2019 program (Microsoft, USA). A steady trend towards a decrease in the calculated need for PHC among adults and children with palliative diagnoses was noted, which was explained by the deterioration of the quality of statistical data collection against the background of the occupation of Ukrainian territories, the global financial crisis, the long and ineffective reform of the health care system of Ukraine, the demographic crisis, but not by improving the general state of public health.

The linear trend values were calculated according to the formula, where:

y – the value of statistical data for each year of data calculation;

x – period number (year);

b – the point of intersection of the trend line with the y -axis on the graph (the minimum level for an uptrend and the maximum for a downtrend); at the same time, the value of the duration of the year should be taken as 1, and the 1st year of the studied period should be set at the zero mark on the x -axis;

a – this is the value by which the amount of the trend changes per unit of the calculation period (year).

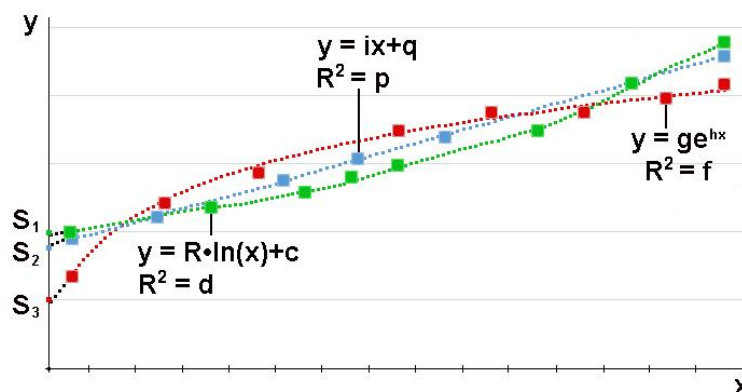


Figure 1 – General view of linear (blue color), exponential (green color) and logarithmic (red color) trends

Note: x – time axis; y – value axis; R^2 – reliability of approximation;

S_1, S_2, S_3 – points of intersection of exponential, linear and logarithmic trends with the axis of values; $c, d, e, f, g, p,$
 q – free variables

In general, the predicted values of the linear trend are refined towards the average value between the values of the linear and logarithmic trend, or between the values of the linear and exponential trend (Fig.1). If the adjusted value is close to the mean and the variance is close to the root mean square deviation, the trend is reliable within the 95% confidence interval (CI) [6, 7].

The obtained trend values are rounded to whole numbers. The linear approximation of the relationships of the linear parameters corresponds to the minimum values of the sums of squared deviations:

$$S = \sum_{i=1}^{i=n} (y_i - a_i - b_i x_i) \rightarrow \min, \quad (2)$$

where n – the volume of the studied population (number of units of observations).

Linear pairwise regression can be calculated as:

$$na + b \sum_i x_i = b \sum_i y_i, \quad (3)$$

$$a \sum_i x_i + b \sum_i x_i^2 = \sum_i x_i y_i \quad (4)$$

The value of b can generally be calculated as:

$$b = \frac{\sum_{i=1}^{i=n} x_i y_i - n \bar{x} \bar{y}}{\sum_{i=1}^{i=n} x_i^2 - n \bar{x}^2} \quad (5)$$

The average value was calculated according to the formula:

$$y_{middle} = \frac{y_{x1} + y_{x2} + \dots + y_{xn}}{n} = \frac{y_{2018} + y_{2019} + \dots + y_{2022}}{5} \quad (6)$$

Approaching the task defined in the study, it is advisable to represent the regression calculation by a system of equations:

$$\sum y = an + b \sum t \quad (7)$$

$$\sum y \cdot t = a \sum t + b \sum t^2 \quad (8)$$

where t – additional parameter specifying a single time interval (year).

