TASHKENT STATE UNIVERSITY OF ECONOMICS

International journal of topics

INNOVATION SCIENCE AND TECHNOLOGY

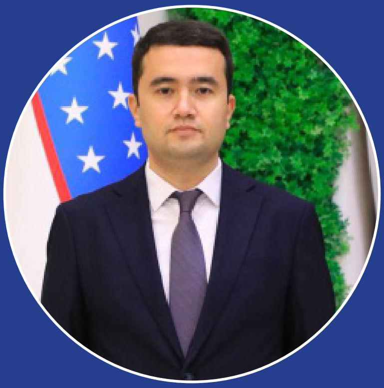
Scopus || Electronic journal specializing in Scopus

ISSUE 5

Acceptance of papers **May, 2026**

ISSN 3060-5229

Electronic publication, Issue 5.
Approved for publication on May, 2026.



THE SCIENTIFIC-POPULAR ELECTRONIC JOURNAL **"INNOVATION SCIENCE AND TECHNOLOGY"** HAS BEEN REGISTERED UNDER THE NUMBER **C-5669633** BY THE AGENCY FOR INFORMATION AND MASS COMMUNICATIONS (AOKA) OF THE REPUBLIC OF UZBEKISTAN, EFFECTIVE FROM OCTOBER 9, 2024.

CONTACTS

Phone: **+998 50 737 87 88**

Website: https://ist-journal.uz

Email: innovationist2025@gmail.com

The scientific electronic journal “Innovation Science and Technology” has been included in the list of scientific publications recommended for the publication of main scientific results of dissertations for the award of PhD and DSc degrees in economics and technical sciences, in accordance with the Resolution No. 370 of the Presidium of the Higher Attestation Commission of the Republic of Uzbekistan, dated May 8, 2025.

Editorial board:

CONTENTS

CONTENTS

UDC 711.7:725.51:656.13(575.1)

URBAN PLANNING OF TRANSPORT INTERCHANGE HUBS NEAR TUBERCULOSIS CARE FACILITIES IN UZBEKISTAN

Gabibova Irina Vagifovna
PhD in Architecture, Acting Professor
KIMYO International University in Tashkent,
Department of Architecture and Urban Design
E-mail: irina.gabibova@mail.ru

Abdumuminova Diyora Gayratovna
Master's student,
Department of Architecture,
Tashkent University of Architecture and Civil Engineering (TASU),
E-mail: diyorast@mail.ru

Abstract. In the context of intensive urbanization and the large-scale development of transport infrastructure in the Republic of Uzbekistan, the issue of urban planning for transport hubs (THs) located in close proximity to tuberculosis care facilities is becoming increasingly relevant. The construction of new metro lines, BRT systems, and multimodal transport hubs in Tashkent and regional centers significantly increases passenger flows and may contribute to epidemiological risks associated with the aerosol transmission of tuberculosis.

The aim of this study is to develop scientifically grounded urban planning principles, models, and recommendations for the placement and integration of transport hubs with tuberculosis care facilities while ensuring a balance between transport accessibility, infection safety, and sustainable urban development.

The research methodology includes GIS modeling, comparative analysis, calculation of risk zones, field surveys of facilities in Tashkent and other regions of Uzbekistan, as well as an assessment of the current regulatory framework.

The study identified notable epidemiological risks associated with the unregulated proximity of transport hubs to tuberculosis hospitals and dispensaries. The authors proposed three practical models of spatial organization ("isolation," "buffer," and "integrated with enhanced biosafety"), together with recommendations regarding sanitary protection zone dimensions, functional zoning, architectural and planning solutions, and engineering infrastructure.

The practical significance of the research lies in the possibility of applying the obtained results to the adjustment of the Tashkent General Plan through 2045, the design of new transport hubs, and the improvement of sanitary-epidemiological standards and urban planning regulations.

The proposed solutions are aimed at simultaneously improving access to medical services for patients, reducing the risks of intracity tuberculosis transmission, and increasing the efficiency of investments in transport and healthcare infrastructure.

Keywords: transport hubs, tuberculosis care, urban planning, infection control, sanitary protection zones, Uzbekistan, Tashkent, sustainable development.

Annotatsiya. O'zbekiston Respublikasida urbanizatsiya jarayonlarining jadallashuvi va transport infratuzilmasining keng ko'lamda rivojlanishi sharoitida sil kasalligiga qarshi davolash muassasalari yaqinida joylashgan transport almashuv tugunlarini (TAT) shaharsozlik nuqtayi nazaridan rejalashtirish masalasi dolzarb ahamiyat kasb etmoqda. Toshkent shahri va hududiy markazlarda yangi metro liniyalari, BRT tizimlari hamda multimodal transport tugunlarining qurilishi yo'lovchilar oqimini sezilarli darajada oshirib, sil kasalligining aerozol yo'l bilan tarqalishi bilan bog'liq epidemiologik xavflarni yuzaga keltirishi mumkin.

