



BMJ Open How the 'HIV/TB co-epidemic–HIV stigma–TB stigma' syndemic impacts on the use of occupational health services for TB in South African hospitals: a structural equation modelling analysis of the baseline data from the HaTSaH Study (cluster RCT)

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ABSTRACT

Introduction Tuberculosis (TB) has become an occupational health hazard in South African hospitals where healthcare workers (HCWs) are additionally confronted daily with HIV and its associated stigma, causing a *syndemic*. Early TB diagnosis and treatment are vital, but the uptake of these services through occupational healthcare units (OHUs) is low. The current study hypothesises that (1) the link between HIV and TB and (2) the perceived HIV stigmatisation by colleagues create (3) a double HIV–TB stigma which increases (4) internalised TB stigma and leads to (5) a lower willingness to use OHU services for TB screening and treatment.

Design A cross-sectional study using the baseline data from the HIV and TB Stigma among Healthcare workers Study (HaTSaH Study).

Setting Six hospitals in the Free State province of South Africa.

Participants 820 HCWs of the six selected hospitals.

Results The study results demonstrate that the co-epidemic ($\beta=0.399$ (screening model) and $\beta=0.345$ (treatment model)) combined (interaction effect: $\beta=0.133$ (screening) and $\beta=0.132$ (treatment)) with the persistent stigmatisation of HIV is altering the attitudes towards TB ($\beta=0.345$ (screening) and $\beta=0.400$ (treatment)), where the stigmatising views of HIV are transferred to TB—illustrating the syndemic impact. Our model demonstrated that this syndemic not only leads to higher levels of internal TB stigma ($\beta=0.421$ (screening) and $\beta=0.426$ (treatment)), but also to a lower willingness to use the OHU for TB screening (probit coefficient= -0.216) and treatment (probit coefficient= -0.160). Confidentiality consistently emerged as a contextual correlate of OHU use.

Conclusions Theoretically, our results confirm HIV as a 'syndemic generator' which changes the social meaning of TB in the hospital context. Practically, the study demonstrated that the syndemic of TB and HIV in a highly endemic context with stigma impacts the intended use of occupational TB services.

Strengths and limitations of this study

- This is the first study to employ a large, quantitative dataset to disentangle the inter-relationships between the different elements of the described syndemic, namely the HIV/tuberculosis (TB) co-epidemic, HIV stigma and TB stigma.
- Structural equation modelling is used to optimally model the complex inter-relationships between HIV, TB and double HIV–TB stigma and the use of TB healthcare services.
- The use of cross-sectional data precludes any causal interpretations of the relationships.

Trial registration number Pre-results of the trial registered at the South African National Clinical Trials Register, registration ID: DOH-27-1115-5204.

INTRODUCTION

The tuberculosis (TB) epidemic has deeply affected sub-Saharan Africa, and especially South Africa, where it is the leading cause of death: 6.5% of deaths in the country in 2016 were attributable to TB.¹ According to WHO estimates, South Africa has the second highest incidence of TB worldwide (615 per 100 000 population in 2019) and—worryingly—approximately 14 000 cases of rifampicin-resistant or multidrug-resistant (MDR) TB.² It is evident that the TB epidemic puts the healthcare system—and healthcare workers (HCWs) in particular—under enormous strain, especially within the contexts of overcrowded health facilities and understaffing.

However, the epidemic is not only affecting South African HCWs in an indirect manner by confronting HCWs with an immense workload. In terms of the risk to acquire TB, HCWs are particularly susceptible to TB infection,^{3–11} almost three times more than the general population.¹² Furthermore, HCWs are also substantially more at risk of being hospitalised for MDR-TB and extensively drug-resistant TB (XDR-TB).¹³

The alarming levels of TB incidence among South African HCWs, including MDR/XDR-TB, have led to TB being classified as an occupational health hazard that calls for workplace solutions.^{13–15} Apart from preventive measures, it is vital to enable HCWs *to be screened for TB* and—if required—*access treatment* in a timely manner as a high TB incidence among HCWs is not only a personal tragedy but also further weakens the vulnerable health system. As a response, HCWs are encouraged to use occupational healthcare units (OHUs). OHUs in hospitals are wards that comprise a variety of health services for HCWs, often linked to occupational hazards. Given the severity of TB in healthcare settings all over sub-Saharan Africa, OHUs are crucially important for the early diagnosis and treatment of HCWs. In 2011, the International Labour Organization (ILO), the Joint United Nations Programme on HIV/AIDS (UNAIDS) and the WHO released joint policy guidelines declaring that all HCWs have the right to TB prevention, testing, care and support in the workplace.¹⁵

Stigma

However, HCWs are sometimes unwilling to use OHUs for TB screening and treatment due to the stigmatisation of TB.^{16–21} The perceived negative views and attitudes of colleagues—namely perceived links with HIV, poverty, low social class, malnutrition or disreputable behaviour—can be internalised by HCWs, creating *internalised TB stigma* and resulting in shame and guilt which can impede health-seeking behaviour.^{22–23} The joint ILO–UNAIDS–WHO policy recognised this threat as it highlights the need to tackle stigma and discrimination as key barriers to effective occupational healthcare for TB.¹⁵ Stigmatisation in the healthcare setting can thus have severe implications for HCWs and health facilities when TB-infected HCWs delay or avoid care, causing increased morbidity and mortality and further strain on an overburdened health system.^{24–25} It is thus important to include TB stigma when studying the determinants of the willingness to use the OHU for TB screening and treatment. In this regard, specific attention should be devoted to the contextual drivers of (internalised) TB stigma in the hospital setting.

