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Indicator-based tuberculosis infection control assessments with knowledge, attitudes, and practices evaluations among health facilities in China, 2017 to 2019

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Abstract

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Background: Tuberculosis Building and Strengthening Infection Control Strategies (TB BASICS) aimed to achieve improvements in TB infection prevention and control (IPC) through structured training and mentorship.

Methods: TB BASICS was implemented in 6 Chinese provinces from 2017 to 2019. Standardized, facility-based risk assessments tailored to inpatient, laboratory, and outpatient departments were conducted quarterly for 18 months. Knowledge, attitudes, and practices surveys were administered to health care workers (HCW) at 9 participating facilities during the first and last assessments. Kruskal-Wallis rank sum test assessed score differences between departments ($\alpha = 0.05$).

Results: Fifty-seven departments received risk assessments. IPC policies and practices improved substantially during follow up. Facility-based assessment scores were significantly lower in outpatient departments than other departments ($P < .05$). All indicators achieved at least partial implementation by the final assessment. Low scores persisted for implementing isolation protocols, while personal protective equipment use among staff was consistent among all departments. Overall, we observed minimal change in IPC knowledge among HCW. In general, HCW had favorable views of their own IPC capabilities, but reported limited agency to improve institutional IPC.

Conclusions: TB BASICS demonstrated improvements in TB IPC implementation. Structured training and mentorship engaged HCW to maintain confidence and competency for TB prevention.

Keywords

Infection prevention; Health care workers; KAP; China

BACKGROUND

Robust infection prevention and control (IPC) implementation in health facilities reduces tuberculosis (TB) infection (TBI) risks for health care workers (HCW), clients, and visitors.¹ A study in China found that regular IPC trainings and ultraviolet germicidal irradiation (UVGI) equipment maintenance were associated with lower TBI rates at the facility level.² Despite the evidence supporting TB prevention measures, poor adherence to IPC standards has been documented.^{3–5} As a result, TBI remains a substantial risk for HCW. A systematic review estimated the pooled prevalence of TBI to be 54% among HCW in low- and middle-income countries.¹ A separate review specific to China found an average TBI prevalence of 52%.⁶

Within a health facility, TB IPC implementation fidelity may be heterogeneous, and some settings may require tailored mitigation strategies. Departments associated with higher risk of TB disease include inpatient TB departments and laboratories.¹ Multiple studies in China have observed higher TBI prevalence among HCW in inpatient departments.^{4,7} One study found that the odds of TBI were 2.9 times higher among HCW in inpatient TB wards and 1.8 times higher among those working in respiratory wards compared to general medicine facilities, although TBI conversion rates were not significantly different between departments at follow up.⁷

Previous studies have found associations between IPC practices and HCW knowledge and attitudes. A systematic review found that HCW knowledge of TB was significantly associated with implementing TB IPC practices.⁸ In another study, HCW reported factors affecting IPC guideline adherence related to attitudes, including workplace culture, trust in personal protective equipment, and a sense of duty to clients.⁹ Another review noted that low managerial support and negative HCW attitudes may impact TB IPC compliance.¹⁰

TB Building and Strengthening Infection Control Strategies (TB BASICS) is a framework for identifying and prioritizing opportunities to improve TB IPC practices and policies in health care settings. The project includes IPC training, mentorship, guided planning to address suboptimal IPC practices, and periodic TB IPC risk assessments. TB BASICS was implemented in 9 health care facilities in China from 2017 to 2019. In addition to the standard project activities, a knowledge, attitudes, and practices (KAP) survey was carried out among HCW at participating facilities. A previous analysis of project data found substantial improvements in TB IPC implementation during follow-up¹¹ but did not evaluate differences between departments, highest- and lowest-performing IPC indicators, or KAP survey results.

METHODS

Nine TB-designated health facilities in 6 provinces in eastern, central, and western China participated in TB BASICS. Baseline IPC risk assessments were conducted at all facilities and repeated quarterly for 18 months using standardized tools.¹¹ Each participating department within a facility was evaluated using standardized, department-specific assessment tools. The inpatient department assessment tool included 33 indicators, laboratory 20, and outpatient 34. Some indicators were tailored to better fit the department type or omitted if irrelevant. For this analysis, each indicator received 2 points for full implementation, 1 point for partial implementation, and no points if not implemented. Risk assessment teams could also designate an indicator as not applicable to the department assessed; in these cases, that indicator would not count toward the department's score. Scores were calculated as the sum of points awarded, divided by maximum possible. Average scores were evaluated by department and by individual indicator. In the department-wise analysis, scores were first averaged at the facility level. Differences between departments were assessed using the Kruskal-Wallis rank sum test with an alpha level of 0.05. The indicator-wise analysis was approached similarly, with indicators assessed in each department averaged first by department type and then by facility.

