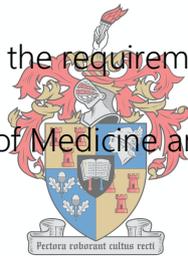


# Improving tuberculosis infection control in the Mossel Bay sub-district of the Western Cape: A quality improvement project

Dr Martha Bedelu Mekebeb

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Supervisor: Professor Louis S Jenkins; MB,ChB, M Fam Med, FCFP(SA), PhD

Co-supervisor: Dr Klaus B von Pressentin; MB,ChB, MMed(FamMed), FCFP(SA), PhD

Division of Family Medicine and Primary Care, Faculty of Medicine and Health Sciences,  
Stellenbosch University.

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## Declaration

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Dr Martha Bedelu Mekebeb

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## Abstract

### **Introduction**

Tuberculosis (TB) is a major global health challenge, and South Africa is one of the high-burden countries. A national TB infection control (TBIC) guideline has stipulated three main areas of infection control at health facilities: work practice and administrative control; environmental control; and personal protection for health workers. The purpose of this project was to identify the gaps and address the challenges in TB infection control in the Mossel Bay sub-district in the Western Cape.

### **Methods**

A quality improvement cycle was used to evaluate and improve TBIC according to the national TBIC draft guideline. Two facilities within the sub-district were used, the district hospital and a primary health care clinic. Each had an existing infection and prevention control and occupational health and safety team, which were used as the audit teams.

### **Results**

A baseline assessment was followed by a set of interventions, which failed to show a significant improvement in TBIC. The difference between the pre- and post-intervention TB screening rate was not statistically significant. An assessment of time interval between 101 patients presenting with TB symptoms and diagnosed with TB was four days at baseline and post-intervention. Most of the anticipated improvements were dependent on the health workers' adherence to the local TBIC policies, which emerged as an unexpected finding.

### **Conclusion**

The study found good managerial commitment reflected by the presence of various policies, guidelines, specific personnel and committees to deal with infection control in general. The project has created awareness about tuberculosis infection control among the staff. It also pointed out the complexity of health workers' behaviour towards adhering to policies.

## Introduction

Tuberculosis (TB) is a major global health challenge. Worldwide, the number of new TB cases in 2015 was higher than in previous years, suggesting that the epidemic is not controlled.<sup>1</sup> The World Health Organization (WHO) has identified high TB burden countries (HBC)<sup>2</sup> and divided them into three categories: 22 HBCs, 41 HBC that combine TB and HIV and 27 HBCs that also have high multi-drug resistance. South Africa (SA) is one of the fourteen countries that are listed in all three categories. Among the HBCs, South Africa has one of the highest prevalence rates of TB.<sup>3</sup>

The National TB Programme (NTP), since its inception in 1994, has shaped the South African response, with the three pillars of the programme being case finding, treatment and prevention.<sup>3</sup> The introduction of Xpert<sup>®</sup>MTB/RIF to replace sputum smear microscopy in 2011 was a milestone for TB case finding.<sup>3</sup> Improving TB treatment outcomes remains the biggest challenge. Treatment success rates among re-treatment cases are still poor, with high losses to follow up of smear positive patients before initiating TB treatment, and high mortality rates even after successful treatment because of high TB-HIV co-infection rates.<sup>3</sup>

It is said that, “prevention of TB has been a neglected aspect of TB control”.<sup>3</sup> The strategies in the NTP that impact on prevention include early diagnosis, early initiation of treatment and treatment of latent infection in high risk groups. In 2006 SA adopted the WHO’s initiative of the “3-Is” to reduce the burden of TB: isoniazid preventive therapy, intensified TB case finding and TB infection control.<sup>3</sup> The importance of infection control at health facility level was highlighted in SA after the description of the extreme drug resistance (XDR) TB epidemic in 2006.<sup>4,5</sup> The outbreak was characterised by a short incubation period between infection and disease, rapid deterioration and death within a few weeks. About 90% of patients from this outbreak died within 4 months of the onset of symptoms. It was a wake-up call for SA and the rest of the world that nosocomial transmission of TB has deleterious consequences. In 2007 the NTP introduced TB infection control as a specific programme, based on international recommendations.<sup>6</sup>

To understand the significance of potential nosocomial transmission of TB one has to review post-mortem diagnoses amongst hospitalised patients. A post-mortem study from Zambia found that 62% of all deaths were due to undiagnosed TB.<sup>7</sup> Another post-mortem study from SA showed 69% of early deaths on antiretrovirals (ARVs) were associated with undiagnosed TB.<sup>8</sup> A study at Tygerberg hospital concluded that 31 patients generated 345 inpatient infectious days with undiag-

nosed multidrug resistance (MDR)-TB during which other patients or staff could have been potentially infected.<sup>9</sup> The concern around nosocomial TB transmission is not limited to other patients with compromised immunity, but is also a concern for health workers and other ancillary staff. Multiple studies from different countries show healthcare workers have a much higher risk of contracting TB than the general population.<sup>10</sup>

