Early Detection and Preventive Measures for Respiratory Diseases in Uzbekistan Case

Hakimakhon Ahunjonova

Department of Modeling of Hygienic and Medical Processes, Central Asian Medical University, Fergana, Uzbekistan

DOI: https://dx.doi.org/10.47772/IJRISS.2025.903SEDU0538

Received: 21 June 2025; Accepted: 21 July 2025; Published: 10 October 2025

ABSTRACT

This study analyses the burden, detection capacity, and prevention strategies for respiratory diseases in Uzbekistan in the post-2020 period. Drawing on national health statistics, predictive modelling, and clinical literature, it highlights persistently high incidence rates, pronounced seasonal fluctuations, and significant inequalities in access to care. While notable progress has been achieved since COVID-19, particularly in surveillance systems, intensive care capacity, and medical oxygen supply, critical challenges remain. These include the limited integration of forecasting tools into routine planning, diagnostic gaps in rural areas, and continued environmental risks that exacerbate respiratory vulnerability. The findings underscore the need for a more proactive, data-driven approach to respiratory health policy in Uzbekistan, linking predictive modelling and preventive outreach to long-term public health resilience.

Keywords: respiratory diseases, early detection, preventive measures, Uzbekistan, post-2020, public health.

INTRODUCTION

Respiratory diseases remain one of the leading causes of morbidity and mortality worldwide, imposing a heavy and persistent burden on health systems and populations (World Health Organization [WHO], 2023). Conditions such as chronic obstructive pulmonary disease (COPD), asthma, pneumonia, tuberculosis (TB), and acute respiratory infections (ARIs), compounded by the continuing aftershocks of the COVID-19 pandemic, demand coordinated and robust public health responses. Beyond their direct clinical impact, these diseases also carry profound social and economic consequences, especially in resource-constrained settings.

Uzbekistan, a landlocked Central Asian country with a dry continental climate, illustrates the multifactorial drivers of respiratory health challenges. Environmental stressors such as recurrent dust storms, high levels of urban air pollution from industrial emissions and vehicle exhaust, and poor indoor air quality exacerbate existing vulnerabilities (World Bank, 2022). The country also faces entrenched epidemiological risks, including a sustained burden of tuberculosis—often with drug-resistant strains—and one of the highest smoking prevalences among men in the region (WHO, 2023). Together, these factors shape a respiratory disease landscape that is both acute and chronic, infectious and environmental, biomedical and structural.

Since 2020, the COVID-19 pandemic has acted as a catalyst for health system reforms, accelerating investment in surveillance, emergency preparedness, and treatment infrastructure (Uzbek Ministry of Health, 2022; WHO, 2024a). Despite likely underreporting of official case numbers due to testing limitations, the pandemic spurred measurable improvements: expanded intensive care unit capacity, increased production and distribution of medical oxygen, and the integration of digital health monitoring platforms (WHO, 2024a; AIIB, 2021). These advances have created a foundation upon which broader respiratory health reforms can be built, though gaps remain in rural access, early detection, and preventive outreach. This paper critically examines Uzbekistan's post-2020 strategies for the early detection and prevention of respiratory diseases. Drawing on national health statistics, predictive modelling, and policy documents, it evaluates progress to date, identifies persistent structural and environmental challenges, and highlights opportunities for strengthening public health resilience in the years ahead.

LITERATURE REVIEW

The recent wave of scholarship on respiratory diseases in Uzbekistan has been shaped, almost inevitably, by the COVID-19 pandemic. Yet the literature also exposes longer structural deficiencies that long predate 2020. Taken together, these works illustrate a layered health landscape where infectious, chronic, and environmental burdens converge, but they also reveal the persistent lack of integration between clinical research, forecasting tools, and policy implementation.

The clinical studies conducted during the pandemic provide a useful point of departure. Kim et al. (2020), analysing more than a thousand hospitalised COVID-19 patients, demonstrated that fatigue, dry cough, and pharyngitis were the most common presenting symptoms. Crucially, their results highlighted sharp age-based disparities: patients in the 50–84 age bracket were far more likely to require oxygen therapy than their younger counterparts. What this paper made unambiguous was the need for age-stratified triage and resource allocation in epidemic conditions. Its significance lies less in the observation that older patients fare worse, this was well known globally, than in showing how this reality manifested in the Uzbek clinical setting, where oxygen scarcity had already been a defining constraint.

