Impact of the COVID-19 Pandemic on Quality of Tuberculosis Care in Private Facilities in Bandung, Indonesia

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Author Contributions

This thesis covers primary data analysis of standardized patient data from Bandung, Indonesia collected in 2021 and 2022, and secondary data analysis of standardized patient data from Bandung, Indonesia collected in 2018 and 2019. The aim of this analysis was formulated by MP, JD, BWL, PH, NA, BA, and AS. Data collection and cleaning was conducted by KU and SDW, with administrative support from RW and supervision from BWL and BA. Data pre-processing, compilation of descriptive statistics, and computation of regression analyses were completed by AS with guidance from BWL, KU, NA, and PH. The analyses received critical appraisal from MP, JD, BD, and AB, and were then revised by AS. The initial manuscript draft was written by AS with support from KU and BWL. All other authors, MP, JD, AB, BD, CO, NA, SDW, LH, and NAV shared constructive feedback, which enabled AS to finalize the manuscript.

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Key Abbreviations

AFB	Acid-fast Bacilli test
ATT	anti-tuberculosis treatment
BMGF	Bill & Melinda Gates Foundation
BPJS Kesehatan	*Badan Penyelenggara Jaminan Sosial Kesehatan*, administrator of Indonesian national health insurance
CHC	Community health center
CI	Confidence interval
COVET	COVID-19 Effects on TB Services in the Private Sector
COVID-19	Coronavirus disease 2019
DAG	Directed Acyclic Graph
DOTS	Directly observed therapy, short-course
DST	Drug susceptibility testing
GDP	Gross domestic product
GP	General practitioner
HBC	High-burden country
HCF	Healthcare facility
HIV	Human Immunodeficiency Virus
IDI	Indonesian Medical Association (*Ikatan Dokter Indonesia*)
IDR	Indonesian Rupiah
IGRA	Interferon-Gamma Release Assay
IQR	Interquartile range

INSTEP	Investigation of services delivered for TB by external care system - especially the private sector
IOM	Institute of Medicine
ISTC	International Standards for Tuberculosis Care
JKN	Jaminan Kesehatan Nasional
JSY	*Janani Suraksha Yojana*, a cash-transfer programme aimed to increase facility births in India
LMIC	Low- and middle-income country
MDR-TB	Multi-drug resistant tuberculosis
MOH	Ministry of Health, Indonesia (*Kementerian Kesehatan Republik Indonesia*)
MTB	*Mycobacterium tuberculosis*
MUHC	McGill University Health Centre
NB	Nota bene
NCD	Non-communicable disease
NGO	Non-governmental organization
NTP	National Tuberculosis Programme
PCR	Polymerase chain reaction
PPA	Patient pathway analysis
PPE	Personal protective equipment
PPM	Public-private mix
PPKM	*Pemberlakuan Pembatasan Kegiatan Masyarakat*, restrictions put into effect beginning in 2021 in response to the COVID-19 pandemic

Puskesmas	*Pusat Kesehatan Masyarakat*, public community health centers in Indonesia
REB	Research ethics board
RR	Rifampicin-resistant (tuberculosis)
Rif	Rifampicin-resistant (tuberculosis)
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SD	Standard deviation
SDG	Sustainable Development Goals
SP	Standardized patient
TB	Tuberculosis
UHC	Universal health care
USAID	United States Agency for International Development
USD	United States dollar
WHO	World Health Organization

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Abstract

Background: Indonesia has the second highest incidence of tuberculosis (TB) in the world. 74% of people with TB in Indonesia first accessed the private health sector when seeking care for their TB symptoms, although the private sector provided only 18% of TB notifications. Indonesia was also one of the global hotspots for the COVID-19 pandemic and COVID-19 led to further disruptions in the health system. However, little is known about private sector care for TB in Indonesia after the emergence of COVID-19. There is therefore an urgent need to understand existing and widening gaps in the quality of TB care. Using unannounced standardized patients (SPs) visits to private providers, we aimed to measure quality of TB care during the COVID-19 pandemic.

Methods: A cross-sectional study was conducted using SPs in Bandung City, West Java, Indonesia with 292 private sector providers. Ten SPs completed 292 visits between 9 July 2021 and 21 January 2022. All SPs were trained to present a presumptive TB case (cough for 2–3 weeks). Results were compared to SP surveys conducted in the same geographical area during 2018–19, before the onset of COVID-19.

Results: Overall, 35% (95% confidence interval (CI): 29.2–40.4%) of visits were managed correctly according to the 2016 Indonesian national TB guidelines. More than two-thirds of SPs were prescribed unnecessary antibiotics (68%, 95% CI: 62.1–73.1%) and 27% were prescribed steroids (95% CI: 21.8–32.2%). Correct TB management was associated with more history questions asked (aOR: 1.07, 95% CI: 1.02–1.13, p=0.004) and more cardinal TB symptoms inquired (aOR: 2.78, 95% CI: 1.82–4.23, p<0.001). Comparing SP visits conducted before and during the COVID-19 pandemic uncovered no major differences in the clinical management of presumptive TB patients apart from an increase in likelihood of providers conducting temperature checks (aOR: 8.05, 95% CI: 2.96–21.9, $p<0.001$) and a decrease in likelihood of providers conducting throat examinations (aOR 0.16, 95% CI: 0.06–0.41, $p = 0.002$) during the pandemic.

Conclusion: Findings show sub-optimal management of SPs with presumptive TB by private providers in Bandung, but no significant changes in quality of care during COVID-19, compared to pre-pandemic SP surveys. As TB notifications declined in Indonesia during COVID-19, there remains an urgent need to increase private provider engagement in Indonesia to find people who have been missed and improve quality of care.

Résumé

Contexte: L'Indonésie a la deuxième incidence la plus élevée de tuberculose (TB) au monde. 74% des personnes atteintes de tuberculose en Indonésie se sont d'abord adressées au secteur privé de la santé lorsqu'elles cherchaient des soins pour leurs symptômes de tuberculose, bien que le secteur privé n'ait fourni que 18% des notifications de tuberculose. L'Indonésie était également l'un des points chauds mondiaux de la pandémie de COVID-19 et la COVID-19 a entraîné de nouvelles perturbations du système de santé. Cependant, on sait peu de choses sur les soins du secteur privé pour la tuberculose en Indonésie après l'émergence de la COVID-19. Il est donc urgent de comprendre les lacunes existantes et croissantes dans la qualité des soins antituberculeux. En utilisant des patients standardisés (PS) pour effectuer des visites chez des prestataires de soins du secteur privé, nous avons cherché à mesurer la qualité des soins antituberculeux pendant la pandémie de COVID-19.

Méthodes: Une étude transversale a été menée à l'aide de PS à Bandung City, West Java, Indonésie avec 292 fournisseurs de soins du secteur privé. Dix PS ont effectué 292 visites entre le 9 juillet 2021 et le 21 janvier 2022. Tous les PS ont été formés pour présenter un cas présumé de tuberculose (toux pendant 2 à 3 semaines). Les résultats ont été comparés aux enquêtes SP menées dans la même zone géographique en 2018-19, avant le début de la COVID-19.

Résultats: Dans l'ensemble, 35% (intervalle de confiance (IC) à 95%: 29,2 - 40,4%) des visites ont été correctement gérées conformément aux directives nationales indonésiennes de 2016 sur la tuberculose. Plus des deux tiers des SP se sont vu prescrire des antibiotiques inutiles (68%, IC à 95% : 62,1 - 73,1%) et 27% se sont vu prescrire des stéroïdes (IC à 95%: 21,8 - 32,2 %). Une prise en charge correcte de la TB était associée à plus de questions posées sur les antécédents (aOR: 1,07, IC à 95%: 1,02 - 1,13, p=0,004) et à plus de symptômes cardinaux de la TB interrogés (aOR: 2,78, IC à 95%: 1,82 - 4,23, p<0,001). La comparaison des visites de PS effectuées avant et pendant la pandémie de COVID-19 n'a révélé aucune différence majeure dans la prise en charge clinique des patients présumés tuberculeux, à l'exception d'une augmentation de la probabilité que les prestataires effectuent des contrôles de température (aOR: 8,05, IC à 95%: 2,96 - 21,9, p<0,001) et une diminution de la probabilité que les prestataires effectuent des examens de la gorge (aOR 0,16, IC à 95%: 0,06 - 0,41, p=0,002) pendant la pandémie.

Conclusion: Les résultats montrent une gestion sous-optimale des PS avec une TB présumée par des prestataires privés à Bandung, mais aucun changement significatif dans la qualité des soins pendant la COVID-19, par rapport aux enquêtes sur les PS pré-pandémiques. Étant donné que les notifications de tuberculose ont diminué en Indonésie pendant la COVID-19, il demeure urgent d'accroître l'engagement des prestataires de soins du secteur privé en Indonésie pour trouver les personnes qui ont été oubliées et améliorer la qualité des soins.

1 Introduction

Indonesia has the second highest incidence of tuberculosis (TB) in the world with close to one million new cases per year (1). Indonesia has also been a hotspot for COVID-19 in Asia, with a massive wave driven by the Delta variant which peaked in July 2021 (2,3). As of December 6, 2022, there have been 6,686,181 confirmed cases of COVID-19 in Indonesia and 160,071 deaths reported to WHO (4). Thus, both TB and COVID-19 are major challenges for the country.

Indonesia also has a large private health sector, accounting for 63% of outpatient healthcare utilization (5). While 74% of people with TB in Indonesia first access the private health sector when seeking care for their TB symptoms, the private sector accounts for only 18% of TB notifications (6). Even in the best of times, these delays in diagnosis can result in significant harm to individuals and the health system, including worsened TB disease and increased risk of antibiotic resistance and death (8).

The COVID-19 pandemic introduced additional urgency surrounding efforts to understand existing and widening gaps in the quality of TB screening and diagnosis. Globally, COVID-19 related disruptions have resulted in 2 million more people left undiagnosed (or un-reported) with TB over the past two years compared to 2019 – known as the "missing millions" (9). These figures suggest that the number of people with undiagnosed and untreated TB has increased, resulting in more TB deaths and infections (9). Indonesia experienced a 14% reduction in case notifications between 2019 and 2020, the second highest of all high TB burden countries, and is one of the four countries that accounted for most of the estimated increase in TB deaths globally in 2021 (9,10). Availability of health services for people with TB symptoms was drastically reduced in Indonesia, especially during the Delta wave (11–14).

Given the drastic disruptions causes by COVID-19, few studies to date have investigated how the quality of TB services was impacted by the COVID-19 pandemic (19,24,25). Using standardized patients (SPs), or individuals recruited from the local community to present the same case to multiple providers in a blinded fashion, we sought out to compare results of an SP study conducted in Bandung City, West Java, Indonesia in 2018-2019 with an identically designed SP study undertaken during the COVID-19 pandemic, from July 2021 to January 2022. As part of a multi-country study on quality of TB care by private providers in the COVID-19 era, our aims were to understand whether private providers in Bandung, the fourth most populous city in Indonesia, are correctly managing mystery patients with TB symptoms, to investigate which types of private providers are more likely to correctly manage patients with TB symptoms, and to estimate the extent of changes in clinical practices in TB care during the COVID-19 pandemic.

2 Literature Review

2.1 Healthcare quality is exceedingly poor in countries where tuberculosis thrives

"Quality should not be the purview of the elite or an aspiration for some distant future; it should be the DNA of all health systems"

— Kruk et al., 2018 (1)

2.1.1 Quality of care definition

Target 3.8 of the Sustainable Development Goals (SDG), adopted by the United Nations in 2015, calls upon countries to achieve universal health coverage (UHC), the point at which all people who need health services can receive high-quality care without financial hardship (2). The World Health Organization (WHO) describes quality of care as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with evidenced-based professional knowledge" (3). While definitions of quality health care vary across countries and institutions, it is often defined by six dimensions based on those presented in the landmark Institute of Medicine (IOM) report, *Crossing the Quality Chasm* (4).

