Improved Outcomes Found After Implementing a Systematic Evaluation and Program Improvement Process for Tuberculosis

ANNE CASS, MPH^a

TAMBI SHAW, MPH^b

MELISSA EHMAN, MPH^b

JAN YOUNG, MSN^b

JENNIFER FLOOD, MD, MPH^b

SARAH ROYCE, MD, MPH^b

ABSTRACT

California's state and local tuberculosis (TB) programs collaborated to develop the Tuberculosis Indicators Project (TIP), a program evaluation and improvement process. In TIP, local and state staff review data, identify program gaps, implement plans to improve local TB program performance, and evaluate outcomes. After 10 years of project implementation, indicator performance changes and patient outcomes were measured. Eighty-seven percent of participating programs showed a performance increase in targeted indicators after three years compared with 57% of comparison groups. Statistically significant performance change was more common in the intervention local health departments (LHDs) than in comparison groups. The most notable performance changes were in the contact investigation and case management indicators. These results indicate that this systematic evaluation and program improvement project was associated with improved LHD TB control performance and may be useful to inform improvement projects in other public health programs.

^aCalifornia Department of Public Health, Center for Infectious Diseases, Division of Communicable Disease Control, Tuberculosis Control Branch, San Diego, CA

^bCalifornia Department of Public Health, Center for Infectious Diseases, Division of Communicable Disease Control, Tuberculosis Control Branch, Richmond, CA

Address correspondence to: Anne Cass, MPH, California Department of Public Health, Center for Infectious Diseases, Division of Communicable Disease Control, Tuberculosis Control Branch, 5353 Mission Center Rd., Ste. 108, San Diego, CA 92018; tel. 619-688-0253; fax 619-688-0281; e-mail <anne.cass@cdph.ca.gov>.

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In 1998, the California Department of Public Health, Tuberculosis Control Branch (TBCB) sought to enhance its program evaluation and improvement efforts. The evaluation process had two aims: (1) to measure the effectiveness of California tuberculosis (TB) control programs in implementing well-established TB control guidelines and ensuring positive patient and public health outcomes and (2) to focus interventions where gaps were identified. From 1998 to 2000, the TBCB worked closely with local health departments (LHDs) to design TB program performance indicators and a collaborative process for the state and local TB programs to use the indicators. The resulting evaluation and program improvement initiative, called the Tuberculosis Indicators Project (TIP), was launched in 2000.

In this article, we describe the implementation of an evaluation framework in multiple high-morbidity local TB control programs in California. We also quantify the program performance changes associated with TIP and examine why these changes might have occurred.

BACKGROUND

After decades of decline in the number of reported cases of TB in the United States, there was a national resurgence of TB in the early 1990s.¹ Since then, the number of reported TB cases has steadily decreased, greatly due to the development of effective interventions enabled by increased resources.² California reports the highest TB morbidity of any state in the U.S., with more than 2,300 active TB cases annually, and one of the highest case rates at more than six cases per 100,000 people.³

The California state TB program, the lead agency for TB control, provides funding, consultation, and oversight to LHDs throughout the state. The 61 LHDs in California conduct TB surveillance, provide or oversee clinical and case management for TB patients, and conduct TB contact investigations. Control of TB in California is complicated by the fact that more than one-third of TB cases receive all of their clinical care in the private sector and more than half of the cases receive at least some of their care from private providers;⁴ however, LHDs are responsible for ensuring the quality of care provided for all TB cases. Effective communication and collaboration between public and private agencies are required for performance objectives to be met.

In 2000, California initiated a structured, collaborative process for using TB indicators to improve performance. Nineteen LHDs with at least 30 TB cases

per year participated in the project. Collectively, these LHDs reported 93% of California's TB cases.

