

Organizational Factors Shaping the TB Workforce in Tashkent Region, Uzbekistan – A Mixed-Methods Multi-Phase Study

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Abstract

Background

This mixed-methods, multi-phase study assessed organizational functioning and workforce dynamics across the tuberculosis (TB) care continuum in the Tashkent region, Uzbekistan, to inform targeted training. It focused on dimensions under-examined in this setting: relational coordination, organizational learning, leadership culture, motivation, and retention.

Methods

Across four sequential phases, we mapped job descriptions along the TB care pathway, conducted 18 semi-structured interviews, and surveyed 175 professionals in hospitals, primary health care (PHC) facilities, and district TB/pulmonology dispensaries. The survey measured Relational Coordination (RC; 1–5) and, on 1–7 scales, Organizational Learning (OL), Health Literate Healthcare Organization (HLHO), Strength of the HRM System (SHRMS), High-Reliability Organization (HRO), and Turnover Intention (TI); absenteeism (AB) used a 1–4 scale. Findings informed training for managers and decision-makers. All multi-item scales showed high internal consistency (Cronbach's $\alpha \geq 0.92$).

Results

Roles were distinct across settings, with nurses as the principal coordination link; motivation was driven mainly by recognition and patient outcomes. RC was moderate within roles ($M = 4.47$) and strong between roles ($M = 4.17$) under role-specific benchmarks, and highest in hospitals. OL, HLHO, and SHRMS were neutral to moderately positive ($M = 4.48, 4.49, 4.18$), with PHC facilities consistently lowest; HRO was lower ($M = 3.48$) and TI low ($M = 2.33$). In regression, TI was positively associated with OL, absenteeism, and HRO, and negatively with RC.

Conclusions

The study identifies actionable gaps in coordination, leadership, and career development, and informs setting-specific training to support a learning health system for TB care. Sustained, equitable investment—particularly in primary care—will be needed to translate these findings into practice.

Introduction

Tuberculosis (TB) remains a serious public health problem in Uzbekistan. According to the WHO Global Tuberculosis Report 2025, the country remains one of the 30 high-burden countries for multidrug- and rifampicin-resistant TB (MDR/RR-TB) while having met the first End TB Strategy milestones—at least a 35% reduction in TB deaths by 2020 and a 20% reduction in TB incidence by 2021 relative to 2015. National case notifications nonetheless rose (14,302 newly detected in 2022), reflecting intensified case-finding rather than rising incidence [1]. Uzbekistan's National TB Strategy (2021–2026) accordingly targets further reductions in incidence and mortality [2], which requires addressing the human resources (HR) constraints that hinder TB control.

Regional disparities underscore the need for targeted workforce interventions. In 2022, the Tashkent region (population 2.574 million) had a TB incidence of 51.6 per 100,000, below the national rate (57.0 in 2022, 53.8 in 2023, 50.7 in 2024 per 100,000) [3, 4]. Sustaining these gains requires a structured approach to define roles, expand training and strengthen motivation.

Severe shortages of skilled staff, turnover and training deficiencies are well-documented barriers to TB control in high-burden settings [5–7]. The Stop TB Partnership's Global Plan to End TB 2023–2030 [8] prioritizes workforce planning, targeted training and retention [9]. In Eastern Europe and Central Asia (EECA), the shift to decentralized, community-based care shows how context-adapted workforce interventions can widen access, consistent with the End TB Strategy and the SDGs [10].

In Uzbekistan, the NTP, supported by the US Government through the Tuberculosis Implementation Framework Agreement (TIFA), launched initiatives such as the TB Commitment Grant (TCG) to strengthen workforce capacity [11]; research on how these address HR constraints in regions such as Tashkent remains limited.

Despite ongoing efforts, empirical data on the impact of workforce structures, motivation, and coordination mechanisms on TB service delivery at the regional level are lacking.

Building on the TCG, this study—conducted by the NOVA National School of Public Health with NTP Uzbekistan and the US Government—assesses this gap through a comprehensive appraisal of HR challenges and opportunities in the Tashkent region, which informed a five-phase HR plan. This sequence operationalizes a learning health system at the regional level, translating workforce evidence into knowledge and feeding it back into practice through targeted training and HR planning. The study draws on validated instruments widely used in health-workforce and organizational research [12–18].

