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BIODIVERSITY OF WOODY PLANTS ON THE TERRITORY OF THE TOWN HOSPITAL

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Abstract

The basic requirements to design of hospital territories and selection of wood plants for their gardening are generalized. It was found that the existing normative indicators on landscaping do not take into account the needs of visitors and doctors and are limited to indicative indicator - the level of landscaping (not less than 55%). The hospital territory of Vyshhorod town, located not far the capital of Ukraine, was studied. The qualitative and quantitative indicators of tree plantations on the hospital territory are analyzed. It was found that little attention was paid to the design of the hospital territory, but there is potential to remedy the situation. Native tree species such as *Tillia cordata, Betula pendula* is dominated in landscaping. There are allergenic tree species. The level of biodiversity of tree species is low and the Shannon Diversity Index is 2.45. It is proposed to increase the efficiency of greenery in the process of improving the health of patients by adding mainly phytoncidal, highly decorative and beautiful flowering shrubs, which will have a positive impact on patients, staff and visitors. This study can become the basis for the design of the future hospital garden, which will be able to organically fit into the town landscape and become a favorite place of rest for citizens.

Keywords: bushes, hospital garden, introducers, tree species

INTRODUCTION

The inclusion of green spaces is important for urban health (Weerasuriya *et al.*, 2019), as green infrastructure has a positive impact on the health of urban citizens, promotes exercise, social activities, mental stimulation, reduces stress, resulting in direct and indirect benefits for mental and physical health (Huma *et al.*, 2021). In particular, the positive effect of green space on mortality from cardiovascular disease has been identified (Shen and Lung, 2016; Chen *et al.*, 2020), on feelings of anxiety and depression (Braçe *et al.*, 2020), body weight of newborns (Dadvand *et al.*, 2012); the health of elderly patients (Heo and Bell, 2019), the risk of dementia (Astell-Burt *et al.*, 2020) and respiratory diseases (Pun *et al.*, 2018), and the relief of nostalgia for home (Zhang *et al.*, 2022), creation a sense of relief from visual contact with green landscapes and encouraging use for leisure, aesthetic or sporting purposes (Jato-Espino *et al.*, 2022).

The most important thing for planning a healthy environment is to maximize the share of green spaces and minimize their fragmentation (Shen and Lung, 2016). In particular, a negative relationship was found between the area of plantations, their proximity and the frequency of bipolar disorder (H.-T. Chang *et al.*, 2021). It is noted that green spaces near residential areas contribute to the development of physical activity and improve the social life of the elderly (Machón *et al.*, 2020). The high density of street trees at a distance of 100 m from the house significantly reduces the risk of depression and the likelihood of prescribing antidepressants (Marselle *et al.*, 2020). Even contemplating greenery through a window can significantly improve mental health and psychological well-being (Elsadek *et al.*, 2020; Mihandoust *et al.*, 2021). The contemplation of flowering plants also has a positive effect on human physical and mental parameters (Zhao *et al.*, 2019). Stress, anger, medication, alcohol use, or doctor

visits during lockdown due to covid-19 were found to be significantly reduced if citizens were close to green infrastructure (Jato-Espino *et al.*, 2022). Strong motives for visiting the green space during the pandemic include its identification as a place for health, escape, social support and as a safe and important place for active recreation (Luo *et al.*, 2021).

Especially in hospitals, where people feel restless and nervous, the role of plants is even more important. Back in the 30s of the last century, the officially recognized method of treatment was horticulture (Pudelska *et al.*, 2016), the experience of the second half of the 20th century did not lead to the creation of a centralized model of the hospital, which together with the adjacent hospital garden on a city scale would merge with the city structure (Bakowski *et al.*, 2016).

Natural therapy and involvement in horticulture are recognized as valuable rehabilitation practices for people with mental disorders (Vujcic-Trkulja *et al.*, 2021) and the importance of the medical garden is growing (Pudelska *et al.*, 2016). It is recognized that the health care environment should be a healing place for all users, including relieving occupational stress in employees. Instead, there is often a lack of suitable green spaces and little satisfaction by existing plantings (Karanikola *et al.*, 2020).

Halajova *et al.* (2019) provides an overview of main theories and research related to the design of outdoor environments in healthcare facilities. The positive effects of greenery on human health are significant especially in therapeutic and healing gardens. Ecosystem services of Hospital grounds are therefore of crucial importance for patients, visitors, hospital employees and residents.

Patients have a strong need for contact with nature and appreciate the relaxed comfortable microclimate. Visiting and inspecting the landscape in hospitals accelerates patients' recovery after surgery and helps staff recover from mental fatigue (K. Chang and Chien, 2017). At the same time, different types of landscape functions help to visit certain groups of users, and features of the landscape that facilitate physical activity, effectively stimulate visits.

The features and the designs of the hospital gardens have importance in the treatment process of the patients spiritually, physically and socially (Duzenli *et al.*, 2017). Well-designed healing hospital gardens form a social atmosphere through saving the patients from the monotony that the clinic environment has and positively affect the clinical results of the patients through reducing stress, and thus they enable patients to feel themselves good psychologically and physiologically.

The use of eco-design for medical centers reduces the level of anxiety among customers and promotes a sense of well-being (Saffarinia *et al.*, 2012). Thus, the micro-parks of the ambulance hospital in Madrid create a natural system of elements for isolation and protection (Jorge, 2021). Microcameras have been set up here, where patients, visitors or healthcare professionals can meet in secluded places surrounded by trees and bushes or long green islands where they can walk. Adapted species with low water consumption that reduce the risk of allergies or respiratory diseases have been selected for landscaping. (Allahyar and Kazemi, 2020) note that the use of Dish Garden has improved children's health through distractions and is offered as a low-budget tool to create an enabling environment in children's hospitals.