Syndemic

TB and its related stigma among HCWs cannot be studied in isolation of the HIV epidemic: the country hosts the highest number of people living with HIV (7.7 million) of which 4.8 million were on antiretroviral treatment in 2018.²⁶ In 2018, approximately 60% of new patients with

TB with a known HIV status were co-infected with HIV,²⁷ displaying how inextricably intertwined HIV and TB are in South Africa. Again, HCWs are not only affected by the disease burden of the vast numbers of patients but also by the epidemic itself because of the mutually reinforcing epidemiology of HIV and TB: estimates of the HIV prevalence among South African HCWs range from 11.5% to 20.0%.²⁸

As a consequence, an investigation into the determinants of the willingness to use the OHU for TB screening and treatment among HCWs does not only require the incorporation of TB stigma, but also attention to the impact of HIV and its associated stigma. The two conditions form a ‘deadly duo’²⁹ which effects become exacerbated within particular social contexts, in this case the hospital setting where the link between TB and HIV is visible every day.³⁰ Making sense of how TB and HIV interact and influence stigma and behaviour requires a lens beyond epidemiology³¹: a *syndemic analytical approach* that allows for a consideration of the interactions between the environmental (hospital), social (stigma) and biological (HIV/TB) factors in this vulnerable group of HCWs.³²

A syndemic refers to a consequential result of (1) overlapping diseases (2) within a particular population, (3) aggravated by certain social conditions that worsen the overall burden of disease of this group.³³ While the sociocultural conditions that encapsulate HIV and TB have been extensively described, research on the TB–HIV co-epidemic has tended to emphasise biological disease interactions while neglecting *social forces*.³⁰ The interactions between social systems, HIV and TB disease, and certain environments³⁴ have thus received much less attention than biological interactions. In our specific context of the hospital, the primary social force is the stigmatisation of both HIV and TB,³⁵ and more importantly the evolving interplay between both stigmas.

Previous studies have stressed the need to study the implications of this syndemic for the *stigmatisation of TB*: Bond and Nyblade stated that TB stigma can no longer be thought of, or addressed, separately from HIV stigma.³⁶ Patients with TB have emerged as a vulnerable group as the co-epidemic—three out of five TB cases with a known HIV status are HIV positive³⁷—renders them easy targets of HIV-related stigmatisation. The syndemic is thus altering TB stigma, as the co-epidemic renders TB not only symbolic, but also symptomatic of HIV.^{36–38–40} The symptoms associated with TB (eg, weight loss) are now also symptomatic of HIV. Conversely, the negative affects normally associated with HIV (eg, immoral behaviour) are—in the context of the co-epidemic—being transferred to TB, creating what Daftary labels double stigma. In other words, the perceived HIV stigmatisation transforms, in the context of the syndemic, external TB stigma by colleagues into *double HIV–TB stigma* where TB is ascribed the negative views and attitudes of HIV.⁴¹

Constructing a syndemic model

It becomes thus relevant—especially in the hospital setting where the co-epidemic is particularly visible—to see how the link between HIV and TB combined with persistent HIV stigmatisation has created the above-described double HIV–TB stigma (ie, the transfer of negative associations with HIV to TB). In line with syndemic theory, we aim to go further: for HCWs, who as a distinct social grouping see the interaction between TB and HIV in their hospital wards, this double stigma may well cause individuals to deny the true effects of TB to themselves and others.³⁴ It has been suggested that HCWs may have elevated levels of internal TB stigma, as well as being more inclined to hide their condition, compared with patient populations¹⁶—all factors which can impede OHU use. As a consequence, we not only want to study how the HIV–TB co-epidemic is altering the stigmatisation of TB through the creation of a double HIV–TB stigma, but also how this double stigma increases *internal TB stigma* and decreases the *willingness to take up OHU services* for TB screening and treatment. The syndemic thus creates a new type of external TB-related stigma (double HIV–TB stigma) which we hypothesise to be a key driver of internal TB stigma and a barrier to the use of the OHU.

The current paper thus hypothesises that South African HCWs are subject of a particular syndemic (*HIV–TB co-epidemic–HIV stigma–TB stigma*) in a context where TB is an occupational hazard. We explore in which way this syndemic impacts on the willingness of HCWs to use the OHU for TB screening and treatment. We will do this by constructing a structural equation model (depicted in figure 1) in

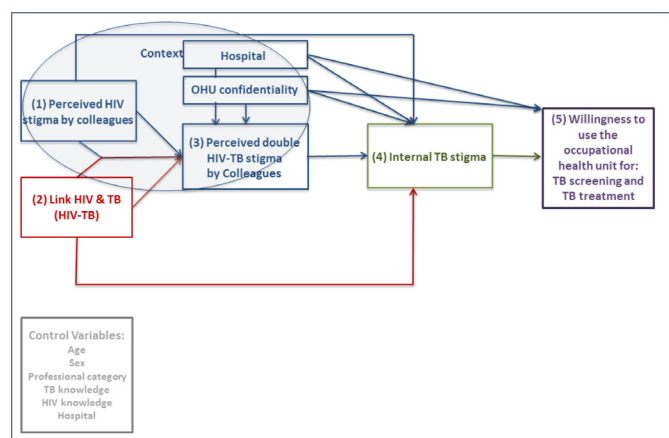


Figure 1 Conceptual model depicting the relationships between (1) the perceived HIV stigma by colleagues; (2) the perceived link between the diseases (HIV and TB); (3) the perceived double HIV–TB stigma by colleague; (4) internal TB stigma and (5) the intended use of the occupational healthcare unit (OHU) for TB screening and treatment—including control variables and the hospital context (hospital and OHU confidentiality)—the blue oval reflects the hospital context. TB, tuberculosis.