This paper outlines Phases I–IV, which use a sequential mixed-methods approach, combining job description analysis, semi-structured interviews, and an organizational survey to gather evidence for both remote and in-person training with local stakeholders. The study aims to identify particular HR needs and develop strategies to address competency gaps, increase motivation, and decrease turnover among healthcare workers involved in TB care. Specifically, the study aims to: (i) map roles and responsibilities across TB care settings; (ii) explore workforce perceptions of motivation, engagement, and training needs;

(iii) assess organizational indicators such as coordination, learning culture, and HR system robustness; (iv) design and deliver tailored training to address identified gaps and enable workforce retention.

Phase V, which introduced a bed-forecasting tool for HR allocation, is described in the full HR plan delivered to NTP Uzbekistan and US Government, but falls outside the scope of this manuscript.

Methods

1. Study Design

A multi-phase, mixed-methods study conducted between 2023 and 2024 to assess HR capacity and needs within the TB care workforce in the Tashkent region. Reporting followed the STROBE statement for the cross-sectional survey component, COREQ for the qualitative interviews, and the GRAMMS framework for the overall mixed-methods design [19–21]. The study comprises four sequential phases: job description analysis, semi-structured interviews to determine HR needs, a survey evaluating various domains of organizational functioning, and, lastly, training sessions informed by the previous findings. The study involved healthcare professionals at different levels of TB care and across facilities in the Tashkent region of Uzbekistan.

Phase III surveyed seven domains: Relational Coordination (RC), Organizational Learning (OL), Health-Literate Healthcare Organizations (HLHO), Strength of Human Resources Management Systems (SHRMS), High-Reliability Organizations (HRO), Absenteeism (AB), and Turnover Intentions (TI).

1. Sampling

Participants were selected in collaboration with key national and local stakeholders based on their roles within the TB continuum. The study included phthisiologists, general practitioners (GPs), laboratory specialists, laboratory technicians, nurses, and administrative staff (healthcare managers) working across three primary settings: the Regional TB and Pulmonology Center, district primary healthcare (PHC) facilities, and District TB and Pulmonology departments. For consistency and clarity, the general terms "hospital," "PHC," and "dispensaries" will be used throughout the document to refer to these three settings.

Phase II Representativeness was ensured by including all three settings and key professional roles. A total of 18 interviews were conducted across the three settings (Regional TB Hospital, $n = 11$; PHC, $n = 4$; dispensary, $n = 3$). The realized sample comprised 10 doctors, 6 nurses, 1 laboratory technician, and 1 administrative staff member; final selection depended on staff availability and willingness to participate, which limited laboratory staff representation.

Phase III 180 individuals were invited to participate in the survey, of which 175 responded, yielding a response rate of 97.2%. Inclusion criteria required participants to be actively engaged in TB-related clinical roles within the designated institutions.

Phase IV Sampling was purposive, aiming to include participants from both regulatory agencies and service providers. Participants held managerial and clinical roles across various institutions, including the Ministry of Health of Uzbekistan, the Regional TB and Pulmonology Center, the Children's TB Hospital, the District TB and Pulmonology department, NGOs, and other regional entities.

1. Data Collection

Phase I. The job description data was developed in close collaboration with the NTP/TIFA and local stakeholders. The primary purpose of this activity was confirmatory in nature, aimed at mapping the professional categories involved in future phases of the study.

Phase II. Semi-structured interviews were held at the three settings over three days in late November 2023. They were conducted by I.A., a female Invited Assistant Professor (PhD in Management) at NOVA National School of Public Health with expertise in human resource management, organizational behavior and relational coordination in healthcare organizations; J.S. and B.D. attended as note-takers and recorded field notes. The interviewer had no prior relationship with participants, who understood that the interviews supported a workforce assessment for the National TB Program. No approached professional declined and there were no dropouts or repeat interviews; transcripts and findings were not returned to participants, but preliminary findings were cross-validated through confirmation interviews with local experts. Interviews lasted 15–60 minutes ($M = 33$), were conducted in Uzbek or Russian by a single translator, and were audio-recorded and transcribed verbatim. Interviewees were predominantly female (66.7%, $n = 12$; mean age 48.2 years, SD 15.1; further detail in Appendix 3).