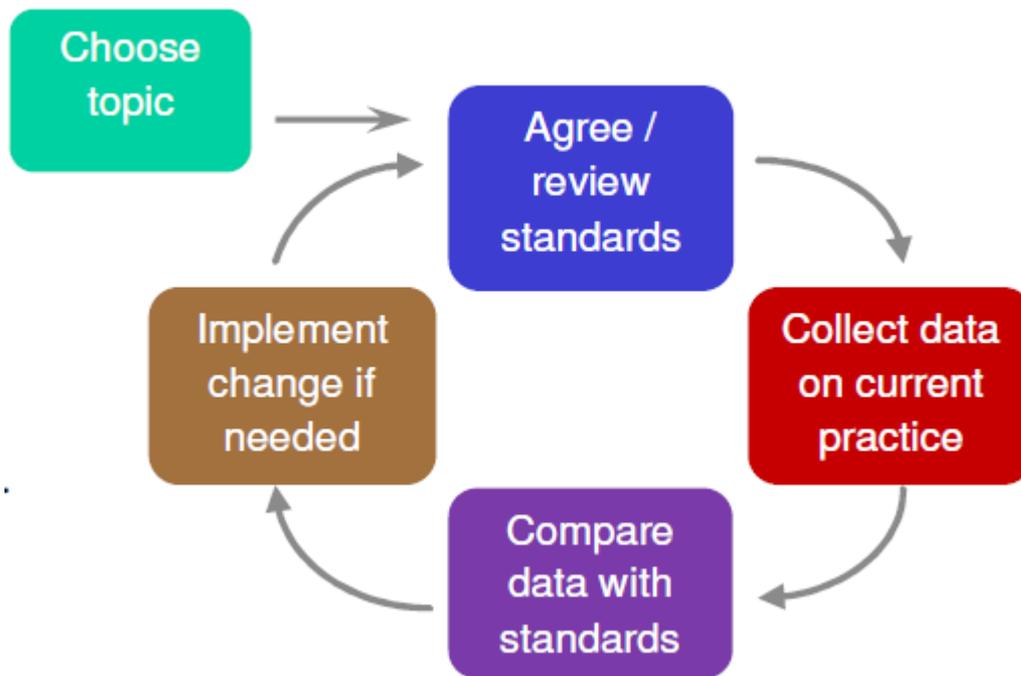
The need for a robust TB infection control plan and practice at every health facility in SA is clearly justified. The NTP's TB infection control programme draft guideline has stipulated three main areas of infection control at health facilities (see Annexure A): work practice and administrative control; environmental control focusing on the use of natural ventilation; and personal protection measures for health workers and other ancillary staff. Nine years after the introduction of the programme it is unclear how much has been implemented. Most of the audits of TB infection control show limited implementation of the guideline.<sup>11,12,13</sup>

The purpose of this project was to identify the gaps and address the challenges in TB infection control in the Mossel Bay sub-district in the Western Cape. The objectives were: to assess the current quality of TB infection control, to plan and implement changes to improve the quality of TB infection control, to assess if the changes are associated with a measurable improvement in the quality of TB infection control and to develop local TB infection control standard operating procedures.

## Methods

### **Study Design**

This was a quality improvement project, composed of cycles and a series of steps (see Figure 1).<sup>14</sup>



**Figure 1: Steps of a quality improvement cycle<sup>14</sup>**

### Setting

Mossel Bay sub-district is the second most populous area of the Eden district in the Western Cape, with a population of 117 840 people. It is a coastal area stretching over 2 011 square kilometers. Based on the Eden District Municipality's draft Integrated Development Plan 2017/2018 – 2021/2022 (IDP), Mossel Bay has the best literacy rate (87%), highest human development index (0.75) and the lowest poverty rate (11.4%) in the Eden district.<sup>15</sup> Mossel Bay sub-district has one district hospital, three primary health care (PHC) clinics, one community day care centre, six satellite clinics, and four mobile clinics. Mossel Bay hospital is a 90-bed district hospital which is divided into three general wards (male, female and paediatrics) and a maternity ward. The average bed occupancy rate is 88%. The hospital has an emergency centre, an outpatient department, a radiology department, laboratory, and other supporting services. Based on the sub-district activity reports, 3500 to 4000 patients are seen monthly at the hospital between OPD and the emergency centre. The hospital has 150 staff, including medical, ancillary and administrative staff. The Alma clinic is located in the most populous area of the sub-district, with a rapid increase in formal and informal settlements. The Alma clinic has a monthly head count higher than Mossel Bay hospital (4500 to 5800). This PHC facility is particularly crowded and has a higher workload compared to other clinics in the sub-district. Based on data from the sub-district HIV, STI and TB team (HAST), there were 846 (2013), 722 (2014), and 781 (2015) TB patients on treatment per year (personal communication received from HAST coordinator). Amongst these patients, 90% were smear or