which the (1) the perceived stigmatisation of HIV by colleagues and (2) the perceived link between the diseases (HIV and TB) jointly stimulate the creation of (3) a perceived double HIV–TB stigma. We also expect that the effect of perceived link between the diseases on double HIV–TB stigma is stronger when the context stigmatises HIV more (perceived external HIV stigma) expressed in the interaction effect in the model. This double HIV–TB stigma then pushes the (4) internal stigmatisation of TB which in turn leads

Table 1 Sample descriptions (N=820)

	n	%
Gender		
Male	225	27.5
Female	593	72.5
Age (mean, SD)	813	43.68 (9.94)
Professional group		
Patient care	415	50.7
Support staff	404	49.3
HIV knowledge (mean, SD)*	820	6.96 (1.65)
TB knowledge (mean, SD)*	820	7.17 (1.51)
TB confidentiality in OHU		
No or not sure	240	29.3
Yes	580	70.7
Link between HIV and TB (HIV–TB)		
Item 1 (mean, SD)	820	1.78 (0.76)
Item 2 (mean, SD)	819	2.14 (0.86)
Item 3 (mean, SD)	817	2.48 (0.83)
External HIV stigma by colleagues		
Item 1 (mean, SD)	819	2.00 (0.80)
Item 2 (mean, SD)	819	2.12 (0.83)
Item 3 (mean, SD)	819	2.00 (0.74)
Item 4 (mean, SD)	819	2.05 (0.81)
Double HIV–TB stigma by colleagues		
Item 1 (mean, SD)	818	1.97 (0.77)
Item 2 (mean, SD)	819	1.95 (0.76)
Internal TB stigma		
Item 1 (mean, SD)	820	1.92 (0.80)
Item 2 (mean, SD)	818	1.86 (0.68)
Intended use of the OHU for TB screening		
No	98	12.0
Yes	720	88.0
Intended use of the OHU for TB treatment		
No	185	22.6
Yes	635	77.4

*Scored 1–10.
OHU, occupational healthcare unit; TB, tuberculosis.

Table 2 Item analysis and goodness of fit of the measurement model (n=813)

Scales	Standardised loadings (λ)	P value
Link between HIV and TB (HIV–TB)		
TB is a sign that someone has HIV	0.659	≤0.001
Someone with TB has probably also got HIV	0.725	≤0.001
TB symptoms make HIV more noticeable	0.527	≤0.001
External HIV stigma by colleagues		
Some of my coworkers in this hospital look down on healthcare workers who they think may be HIV infected	0.694	≤0.001
There are healthcare workers who make negative remarks about the health of coworkers who are involved in HIV care and treatment	0.669	≤0.001
Some healthcare workers who are suspected of having HIV get rejected by others in the workplace	0.705	≤0.001
Other healthcare workers in this hospital are afraid of catching HIV from colleagues who care for HIV-positive patients	0.697	≤0.001
Double HIV–TB stigma by colleagues		
People with TB tend to be treated badly because they may have HIV	0.817	≤0.001
People are afraid of working together with someone who has TB because they think that the person also has HIV	0.864	≤0.001
Internal TB stigma		
As a healthcare worker, I would feel it was my fault if I was infected with TB	0.410	≤0.001
If I was diagnosed with TB, I would feel alone in my workplace	0.667	≤0.001
Goodness of fit		
RMSEA	0.037	
CFI	0.971	
TLI	0.958	
SRMR	0.028	

CFI, Comparative Fit Index; RMSEA, Root Mean Square Error of Approximation; SRMR, Standardised Root Mean Squared Residual; TB, tuberculosis; TLI, Tucker-Lewis Index.

to (5) a lower willingness to employ the OHU for TB screening and treatment.

METHODS

Study design and population

The study applied a syndemic approach to study HIV and TB stigma in the hospital setting by exploring the baseline data of a randomised controlled trial (RCT) entitled the ‘HIV and Tuberculosis Stigma among Healthcare workers Study’ (HaTSaH Study—primary aim: reduce HIV and TB stigma among HCWs).^{42 43}

A study sample of 882 HCWs—both clinical staff (446) (doctors and nurses) and non-clinical staff (436) (eg, messengers, cleaners and administrators)—working in eight hospitals in the Free State was randomly drawn from the healthcare workforce register (total of 2028 HCWs across the eight hospitals). Fifteen HCWs refused to participate and were replaced by an HCW from the same hospital and from the same professional category. After obtaining written informed consent from all participants, trained field workers provided the participants

with the standard questionnaires that were completed in a self-administered process (data collected January–March 2016). For the study, six hospitals were included, as two lacked an OHU—resulting in a sample size of 820 HCWs.

Measures

The main outcome of the model depicted in [figure 1](#), the *willingness to use the occupational healthcare unit for TB services*, was measured with two questions: ‘Would you use the occupational healthcare unit (sick bay) for TB screening?’ and ‘Would you use the occupational healthcare unit (sick bay) for anti-TB treatment?’ (no/yes). As we expect that the co-epidemic—visible in the model in the interaction effect (link between HIV and TB×external HIV stigma) on double HIV–TB stigma and internal TB stigma—can have a different impact on once-off screening and 6-month TB treatment, we will test two separate models: (1) one for screening and (2) one for treatment.