Prior to baseline IPC risk assessments, a KAP survey was administered to all HCWs assigned to the departments assessed. The same survey was repeated at the time of the final risk assessment. The knowledge portion included 10 multiple choice questions. Results were converted into facility-level knowledge scores by summing the percentage of correct responses and dividing by the total number of questions. In the attitudes portion, respondents were asked to rate 13 statements on a scale of 1 to 4, with 1 representing strong agreement and 4 representing strong disagreement. About half of the questions were phrased as positive views or attitudes that would be expected to support IPC guideline adherence. To assess self-reported IPC practices, respondents were asked 28 multiple choice questions. For some

questions, respondents could select multiple responses. The KAP survey did not undergo validity testing, but questions were based on extensive literature review.

This was a China CDC and US CDC cooperation activity, and the protocol was reviewed and approved by both sides, deemed not research, and was conducted consistent with applicable Chinese and US law and policy. For US CDC, nonresearch determination was defined by the US Department of Health and Human Services, Protection of Human Subjects 45 CFR §46.102(l).

RESULTS

Among the 9 facilities participating in TB BASICS, 57 departments received risk assessments during follow-up. Of these, 40% were inpatient, 18% were laboratory, and 42% were outpatient departments.¹¹

Results by department

At baseline, average IPC assessment scores were 63%, 69%, and 49% for inpatient, laboratory, and outpatient departments, respectively (Fig. 1), and differences were statistically significant ($P = .02$). In all department types, the greatest improvements in scores were reported in the first 2 quarters of follow-up. Scores for laboratory departments remained higher than other department types, and outpatient department scores remained lowest. At the final evaluation, the average score was highest for laboratories at 90%, followed by inpatient departments at 84% and outpatient departments at 79%, and differences were no longer statistically significant ($P = .17$). Differences between departments were statistically significant at all timepoints except the Quarter 4 and Quarter 6 follow-ups.

Results by indicator

Overall results by indicator: Table 1 presents the indicator scores of the departments of inpatient, laboratory and outpatient, during the intervention so that lowest-scoring indicators appear first. Among indicators with a baseline average score less than 1, 7 related to isolation protocols (Indicators A, D-H, and J). Separation of persons with presumptive TB from immunocompromised persons (Indicator A) was not being implemented in any participating facilities, giving it the lowest score of all indicators assessed. Three low-scoring indicators assessed cough triage and education (Indicators B, L, and M). Proper ventilation or maintaining negative pressure was another common theme among the lowest-scoring indicators, with 4 IPC controls averaging a score less than 1 (Indicators C, I, O, and P).

At the baseline assessment, all participating departments in all facilities reported that sputum-smear microscopy results could be obtained within 24 hours (Indicator AO), which was among 3 high-scoring indicators related to rapid and accurate TB diagnostic services (Indicators AF, AN, and AO). Use and availability of respiratory protection also emerged as a common trend (Indicators AG, AI, and AJ).

All indicators achieved scores greater than 1 by the endpoint evaluation. Among the most-improved IPC practices were client separation (Indicators A, D, and E), ventilation signage (Indicator C), and cough monitoring (Indicator B). Ten indicators moved from partial to full implementation across all departments, including 6 related to respiratory protection use and availability (Indicators Z, AA, AB, AG, AI, and AJ). Controls with minimal improvement included inpatient bed spacing (Indicator S), timely availability of molecular diagnostic testing results (Indicator V), availability of supplies for persons with cough (Indicator AC), prompt TB treatment initiation (Indicator AD), and drug susceptibility testing for those with presumptive drug-resistant TB (Indicator AF).

Department results by indicator: In inpatient departments, the lowest-scoring indicator at baseline was proper use of upper-room UVGI, which was not implemented by any participating departments (Indicator N). Other low-scoring indicators related to ventilation/negative pressure (Indicators C and O), client separation (Indicator D), and cough etiquette signage (Indicator L). Four indicators were fully implemented at baseline in all inpatient facilities assessed: receiving microscopy and molecular diagnostic test results within 24 hours (Indicators V and AO), having a treatment linkage system (Indicator AL), and controlling client crowding (AM). At the final evaluation, 2 ventilation-related controls remained among the lowest scoring indicators (Indicators O and R), and several indicators related to client separation were also among the least implemented (Indicators F and J).