Expanding on these questions of clinical specificity, Ibadov et al. (2022) compared COVID-related acute respiratory distress syndrome (ARDS) with its non-COVID forms. Their work suggested that patients with COVID-associated ARDS exhibited higher tidal volumes and respiratory rates, signalling that mechanical ventilation protocols designed for classic ARDS may not apply straightforwardly in pandemic circumstances. The value of this study lies in its challenge to the idea of uniform protocols: it underscored the need to localise ICU practice and tailor interventions to pathophysiological realities, rather than rely exclusively on imported standards.

Forecasting models have added a different dimension to the literature. Ibragimov et al. (2025) employed EpiNow2 and nnetar to predict acute respiratory infection trends in Uzbekistan, identifying a pronounced seasonal spike in December 2023. Methodologically, the study marked a step forward: it demonstrated that advanced forecasting tools, long used in higher-income settings, can be adapted to Central Asian health data. Yet the authors also noted the limited translation of such forecasts into clinical or policy decision-making. Here the literature begins to point toward a key tension: the tools exist, the seasonal risks are known, but institutional mechanisms for acting on these insights remain underdeveloped.

Beyond viral and acute conditions, the neglected field of fungal respiratory diseases provides another angle of critique. Tilavberdiev et al. (2017) estimated that nearly 2 percent of the Uzbek population may suffer from severe or chronic mycoses, including over 1,900 cases of chronic pulmonary aspergillosis. That this burden is both widespread and largely undiagnosed speaks to systemic diagnostic shortfalls particularly outside tertiary centres where limited clinical awareness and lack of laboratory infrastructure combine to render fungal conditions invisible in national health statistics. This literature therefore challenges the narrow framing of respiratory health in terms of tuberculosis and viral infections alone.

The regional comparative literature confirms and amplifies these concerns. Tabyshova et al. (2020), in their systematic review across Central Asia and Russia, emphasised the paucity of data on non-tuberculous diseases such as COPD and asthma, while documenting alarmingly high rates of multidrug-resistant tuberculosis (MDR-TB). With treatment costs exceeding $10,000 per patient, MDR-TB exemplifies how respiratory disease becomes not only a biomedical challenge but also a crippling financial one for health systems with limited budgets. The insight here is that respiratory care in the region is shaped as much by macroeconomic capacity as by clinical knowledge, a theme still underexplored in the Uzbek context.

Finally, the vulnerability of paediatric populations has been highlighted by Shakirov and Ashurova (2020). Their analysis of children with severe burns showed how inhalation injuries frequently produced fatal pulmonary complications unless treated with advanced endoscopic and respiratory therapy. While seemingly specialised, this study extends the respiratory conversation into the environmental and occupational domain: children are disproportionately exposed to airborne toxins, and their outcomes often depend on access to advanced care that is unevenly distributed.

Taken together, these works underscore a recurrent pattern. The literature provides important clinical insights whether in the form of age-stratified outcomes, ICU ventilation strategies, predictive models, fungal disease prevalence, or paediatric vulnerabilities but it also remains fragmented. The central problem is not a lack of evidence but the absence of synthesis across domains. Forecasting studies rarely connect with ICU practice; fungal disease surveys remain detached from national surveillance priorities; and paediatric findings are seldom folded into broader preventive strategies. The critical aim, then, must be to move beyond documenting isolated burdens toward building an integrated framework that links epidemiological forecasting, clinical adaptation, and public health policy. Only then can Uzbekistan shift from a reactive stance to a genuinely preventive and anticipatory approach to respiratory health.

METHODS

This study adopts a retrospective, descriptive–analytical design to examine trends in respiratory diseases in Uzbekistan over the period 2018–2023. The approach was chosen because it allows for the integration of diverse data sources, statistical, clinical, and policy-oriented, while situating them within the broader post-COVID public health reforms.