Perceived colleagues’ external stigma towards HIV expresses the perceived stigmatisation by colleagues of other colleagues—thus assessing the stigmatising climate at

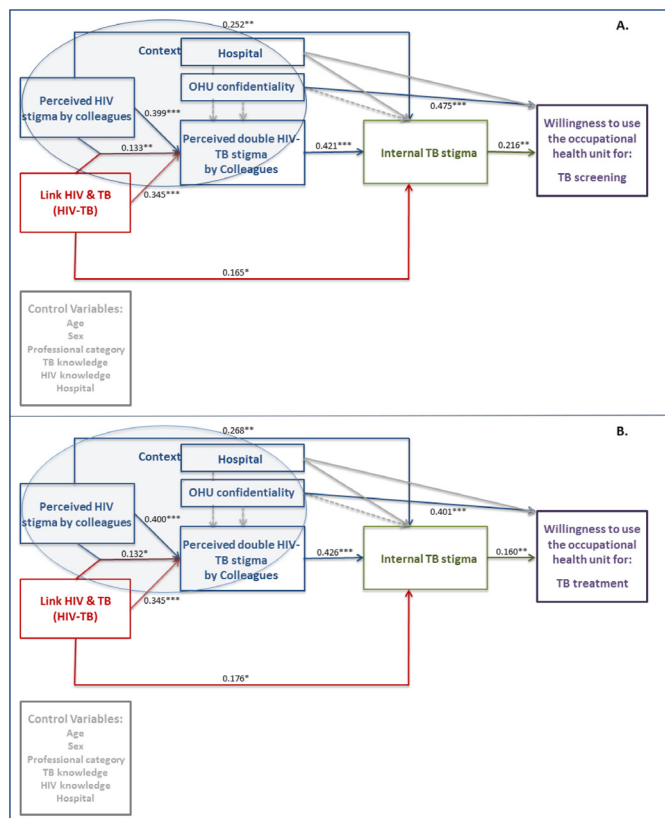


Figure 2 Outcomes of the structural models explaining the willingness to employ the OHU for (A) TB screening and (B) TB treatment. All numbers are standardised linear regression coefficients except for the arrows pointing to TB screening: there are standardised probit regression coefficients.^{1,2} ¹Solid arrows depict significant relationships, dotted lines depict non-significant relationships. ²Only a limited number of hospital effects were significant—these are visible in table 3. *P≤0.05; **p≤0.01; ***p≤0.001. OHU, occupational healthcare unit; TB, tuberculosis.

the hospital. It was measured by a 4-point Likert scale (strongly agree–agree–disagree–strongly disagree) with four items (‘Some of my coworkers in this hospital look down on healthcare workers who they think may be HIV infected’ (item 1); ‘There are healthcare workers who make negative remarks about the health of coworkers who are involved in HIV care and treatment’ (item 2); ‘Some healthcare workers who are suspected of having HIV get rejected by others in the workplace’ (item 3); and ‘Other healthcare workers in this hospital are afraid of catching HIV from colleagues who care for HIV-positive patients’ (item 4)). This scale was previously validated by Wouters *et al.*⁴⁴

The *perceived link between HIV and TB* (HIV–TB) was measured by a 4-point Likert scale (strongly agree–agree–disagree–strongly disagree) with three items (‘TB is a sign that someone has HIV’ (item 1); ‘Someone with TB has probably also got HIV’ (item 2); and ‘TB symptoms make HIV more noticeable’ (item 3)).

Double HIV–TB stigma—indicating the transfer of stigma from HIV to TB—was measured by a 4-point Likert scale

(strongly agree–agree–disagree–strongly disagree) with two items, namely ‘People with TB tend to be treated badly because they may have HIV’ (item 1) and ‘People are afraid of working together with someone who has TB because they think that the person also has HIV’ (item 2). All items were (re)coded so that higher scores would denote higher levels of stigma.

Internal TB stigma expresses the stigmatisation of HCWs towards themselves if they had TB. It was measured by a 4-point Likert scale (strongly agree–agree–disagree–strongly disagree) with two items, namely ‘As a healthcare worker, I would feel it was my fault if I was infected with TB’ (item 1) and ‘If I was diagnosed with TB, I would feel alone in my workplace’ (item 2)—both scored using a 4-point Likert scale. The scale was previously validated by Wouters *et al.*⁴⁵ All items were (re)coded so that higher scores would denote higher levels of stigma.

As we intend to study the syndemic of HIV and TB in the hospital setting, two context-related variables are included. First, we expect that the perceived confidentiality in the OHU is a key aspect in the syndemic—measured by the question ‘Do you think that confidentiality about TB is maintained in your occupational healthcare unit (sick bay)?’. Second, the general hospital context potentially shapes the syndemic: we therefore controlled for potential hospital effects arising from the cluster RCT design.

In order to model social reality as closely as possible, a number of control variables are included in our analyses. The survey included a series of sociodemographic questions (age and sex). As we expect differences in various dependent variables between HCWs with medical training (nurses and doctors) and HCWs without any formal medical training (clerks, cleaners, administrators, etc), this study will also include a measure of the professional category of the health workforce (medical staff vs non-medical staff). In addition, this study includes the HIV-related (10 items—total score between 0 and 10) and TB-related knowledge (10 items—total score between 0 and 10) of the healthcare workforce as the literature has repeatedly shown a link between knowledge and stigma.⁴⁶

Analysis

In a recent methodological paper, Tsai stresses the need to study the inter-relationships between the different factors of a syndemic in an appropriate manner.⁴⁷ He explicitly states that models of serially causal or co-epidemics need to be studied using path analysis (structural equation modelling (SEM)). SEM (MLR estimator (full information with listwise deletion for observed covariates)) is thus used to test our syndemic model investigating the impact of (1) the perceived HIV stigma by colleagues and (2) the perceived link between HIV and TB on (3) double HIV–TB stigma, (4) internal TB stigma and eventually (5) the willingness to use the OHU for TB screening and treatment. In accordance with standard SEM practices, we use a two-step approach: (1) a measurement model and (2) two-path models for TB screening and TB treatment, respectively.