At the initial assessment, no laboratory departments were found to have signage to keep doors and windows open (Indicator C) or to be using upper-room UVGI properly (Indicator N). All of the other lowest-scoring indicators related to natural and mechanical ventilation (Indicators I, O, and P). Laboratory performance indicators were highest for rapid and accurate TB diagnostic services (Indicators AF, AN, and AO), followed by availability and use of respiratory protection (Indicators AI and AJ). Several of the most-improved controls at the endpoint evaluation related to natural and mechanical ventilation (Indicators C, I, and O), and upper-room UVGI was being used properly in all labs assessed (Indicator N).

In outpatient departments, 7 out of the 8 indicators related to client separation were applicable and all scored low at baseline (Indicators A, D, E, F, G, H, and J). All participating departments reported that sputum smear results were available within 24 hours (Indicator AO). At the endpoint assessment, the 7 indicators related to respiratory isolation remained among the lowest scores, although scores suggested at least partial implementation. The only control scoring lower than those related to respiratory isolation was cough monitoring (Indicator B).

KAP results: At the baseline survey, 3,293 responses were received. Mean age among respondents was 31 years of age; 77% of respondents were female. Most respondents were nurses (49%) or physicians (26%). The mean length of time in current profession was 6 years. Seventy-eight percent and 91% of respondents reported having attended TB IPC and hospital-associated infections training in the last year, respectively. A total of 3,497 respondents participated in the repeat KAP survey. The repeat survey did not necessarily include the same respondents as the first. At the repeat survey, demographic characteristics were similar among respondents.

Knowledge: Average facility-level knowledge score was 61% for the initial baseline survey (Fig. 2). The highest scoring question related to installing exhaust fans (Question A); 92% of respondents correctly identified this as an environmental control. The lowest scoring questions related to the type of precautions that should be used to prevent TB transmission (Question J; 16% said airborne), and the most common way that TB is spread from person to person (Question I; 18% said air). At the repeat survey, the average overall score was slightly higher, at 63%. Scores improved for 7 out of 10 questions (Questions A-E and G-H).

Attitudes: Over 90% of respondents agreed with 3 statements phrased positively about their own IPC and TB understanding and training (Fig. 3; Statements J, K, and M). Respondents viewed their facilities overall IPC policies and practices slightly less favorably, with 82% agreeing that the facility had put measures in place to protect them from TB (Statement G), 85% agreeing that the facility was adequately equipped to safely take care of persons with TB (Statement H), and 91% agreeing that the facility was concerned about their health and safety (Statement I). The proportion of respondents agreeing remained high for all positively-framed statements at the repeat survey.

The questionnaire also included 6 statements (Statements A-F) that may suggest a negative view of TB IPC or nonadherence to recommended practices. At the first survey, less than 10% of respondents agreed with 3 of these statements (Statements A-C), including 2 related to mask-wearing. Over half of respondents agreed with 2 negatively framed statement (Statements E and F). Fifty-eight percent agreed that they had a limited role in improving TB IPC (Statement E), and 96% said they would not tell anyone at work if they developed TB symptoms (Statement F). Agreement levels remained similar for most negatively framed statements at the repeat survey, but the proportion agreeing that they didn't offer surgical masks because of patient resistance (Statement C) and that their role in improving IPC was limited (Statement E) increased to 17% and 98%, respectively.

Practices: When asked what they do when entering a room with a person with TB, 81% of respondents said they would don a respirator, 64% would give the client a tissue to cover their mouth when coughing, and 56% would ask the client to wear a mask. These values declined to 45%, 50%, and 44%, respectively, at the repeat survey. Among those who reported collecting sputum samples, 41% said they did so indoors most of the time or always. This proportion decreased to 26% at the repeat survey. The proportion of respondents who reported checking respirator fit each time increased from 39% to 46%. In terms of their own health care, 53% of respondents said they had been screened for TB in the last year. This proportion increased to 88% at the repeat survey.

DISCUSSION

Risk assessments highlighted controls that demonstrated substantial improvement during follow-up, while others, such as respiratory isolation, remained persistently low scoring. Limited changes in knowledge scores, and mixed responses on self-reported IPC practices may suggest the need for more intensive staff training. While scores in all departments increased from the baseline to final assessments, differences between departments remained. Greater attention may be needed to client-facing departments for a facility to achieve high

IPC standards in all areas. The greatest improvements in laboratories were documented for the worst-performing areas at baseline, which were related to ventilation and UVGI. Proper UVGI moved from a score of 0 at baseline to a perfect score at the final evaluation, although this was the indicator most commonly marked not applicable in all department types. Natural ventilation may not have been appropriate in laboratory settings. Improvements in these areas are particularly notable, given that UVGI and natural and mechanical ventilation have previously been reported to reduce the risk of nosocomial TB transmission.¹²

Although some improvement was documented, sustained low facility-based risk assessment indicator scores related to client separation suggests perceived barriers to adopting these measures. Low implementation of fast-tracking and client separation have previously been documented in health care facilities in China.⁵ Limited space for client separation has been noted in other analyses as an influence on TB IPC implementation.¹³

Ventilation/negative pressure and management of persons with cough also emerged as themes among low-scoring indicators. While signage related to natural ventilation became more prevalent, the presence of openings on opposing walls remained low, likely due to the need for infrastructure changes. Keeping doors and windows open may have been impractical depending on weather conditions.