High-quality health care is that which is:

1. **Safe:** avoids harm;
2. **Effective:** provides evidence-based services to those who need them;

3. **People-centred:** provides care that is respectful of and responsive to individual needs, values, and preferences;
4. **Timely:** reduces waiting times and delays;
5. **Efficient:** maximizes available resources and avoids waste; and
6. **Equitable:** does not vary in quality on account of gender, ethnicity, location, socio-economic status, or other personal characteristics (5);

More than 50 years ago, Avedis Donabedian created a conceptual framework to understand healthcare quality based on structure, process, and outcomes (6–8). Structural quality evaluates health system capacities based largely on its physical inputs: health workforce and their qualifications; availability of essential technology and medicines; health infrastructure including adequate facilities, roads, and ambulances; adequate financing; administration and related supports that bring forth the provision of care; and other necessary inputs – what the late Dr. Paul Farmer termed the “5Ss”: “staff, space, stuff, support, and systems” (9). Process quality evaluates interactions between clinicians and patients, attempting to measure such things as the appropriateness, competency, completeness, effectiveness, and acceptability of given medical care. Outcomes offer evidence about changes in patients’ health status as the result, in part, of structure and process: measures accounting for patient recovery, restoration of function, and survival. Figure 2.1-1 below shows an integration of the Institute of Medicine (IOM) quality dimensions with the Donabedian structure, process, and outcomes framework (5).

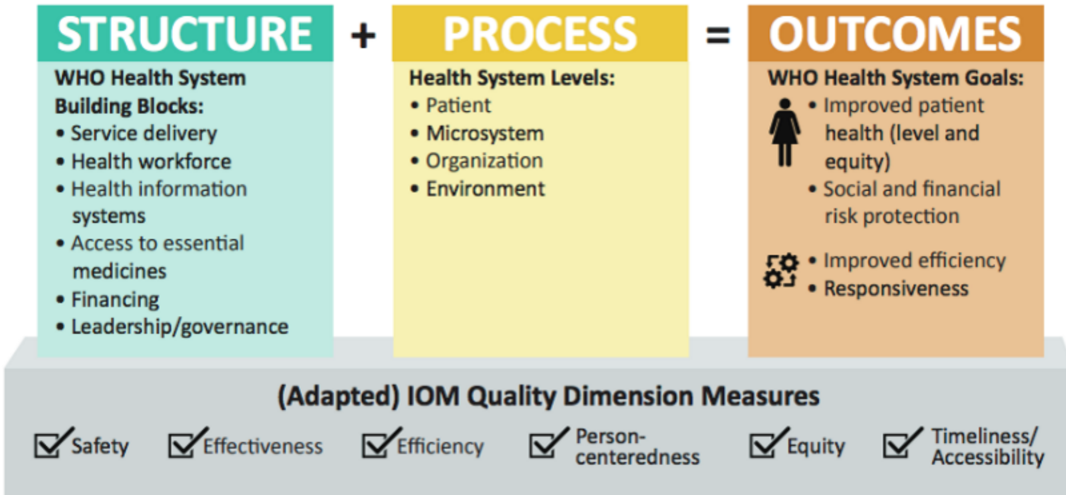


Figure 2.1-1 Integration of conceptual frameworks guiding health systems and quality of care

NB: IOM = Institute of Medicine, WHO = World Health Organization. Source: Crossing the Global Quality Chasm. (5)

Unfortunately, though we have the knowledge and technology to provide high-quality, evidence-based care, health care services worldwide often fall short of this goal. In 2000, the IOM report *To Err Is Human* estimated that 98,000 people in the United States die each year from preventable medical errors. Importantly, this report demonstrated that these errors occur not from a lack of good will, but from serious issues with the way care is organized (4). This report and its successor, *Crossing the Quality Chasm*, ignited a charge to improve health care quality in the United States and other high-income countries. In the two decades that followed, progress has been made across high-income settings especially in the reduction of hospital-acquired conditions and other adverse events (10). While quality of care still needs improvement in high-income settings, nowhere else is the problem of low-quality care is more visible than in low- and middle-income countries (LMICs).

2.1.2 Quality of care in low- and middle-income countries

For billions of people, universal health coverage—the important mainstay of the World Health Organization's (WHO's) Sustainable Development Goal (SDG) 3—will be an empty vessel unless and until quality improvement, for all nations, becomes as central an agenda as universal health coverage itself.

— Don Berwick & Sania Nishtar, "Crossing the Global Quality Chasm: Improving Health Care Worldwide" (5)

While quality of health care is a concern in all parts of the world, the quality of care in low- and middle-income countries (LMICs) is of particular and growing concern. An estimated 134 million adverse events and 2.6 million deaths occur each year as a result of unsafe medical care in LMICs (5). Approximately 8.4 million people with a diagnosed communicable disease and 831 million people with a non-communicable disease (NCD) are not properly treated each year in LMICs; due to limited available data, these figures are estimated to be a gross underestimate of deaths due to ineffective care (5). Roughly one-third of patients in LMICs experience disrespectful care, short consultations, poor communication, or long wait times, and some patients experience outright disrespectful treatment and abuse (1). Inefficient and inappropriate antibiotic prescribing is high in certain LMICs: a secondary analysis of standardized patients studies in Kenya, China, and India conducted across multiple conditions showed that antibiotics were given inappropriately in half of the SP-provider interactions in India and Kenya, and 28.8% in China. Despite overall country-level progress towards health and development indicators, relative inequities in health improvement are growing in some LMIC countries (11).

Crossing the Global Quality Chasm, the update to the IOM's *Crossing the Quality Chasm* (2001), estimated between 5.7 and 8.4 million deaths annually are attributed to poor-quality care in LMICs, and up to 107 million years of life lived with disability annually (5). Overall, poor-quality care is responsible for up to 15 percent of all deaths in LMICs and costs of $1.4 to $1.6 trillion each year in lost productivity. Similarly, the 2018 report by the *Lancet Global Health* Commission on High-Quality Health Systems in the Sustainable Development Goal (SDG) Era estimated that 8 million deaths that could be averted each year in LMICs through the provision of high-quality health care (1).

Health systems strengthening activities in global health have historically been focused on increasing access to health care, through supply-side efforts such as building new health care facilities (e.g., clinics and hospitals), training new health staff, and ensuring adequate provision of necessary drugs and other medical technologies, and demand-side efforts including patient and community outreach, health education, and patient behavior-change initiatives (1,5). These approaches are predicated on the assumption that the reason there are so many excess deaths in LMICs is because patients cannot access healthcare when they are sick, or do not seek out healthcare when they should. However, according to findings from the 2018 report by the Lancet Global Health Commission on High-Quality Health Systems in the SDG Era (1), more than half of these 8 million annual deaths are attributable to patients who accessed poor-quality health services. Health system strengthening approaches that focuses only on increasing access to care without focusing on the quality of that care are fundamentally flawed.

An example of this phenomenon is the *Janani Suraksha Yojana* (JSY) programme in India, which used a conditional cash transfer scheme to promote institutional births with the aim of reducing maternal mortality. The programme succeeded in increasing the rate of institutional births from 20% to 49% in 5 years, but despite this failed in reducing maternal mortality (12). This lack of association between institutional birth proportions and maternal mortality is likely due to poor quality of care offered at institutions, especially at lower-level facilities that are unable to handle birth complications appropriately (13). Paxton et al. pointed out that correlations between skilled attendance at birth and maternal mortality are weaker for developing countries when compared to developed countries, and this association grows even weaker in countries with high maternal mortality (14). In this example, increasing patient demand to a system with a weak supply of quality health care did not improve birth outcomes, precisely because increasing access to a system providing poor quality care is a failed approach. In their 2014 systematic review on the impact of demand-side financial incentives on the supply-side in LMICs, Gopalan et al. indicate that service delivery capacity was often not optimal to meet the increased demand for care brought about by demand-side financing programmes (15). The examples given include how insufficient supply of preventive care services became a barrier to success for financial incentive programmes aimed to increase use of preventive care services in Turkey, Mexico, and Honduras, and how vaccine shortages impeded the progress of financial incentive programs aimed at increasing childhood immunizations. Ensuring the provision of high-quality care is a key aspect of UHC, because even with increased access to services, health improvements cannot be made if those services are not providing effective care. We cannot accomplish universal health coverage if health care is poor quality.

2.1.3 Variations in quality of care across public and private health sectors

An additional element of complexity in the provision of quality health care in LMICs is the widespread mix of public and private health care within many countries. While many health care systems have a mix of public and private financing and delivery, the public sector comprises of government-owned, operated, and financed institutions that directly provide medical care, while the private sector refers to privately-owned institutions and individuals that provide care (16). The private sector is quite heterogenous among low- and middle-income countries, and even within nations. The private sector can range from informal providers with little-to-no medical training, to providers operating their own clinics, to hospitals, networks of clinics, and chain pharmacies. Private sector facilities can be for-profit or non-for-profit, run by non-governmental organizations (NGO) and/or religious organizations.

There is a widespread debate in global health concerning the balance between public and private health sectors in mixed health systems (17–19). Advocates for the private sector argue that private providers increase access for needed care in areas where the public sector, which is traditionally underfunded, has failed to do so, and that people often seek care in the private sector because of convenience and proximity to where they live (18). Public sector advocates argue that the private sector is extremely difficult to regulate, is potentially exploitative, has poor incentive for coordination with the public sector regarding public health efforts and preventative services, and is either accessed by wealthier patients or disproportionally accessed by the poor, who can only afford to seek care from the informal private sector (18). Nevertheless, in many places, the private sector is fast-growing and playing an increasingly important role in healthcare delivery.

Research comparing quality of care in the public sector versus the private sector has often resulted in conflicting conclusions. A systematic review published in *PLoS Medicine* by

Berendes et al in 2011 summarized findings from 80 studies to compare the quality of formal private and public ambulatory health care in LMICs (19). Though the evidence was limited, quality in both public and private providers was poor, with the private sector performing better in drug availability, responsiveness to patient's needs, and effort (defined as length of consultation, whether a physical examination is performed, and number of explanations given). Private sector clinical practice, defined as whether practice was conducted according to standards, was also marginally better than public sector care. The article also summarized findings factors thought to be related to low public-sector quality from eight qualitative studies, which included resource constraints, low salaries, high workload, poor conditions of service, patients not being able to return to the provider of their choice, lack of sufficient information shared with patients, among other factors. Conversely, another systematic review also published in *PLoS Medicine* by Basu et al in 2012 summarized findings from 102 studies in LMICs and found that private sector providers more frequently failed to provide appropriate medical care and had poorer patient outcomes (18). The review also found that private providers had greater reported timeliness and showed a higher level of hospitality to patients. Interestingly, the wide difference in conclusions between these two reviews prompted a response by Coarasa et al. in which the authors critique the methods used by both systematic reviews and indicate that only one of the included studies met the gold standard for methodological robustness (20).

In its summary of the evidence of quality of care among public and private facilities, the *Lancet Global Health* Commission on High-Quality Health Systems in the SDG Era provides examples of where private facilities outperform public ones (such as regarding adherence to WHO guidelines for care of sick children in the Democratic Republic of the Congo, Kenya, Rwanda, and Uganda), where private and public facilities perform similarly (regarding antenatal care quality across 46 countries), and where private facilities provided worse quality care (citing the systematic review by Basu et al.) (1). Indeed, one thing these reviews can agree on is that additional evidence is needed to evaluate differences in quality across the public and private sector in LMICs.

2.1.4 Measuring clinical quality of care: introduction to the standardized patients methodology

Numerous challenges existing in the measurement of healthcare quality. As detailed in Section 2.1.1, quality can be defined in myriad ways, and with each way of defining also comes an extensive list of metrics. Here I will focus my review on ways to measure clinical effectiveness or appropriateness of care, which aims to provides evidence-based services to those who need them. As described by Hanefeld et al. (2017), clinical quality of care "relates to the interaction between healthcare providers and patients and the ways in which inputs from the health system are transformed into health outcomes" (21) – in other words, the processes of care.