The interview guide (Appendix 1) contained questions on factors affecting capability, intrinsic motivation (the love of work), and extrinsic motivation (recognition, structure, seeing results, social respect, career, salary, working conditions, and an adequate workload), as well as general HR practices.

Confirmation interviews were conducted via Zoom in individual sessions, each lasting 40 minutes, and were used solely for validation of the current and next Phase; thus, they were not included in the analysis.

Phase III. The survey, developed in Microsoft Forms, consisted of 41 items distributed across 21 categories comprising 7 domains, organized into 4 sections. The questions were translated and validated into Russian. Data collection took place over three weeks in February 2024, with distribution and follow-up reminders managed by the NTP/TIFA counterparts.

Domains were measured with items adapted from validated instruments: relational coordination [12], organizational learning [13], the HLHO-10 questionnaire [14], strength of the HRM system [15, 22, 23], high-reliability organizations [16], absenteeism [17] and turnover intention [18] (see also [24]). A pilot confirmed the item's clarity and required no structural changes; the full item wording and response anchors are provided in Appendix 2.

The survey sample (n = 175) comprised hospital (93), dispensary (67) and PHC (15) respondents across phthisiologists (n = 35), nurses (n = 103), laboratory technicians (n = 32), laboratory specialists (n = 4) and GPs (n = 1). Respondents were predominantly female (81.7%, n = 143); 74.9% (n = 131) held a high school diploma as their highest qualification (further details in Appendix 4). All responses were valid.

The inclusion of the GP and Lab Specialists in the analysis was maintained to preserve the diversity of professional perspectives and ensure the role's representativeness. This limited sample size may have influenced the results, particularly in RC scores. No information was obtained regarding the overall representativeness of the sample within the settings.

Phase IV trainings were delivered online via Zoom and on-site at a location selected and organized by the NTP/TIFA. Each session accommodated a maximum of 30 participants.

1. Data Analysis

A mixed-methods approach was employed to analyze data across the study's phases.

Phase I and II. Phase I data served only for role mapping. Phase II interviews were thematically coded in MAXQDA 2022 (VERBI Software, Berlin, Germany), with keywords iteratively categorized into themes; participants were anonymized (INT01–INT18, not reflecting role or setting). Code saturation was effectively reached by interviews 12–14 (95% of codes present by interview 12 and 100% by interview 14, with none emerging thereafter), consistent with Guest et al. [25].

Phase III. Descriptive statistics and regression analyses were performed in Stata 18 (StataCorp LLC, College Station, TX, USA). Turnover intention was regressed on the six domain scores (relational coordination, organizational learning, health-literate organization, strength of the HRM system, high-reliability organization and absenteeism) and two covariates (sex and age) using ordinary least squares. Six missing age values were imputed using the average age within each job tenure category. Survey domains were assessed using adapted multi-dimensional scales from established theoretical frameworks. Internal consistency was high for all multi-item scales (Cronbach's α : relational coordination 0.98, organizational learning 0.96, strength of the HRM system 0.94, health-literate organization 0.93, high-reliability organization 0.92, turnover intention 0.93); absenteeism, measured with a single item, was not assessed for internal consistency. The absenteeism item was scored so that higher values indicate more sick days. As respondents were nested within three care settings, the turnover-intention model was re-estimated with setting fixed effects as a sensitivity analysis; formal multilevel or cluster-robust estimation was not pursued given the small number of clusters.

Phase IV. Feedback provided during the training was qualitatively assessed through direct observation and reviewed to ensure alignment with identified needs.

1. Ethical Clearance

The research was conducted in accordance with the Declaration of Helsinki [26]. Written informed consent was obtained from all participants. All data collected during the interviews were anonymized to ensure participant confidentiality. Only the involved researchers have access to the original recordings, which are securely stored and protected. Personal identifiers were removed during transcription to safeguard privacy. No participant received any form of compensation for taking part in the study. The study ensured the rights and well-being of all participants in interviews, surveys, and training sessions. The study was approved by the NOVA National School of Public Health research ethics committee (CEENSP no 32/2023). The study was not registered.