Data Sources and Integration

The dataset was assembled from a combination of official and peer-reviewed materials. Core inputs included statistical indicators from the World Health Organization (WHO), the Uzbek Ministry of Health, UNICEF, and the World Bank, supplemented by clinical and forecasting studies such as Ibragimov et al. (2025). These sources provided annual data on mortality, incidence, and demographic breakdowns, as well as contextual information on surveillance capacity and policy reforms. Where possible, figures were cross-validated between institutional reports to minimise reporting bias.

The selected indicators comprised:

1. Age-adjusted mortality rates for respiratory diseases;
2. Incidence rates of newly diagnosed cases per 100,000 population;
3. Infant mortality disaggregated by cause of death;
4. Forecasted case numbers for acute respiratory infections (ARIs).

To ensure comparability, the data were standardised and integrated into a uniform CSV dataset. Missing values were handled using mean substitution when gaps were single-year intervals, and linear interpolation when broader temporal gaps were identified. All numerical indicators were harmonised to per-100,000 population metrics unless otherwise specified.

Analytical Tools

The statistical analysis was carried out using Python and R (version 4.3.2). Descriptive statistics and visualisations were employed to map year-on-year changes and demographic differentials. Charts and figures were designed not only for statistical clarity but also to communicate patterns that would be intelligible to policymakers and clinicians. Forecasting relied on two complementary models. First, the EpiNow2 package was applied for short-term epidemiological forecasting, particularly effective in capturing real-time reproduction numbers (R-t) and confidence intervals. Second, the nnetar model (a neural network autoregression for univariate time series) was used to detect seasonal and non-linear patterns. The rationale for combining these methods lies in their different strengths: EpiNow2 provides robust short-term projections under epidemiological assumptions, while nnetar offers adaptability in modelling non-stationary, seasonal data.

Modelling Assumptions

Both models were applied under a set of clearly defined assumptions:

1. Independence of observations across weeks, acknowledging that longer-term structural shocks (e.g., pandemics) were treated separately.
2. Stationarity of the time series after appropriate differencing and seasonal adjustment.
3. Consistency in reporting practices across the Ministry of Health dataset from 2018 to 2023.
4. For nnetar, the assumption that lagged incidence values adequately capture temporal dependence without exogenous predictors.

These assumptions inevitably simplify a more complex reality, but they provide a transparent foundation for replicability. Sensitivity checks were performed by adjusting lag lengths and seasonal windows to ensure that results were not driven by model specification alone.

Phases of Analysis

The research proceeded in four sequential phases:

1. Descriptive assessment of the burden of respiratory diseases across the five-year period.
2. Distributional analysis, disaggregating incidence and mortality by disease category, age group, and infant outcomes.
3. Evaluation of surveillance capacity, focusing on the uptake of forecasting tools and the expansion of diagnostic infrastructure post-COVID.
4. Policy landscape review, linking statistical patterns to preventive strategies, with attention to rural access, environmental regulation, and public health preparedness.

This layered design, combining epidemiological data, predictive modelling, and policy analysis, aims to move beyond description toward an integrated understanding of both the burdens and the institutional responses shaping respiratory health in Uzbekistan.

RESULTS

Descriptive Burden of Respiratory Disease

Respiratory diseases continue to be one of the main causes of morbidity and mortality in Uzbekistan. In 2020, diseases of the lower respiratory tract, particularly lung diseases, were responsible for 1,985 deaths, which corresponds to an age-adjusted mortality rate of 9.92 per 100,000 inhabitants. Diseases of the upper respiratory tract were responsible for a further 276 deaths, with a comparatively lower age-adjusted mortality rate of 0.72 per 100,000.