To determine the accuracy of the trend calculation, the following calculations were performed:

1) variances of the sample – (8), (9); equation errors – (10):

$$D(t) = \frac{\sum t_i^2}{n} - \bar{t}^2 \quad (8)$$

$$D(t) = \frac{\sum y_i^2}{n} - \bar{y}^2 \quad (9)$$

$$S_y^2 = \frac{\sum (y_i - y_t)^2}{n - m - 1} \quad (10)$$

where $m = 1$ – the number of influencing factors in the trend model.

2) standard error of the equation – (11), (12), (13):

$$S_y = \sqrt{S_y^2} \quad (11)$$

$$S_b = S_y \cdot \frac{\sqrt{\sum t^2}}{n \sigma_t} \quad (12)$$

$$S_a = \frac{S_y}{\sqrt{n} \sigma_t} \quad (13)$$

3) coefficient of the linear equation of the trend was carried out by the method of t-statistics (Student's test) and T_{Table} – (14):

$$T_{Table}(n - m - 1; \frac{\alpha}{2}) \quad (14)$$

4) statistical significance of coefficients a and b – (15) and (16):

$$t_a = \frac{a}{S_a} \quad (15)$$

$$t_b = \frac{b}{S_b} \quad (16)$$

5) 95% confidence interval of coefficients a and b – (16) and (17):

$$(a - t_{observ} S_a; a + t_{observ} S_a) \quad (17)$$

$$(b - t_{observ} S_b; b + t_{observ} S_b) \quad (18)$$

The proposed algorithm for detailing the calculation makes the method more sensitive to a larger number of factors important in martial law conditions: migration processes (dependency on the number of available population), quality of statistical data collection (medical and demographic). In connection with the study of the need for dynamics and the need to simultaneously check previous forecasts and make new ones, the creeping trend method with a constant smoothing segment was chosen for forecasting [7, p. 57–60]. Combined data on weight coefficients of categories of palliative patients of corresponding categories and data of official national statistics were also used for calculation by this method, but also the method of proportional change in

the number of the population for the period of occupation of the respective territories was used. For example, if it is known that part of the territory of the Kyiv region was occupied for about two months in 2022 (from February 24 to April 4), then for diseases whose average duration of hospitalization is measured in months per year, the total number of patients with the corresponding diagnosis of the previous year is subtracted the number of patients who could have been hospitalized during the period of occupation and another one the following month, when the medical system adapted after deoccupation.

RESULTS AND DISCUSSION

The calculation of the need for PHCB among adults and children of Ukraine for the period of 2021 and 2022 was carried out. Its results are compared with the 2021 forecast [5] (*Table 1*). It should be noted that forecasting in 2021 for 2021 is a correct procedure, because it was carried out before the publication of official statistical data on the levels of morbidity, mortality, hospitalizations and discharges from medical institutions for this year.

The study found that in 2022, the trend toward a reduction in the need for PHC in absolute numbers among both adults and children continued. At the same time, this decrease according to the calculation data in 2022 was 1.97 times greater than the indicator predicted by the linear trend method among adults (87,254 vs. 172,303, respectively), and 1.63 times greater among palliative patients of all age categories (133 376 vs. 217,820, respectively), but this decrease turned out to be less than predicted by the linear trend by 1.3% (46,122 vs. 45,517, respectively). The same regularity was detected in relation to forecast refinement using the creeping trend method with a constant smoothing segment. The updated forecast for 2022 was 4.70 times closer to the calculated need than the linear trend forecast for adult palliative patients, 1.25 times closer for all age categories, but for children, the forecast turned out to be a creeping trend by 1.42 times less accurate than a linear trend forecast. This difference in projections in children can be explained by the significant difference between the calculated data for congenital malformations and the projected data for these palliative diagnoses in 2021 and 2022. Researchers explain the sharp decrease in diagnoses of the group of congenital malformations recorded in 2019 and 2020 by the reduction of the network of medical and genetic consultations in Ukraine in 2018–2019 as a result of the reform of this