**Table 3** Structural model outcomes (minus the hospital effects) (n=803)

Path		TB screening path coefficient	TB treatment path coefficient
<i>Standardised linear regression coefficients</i>			
Age	→ Double HIV–TB stigma	–0.002	–0.002
Sex	→ Double HIV–TB stigma	–0.048	–0.048
Professional category	→ Double HIV–TB stigma	–0.070	–0.070
Confidentiality	→ Double HIV–TB stigma	–0.082	–0.082
Hospital (hospital 1=reference)			
Hospital 2	→ Double HIV–TB stigma	0.145	0.145
Hospital 3	→ Double HIV–TB stigma	0.063	0.063
Hospital 4	→ Double HIV–TB stigma	–0.010	–0.010
Hospital 5	→ Double HIV–TB stigma	–0.002	–0.002
Hospital 6	→ Double HIV–TB stigma	0.168	0.168
HIV knowledge	→ Double HIV–TB stigma	0.038	0.038
TB knowledge	→ Double HIV–TB stigma	–0.133***	–0.133***
External HIV stigma by colleagues (1)	→ Double HIV–TB stigma	0.345***	0.400***
Link between HIV and TB (2)	→ Double HIV–TB stigma	0.399***	0.345***
Interaction (1)×(2)	→ Double HIV–TB stigma	0.133**	0.132*
Internal TB stigma			
Age	→ Internal TB stigma	0.002	0.001
Sex	→ Internal TB stigma	0.223**	0.222*
Professional category	→ Internal TB stigma	0.071	0.071
Confidentiality	→ Internal TB stigma	–0.082	–0.073
Hospital (hospital 1=reference)			
Hospital 2	→ Internal TB stigma	–0.138	–0.136
Hospital 3	→ Internal TB stigma	–0.190	–0.192
Hospital 4	→ Internal TB stigma	0.078	0.079
Hospital 5	→ Internal TB stigma	–0.224	–0.225
Hospital 6	→ Internal TB stigma	0.372	0.384*
HIV knowledge	→ Internal TB stigma	–0.011	–0.012
TB knowledge	→ Internal TB stigma	–0.039	–0.040
External HIV stigma by colleagues	→ Internal TB stigma	0.252**	0.268**
Link between HIV and TB	→ Internal TB stigma	0.165	0.176*
Double HIV–TB stigma	→ Internal TB stigma	0.421***	0.426***
<i>Probit coefficients</i>			
Age	→ TB care	–0.002	0.012*
Sex	→ TB care	–0.185	–0.171
Professional category	→ TB care	0.054	0.104
Confidentiality	→ TB care	0.475***	0.401***
Hospital (hospital 1=reference)			
Hospital 2	→ TB care	0.385*	0.284*
Hospital 3	→ TB care	0.073	0.153
Hospital 4	→ TB care	–0.110	–0.073
Hospital 5	→ TB care	0.022	0.360
Hospital 6	→ TB care	0.506*	0.224
HIV knowledge	→ TB care	0.051	0.083

Continued

Table 3 Continued

Path		TB screening path coefficient	TB treatment path coefficient
TB knowledge	→ TB care	0.051	0.082
Internal TB stigma	→ TB care	-0.216**	-0.160**
Test for fit without interaction effect		Model	Model
RMSEA		0.030	0.029
Comparative Fit Index		0.952	0.955
Tucker-Lewis Index		0.924	0.929

*P≤0.05; **p≤0.01; ***p≤0.001.

RMSEA, Root Mean Square Error of Approximation; TB, tuberculosis.

The full analytical strategy can be found in online supplemental appendix 1.

Patient and public involvement

No patient involved.

RESULTS

Sample characteristics

The characteristics of our sample are depicted in [table 1](#). Attrition analyses revealed no significant differences between the 10 respondents (who missed a response on one or more variables) and the rest of the sample on the other variables.

Measurement model

The measurement model displays an excellent fit to the data, as presented in [table 2](#). All items displayed sufficient factor loadings (λ) except for one item of the perceived link between HIV and TB having a rather low factor loading ($\lambda=0.410$). Combined, these findings support the fit of the measurement model to the data as well as the reliability of these constructs and their indicators.

Structural models

Both structural models—looking at the willingness to use the OHU services for (a) TB screening and (b) TB treatment ([figure 2A,B](#))—fitted the data well (Comparative Fit Index and Tucker-Lewis Index ≥ 0.95 , Root Mean Square Error of Approximation ≤ 0.06). The models without the interaction effects displayed good fit indices ([table 3](#)), and the interaction effect we added was significant. In addition, difference testing using the log likelihood demonstrated that the two nested models (with and without interaction effect) were significantly different and that adding the interaction factor improved the model fit significantly.

Double HIV–TB stigma

In line with our hypotheses, we see that (1) the perceived link between the diseases (HIV and TB) and (2) the perceived stigmatisation of HIV by colleagues are positively associated with double HIV–TB stigma. In addition, the interaction effect between the two latent factors is

also positively and significantly associated with double HIV–TB stigma. In other words, HCWs who know that TB and HIV are linked in an environment where colleagues stigmatise HIV, are especially inclined to transfer stigmatising attitudes from HIV to TB.