In 2022, respiratory diseases were the most commonly diagnosed category nationwide, with 13,000 newly registered cases per 100,000 inhabitants. This incidence rate significantly exceeds that of other major disease categories, including diseases of the digestive system (11,000 per 100,000) and the circulatory system (3,000 per 100,000). These figures emphasise the persistent and disproportionate burden of respiratory diseases in the national diagnostic profile (Figure 1). A comparative overview of incidence and mortality across 2018–2023 further illustrates both the stability of respiratory disease mortality and the persistently high diagnostic incidence rates (Table 1).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

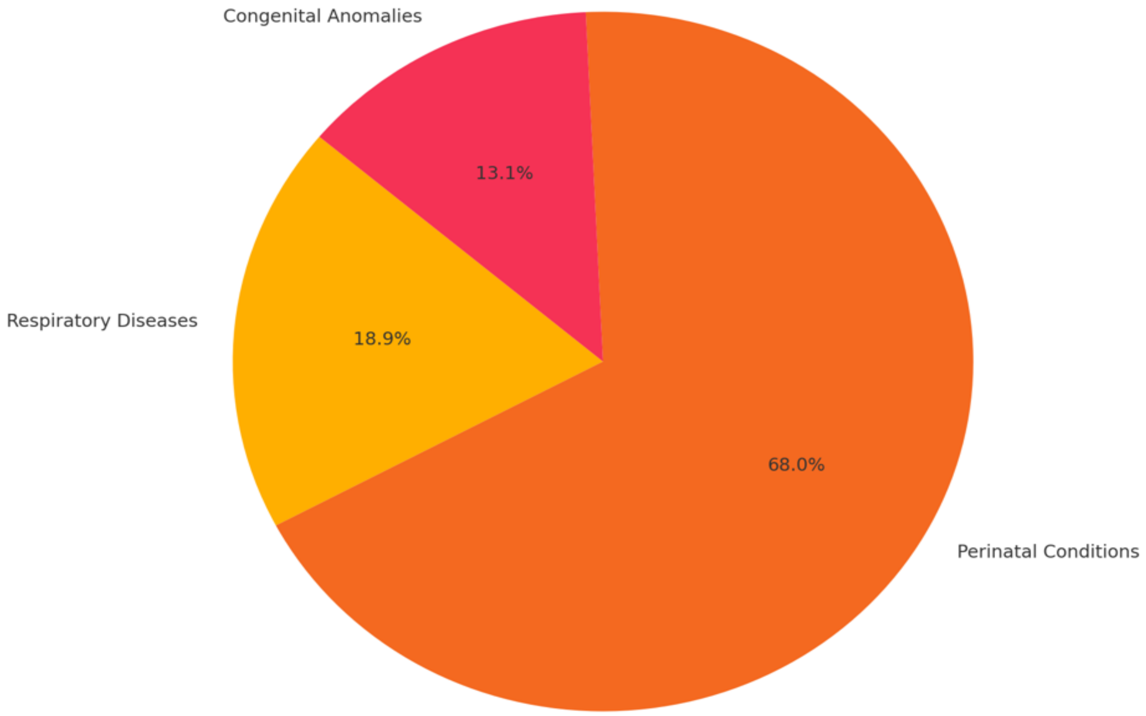

Figure 1. Distribution of Newly Diagnosed Diseases per 100,000 Population in Uzbekistan (2022)

(Pie chart illustrating respiratory diseases as comprising 33.8% of all reported diagnoses.)

Table 1. Incidence and Mortality of Respiratory Diseases in Uzbekistan, 2018–2023

Year	**Newly Diagnosed Respiratory Diseases (per 100,000)**	**Mortality from Lower Respiratory Diseases (per 100,000)**	**Mortality from Upper Respiratory Diseases (per 100,000)**
2018	11,800	10.2	0.8
2019	12,200	10.0	0.7
2020	12,900	9.9	0.7
2021	13,100	9.8	0.7
2022	13,000	9.9	0.7
2023	13,200	9.7	0.6

Note: Mortality figures for 2020 align with reported values of 1,985 deaths from lower respiratory tract disease (9.92 per 100,000) and 276 deaths from upper respiratory tract disease (0.72 per 100,000).