Xpert<sup>®</sup>MTB/RIF positive. The Alma clinic is one of the three TB hotspot clinics outside of the Cape Town metropolitan area identified by the burden of disease project.<sup>16</sup> According to the local staff health statistics, two health workers in the Mossel Bay sub-district have been treated for TB in the past five years (personal communication from the OHS nursing professional).

### Selecting a team

Two teams were identified, one for each site: Mossel Bay hospital and Alma clinic. The researcher joined the teams to introduce the project and discussed the research proposal.

At the hospital, management decided to bring the project to the monthly occupational health and infection control committee meeting and refrain from forming a new subcommittee. It was convenient as the committee is very active with monthly meetings. In addition, the hospital has a dedicated nurse who functions as the infection control (IC) and occupational health and safety (OHS) officer.

At Alma clinic the facility manager also identified the clinic's occupational health and infection control team to work on the project. However, the committee has not been active since its formation and only deals with the occasional workplace injuries. There were a few challenges to overcome, for example the assigned team leader has multiple clinical responsibilities and little allocated time for infection and prevention control (IPC). Furthermore, some of the team members specified in the document were no longer working at the facility. These issues were resolved by the facility manager, new members were assigned and the team members finally acknowledged their responsibility.

### Agreement on standards of TB infection control services

Both teams agreed with the seventeen Tuberculosis Infection Control (TBIC) standards as stipulated by the national TB Infection control draft guideline to be the minimum criteria expected from the facilities as part of TB infection control services.<sup>6</sup> (See annex for the standards list.)

**Table 1: National TB program TB infection control (TBIC) target standards**

		Means of verification*
A. Workplace and administrative control		
1	There is a written facility-specific infection control plan (that includes TB infection control (TBIC))	Document review
2	There is a designated person (and committee in larger facilities) responsible for implementing TBIC practices in the facility.	Confirmation from facility manager

3	All clinical staff have received training or refresher training within the past 1 year on tuberculosis infection control	Training records and IC nurse
4	All patients entering the facility are screened with a questionnaire. Those with a cough are given guidance on cough etiquette, separated from other patients and fast-tracked through all waiting areas, including consultation, investigations and drug collection.	File review
5	Coughing patients are supplied with face mask, and tissues	Observation in waiting areas
6	There is a tracking mechanism (e.g. register) and person responsible for monitoring turn-around time from TB screening to diagnosis, and from TB diagnosis to treatment initiation	Review of the sputum register
7	The median time between screening positive for TB symptoms and actual diagnosis is no more than one day.	File review
8	The median time between actual diagnosis and treatment initiation is no more than one day.	File review
9	HIV testing is offered to all patients with presumptive TB and evaluation for time to start ART is carried out if found HIV-positive.	File review
<b>B. Environmental control</b>		
10	Waiting area is well ventilated (i.e. windows and doors open)	Site visit
11	Patients are not crowded in hallways or waiting areas.	Site visit
12	Sputum samples are collected in a well-ventilated, clearly designated area away from others, preferably outdoors.	Presence of sputum collection area and observation
13	Diagnosed and suspected hospitalized TB patients are isolated or grouped according to sputum status in rooms with adequate natural ventilation	Site visit
<b>C. Staff protection</b>		
14	A package of HIV and HIV-associated TB prevention and care is available for facility staff on site including (1) confidential HIV testing and post-exposure prophylaxis for all staff, and (2) antiretroviral therapy (ART) and isoniazid preventive therapy (IPT) for HIV+ staff.	Occupational health nurse interview

15	Respirators are readily available for and being used by staff, particularly for high-risk aerosol-generating procedures and for providing care to patients with diagnosed or suspected infectious Rifampicin sensitive TB, MDR-TB and XDR-TB	Occupational health nurse interview
16	Staff have been trained in the proper fit and use of respirators.	Occupational health nurse interview
17	TB symptoms occurring among staff are immediately investigated and, if TB is diagnosed, is treated, registered and reported in the confidential occupational health records or in the TB register.	Occupational health nurse interview

\*WHO checklist for periodic evaluation of TB infection control.<sup>17</sup>

## Collect and analyse data on current practice and compare data with standards

### a. Study population and sample size

The three main process criteria (criteria 4, 7 and 8 in Table 1) were evaluated using the before and after surveys of the proportion of patients visiting health facilities who were screened for TB and the mean time intervals between presenting with TB symptoms and sputum collection, as well as presenting with TB symptoms and initiation of therapy.