Internal TB stigma

The structural models also confirm our hypotheses regarding internal TB stigma: (1) the perceived link between HIV and TB and (2) the perceived stigmatisation of HIV by colleagues and the resulting (3) double HIV–TB stigma are all positively associated with (4) internal TB stigma. When HCWs see the link between HIV and TB, see other HCWs stigmatising HIV and thus transfer stigmatising attitudes from HIV to TB, they are also more inclined to feel lonely and guilty when they would have TB.

Willingness to use the OHU for screening/treatment

When looking at our first outcome ([table 3](#)), the willingness to use the OHU for TB screening, our hypothesis is confirmed. The significant negative association between internal TB stigma and the willingness to use the OHU signals the negative impact of stigma on healthcare use. In addition, the perceived confidentiality of the OHU was an important contextual correlate of the willingness to use the OHU for TB screening.

The second model ([table 3](#))—looking at willingness to use the OHU for TB treatment—similarly demonstrates a significant negative association between internal TB stigma and the OHU use for TB treatment. Again, the perceived confidentiality of the OHU emerged as an important contextual factor in the willingness to use the OHU.

DISCUSSION

In the context of the protracted TB–HIV co-epidemic, we hypothesised that South African HCWs are subject of a particular syndemic (*HIV–TB co-epidemic–HIV stigma–TB stigma*) in a context where TB is an occupational hazard. In this article, we explored in which way this syndemic impacts on the willingness of HCWs to use the OHU for



TB screening and treatment. This syndemic model was tested in line with Tsai's methodological recommendations for the study of syndemics.⁴⁷ It also responds to a paucity of conceptual explanations on how structural and social forces intersect with different dimensions of stigma to produce specific outcomes.⁴⁸

The study results demonstrate that the co-epidemic, producing a clear link between HIV and TB, combined with the persistent stigmatisation of HIV, is altering the attitudes towards TB (signalled by the occurrence of double HIV–TB stigma), where the stigmatising views of HIV are transferred to TB. This is in line with previous research indicating that—in high HIV-prevalence contexts—discriminatory attitudes against HIV are transferred to individuals with TB.^{41 49 50} Our model demonstrated that this syndemic not only leads to higher levels of internal TB stigma among HCWs, but also to a lower willingness to use the OHU for both TB screening and treatment. A principal mechanism in avoiding OHU services is stigma and associated fears that confidentiality might be breached, leading to others suspecting one of being HIV positive.^{16–19 51} It is important to note that these mechanisms were active even though the mean levels of stigma in the participating hospitals were not high—indicating that the hospital climate can be affected by a few individuals displaying stigmatising attitudes.

There is prevailing consensus that TB/HIV health services for HCWs—including routine screening for TB—should be integrated into hospital-based OHUs.¹⁴ This is in line with international recommendations, particularly the joint WHO–ILO–UNAIDS policy guidelines on improving health workers' access to HIV and TB services¹⁵; the WHO policy on TB infection control in healthcare facilities, congregate settings and households; and the ILO occupational safety and health convention. In South Africa, these directives are supported by the Draft National Infection Prevention and Control Policy for TB, MDR-TB and XDR-TB and the Occupational Health and Safety Act. The ideal of facility-based TB/HIV OHU services to address the burden of TB among HCWs in South Africa is however questioned by our results that clearly demonstrate that the syndemic (HIV–TB co-epidemic–HIV stigma–TB stigma–TB as an occupational hazard), combined with low levels of perceived confidentiality, act as significant barriers against the use of these services: almost one out of every four HCWs did not intend to use the OHU for TB treatment. This finding supports previous research that show low rates of occupational screening for TB in South African health facilities,^{52–54} that, even when it is offered, it is often not taken up by HCWs.¹⁸ It is thus clear that evidence-based policies and strategies are needed to increase the uptake of occupational screening and treatment for TB in South African hospitals.

This study had, however, several limitations. First, we were unable to make any attributions of causal influence among the different independent variables and the intended healthcare use as the study only used baseline

data. Second, this study collected data on a random sample of HCWs active in the six selected hospitals, irrespective of their HIV status or TB history, thus gathering data on their healthcare use in the hypothetical case of a TB/HIV co-infection. Third, in absence of a validated double HIV/TB stigma scale, we had to resort to a self-developed two-item scale: further research is needed to develop more a more elaborate scale to measure this concept. Fourth, it is important to note that this study only assessed correlates of the willingness to use the OHU for TB services—willingness to use does not always reflect actual use. Fifth, the current study only included internalised TB stigma, it would also be interesting to investigate the role of other forms of TB stigma (enacted, anticipated) in this context. Sixth, this study did not explore stigma related to drug-resistant TB (MDR-TB and XDR-TB), which is known to have distinct and more severe manifestations. Finally, further qualitative research is required to understand the mechanisms underlying the discovered associations (eg, the impact of the co-epidemic on TB stigma).

CONCLUSIONS

Several important insights have emerged from this study, with implications for both theory and practice. From a theoretical point of view, the empirical testing of the conceptual syndemic model pushes our understanding of the complex medical and social inter-relationships between HIV and TB. The model clearly confirms HIV as a 'syndemic generator'⁵⁵ which clearly changes the social meaning of TB in the hospital context. As indicated above however, in-depth qualitative work is required to explain the mechanisms underlying these changes. Second, our study demonstrated that this syndemic transformation of TB has practical implications as it significantly impacted the willingness to use TB services. The fact that almost one out of every three HCWs were not convinced TB confidentiality was maintained in the hospital sick bay aggravates the context of distrust surrounding the OHU. If policymakers want to stimulate the use of OHU services for TB in order to minimise HCW absenteeism and optimise the hospital functioning, there is a clear need to fight both HIV and TB stigma as well as ensure OHU confidentiality in South African hospitals.¹⁹

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ME supervised the overarching study. All authors read and approved the final manuscript. EW was responsible for the overall content of the paper as guarantor.