The principal challenge in measurement of effectiveness of care is that the processes of care are determined by provider behavior, which is difficult to measure. Methods designed to measure provider behavior include exit interviews (of patients, carers, and family, or of providers), direct observation of patient visits, medical chart review, prescription audits, and the use of standardized patients. The strengths and limitations of these methods have been discussed extensively, particularly in the context of quality measurement in the LMIC context where some of the classic forms of quality measurement, such as chart review or the use of electronic medical records, are not as readily available. Table 2.1-1 below outlines strengths and limitations of these methods, as published in Satyanarayana et al, 2015 (22).

Study methodology or design	Quality level: measurement of knowledge	Quality level: measurement of practice	Major limitation of study method
Standardised patient studies*	High	Very high	Gold standard method, but highly resource-intensive
Clinical observation studies of providers with case and patient-mix adjustments†	High	Medium	Hawthorne effect‡
Clinical observation studies of providers without case and patient-mix adjustments	Medium	Low	Hawthorne effect
Chart abstraction or prescription audits with case and patient-mix adjustments	Medium	Medium	May be very limited by incomplete, poor quality or absent documentation
Chart abstraction or prescription audits without case and patient-mix adjustments	Low	Low	May be very limited by incomplete, poor quality or absent documentation
Surveys of providers using vignettes or mock prescription writing to assess knowledge, attitudes and behaviours	Very high	Low	Hawthorne effect
Surveys providers using basic questions or self-report to assess knowledge, attitudes, and behaviours	Medium	Low	Hawthorne effect
Surveys of patients to assess provider practices	Uncertain due to lack of validation	Uncertain due to lack of validation	Recall limitations on the part of patients

* Also known as 'mystery clients', these are normal (non-diseased) individuals from the local community who are trained to visit health care providers, present with supposed TB symptoms and seek medical advice and care, without the providers being aware that they are actors.
† Different clinical presentations and characteristics (e.g., sputum-positive, sputum-negative, different age and sex groups, etc.).
‡ Also known as the 'observer effect', which refers to changes in people's behaviour when they know that they are being observed.
TB = tuberculosis.

Table 2.1-1 Quality level and limitations of various study methods that may be used to assess quality of care in developing country settings. Taken from Satyanarayana et al. (2015). (22)

A systematic review conducted in 2007 by Rethans et al. defined a standardized patient (SP) as "a healthy subject, or in some cases an actual patient, who has been trained to portray accurately and consistently a particular patient case, and who is also trained to assess the performance of students or doctors based on pre-defined criteria" (23). SPs have been used in medical education for decades to evaluate providers in training (23,24). Unannounced SPs, sometimes called mystery clients, simulated patients, surrogate patients, undercover care-seekers, or incognito SPs, are SPs who are used to assess the performance of providers in real-world practice (25). SPs have also been used to evaluate interventions aimed at improving provider behavior (26).

There are several advantages to using SPs for measuring provider behavior that set it apart from other methods, particularly in LMICs. First, the SP methodology is uniquely designed to avoid common biases found in other methods, like recall bias, social desirability bias, and the Hawthorne effect. Patient exit interviews are subject to recall bias, where patients may not remember the details of their interaction with providers after a period of time. In SP studies SPs are trained to remember details of their interaction with providers and are debriefed using a standardized questionnaire shortly after each visit, thus minimizing recall bias (27). Direct observations of providers can also be subject to social desirability bias, wherein providers answer questions with what they deem is expected of them, and under-report undesirable behavior (28). Since providers are unaware their patient is an SP, provider behavior can be observed without the Hawthorne effect, wherein providers change their behavior when they know they are being observed (29,30).

Second, SPs are trained to present the same case (which is fixed, by design) to each provider in a consistent manner, thus allowing for comparisons across providers and facilities. This approach controls for confounders related to differential patient and case-mix that would be found in medical record review or patient exit interviews, wherein certain providers might be visited by sicker patients compared to others, for example (27,31).

Third, in the SP methodology the underlying condition and appropriate management are known and precisely specified. This advantage is not found in patient exit interviews, medical record review, nor direct observation. Knowing the underlying diagnosis of a patient is important when attempting to assess effectiveness of care as the same provider behavior can be construed as a misdiagnosis, undertreatment, or overtreatment of a patient depending on their specific condition (25).

Fourth, the SP methodology in combination with vignettes can be used to assess the difference between provider behavior and provider knowledge. It is well-documented in the literature that a provider’s response to a vignette may differ significantly from their behavior towards that same case in real practice – a phenomenon known as the "know-do gap”. The know-do gap was reported in India and Tanzania and has since been replicated in multiple SP studies (32–34). One such study by Sylvia et al. in China showed that although 26% of providers said they would recommend a presumptive TB case to receive a sputum AFB test, only 4% of those same providers made that referral when they were visited by an SP presenting with textbook TB symptoms (35).

The SP methodology has been used in LMICs to measure clinical quality of care for a variety of different conditions, including unstable angina, asthma, childhood illnesses including dysentery, diarrhea, and pneumonia, family planning, HIV, and tuberculosis (25,29,35–43). SP studies have been conducted in public and private primary care clinics and hospitals, among private informal providers, and in pharmacies (44,45). SP studies are particularly used in tuberculosis research, where we will focus the remainder of this literature review.

2.2 Global epidemiology of tuberculosis

If the pandemic has taught us anything, it's that with solidarity, determination, innovation and the equitable use of tools, we can overcome severe health threats. Let's apply those lessons to tuberculosis. It is time to put a stop to this long-time killer. Working together, we can end TB.

Dr. Tedros Adhanom Ghebreyesus, Director-General, World Health Organization (46)

2.2.1 Introduction to tuberculosis

Tuberculosis (TB) is the second-leading cause of death globally from a single infectious agent, exceeded only in 2020 by COVID-19. In 2021, an estimated 1.6 million people died from TB (1.4 million deaths among HIV-negative people and 187,000 deaths among HIV-positive people) and 10.6 million people newly developed the disease (46). TB is spread through airborne transmission, when air droplets containing the *Mycobacterium tuberculosis* bacteria are expelled from the body through coughing, sneezing, or spitting. TB most often affects the lungs (pulmonary TB) but it can also manifest in other areas of the body (extra-pulmonary TB). The cardinal symptoms of TB in adults are chronic cough, blood in sputum, night sweats, weight loss, and fever (47). Infection from the bacterium *M. tuberculosis* can manifest in two ways: TB disease, formerly known as active TB, and TB infection, formerly known as latent TB. About 25% of the world's population has a TB infection, which occurs when people have been infected by TB bacteria but do not have symptoms and cannot spread the disease (47). Many people who are infected with TB will not develop TB disease, but certain risk factors can increase the likelihood a person will develop TB disease, such as smoking, undernutrition, HIV co-infection, diabetes, and alcohol consumption (48). TB disproportionately affects people living in resource-poor settings. Countries with lower gross domestic product (GDP) per capita and higher prevalence of undernutrition are associated with higher TB incidence rates (48). Thirty countries accounted for 84% of the world’s annual TB cases in 2019, with India, Indonesia, and China experiencing the highest number of cases per year globally (48). The majority (56.5%) of new cases in 2021 were among adult men (46).

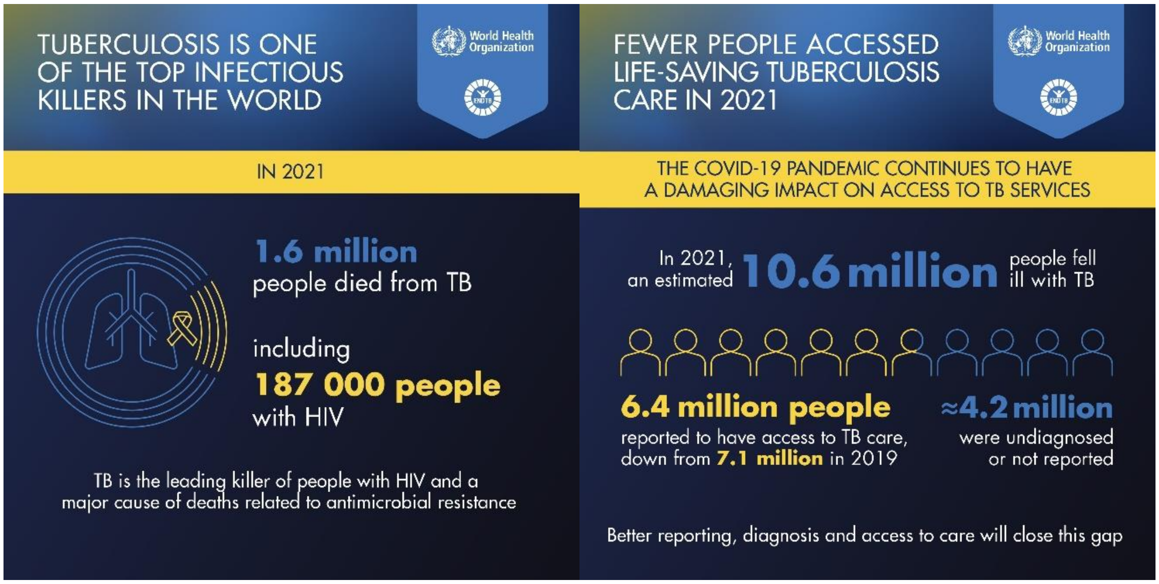


Figure 2.2-1 Snapshot of global tuberculosis burden. Infographics taken from the World Health Organization

TB is curable and preventable. Approximately 85% of people who develop TB disease can be successfully treated with a 6-month drug regimen, and people with TB infection can be treated using regimens of 1 to 6 months (48). Thus, it is imperative that every person with TB be tested for TB, diagnosed with TB, prescribed TB treatment, and complete their treatment regimen. In 2014, the 67th World Health Assembly codified WHO's global tuberculosis strategy for the post-SDG era, known as the END TB Strategy (49). The vision of this new strategy is to make the world free of tuberculosis, with zero deaths, disease, and suffering due to the disease. The End TB Strategy operationalizes this goal with ambitious targets of 95% reduction in tuberculosis deaths and 90% reduction in tuberculosis incidence globally by 2035.

TB can be detected microbiologically through sputum microscopy or WHO-endorsed rapid diagnostic tools such as GeneXpert MTB/Rif (Cepheid, Inc.) and TrueNAT MTB-RIF (Molbio Diagnostics), which have the added advantage of detecting resistance to rifampicin. The 2014 International Standards for Tuberculosis Care (ISTC) stipulates that proper management of people with presumptive TB. The international community largely favors microbiological methods of testing for TB above clinical diagnostic tools such as chest x-ray, which are ideal for screening but not diagnosis (50).

One of the major challenges in the fight to end TB is that up to 35% of people with tuberculosis disease are not being diagnosed or made known to national tuberculosis programmes (51). This amounts to approximately 3-4 million new cases each year that do not get diagnosed and reported, known as the “missing millions” (52–54). In 2021, 10 countries accounted for 75% of the global gap between estimated TB incidence and the number of notified TB cases, with India (24% of the global gap), Indonesia (13%), and the Philippines (10%) topping this list (46). Health system and health care-seeking interruptions stemming from the COVID-19 pandemic have worsened this gap: in 2020, 5.8 million of the approximate 10 million people who developed TB were diagnosed and reported compared to 7.1 million in 2019 (48). There was a slight recovery to 6.4 million diagnosed and reported out of 10.6 million estimated new cases (46). Ninety percent of the global reduction in the reported number of people newly diagnosed with TB between 2019 and 2021 was accounted for by five countries: India, China, Indonesia, Philippines, and Myanmar. Failure to diagnose and treat an individual with TB has been shown to result in worsened TB disease and increased risk of spreading TB (55,56). Moreover, several patient pathways studies have shown that once a provider correctly diagnoses and notifies a person with TB, they are more likely to achieve treatment success (53). For these reasons, ensuring that providers correctly diagnosis and notify patients with TB – providing high-quality care – is a major priority in the fight to end TB (51).