While some indicators assessing management of persons with cough did not achieve optimal implementation, 6 out of 11 indicators with perfect endpoint scores related to respiratory protection. This may suggest that implementation of respiratory protection controls related to supply availability and staff behavior were more feasible or preferable over controls aiming to affect client behavior.

While sputum-smear microscopy results could be obtained within 24 hours prior to TB BASICS implementation, timely availability of molecular diagnostic results was one of the least-improved indicators. However, this trend seems to have been driven primarily by outpatient departments, as this indicator was among the highest-scoring for inpatient departments throughout follow-up.

Full implementation of some indicators may have been affected by factors not assessed in this analysis. For example, a previous study in China found that having a designated sputum collection area was associated with having more staff and more clients with confirmed TB.⁵ An IPC measure such as outdoor sputum collection may also have been affected by the local climate.

Suboptimal implementation of some measures despite most respondents reporting recent TB and hospital-associated infections trainings suggests that annual periodicity may be insufficient. Relatively small changes in knowledge scores may indicate that additional refresher trainings were needed, or that staff attrition was high. Previous studies suggest that the relationship between TB IPC knowledge and routine practices is complex. Among HCW in Nepal, respondents working in TB wards with isolation rooms achieved higher TB IPC knowledge scores,³ demonstrating that levels of IPC knowledge may vary within department types. Studies in Brazil and Thailand found high TB IPC-related awareness but relatively low use of respiratory protection.^{14,15}

Respondents had generally positive views about their own capabilities and facilities' willingness and ability to protect them. Overall, respondents tended to express that they had the appropriate IPC knowledge but lacked agency in improving IPC practices. A systematic review of HCW TB IPC perspectives found that respondents reported superior infection prevention practices than what was observed,¹⁶ which may help explain why self-assessments were high at the second KAP survey while gaps in TB IPC implementation remained. Almost all respondents reported that they would tell no one at work if they had TB symptoms, which may indicate fears of stigmatization.

Several limitations may have affected the results of this analysis. While the intention was to survey the same cohort at the repeat iteration of the KAP survey, staff attrition may have occurred in the interim. Question wording may have influenced responses. For example, the lowest-scoring knowledge questions related to TB transmission. Persisting low scores for these questions may have been due to use of terms such as "airborne transmission." The potential for confusion around this term has since been acknowledged by a WHO Technical Consultation Group, which proposed use of "transmission through the air" to cover both airborne transmission/inhalation and direct deposition.¹⁷ While surveys were anonymous, respondents may have felt pressure to report what they considered were correct attitudes or practices. Differences in IPC scores by department may be a reflection of the applicable indicators in each setting. Laboratories are by nature more controlled environments than client-facing departments, which may help explain why laboratory scores were consistently higher than inpatient and outpatient departments.

CONCLUSIONS

This analysis, which follows an earlier manuscript describing the TB BASICS framework in China in greater detail,¹¹ suggests that IPC practices and policies may not be implemented uniformly within health facilities. Future IPC quality improvement initiatives may consider investing greater time or resources in outpatient departments. Ongoing efforts to continue improving TB IPC in health care facilities are needed to ensure adequate protection from nosocomial transmission for HCW and their clients.