Knowing users' preferences for hospital landscaping is important to get the most out of greenery for the well-being and health of patients. (Allahyar and Kazemi, 2021). Gardens are best calming and should be close to hospitals. Moreover, middle-aged adults in the garden prefer peace and quiet, and the elderly are more likely to seek stimulation. Also advise to avoid very fragrant plants to patients undergoing chemotherapy (Franklin, 2012).

Successful medicinal gardens have common features, in particular there should be more greenery and trees than concrete (Akdeniz, 2020). Landscapes with shady trees, flowers and shrubs should take up about 70% of the space (Franklin, 2012). Creating visually effective plant compositions in hospital gardens is important for relaxation and socialization. As a rule, hospital gardens have a rich plant diversity with some predominance of exotic species, but insufficient plant design.

Preservation and use of greenery around hospitals reduces the cost of recovery, has a positive effect on patients' chances of survival and quality of life during hospital stay (Schmoldt *et al.*, 1975). Recently, ecological design of hospitals based on the principles of sustainable development has been proposed, aimed at reducing the negative impact of urbanization processes (Bulakh *et al.*, 2021). The development of medicine testifies to the living standards of society, the attitude to the health of citizens. Ukraine lags far behind the world's leading countries in a number of indicators of the quality and efficiency of health care facilities. This article is an attempt to focus attention on still not inactive nature based solutions as part of the treatment process using the example of an analysis of the species structure of tree plantations on the territory of a hospital in a small town, the number of which is 75% of the total number of Ukrainian cities. This study contributes to the limited data on the quality of green spaces in small towns, specifically for such important specific limited-use facilities as hospitals, and highlights some of the untapped opportunities for their use in the healing process.

MATERIALS AND METHODS

We studied greenery on the territory of the district hospital (municipal non-profit enterprise “Primary Health Care Center” Vyshgorod Town Council) of a small historic Vyshgorod town with a population

of over 27 thousand inhabitants, located 20 km from the Kyiv city on the right bank Dnieper river.

The ancient Vyshhorod town is currently also a modern energy town and is sufficiently greened: the level of greening here is 53.1%. At the same time, the town is not sufficiently equipped with green spaces for public use (for example, parks, gardens, embankments). Provision by these green spaces for public use is only 1.8 m^3 per person. Currently, there is no town park here, however, the town is picturesquely framed by Dnipro river and artificial pine forests, which potentially provides an opportunity to create a forest park for the recreation of local residents.

The hospital is located on a hill in the newly built in the 60s of the last century part of the town, near both the business center and the artificial pine forest on its outskirt. The hospital buildings are three- and five-storey buildings. The purpose of the research is to summarize the literature data on the modern principles of the formation of green spaces on hospital territories, to assess the species diversity and condition of trees and shrubs on the model territory of the hospital in Vyshhorod town, Kyiv region and to consider the compliance of its greening with generally accepted norms. To achieve this goal, the following tasks were performed: analysis of the planning structure of the territory; study of species composition and age structure of plantations; assessment of the condition of woody and shrubby plants. The research is ultimately aimed at creating favorable environmental (sanitary and hygienic) and aesthetic conditions for patients. The obtained data can be used in further recreational organization of the town.

To perform the tasks we conducted a continuous inventory of all trees and shrubs on the selected in Fig. 1 territory (area 3.12 ha). The rest of the site was a steep hill dominated by herbaceous vegetation.

During the inventory, the species name, age, height, diameter, condition and decorativeness of each plant specimen were described. The condition and decorativeness of woody plants were determined according to point expert evaluations common in similar studies: the condition - according to a 5-point rating (1 - excellent condition, 2 - good, 3 - satisfactory, 4 - trees that are drying, 5 - dry trees); the decorativeness - according to a 4-point rating (1 - high decorative, 2 - moderate decorative, 3 - satisfactory decorative, 4 - low decorative).

During the analysis, the share of tree species in plantations was determined as the ratio of the number of specimens of a certain species to the total number of surveyed tree plants in the territory. Structural analysis of tree plantations identifies species with a very low share of participation (less than 0.5%); with low (from 0.5 to 1%); with average (from 1 to 5% inclusive); with a high (from 5 to 10%) and with a very high share of participation (over 10%). Biodiversity of woody plants in Vyshhorod town, including on the hospital territory, was described by us earlier (Zibtseva, 2021). To assess the biodiversity of tree plantations on the hospital territory, the Margalef richness index and the Shannon diversity index were calculated and compared with similar indicators for street plantations in the town (Zibtseva, 2022). The ratios of aboriginal and introduced species, critical species (according to the Santamuro (2002) rule 10-20-30), their age structure and the correspondence of the Richards (1983) distribution were also determined. In addition, planting density per 1 ha was established, as well as the ratio of trees and shrubs and its compliance with the recommended values. STATA version 10 was used in the data analysis.

1: *The researched territory of the hospital in Vyshgorod town (taken from Google.com/maps) relatively to the downtown: 1 – polyclinic; 2 – hospital buildings.*

RESULTS

The territory of the institution belongs to the pavilion type of system building, ie there is a polyclinic on the territory, various departments, which are located in separate buildings. The following functional zoning is provided on the territory of the hospital: polyclinic, hospital buildings area; economic zone, unformed walking (park) zone and some others.

Trees on the territory of the hospital are arranged mainly according to geometric layout: in the form of ordinary plantings along buildings and roads and single specimens and groups and perform mainly a demarcating function. The area along the north-western side of the buildings is very shaded, which affects the condition of woody plants and creates depressing impression. Trees along the roadway are affected by *Viscum album* L. Apparently, trees can be seen from all the windows of the hospital (mostly the usual native species), but the area itself is not suitable for walking and recreation, there are no benches and other elements of landscaping, well-thought-out landscaping is also missing. From the north-western part of the territory, just behind the buildings, a rather steep

hill with a wasteland begins, which is currently not suitable for recreation. Row planting of trees along the perimeter of the territory is also absent. There is no flower gardening, the color scheme of the green zone is quite monotonous - green during the growing season and leafless in winter. Colorful colors and fragrant effects on the condition and recovery of patients are not used.