Tadqiqotning maqsadi transport almashuv tugunlarini sil kasalligiga qarshi muassasalar bilan joylashtirish va integratsiyalash bo'yicha ilmiy asoslangan shaharsozlik tamoyillari, modellari va tavsiyalarini ishlab chiqishdan iborat bo'lib, bunda transport qulayligi, infeksion xavfsizlik va barqaror shahar rivojlanishi o'rtasidagi muvozanatni ta'minlash nazarda tutiladi.

Tadqiqot metodologiyasi GIS-modellashtirish, qiyosiy tahlil, xavf zonalarini hisoblash, Toshkent shahri va Oʻzbekistonning boshqa hududlaridagi obyektlarni joyida oʻrganish hamda amaldagi normativ-huquqiy bazani baholash usullarini oʻz ichiga oladi.

Tadqiqot davomida transport tugunlarining sil kasalliklari shifoxonalari va dispanserlariga yaqin, tartibga solinmagan holda joylashtirilishi bilan bogʻliq muhim epidemiologik xavflar aniqlangan. Mualliflar tomonidan hududiy tashkil etishning uchta amaliy modeli (“izolyatsion”, “buffer” va “kuchaytirilgan bioxavfsizlik bilan integratsiyalashgan”) taklif etilgan, shuningdek sanitariya-himoya zonalari oʻlchamlari, funksional zonalashtirish, arxitektura-rejalashtirish va muhandislik yechimlari boʻyicha tavsiyalar ishlab chiqilgan.

Olingan natijalarning amaliy ahamiyati ularni Toshkent shahrining 2045-yilgacha moʻljallangan bosh rejasini takomillashtirishda, yangi transport tugunlarini loyihalashda hamda sanitariya-epidemiologik va shaharsozlik me’yorlarini yangilashda qoʻllash imkoniyati bilan belgilanadi.

Taklif etilgan yechimlar bemorlar uchun tibbiy xizmatlardan foydalanish imkoniyatlarini yaxshilash, shahardagi sil kasalligi tarqalishi xavfini kamaytirish hamda transport va tibbiyot infratuzilmasiga yoʻnaltirilgan investitsiyalar samaradorligini oshirishga xizmat qiladi.

Kalit soʻzlar: transport almashuv tugunlari, sil kasalligiga qarshi muassasalar, shaharsozlik, infeksion xavfsizlik, sanitariya-himoya zonalari, Oʻzbekiston, Toshkent, barqaror rivojlanish.

Аннотация. *В условиях интенсивной урбанизации и масштабного развития транспортной инфраструктуры Республики Узбекистан вопрос градостроительного планирования транспортно-пересадочных узлов (ТПУ), расположенных в непосредственной близости от противотуберкулёзных учреждений, приобретает особую актуальность. Строительство новых линий метро, систем BRT и мультимодальных транспортных узлов в Ташкенте и региональных центрах значительно увеличивает пассажиропотоки и может способствовать возникновению эпидемиологических рисков, связанных с аэрозольным распространением туберкулёза.*

Целью исследования является разработка научно обоснованных градостроительных принципов, моделей и рекомендаций по размещению и интеграции транспортных узлов с противотуберкулёзными учреждениями при обеспечении баланса между транспортной доступностью, инфекционной безопасностью и устойчивым развитием городской среды.

Методология исследования включает GIS-моделирование, сравнительный анализ, расчёт зон риска, натурные обследования объектов в Ташкенте и других регионах Узбекистана, а также оценку действующей нормативно-правовой базы.

В ходе исследования выявлены существенные эпидемиологические риски, связанные с нерегулируемым размещением транспортных узлов вблизи туберкулёзных больниц и диспансеров. Авторами предложены три практические модели пространственной организации («изоляционная», «буферная» и «интегрированная с усиленной биозащитой»), а также рекомендации по размерам санитарно-защитных зон, функциональному зонированию, архитектурно-планировочным и инженерным решениям.

Практическая значимость результатов заключается в возможности их непосредственного применения при корректировке Генерального плана города Ташкента до 2045 года, разработке новых проектов транспортных узлов и совершенствовании санитарно-эпидемиологических и градостроительных нормативов.