Results

Roles and Responsibilities

GPs, mainly in PHC units, refer patients for diagnostic tests and coordinate treatment, with weekly specialist follow-up; their role varies by setting. Nurses span all settings, coordinating patient care, active case-finding, treatment, monitoring, medication stock and follow-up reminders. Laboratory technicians collect samples and run tests (e.g., GeneXpert) and quality control, while laboratory specialists perform complex analyses and identify resistant strains; both operate across settings. Phthisiologists, mainly in hospitals and dispensaries, diagnose, prescribe and adjust regimens and manage severe cases, often consulting the TB Concilium. Nurses serve as the primary community-education liaison. The mapped TB patient pathway is shown in Appendix 5.

Findings from Phases II and III are presented together by theme, combining qualitative categories with the corresponding quantitative domains (Appendix 6).

Additional supporting quotations are provided in Appendix 7.

Relational Coordination and Communication

Effective communication and teamwork were highlighted across interviews, with emphasis on meaningful team relationships and patient-centered communication (INT05: "We work as one team, from a patient's initial diagnosis to the completion of their treatment... We support one another"). Telegram was widely used as a supplementary operational channel alongside formal reporting and coordination mechanisms.

Survey RC dimensions were classified using the developer's benchmarks [27]: within-role ties as weak (< 4.1), moderate (4.1–4.6) or strong (> 4.6), and between-role ties as weak (< 3.5), moderate (3.5–4.0) or strong (> 4.0); the higher within-role benchmarks reflect the expectation that coordination within a

professional group exceeds coordination across groups. Under this scheme, the overall within-role mean (4.47) is moderate whereas the between-role mean (4.17) is strong relative to between-role norms, even though it is numerically lower (Appendix 8).

Across roles and settings, within-role RC was moderate (overall M = 4.47) and between-role RC strong (M = 4.17), with hospitals and phthisiologists scoring highest and PHC facilities lowest—most markedly for problem-solving communication (BR = 3.23). Shared knowledge was the strongest dimension and shared goals the weakest. Estimates for GPs (n = 1) and laboratory specialists (n = 4) are reported for completeness only. Full per-dimension values by setting and role are given in Table 1.

Table 1
RC per dimension, setting, and role. Phase III: Survey.

	PHC		Hospital		Dispensary		Overall	
	WR	BR	WR	BR	WR	BR	WR	BR
RC1 Frequent communication	4.33	4.00	4.65	4.45	4.36	4.09	4.51	4.27
RC2 Timely communication	4.40	3.57	4.65	4.39	4.31	3.92	4.50	4.14
RC3 Rigorous communication	4.33	3.57	4.75	4.62	4.00	3.64	4.43	4.16
RC4 Problem-solving communication	4.07	3.23	4.65	4.46	4.10	3.77	4.39	4.09
RC5 Shared knowledge	4.33	3.70	4.74	4.57	4.39	3.93	4.57	4.25
RC6 Shared goals	4.33	3.62	4.51	4.36	4.16	3.66	4.36	4.03
RC7 Mutual respect	4.33	3.58	4.70	4.52	4.30	4.03	4.51	4.26
Overall	4.30	3.61	4.66	4.48	4.23	3.87	4.47	4.17
	WR	BR						
Phthisiologist (n = 35)	4.68	4.52						
Nurse (n = 103)	4.56	4.09						
Lab technician (n = 32)	4.02	4.22						
Lab Specialist (n = 4)†	4.00	4.11						
GP (n = 1)†	4.14	3.94						
Overall	4.47	4.17						
† n < 5: not interpretable; shown for completeness.								

Organizational Culture, Capacity, and Reliability

Interviews frequently emphasized the importance of continuous learning and research in TB management.

Across settings, OL was moderate (M = 4.48, 7-point scale), strongest for education and learning and weakest for information transfer; dispensaries scored highest and PHCs lowest (M = 3.82), particularly for information collection/analysis (Table 2).

Health literacy and TB stigma emerged around informing patients about confidentiality and prevention, particularly for those misinformed or in remote areas (INT11: "TB patients are shy about their disease"; INT06: patients should trust providers to keep their information confidential).

HLHO scores were moderate (M = 4.49), highest for workforce and communication standards and lowest for media variety, driven by low PHC scores (M = 3.13) versus hospitals and dispensaries (Table 2).

HRO showed lower, moderate agreement with transparency-related practices (M = 3.48), suggesting reluctance to disclose mistakes, particularly at dispensary level (Table 2).