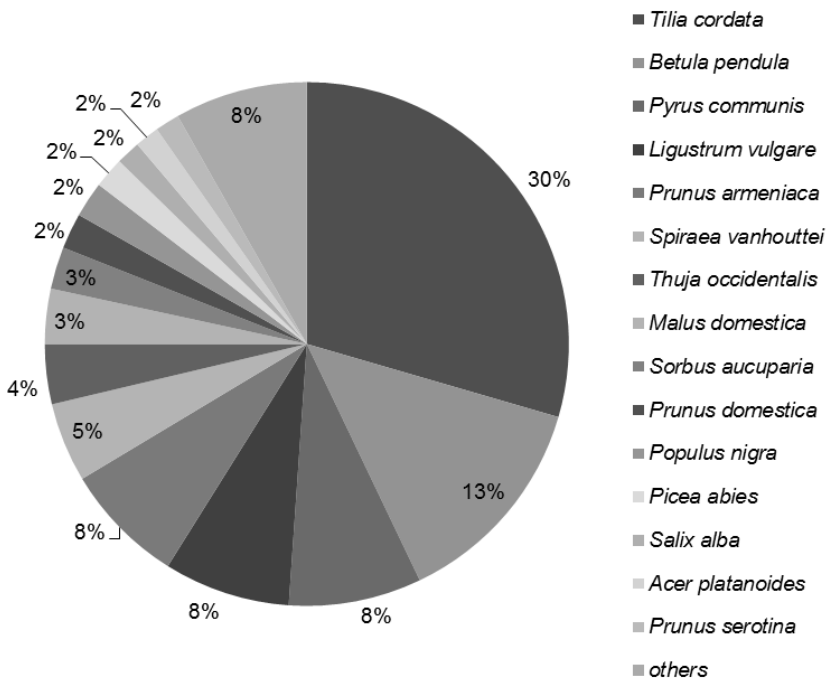
Biodiversity of urban ecosystems is considered one of the indicators of the quality of the organization of the urban environment. A number of authors recommend "liberal use", according to which the species should not exceed 10% of the total number of trees. Moreover, plantings should be of different ages. When planning territories, it is recommended to take into account the specifics of the territory and the requirements of the population, to preserve aboriginal species and increase the diversity of species. An important result of the inventory is the identification of critical species (Santamour, 2002) on species diversity and distribution of plants by diameter classes, compliance which to ideal (Richards, 1983) indicates stability of development of urban plantations.

Was found 28 species of trees and shrubs in the amount of 274 specimens on the Vyshhorod hospital territory (Fig. 2). In total, 20 species of trees and 7 species of shrubs and 1 liana are represented in the research area. Of these, 12 species (42.8% of the total) were introducers, including 7 species (35%) of trees. Among the bushes were 5 introduced species (55.5% of the total number of bush species). Quantitatively, the number of introducers is 58 (or 21.2% of all plants), that is native species predominate, which corresponds to the numerous recommendations of scientists on landscaping of hospitals.

Only two native species are characterized by a very high share of participation (over 10%): *Tilia cordata* and *Betula pendula*, whose share is 29.5% and 13.4%, respectively. They belong to the category of critical species. Three species are characterized by a high share (5–10%): *Pyrus communis* L., *Ligustrum vulgare* L., *Prunus armeniaca* L.; 12 species are characterized by an average share of participation (from 1 to 5%); 2 species - *Ulmus laevis* Pall. and *Picea pungens* Engelm. - are low participation rate (from 0.5 to 1%); 6 species with a very low share of participation (less than 0.5%), that are occur only singly.

The total number of tree species on the territory of the hospital is less than on the streets of Vyshhorod, where 35 species were found (Zibtseva, 2022). Margalef Richness Index for hospital plantings is 4.81 and it is lower than for streets plantings with Index value 5.23. Simpson Diversity Index equal 8.07, while for street plantings - 11.10. Shannon Diversity Index equal 2.45 versus 2.71 for street plantings. Thus, such an important facility as the only district hospital has an even lower level of woody plant diversity than the street landscaping done mainly in the 1960s using mass plantings of native forest tree species.

The recommended number for health facilities per hectare are 140–150 trees and 700–780 shrubs (1 : 5 ratio). A total of 225 trees and 49 bushes were registered on the territory (that is 72 trees and 16 bushes per 1 ha of the total territory). Of these there are 17 conifers (6% of the total number of trees), 5 coniferous shrubs (10% of the total number of



2: *Species composition of green plantings on the territory of the hospital in Vyshgorod town (Zibtseva, 2021).*

shrubs). The quantitative ratio of trees and shrubs in the area is 4.6 : 1, that is does not meet the norm. There are many trees and very few shrubs in the area.

The age of plants varies from 3–5 to more than 50 years. The oldest (age 30–50 years) include specimens of *Aesculus hippocastanum* L., *Salix alba* L. (allergenic species according to Ribeiro *et al.* (2009) studies), *Tilia cordata* Mill., *Betula pendula* Roth., *Populus nigra* L.; younger than 10 years are *Pyrus communis, Thuja occidentalis* L. There are 43 specimens of trees aged 40 years and over (or 19%), and 19 specimens aged 10 years and less (or 8.4%).