#### *i. Proportion of patients screened for TB (criterion 4)*

This sample size was calculated using a z-test. To ensure a power of 80% to show a significant difference between two independent proportions ( $p\text{-value} < 0.05$ ), a sample size of 152 patient records before and after the intervention was needed. Appreciating an attrition rate of 10%, a sample size of 165 patient records would be systematically reviewed before and after the intervention.

#### *ii. The time intervals between patients presenting with TB symptoms and diagnosed with GXP positive TB, and between positive sputum diagnosis and initiation of TB treatment (criteria 7 and 8)*

The Wilcoxon-Mann-Whitney t-test was used to calculate this sample size. A sample size of 104 consecutive patient records before and after the intervention would give a power of 80% to show a statistical significant difference ( $p\text{-value} < 0.05$ ), if the effect size = 40% (the researcher estimated a reduction in time interval from 5 to 2 days). Appreciating an attrition rate of 10%, a sample size of 110 patient records would be systematically reviewed before and after the intervention.

## b. Data collection tools and process

A checklist of the standards of TBIC activities were completed after interviewing the occupational health and infection control persons of the two facilities at baseline and post intervention. In addition, a record review was conducted for the three process criteria. The checklist was a modification of the WHO checklist for periodic evaluation of TB infection control.<sup>17</sup>

### *i. Proportion of patients screened for TB (criterion 4)*

All patient records seen for 24-hours of the day's assessment were kept aside by the clerks and reviewed the same day or the day after the researcher completed an audit tool for each patient record reviewed. Data on demography, site where the patient was seen, category of the nursing personnel, working time, symptomatic TB screening and actions were collected.

### *ii. The time intervals between patients presenting with TB symptoms and diagnosed with GXP positive TB, and between positive sputum diagnosis and initiation of TB treatment (criteria 7 and 8)*

The TB clinic nurses retrieved all the GXP positive TB patient records who were on treatment. The TB registers were used to identify the GXP positive patients. The duration used was dating back six months from the dates of the assessment. All consecutive patients' record in that order were reviewed. The researcher completed an audit tool for each TB patient medical record reviewed. Data on demography, PHC clinic, time interval from presenting with TB symptom and sputum collection (interval one), time interval from sputum collection to sputum result being available at the National Health Laboratory Services (NHLS) site (interval two), and total time interval for presenting with TB symptoms to initiation of TB treatment in days (interval three) were collected (See Annexure A for audit tool).

## c. Data analysis

Quantitative data were captured in an MS Excel® spreadsheet, checked for omissions or errors, and analysed in the Statistical Package for the Social Sciences (SPSS) software programme.<sup>18</sup> The findings of the base line assessment were summarised using simple descriptive statistics, and presented to the quality improvement cycle (QIC) team. Six months after implementing changes, the same data collection tools were used to assess any improvement in the quality of TBIC. Post intervention data were added in the same data capturing tool of the baseline. Pre- and post-intervention comparison was done for TB screening and time interval with inferential statistics using the Chi-Square test and Mann-Whitney U test to detect significant differences ( $p < 0.05$ ).

## **Feedback, planning and implementation of change**

The findings of the baseline assessment for each site were presented to the respective teams (see Annexure B). A reflection on the shortcomings of TBIC was facilitated via root cause analysis by

asking consecutive “why?” questions.<sup>14</sup> As an outcome of this meeting a set of action plans to improve the quality of TBIC were agreed upon (see Table 2). These action plans represent the intervention between the baseline and subsequent assessment. Members of the QIC team were delegated with specific tasks. The next date for reassessment was decided to be after six months.