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REFERENCES

- 1 Statistics South Africa. *Mortality and causes of death in South Africa, 2016: findings from death notification*. Pretoria: Statistics South Africa, 2018.
- 2 WHO. *Global TB report*. Geneva: WHO, 2020.
- 3 Alele FO, Franklin RC, Emeto TI, et al. Occupational tuberculosis in healthcare workers in sub-Saharan Africa: a systematic review. *Arch Environ Occup Health* 2019;74:95–108.
- 4 Joshi R, Reingold AL, Menzies D, et al. Tuberculosis among health-care workers in low- and middle-income countries: a systematic review. *PLoS Med* 2006;3:e494.
- 5 Tudor C, Van der Walt M, Margot B, et al. Tuberculosis among health care workers in KwaZulu-Natal, South Africa: a retrospective cohort analysis. *BMC Public Health* 2014;14:891.
- 6 Baussano I, Nunn P, Williams B, et al. Tuberculosis among health care workers. *Emerg Infect Dis* 2011;17:488–94.
- 7 Menzies D, Joshi R, Pai M. Risk of tuberculosis infection and disease associated with work in health care settings. *Int J Tuberc Lung Dis* 2007;11:593–605.
- 8 McCarthy KM, Scott LE, Gous N, et al. High incidence of latent tuberculous infection among South African health workers: an urgent call for action. *Int J Tuberc Lung Dis* 2015;19:647–53.
- 9 Rafiza S, Rampal KG, Tahir A. Prevalence and risk factors of latent tuberculosis infection among health care workers in Malaysia. *BMC Infect Dis* 2011;11:19.
- 10 Chen B, Gu H, Wang X, et al. Prevalence and determinants of latent tuberculosis infection among frontline tuberculosis healthcare workers in southeastern China: a multilevel analysis by individuals and health facilities. *Int J Infect Dis* 2019;79:26–33.
- 11 Grobler L, Mehtar S, Dheda K, et al. The epidemiology of tuberculosis in health care workers in South Africa: a systematic review. *BMC Health Serv Res* 2016;16:416.
- 12 Uden L, Barber E, Ford N, et al. Risk of tuberculosis infection and disease for health care workers: an updated meta-analysis. *Open Forum Infect Dis* 2017;4:ofx137.
- 13 O'Donnell MR, Jarand J, Loveday M, et al. High incidence of hospital admissions with multidrug-resistant and extensively drug-resistant tuberculosis among South African health care workers. *Ann Intern Med* 2010;153:516–22.
- 14 Tudor C, Van der Walt M, Hill MN, et al. Occupational health policies and practices related to tuberculosis in health care workers in KwaZulu-Natal, South Africa. *Public Health Action* 2013;3:141–5.
- 15 World Health Organization, International Labour Organization, UNAIDS. *The joint WHO-ILO-UNAIDS policy guidelines on improving health workers' access to HIV and TB prevention, treatment, care and support services* Geneva, 2010.
- 16 Coreil J, Lauzardo M, Heurtelou M. Anticipated tuberculosis stigma among health professionals and Haitian patients in South Florida. *J Health Care Poor Underserved* 2012;23:636–50.
- 17 Murray EJ, Bond VA, Marais BJ, et al. High levels of vulnerability and anticipated stigma reduce the impetus for tuberculosis diagnosis in Cape town, South Africa. *Health Policy Plan* 2013;28:410–8.
- 18 Zelnick JR, Gibbs A, Loveday M, et al. Health-Care workers' perspectives on workplace safety, infection control, and drug-resistant tuberculosis in a high-burden HIV setting. *J Public Health Policy* 2013;34:388–402.
- 19 Masquillier C, Wouters E, Sommerland N, et al. Fighting stigma, promoting care: a study on the use of occupationally-based HIV services in the free state Province of South Africa. *AIDS Care* 2018;30:16–23.
- 20 Engelbrecht MC, Yassi A, Spiegel JM. Tuberculosis and blood-borne infectious diseases: workplace conditions and practices of healthcare workers at three public hospitals in the free state. *Southern African Journal of Epidemiology and Infection* 2014.
- 21 Macintyre K, Bakker MI, Bergson S, et al. Defining the research agenda to measure and reduce tuberculosis stigmas. *Int J Tuberc Lung Dis* 2017;21:87–96.
- 22 Courtwright A, Turner AN. Tuberculosis and stigmatization: pathways and interventions. *Public Health Rep* 2010;125 Suppl 4:34–42.
- 23 Kelly P, Isolation KP. Isolation and stigma: the experience of patients with active tuberculosis. *J Community Health Nurs* 1999;16:233–41.
- 24 Weiss MG, Ramakrishna J, Somma D. Health-Related stigma: rethinking concepts and interventions. *Psychol Health Med* 2006;11:277–87.
- 25 Nyblade L, Stangl A, Weiss E, et al. Combating HIV stigma in health care settings: what works? *J Int AIDS Soc* 2009;12:15.
- 26 UNAIDS. *Global report 2018. fact sheet*. Geneva: UNAIDS, 2018.
- 27 WHO. *Global TB report 2018*. Geneva: WHO, 2018.
- 28 Adamsi S, Ehrlichi R, Ismailii N. Occupational Health Challenges Facing the Department of Health: Protecting employees against tuberculosis and caring for former mineworkers with occupational health disease. In: Padarath A, English R, eds. *South African health review 2012/13*. Durban: Health Systems Trust, 2013: 67–82.
- 29 Singer M. *Introduction to Syndemics: A Critical Systems Approach to Public and Community Health*. San Francisco: Jossey-Bass, 2009.
- 30 Lerman S, Ostrach B, Singer M. *Foundations of Biosocial health: stigma and illness interactions*. Lanham: Lexington Books, 2017.
- 31 Diez Roux AV, Aiello AE. Multilevel analysis of infectious diseases. *J Infect Dis* 2005;191 Suppl 1:S25–33.
- 32 Mendenhall E. Syndemics: a new path for global health research. *Lancet* 2017;389:889–91.
- 33 Ostrach B, Ginzburg SL, Singer M. *Stigma Syndemics: new directions in Biosocial health*. Lanham: Lexington Books, 2017.
- 34 Singer M. *The Anthropology of infectious disease*. Walnut Creek: Left Coast Press Inc, 2015.
- 35 Khan R, Yassi A, Engelbrecht MC, et al. Barriers to HIV counseling and testing uptake by health workers in three public hospitals in free state Province, South Africa. *AIDS Care* 2015;27:1–8.
- 36 Bond V, Nyblade L. The importance of addressing the unfolding TB-HIV stigma in high HIV prevalence settings. *J Community Appl Soc Psychol* 2006;16:452–61.
- 37 Engelbrecht M, Rau A, Gigozi G, et al. Waiting to inhale: factors associated with healthcare workers' fears of occupationally-acquired tuberculosis (TB). *BMC Infect Dis* 2019;19:475.
- 38 Daftary A, Padayatchi N. Social constraints to TB/HIV healthcare: accounts from coinfecting patients in South Africa. *AIDS Care* 2012;24:1480–6.
- 39 Wouters E, Heunis C, van Rensburg D, et al. Physical and emotional health outcomes after 12 months of public-sector antiretroviral treatment in the free state Province of South Africa: a longitudinal study using structural equation modelling. *BMC Public Health* 2009;9:103.