Through collaboration between local and state TB programs, a set of TB control indicators was developed. To improve indicator performance, a systematic process for selecting and evaluating interventions and measuring outcomes was designed. The TIP process fosters state and local collaboration in developing, implementing, and evaluating programmatic interventions designed to improve performance on targeted indicators. Figure 1 presents a comprehensive list of the TIP indicators and Figure 2 describes the steps of the improvement cycle. State and local TB teams work together to review data, select interventions, and evaluate outcomes. The interdisciplinary state teams include a program consultant and an epidemiologist, with fiscal, physician, and administrative support when needed. The local team typically includes the TB controller, program manager, nursing and allied health professional supervisors and staff, and an epidemiologist where available. Figure 3 specifies the local and state roles in TIP implementation.

New TIP cycles are launched when LHD and TBCB staff indicate readiness to begin the multiyear program improvement process. The state and local teams initially meet to review the indicator data and select an indicator for intervention. Once the indicator is selected, staff members identify possible factors contributing to underperformance and then develop a performance improvement plan. The plan is revisited at regular intervals to monitor progress and to assess short-term impact. The long-term outcomes are measured when data become available. Each program improvement cycle averages two years and includes multiple in-person meetings between the state and local TB program staff.

METHODS

In this retrospective observational analysis, the study period was 2000–2010. We assessed all TB cases reported during this time frame in the 19 California TIP LHDs. We compared outcomes of cases from California LHDs implementing interventions to improve performance on a specific indicator through TIP with those of cases from California LHDs participating in TIP but not targeting the specific indicator for improvement.

Data sources

Indicators measuring TB control activities were calculated using surveillance data sources for TB cases⁵ and contacts.⁶ Case reports are submitted to the state

TB program for each verified case of TB disease. The case reports contain a broad range of data on patient demographic and clinical characteristics and treatment outcomes. Contact reports contain aggregate information for contacts identified and evaluated for TB and treated for latent TB infection (LTBI).

Analysis

We identified LHDs implementing interventions as part of TIP (hereafter, intervention LHDs) with at least three years of available data during and after intervention implementation. Data from the year immediately prior to the intervention period served as

Figure 1. Tuberculosis control performance indicators used in program improvement cycles: California Tuberculosis Indicators Project, 2000–2010

Goals and performance indicators	Indicator
Goal A: Ensure sufficient resources are available and effectively used to support a public health infrastructure capable of controlling and eliminating TB	
A1. Program capacity	Demonstrated capacity (organization, staffing, resources, and facilities) to carry out the core components of a TB control program
Goal B: Ensure early identification and reporting of all people with TB	
B1. TB case rate	TB case rate per 100,000 population
B2. Timely reporting	Proportion of verified TB cases reported to the LHD within one working day of treatment start date
B3. Complete reporting	Proportion of cases with complete data on key variables (e.g., homelessness, drug use, and excess alcohol use) for TB
B4. Culture identification	Proportion of pulmonary or laryngeal TB cases >12 years of age with sputum culture obtained
B5. Timely evaluation of people with immigrant TB notification ^a	Proportion of people with immigrant TB notification whose evaluation for TB disease/infection is completed within 60 days of LHD receiving the notification
Goal C: Ensure timely completion of appropriate therapy for all people with TB	
C1. Recommended initial therapy	Proportion of TB cases started on recommended four-drug regimen
C2. Timely treatment initiation	Proportion of sputum smear-positive pulmonary or laryngeal TB cases initiating treatment in <7 days from specimen collection
C3. Culture conversion	Proportion of sputum culture-positive TB cases with documented conversion to sputum culture-negative within 60 days of treatment initiation
C4-A. Appropriate DOT	Proportion of TB cases for whom DOT is recommended who receive DOT throughout the course of treatment
C4-B. Inappropriate SAT	Proportion of TB cases for whom DOT is recommended who receive SAT throughout the course of treatment
C5. Timely completion of therapy	Proportion of TB cases who complete treatment in ≤12 months
C6. Not defaulting from treatment	Proportion of TB cases who do not default prior to completing treatment
C7. Moved cases completing treatment	Proportion of TB cases moving during treatment who completed treatment in ≤12 months
Goal D: Ensure contacts to a person with infectious TB are promptly identified, examined, and, if appropriate, complete treatment for LTBI	
D1. Contact identification	Proportion of sputum smear-positive cases with at least one contact identified
D2. Contact evaluation	Proportion of identified contacts to sputum smear-positive cases who complete evaluation for TB infection or disease
D3. Contact LTBI treatment initiation	Proportion of infected contacts to pulmonary cases started on treatment for LTBI
D4. Contact LTBI treatment completion	Proportion of infected contacts to pulmonary cases started on treatment for LTBI who complete treatment
Goal SE: Reduce the occurrence of sentinel events	
SE1. Pediatric TB cases	Proportion of TB cases in children 0–4 years of age
SE2. TB deaths	Proportion of people who die with TB disease