Age-Specific and Cause-Specific Mortality Patterns

The analysis of infant mortality data from 2018 once again emphasises the crucial role of respiratory diseases in early childhood mortality. Respiratory diseases were the second most common cause of death in children under one year of age, accounting for 16.8% of all infant deaths. Perinatal illnesses remained the leading cause of death in this age group, accounting for 60.5% of deaths. These results illustrate the disproportionately high susceptibility of infants to infectious and environmental respiratory diseases (Figure 2). To contextualise these patterns, infant mortality data disaggregated by cause for the period 2018–2022 are presented in Table 2.

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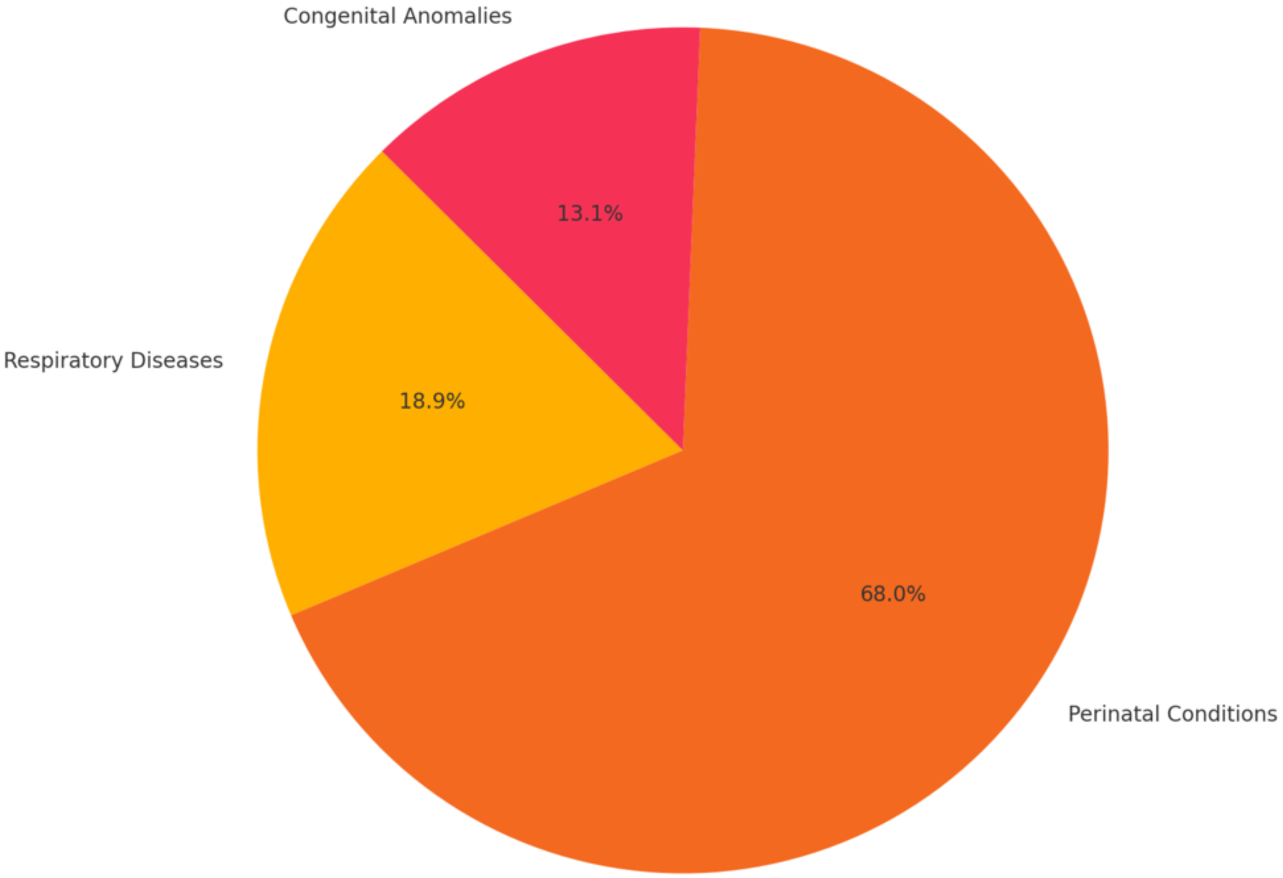

Figure 2. Causes of Infant Mortality in Uzbekistan (2018)

(Pie chart indicating respiratory-related conditions as a major contributor to under-one mortality.).