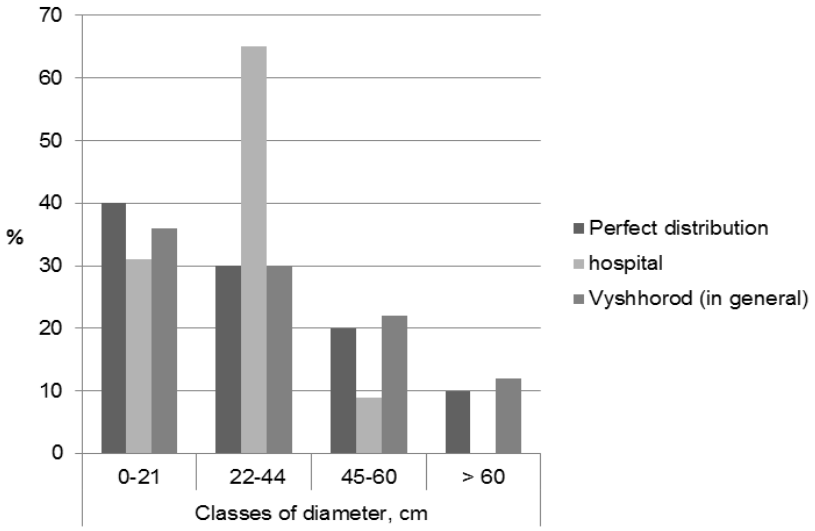
21 specimens (or 9.3%) of natural regeneration were identified, including invasive introduced species: 6 specimens of *Robinia pseudoacacia* L., 3 specimens of *Morus alba* L., as well as of native plants: 2 specimens of *Ulmus laevis*, 4 specimens of *Pyrus communis*, 1 specimen of *Acer platanoides* L. and 1 specimen of *Populus nigra.*

Characteristics of the predominant tree species are given in Tab. I.

Such species as *Acer platanoides, Betula pendula, Picea abies, Prunus armeniaca* and *Ligustrum vulgare* are noted for their better condition and decorativeness. 9 (3%) trees are characterized by the worst condition (3 points corresponds to satisfactory condition), including one specimen of *Betula pendula*, *Populus nigra* and *Picea abies* (L.) H. Karst., 6 specimens of *Thuja occidentalis* and 12 (24.5%) of shrubs: 1 specimen of *Juniperus communis* L. and

I: *Characteristics of the most common plants on the Vyshgorod hospital territory*

Species	Amount	Average values of indicators				
		Age, years	Height, (m)	Diameter, (cm)	State, points	Decorativeness, points
Tilia cordata	79	39 ± 1.3	9 ± 0.3	25 ± 1.8	2.8 ± 0.11	2.0 ± 0.04
Betula pendula	36	33 ± 2.9	11 ± 0.8	41 ± 4.9	1.8 ± 0.16	1.2 ± 0.13
Pyrus communis	22	5	2	-	2	2
Prunus armeniaca	20	22 ± 5.9	5 ± 1.0	24 ± 9.3	1.8 ± 0.25	1.7 ± 0.25
Malus domestica	11	25 ± 5.0	5	30 ± 10	3	2
Thuja occidentalis	10	8 ± 0.9	1.5 ± 0.2	-	3	2. ± 0.16
Sorbus aucuparia	7	18 ± 4,0	6 ± 1.1	15 ± 1.8	2 ± 0.36	1.3 ± 0.21
Prunus domestica	6	18 ± 3.7	4 ± 0.5	13 ± 0.7	2.4 ± 0.24	1.4 ± 0.24
Populus nigra	6	35	12	32	2	2
Picea abies	5	27 ± 3.0	7 ± 0.8	18 ± 3.5	1.8 ± 0.49	1.6 ± 0.4
Salix alba	4	35	7.5	20	2	1
Cerasus vulgaris	3	15	3	8	2	1
Acer platanoides	4	25 ± 13,2	6.3 ± 2.9	23.3 ± 18.5	1	1
Robinia pseudoacacia	6	5	2	-	2	3
Prunus serotina Ehrh.	4	20	5	12	2	1
Morus alba	3	3	1			
Picea pungens	2	30	6	14	3	2
Ulmus laevis	2	5	2			
Aesculus hyppocastanum	1	50	13	68	2	1
Pinus sylvestris	1	7	2	-	2	2
Ligustrum vulgare	21	8	1.5	-	1.5	2
Spiraea vanhouttei	13	7 ± 0.4	1.3 ± 0.2	-	2 ± 0.3	2 ± 0.3
Juniperus sabina	3	5	0.5	-	3	3
Juniperus communis	1	7	1	-	3	3
Philadelphus coronarius L.	1	7	2	-	2	2
Syringa vulgaris	1	7	2	-	2	2
Buxus sempervirens	1	5	0.5	-	3	3
Vitis vinifera L.	1	7	2	-	2	2



3: *Correspondence of plantings of Vyshgorod hospital to ideal distribution of Richards (1983)*

1 specimen of *Buxus sempervirens* L., 7 specimens of *Spiraea vanhouttei* (Briot) Zabel., 3 specimens of *Juniperus sabina* L., which grow in shaded areas behind hospital buildings.

The age structure of trees (Fig. 3) does not correspond to stable development: there are no older trees with a larger diameter, namely, they would bring peace to the hospital landscape.

In general, the following shortcomings in the organization of the landscaping area were revealed: lack of compositional solution of plantings; local loss of decorativeness due to excessive shading of the walls of buildings; violation of landscaping standards, namely non-compliance with the minimum distances from the wall of the building (in some places the distances are less than the normative 5 m) and non-compliance with the recommended ratio of trees and shrubs; ill-considered species composition, use of allergenic plants, lack of flower beds, limited use of beautiful flowering and ornamental deciduous shrubs, uniformity of colors; and in general - lack of attention to the emotional state of patients, staff and visitors. All this should be taken into account in the future landscape design of the territory. Both a quiet recreation area and an active area that would encourage older patients, as well as a children's area, need thoughtful landscaping. However, the creation of a hospital garden, taking into account all possible benefits, will require the expansion of the area of the site in the direction of the adjacent pine forest.

Public plantings of trees on the territory of the hospital were carried out in recent years, which however, were not well thought out, were performed without developed by relevant specialists a landscaping project and could not significantly improve the situation.