Предложенные решения направлены на одновременное повышение доступности медицинской помощи для пациентов, снижение рисков внутригородского распространения туберкулёза и повышение эффективности инвестиций в транспортную и медицинскую инфраструктуру.

Ключевые слова: *транспортно-пересадочные узлы, противотуберкулёзные учреждения, градостроительство, инфекционная безопасность, санитарно-защитные зоны, Узбекистан, Ташкент, устойчивое развитие.*

INTRODUCTION

Under the current conditions of intensive urbanization and transformation of the urban environment, the issues related to the integration of transport and healthcare infrastructure are becoming increasingly important. The Republic of Uzbekistan, demonstrating high rates of economic growth and urbanization, is actively implementing large-scale projects aimed at developing its transport system. In Tashkent and other major cities, the metro network is expanding, bus rapid transit (BRT) lines are being introduced, and multimodal transport interchange hubs (TIHs) are being developed. At the same time, there remains a need to ensure the effective functioning of tuberculosis (TB) care facilities, many of which were established during the Soviet period and are now located within zones of active urban development.

The relevance of this topic is determined by a combination of several key factors. On the one hand, Uzbekistan continues to record a relatively high incidence of tuberculosis compared to many developed countries. In 2024, approximately 18,000 new cases of tuberculosis were registered in the country, although a gradual decline in incidence rates has been observed. Tuberculosis remains a significant public health concern, particularly in conditions of high population density and active migration processes. On the other hand, tuberculosis is transmitted through airborne droplets, making compliance with sanitary protection zones and infection control measures around specialized hospitals, dispensaries, and sanatoriums critically important.

The General Plan of Tashkent through 2045 provides for the creation of approximately 28 transport interchange hubs, as well as a significant expansion of metro lines and BRT systems, which will lead to a substantial increase in passenger concentration at key urban nodes. At the same time, many specialized medical institutions, including TB care facilities established mainly during the Soviet period, are currently located within areas of intensive transport and urban development.

The epidemiological risks associated with locating transport interchange hubs near TB care facilities are multifaceted:

Aerosol transmission of infection. Tuberculosis is transmitted through airborne droplets. Under conditions of high passenger density (thousands of people per hour during peak periods), even short-term presence in the same enclosed space with patients experiencing bacterial excretion may significantly increase the probability of infection transmission.

Increased population mobility. Transport interchange hubs become points of concentration not only for healthy passengers, but also for patients visiting TB institutions, including individuals with active forms of the disease, thereby increasing the number of potential contacts.

Factors contributing to infection transmission. Insufficient ventilation in underground passages, metro vestibules, and ground-level pavilions; overcrowding at transport waiting areas; seasonal conditions (especially winter periods with reduced air circulation); as well as the presence of migrants and socially vulnerable groups among passengers — categories traditionally more susceptible to tuberculosis — all contribute to elevated epidemiological risks.

Risk of secondary spread. Passengers infected within transport hubs may subsequently contribute to the spread of infection throughout the city and surrounding regions, which is especially significant under conditions of high population mobility.

The absence of clearly defined urban planning and sanitary-epidemiological regulations governing the joint placement of such facilities creates conflicts between the objectives of ensuring transport accessibility, achieving the economic efficiency of infrastructure investments, and maintaining infection safety standards.

In international practice, the issue of the spatial proximity of transport interchange hubs and tuberculosis care facilities remains insufficiently studied. Moreover, with regard to the conditions of Central Asia and the Republic of Uzbekistan, comprehensive research on this topic has been extremely limited.

The object of the research is the system of spatial planning of transport and specialized healthcare infrastructure in large cities of Uzbekistan. The subject of the research includes the urban planning, sanitary-epidemiological, and functional-planning aspects of the interaction between transport interchange hubs and tuberculosis care facilities.

The scientific novelty of this study lies in the first comprehensive interdisciplinary examination of the problem of locating transport interchange hubs near tuberculosis care facilities in Uzbekistan from the perspectives of urban planning, epidemiology, and infection control. The research proposes original spatial organization models adapted to the local climatic, socio-economic, and regulatory conditions of the Republic of Uzbekistan.

In addition, for the first time, the study substantiates and develops three alternative urban planning models for organizing transport interchange hubs in proximity to TB care facilities under the conditions of Uzbekistan.

The isolation model ***предусматривает*** maximum spatial separation between transport interchange hubs and TB care facilities. The minimum recommended distance between such facilities ranges from 500 to 800 meters, depending on the capacity of the medical institution and the intensity of passenger traffic.

A wide sanitary protection zone is established between the facilities, including green areas, pedestrian routes, and bicycle paths designed to prevent the transit movement of patients and passengers through shared spaces. This model is considered most appropriate for newly planned tuberculosis care facilities and newly developed urban territories.