2.2.2 Quality of tuberculosis care

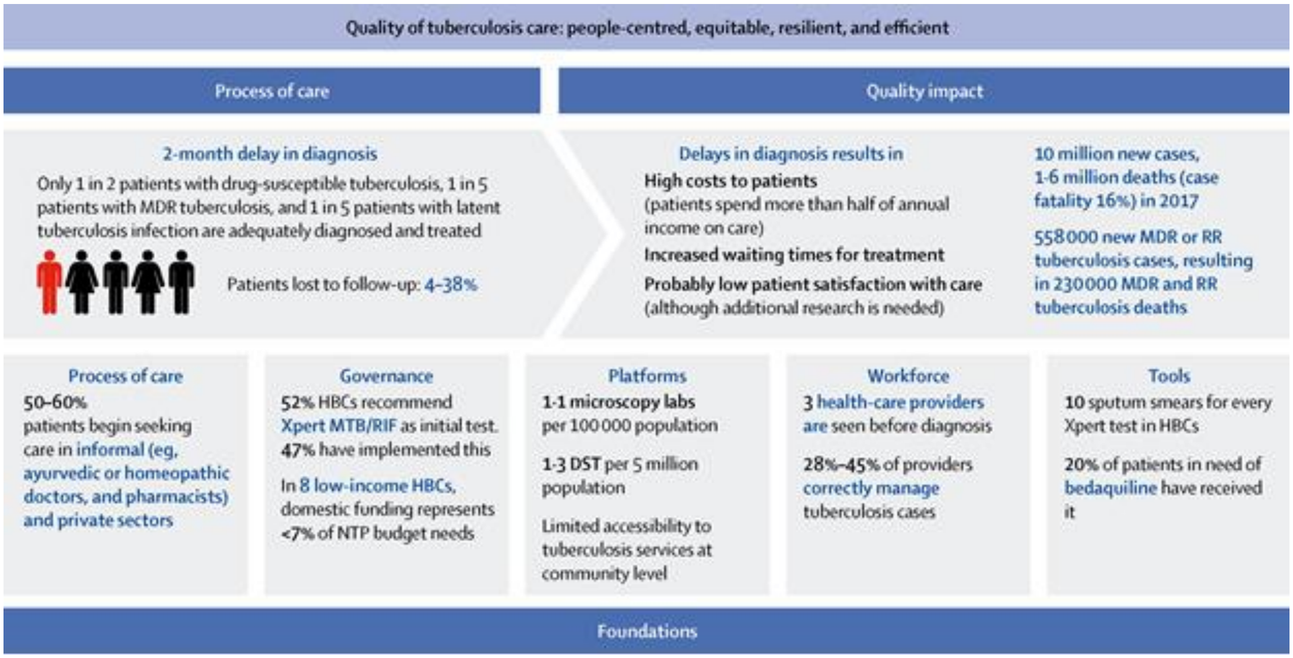


Figure 2.2-2 Dimensions of tuberculosis care quality and barriers that undermine optimal service quality. Based on the framework used by the Lancet Global Health Commission on High Quality Health Systems in the SDG Era. DST = drug-susceptibility testing, HBC = high-burden countries, MDR = multidrug-resistant, RR = rifampicin-resistant. Source: Reid et al. 2019 (51)

The first priority recommended by the Lancet Commission on Tuberculosis to achieve a tuberculosis-free world in a generation is to "invest first to ensure that *high quality* rapid diagnostics and treatment are provided to all individuals receiving care for tuberculosis, wherever they seek care" (51). At present, the quality of tuberculosis care in high-burden countries is exceedingly poor. For many years, the primary focus in tuberculosis mirrored that of global health: to expand access to care, namely directly observed treatment short-course (DOTS) without a focus on quality (51,57). The result of these policies is the presence of serious gaps in tuberculosis care quality. More than one-third of people with tuberculosis disease are not being diagnosed and treated, or made known to national tuberculosis programmes (51). Inappropriate prescribing practices are common in many settings, where people with TB symptoms are given steroids, broad-spectrum antibiotics, first- or second-line anti-tuberculosis treatment (ATT) without receiving a diagnostic test, which can mask the symptoms of TB and result in increased risk of drug-resistant TB (46,58,59). These issues sum into an alarming statistic: an estimated half of TB deaths are attributable to poor-quality care (1).

An analysis of the 2016 Global TB Database found that the biggest gap in the TB care cascade – a visualization of the totality of treated and untreated people with TB in a given area – for 25 of the 30 high-TB burden countries was the gap between total number of people with TB (incidence) and the number of people diagnosed (Figure 2.2-3) (60). A factor contributing to the gap in TB diagnoses is a deficit in provider knowledge and behavior regarding the management of people presenting with TB symptoms. A 2015 systematic review by Satyanarayana et al. of studies assessing TB care quality in India identified 47 studies on providers' self-reported knowledge and practice regarding TB (22,61). Of the 22 studies that assessed providers' knowledge about TB diagnosis, 10 studies found that less than half of providers knew how to use sputum microscopy correctly for diagnosing people with TB symptoms. Three out of four studies that assessed providers' self-reported practices found that less than a quarter of providers reported ordering sputum smears for people with typical TB symptoms. Half of the six studies that assessed the ISTC standard 1, awareness or suspicion of TB in people with cough longer than 2-3 weeks, found that less than half of sampled providers knew that TB should be suspected in people who have a cough longer than 2-3 weeks. A 2022 systematic review conducted by Divala et al. examined the TB care cascade among studies conducted in the 30 high TB-burden countries (62). This review found that the proportion of patients with TB symptoms who were offered a diagnostic test was highly variable, ranging from 4 to 84%, with a median of 38%. This review suggests that a failure to identify TB symptoms and test those who present with TB symptoms may be a key driver of missed diagnosis in high-burden settings.

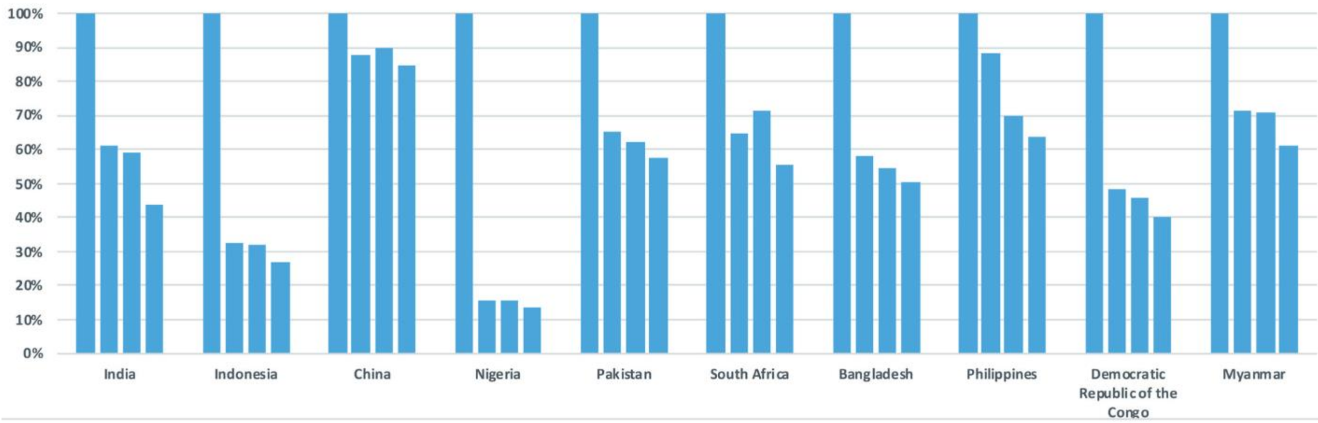


Figure 2.2-3 TB care cascade for 10 of the 30 high-TB burden countries. Data from 2015. Steps correspond to, in order, Incidence, Diagnosed, Treatment Started, and Treatment Completed. Source: Kim et al. 2019 (60)

Research using SPs and vignettes have documented a substantial know-do gap among tuberculosis care providers. Das and colleagues (2015) compared provider performance using vignettes (which measures provider knowledge) versus provider performance using SPs (which measures actual practice) and found that while 72.5% of providers in India said they would conduct a chest x-ray or a sputum test in response to the vignette, only 10.1% of those same providers recommended a chest x-ray or sputum test when presented with an SP displaying the same symptoms as the vignette (38). Using the same method, Sylvia et al. found that although 26% of providers in China said they would recommend a presumptive TB case to receive a sputum AFB test, only 4% of those same providers made that referral when they were visited by an SP presenting with textbook TB symptoms (35). In a South African study of private providers TB and HIV management practices, Boffa et al. (2021) observed 80% reported ideal management for TB through vignettes compared to 43% ideal management for TB in practice using SPs (41).

Inappropriate prescribing practices are commonly conducted in the provision of tuberculosis care. In 2019, Daniels et al. summarized findings from SP studies of TB care involving 3,086 interactions undertaken in India, China, South Africa, and Kenya (29).

Relatively few SPs were offered appropriate diagnostic tests and 83% of interactions resulted in prescription of medication, frequently inappropriate broad-spectrum antibiotics, fluoroquinolones, and steroids. A study using SPs among private providers in South Africa found that one or more medicines were dispensed or prescribed in 88.5% of visits, with the most common medicine being antibiotics (76.5% of all visits) (63).

The issues described above are notably worse in the private health sector. The Satyanarayana et al. 2015 systematic review on TB care quality in India included eight studies that provided direct comparisons of TB care quality provided by public vs. private sector providers (22). Five of these eight studies included data on ISTC-2, awareness/use of sputum smear for persons with presumptive pulmonary TB. All five studies reported that public sector providers were more likely to know that sputum smear examination is the primary test for TB compared to private sector providers. Among the six studies that reported on the proportion of providers who received formal training on TB care guidelines from the national TB program in India, a higher proportion of public providers (73-92%) reported attending a training on TB care compared to private providers (17-58%). Additionally, one study that compared knowledge among private vs. public providers reported that 89% of government providers know that a cough longer than 2-3 weeks warrants a sputum examination compared to 48% of private providers. Previous SP studies of private provider management in four high TB-burden countries have found that between 21 and 43% of SPs presenting with TB symptoms were offered appropriate diagnostic tests, and many were offered broad-spectrum antibiotics and steroids, which can mask TB symptoms and increase the risk of antibiotic resistance (29,37,38,40,41,64). Modeling studies also suggest that untreated or poorly treated patients in the private sector are a major source of tuberculosis transmission, as the result of delays diagnosis and treatment initiation as well as recurrent TB among patients who were inadequately treated in the private sector (65).

Another major challenge is the low rate of notifications of TB diagnoses to national TB programmes (NTPs) in countries with a dominant private health sector. While TB diagnoses made through the public sector generally are notified through routine reporting systems, private sector providers often fail to notify new TB diagnoses, even in countries where notification of TB is mandatory (66). Stallworthy et al. (2020) collated data from high-TB burden country NTPs and showed that in two of the top three countries with high TB incidence, India and Indonesia, 25% of all notified TB diagnoses in India and 18% in Indonesia were notified by the private sector (67). As private sector facilities do not publish data on the number of TB cases they diagnose in any other outlets, it is difficult to estimate how many diagnoses are being made by private practitioners that are not being notified to the NTP.

One reason for low diagnostic and notification numbers among private providers is the lack of suitable diagnostic capacity in private facilities in most high-TB burden settings. A summary of patient-pathway studies in high-TB burden countries found that only 13% of private primary health centers and clinics have the capacity for microscopy (53). Approximately two-thirds of patients in these studies sought initial care in private facilities, meaning that they had to be seen by several providers before receiving diagnosis and treatment in the public sector, or they were diagnosed and treated in the private sector and never reported to the national TB programme.