sector of health care in Ukraine [8]. During this period, the function of collecting statistical information on congenital malformations was transferred to the midwifery service, which performed calculations using a different methodology. As a result, the number of registered diagnoses of congenital malformations (Q00–Q99 according to ICD-10) decreased from 16,237 in 2018 to 4,483 in 2019, and to 3,531 in 2020. Considering the clearly erroneous method of calculating the diagnoses of this group, we fixed the figure of 3,531 patients for the forecast for 2021 and 2022. But in 2021 and 2022, the medical genetics service restored the previous calculation method, and in 2022, the calculation based on the available data on congenital malformations already amounted to 8,229. But with such a difference from the previous forecast, even the improved forecasting method did not correct the overall picture, although was more accurate compared to the linear trend calculation by 2.12 times. At the same time, the total number of palliative diagnoses from the group of congenital malformations was 17.8% (8,229 out of 46,122). At the same time, it should be noted that medical statistics data on children with palliative diagnoses are collected more accurately. And even in the conditions of significant migration processes associated with the war, the refined prognosis for children corresponded to 95% CI in 9 out of 14 categories against 3 out of 10 categories in adult palliative patients. But even under this condition, we were unable to refine the forecast to the level of 95% CI of the entire age category, neither in adults nor in children. In our opinion, the ability to refine the forecast in the need for PHC to the level of 95% CI characterizes the quality and reliability of the procedure for collecting statistical information of various branches of the health care system, the commitment of medical statistics services specialists to the consistent and reliable performance of the data collection procedure, the adaptability of the medical statistics system to the extreme conditions of war. A significant disadvantage of hard times is inaccurate information about the number of available population, which prevents comparison of standardized indicators. A similar opinion is held by other researchers, Murtagh F.E. et al. [9] and Santos C.E.D. et al. [10]. Also, these researchers support the opinion about the need to expand the list of palliative diagnoses, for which it is necessary to both make predictions and finance the treatment and care of these patients.

Table 1 – The need for palliative and hospice care for an expanded list of palliative diagnoses, predicted and calculated based on available data for 2021 and 2022

| Year Palliative diagnoses | 2021 | | | 2022 | | |
|---|----------------|----------------|----------------|----------------|----------------|----------------|
| | Calculation* | Forecast | | Calculation** | Forecast | |
| | | Linear trend | Creeping trend | | Linear trend | Creeping trend |
| Adults | 194,537 | 194,537 | 164,165 | 87,254 | 172,303 | 105,341 |
| Including: | | | | | | |
| Malignant neoplasms | 56,627 | 56,627 | 46,433 | 32,922 | 45,174 | 31,810*** |
| Cardiovascular diseases | 76,791 | 76,791 | 67,674 | 24,471 | 77,669 | 29,212 |
| Dementia | 21,661 | 21,661 | 17,290 | 14,267 | 17,909 | 19,334 |
| Tuberculosis | 15,059 | 15,059 | 14,388 | 11,248 | 14,229 | 13,671 |
| Diabetes | 8,414 | 8,414 | 6,392 | 1,620 | 5,191 | 4,577 |
| Rheumatoid arthritis | 4,007 | 4,007 | 2,084 | 15 | 412 | 678 |
| Fibrosis and liver cirrhosis | 3,875 | 3,875 | 2,642 | 1741 | 3,654 | 1,782*** |
| Chronic obstructive pulmonary disease | 5,529 | 5,529 | 5,103 | 288 | 6,060 | 2,844 |
| HIV/AIDS | 1,830 | 1,830 | 1,458 | 126 | 1,341 | 822 |
| Kidney disease | 744 | 744 | 701 | 556 | 664 | 611*** |
| Children | 48,261 | 48,261 | 48,336 | 46,122 | 45,517 | 44,660 |
| Including: | | | | | | |
| Congenital malformations | 3,531 | 3,531 | 5,324 | 8,229 | 3,531 | 6,018 |
| Perinatal conditions | 11,082 | 11,082 | 10,913 | 9,997 | 10,840 | 9,106*** |
| Children's cerebral palsy | 9,469 | 9,469 | 9,117 | 8,901 | 9,022 | 8,923*** |
| Malignant neoplasms | 9,145 | 9,145 | 8,763 | 6,094 | 8,232 | 7,349 |
| Diabetes | 6,965 | 6,965 | 6,804 | 6,995 | 7,221 | 7,032*** |
| Mental retardation (severe and profound) | 3,200 | 3,200 | 2,839 | 2,167 | 2,746 | 2,338 |
| HIV/AIDS | 1,383 | 1,383 | 1,327 | 1,194 | 1,263 | 1,202*** |
| Inflammatory diseases of the central nervous system | 629 | 629 | 594 | 529 | 217 | 534*** |
| Cardiovascular diseases | 433 | 433 | 385 | 213 | 104 | 166 |
| Tuberculosis | 728 | 728 | 614 | 301 | 635 | 469 |
| Phenylketonuria | 865 | 865 | 844 | 785 | 865 | 789*** |
| Cystic fibrosis | 629 | 629 | 620 | 585 | 637 | 591*** |
| Chronic hepatitis | 106 | 106 | 99 | 43 | 106 | 51*** |
| Mucopolysaccharidoses | 96 | 96 | 93 | 89 | 98 | 92*** |
| All age categories | 242,798 | 242,798 | 212,501 | 133,376 | 217,820 | 150,001 |