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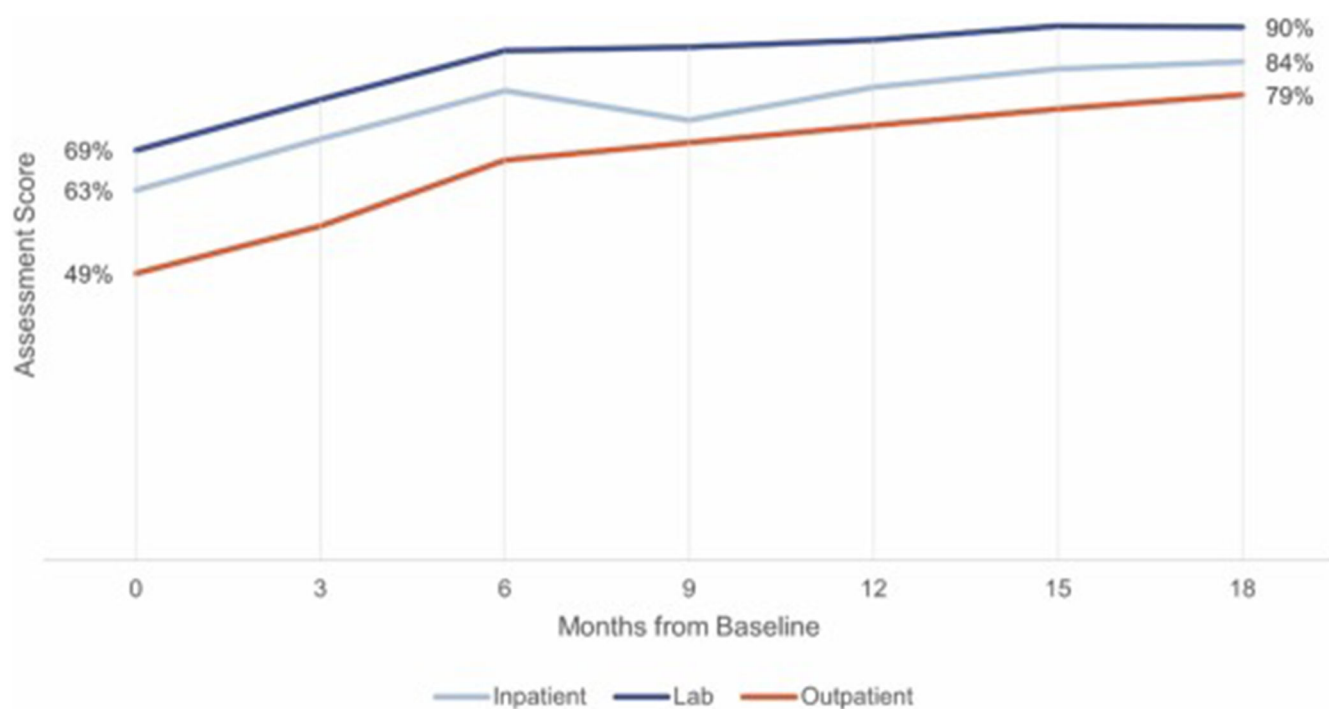


Fig. 1. Average facility-based risk assessment score by department type among 9 health facilities in China, 2017 to 2019.