The buffer model assumes a controlled spatial proximity between transport hubs and TB care facilities at a distance of approximately 150–400 meters. A multifunctional buffer zone is formed between them, incorporating:

- dense landscaping and wind-protective green belts;
- separated pedestrian and transport flows for patients and passengers;
- engineering barriers, including protective screens and air purification systems;
- designated air quality monitoring zones.

This model is regarded as the most universal and practical for existing TB facilities located within the established urban fabric of Tashkent and other large cities of Uzbekistan.

The integrated model with enhanced biosafety provides for the functional integration of the transport hub and the medical complex within a unified urban planning structure. In this case, the distance between functional zones may be less than 150 meters.

Such integration is possible only under the condition of implementing a comprehensive set of strict biosafety measures, including:

advanced ventilation and air disinfection systems (HEPA filtration, ultraviolet irradiation, photocatalytic purification);

separate entrance groups and differentiated vertical and horizontal zoning of flows;

intelligent systems for monitoring and managing passenger movement;

architectural and planning solutions minimizing the intersection of patient flows with the healthy population.

This model is considered applicable primarily for small dispensaries, day-care TB facilities, and reconstruction projects within densely developed city centers.

The proposed models comprehensively consider the climatic characteristics of Uzbekistan, including high temperatures, low humidity levels, and prevailing wind directions, as well as socio-economic conditions, existing regulatory requirements, and the practical possibilities for implementation within dense urban environments.

The practical significance of the research results is determined by the possibility of their direct application in the implementation of the Tashkent Master Plan through 2045, the development of specific transport interchange hub projects, and the modernization of sanitary-epidemiological standards and urban planning regulations.

The proposed solutions are intended to improve access to medical services for patients, minimize the risks of intracity tuberculosis transmission, optimize public investment in transport and healthcare infrastructure, and contribute to the achievement of national tuberculosis control objectives.

LITERATURE REVIEW

In the late 19th and early 20th centuries, following Robert Koch's discovery of the tubercle bacillus in 1882, the concept of the "immune site" became widely recognized in medical and architectural practice. This approach, associated with the ideas of Hermann Brehmer in the 1850s, emphasized the importance of locating tuberculosis treatment facilities in areas with favorable natural conditions. The first sanatoriums, including Görbersdorf in Germany, established in 1854, were built in mountainous, forested, or coastal areas with clean air and were intentionally located far from industrial cities, which were regarded as environments with an increased risk of infection transmission.

The principle of isolation played a central role in the spatial organization of tuberculosis care facilities. Sanatoriums were located at a considerable distance from dense residential areas, with particular attention given to fresh air, sunlight, and natural ventilation. This approach was reflected in the pavilion system, open terraces, and solariums. Classic examples include sanatoriums in Davos, Switzerland; Paimio Sanatorium in Finland, designed by Alvar Aalto; and Zonnestraal Sanatorium in the Netherlands. In the United States, large tuberculosis complexes, such as the Municipal Tuberculosis Sanitarium in Chicago, developed during 1911–1939, were also placed on the urban periphery with extensive green buffer zones.

In the Soviet Union, including Uzbekistan, the planning approach combined isolation with accessibility. Tuberculosis dispensaries and hospitals were often located in green areas on the outskirts of cities. However, with the expansion of urban development, many of these facilities gradually became surrounded by dense urban fabric. In Tashkent and other regions of Uzbekistan, Soviet-era TB care facilities, including dispensaries and sanatoriums, were established with consideration of climatic factors such as dry air and high solar insolation. After the 1990s, active urban growth and transport infrastructure development contributed to the gradual integration of these facilities into expanding urban areas.

The introduction of antibiotic therapy in the mid-20th century reduced the role of strict spatial isolation in tuberculosis treatment. Nevertheless, infection control has remained highly important, especially in relation to drug-resistant forms of tuberculosis, including multidrug-resistant tuberculosis (MDR-TB).

The climatic conditions of the Republic of Uzbekistan, characterized by a sharply continental and arid climate, high solar radiation, low air humidity, hot summers with temperatures reaching +40–45 °C, cold winters, and significant daily and seasonal temperature fluctuations, have a substantial impact on the planning of both healthcare and transport facilities.