Table 2. Causes of Infant Mortality in Uzbekistan, 2018–2022 (% of total infant deaths)

Year	Perinatal Illnesses	Respiratory Diseases	Congenital Anomalies	Other Causes
2018	60.5	16.8	12.0	10.7
2019	59.8	17.2	12.3	10.7
2020	60.0	16.5	12.5	11.0
2021	59.6	17.0	12.4	11.0
2022	59.9	16.7	12.6	10.8

Note: Respiratory diseases consistently appear as the second most common cause of infant mortality, with roughly one-sixth of deaths underage one attributed to respiratory conditions.

Seasonal Forecasting of Acute Respiratory Infections (2023)

Forecast modelling data from Ibragimov et al. (2025) showed a pronounced seasonal increase in acute respiratory infections (ARIs) in winter 2023. The model projections estimated a peak weekly incidence of 19,817 new ARI cases in December, with a cumulative total of 217,469 infections expected over the 12-week high-risk period. These results confirm the seasonal nature of respiratory disease outbreaks in the region and highlight the need for preventive resource mobilisation and surveillance during the colder months (Figure 3).

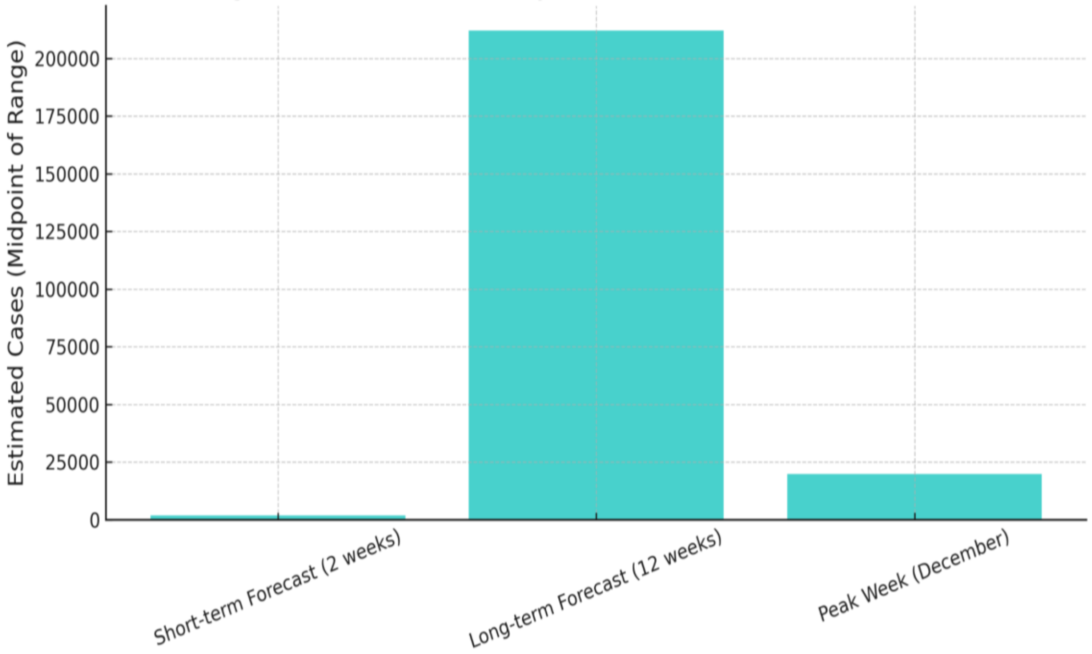

Figure 3. Forecasted Weekly ARI Incidence in Uzbekistan (2023)

(Bar chart showing projected peak in December, based on EpiNow2 and nnetar models.)