Qualitative studies of private providers have attempted to explain the reasons for these gaps in performance. Findings from three qualitative case studies focusing on the diagnosis of TB in India found evidence of the know-do gap, where patients were given medicine to try, with diagnostic tests only ordered if there was no improvement in the patient's health, even when providers knew best practices. Overburdened laboratories resulted in diagnostic delays, so providers instead would treat empirically rather than wait for test results. Patients also expected to receive a tangible product, like medication, when visiting a private pharmacy – this element was capitalized upon in an intervention which allowed pharmacists to "sell" a referral for a TB test, thus fulfilling that expectation (68). Another study conducted in Yogyakarta, Indonesia explored private providers' attitudes concerning mandatory notification, which was implemented in Indonesia in 2016. This study concluded that private practitioners do not notify tuberculosis cases due to a combination of a lack of knowledge about the mandatory notification policy, a perception of mandatory notification and its penalties as being "burdensome", and ethical concerns among the private practitioners about patient's privacy and potentially losing their clientele to other facilities. While some interventions aimed at increasing diagnoses and notifications from the private sector have had moderate success (69–72), more research and larger-scale interventions are required to bridge this gap.

Public-private mix (PPM) has been a strategy emphasized by WHO to address the gap in diagnoses, notifications, and proper treatment of people with TB in the private sector (71–76). In their 2019 report, the Lancet Commission on Tuberculosis specifies that "achieving universal, high-quality person-centred and family-centred care -- including sustained improvement in the performance of private sector providers -- usually should be the top policy and budget priority" (51). This statement rings particularly true in Indonesia – one of the 30 high-TB burden countries with the second highest number of estimated missing cases and a sizeable private sector.

2.3 Epidemiology of tuberculosis in Indonesia

2.3.1 The Indonesian health care system

Indonesia is the fourth largest county in the world by population, with 276 million population as of 2021 (77). It is situated on the largest archipelago in the world with an estimated 17,504 islands. 80% of the population lives on the islands of Java and Sumatra (78). The country's dispersed population has necessitated a transition to a decentralized political and governmental structure, including how its public health sector is organized. Indonesia is a middle-income country with a gross domestic product (GDP) per capita of approximately $4,300 (79). Like many other middle-income countries, Indonesia is experiencing the demographic transition, where the disease burden is made up of both infectious diseases and non-communicable diseases (NCDs) (Table 2.3-1) (78).

	1990	1995	2000	2005	2010
Communicable diseases	29.1	23.6	20.7	19.4	16.4
Tuberculosis	11.3	10.3	10.4	11.0	9.5
Lower respiratory infections	12.0	9.4	6.1	4.6	4.1
Diarrhoea	5.8	3.9	4.2	3.8	2.8
Noncommunicable diseases	35.9	42.4	47.8	51.8	55.6
Cancer	7.5	9.1	9.9	10.4	11.3
Liver cancer	0.6	0.7	0.8	0.8	0.9
Colon cancer	0.5	0.6	0.7	0.8	0.9
Cancer of the trachea, bronchus and lung	1.2	1.6	1.8	1.9	2.1
Breast cancer	0.6	0.7	0.8	0.9	1.0
Cervical cancer	0.6	0.7	0.7	0.7	0.7
Diabetes	3.7	4.6	5.2	5.7	6.0
Ischaemic heart diseases	4.9	5.9	6.6	7.3	8.1
Stroke	12.4	14.0	16.5	18.4	19.5
Chronic respiratory diseases	3.9	4.5	4.8	4.9	5.1
External cause	3.3	4.3	4.5	4.0	4.2
Road injury	3.3	4.3	4.5	4.0	4.2

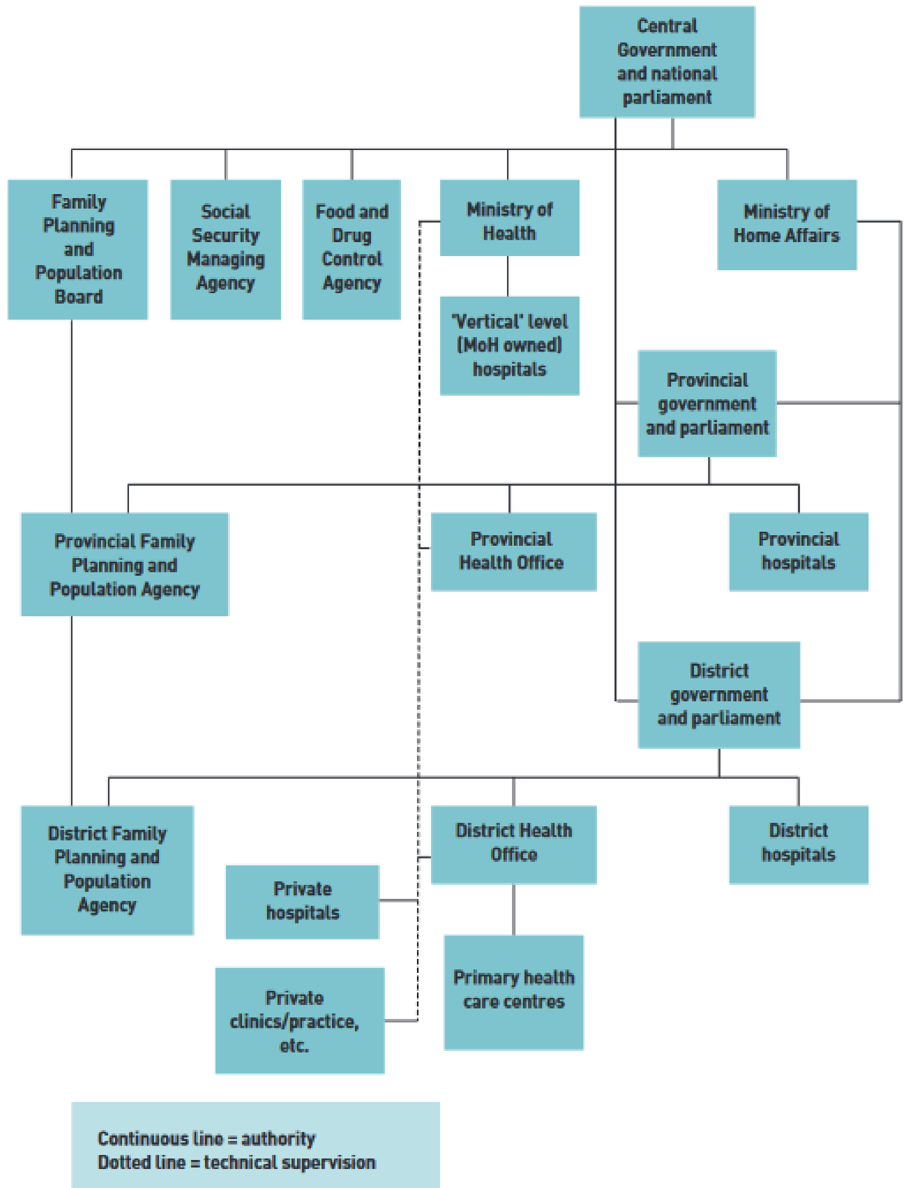
Source: http://vizhub.healthdata.org/gbd-compare/ (Institute for Health Metrics and Evaluation, 2013).

Table 2.3-1 Main causes of death in Indonesia, 2013. Source: Mahendradhata et al. 2017 (78)

The Indonesian health care system is a mixed system with both public and private providers and financing. As a decentralized system, responsibilities are shared across central

(Ministry of Health (MOH), or *Kementerian Kesehatan Republik Indonesia*), provincial, and district-level responsibilities (Figure 2.3-1) (78). District and municipal governments are responsible for administration of public community health centers called *Puskesmas* (*Pusat Kesehatan Masyarakat*). Puskesmas act as the gatekeeper for individuals participating in the Indonesian national health insurance scheme, *Jaminan Kesehatan Nasional* (JKN); JKN participants cannot go to higher-level providers without a referral from a Puskesmas. Puskesmas are also primarily responsible for community-level management of public health programmes, including those to combat communicable diseases (HIV, TB, malaria, dengue, others), health promotion, maternal and child health, family planning, community nutrition, environmental health including water and sanitation, and ambulatory care (78).

In addition to the public system, there are a range of private providers, including not-for-profit hospital and clinic networks, for-profit providers, and individual private doctors and midwives who engage in dual practice (i.e., work in a public facility as well as their own private clinic). In 2018, approximately two-thirds of the 27,694 primary health facilities were private clinics (80).



Source: Government organization, decentralization and health system (Government of Indonesia, 2007; House of Representatives, 2004g; House of Representatives, 2008; House of Representatives, 2014b; President of Indonesia, 2011a; President of Indonesia, 2011b).

Figure 2.3-1 Organization of the Indonesia health system, 2014. Source: Mahendradhata et al. 2017 (78)

Increasing health expenditures in the country are a pervasive challenge, as health spending increased between 2009 and 2017 by 222% overall (78). Health spending as a proportion of GDP is below average among other low- and middle-income countries (2.9% of GDP in 2019) (81). Sixty percent of health spending is private, primarily out-of-pocket spending.

In 2014, Indonesia introduced the national health insurance scheme JKN, which is run by a single implementing agency, BPJS Kesehatan (*Badan Penyelenggara Jaminan Sosial Kesehatan*) (78). As of 2021, approximately 85% of the Indonesian population is insured under JKN (82).

2.3.2 Tuberculosis in Indonesia

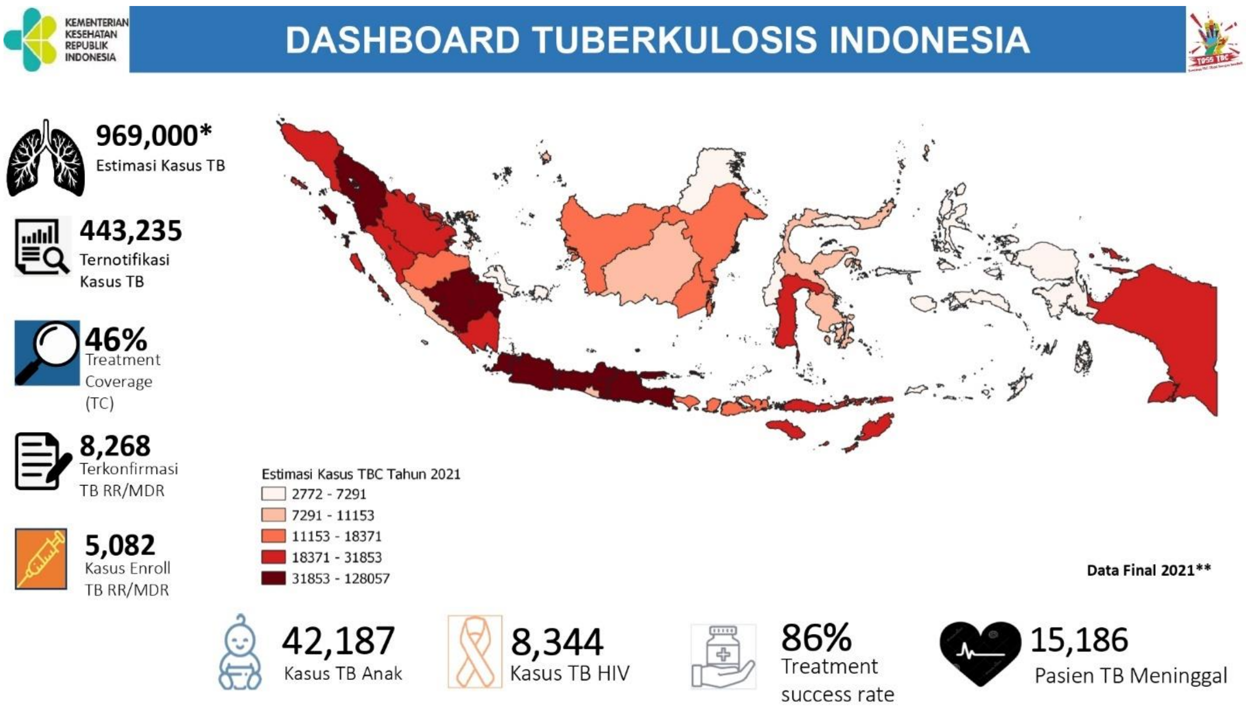


Figure 2.3-2 Indonesia tuberculosis dashboard for 2021, last updated 2 June 2022 (83)

In 2021, the WHO in collaboration with the Indonesian government estimated 969,000 new cases of TB occurred, giving forth an incidence rate of 354 per 100,000 population. A total of 150,500 people died from TB in 2021 (144,000 deaths among HIV-negative people, 6,500 deaths among HIV-positive people) (46). 443,235 cases were notified in 2021, resulting in 525,765 missing people with TB who were either not diagnosed or not notified to the Indonesian NTP, or 54% of the total TB burden for that year. Figure 2.3-2 above shows a summary of TB statistics for 2021 (83). According to the most recent TB prevalence survey conducted in

Indonesia in 2013-2014 and the TB Inventory Study conducted in 2017, Indonesia had an estimated TB incidence of 316 per 100,000 population in 2018, with an estimated under-reporting of detected cases of 41% (84). TB case notification increased substantially due to efforts to close the under-reporting gap over the last decade (Figure 2.3-3). TB prevalence is higher among males compared to females, highest among older age groups (55 years and above) (84,85). Major risk factors in Indonesia include diabetes mellitus, smoking, and bad housing conditions.