Motivation, Recognition, and Retention

Measures of AB were low overall. 77.71% participants reported having taken less than two sick days in the past three years (87.10% in hospitals). Table 3

Workload was generally manageable and job satisfaction high, driven mainly by dedication to patients (INT18: "The most fulfilling aspect of my job is witnessing the happiness and good mood of the patients").

Informal comments from nurses in the hospital setting reveal a high level of job satisfaction and dedication, with some staff members putting in extra hours driven by their passion for the work and a commitment to providing better patient care, rather than seeking bonuses or recognition.

SHRMS scores were neutral to moderately positive ($M = 4.18$); respondents emphasized the need for greater transparency in HR processes and more accessible career progression. Recruitment and selection showed the greatest disparity, with PHCs notably lower ($M = 2.80$) than hospitals ($M = 4.35$) and dispensaries ($M = 4.12$) (Table 2).

Recognition and incentives—performance-based bonuses and, for nine participants, acknowledgment of achievements (often a letter of appreciation)—were linked to motivation (INT10: "The Administration permanently recognizes/values our work"). Some settings combined monetary and non-monetary incentives.

TI was low, indicating limited intent to leave ($M = 2.33$), with the highest retention in hospitals ($M = 2.17$) (Table 2).

A multiple linear regression on TI predictors was significant, $F(8, 166) = 10.15$, $p < .001$, explaining 32.8% of variance ($R^2 = .328$; adjusted $R^2 = .296$): OL, AB and HRO were positive predictors and RC a negative predictor (Table 4).

Table 2
OL, HLHO, SHRMS, TI, HRO per dimension, and setting. Phase III: Survey.

	Hospital				Dispensary				PHC				Total Sample		
	(n = 93)				(n = 67)				(n = 15)				(N = 175)		
Organizational Learning (7-point scale)	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%
OL1 Psychological safety	3.95	1.75	3.59	4.31	4.74	1.66	4.33	5.14	4.00	1.80	3.00	5.00	4.26	1.75	4.00
OL2 Valuing differences	4.30	1.67	3.95	4.64	4.92	1.71	4.50	5.34	4.33	1.87	3.30	5.37	4.54	1.72	4.28
OL3 Openness to new ideas	4.34	1.72	3.99	4.70	5.21	1.69	4.80	5.62	3.77	1.81	2.76	4.77	4.63	1.78	4.36
OL4 Time to reflect	4.53	1.79	4.16	4.90	5.12	2.05	4.62	5.62	3.67	1.84	2.65	4.68	4.68	1.93	4.39
OL5 Experimentation	4.33	1.78	3.96	4.70	5.01	1.87	4.56	5.47	3.60	1.75	2.63	4.57	4.53	1.85	4.25
OL6 Collection of information/Analyzes	4.42	1.85	4.04	4.80	4.99	2.03	4.49	5.48	3.00	1.73	2.04	3.96	4.51	1.98	4.22
OL7 Education and learning	4.61	1.85	4.23	4.99	5.42	1.74	4.99	5.84	3.33	1.91	2.27	4.39	4.81	1.90	4.53
OL8 Information transfer	4.09	1.90	3.70	4.48	4.60	1.93	4.13	5.07	3.70	2.10	2.54	4.86	4.25	1.94	3.96
OL9 Leadership that reinforces learning	3.96	1.79	3.59	4.33	4.75	1.80	4.31	5.19	4.27	1.99	3.17	5.37	4.29	1.84	4.02
	4.24	1.53	3.93	4.55	4.95	1.51	4.58	5.32	3.82	1.48	3.00	4.64	4.48	1.56	4.24
Health Literate Healthcare Organizations (7-point scale)	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%
HLHO1 Workforce	4.54	1.76	4.18	4.90	4.91	1.90	4.45	5.38	4.33	2.02	3.21	5.45	4.66	1.84	4.39
HLHO2 Inclusion of the served	4.41	1.82	4.03	4.78	4.51	1.95	4.03	4.98	4.33	2.02	3.21	5.45	4.44	1.84	4.17
HLHO3 Communication standards	4.51	1.71	4.15	4.86	4.75	2.02	4.25	5.24	4.33	2.02	3.21	5.45	4.58	1.84	4.31
HLHO4 Provide access	4.51	1.78	4.14	4.87	4.61	2.15	4.09	5.14	4.40	2.06	3.26	5.54	4.54	1.84	4.26
HLHO5 Media variety	4.45	1.89	4.06	4.84	4.13	2.17	3.61	4.66	3.13	2.03	2.01	4.26	4.22	1.84	3.94
	4.48	1.66	4.14	4.82	4.58	1.73	4.16	5.00	4.11	1.90	3.05	5.16	4.49	1.70	4.23
Strength of Human Resources Management Systems(7-point scale)	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%
SHRMS1 Performance appraisal	4.30	1.54	3.98	4.62	4.28	1.72	3.86	4.70	4.07	1.79	3.07	5.06	4.27	1.63	4.03
SHRMS2 Career development	4.25	1.54	3.93	4.56	3.90	1.71	3.48	4.31	3.87	2.07	2.72	5.01	4.08	1.65	3.83
SHRMS3 Communication	4.33	1.52	4.02	4.65	4.03	1.62	3.63	4.43	4.00	1.77	3.02	4.98	4.19	1.58	3.95
SHRMS4 Performance-pay	4.40	1.50	4.09	4.71	4.06	1.65	3.66	4.46	4.13	1.88	3.09	5.18	4.25	1.59	4.01
SHRMS5 Recruitment and selection	4.35	1.49	4.05	4.66	4.12	1.81	3.68	4.56	2.80	2.01	1.69	3.91	4.13	1.71	3.88
	4.33	1.43	4.03	4.62	4.08	1.47	3.72	4.44	3.77	1.68	2.84	4.70	4.18	1.47	3.96
Turnover Intentions (7-point scale)	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%