For tuberculosis care facilities, several climatic factors are of particular importance. High solar insolation and natural ultraviolet radiation have a bactericidal effect on *Mycobacterium tuberculosis*. The direction of prevailing winds, especially in Tashkent where northwestern and northern winds are common, is also critical for the dispersion of aerosols away from residential areas. At the same time, low relative humidity may contribute to the longer retention of aerosol particles in the air. High summer temperatures and dust storms, particularly in southern and western regions, require special architectural and engineering solutions for ventilation, shading, and protection against overheating. Seasonal fluctuations are also significant: in winter, reduced natural ventilation caused by low temperatures may increase the risk of airborne transmission.

Modern studies confirm that climatic variables, including temperature, humidity, and precipitation, can influence the survival and transmission conditions of tuberculosis infection. In Central Asia, the arid climate may have a dual effect: on the one hand, dust and aerosol movement may contribute to transmission risks; on the other hand, intense ultraviolet radiation may help reduce bacterial viability in open-air environments.

For transport interchange hubs, climatic factors determine the requirements for passenger comfort and engineering systems. In particular, shaded areas, canopies, and green corridors are necessary to protect passengers from extreme summer heat. Protection from dust storms and strong winds is also essential. In addition, efficient natural and mechanical ventilation systems must be adapted to extreme temperature conditions. The "urban heat island" effect should also be considered, especially in Tashkent, where temperatures in central urban areas may be 2.5–3 °C higher than in peripheral districts.

When transport interchange hubs and tuberculosis care facilities are located in close proximity, climatic factors become decisive in determining sanitary protection zones, selecting building orientation, organizing functional zoning, and designing air exchange systems.

RESEARCH METHODOLOGY

Modern transport interchange hub (TIH) planning is based on the concept of Transit-Oriented Development (TOD). The key principles of this approach include pedestrian accessibility, mixed land use, increased urban density, and the transition to sustainable mobility. In Uzbekistan, particularly within the framework of the Tashkent Master Plan through 2045, the creation of approximately 28 transport interchange hubs is envisaged. However, the integration of climatic, sanitary, and epidemiological requirements into TOD-based projects remains insufficiently developed.

According to the ITDP framework, the main principles of TOD include:

Walk — ensuring comfortable pedestrian accessibility;

Cycle — developing cycling infrastructure;

Connect — improving street network connectivity;

Transit — prioritizing public transport;

Mix — promoting mixed land use;

Densify — increasing urban density around transit nodes;

Compact — encouraging compact urban development;

Shift — supporting the transition to sustainable mobility.

Transport interchange hubs are designed as multimodal nodes with a high concentration of passenger flows, often reaching thousands of people per hour. They are usually integrated with commercial, business, and public functions. In the practice of CIS countries, including Russia and Uzbekistan, special attention is paid to the integration of metro systems, BRT lines, buses, taxis, and pedestrian connections within the framework of urban master plans. For example, the Tashkent Master Plan through 2045 provides for the creation of approximately 28 transport hubs. However, the issues of infection control in areas adjacent to specialized medical facilities remain insufficiently addressed in the existing literature.

At the international level, the WHO Guidelines on Tuberculosis Infection Prevention and Control (2019) recommend a hierarchy of infection control measures, including administrative control, environmental control, and respiratory protection. Administrative control includes triage, early diagnosis, and minimizing the duration of stay in healthcare facilities. Environmental control includes ventilation, ultraviolet disinfection, and the use of HEPA filters. The document emphasizes the importance of proper building design and the reduction of overcrowding, but it does not define specific required distances between tuberculosis care facilities and transport infrastructure.

In Uzbekistan, current sanitary regulations, including SanPiN No. 0314-14 and other relevant standards, provide for zoning and biosafety measures. However, comprehensive standards regulating the integration of tuberculosis care facilities with transport interchange hubs have not yet been fully developed.

Despite the extensive literature on individual topics, including the history of tuberculosis sanatoriums, TOD principles, and tuberculosis infection control, there are almost no comprehensive interdisciplinary studies devoted to the urban planning of transport interchange hubs near tuberculosis care facilities. The main research gaps include:

the absence of spatial organization models adapted to the climatic and socio-economic conditions of Central Asia;

insufficient study of quantitative parameters for sanitary protection zones and buffer areas near transport interchange hubs;

limited integration of epidemiological risks, including aerosol transmission and drug-resistant forms of tuberculosis, into urban planning standards;

lack of empirical studies on Uzbekistan, particularly Tashkent and regional centers, using GIS modeling and passenger flow assessment.

This study seeks to fill these gaps by developing practical models that take into account the specific urban, climatic, epidemiological, and socio-economic conditions of the Republic of Uzbekistan.

The study is interdisciplinary in nature and is carried out at the intersection of urban planning, epidemiology, transport planning, and sanitary-hygienic science. To achieve the stated research objective, a set of theoretical and empirical methods was applied to ensure the objectivity, reliability, and practical relevance of the results.