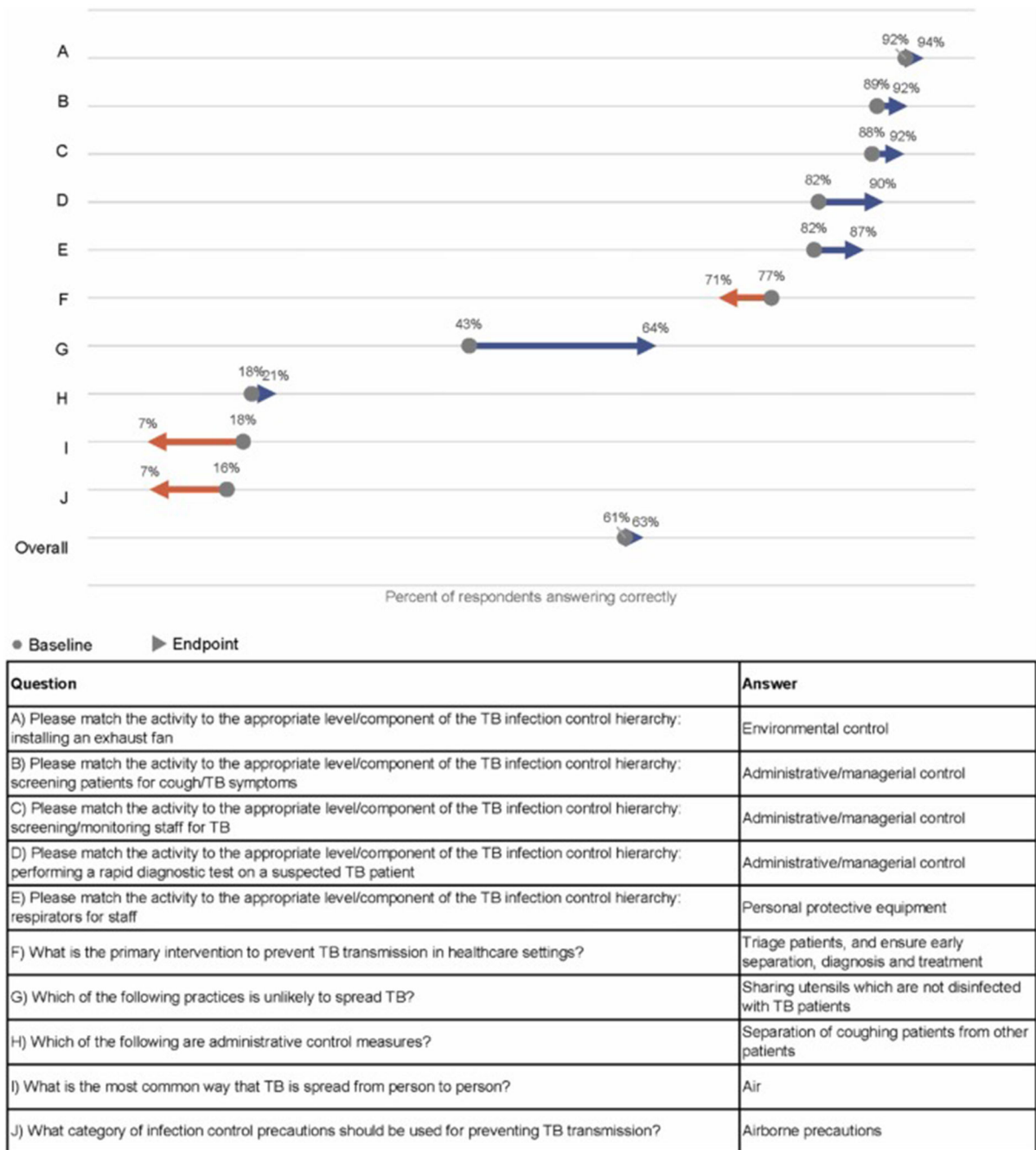
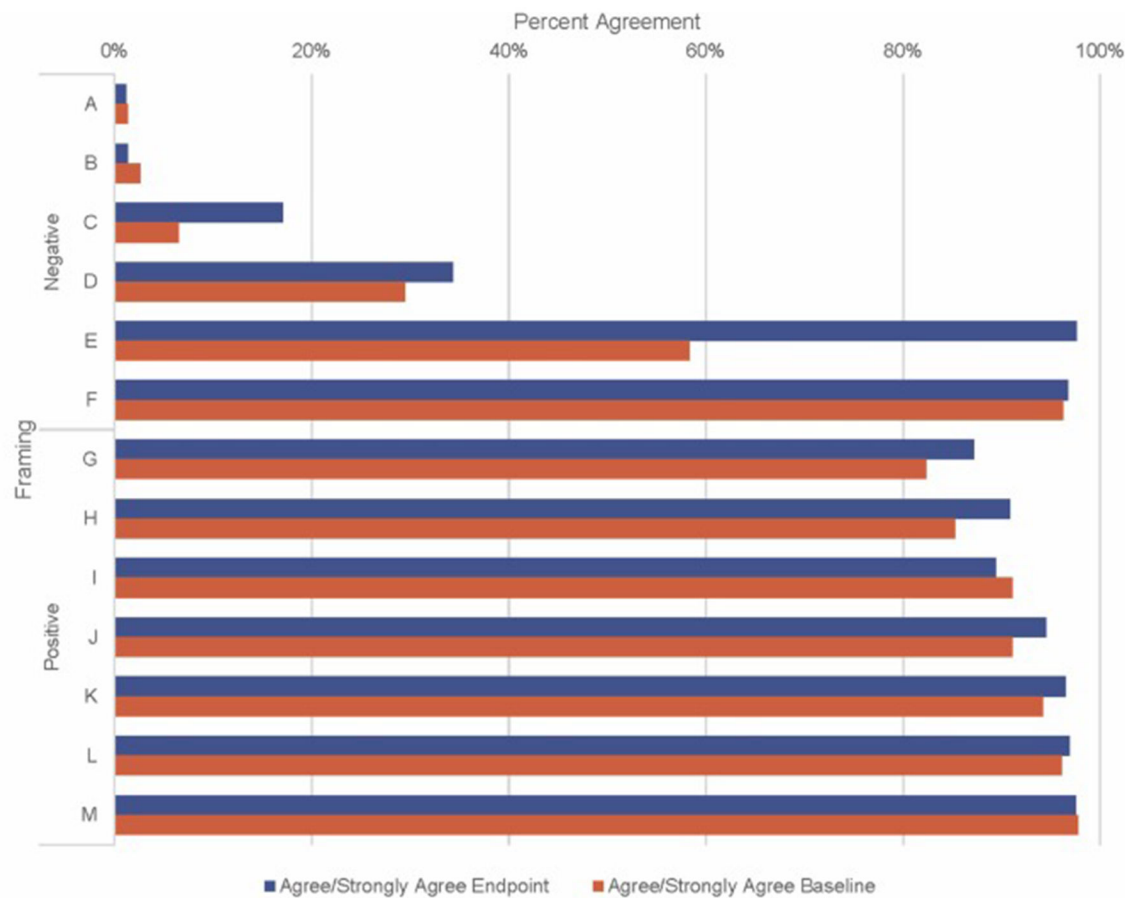