DISCUSSION

Landscaping of hospitals aims to create favorable sanitary and hygienic conditions for rest and recovery of patients (Aksyanova and Rossinina, 2009). It should be noted that attention to the needs of workers and visitors was not paid even in the regulations of the organization of hospitals in Soviet and post-Soviet times. It is generally accepted that the hospital project should take into account landscaping to help hospitalized patients recover faster. At the same time, the hospital garden also has a public purpose and becomes a real city park (Spanò, 2014). Unfortunately, the studied area has not even been considered to solve such problems so far, although such potential is available.

As a rule, the maximum landscaping of hospitals is recommended: at least 55% of the territory at the optimal 70%, but often the level of landscaping is even twice less than the norm (Aksyanova and Rossinina, 2009; Lovinska *et al.*, 2010). This standard for the hospital territory in Vyshgorod town is met: undeveloped areas occupy at least 55% of the territory.

According to (Lehmann *et al.*, 2010), medical institutions consume twice as much energy per unit area than office buildings and require a sustainable “healthy” architecture to reduce the negative impact on the environment. The effectiveness of the use of rows of trees of different species, including apple trees, as barriers to minimize electromagnetic pollution (Cuiñas *et al.*, 2005), as well as protection by perimeter ordinary plantings (Aksyanova and Rossinina, 2009) were reveal. However, such plantigs are currently absent in the study area. There are only row street plantings along the highway to the office center of the town on the border with the hospital.

Proper plant selection in hospital areas is important. According to (Akdeniz, 2020). 41.05% of trees and 58.95% of bushes are represented in hospitals. (It is known that a relatively large number of trees is desirable in more southern latitudes, where shading helps to create more comfortable conditions). Under study area, located in the area of mixed forests, 82% of trees are represented in the landscaping, although according to the standard (1 : 5) there should be about 11% of trees and 89% of bushes.

Only 11 species of woody plants in the amount of 30 specimens of trees and 14 specimens of shrubs on an area of 6 hectares in the hospital of Zaporozhye (Ukraine) were found and *Populus alba* L. *Betula pendula, Spiraea japonica* L. were predominant (Lovinska *et al.*, 2010). There is evidence that the use of native species provides patients with moral support (Akdeniz, 2020; Yucel, 2013). This recommendation was followed on the study hospital area, where the native plants predominates. It is noted that the contradiction between the provision of ecosystem services and the ecological integrity associated with the role of local species can be reduced by recognizing that non-native species are suitable for both ideas in urban landscapes (Conway *et al.*, 2019). Refusal to prioritize local species will allow for better coordination plans with current practice.

(Vardanyan, Airapetyan, 2009) to the functional capabilities of medical phytodesign include bactericidal, bacteriostatic, fungicidal action of specially selected plant species composition on pathogenic microflora. They recommended to use the most volatile *Juniperus*, as well as *Pinus*, *Picea, Betula, Quercus, Thuja, Acer, Larix, Sorbus, Padus, Siringa*.

Such species as *Acer negundo* L., *Malus baccata* (L.) Borkh., *Larix sibirica* Ledeb., *Prunus maackii* Rupr., and *Populus trichocarpa* Torr. & A. Grey ex. Hook. were dominated on the hospital territory in the study Aksyanova and Rossinina (2009), and 20% plants belonged to conifers and 80% to angiosperms on the territory of hospitals in the study Akdeniz (2020).

According to Ribeiro *et al.* (2009), the number of hospitalizations was positively correlated with tree pollen. The highest affinity was observed with pollen extracts of *Acer negundo, Salix babylonica* L. and *Platanus occidentalis* L., and the lowest - with *Populus* × *canescens* (Aiton) Sm. Allergenic species were found on the territory of the studied hospital, which indicates that this issue was not given the necessary attention during landscaping.

It is advisable to prefer trees with thick and spreading crowns, to contrasting colors, flowering shrubs; create colorful groups and many flower beds. Phytoncidal species are presented on the territory of the studied hospital, but it would be expedient to increase the number of plants of the genera *Juniperus, Sorbus, Picea*, to add plants of the generas *Larix, Padus, Siringa*.

It is important to take into account the aesthetic qualities and psycho-emotional impact of plants. According to the literature, stimulating plants include *Pinus sylvestris* L., *P. nigra* J. F. Arnold., *P. strobus* L., *Tilia cordata, Acer platanoides* with *Euonymus europaeus* L., *Viburnum opulus* L., *V. Lantana* L. Soothing plants include trees with a spreading or umbrella crown, such as *Acer* L., *Prunus* L., *Castanea* Mill., *Quercus robur* L. Plants of both groups are represented on the territory, but there is no well-thought-out design and recreational zoning of the territory.

We do not quite agree with (Lovinska *et al.*, 2010) that plant compositions should be only soothing and that lush, brightly flowering vegetation should be avoided. On the contrary, this landscapind design is better suited to a certain group of patients, encourages action and restores interest to life.

In hospital gardens, it is recommended to prefer green, blue, white, yellow and purple colors (Ender *et al.*, 2016). The aroma of plants is also important, especially for patients with visual impairments, memory loss (Yücel, 2013; Sakıcı and Var, 2013). *Pinus* sp., *Thuja* sp., *Ligustrum* sp. and *Buxus sempervirens* give a sense of calm and confidence and are widely used. According to scientific sources, white and cream flowering plants were used extensively in hospitals, but there were few plants with stimulant pink and yellow colors. The use of multicolored deciduous species is less common, and was not observed in our research area.

We agree that *Ligustrum* sp. are preferred as fence plants, species such as *Picea pungens* are preferred as accent plants and species as *Pinus* sp. for separating and guiding purposes. Among the recommended for landscaping hospitals blue species for the study area also can be offered *Abies concolor* (Gordon) Lindl. ex Hildebr., *Juniperus scoplorum* Sarg., *Picea pungens*, etc.; as pink, purple and yellow color plants - trees *Malus floribunda* Siebold ex Van Houtte, *Prunus* sp. and shrubs *Spirea arguta* Hook.F., *Syringa vulragis* L., etc.; as fragrant species - such as *Lavandula* sp. and *Rosmarinus* sp.; as species that attract birds and butterflies - such as *Buddleja davidii* Franch., *Elaeagnus pungens* Thunb. and *Viburnum* sp., as well as species with decorative autumn color, such as *Ginkgo biloba* L. and *Liriodendron tulipifera* L. (Franklin, 2012).