**Table 2: Feedback, planning and implementation of change for each site**

Site	Problems identified at baseline	Action plans agreed on (intervention)
<b>Mossel Bay hospital</b>	<ul style="list-style-type: none"> <li>• Screening rate for TB was only 40% at OPD and EC.</li> <li>• Poor compliance to the open window and door policy in the colder months and at night, otherwise very good adherence.</li> <li>• Despite having open outside spaces for sputum collection for hospitalised patients, night staff collected sputum at bedside of patients.</li> <li>• Sputum from symptomatic patients coming to EC was not always collected because staff believed sputum should be collected at local clinics, not at the hospital.</li> <li>• Isolation rooms' rules were not always respected by the staff.</li> <li>• Isolation room was not available at EC, which was a challenge as some sick patients needed to stay in open EC setting for hours before isolation room bed was made available for them.</li> <li>• Posters and signs were not adequately displayed around the hospital on cough hygiene, open window policy, and warning visitors that they were entering a high TB area with risk of acquiring infection.</li> </ul>	<ul style="list-style-type: none"> <li>• Increased staff training on TBIC were conducted by the researcher, which included the nursing and supporting staff for each ward, as well as after-hours sessions for the night staff.</li> <li>• The infection control focal person agreed to do daily rounds in every department to check for open window and door adherence and maintain an open window and door register.</li> <li>• The infection control nurse met with the maintenance people to fix structural problems.</li> <li>• The sub-district health office were approached to provide education materials (including posters on cough hygiene).</li> <li>• Sputum specimen from ambulatory symptomatic patients were to be collected at EC any time of the day. Patients should be referred to the local clinic the next working day to access result and start treatment if tested positive.</li> <li>• The medical manager of the sub-district would explore a plan to identify a temporary structure for isolating coughing sick patients waiting for admission from the EC.</li> </ul>

Site	Problems identified at baseline	Action plans agreed on (intervention)
<b>Alma clinic</b>	<ul style="list-style-type: none"> <li>• The infection control and occupational safety committee was not active.</li> <li>• The base line assessment identified a good rate of TB screening (60%), but the quality of screening was questionable.</li> <li>• Some of the waiting areas were extremely crowded and impossible to assure natural ventilation because of absence of windows and doors in these waiting areas.</li> <li>• Some maintenance issues were found, including broken face mask dispensers, windows of consultation rooms unable to be opened, and the whirlybirds for roof ventilation.</li> <li>• The median time to start TB treatment after presenting with TB symptoms for those who tested GXP positive was 4 days (96hrs). The WHO recommendation is 48 hrs.</li> </ul>	<ul style="list-style-type: none"> <li>• The facility's operational manager committed to establish an active occupational safety and infection control committee.</li> <li>• Continue to improve systematic TB screening services at all service points. This should be done as part of the initial observation for all patients seen at the facility.</li> <li>• The staff will regularly survey the waiting crowd to identify coughing patients and fast track them out of the clinic.</li> <li>• One of the committee members agreed to be responsible for the open window and door register during a daily round.</li> <li>• Another member would investigate and find out about the maintenance of the whirlybirds roof ventilation.</li> <li>• Training was held for each members of the committee on the basics of TBIC by the researcher, with the plan that each member would train everyone else in their team.</li> <li>• As natural ventilation was not possible in some of the waiting areas the triage nurses will stagger the number of patients waiting in the poorly ventilated waiting areas by allowing only maximum four patients to sit and wait at those areas at a time.</li> <li>• The aim was to reduce the time interval from presenting with TB symptoms to initiation of therapy from 4 days to 2 days, as well as to improve the working relationship with the CHWs and their coordinators.</li> </ul>

### Repeat analysis after intervention period and reflection on re-analysis

An assessment using the same checklist and the audit tool as the base line was repeated six months after the intervention period, to document whether there was any improvement in TB infection control practices. Medical records (a different set than the records used during the baseline audit) were audited to evaluate criteria 4, 7 and 8. Data was entered and analysed as in the baseline assessment described above.

### Ethical considerations

Informed voluntary consent was obtained from health workers who participated in the study. A waiver of informed consent was approved for data extracted from medical records and registers. Data was anonymised before analysis and reporting to preserve the confidentiality and privacy of

individuals. Approval of the study was obtained from HREC (reference number: S16/07/134) as well as permission from the Department of Health and local district managers (PHRC reference number: WC\_2016RP34\_431).

## Results

### Workplace and administrative control

At baseline, many measures were already in-place in both facilities to prevent nosocomial TB transmission, particularly administrative control. However, they were not optimally implemented.

Mossel Bay hospital had a specific TBIC policy. Alma clinic also had a policy on infection control in general and a specific TBIC policy was compiled as part of the interventions suggested by the infection control committee during this intervention. At the hospital, there was a dedicated person for infection control and occupational safety, and an existing committee which met monthly (this was observed both at baseline and throughout the QI cycle). However, at Alma clinic the occupational safety and infection control committee existed only on paper at baseline as most of the members did not feel empowered to own the role. During the implementation phase meetings with facility and sub-district management lead to a revival of this clinic's committee. The other measures in administrative control, like cough hygiene education to symptomatic patients, cough officers, fast tracing, making outdoors waiting area available for fast traced patients, providing masks to cover cough, were not measured quantitatively but were noted to be implemented inconsistently.