Fig. 2. Knowledge scores by question among 9 health facilities in China, 2017 to 2019. TB, tuberculosis.



A: Healthcare workers should not wear masks because it makes the patient feel stigmatized.
B: Most healthcare workers have already been infected with TB, so prevention measures are not necessary
C: I think our patients will resist wearing a surgical mask, so I don't offer it or ask them to wear one
D: I think patients will complain if the windows in my ward or unit are kept open at all times
E: I feel I have a limited role in improving TB IC at this facility
F: If I develop symptoms of TB, I would not tell anyone at work
G: My facility has put measures in place to protect me from TB
H: This facility is adequately equipped to safely take care of TB patients
I: I believe my health facility is concerned about my health and safety
J: I have been adequately trained in infection control measures by my facility
K: I believe I have a good understanding of my health facility's infection control policy
L: I think the healthcare facility should provide screening for TB and other illnesses to staff member
M: I feel comfortable educating patients about TB and how to prevent TB spread

Fig. 3.

Attitude statements by framing and level of agreement among health care workers at 9 health facilities in China, 2017 to 2019. IC, infection control; TB, tuberculosis.

Table 1

Baseline and final facility-based risk assessment scores by department among 9 health facilities in China, 2017 to 2019

Category	Indicator ID	Description	Timepoint	Inpatient	Lab	Outpatient	Overall
Cough Triage and Education	B	A cough monitor assists with triage/ gives cough etiquette guidance	Baseline			0.1	0.1
			Endpoint			1.1	1.1
	L	Signage for cough etiquette is present	Baseline	0.5		0.9	0.7
			Endpoint	1.7		1.8	1.8
	M	Patients receive guidance and education on cough etiquette	Baseline	0.8		0.7	0.7
			Endpoint	1.8		1.5	1.7
	Q	Patients are routinely asked about cough upon entry	Baseline	1.5		0.8	1.0
			Endpoint	2.0		1.5	1.7
	S	If beds are present, there is at least 1.1 meters between two beds, for prevention of droplet transmission	Baseline	1.0			1.0
			Endpoint	1.4			1.4
Patient Crowding	AE	Occupancy of wards does not exceed one person per 6 square meters	Baseline	1.5			1.5
			Endpoint	1.2			1.2
	AM	Patients are not crowded in waiting areas or hallways	Baseline	2.0		1.9	1.9
			Endpoint	1.8		1.9	1.9
	A	Patients with low immunity are treated separately from presumptive or confirmed TB patients	Baseline			0.0	0.0
			Endpoint			1.2	1.2
Patient Separation	D	Patients with presumptive TB are separated from other patients in a separate room/ward	Baseline	0.6		0.2	0.4
			Endpoint	1.3		1.2	1.3
	E	Patients with cough or other symptoms of TB are fast tracked to a care giver or other clinical services	Baseline			0.6	0.6
			Endpoint			1.3	1.3
	F	Patients with presumptive drug-resistant TB are separated from other patients in a separate room/ward	Baseline	1.0		0.0	0.6
			Endpoint	1.3		1.0	1.1
	G	Diagnosed TB patients are separated from other patients in a separate room/ward	Baseline	1.1		0.3	0.6
			Endpoint	1.5		1.2	1.3
	H	Patients with cough or other symptoms of TB are promptly separated from others	Baseline	1.2		0.3	0.6
			Endpoint	1.7		1.3	1.5