^aIndicator not implemented due to data inaccessibility

TB = tuberculosis

LHD = local health department

DOT = directly observed therapy

SAT = self-administered therapy

LTBI = latent tuberculosis infection

Figure 2. Key steps in a tuberculosis control program improvement cycle: California Tuberculosis Indicators Project, 2000–2010

<i>TIP steps</i>	<i>Activities</i>
Perform initial assessment	<ul style="list-style-type: none"> • Perform infrastructure assessment to determine local capacity to meet TB control standards. • Perform initial review of indicator data comparing local program performance with statewide performance and state/national objectives. • Select indicators for additional analyses.
Analyze and plan	<ul style="list-style-type: none"> • Perform chart reviews, additional stratifications of surveillance data, and key informant interviews to identify possible reasons for suboptimal indicator performance. • Select indicator(s) to target for intervention. • Develop contributing factors diagram that depicts factors hindering optimal program performance.
Develop and implement performance improvement plan	<ul style="list-style-type: none"> • Develop a performance improvement plan for targeted indicator(s). • Implement performance improvement plan.
Evaluate	<ul style="list-style-type: none"> • Conduct short- and long-term evaluation of the performance improvement plan: <ul style="list-style-type: none"> ◦ Review and update the performance improvement plan at regular intervals. ◦ Review outcome data. ◦ Perform written evaluations and key informant interviews to obtain feedback from local and state staff.
Implement next TIP cycle	<ul style="list-style-type: none"> • When local and state staff are ready, implement next TIP cycle.

TIP = Tuberculosis Indicators Project

TB = tuberculosis

the baseline year. Three years was chosen for the time interval to allow for gradual implementation of more complex interventions; it was also sufficient to observe performance changes related to the intervention. We compared cases or contacts in each intervention LHD for an indicator with pooled cases or contacts from all other TIP LHDs that were not implementing interventions for that same indicator during that same three-year period. Baseline and follow-up years were selected based upon the year TIP interventions began; therefore, they differed among LHDs. Separate comparisons were made for LHDs that implemented interventions for the same indicator but during different time periods to account for differences in secular trends in indicator performance during different time periods. We used the Chi-square test of proportions to assess statistical significance of performance

change between intervention and comparison groups of cases or contacts, comparing aggregate baseline and three-year performance between the two groups for each indicator and time period. Within indicators, we stratified by baseline year to control for changes in baselines over time. When more than one LHD implemented interventions for a given indicator in the same time period, we analyzed results for cases or contacts in each intervention LHD.

We calculated the absolute percentage change in performance between baseline and year three of performance improvement plan implementation for each intervention and comparison group. The performance change was designated as positive when the change was in the direction of the desired outcome. For most indicators, the desired change was a numerical increase in the indicator result. However, for two TIP indicators,

Figure 3. Local and state roles in a tuberculosis control program improvement cycle: California Tuberculosis Indicators Project, 2000–2010

<i>Agency</i>	<i>Roles</i>
Local health department	<ol style="list-style-type: none"> 1) Select indicator(s) to target for improvement. 2) Set realistic local performance objectives for the targeted indicator(s). 3) Identify the factors contributing to suboptimal performance in the targeted indicator(s). 4) Develop and implement interventions to facilitate achievement of the local performance objective.
State TB control branch	<ol style="list-style-type: none"> 1) Provide Web-based indicator reports. 2) Serve as evaluation consultants and facilitators, providing guidance, tools, and technical assistance throughout the process.