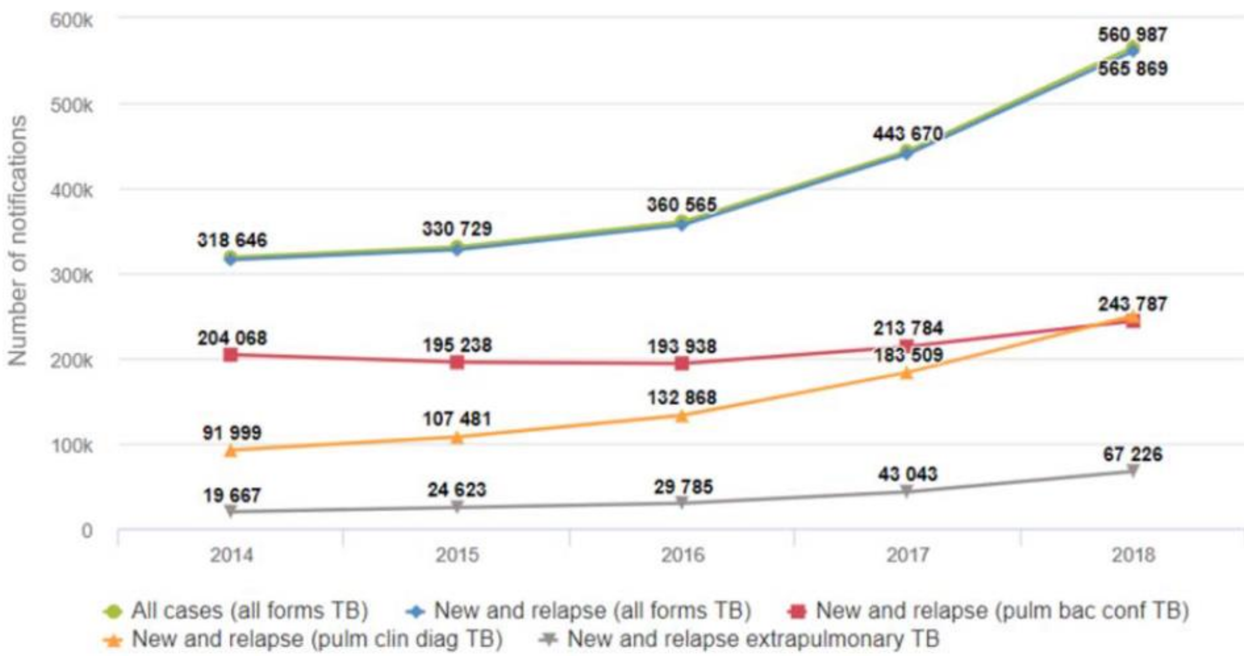


Figure 2.3-3 TB case notifications in Indonesia, 2014-2018, by type of TB. Source: The Republic of Indonesia Joint External Monitoring Mission for Tuberculosis. (84)
Pulm bac conf TB = bacteriologically confirmed pulmonary TB, pulm clin diag TB = clinically diagnosed pulmonary TB.

In 1972, hospital-based TB treatment was replaced with outpatient treatment, mostly taking place at Puskesmas. Every Puskesmas and hospital is required to have at least one doctor and one staff member who is in charge of the TB programme, as well as one trained member of the laboratory staff (78). People with TB can receive free TB services at Puskesmas (85). Despite this, as has been shown through patient pathways surveys in Indonesia, majority of people with TB symptoms prefer to access the private sector for their symptoms, especially in their first visits (53,86,87).

The 2016 Indonesian NTP algorithm for tuberculosis and rifampicin-resistant tuberculosis stipulates that correct management of presumptive tuberculosis for new patients with no history of prior TB treatment, no history of close contact with rifampicin-resistant TB patients, and unknown HIV status or HIV-negative patients is clinical assessment and bacteriological examination by sputum smear or rapid molecular test (Xpert MTB/Rif (GeneXpert), Cepheid, Sunnyvale, CA) (88). These guidelines were updated in 2021 to stipulate that all those with presumptive tuberculosis should be tested with Xpert MTB/Rif (89).

Indonesia doubled the amount of domestic funds allocated to TB from US$53 million in 2017 to US$ 109 million in 2019 (84). In addition to their numerous other public health responsibilities, Puskesmas are responsible for engaging their local private providers in TB care, through such activities as encouraging private providers to notify diagnosed TB cases or notifying private provider cases as if they had presented at the Puskesmas (personal communication).

2.3.3 Quality of tuberculosis care in Indonesia’s private sector

Indonesia is one of seven of the highest TB-burden countries with a dominant private sector that are priority countries for PPM. A patient pathway analysis conducted by Surya et al. estimated that 74% of early care-seeking among people with TB symptoms is done in the private sector. At the same time, only 13% of notifications of newly diagnosed people with TB occur in the private sector (Table 2.3-2) (51). As indicated in Section 2.2.2, this gap between care seeking and notifications in the private sector indicates that three things could be happening: 1) people with TB visit the private sector first and are ultimately referred to the public sector to be tested and diagnosed with TB, 2) people with TB visit the private sector first and are not diagnosed (lost to follow-up), or 3) people with TB are being diagnosed in the private sector but not notified.

	Tuberculosis incidence (thousands [rank]) in 2017	Missing cases (thousands [rank]) in 2017*	Multidrug-resistant tuberculosis cases (thousands [rank]) in 2017	Private share of early care-seeking	Tuberculosis notifications by private for-profit providers, 2017			Private share of tuberculosis treatment	
					n	% of total notifications	% of estimated incidence	Population survey	Drug sales
India	2740 (1)	953 (1)	135 (1)	80%	383784	20%	14%	46%	54%
Indonesia	842 (3)	400 (2)	23 (7)	74%	59549	13%	7%	46%	51%
Nigeria	418 (6)	316 (3)	24 (6)	67%	3975	5%	1%	22%	NA
Philippines	581 (4)	264 (4)	27 (4)	70%	52375	16%	9%	21%	43%
Pakistan	525 (5)	166 (5)	27 (4)	85%	79332	22%	15%	NA	45%
Bangladesh	364 (7)	121 (6)	8 (11)	82%	67332	28%	18%	30%	NA
Myanmar	191 (10)	61 (13)	14 (8)	78%	18149	14%	10%	..	..
Total	5661	2021	244	75%	665489	20%	12%	..	..
% of global total	57%	56%	41%	..	..	..	..	..	..

*Table 2.3-2 Misalignment of tuberculosis notifications with care-seeking and treatment in seven high-burden countries with dominant private sectors. NA = not applicable. *Not diagnosed or reported to the national tuberculosis programme. Source: Reid et al. 2019 (51)*

Several researchers have attempted to explore this issue through cross-sectional provider surveys. A survey of 164 private providers was conducted in Yogyakarta in 2004. 63% reported having seen TB suspects in their private practices (90). Among those that had seen TB suspects and provided information on their diagnostic practice, 42% used methods in line with NTP guidelines, while the remainder reported practices not in line with these guidelines. No significant differences were found between specialists and general practitioners (GPs). The first sentence of this article's discussion section concluded that TB suspects in Yogyakarta do not seek care at private clinics. This conclusion ignores the possibility that the surveyed providers are not properly identifying their clients as having TB symptoms, nor diagnosing them properly. A follow-up to this study was performed in 2011 among private GPs across eight cities in

Indonesia. In five of the cities, less than half of GPs were away of the ISTC guidelines (range: 24.6% – 74.3%) (91). Four to 42% of GPs had not received training on these guidelines. 47 to 89% of GPs had seen presumptive TB in their patients. 62 to 85% of GPs used smear microscopy in diagnosing TB. This study concluded that although private GPs in Indonesia do see presumptive TB, engagement of these private providers would not necessarily increase case notification. However, the authors here discount the possibility that providers' reported behavior could be different from their behavior in practice.

We can establish a more precise estimate of private provider behavior using the standardized patients methodology. The first SP study on tuberculosis in Indonesia was conducted in Bandung City in West Java in 2018-2019 as part of the "Investigation of services delivered for TB by external care system - especially the private sector" (INSTEP) project (92,93). This study, which will be published in 2023, found that 30% of private GPs and 20% of private specialists managed SPs presenting with presumptive TB symptoms according to Indonesian national guidelines, compared to 87% of public GPs (92). For SPs presenting with textbook TB symptoms (cough for 2-3 weeks), private GPs preferred diagnosis with chest x-ray (52%) over sputum microscopy (31%). The same pattern was shown for private specialists (87% chest x-ray, 20% sputum microscopy). These findings contradict those from the survey of provider behavior conducted in 2017, which indicated that 74% of surveyed providers in Bandung use sputum microscopy to diagnose TB (91).

The lack of appropriate management for TB in the private sector in Indonesia is particularly concerning given the strong preference for people with TB to seek care in the private sector. A patient pathway analysis conducted by Surya et al. in 2017 found that nearly three-quarters of patients sought care for TB symptoms in the private sector (86). This study found that more than half of patients seeking care in the private sector visited facilities like drug shops and pharmacies, where diagnostic confirmation would not be expected to be available. Findings from this study suggest that patients sought treatment with providers who corresponded more closely with their care preferences, as some patients who initially sought care in the private sector but were diagnosed in the public sector ultimately returned to the private sector for treatment (86). In another patient pathway study in Bandung, West Java, 75% of people with TB first sought care at an informal or private provider and experience a complex pathway of public and private providers to obtain a diagnosis. Participants attended a median six of visits before receiving a diagnosis (IQR 4-8). Longer delays were among those who initially visited private providers. The authors hypothesized that patients may prefer to visit private providers for reasons of convenience or because their symptoms are non-specific in the beginning of their illness. An additional study of out-of-pocket costs for people diagnosed with TB in Bandung found that people who presented first to a private provider experienced higher pre-treatment costs (median $40.71) compared to those who presented first at a Puskesmas (median $13.52) (94).

Strategies for increasing engagement of private providers in TB care have been implemented in Indonesia over the past two decades. The Hospital-DOTS Linkage project began in 2000 as a partnership between the Indonesian MOH and the Indonesian Hospital Association to expand DOTS into public and private hospitals. A number of articles were published on the pilot project of this effort in Yogyakarta (90,95–101). In part as the result of this project, notification of TB suspects by hospitals and chest clinics in Yogyakarta grew from 298 in 2000 to 7141 in 2004 (96). Maintaining quality of care through this expansion of DOTS was a challenge, as the research team later noted in a 2008 case study that indicated some evidence that quality of DOTS was higher in Yogyakarta compared to Central Java, where the project had been expanded to after the initial pilot (95). A survey conducted among a small sample of private and public hospitals in Java in 2006-2007 found that although all surveyed private hospitals had access to the NTP guidelines and manual, 55% had a standard operational procedure in place for adult TB patients and 45% had a memorandum of understanding with the NTP to provide DOTS (101). A retrospective cohort study was later conducted in Central Java among all health facilities to evaluate how the case detection rate for tuberculosis changed from 2000 to 2014. The case detection rate for tuberculosis increased during the initial phase of the Hospital DOTS Linkage project (2000-2005) and increased overall from 13% in 2000 to almost 60% in 2014, but remains below the national target of 70% (102). Other PPM projects in Indonesia include a private provider engagement program in Papua province (103), a PPM initiative in Surabaya, East Java (104,105), and a public-private partnership in Bandung, West Java (106,107). A recent study of willingness to engage in a district-based PPM strategy among private practitioners in Purwarkarta, West Java identified that while private hospitals contribute as much as three times as many TB case detections compared to public hospitals, almost no cases were detected by private primary health clinics (108).