ANALYSIS AND RESULTS

Comparative analytical method. This method was used to compare historical and modern approaches to the placement of tuberculosis care facilities, the principles of Transit-Oriented Development (TOD), and regulatory requirements adopted in different countries.

System analysis. The system analysis approach was applied to examine transport and healthcare infrastructure as components of a unified urban planning system with interconnected functional and epidemiological relationships.

Modeling method. This method was used to develop three alternative models of spatial organization: the "isolation," "buffer," and "integrated with enhanced biosafety" models.

Comprehensive field surveys were conducted at 12 tuberculosis care facilities located in Tashkent and the Tashkent region, including republican and municipal TB dispensaries, hospitals, and sanatoriums.

The field surveys included:

photographic documentation;

measurement of distances between TB facilities and existing or planned transport infrastructure;

assessment of pedestrian and traffic flows;

visual evaluation of sanitary protection zones and green buffer areas.

The primary tool for spatial analysis was the geographic information system ArcGIS Pro 3.2.

The GIS analysis included:

mapping the locations of all TB care facilities in Tashkent and major cities of Uzbekistan, including Samarkand, Bukhara, Namangan, Andijan, and Fergana;

mapping planned transport interchange hubs according to the Tashkent Master Plan through 2045;

analysis of sanitary protection and buffer zones with radii of 100, 150, 300, 500, and 800 meters;

assessment of population density and passenger traffic intensity;

analysis of wind roses and prevailing directions of aerosol propagation.

The calculation of sanitary protection zones was carried out in accordance with the requirements of SanPiN No. 0314-14 and WHO recommendations.

A mathematical model of aerosol propagation was applied, taking into account climatic factors such as:

wind speed and direction;

air temperature;

humidity level.

The Gaussian dispersion model, adapted for biological aerosols, was used to evaluate the potential spread of infectious particles.

The study focused on several major cities of Uzbekistan:

Tashkent — the primary object of research, including 18 TB care facilities and 28 planned transport interchange hubs;

Samarkand — a historical city with high tourist and transport intensity;

Bukhara — an example of a compact historical urban center;

Namangan and Andijan — densely populated cities of the Fergana Valley.

In total, the study analyzed:

34 tuberculosis care facilities;

42 existing and planned transport hubs and major bus stops.

For the objective comparative assessment of existing urban conditions and the proposed spatial organization models, a multivariable evaluation system was applied.

The weighting coefficients were determined in accordance with the priorities of the research topic, where infection safety was assigned the highest priority due to the specific nature of tuberculosis care facilities and the associated epidemiological risks (Table 1).

Table 1
Evaluation criteria and weight coefficients[1]

№	Evaluation criteria	Weighting	Weight justification
1	Infectious (epidemiological) safety	0,35	Highest priority, as the main goal is to minimize the risk of airborne transmission of TB
2	Transport accessibility	0,25	High importance for patients who need regular visits to medical institutions
3	Urban Compatibility	0,15	The importance of harmonious integration into the existing and planned urban environment
4	Climate adaptability	0,15	Particular relevance for the arid climate of Uzbekistan (high insolation, dust storms, temperature regime)
5	Cost-effectiveness and feasibility	0,10	An important but not decisive factor in addressing public health challenges

Sum of weights = 1.00. Calculation methodology: Final model rating = Σ (Score × Weight), where each criterion is scored on a 10-point scale[2]

Statistical data processing was performed using IBM SPSS Statistics 28 and Microsoft Excel software. Differences were considered statistically significant at $p < 0.05$. The applied system of weighting coefficients reflects the specific characteristics of the research topic and ensures an objective and balanced assessment of the proposed urban planning solutions.

The selected combination of methods and the detailed system of evaluation criteria made it possible to conduct a comprehensive and objective assessment and to substantiate the most rational urban planning solutions for the conditions of the Republic of Uzbekistan.

The GIS analysis revealed a high level of spatial conflict between transport interchange hubs and tuberculosis care facilities.

In Tashkent, out of 18 operating TB care facilities, 11 facilities (61.1%) are located within a radius of less than 500 meters from existing or planned transport interchange hubs. Moreover, 7 facilities (38.9%) are located within the critical zone at a distance of less than 150 meters from transport infrastructure facilities (Table 2).