TB = tuberculosis

Inappropriate Self-Administered Therapy (SAT) and Pediatric TB Cases, a decrease in the indicator result was the desirable outcome, and numerical decreases were shown as a positive result.

OUTCOMES

From 2000 to 2007, 15 TIP LHDs developed 29 performance improvement plans for 12 separate indicators. By the end of the study period in 2010, three-year outcomes were available for 25 plans. One plan was omitted from outcome analysis because the baseline performance was zero and relative change could not be calculated. We analyzed the outcomes of 24 performance improvement plans.

The number of cases or contacts in LHDs implementing performance improvement plans ranged from 14 to 1,275. The number of cases or contacts in each comparison group ranged from 670 to 10,717, according to the time period and indicator.

Results of the performance change analysis are shown in the Table. We observed improved outcomes following three years of implementation in 87% (21/24) of the performance improvement plans, while 57% (12/21) of the comparison groups saw improvement during the same time period. Statistically significant performance change at the $p < 0.05$ level was more common in the intervention LHDs than in the comparison groups. Following implementation of performance improvement plans, 50% (12/24) of the intervention LHD groups showed significant improvement, with no significant declines in performance. Among comparison groups, 33% (7/21) showed significant improvement while 10% (2/21) significantly worsened.

Structured feedback from both LHD and state staff participating in the project indicated that TIP provided a forum for improved collaboration between the two entities, and LHD staff expressed satisfaction with both the TIP process and outcomes.

Amenability to intervention

The difference in performance change between intervention and comparison groups was shown most clearly for the Contact Evaluation indicator, which measures the percentage of close contacts to infectious TB cases who are fully evaluated for TB disease and infection. For this indicator, performance in all four intervention LHDs significantly improved (range: 6%–26%, all $p < 0.005$), while performance in two of the three comparison groups significantly declined (by –2% and –3%, both $p < 0.005$) (Table).

Two other indicators of note concerned the provi-

sion of directly observed therapy (DOT) to patients with special indications for ensuring treatment completion, such as those with drug-resistant TB. Three LHDs focused on ensuring that high-priority patients received all treatment via DOT, and two aimed to prevent high-priority patients from receiving SAT throughout treatment. All five intervention LHDs showed improved performance compared with baseline (range: 1%–70%). Three of the five comparison groups showed improvement (range: 3%–14%) and the remaining two comparison groups showed performance decreases (–1% and –3%).

Another indicator that showed significant improvement after TIP implementation was Contact LTBI Treatment Initiation. The LHD that targeted this indicator improved 34% ($p < 0.005$) while the comparison group declined by 1% ($p = 0.125$).

The other seven indicators showed improvement in intervention LHDs after implementing 11 of 14 performance improvement plans. Eight of the corresponding comparison groups also showed performance increases, with one decline and three instances of no change.

Interventions implemented to improve performance

Figure 4 shows seven categories of interventions included in TIP performance improvement plans. The Appropriate DOT/Inappropriate SAT indicators were combined in Figure 4 because the interventions for the two indicators had the same goal: to increase the use of DOT in high-priority patients. While there was a wide range in the number of intervention types implemented by LHDs to improve indicator performance, the most common interventions were the use of internal quality assurance processes, the development of new forms and LHD processes, and the implementation of outreach and education for private medical doctors (PMDs). Nearly half of all indicators had reporting issues that were identified and addressed through the TIP process.

LESSONS LEARNED

Eighty-seven percent of LHDs targeting an indicator for improvement showed performance improvement after implementing interventions using the TIP process. In contrast, 57% of the comparison groups saw improved performance for those indicators.