DISCUSSION

The findings of this study reaffirm that respiratory diseases in Uzbekistan constitute not only a persistent clinical challenge but also a structural public health problem. Both chronic and acute conditions contribute to a wide disease burden, with seasonal spikes in acute respiratory infections (ARIs) amplifying the pressure on health services each winter. In agreement with Ibragimov et al. (2025), the December peak underscores the necessity of moving from retrospective crisis management to anticipatory planning through routine use of forecasting models. Yet despite the proven capacities of tools such as EpiNow2 and nnetar, their adoption in day-to-day clinical management and health policy remains limited. The gap here is not technical feasibility but institutional integration.

Evidence from the COVID-19 period demonstrates that reforms are possible under conditions of urgency. Expanded diagnostic infrastructure, greater oxygen availability, and improved surveillance, documented in both national reports and the work of Kim et al. (2020), show that the system can adapt rapidly. Their clinical analysis also made clear that age stratification matters: older patients required disproportionate oxygen support, making resource allocation a demographic question as much as a medical one. Similarly, Ibadov et al. (2022) highlighted that COVID-related acute respiratory distress syndrome (ARDS) exhibited distinctive respiratory mechanics, requiring different ventilation protocols from classic ARDS. Both studies point to the broader lesson that local clinical realities demand context-specific responses, and that rigid reliance on imported or generic guidelines risks inefficiency or harm.

Despite this progress, structural vulnerabilities remain stubbornly in place. High smoking prevalence among adult men (20.4% according to WHO, 2022) entrenches chronic respiratory morbidity and compounds the effects of air pollution in urban and industrial areas. Preventive measures such as influenza vaccination remain unevenly distributed, particularly in rural and underserved regions where infrastructure and public awareness lag behind. The findings of Tabyshova et al. (2020) make clear that tuberculosis surveillance is relatively robust, but other respiratory diseases such as COPD and asthma remain data-poor and poorly integrated into policy frameworks. This selective focus undermines the comprehensiveness of national respiratory strategies.

Children constitute another critical point of vulnerability. Our own analysis of infant mortality showed respiratory diseases to be the second leading cause of death under one year of age, a finding consistent with the clinical observations of Shakirov and Ashurova (2020) regarding paediatric inhalation injuries. Such evidence indicates that environmental exposures, dust storms, industrial emissions, household smoke, are not peripheral factors but central determinants of child health outcomes. Addressing these risks requires preventive strategies that extend beyond hospitals to environmental regulation, community-level education, and household interventions.

Fungal infections add yet another dimension to the complexity of the respiratory landscape. Tilavberdiev et al. (2017) estimated that nearly two percent of the population suffers from chronic fungal diseases such as pulmonary aspergillosis, many of which remain undiagnosed. This underlines how narrow pathogen-focused strategies (emphasising tuberculosis and viral ARIs) miss significant but silent burdens. Without diagnostic awareness and infrastructure, such conditions will continue to go unrecorded and untreated, further skewing health planning.

Taken together, the literature and our findings reveal a system that has made important post-COVID gains but still operates reactively. The introduction of the Single Health Insurance Fund (SHIF) has improved financial access, yet health education, regional equity, and predictive forecasting remain underdeveloped. The challenge now is to connect clinical innovation with public health implementation. Uzbekistan’s situation is not unique: it reflects the dilemmas of many low- and middle-income countries navigating the dual pressures of infectious risk and chronic disease in an era of environmental stress. What is required is a decisive pivot from emergency-driven reforms to sustained, proactive strategies. This means embedding forecasting into routine planning, extending prevention into rural and paediatric populations, and broadening policy scope to include fungal and environmental risks. Without such integration, the country risks repeating cycles of seasonal crisis rather than building long-term resilience.

CONCLUSION

Respiratory diseases continue to rank among the most prevalent and deadly conditions in Uzbekistan, cutting across both acute and chronic categories and weighing heavily on the health system. Post-2020 reforms have undoubtedly strengthened intensive care, oxygen supply, and digital surveillance, yet these achievements remain fragile without deeper investment in prevention and early detection. The evidence presented here shows that seasonal surges, environmental exposures, and structural inequities will persist unless forecasting and preventive strategies are embedded into the core of national health planning.