Although Indonesia experienced an increase in TB case notifications leading up to 2020, the COVID-19 pandemic had a severe impact on health services for people with TB. We turn our attention to this pandemic for the remainder of the literature review.

2.4 Impact of COVID-19 on tuberculosis services in Indonesia

The COVID-19 pandemic introduces additional urgency surrounding efforts to understand existing and widening gaps in the quality of TB screening and diagnosis. Globally, COVID-19 related disruptions have resulted in 2 million more people left undiagnosed with TB over the past two years compared to 2019 (46). These figures suggest that the number of people with undiagnosed and untreated TB has increased, resulting in more TB deaths and infections.

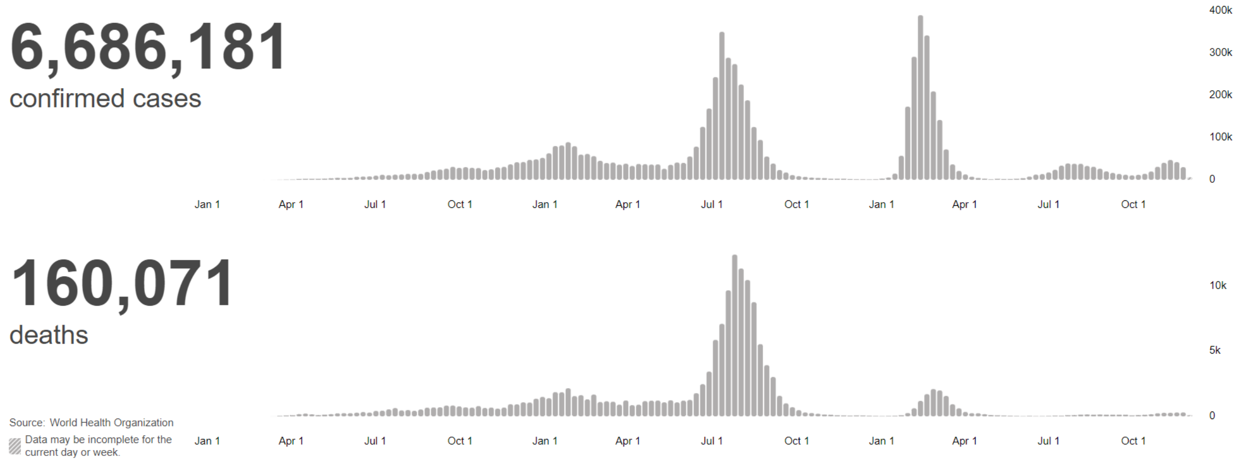


Figure 2.4-1 Weekly COVID-19 confirmed cases and deaths in Indonesia. Accessed 6 December 2022. Source: World Health Organization (109)

The first case of COVID-19 in Indonesia was announced on March 2, 2020 (110,111). As of December 6, 2022, there have been 6,686,181 confirmed cases of COVID-19 and 160,071 deaths (Figure 2.4-1). On March 13, 2020, President Joko Widodo established a COVID-19 Task Force, which provides live updates to the public on an official government website. Beginning on March 31, 2020, large scale social restrictions were placed in effect that included closure of schools and workplaces, restriction of religious activities, restriction of activities in public spaces and facilities, restriction of social and cultural events, and restriction of transportation (110). These restrictions were superseded by a new set of restrictions called *Pemberlakuan Pembatasan Kegiatan Masyarakat*, or PPKM. Detailed information on restrictions at each of the four levels of PPKM can be found in Table 2.4-1. Indonesia experienced a severe second wave beginning in July 2021 due to the Delta variant of the SARS-CoV2 virus, with over 44,000 new cases confirmed each day during the height of that wave (110).

PPKM level	**Criteria needed for a region to be at**	**Applicable restrictions**

	this level	
Level 4	• Confirmed COVID-19 cases >100 per 100,000 population per week • Hospitalized COVID-19 cases >30 per 100,000 population per week • COVID-19 death rate >5 per 100,000 population per week	• Supermarkets open at 50% capacity • Non-essential sector working entirely from home • Shopping centers and malls closed • Restaurants open for take-away only • Places of worship closed • Educational institutions to implement online learning
Level 3	• Confirmed COVID-19 cases between 65 and 100 cases per 100,000 population • Hospitalized COVID-19 cases between 10 and 30 per 100,000 population per week • COVID-19 death rate 2-5 per 100,000 population per week	• Supermarkets open at 50% capacity • Non-essential sector working 75% from office with COVID-19 protocol • Shopping centers and malls open at 25% capacity • Restaurants open for dining with 25% capacity • Places of worship closed • Educational institutions to implement online learning
Level 2	• Confirmed COVID-19 cases between 40 and 64 per 100,000 population per week • Hospitalized COVID-19 cases between 5 and 9 per 100,000 population per week • COVID-19 death rate 1-1.9 per 100,000 population per week	• Supermarkets open at 75% capacity • Non-essential sector working 50% from office (upon vaccination) • Shopping centers and malls open at 50% capacity • Restaurants open for dining with 50% capacity • Places of worship open with 50% capacity and strict procedures • Educational institutions to implement blended learning (50% online, 50% offline)
Level 1	• Confirmed COVID-19 cases <20 per 100,000 population per week • Hospitalized COVID-19 cases <5 per 100,000 population per week • COVID-19 death rate <1 per 100,000 population per week	• Supermarkets open at 100% capacity • Non-essential sector working 100% from office (upon vaccination) • Shopping centers and malls open with 100% capacity • Restaurants open for dining with 75% capacity • Places of worship open with 100% capacity and strict procedures • Educational institutions to

		implement 100% face-to-face learning with strict procedures

Table 2.4-1 PPKM levels, criteria, and applicable restrictions on July 21, 2021. Adapted from Mahendradhata et al. 2021 and BeritaSatu.com. (110,112)

In 2020, all patients with COVID-19 symptoms were only allowed to be referred to a COVID-19 referral hospital. As case numbers increased due to higher local transmission, private clinics began to receive support from the local government for procurement of PPE and medical supplies, and to fund patient transfer to a COVID-19 referral hospital, but this policy varied by region (110). Private hospitals also increased their inpatient bed capacity in line with MOH requests. By the end of 2020, Indonesia had 570 laboratories to process COVID-19 tests, 23% of which had GeneXpert machines. Some of these machines were previously used for TB and had to be redirected to COVID-19 testing.

The COVID-19 pandemic had a strong impact on TB services in Indonesia. The country experienced a 14% reduction in case notifications between 2019 and 2020, the second highest of all high TB burden countries, and is one of the four countries that accounted for most of the estimated increase in TB deaths globally in 2021 (46,48). On the supply side, availability of health services for people with TB symptoms was drastically reduced in Indonesia, especially during the Delta wave (113–116). Case-finding activities for TB were disrupted by government stay at home directives (110), resources were diverted from TB budgets to support COVID-19 activities (115), and facility closures were common due to healthcare workers contracting COVID-19 and encouragement from the Indonesian Medical Association for doctors over age 65 to reduce work or stop working to reduce morbidity among the healthcare workforce (117–119). On the demand side, stay-at-home directives and fears of contracting COVID-19 at healthcare facilities also reduced TB care seeking (110,115).

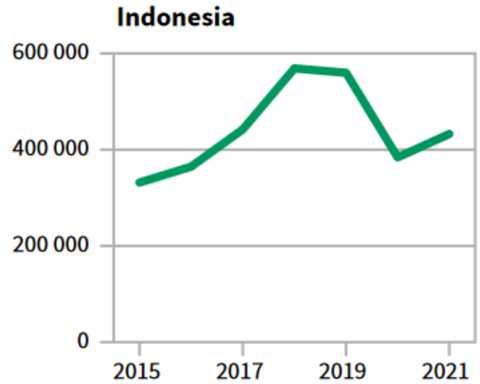


Figure 2.4-2 Case notifications of people newly diagnosed with TB in Indonesia, 2015-2021. Data shows that Indonesia experienced a negative impact in 2020 and a partial recovery in 2021. Source: Global tuberculosis report 2022 (46)

The government of Indonesia has mandated the use of personal protective equipment (PPE) in all public indoor locations including health facilities since COVID-19 was declared a national emergency (120,121). Self-reported mask usage in public places in Indonesia remained above 80% until the end of the Delta wave (122). Available information indicates that compliance with PPE directives was also high among private providers and pharmacists (123–125). In mid-2020, President Widodo encouraged facilities to implement bi-directional screening for TB and COVID-19, though it is unclear how that directive has been implemented in the private sector thus far (126). Each of these changes has the potential to affect the availability and quality of TB services in Indonesia, especially in private sector facilities as they have been traditionally less engaged with the Indonesian NTP (102,127).

2.4.1 Impact of COVID-19 on the private sector in Indonesia

Data are limited on the impact of COVID-19 on private sector providers in Indonesia, especially concerning TB service provision. A survey of intermediary NGOs in Indonesia and six other high-TB burden countries was conducted between March and December 2020. Representatives from an international NGO operating in Indonesia reported that private providers charged more for patient visits to cover expenses for PPE and other protective measures (128). The article also reported that people were fearful of going to hospitals out of fear of acquiring COVID-19.

A cross-sectional survey of providers who work at private health facilities in West Java province gathered data on adaptations made during the COVID-19 pandemic from March to September 2022, particularly related to TB service delivery. 71% of facilities represented in the survey required use of PPE as regulated by the government and 67% of facilities offered COVID-19 rapid antigen tests. Only 21% of HCFs survey ever closed temporarily during the pandemic, though 31% of facilities had to discontinue some services in their practice. Additionally, almost all healthcare workers surveyed (96%) were aware of mandatory reporting for TB cases, but 25% reported feeling uncomfortable mainly (44%) because of paperwork burden.

65% of surveyed private clinics and 63% of surveyed private hospitals offered COVID-19 testing or treatment. 30% of solo providers, 39% of private clinics, and 38% of private hospitals experienced a short-term disruption (less than 3 months) in medical supplies. Approximately 24% of general practitioners and 28% of specialists reported that they test for both COVID-19 and TB in all patients with appropriate symptoms.

What is still unknown is the extent that COVID-19 affected the quality of TB care among private providers in Indonesia. Of particular concern is the overlap in TB and COVID symptoms, which experts feared may further decrease the likelihood that people with TB would be properly diagnosed.

The following manuscript attempts to answer three research questions:

1. Are private providers in Bandung, the fourth most populous city in Indonesia, correctly managing people presenting with TB symptoms?
2. Which types of private providers are more likely to correctly manage people with TB symptoms?
3. What is the extent of changes in clinical practices in TB care during the COVID-19 pandemic?

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3 Manuscript

Impact of the COVID-19 Pandemic on Quality of Tuberculosis Care in Private Facilities in Bandung, Indonesia: a comparison of cross-sectional, standardized patients studies

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3.1 Abstract

Background: Indonesia has the second highest incidence of tuberculosis (TB) in the world. 74% of people with TB in Indonesia first accessed the private health sector when seeking care for their TB symptoms, although the private sector provided only 18% of TB notifications. Little is known about private sector care for TB in Indonesia after the emergence of COVID-19, which severely disrupted health services for TB worldwide. There is therefore an urgent need to understand existing and widening gaps in the quality of TB care. Using unannounced standardized patients (SPs) visits to private providers, we aimed to measure quality of TB care during the COVID-19 pandemic.