- 40 Assefa Y, Lynen L, Wouters E, *et al.* How to improve patient retention in an antiretroviral treatment program in Ethiopia: a mixed-methods study. *BMC Health Serv Res* 2014;14:45.
- 41 Daftary A. Hiv and tuberculosis: the construction and management of double stigma. *Soc Sci Med* 2012;74:1512–9.
- 42 Rau A, Wouters E, Engelbrecht M, *et al.* Towards a health-enabling working environment - developing and testing interventions to decrease HIV and TB stigma among healthcare workers in the Free State, South Africa: study protocol for a randomised controlled trial. *Trials* 2018;19:351.
- 43 Sommerland N, Masquillier C, Rau A, *et al.* Reducing HIV- and TB-Stigma among healthcare co-workers in South Africa: results of a cluster randomised trial. *Soc Sci Med* 2020;266:113450.
- 44 Wouters E, Masquillier C, Sommerland N, *et al.* Measuring HIV- and TB-related stigma among health care workers in South Africa: a validation and reliability study. *Int J Tuberc Lung Dis* 2017;21:19–25.
- 45 Wouters E, Rau A, Engelbrecht M, *et al.* The development and Piloting of parallel scales measuring external and internal HIV and tuberculosis stigma among healthcare workers in the free state Province, South Africa. *Clin Infect Dis* 2016;62 Suppl 3:S244–54.
- 46 Yang H, Li X, Stanton B, *et al.* Hiv-Related knowledge, stigma, and willingness to disclose: a mediation analysis. *AIDS Care* 2006;18:717–24.
- 47 Tsai AC. Syndemics: a theory in search of data or data in search of a theory? *Soc Sci Med* 2018;206:117–22.
- 48 Craig GM, Daftary A, Engel N, *et al.* Tuberculosis stigma as a social determinant of health: a systematic mapping review of research in low incidence countries. *Int J Infect Dis* 2017;56:90–100.
- 49 Mavhu W, Dauya E, Bandason T, *et al.* Chronic cough and its association with TB-HIV co-infection: factors affecting help-seeking behaviour in Harare, Zimbabwe. *Trop Med Int Health* 2010;15:574–9.
- 50 Ngamvithayapong J, Winkvist A, Diwan V. High AIDS awareness may cause tuberculosis patient delay: results from an HIV epidemic area, Thailand. *AIDS* 2000;14:1413–9.
- 51 Khan R, Yassi A, Engelbrecht MC, *et al.* Barriers to HIV counseling and testing uptake by health workers in three public hospitals in free state Province, South Africa. *AIDS Care* 2015;27:198–205.
- 52 Sissolak D, Marais F, Mehtar S. TB infection prevention and control experiences of South African nurses—a phenomenological study. *BMC Public Health* 2011;11:262.
- 53 Engelbrecht M, Janse van Rensburg A, Kigozi G, *et al.* Factors associated with good TB infection control practices among primary healthcare workers in the free state Province, South Africa. *BMC Infect Dis* 2016;16:633.
- 54 Engelbrecht MC, Kigozi G, Janse van Rensburg AP, *et al.* Tuberculosis infection control practices in a high-burden Metro in South Africa: a perpetual bane for efficient primary health care service delivery. *Afr J Prim Health Care Fam Med* 2018;10:e1–6.
- 55 Singer M, Bulled N, Ostrach B, *et al.* Syndemics and the biosocial conception of health. *Lancet* 2017;389:941–50.