The quantitative assessment included the level of screening (criterion 4) at Mossel Bay hospital and Alma clinic. Mossel Bay hospital OPD and EC had overall screening rate of 40% and Alma clinic scored 61% at base line. Post-intervention the screening rate dropped for Alma clinic to 37% and at the Mossel Bay hospital to 34.8% (see Tables 3,4, and 5). The difference between the pre- and post-interventions was not statistically significant for Mossel Bay hospital, but it was significant for Alma clinic.

**Table 3: Baseline characteristic of patient records reviewed**

Characteristics of patient records		Baseline	Post-intervention	p-value
Age (mean, SD)		40(19.37)	42(18.84)	0,837
Gender (n and %)	Male	99 (41.8%)	83(41.7%)	0,534
	Female	138 (58.2%)	116(58.3%)	
Race (n and %)	African	102(43%)	68(34.2%)	0,21

Characteristics of patient records		Baseline	Post-intervention	p-value
	White	31(13.1%)	47(23.6%)	
	Color	103(43.5%)	84(42.2%)	
	Unknown	1(0.4%)	0	
Triage category (n and %)	Green	8(3.4%)	18(9.0%)	0,095
	Yellow	31(13.3%)	20(10.1%)	
	Orange	9(3.9%)	10(5.0%)	
	Red	1(0.4%)	0	
Time of the day (n and %)	Not Triaged	184 (79%)	151(75.9%)	0,417
	Office hours	194(81.9%)	158(80.6%)	
	After hours	43(18.1%)	38(19.4%)	

**Table 4: TB screening rate**

		Baseline (n and %)	Post-intervention (n and %)	p-value
TB screening	Yes	122(52.4%)	69(35.8%)	<0,0001*
	No	111(47.6%)	124(64.2%)	
Result of screening	Positive	0	2(2.9%)	
	Negative	121(100%)	67(97.1%)	

\*Significant at  $p < 0.05$ .**Table 5: TB Screening per site**

Site	TB Screening	Baseline n and %	Post-intervention n and %	p-value
Mossel Bay hospital	Yes	34 (40%)	40(34.8%)	0,271
	No	51(60%)	75(65.2%)	
Alma clinic	Yes	88(59.5%)	29(37.2%)	0,001*
	No	60(40.5%)	49(62.8%)	

\*Significant at  $p < 0.05$ .

For the quantitative assessment of time intervals between patients presenting with TB symptoms and diagnosed as Expert<sup>®</sup>MTB/Rif positive, and between positive sputum diagnosis and initiation of TB treatment, 101 TB patients' records were reviewed from Alma clinic before and after the intervention. The 101 patients represent the total population of sputum Expert<sup>®</sup>MTB/Rif positive patients who were receiving care at Alma clinic. Their characteristics are presented in Table 6. No statistically significant differences in intervals were found between baseline and post-intervention assessments (see Table 7). The median time for a patient presenting with TB symptoms until initiation of TB treatment once sputum was Expert<sup>®</sup>MTB/Rif positive was four days at baseline. This delay did not show improvement post-intervention and remained the same. The time interval between presenting with TB symptoms and sputum collection, and the time from sputum collection to when sputum results were available on the National Health Laboratory Services (NHLS) system, was almost always one day. Interval three (the time interval between when sputum result was available in the NHLS system until the initiation of TB treatment) was where most of the delay occurred, contributing to the overall four day delay from presenting with TB symptoms until the starting of TB treatment (see Table 7).

**Table 6: Time interval between presenting with TB symptoms until initiation of TB treatment, base-line characteristics**

Variable	Categories	Baseline (N, % except for age)	Post intervention (N, % except for age)	p-value
Age (mean, SD)		40.3(17.3)	35.7(12.7)	T-test, P=0.032*
Gender	Male	70(69.3%)	65(64.4%)	0,455
	Female	31(30.7%)	36(35.6%)	
Race	African	53(52.5%)	50(49.5%)	0,535
	White	1(1.0%)	0(0.0%)	
	Colored	47(46.5%)	51(50.5%)	
Comorbidities	None	60(59.4%)	65(64.4%)	0,622
	HIV	37(36.3%)	33(32.7%)	
	Diabetes	0(0.0%)	1(1.0%)	
	Hypertension	3(3.0%)	2(2.0%)	
	Multiple conditions	1(1.0%)	0(0.0%)	
Screening tool used	Yes	26(26.0%)	1 (1.0%)	<0,0001*
	None	74(74.0%)	100(99.0%)	

\*Significant at P&lt;0.05

**Table 7: Time interval between presenting with TB symptoms and initiation of TB therapy (N = 101 for pre- and post-intervention, Alma clinic)**