Note: * – the official data of the medical statistics for 2021 in 2022 (the 1st year of the war) were not made public, so we take them as equal to the linear trend forecast for this year. Data on oncological diseases are refined according to the data of the National Cancer Registry, data on the number of deaths from HIV/AIDS and tuberculosis – according to the data of the State Statistics Service of Ukraine and the National Register of Tuberculosis. All calculations are rounded to whole values and carried out without taking into account the temporarily occupied territories of the Donetsk and Luhansk regions, as well as the Autonomous Republic (AR) of Crimea;

** – all calculations are rounded to whole values and carried out without taking into account the temporarily occupied territories: during the period of occupation and resumption of statistical data collection – Zhytomyr, Kyiv, Chernihiv, Sumy, Kharkiv, Mykolaiv, Zaporizhzhya; for the whole year – Donetsk and Luhansk regions, AR Crimea;

*** – the result is within 95% CI.

The choice of forecasting method significantly affects the forecast. The mortality rate, the prevalence of severe symptoms of palliative diseases, the prevalence of the disease, and the number of medical services provided are often taken into account in the forecast of the need for PHC. The rate of unexpected deaths is taken into account when patients did not receive palliative care on the eve of death. According to Murtagh F.E. et al. on research in Great Britain and Spain [9], it can be between 25% and 40%. For example, in Catalonia it was estimated [11] that 3/4 of deaths are related to chronic progressive diseases. Additional emphasis in the study was made on patients aged 65 years and older: with long-term chronic pathology and a limited life expectancy, with dementia, patients in nursing homes and with multiple diseases. Thus, in 2012, in the countries of Western Europe, the list of diagnoses originally proposed by Rosenwax L.K. et al. (2005) [12], which included cancer and stroke, was gradually expanded to the list presented in our study.

Expanding the list of palliative diagnoses increases the costs of health care systems and makes it difficult to calculate the need, taking into account the specifics of the work of statisticians in medical institutions of various medical profiles. But without such a calculation, it is difficult to justify significant expenditures of the state

CONCLUSIONS / ВИСНОВКИ

1. The study revealed a continued trend towards a steady decrease in the need for PHC among adults and children in Ukraine for the period from 2018 to 2022 (from 258,207 in 2018 to 87,254 in 2022 among adults, and from 65,906 to 46,122 among children, respectively).

2. Forecasting the need for PHC for 2021 and 2022 turned out to be significantly less accurate compared to the forecasting using the creeping trend method with a constant smoothing segment: the direct calculation of the reduction in demand in 2022 was 4.70 times more accurate than the creeping trend method for adult palliative patients, and in 1.25 times more accurate among palliative patients of all age categories.