Of all of the indicators, the most notable improvement was seen in the Contact Evaluation indicator. All four intervention LHDs saw statistically significant performance increases while two of the three comparison groups had statistically significant performance decreases. Interventions cited by LHD key informants

as contributing to their performance change included prioritization of contacts, staff training, development of educational materials and tools, and efforts to improve data quality. Also, the performance improvement plans for the Contact Evaluation indicator included interventions from all seven intervention categories, and it is possible that the breadth of interventions contributed to the observed performance improvements.

Ensuring that patients adhere to and complete an appropriate treatment regimen is a key responsibility of TB control programs.⁷ DOT is used to ensure that

TB patients are taking their required medications until cure.⁸ Improvement was noted in all five LHDs targeting the two indicators focused on DOT (i.e., Appropriate DOT and Inappropriate SAT), with one LHD observing a performance change from 29% to 89%. Similar to the Contact Evaluation indicator, the DOT/SAT performance improvement plans included a wide range of intervention types, which also may have contributed to the improved outcomes.

Monitoring of sputum cultures until conversion is performed to ensure that patients are responding

Table. Performance change in local tuberculosis control programs after implementation of program improvement activities, by indicator: California Tuberculosis Indicators Project, 2000–2010

Indicator	LHD or comparison group ^a (baseline year)	Performance		Year 3 vs. baseline	
		Baseline year Percent (N) ^b	Year 3 of interventions Percent (N)	Absolute performance change ^c	P-value ^d
Timely Reporting	A (2001)	64 (192)	76 (135)	+12	0.02
	K (2001)	84 (50)	89 (63)	+5	0.45
	Comparison (2001)	84 (2,781)	89 (2,525)	+5	<0.01
Complete Reporting	I (2001)	83 (126)	99 (156)	+16	<0.01
	Comparison (2001)	96 (2,935)	97 (2,613)	+1	0.26
Culture Conversion ≤60 Days	B (1999)	56 (45)	80 (35)	+24	0.02
	Comparison (1999)	64 (1,495)	65 (1,313)	+1	0.89
	D (2000)	81 (21)	75 (16)	−6	0.66
	J (2000)	68 (184)	74 (175)	+6	0.27
	Comparison (2000)	56 (1,445)	74 (1,306)	+18	<0.01
Appropriate Directly Observed Therapy	B (1999)	11 (27)	81 (16)	+70	<0.01
	Comparison (1999)	63 (967)	77 (761)	+14	<0.01
	A (2001)	29 (59)	89 (28)	+60	<0.01
	Comparison (2001)	75 (851)	72 (767)	−3	0.15
	E (2003)	28 (18)	29 (14)	+1	0.96
	Comparison (2003)	73 (799)	72 (597)	−1	0.75
Inappropriate Self-Administered Therapy	L (2001)	31 (95)	15 (104)	+16	0.01
	Comparison (2001)	16 (1,745)	11 (1,538)	+5	<0.01
	B (2004)	22 (32)	5 (22)	+17	0.08
	Comparison (2004)	11 (1,538)	8 (1,306)	+3	<0.01
Timely Completion of Therapy	B (1999)	76 (89)	89 (57)	+13	<0.05
	Comparison (1999)	80 (2,602)	81 (2,312)	+1	0.29
	H (2000)	75 (56)	84 (63)	+9	0.23
	Comparison (2000)	80 (2,377)	80 (2,322)	NC	0.51
	A (2001)	84 (177)	86 (122)	+2	0.56
	Comparison (2001)	81 (2,412)	81 (2,228)	NC	0.89
Contact Identification	M (2006)	94 (365)	91 (274)	−3	0.13
	Comparison (2006)	90 (670)	95 (603)	+5	<0.01
Contact Evaluation	J (2002)	83 (845)	89 (714)	+6	<0.01
	C (2002)	57 (329)	78 (412)	+21	<0.01
	Comparison (2002)	92 (9,451)	90 (9,736)	−2	<0.01
	I (2003)	76 (269)	90 (1,275)	+14	<0.01
	Comparison (2003)	90 (10,717)	87 (8,467)	−3	<0.01
	N (2006)	49 (491)	75 (685)	+26	<0.01
	Comparison (2006)	87 (8,467)	89 (9,757)	+2	<0.01