It is advised to take into account that children prefer combinations of flowers and sod plants, weeping forms of trees and small architectural forms in combination with plants (Allahyar and Kazemi, 2021). Vardanyan and Hayrapetyan (2009) when decorating flower beds recommend the maximum use of calm shades, prefer round and oval shapes, horizontal lines, which causes a sense of calm and tranquility. However, this recommendation is more suitable for medieval patients and staff. The recreation area for older people should set patients up for more active activities, which means

containing yellow, contrasting colors, accents with vertical shapes. We believe that on the territory of the Vyshgorod hospital, it would be appropriate to include in the landscape design flower beds with the recommended white-blue calm and yellow-pink life-affirming colors of flowers.

As noted Vardanyan and Hayrapetyan (2009), adherence to these nuances of landscaping the hospital area, contributing to the formation of the most favorable treatment and protection regime, will be an element of additional therapy for the patient, natural remedies from stress in connection with a diagnosis. In contact with Nature, the patient regains his mental strength, gains control over his feelings and emotions.

CONCLUSION

The analysis of literary sources shows that green spaces on the territory of the hospital can be an active element in the successful process of treatment and rehabilitation of patients. At the same time, the normative indicators of greening should take into account not only the level of greening of the territory and the capacity of patients in the hospital, but also the number of hospital staff and visitors and their needs. An important qualitative indicator of the landscaping of the hospital is the species composition of tree plantations, which should be selected taking into account all possible risks and benefits.

The reform of the health protection sector should also concern the landscape of hospital institutions. The study of the situation in the most numerous category of cities - small cities is currently relevant. The model Vyshhorod town is one of the small cities of the capital region with relatively high levels of greening. The study of the green zone on the territory of the hospital showed that the normative level of greening was observed on the territory, but the qualitative level of improvement of the territory was insufficient. The landscaping of the hospital is quite formal. At present the data of modern global research on the healing effect of green space is absolutely not taken into account. In this context, the research area has the potential to arrange a rest area, positive attitude of patients, inclusion of nature-based solutions in the process of their recovery.

The level of biodiversity of woody plants on the territory of the hospital is quite low, even lower than in the street landscaping of the city. Shannon Diversity Index of tree plants on the territory of the hospital equal 2.45 versus 2.71 for street plantings. A total of 28 types of trees and bushes are represented here. Local tree species predominate. We consider it expedient to enrich the plantation with interesting introduced species. It is also necessary to supplement plantings with bushy plants to the established normative ratio of trees and bushes. First of all, plantings should take place at the expense of phytoncide decorative, beautifully flowering and decoratively leafy bushes, such as *Caragana arborescens* Lam., *Viburnum opulus* L., *Juniperus* L., *Berberis* L., *Spiraea* L., *Forsythia* Vahl. At the same time, it will be necessary to combine plants into landscape compositions that provide a person with emotional and physical comfort.de a person with emotional and physical comfort.

High-quality designed territory in the form of a hospital garden has the potential to enrich the landscape of the whole small town and to become a favorite vacation spot of citizens. The results of research can serve as a basis for the development of recommendations for landscaping of medical institutions in small towns, in particular on the appropriate therapeutic and sustainable range of woody and shrubby plants.

REFERENCES

AKDENIZ, S. N. 2020. Woody Landscape Plants Used in The Design Of Hospital Gardens and Their Sensory Effects On Users. *Bartın Orman Fakültesi Dergisi*, 22(1): 47–62. https://doi.org/10.24011/barofd.619469

AKSYANOVA, T. Y. and ROSSININA, A. A. 2009. *Monitoring of green spaces on the territory of the city hospital. named after Karpovich in the Krasnoyarsk city* [in Russian: *Monitoring zelenyih nasazhdeniy na territorii gorodskoy bolnitsyi im. Karpovicha v gorode Krasnoyarske*]. Available at: https://studylib.ru/doc/3997730/monitoring-zelenyh-nasazhdenij-na-territorii-gorodskoj [Accessed: 2021, November 7]

ALLAHYAR, M. and KAZEMI, F. 2020. The role of dish gardens on the physical and neuropsychological improvement of hospitalized children. *Urban Forestry & Urban Greening*, 53: 126713. https://doi.org/10.1016/j.ufug.2020.126713

ALLAHYAR, M. and KAZEMI, F. 2021. Landscape preferences of a children's hospital by children and therapists. *Urban Forestry & Urban Greening*, 58: 126984. https://doi.org/10.1016/j.ufug.2021.126984

ASTELL-BURT, T., NAVAKATIKYAN, M. A. and FENG, X. 2020. Urban green space, tree canopy and 11-year risk of dementia in a cohort of 109,688 Australians. *Environment International,* 145: 106102. https://doi.org/10.1016/j.envint.2020.106102

BĄKOWSKI, J., POPLATEK, J. and KOŁODZIEJ, A. 2016. Hospital as a landscape mark. In: *3rd International Multidisciplinary Scientific Conference on Social Sciences & Arts SGEM,* 2016, pp. 303–310.