	Baseline (days)	Post intervention (days)	p-value
Median	4	4	0,959 (retain the null hypothesis)
25 Percentile	2	2	
75 Percentile	7.8	7	
Minimum	0	1	
Maximum	58	31	

**Environmental control**

Environmental control is limited to respecting the open window and door policy and having a functioning whirlybirds roof ventilation. During the baseline and follow-up assessment, all consultation

and ward rooms had open doors and windows. Mossel Bay hospital has open door and window register completed by the OHS nurse on her daily round. However, this did not happen consistently in cold weather and at night. At Alma clinic the team could not locate the open door and window register during the intervention period. The register was introduced at the time of the baseline assessment. There was no dedicated person completing the register despite assigning the task to one of the infection control committee members. Assessing the appropriate functioning of the roof ventilators was a challenge at the baseline as there were no technical person in the team. Later on maintenance staff confirmed that none of the roof ventilators were in working condition due to lack of maintenance. Alma clinic had some permanent infrastructure challenges at the time of the QI cycle. Some of the waiting areas and the emergency room were devoid of windows and doors which opened into a corridor with no direct communication with the outside space.

### **Staff protection**

All measures to protect health care workers and staff were in place. The IC and OHS nurses at each site were open and available for any staff member who needed the service. It was up to the discretion of health care workers to access these services at the occupational health and safety clinic. N-95 masks were consistently available everywhere and their appropriate utilisation were the responsibility of every health worker. Fits tests were done regularly. What put health care workers at high risk of nosocomial infection was not the lack of staff protection measures but the poor implementation of administrative and environmental control measures.

## **Discussion**

This quality improvement cycle (QIC) aimed to evaluate and improve the TB infection control (TBIC), against a national draft policy document within a high TB-burden, rural sub-district of the Western Cape Province. The QI cycle involved two facility types within the sub-district, the district hospital and one of its main PHC clinics. Each facility had an existing IPC and OHS team, which were used as the audit teams. A planned set of interventions following the baseline assessment failed to show significant improvement in the implementation of the national TBIC policy document components (workplace and administrative control, environmental control and staff protection).

We set out to assess the current quality of TBIC, to plan and implement changes to improve the quality of TB infection control. Activities were implemented at the two sites during the six months' intervention period after the baseline assessment. Some of the activities were reinforcing and im-

proving good practice (TB screening), conducting training for staff (improve knowledge and attitude); some were tasks for the focal persons and the managers (education materials, posters, and supervision) and others were infrastructural problems beyond the scope of the teams' ability to solve (isolation facilities, improving natural ventilation and maintenance).

We also set out to assess if these changes were associated with an improvement in the quality of TB infection control. Looking at the process indicators, TB screening and the time delay before initiation of TB treatment, there was no objective improvement comparing before and after intervention at both facilities. This was complicated by the fact that the baseline assessment at Alma clinic was not valid as it documented an exceptionally high TB screening rate which was biased because of the knowledge of the nurses about the reason for the assessment on the day of the baseline data collection (the so-called Hawthorne effect).<sup>19</sup> This deterioration in practice was verified by the proportion of Xpert<sup>®</sup>MTB/RIF patients identified with the TB screening tool, which dropped from 26% at the base line to 1% post intervention (see Table 6).

We hoped that this first cycle of the TBIC QIC would result in developing robust TB infection control standard operating procedures for Mossel Bay sub-district, in line with the national policy document. On the one hand, this first cycle managed to clarify the questions to be asked and which interventions to prioritise. For example, there was a need to focus on administrative control at both facilities as this was controlled by health workers and could be improved without additional resources. On the other hand, this first cycle unmasked several potential reasons for the delay between diagnosis and start of treatment which required further unpacking. A similar delay of four days was documented by Schmidt *et al.* who compared the difference before and after Xpert<sup>®</sup>MTB/RIF rollout on parameters related to TB diagnosis.<sup>20</sup> After the introduction of Xpert<sup>®</sup>MTB/RIF, the median time from presenting with TB symptoms to initiation of TB treatment was reduced from five days to four days.<sup>20</sup> This begs the question of how realistic the WHO target of 48 hours is for South Africa. The extreme outliers on the baseline assessment at Alma clinic were discussed with the TB clinic nurse to explore the reason for the long delay before initiation of treatment. There was good documentation of the efforts made by the TB nurse and community health worker (CHW) in trying to contact the patients, but the biggest challenges were incorrect or absent addresses and incorrect telephone numbers.