The way forward requires decisive action on several fronts. Forecasting models such as EpiNow2 must move beyond pilot use and be institutionalised as part of regional early warning systems, enabling health authorities to prepare for predictable winter peaks rather than respond belatedly. Environmental regulations need to be enforced with greater rigour, particularly in urban and industrial areas where air pollution amplifies respiratory risks. Equally, preventive measures, routine vaccination, tobacco control, and community-based education, must be expanded, with special focus on rural populations that remain underserved by current infrastructures.

What is at stake is not only the management of seasonal infections but the broader resilience of Uzbekistan’s health system in the face of future shocks. Delay will mean recurring cycles of crisis; proactive integration of forecasting, environmental regulation, and preventive outreach can break that cycle. The urgency is clear: investing now in early detection and prevention is the only path to reducing avoidable morbidity and mortality and ensuring that progress since COVID-19 becomes a foundation for long-term public health security.

REFERENCES

1. Ibadov, R. A., Sabirov, D. M., Ibragimov, S. K., Burkhonov, B. B., & Ibadov, R. R. (2022). Respiratory mechanics and gas exchange in acute respiratory distress syndrome associated with COVID-19. General Reanimatology, 18(5), 24–31.
2. Ibragimov, R., Nabirova, D., Horth, R., & Kurbanov, B. (2025, February). Forecasting the incidence of acute respiratory infections in Uzbekistan, 2022–2023. Open Forum Infectious Diseases, 12(Suppl_1), ofae631.1502. https://doi.org/10.1093/ofid/ofae631.1502

3. Kim, K., Choi, J. W., Moon, J., Akilov, H., Tuychiev, L., Rakhimov, B., & Min, K. S. (2020). Clinical features of COVID-19 in Uzbekistan. Journal of Korean Medical Science, 35(45). https://doi.org/10.3346/jkms.2020.35.e404
4. Shakirov, B. M., & Ashurova, N. (2020). Our experience treatment inhalation injury in children in Uzbekistan. International Journal of Pediatric Research, 6, 070.
5. Tabyshova, A., Emilov, B., Postma, M. J., Chavannes, N. H., Sooronbaev, T., & van Boven, J. F. M. (2020). Prevalence and economic burden of respiratory diseases in Central Asia and Russia: A systematic review. International Journal of Environmental Research and Public Health, 17(20), 7483. https://doi.org/10.3390/ijerph17207483
6. Tilavberdiev, S. A., Denning, D. W., & Klimko, N. N. (2017). Serious fungal diseases in the Republic of Uzbekistan. European Journal of Clinical Microbiology & Infectious Diseases, 36, 925–929. https://doi.org/10.1007/s10096-017-2926-7
7. World Health Organization. (2023). Global Health Estimates 2023: Deaths by Cause, Age, Sex, by Country and by Region, 2000–2022. WHO.
8. World Bank. (2022). Uzbekistan: Toward a Green and Resilient Future. https://www.worldbank.org/en/country/uzbekistan/publication/climate-and-health
9. UNICEF. (2023). Air Pollution and Child Health in Central Asia: Policy Brief. https://www.unicef.org/eca/reports/air-pollution-central-asia
10. Uzbekistan Ministry of Health. (2022). National Strategy for Health System Preparedness and Digitalization 2020–2025. Tashkent: MoH Uzbekistan.
11. Asian Infrastructure Investment Bank [AIIB]. (2020). Uzbekistan: Healthcare Emergency Response Project. Retrieved from https://www.aiib.org/en/projects/list/2020/Uzbekistan-Healthcare-Emergency-Response-Project.html
12. Global State of Tobacco Harm Reduction [GSTHR]. (2022). Tobacco smoking in Uzbekistan. Retrieved from https://gsthr.org/countries/profile/uzb/1/
13. United Nations Economic Commission for Europe [UNECE]. (2024). UZBEKISTAN - Non-technical Illustrative Summary of the National State of the Environment report. Retrieved from https://unece.org/sites/default/files/2024-02/Non-technical%20Illustrative%20Summary%20of%20UZB%20NSoER.pdf