BRAÇE, O., GARRIDO-CUMBRERA, M., FOLEY, R., CORREA-FERNÁNDEZ, J., SUÁREZ-CÁCERES, G. and LAFORTEZZA, R. 2020. Is a View of Green Spaces from Home Associated with a Lower Risk of Anxiety and Depression? *International Journal of Environmental Research and Public Health*, 17(19): 7014. https://doi.org/10.3390/ijerph17197014

BULAKH, I., KOZAKOVA, O., DIDICHENKO, M. and CHALA, O. 2021. Systematization of Features and Recommendations Regarding Architectural and Urban Planning and Placement of University Hospitals. *Civil Engineering and Architecture*, 9(7): 2476–2491. https://doi.org/10.13189/cea.2021.090732

CHANG, H. T., WU, C. D., WANG, J. D., CHEN, P. S. and SU, H. J. 2021. Residential green space structures are associated with a lower risk of bipolar disorder: A nationwide population-based study in Taiwan. *Environmental Pollution*, 283: 115864. https://doi.org/10.1016/j.envpol.2020.115864

CHANG, K. and CHIEN, H. 2017. The Influences of landscape features on visitation of hospital green spaces–a choice experiment approach. *International Journal of Environmental Research and Public Health,* 14(7): 724. https://doi.org/10.3390/ijerph14070724

CHEN, H., BURNETT, R. T., BAI, L., KWONG, J. C., CROUSE, D. L., LAVIGNE, E., GOLDBERG, M. S., COPES, R., BENMARHNIA, T., ILANGO, S. D., VAN DONKELAAR, A., MARTIN, R. V. and HYSTAD, P. 2020. Residential greenness and cardiovascular disease incidence, readmission, and mortality. *Environmental Health Perspectives,* 128(8): 087005. https://doi.org/10.1289/EHP6161

CONWAY, T. M., ALMAS, A. D. and COORE, D. 2019. Ecosystem services, ecological integrity, and native species planting: How to balance these ideas in urban forest management? *Urban Forestry & Urban Greening*, 41: 1–5. https://doi.org/10.1016/j.ufug.2019.03.006

CUIÑAS, I., ALEJOS, A. V. and SÁNCHEZ, M. G. 2005. Vegetal barriers for minimising electromagnetic pollution at cellular phone bands. *Electronics Letters*, 41(6): 340. https://doi.org/10.1049/el:20058001

DADVAND, P., DE NAZELLE, A., FIGUERAS, F., BASAGAÑA, X., SU, J., AMOLY, E., JERRETT, M., VRIJHEID, M., SUNYER, J. and NIEUWENHUIJSEN, M. J. 2012. Green space, health inequality and pregnancy. *Environment International*, 40: 110–115. https://doi.org/10.1016/j.envint.2011.07.004

DUZENLI, T., YILMAZ, S. and EREN, E. T. 2017. A study on healing effects of hospital gardens. *Fresenius Environmental Bulletin*, 26(12): 7342–7352.

ELSADEK, M., LIU, B. and XIE, J. 2020. Window view and relaxation: Viewing green space from a high-rise estate improves urban dwellers' wellbeing. *Urban Forestry & Urban Greening*, 55: 126846. https://doi.org/10.1016/j.ufug.2020.126846

ENDER, E., AKDENIZ, N. S. and ZENCIRKIRAN, M. 2016. Colors and Landscape. *Journal of Agricultural Faculty of Uludag University*, 30: 669–676.

FRANKLIN, D. 2012. How Hospital Gardens Help Patients Heal. *Scientific American* [online]. Available at: https://www.scientificamerican.com/article/nature-that-nurtures/ [Accessed: 2021, November 10]

HALAJOVÁ, D., TÓTH, A. and BIHUŇOVÁ, M. 2019. Hospital green spaces as designed nature for recovery and recreation: case study Nitra, Slovakia. In: FIALOVÁ, J. (ed.). *Conference proceeding Public Recreation and Landscape Protection-With Sense Hand in Hand.* 13th–15th May 2019, Křtiny. Mendel university in Brno, Brno, pp. 185–191.

HEO, S. and BELL, M. L. 2019. The influence of green space on the short-term effects of particulate matter on hospitalization in the U.S. for 2000–2013. *Environmental Research,* 174: 61–68. https://doi.org/10.1016/j.envres.2019.04.019

HUMA, Z., LIN, G. and HYDER, S. L. 2021. Promoting Resilience and Health of Urban Citizen through Urban Green Space. *Water and Environmental Sustainability*, 1(1): 37–43. https://doi.org/10.52293/WES.1.1.3743

JATO-ESPINO, D., MOSCARDÓ, V., VALLINA RODRÍGUEZ, A. and LÁZARO, E. 2022. Spatial statistical analysis of the relationship between self-reported mental health during the COVID-19 lockdown and closeness to green infrastructure. *Urban Forestry & Urban Greening*, 68: 127457. https://doi.org/10.1016/j.ufug.2021.127457

JORGE, C., 2021. Landscape intervention in the Hospital for Covid-19 pandemic in Madrid. *Landscape Architecture and Art*, 18: 39–48. https://doi.org/10.22616/j.landarchart.2021.18.04

KARANIKOLA, P., ANDREA, V., TAMPAKIS, S. and TSOLAKIDOU, A. 2020. Indoor and Outdoor Design in Healthcare Environments: The Employees' Views in the General University Hospital of Alexandroupolis, Greece. *Environments,* 7(8): 61. https://doi.org/10.3390/environments7080061

LEHMANN, S., AL-QAWASMI, J. and AL WAER, H. 2010. *Sustainable Architecture and Urban Development*. (SAUD 2010), VOL III. CSAAR Press, pp. 431–446.

LOVINSKA, V. M., ZAYTSEVA, V. A., SYTNIK, S. A., VERBISKA, O. O. and TSYMBAL, T. S. 2010. Greening the hospital railway of Zaporizhzhia [in Ukrainian: Modernizatsiia systemy zelenykh nasadzhen na terytorii likarni zaliznychnykiv m. Zaporizhzhia]. *Issues of bioindication and ecology*, 15(2): 135–144.