Category	Indicator ID	Description	Timepoint	Inpatient	Lab	Outpatient	Overall
Rapid and Accurate TB Diagnostic Services	J	Diagnosed DR TB patients are separated from other patients in a separate room/ward	Baseline	1.3		0.2	0.7
			Endpoint	1.2		1.1	1.1
	AK	Whether or not have non-TB patients in the TB ward	Baseline	1.8			1.8
			Endpoint	1.6			1.6
	V	mWRD results are available within 24 hours	Baseline	2.0	1.0	0.8	1.2
			Endpoint	1.5	1.0	1.3	1.3
Respiratory Protection Use/Availability	AF	Drug susceptibility testing is performed in persons with presumptive drug-resistant TB	Baseline	1.4	1.8	1.4	1.6
			Endpoint	1.8	1.9	1.7	1.8
	AN	Tracking mechanism of detecting results turn around time of sputum specimens	Baseline		1.9		1.9
			Endpoint		2.0		2.0
	AO	Sputum smear results are received within 24 hours	Baseline	2.0	2.0	2.0	2.0
			Endpoint	2.0	2.0	1.9	2.0
	U	Surgical masks are available for patients with cough or other TB symptoms	Baseline	1.6		1.0	1.2
			Endpoint	1.7		1.4	1.6
	Z	Staff can demonstrate proper respirator use	Baseline	1.3	1.6	1.2	1.3
			Endpoint	2.0	2.0	2.0	2.0
	AA	N-95 or FFP2 respirators are readily available to all staff who have contact with patients with TB or presumptive TB	Baseline	1.6	1.3	1.4	1.4
			Endpoint	2.0	2.0	1.9	2.0
	AB	Staff were trained on proper respirator use in the past one year	Baseline	1.7	1.7	1.4	1.5
			Endpoint	2.0	2.0	2.0	2.0
	AC	Supplies are available for coughing patients (tissues, masks, cloths, trash bins, etc.)	Baseline	1.6		1.4	1.5
			Endpoint	1.8		1.6	1.7
	AG	There have been no stock-outs of surgical masks in the past 3 months	Baseline	1.8		1.6	1.6
			Endpoint	2.0		2.0	2.0
	AI	There have been no stock-outs of respirators in the past 3 months	Baseline	1.8	1.8	1.7	1.7
			Endpoint	2.0	2.0	2.0	2.0
	AJ	Lab staff wear respirators when perform procedures that have risk of generating TB aerosols from specimens	Baseline		1.8		1.8
			Endpoint		2.0		2.0

Category	Indicator ID	Description	Timepoint	Inpatient	Lab	Outpatient	Overall
Specimen Management	K	Sputum samples are collected in a designated area with good ventilation away from others	Baseline	0.8		0.5	0.7
			Endpoint	1.7		1.7	1.7
	W	Biosafety cabinets: Records of maintenance and certification in the past year	Baseline		1.2		1.2
			Endpoint		1.9		1.9
	Y	Sputum specimens are delivered to the laboratory by the health care provider rather than the patient	Baseline		1.3		1.3
			Endpoint		2.0		2.0
Treatment Linkage	AD	TB treatment is started within 24 hours of when lab results are received	Baseline			1.5	1.5
			Endpoint			1.6	1.6
	AL	There is a formal system for linking patients diagnosed with TB in the inpatient setting to outpatient care for follow-up	Baseline	2.0		1.8	1.8
			Endpoint	2.0		2.0	2.0
UVGI	N	Upper-room UVGI is being used properly	Baseline	0.0	0.0	0.8	0.8
			Endpoint	1.4	2.0	1.6	1.8
	X	Traditional UVGI is being used properly	Baseline	1.2	1.4	1.2	1.3
			Endpoint	1.7	2.0	1.7	1.8
Ventilation/Negative Pressure	C	Signage is in place to keep doors and windows open	Baseline	0.2	0.0	0.3	0.2
			Endpoint	2.0	1.5	1.9	1.8
	I	Regular maintenance for directional and extractor fans is conducted	Baseline	1.0	0.8	0.4	0.6
			Endpoint	1.6	1.3	1.5	1.2
	O	Areas of openings of at least 10% of area of room on opposing sides of room (total ≥20%)	Baseline	0.3	0.6	1.1	0.8
			Endpoint	1.0	1.0	1.3	1.1
	P	All appropriate windows/doors are open on observation	Baseline	1.0	0.9	0.8	0.9
			Endpoint	1.8	1.3	1.6	1.6
	R	Visualization of airflow patterns with smoke from supply and exhaust grilles/openings	Baseline	0.7	1.4	0.8	1.0
			Endpoint	1.3	1.6	1.5	1.5
	T	Openings on opposing walls of room	Baseline	1.0	1.8	0.8	1.2
			Endpoint	1.4	1.7	1.8	1.7
	AH	No chemical or human odors relative to the outdoors	Baseline	1.5	1.7	1.9	1.7
			Endpoint	2.0	2.0	2.0	2.0

DR TB, drug-resistant tuberculosis; *mWRD*, molecular World Health Organization-recommended rapid diagnostic; *UVGI*, ultraviolet germicidal irradiation.