	Hospital				Dispensary				PHC				Total Sample		
	(n = 93)				(n = 67)				(n = 15)				(N = 175)		
TI1 Consideration to leave organization	1.97	1.87	1.58	2.35	2.40	1.78	1.97	2.84	2.20	1.74	1.24	3.16	2.15	1.83	1.88
TI2 Job search plan	2.06	1.90	1.67	2.46	2.13	1.37	1.80	2.47	2.20	1.74	1.24	3.16	2.10	1.70	1.85
TI3 Networking intent	2.19	2.08	1.76	2.62	2.57	1.54	2.19	2.94	2.13	1.92	1.07	3.20	2.33	1.88	2.05
TI4 Future employment plan	2.56	2.31	2.08	3.03	3.12	2.06	2.62	3.62	2.13	1.92	1.07	3.20	2.74	2.20	2.41
	2.20	1.93	1.80	2.59	2.56	1.33	2.23	2.88	2.17	1.81	1.16	3.17	2.33	1.72	2.08
High-Reliability Organizations (7-point scale)	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%	UI95%	M	SD	LI95%
HRO1 Difficulty in hiding errors	3.49	1.95	3.09	3.90	3.21	2.00	2.72	3.70	3.67	1.80	2.67	4.66	3.40	1.95	3.11
HRO2 Reporting errors	3.58	1.88	3.19	3.97	3.48	1.96	3.00	3.95	3.87	1.77	2.89	4.85	3.57	1.90	3.28
	3.54	1.86	3.15	3.92	3.34	1.90	2.88	3.81	3.77	1.69	2.83	4.70	3.48	1.85	3.21

Table 3
AB per dimension, and setting. Phase III: Survey.

AB in the last 3 years				
	> 5 times	2 to 5 times	Once	None
Dispensary	25.37%	8.96%	17.91%	47.76%
Hospital	9.68%	3.23%	27.96%	59.14%
PHC	0.00%	26.67%	40.00%	33.33%
Total Sample	14.86%	7.43%	25.14%	52.57%

Table 4
TI: Linear Regression (Total Sample). Phase III: Survey.

Predictor	B	SE	t	p	95% CI
Relational coordination	-0.37	0.13	-2.73	0.007	-0.63, -0.10
Organizational learning	0.23	0.09	2.50	0.013	0.05, 0.42
Health-literate organization	0.02	0.09	0.19	0.846	-0.16, 0.19
Strength of HRM system	0.11	0.10	1.09	0.278	-0.09, 0.30
High-reliability organization	0.26	0.07	3.86	< 0.001	0.13, 0.39
Absenteeism	0.35	0.10	3.43	0.001	0.15, 0.55
Sex (female vs male)	0.25	0.28	0.89	0.373	-0.30, 0.80
Age (years)	-0.02	0.01	-1.97	0.050	-0.04, 0.00
Constant	1.47	0.77	1.90	0.059	-0.05, 2.99

Outcome: turnover intention (1–7). Ordinary least squares; $n = 175$. $F(8, 166) = 10.15$, $p < 0.001$; $R^2 = 0.328$; adjusted $R^2 = 0.296$. B, unstandardized coefficient; CI, confidence interval. Absenteeism scored so that higher values indicate more sick days. Age imputed for 6 cases by tenure-category mean. Analysis in Stata 18.