Most of the anticipated improvements following the implementation of interventions were dependent on the health workers' adherence to the locally agreed TBIC policies. While exploring factors affecting health workers' compliance with policies was not one of the study objectives, it emerged

as a significant factor. For example, systematic TB screening is not a complicated task and the tool required was available at the desk of each health worker. Each health worker was trained in screening, but it was difficult to explain why it was not done. The importance of buy-in and capacitating health workers to engage with the QI process was supported by Shah *et al*, who described the ways in which health workers appraise their own behavior.<sup>21</sup> These authors reported that health workers experienced an ‘ambiguity about responsibility of certain infection control practices’, a ‘divergence in values attached to some infection control practices by prioritising other activities’, and a ‘hierarchy of influence’, which prevented health workers from fully engaging on these matters as they found it difficult when they perceived that their superiors were not really respecting and supporting the policies practically.<sup>21</sup> This phenomena on hierarchy of influence was observed in our QI cycle during the TBIC training of hospital-based nurses as they were asking if doctors also knew the TBIC guidelines, as many of the activities required the participation of doctors. TB infection control relies on the participation and adherence of everyone who is working or visiting a health facility. This could only be achieved when everyone is on board, but in a hierarchical organisation this is almost impossible as health workers observe their supervisors not implementing their own policies, with the implied conclusion that it is not important. It was also noted at Alma clinic that the IC and OHS team did not feel empowered to be able to do what they were assigned to do because of conflicting policy decisions from their seniors. The best baseline finding for Alma clinic was the open waiting area of the TB clinic and that the TB clinic was physically separated from the rest of the clinic structure, which made it easier to implement TBIC measures. This also enabled coughing patients to wait in an open waiting area at the TB clinic while waiting to provide sputum specimens. This separation is supported by the TBIC standard as described on the draft national guideline on TB infection control.<sup>6</sup> However, during the intervention period a decision was made by management to move the TB clinic into the building where the rest of chronic illness and acute care clinics were run. This brought in patients with various types of TB, including MDR-TB, to wait in the same waiting area as the acute and chronic care patients. This situation arose from implementing two conflicting policy guidelines for clinics namely the “National Core Standards”<sup>22</sup>, which is in favour of separation of patients with TB, and the “Ideal clinic”<sup>23</sup>, which states that patients with TB are part of chronic illness and should be integrated with the rest of the chronic illness clinic. This apparent ambiguity in policy directives was echoed by Zinatsa *et al*. in their recent qualitative study, “Voices from the frontline: barriers and strategies to improve tuberculosis infection control in primary health care facilities in South Africa”.<sup>24</sup> Clarity is required on how to ensure TBIC when integrating chronic care services at PHC facility level.

## Limitations

The baseline assessment of TB screening at Alma clinic was prejudiced because of the knowledge of nurses as to the purpose of the baseline assessment. This was noticed in retrospect and during the intervention period as routine TB screening was not as enthusiastic as that of the baseline. This made us question the validity of the baseline screening assessment at Alma clinic as a potential source of bias was introduced at the time of data collection and only retrospectively noted. Another limitation was the over-ambitiousness of the project which aimed at targeting all 17 standards. The success of the project depended on consistent implementation of multiple activities, and it was observed over time that the teams lost focus. The lead researcher, as family medicine registrar, felt challenged by the realities of the context which influenced her ability to play a consistent role as facilitator of the quality improvement initiative, especially at the PHC facility level. The aspired roles of the doctor in the PHC facility have been agreed upon recently by a set of national stakeholders, which aimed to challenge the current reality in which primary care doctors have a perceived limited influence beyond merely performing a clinical outreach function.<sup>25</sup> This reality of having to “push the numbers”<sup>26</sup> (service delivery priority with little or no role in strengthening the service) may have impacted on the registrar’s availability to help drive the TBIC QIC on an ongoing basis. Lastly, the lack of representation of maintenance and infrastructure personnel in the clinic team limited implementation as challenges of maintenance and structure were constant themes in every meeting of the IC and OHS team.

## Recommendations

The study showed that one QIC is not adequate to resolve implementation challenges and the need to make ongoing QICs an integral part of facilities’ work, with periodic evaluation. Next steps should include an ongoing QIC, which focuses on specific areas of tuberculosis infection control. There is an urgency to focus on administrative control, specifically TB screening, as this is the first line of defense against nosocomial TB transmission. Having knowledge about what needs to be done for tuberculosis infection control does not necessarily translate into consistent behavioural change (the so-called “know-do gap”). Further research in the local context should focus on creating a better understanding of the factors which enable implementation of the policy.

## Conclusion

The aim of this study was to assess and improve the quality of tuberculosis infection control in the Mossel Bay sub-district. The study found good managerial commitment reflected by the presence of

various policies, guidelines, specific personnel and committees to deal with infection control in general. The project has created awareness about tuberculosis infection control among the staff. The project also pointed out the complexity of health workers' behaviour towards adhering to policies.

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