LUO, S., XIE, J. and FURUYA, K. 2021. “We Need such a Space”: Residents' Motives for Visiting Urban Green Spaces during the COVID-19 Pandemic. *Sustainability*, 13(12): 6806. https://doi.org/10.3390/su13126806

MACHÓN, M., VROTSOU, K., LARRAÑAGA, I. and VERGARA, I. 2020. Proximity to Facilities and Its Association with the Health-Related Habits of Functionally Independent Older Adults. *International Journal of Environmental Research and Public Health,* 17(22): 8677. https://doi.org/10.3390/ijerph17228677

MARSELLE, M. R., BOWLER, D. E., WATZEMA, J., EICHENBERG, D., KIRSTEN, T. and BONN, A. 2020. Urban street tree biodiversity and antidepressant prescriptions. *Scientific Reports*, 10(1): 22445. https://doi.org/10.1038/s41598-020-79924-5

MIHANDOUST, S., JOSEPH, A., KENNEDY, S., MACNAUGHTON, P. and WOO, M. 2021. Exploring the Relationship between Window View Quantity, Quality, and Ratings of Care in the Hospital. *International Journal of Environmental Research and Public Health*, 18(20): 10677. https://doi.org/10.3390/ijerph182010677

PUDELSKA, K., DUDKIEWICZ, M., DURLAK, W. and PARZYMIES, M., 2016. An importance of the former and present therapeutic gardens. *Acta Scientiarum Polonorum Formatio Circumiectus,* 15(1): 125–137. https://doi.org/10.15576/ASP.FC/2016.15.1.125

PUN, V. C., MANJOURIDES, J. and SUH, H. H. 2018. Association of neighborhood greenness with self-perceived stress, depression and anxiety symptoms in older U.S adults. *Environmental Health*, 17(1): 39. https://doi.org/10.1186/s12940-018-0381-2

RIBEIRO, H., OLIVEIRA, M., RIBEIRO, N., CRUZ, A., FERREIRA, A., MACHADO, H., REIS, A. and ABREU, I. 2009. Pollen allergenic potential nature of some trees species: A multidisciplinary approach using aerobiological, immunochemical and hospital admissions data. *Environmental Research*, 109(3): 328–333. https://doi.org/10.1016/j.envres.2008.11.008

RICHARDS, N. A. 1983. Diversity and stability in a street tree population. *Urban Ecology,* 7(2): 159–171. https://doi.org/10.1016/0304-4009(83)90034-7

SAFFARINIA, M. TAVAKKOLI, S. and ALIPOR, A. 2012. Effects of Environmental Design Inspired by nature on Psychological and Physiological Responses of Clients in Medical Spaces. *International Journal of Environmental Research*, 6(3): 689–694.

SAKICI, C. and VAR, M. 2013. The Determination of Restorative Experiential Qualities and Design Attributes Because of Revealed to Recuperative Effects of Psychiatric Hospital Gardens. *Journal of the Faculty of Forestry, Istanbul University*, 63(2): 21–32.

SANTAMOUR, F. S. Jr. 2002. *Trees for urban planting: Diversity uniformity, and common sense.* U.S. Department of Agriculture.

SCHMOLDT, A., BENTHE, H. F. and HABERLAND, G. 1975. Digitoxin metabolism by rat liver microsomes. *Biochemical Pharmacology*, 24(17): 1639–1641.

SHEN, Y. S. and LUNG, S. C. C. 2016. Can green structure reduce the mortality of cardiovascular diseases? *Science of The Total Environment*, 566–567: 1159–1167. https://doi.org/10.1016/j.scitotenv.2016.05.159

SPANÒ, S. 2014. Urban Regeneration and Specialized Health Care Center. *Advanced Engineering Forum,* 11: 291–296. https://doi.org/10.4028/www.scientific.net/AEF.11.291

VARDANYAN, K. K. and HAYRAPETYAN, A. K. 2009. Landscaping as a natural factor in the hygienization of the external and internal environment of the operating hospitals in the Yerevan city [in Russian: Ozelenenie kak estestvennyiy faktor gigienizatsii vneshney i vnutrenney sredyi deystvuyuschih bolnits goroda Erevana]. *Medical Science of Armenia NAS RA*, 4: 105–110.

VUJCIC-TRKULJA, M., TOMICEVIC-DUBLJEVIC, J., TOSEVSKI, D. L., VUKOVIC, O. and TOSKOVIC, O. 2021. Development of Evidence-Based Rehabilitation Practice in Botanical Garden for People With Mental Health Disorders. *Health Environments Research & Design Journal*, 14(4): 242–257. https://doi.org/10.1177/19375867211007941

WEERASURIYA, R., HENDERSON-WILSON, C. and TOWNSEND, M. 2019. A systematic review of access to green spaces in healthcare facilities. *Urban Forestry & Urban Greening,* 40: 125–132. https://doi.org/10.1016/j.ufug.2018.06.019

YUCEL, G. F. 2013. Hospital Outdoor Landscape Design. In: *Advances in Landscape Architecture*. Chapter 15. IntechOpen. http://dx.doi.org/10.5772/55766

ZHANG, Z., JIA, Z. and ZHOU, Z. 2022. Can urban green space cure homesickness? Case study on China poverty alleviation migrants in Anshun, Guizhou. *Urban Forestry & Urban Greening*, 68: 127478. https://doi.org/10.1016/j.ufug.2022.127478

ZHAO, R. L., ZHANG, G., WANG, X., ZHANG, B. T., GUO, L. N., NIU, L. X. and ZHANG, Y. L. 2019. Psycho-Physiological Effects of a Peony-Viewing Program on Middle-Aged and Elderly Individuals at Different Phenological Stages. *International Journal of Environmental Research and Public Health*, 16(3): 439. https://doi.org/10.3390/ijerph16030439

ZIBTSEVA, O. 2021. Tree species diversity in two small cities of Kyiv region, Ukraine. *AgroLife Scientific Journal*, 10(2): 218–227.
ZIBTSEVA, O. 2022. Tree Species Biodiversity in Small Ukrainian Towns. *Ekológia (Bratislava)*, 41(2): 161–171. https://doi.org/10.2478/eko-2022-0017.

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