Training and Resource Needs

Professional development and training were a universal aspiration, especially in diagnostics and communication (INT09: "training on psychology, teamwork, conflict management, and decision-making will be appropriate"). Seminars and workshops are already organized with US Government, NGO, academic and administrative support, mostly on diagnostics; one participant noted that staff in remote areas are invited only rarely (INT11).

International collaboration and exchange programs were a recurring aspiration, with five interviewees favoring English-language training (INT18: exchange programs and incoming specialists would aid professional development, though language proficiency is a barrier).

Infrastructure, technology and equipment quality were raised in five interviews as shaping working conditions and care delivery (INT07: "There is a shortage of equipment... which can result in redirecting patients"; INT03: some remote areas are poorly equipped), though four interviewees noted recent laboratory

budget allocations.

Remote and on-site trainings

Phase IV training covered the domains identified in the assessment (human resources management, work-coordination mechanisms, learning organizations, high-reliability organizations and relational coordination), supported by curated materials. Mid- and top-level managers and regulators (including the Ministry of Health of Uzbekistan) attended a three-day remote course, and low- and mid-level managers a two-day in-person course. Through individual and group work on the shared instruments, participants reflected on organizational dynamics and on the challenges of applying these concepts within their institutions.

Discussion

The study reveals a TB care system marked by strong professional commitment but asymmetric organizational support. Structural clarity in role and focus on teamwork exist. Still, RC scores show that within-role collaboration is stronger than between-role collaboration, indicating that structural clarity alone does not guarantee integrated care [28, 29]. Weak cross-unit coordination at the primary-care interface parallels TB-specific evidence that referral between services is where coordination most often breaks down [30]. Widespread use of Telegram as a coordination tool also illustrates this gap, evidencing adaptive resourcefulness in lieu of formal coordination systems. This mirrors evidence from other resource-constrained systems, where mobile instant messaging connects a geographically dispersed and professionally isolated workforce [31]; yet such informal channels raise unresolved confidentiality and data-security concerns [32] that are especially salient given TB-related stigma.

The Tuberculosis Data-to-Action Continuum (D2AC) technical report [33] confirms these findings. Weaknesses in data integration and exchange, organizational structure and function, and information and communications technology infrastructure (data interpretation, skill and knowledge development, and decision-making ability) are cited as factors contributing to long-term workforce sustainability [34].

Additionally, moderate OL and HLHO scores reflect a culture of reflection and patient-centeredness. Setting-level variation, especially in PHCs, reveals gaps in leadership reinforcement, information transfer, and media diversity. These findings may reflect broader challenges commonly described in public-sector HR reforms in transition settings, including Uzbekistan [35, 36]. These gaps may restrict the system's flexibility and innovative capacity.

Despite structural shortcomings, AB rates were low and job satisfaction high, particularly in hospitals. Morale was driven more by patient satisfaction and professional pride than by compensation, consistent with health-workforce research in low-resource settings where professional ethos and non-financial recognition rather than pay sustain motivation [37], and where erosion of non-material rewards precipitates exit [38].

In healthcare specifically, this has produced mixed implementation of workforce-development strategies and limited responsiveness of HR systems to frontline needs [36].

Additionally, the regression revealed a paradox: OL, AB and HRO were positively associated with TI, suggesting that even highly motivated staff may consider leaving if their development goals exceed the available career progression. This is consistent with Self-Determination Theory, which stresses competence, autonomy and relatedness in sustaining motivation [39]. Interview data echo this, with employees perceiving limited opportunities for career development and growth. Comparable findings recur across LMIC health systems, where limited career-development opportunities independently predict turnover intention [40]; notably, more qualified staff are often the most likely to leave when growth is capped [41].