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Table (continued). Performance change in local tuberculosis control programs after implementation of program improvement activities, by indicator: California Tuberculosis Indicators Project, 2000–2010

Indicator	LHD or comparison group ^a (baseline year)	Performance		Year 3 vs. baseline	
		Baseline year Percent (N) ^b	Year 3 of interventions Percent (N)	Absolute performance change ^c	P-value ^d
Contact LTBI Treatment Initiation	O (2006)	56 (68)	90 (97)	+34	<0.01
	Comparison (2006)	62 (3,652)	61 (3,146)	–1	0.13
Contact LTBI Treatment Completion	G (2003)	71 (245)	69 (183)	–2	0.56
	Comparison (2003)	60 (2,907)	57 (2,135)	–3	0.08
Pediatric TB Cases	B (1999)	8 (97)	2 (69)	+6.8	0.06
	Comparison (1999)	4 (2,868)	3 (2,578)	+0.6	0.24
	A (2001)	2 (196)	1 (143)	+0.8	0.48
	Comparison (2001)	4 (2,754)	4 (2,548)	NC	0.98
	F (2003)	6 (65)	<1 (39)	+6.2	0.11
	Comparison (2003)	4 (2,654)	4 (2,394)	+0.5	0.31

^aA–O = TIP LHDS (coded); comparison = aggregate cases or contacts across all TIP LHDS not developing interventions for a given TIP indicator during the specified time period

^bBaseline year is the year immediately prior to the intervention period, and varies by LHD.

^cTo consistently represent positive change as change toward a desirable outcome, performance change for indicators measuring cases with an undesirable outcome (e.g., Inappropriate Self-Administered Therapy and Pediatric TB Cases) is calculated as (baseline [pre-TIP] performance percent – Year 3 [post-TIP] performance percent).

^dFor Chi-square test of proportions

LHD = local health department

NC = no change

LTBI = latent tuberculosis infection

TB = tuberculosis

TIP = Tuberculosis Indicators Project

to therapy and to determine the appropriate length of treatment.⁹ Improvement was seen in two of three performance improvement plans targeting the Culture Conversion indicator. Local TB program staff reported that a review of culture status at case conferences, the development of a tracking tool, the identification of alternate means for sputum specimen collection, and the development of a clinic protocol all likely contributed to performance improvement.

Both health departments and PMDs provide care for active TB cases and their contacts. While several performance improvement plans included interventions directed toward PMDs, LHDs targeting the Contact LTBI Treatment Initiation, Timely Reporting, and Complete Reporting indicators all reported that their improved communication with PMDs was key to performance change. All three of these indicators showed performance improvement after TIP implementation. Public health budget reductions and U.S. health-care reform will further increase the need for LHDs to effectively work with the private health-care delivery system.

Contact Identification, Contact LTBI Treatment

Completion, and Pediatric TB Cases indicators were the least likely to show significant improvement in either the intervention or comparison groups. Contact identification can be challenging, as TB patients are often reluctant to share contact information due to disease-associated stigma, embarrassment, or involvement in illegal activities. Ensuring completion of treatment for both TB cases and contacts also presents a significant challenge for TB control practitioners.^{9,10} Treatment is lengthy and must be provided even when patients do not feel sick. Patients with TB disease or infection often have competing priorities in their lives, including substance abuse and/or homelessness, which make adhering to a treatment regimen difficult.¹¹ Multiple factors contribute to the development of pediatric TB, and missed opportunities for TB prevention in this population are well-documented.^{12,13}

As mentioned previously, the most common interventions across all LHDs and indicators were the use of internal quality assurance processes such as case conferences, the development of new forms and LHD processes, and outreach and education for PMDs. Case conferences are recommended for identifying and

Figure 4. Common themes among program improvement interventions, by indicator: California Tuberculosis Indicators Project, 2000–2010