3. The chosen method of the creeping trend with the detailing proposed by us allows the forecast to be considered reliable if the forecasted value is within 95%

budget [2, 3]. Therefore, every state that seeks to fully integrate the system into the national health care system must not only constantly conduct similar forecasting, but also refine the forecast based on the available data of subsequent periods, and build optimal statistical models for calculating the need.

In stochastic models, the predicted values depend on the probability distribution. Values obtained for the populations of entire countries are more easily transferred to smaller samples when calculating regional PHC requirements than vice versa. But one should understand the specifics of wartime. If, for forecasting for 2021 and 2022, we excluded from the data of national statistics only the temporarily occupied territories of Donetsk and Luhansk regions, as well as the entire territory of the AR Crimea, then since the beginning of the full-scale war, the number of regions of Ukraine whose data can be distorted as a calculation for the entire country in 2022, as well as the forecast of PHC needs in 2023, increased by another eight, at the expense of Zhytomyr, Kyiv, Chernihiv, Sumy, Kharkiv, Mykolaiv, Zaporizhzhya and Kherson regions. To assess the impact of the occupation of Ukrainian territories, important facts are whether the regional center is occupied, how long the occupation lasted, how many people left the territory of the region during the occupation, and how many people returned after the deoccupation.

CI. The updated prognosis was reliable in adult palliative patients with diagnoses of malignant neoplasms (C00–C97 and D00–D48 according to ICD-10), fibrosis and cirrhosis of the liver (K74) and kidney disease (N00–N15 and N20–N23), as well as among children (0–17 years) with palliative diagnoses of severe perinatal conditions (P05–P96), cerebral palsy (G80), diabetes (E10–E14), HIV/AIDS (B20–B24), inflammatory diseases of the central nervous system (G00, G03, G04, G06, G08 and G09), phenylketonuria (E70.0), cystic fibrosis (E84), chronic hepatitis (K73, K75.2 and K75.3), mucopolysaccharidoses (E76). The number of patients with unequal diagnoses did not allow to obtain statistical reliability of the forecast within 95% CI neither in adults nor in children. The result was most affected by significant wartime migration processes and the deterioration of the collection of statistical information.

PROSPECTS FOR FUTURE RESEARCH / ПЕРСПЕКТИВИ ПОДАЛЬШИХ ДОСЛІДЖЕНЬ

Every year, starting from 2018, and even during the war, the amount of funding for palliative care for adults and children in Ukraine is increasing. But according to our calculation, the proven need for PHC is on the contrary decreasing. At the next stage of the research, we plan to study the limits of the expedient increase in PHC funding by the National Health Service of Ukraine, as well as the issue of the targeted use of package funds for palliative patients by medical institutions of Ukraine.

AUTHOR CONTRIBUTIONS / ВКЛАД АВТОРІВ

- A – Work concept and design (Концепція роботи та дизайн)
 B – Data collection and analysis (Збір та аналіз даних)
 C – Statistical analysis (Статистичний аналіз)
 D – Writing the article (Написання статті)
 E – Critical review (Критичний огляд)
 F – Final approval of the article (Остаточне затвердження статті)

Valentyna Nesterenko: A–F

Valentina Shevchenko: C, E

FUNDING / ДЖЕРЕЛА ФІНАНСУВАННЯ

The research has no external sources of funding.

CONFLICT OF INTEREST / КОНФЛІКТ ІНТЕРЕСІВ

The authors declare no conflict of interest.