Moreover, the training covered how staffing systems impact morale and retention, how day-to-day work processes can be structured to prevent fragmentation, and how leadership can yield learning and an accountability culture. Participants were also introduced to metrics for measuring coordination quality, psychological safety, and HR transparency, providing them with a concrete way to surface underlying issues and amplify staff voices. They were encouraged to employ these tools to construct ongoing dialogue and improvement.

These findings are consistent with the strategic priorities delineated in regional initiatives such as TB-REP [42], TB-Free Central Asia [43], and ETICA (Eliminate TB in Central Asia), which emphasize strengthening workforce capacity, building coordination mechanisms, and integrating TB services into primary care. Despite the fact that these projects do not directly assess frontline motivation or retention, they emphasize HR management reform and system-level resilience as means to address organizational asymmetries and informal coordination practices.

Future research should track the longitudinal impact of these tools on coordination outcomes, test the introduction of digital platforms, and assess scalability to other high-burden, resource-constrained settings.

Limitations

Several limitations to this research must be considered when interpreting its findings. While the mixed-methods design strengthened the analysis, the reliance on self-reported data, particularly in the survey components, could result in social desirability bias, especially for sensitive constructs such as burnout and turnover intention. This would mean that the actual turnover intentions are underreported, particularly in environments where dissatisfaction is discouraged.

In the RC dimensions, participants were not given the option to skip items related to colleagues with whom they do not work. This may have led to coerced responses that might not validly reflect coordination dynamics, particularly in settings with less cross-role interaction. Purposive sampling is also prone to selection bias, as participants were selected based on access and role rather than through random sampling. Respondents were also clustered within a

small number of care settings; the turnover-intention associations were robust to the inclusion of setting fixed effects, but with only three clusters formal multilevel modeling was not feasible and the pooled standard errors may be modestly understated.

The adaptation of validated scales to the local context, including translation and cultural framing, may have influenced how respondents interpreted some constructs. Further, the adapted tools were not psychometrically validated to full extent in the Uzbek context and therefore could impact the reliability of some measures.

Additionally, the training included no follow-up to assess implementation or sustainment. As the study covered a single region, generalizability to other settings may be limited; future work should include more remote and underserved settings, longitudinal measurement, and context-specific instruments.

Despite these limitations, the current study is an important contribution to the TB workforce development and organizational performance evidence base for EECA, and offers context-specific insights that can inform future interventions and research.

Conclusions

This study highlights the interplay between professional dedication and organizational challenges within Uzbekistan's TB care system. While staff demonstrate high intrinsic motivation and commitment to patient outcomes, systemic gaps in coordination, leadership, and career development pose risks to long-term retention and resilience. The paradoxical link between motivation and turnover intention underscores the need for work environments that foster professional growth through transparent HR practices and accessible career pathways. The training initiative addressed some of these challenges by equipping managers with organizational diagnostic instruments and strategies to foster psychological safety, improve coordination, and amplify staff voices. By encouraging ongoing reflection and local application, the intervention supported the development of more responsive and resilient organizational practices. In this sense, the study demonstrates a learning health system operating at the regional scale, with routine workforce evidence translated into a concrete improvement response. Moving forward, equitable investment, particularly in remote areas, will be crucial to ensure that these efforts yield lasting organizational change. Strengthening these organizational practices from within is feasible and central to sustaining a resilient TB workforce.

Declarations

Ethics approval and consent to participate

The study was approved by the research ethics committee of the NOVA National School of Public Health, NOVA University Lisbon (reference CEENSP no 32/2023), and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to data collection.

Consent for publication

Not applicable. The manuscript contains no details, images, or videos relating to an identifiable individual; interview quotations are anonymized.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

AL and NN contributed to the conceptualization of the study, supporting the formulation of overarching research goals and aims. IA led the methodological design, developed the interview guide, selected the assessment scales, and delivered the training. BD organized the data, supported the information review, and performed the formal analysis for this manuscript. JS provided continuous support and critical input throughout. JS and BD supported the development of the interview guide and survey tools. NP, SY, SA, and NN facilitated study implementation and data collection in the Tashkent region, provided institutional access and local contextual validation, and critically reviewed the manuscript for important intellectual content. All authors reviewed and approved the final manuscript.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. Owing to the sensitive nature of the qualitative interview transcripts and individual survey responses, and to protect participant confidentiality, these data are not publicly available.

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