Indicator (number of performance improvement plans)	Establish internal quality assurance processes	Establish other internal processes	Create and use forms and protocols	Train staff	Fix reporting issues	Educate patients	Educate private medical doctors	Number of intervention types
Timely Reporting (2)	X				X		X	3
Complete Reporting (1)	X	X	X	X				4
Culture Conversion ≤60 Days (3)	X	X	X	X	X	X	X	7
Appropriate Directly Observed Therapy/ Inappropriate Self-Administered Therapy (5)	X	X	X	X	X	X	X	7
Timely Completion of Therapy (3)								
Contact Identification (1)	X	X	X	X	X		X	5
Contact Evaluation (4)	X	X	X	X	X	X	X	1
Contact LTBI Treatment Initiation (1)	X	X	X	X		X	X	7
Contact LTBI Treatment Completion (1)	X	X	X	X		X	X	6
Pediatric TB cases (3)	X	X	X	X		X	X	6
								6

LTBI = latent tuberculosis infection

TB = tuberculosis

resolving programmatic issues in TB control, as they provide a forum for monitoring clinical, case management, and contact investigation processes and outcomes.^{14,15} In TIP, state staff provide tools and technical assistance to help LHDs implement case conferences. Cohort review, another program improvement strategy, has recently been adopted by several California LHDs but was not included as an intervention in any of the TIP performance improvement plans included in this study. LHDs can implement new forms and processes without significant resources but with a significant impact. After a successful TIP intervention has been implemented, state and local staff are able to share the tool and/or process with other LHDs. An example of this information sharing is the development of a fact sheet on state letterhead that LHDs can use to educate PMDs about the need for DOT in high-risk patients.

Several performance improvement plans contained interventions to correct reporting issues identified during the TIP process. According to LHD management staff, five indicators likely improved, at least in part, because of improved data quality.

Limitations

Our analysis was subject to several limitations. Other factors outside of interventions driven by TIP that could have impacted performance were not systematically evaluated, such as changes in local funding, staffing, or concurrent non-TIP interventions. For some indicators, such as Pediatric TB Cases, small numbers of cases for analysis may have hampered our ability to evaluate improvement using statistical significance tests. Small numbers were also a limitation in comparing the small case or contact numbers of the intervention LHDs with larger pooled comparison groups of cases or contacts; there was greater power to detect a statistically significant change for the comparison groups.

The variation among LHDs that participated in TIP also may hinder generalizability. Additionally, state and local TB program staffing levels and budgets have diminished since the study period began. Thus, it is not known if these results are reproducible at the present time, given current resources.

When LHDs implemented interventions to improve performance on a specific indicator, such actions may have had a positive impact on other TB practice areas. For example, implementing case conferencing to improve DOT might also improve culture conversion. This improvement might have affected performance in indicators not specifically targeted and could account for some of the program performance improvements that were seen in the comparison groups. Also, a review of indicator data occasionally resulted in LHDs initiating

interventions to improve indicator performance without developing a formal performance improvement plan.

CONCLUSIONS

The results of our evaluation suggest that this systematic improvement and evaluation project was associated with improvements in TB control performance indicators in California. Findings include improved TB control outcomes after implementing 21 of 24 performance improvement plans, and a higher proportion of statistically significant improvements in intervention groups vs. comparison groups.

In addition to providing California with a process to use data to guide TB program performance efforts, TIP implementation has also contributed to improved data quality and increased collaboration between the state TBCB and LHDs. While the concept of an indicator set has already been replicated nationally by the Centers for Disease Control and Prevention as the National TB Indicators Project,¹⁶ the systematic improvement process used in TIP could also be replicated by other public health programs. In an era of declining public health resources¹⁷ and loss of the infrastructure necessary for key public health activities,¹⁸ interventions such as TIP can help ensure that limited resources are used effectively for program improvement.

Further research is needed to increase our understanding of how inputs such as funding, staffing, and program organization impact program performance. Data are also needed to strengthen the evidence base for TB program interventions.

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