REFERENCES/СПИСОК ЛІТЕРАТУРИ

- Lynch T, Connor S, Clark D. (). Mapping levels of palliative care development: a global update. *J Pain Symptom Manage*. 2013;45(6):1094-106. <https://doi.org/10.1016/j.jpainsymman.2012.05.011>
- Holovanova IA, Shevchenko AS. Determination of the main needs of palliative patients and ways of their provision in the health care system of Ukraine. *Experimental and Clinical Medicine*. 2021;90(3):88-94. <https://doi.org/10.35339/ekm.2021.90.3.hos>
- Planning and implementing palliative care services: a guide for program managers. Geneva: WHO; 2016. 91 p. Available at: <https://iris.who.int/bitstream/handle/10665/250584/9789241565417-eng.pdf?sequence=1>
- The need for palliative care: an assessment based on 2018 data*. Ukrainian Center for Public Data, 2019 [Internet]. Available at: <https://socialdata.org.ua/palliative> [accessed April 02, 2024]. [In Ukrainian].
- Nesterenko VG. Forecasting the need for palliative and hospice care in Ukraine for 2021–2022. *Experimental and Clinical Medicine*. 2021;90(4):25-34. <https://doi.org/10.35339/ekm.2021.90.4.nes> [in Ukrainian].
- Bulyha K, Bulyha O. The use of information technologies for analysis of epidemiological situation. *Digital Platform: Information Technologies in Sociocultural Sphere*. 2020;3(2):161-9. <https://doi.org/10.31866/2617-796x.3.2.2020.220590> [in Ukrainian].
- Chumachenko DI, Chumachenko TO. Mathematical models and methods of epidemic processes forecasting: monograph. Kharkiv: Planeta-Print Ltd.; 2020. 180 p. Available at: <https://www.researchgate.net/publication/344771190> [in Ukrainian].
- Alieva TDK, Shevchenko A. On the issue of reproductive losses prevention in Ukraine. *Inter Collegas*. 2021;8(1):59-66. <https://doi.org/10.35339/ic.8.1.59-66>
- Murtagh FE, Bausewein C, Verne J, Groeneveld EI, Kaloki YE, Higginson IJ. How many people need palliative care? A study developing and comparing methods for population-based estimates. *Palliative medicine*. 2014;28(1):49-58. <https://doi.org/10.1177/0269216313489367>
- Santos CED, Campos LS, Barros N, Serafim JA, Klug D, Cruz RP. Palliative care in Brasil: present and future. *Revista da Associação Médica Brasileira (1992)*. 2019;65(6):796-800. <https://doi.org/10.1590/1806-9282.65.6.796>
- Gómez-Batiste X, Martínez-Muñoz M, Blay C, Espinosa J, Contel JC, Ledesma A. Identifying needs and improving palliative care of chronically ill patients: a community-oriented, population-based, public-health approach. *Current opinion in supportive and palliative care*, 2012;6(3):371-78. <https://doi.org/10.1097/SPC.0b013e328356aaed>
- Rosenwax LK, McNamara B, Blackmore, AM, Holman CD. Estimating the size of a potential palliative care population. *Palliative medicine*. 2005;19(7):556-62. <https://doi.org/10.1191/0269216305pm1067oa>

Received 25.06.2024

Accepted 23.08.2024

Одержано 25.06.2024

Затверджено до друку 23.08.2024

INFORMATION ABOUT THE AUTHORS / ВІДОМОСТІ ПРО АВТОРІВ

Валентина Нестеренко – кандидат медичних наук, доцент, доцент кафедри громадського здоров'я та управління охороною здоров'я, Харківський національний медичний університет.

Valentyna Nesterenko – MD, Candidate of Medical Sciences, Docent, Associate Professor of the Department of Public Health and Health Care Management, Kharkiv National Medical University.

E-mail: vh.nesterenko@knu.edu.ua

<https://orcid.org/0000-0002-3773-9525>

+38 063 069 9000 (corresponding author)

Валентина Шевченко – доктор технічних наук, професор, професор кафедри електричних машин, Національний технічний університет «Харківський політехнічний інститут».

Valentina Shevchenko – Doctor of Technical Sciences, Professor, Professor of the Department of Electrical Machines, National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine.

E-mail: zurbagan8454@gmail.com

<https://orcid.org/0000-0002-9557-9849>