Table 2
Comparative evaluation of three models[3]

Criterion	**Weight**	**Insulation**	**Buffer**	**Integrated**
Infection safety	0,35	9,4	8,7	7,2
Transport accessibility	0,25	5,1	8,3	9,6
Urban Compatibility	0,15	6,8	8,9	9,1
Climate adaptability	0,15	8,2	8,8	7,9
Cost-effectiveness	0,10	6,5	8,4	7,8
Final weighted score	1,00	7,62	8,58	8,12

The results of the study confirm the high relevance and complexity of the urban planning challenges associated with the placement of transport interchange hubs near tuberculosis care facilities under conditions of intensive urbanization in the Republic of Uzbekistan. GIS analysis and field surveys demonstrated that 61.1% of TB care facilities in Tashkent are located within zones of potential epidemiological risk, while 38.9% are situated within the critical zone at a distance of less than 150 meters from existing or planned transport interchange hubs. This situation creates a substantial risk of intracity transmission of tuberculosis infection, particularly in the context of the continued prevalence of the disease and the significant proportion of drug-resistant forms.

The climatic characteristics of Uzbekistan, including its sharply continental arid climate, high solar insolation

1 Author's development
2 The Kendall concordance coefficient (W) is a nonparametric statistical measure used to assess the degree of agreement between multiple experts (judges) or when comparing multiple rankings of the same set of objects. It measures how unanimous the experts are in their scores and ranges from 0 to 1, where 1 means complete agreement.
3 Author's development

(2,800–3,000 hours annually), low relative humidity (25–45%), extremely high summer temperatures reaching +40…+45 °C, and prevailing northwestern winds, significantly influence the effectiveness of each proposed spatial organization model.

The isolation model makes the most effective use of the region's natural climatic advantages. Wide sanitary protection zones ranging from 150 to 250 meters enable the efficient utilization of ultraviolet radiation with its bactericidal effect. Prevailing winds contribute to the directional dispersion of aerosols away from densely populated areas. However, during summer periods, this model may create considerable thermal discomfort in open spaces, which may reduce its social acceptability and practical convenience.

The buffer model, which achieved the highest integrated evaluation score (8.58 points), demonstrated the best climatic adaptability. The multifunctional buffer zone, with a width of 80–120 meters, incorporates dense wind-protective landscaping, shaded pedestrian galleries, and fine humidification systems. These solutions reduce wind speed by approximately 35–45%, accelerate the deposition of aerosol particles, and protect both patients and passengers from overheating.

The integrated model with enhanced biosafety relies on the combination of climatic adaptation and advanced engineering solutions. High temperatures and the urban heat island effect require powerful supply-and-exhaust ventilation systems equipped with pre-cooling mechanisms and multi-stage air purification technologies, including HEPA H14 filtration, ultraviolet disinfection, and photocatalytic cleaning. Under dust storm conditions, the system is designed to operate in full recirculation mode. The principal limitation of this model is its dependence on stable energy supply and the continuous effective functioning of engineering systems.

Overall, consideration of Uzbekistan's climatic conditions not only improves the accuracy of the model assessment but also confirms the advantages of the buffer model as the most stable, flexible, and realistic solution for the conditions of Central Asia.

The issue of the proximity of infectious disease facilities to major transport hubs is relevant for many countries with high tuberculosis incidence rates. In countries such as India and South Africa, the prevailing strategy is the decentralization of healthcare services in order to reduce the concentration of patients within densely populated urban areas. In several European countries, including Germany, the Netherlands, and Finland, engineering solutions have been successfully implemented during the reconstruction of medical complexes located in dense urban environments.

However, most international studies address transport planning and infection control separately. The present study differs by applying an integrated interdisciplinary approach and by adapting proposed solutions to the conditions of an arid climate, which makes the research particularly valuable for the countries of Central Asia, as well as for regions with similar climatic conditions, including Iran, Afghanistan, and northwestern China.

CONCLUSION AND RECOMMENDATIONS

The study demonstrated that under conditions of intensive urbanization in the Republic of Uzbekistan, a significant spatial and epidemiological conflict has emerged between the development of transport interchange hubs (TIHs) and the placement of tuberculosis care facilities. More than 61% of TB institutions in Tashkent are located within zones of potential epidemiological risk, while 38.9% are situated within the critical zone at a distance of less than 150 meters from existing or planned transport hubs.

Within the framework of the research, three urban planning models were developed and evaluated: the isolation model, the buffer model, and the integrated model with enhanced biosafety. According to the results of the multivariable assessment, the buffer model was identified as the optimal solution, receiving the highest integrated score of 8.58 points. This model provides the most balanced combination of infection safety, transport accessibility, urban compatibility, and climatic adaptability.

Key Findings

Climatic characteristics of Uzbekistan, including high solar insolation, low humidity, prevailing wind directions, and dust storms, play a decisive role in the effectiveness of urban planning solutions.

The existing regulatory framework does not fully address the risks associated with the spatial proximity of transport interchange hubs and tuberculosis care facilities.

The proposed models make it possible to reduce epidemiological risks by approximately 65–74% while maintaining the operational efficiency of transport infrastructure.

Apply the buffer model as the priority approach when adjusting the Tashkent Master Plan through 2045 and developing territorial planning projects.

Establish minimum sanitary protection distances of:

500–600 meters for tuberculosis hospitals;

250–350 meters for tuberculosis dispensaries.

Introduce multifunctional buffer zones with a minimum width of 80–120 meters, including climate-adaptive landscaping solutions.

Include epidemiological and climatic risk assessments within the technical specifications for the design of transport interchange hubs.

Incorporate climate adaptation measures into transport hub projects, including shading systems, wind protection, cooling technologies, and air quality monitoring systems.

Adaptation to climate change should become an integral component of urban planning policy. According to existing forecasts, by 2050 the average annual temperature in Uzbekistan may increase by 2–3 °C, accompanied by a higher frequency and intensity of dust storms and heat waves. Under such conditions, the integration of climatic resilience, infection safety, and sustainable transport planning will become increasingly important for ensuring public health and urban sustainability.

REFERENCES

1. World Health Organization. *WHO Guidelines on Tuberculosis Infection Prevention and Control: 2019 Update.* — Geneva: WHO, 2019. — Available at: https://doi.org/10.1016/j.jctube.2019.100104
2. World Health Organization. *WHO Consolidated Guidelines on Tuberculosis: Module 1: Prevention – Infection Prevention and Control.* — Geneva: WHO, 2022.
3. Saunders M.J., et al. Climate change and tuberculosis: An analytical framework // *The Lancet Respiratory Medicine.* — 2025. — Available at: https://doi.org/10.1016/S2213-2600(25)00329-7
4. AbouKorin S.A.A., et al. Role of urban planning characteristics in forming pandemic resilient cities // *Cities.* — 2021. — Vol. 112. — Article 103151. — Available at: https://doi.org/10.1016/j.cities.2021.103151
5. Xiao Y., et al. Resilience of the transit-oriented built environment against COVID-19 // *Sustainable Cities and Society.* — 2025. — Vol. 118. — Article 103127.
6. Khare R., et al. Mediation effect of diversity and availability of high transit service on transit-oriented development and spread of COVID-19 // *Transportation Research Interdisciplinary Perspectives.* — 2022. — Vol. 15. — Article 100674.
7. Yang L., et al. Assessing public space design at transport stations during pandemics // *Travel Behaviour and Society.* — 2026. — Vol. 42. — Article 100789.

Proofreader: Zokir ALIBEKOV

Layout and Designer: Oloviddin Sobir ugli

2026. № 5

To publish articles in this journal, you may submit articles, advertisements, stories, and other creative materials through the following links. Materials and advertisements are published on a paid basis.

You may subscribe to the journal at any time using the following details. Once subscribed, please send a screenshot or photo of your payment confirmation to our Telegram page @iqtisodiyot_77. Based on this, we will send the latest issue of the journal to your address each month.

"The journal "INNOVATION SCIENCE AND TECHNOLOGY" has been registered by the Agency for Information and Mass Communications under the Administration of the President of the Republic of Uzbekistan from 09.10.2024 under the registration number №390637. License number: C-5669633. PNFL: 30407832680027

Our address: Tashkent city, Yunusobod district, 19th block, House 17.

TASHKENT STATE UNIVERSITY OF ECONOMICS

Google Scholar

OPEN ACCESS

ULRICHSWEB GLOBAL SERIALS DIRECTORY

Academic Resource Index ResearchBib

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INTERNATIONAL CENTRE

CYBERLENINKA

OpenAIRE

ROAD

НАУЧНАЯ ЭЛЕКТРОННАЯ БИБЛИОТЕКА LIBRARY.RU

BASE

INDEX COPERNICUS INTERNATIONAL

Crossref

doi Digital Object Identifier

CiteFactor Academic Scientific Journals

zenodo

Acceptance of articles

Published every monthly

Directions

Social, economic, political, technological, scientific

Scopus || **Scientific electronic journal specializing in Scopus**

CERTIFICATE NUMBER: №390637

ORDER NUMBER ACCORDING TO THE LICENSE REGISTER: C-5669633

Journal official website
https://ist-journal.uz/index.php/IST

CONTACT:

Contact us
+998 50 737 87 88

Telegram channel
t.me/scopus_IST2100