Methods: A cross-sectional study was conducted using SPs in Bandung City, West Java, Indonesia with 292 private sector providers. Ten SPs completed 292 visits between 9 July 2021 and 21 January 2022. All SPs were trained to present a presumptive TB case (cough for 2–3 weeks). Results were compared to SP surveys conducted in the same geographical area during 2018–19, before the onset of COVID-19.

Results: Overall, 35% (95% confidence interval (CI): 29.2–40.4%) of visits were managed correctly according to the 2016 Indonesian national TB guidelines. More than two-thirds of SPs were prescribed unnecessary antibiotics (68%, 95% CI: 62.1–73.1%) and 27% were prescribed steroids (95% CI: 21.8–32.2%). Correct TB management was associated with more history questions asked (aOR: 1.07, 95% CI: 1.02–1.13, $p=0.004$) and more cardinal TB symptoms inquired (aOR: 2.78, 95% CI: 1.82–4.23, $p<0.001$). Comparing SP visits conducted before and during the COVID-19 pandemic uncovered no major differences in the clinical management of presumptive TB patients apart from an increase in likelihood of providers conducting temperature checks (aOR: 8.05, 95% CI: 2.96–21.9, $p<0.001$) and a decrease in likelihood of providers conducting throat examinations (aOR 0.16, 95% CI: 0.06–0.41, $p = 0.002$) during the pandemic.

Conclusion: Findings show sub-optimal management of SPs with presumptive TB by private providers in Bandung, but significant changes in quality of care were not detected during COVID-19 compared to pre-pandemic SP surveys. As TB notifications declined in Indonesia during COVID-19, there remains an urgent need to increase private provider engagement in Indonesia to find people who have been missed and improve quality of care.

3.2 Background

Indonesia has the second highest incidence of tuberculosis (TB) in the world, with close to 1 million new cases per year (1). Indonesia has also been a hotspot for COVID-19 in Asia, with a massive wave driven by the Delta variant which peaked in July 2021 (2,3). As of December 6, 2022, there have been 6,686,181 confirmed cases of COVID-19 in Indonesia and 160,071 deaths reported to WHO (4). Thus, both TB and COVID-19 are major challenges for the country.

Indonesia also has a large private health sector, accounting for 63% of outpatient healthcare utilization (5). Studies have shown that while 74% of people with TB in Indonesia first access the private health sector when seeking care for their TB symptoms, the private sector accounts for only 18% of TB notifications (6). A recent study in Indonesia found that 75% of patients first sought care at an informal or private provider, and pathways were often complex with multiple visits (7). Even in the best of times, these delays in diagnosis can result in significant harm to individuals and the health system, including worsened TB disease and increased risk of antibiotic resistance and death (8).

Adding to the existing deficits, the COVID-19 pandemic introduced additional urgency surrounding efforts to understand existing and widening gaps in the quality of TB screening and diagnosis. Globally, COVID-19 related disruptions have resulted in 2 million more people left undiagnosed (or un-reported) with TB over the past two years compared to 2019 (9). These figures suggest that the number of people with undiagnosed and untreated TB has increased, resulting in more TB deaths and infections, as per the latest Global TB Report 2022 (9). Indonesia experienced a 14% reduction in case notifications between 2019 and 2020, the second highest of all high TB burden countries, and is one of the four countries that accounted for most of the estimated increase in TB deaths globally in 2021 (9,10). Availability of health services for people with TB symptoms was drastically reduced in Indonesia, especially during the Delta wave (11–14). Case-finding activities for TB were disrupted by government stay at home directives (3), resources were diverted from TB budgets to support COVID-19 activities (13), and facility closures were common due to healthcare workers contracting COVID-19 and encouragement from the Indonesian Medical Association for doctors over age 65 to reduce work or stop working to reduce morbidity among the healthcare workforce (15–17).

On the demand side, stay-at-home directives and fears of contracting COVID-19 at healthcare facilities also reduced TB care seeking (3,13). Public health measures designed to limit the spread of COVID-19 may have also made an impact on the quality of TB services, such as mandates for the use of personal protective equipment (PPE) and integrated testing for COVID-19 and TB, known as bi-directional screening. Self-reported mask usage in public places in Indonesia remained above 80% until the end of the Delta wave (18), and compliance with PPE directives was also high among private providers and pharmacists (19–21). In mid-2020, the President of Indonesia encouraged facilities to implement bi-directional screening for TB and COVID-19, though it is unclear how that directive has been implemented in the private sector thus far (22,23). Each of these changes has the potential to affect the availability and quality of TB services in Indonesia, especially in private sector facilities as they have been traditionally less engaged with the Indonesia National Tuberculosis Programme (NTP) (24,25).

Given the drastic disruptions causes by COVID-19, few studies to date have investigated how the quality of TB services was impacted by the COVID-19 pandemic (19,26,27). As part of a multi-country study on quality of TB care by private providers in the COVID-19 era, we sought to understand whether private providers in Bandung, the fourth most populous city in Indonesia, are correctly managing mystery patients with TB symptoms, to investigate which types of private providers are more likely to correctly manage patients with TB symptoms, and to estimate the extent of changes in clinical practices in TB care during the COVID-19 pandemic.

To do so, we used standardized patients (SPs), or individuals recruited from the local community to present the same case to multiple providers in a blinded fashion. SPs are considered the gold standard for measurement of clinical correctness of care, an important aspect of healthcare quality (8). Since SPs present the same case to each provider, confounders related to differential patient and case-mix are better controlled than in other approaches to ascertain quality of care, such as administrative data or medical records (28). Additionally, SP studies allow researchers to take accurate measurements of multidimensional quality outcomes with no missing observations and without the Hawthorne effect, wherein providers change their behavior when they know they are being observed (29).

Previous SP studies of private provider management in four high TB-burden countries have found that between 21 and 43% of SPs presenting with TB symptoms were offered appropriate diagnostic tests, and many were offered broad-spectrum antibiotics and steroids, which can mask TB symptoms and increase the risk of antibiotic resistance (29–34). Beyond a comparison with studies in other countries, we can also establish a more precise pre-COVID-19 comparator with a previous SP study conducted in Bandung City in West Java in 2018-2019. This study found that 30% of private general practitioners (GPs) and 20% of private specialists correctly managed SPs presenting with presumptive TB symptoms according to Indonesian national guidelines (35).

3.3 Methods

3.3.1 Study setting

Indonesia is one of three countries that are part of the COVID Effects on TB Services in the Private Sector (COVET) study, supported by the Bill & Melinda Gates Foundation, which set out to evaluate the impact of the COVID-19 pandemic on tuberculosis services in the private health care sectors of India, Indonesia, and Nigeria. As part of the study, a cross-sectional study was conducted between 9 July 2021 and 21 January 2022 using standardized patients (SPs) in Bandung City, West Java, Indonesia. Bandung is the capital of West Java Province, with an area of 167,310 square kilometers and a population of 2.4 million (36). Bandung is divided into 30 administrative districts with 32 hospitals, 80 community health centers (CHC, Indonesian: Pusat Kesehatan Masyarakat [Puskesmas]), 16 public clinics, and 342 public clinics. In 2019, there were 3,623 registered general practitioners and 955 specialists in West Java province across the public and private health sectors (37). Dual practice is permitted by government regulation and is common in Indonesia, with reports of up to 70% of Puskesmas general practitioners and virtually all public specialists engaging in private practice (5,38).

3.3.2 Sampling frame and sample size

The sampling frame for this study matched a pre-COVID-19 SP study conducted in 2018–2019, called Investigation of services delivered for TB by external care system - especially the private sector (INSTEP), supported by USAID (35,39). The INSTEP SP study examined TB management among both public and private sector providers and included four TB case scenarios: the presumptive TB case identical to the one used in this study, and three others in which SPs presented as patients who had already received sputum test results. 67 standardized patient visits were made to private providers in the INSTEP SP study using the presumptive TB case scenario identical to the one used in this study.

For both studies, 36 Puskesmas were randomly selected from the 80 Puskesmas in Bandung. A mapping survey of all private practitioners in these catchment areas was conducted from 15 May 2021 to 27 December 2021. The results of this mapping survey will be published elsewhere. Eligible participants were all private practitioners who participated in the mapping study and who indicated that they were currently providing health services for patients with general symptoms, including fever, cough, and shortness of breath. Less than one-third (29%, 85/292) of the providers visited in this study were also visited in the INSTEP study with any of the four case scenarios. This attrition was likely due to providers moving or ending their practice, no longer accepting new patients, or retiring. Given the random selection of Puskesmas and providers, the samples are nevertheless comparable.

We used 350 visits as target minimal sample for SP visits following the protocol described in the pilot SP study in India by Das et al., 2015 (30). We anticipated that 30% of the SP visits will be managed correctly, based on the previous SP survey in Bandung. A sample size of 350 interactions would allow us to estimate this proportion with a 95% confidence interval of 21% to 40%.

The comparison between SP visits in this study and the pre-COVID-19 study used fixed sample sizes as we had no control over the sample size in the previous study, and the sample size for this study was standardized across the three countries. A post-hoc power calculation indicates that with 67 SP interactions in the pre-pandemic survey, and 350 interactions in the present study, we had a power of 80% to detect a drop of 15 percentage points in the correct management proportion.

3.3.3 SP training and case scenario

Ten SPs were recruited from residents who were determined healthy after being screened for TB and COVID-19. Seven of these SPs had participated in the previous INSTEP SP study. SPs were trained using the clinical scenario, exit questionnaire and standard operational procedure detailed in Kwan et al. (28). SPs were trained to present detailed case scenarios in a standardized manner to each provider and to avoid any invasive tests (chest X-ray, injections, etc.).

SPs presented a presumptive TB case, telling the doctor that they have had a cough for 2–3 weeks. If asked, SPs would disclose that they also have a productive cough with yellow phlegm and without blood, an intermittent mid-grade fever, night sweats, loss of appetite, weight loss, fatigue, and that they self-medicated for one week using only acetaminophen and cough syrup with no improvement. If asked, the SP would also disclose that they smoke cigarettes and do not live with their family. These details are identical to the case presentation in the INSTEP SP study (11).

Where the COVET case differed from the INSTEP study was in the additional standardization of SP responses to any COVID-19 related questions. Specifically, if asked about COVID-19 precautions, the SP would disclose that they always wear a mask at work, keep distance from others, have received the first dose of a COVID-19 vaccine, have had no close contacts with COVID-19 cases, and have never had a nasopharyngeal swab test (antigen or PCR). If asked, they would explain that no close colleagues or family have had similar symptoms, but the friend they live with has a persistent cough and is three months into TB treatment (Table 1 and Supplement 1).

3.3.4 SP visits and data collection

This study began with a mapping survey to identify all practicing private practitioners in these catchment areas, which was conducted from 15 May 2021 to 27 December 2021. This survey captured demographic, geospatial and health service information regarding these providers and their facilities that were used in analysis for this study. The full results of this mapping survey will be published elsewhere. A total of 424 doctors (393 general practitioners and 31 specialists) were eligible to be visited in this study, of whom 74 providers (69 general practitioners and 5 specialists) were excluded from the study as they were assigned virtual SP visits as part of a pilot study on whether the SP methodology could be used in telehealth consultations (Figure 1). All remaining 350 providers were assigned to the presumptive TB (2–3 weeks' cough) case scenario. SPs were purposively assigned to providers to ensure that each SP did not visit any providers they visited in the previous study and to ensure that each SP did not visit the same health care facility more than once. Additionally, all female SPs were assigned to female doctors to ensure the SPs' comfort and safety. We conducted two rounds of piloting to make sure that the scenario and exit questionnaire were coherent and reasonable.

After piloting, each doctor received an unannounced visit during business hours by one SP. All SPs paid the providers their usual fee and paid for and collected medicines up to a limit of 300,000 rupiah (IDR) (USD $20) for general practitioner visits and 350,000 IDR (USD $23) for specialist visits. This limit was determined for budgetary reasons and was based on the average fee for private provider services in Bandung. If the total amount of the medicines and visit exceeded the budget, SPs were trained to retain all prescriptions but only redeem half of the medicine.

Data were collected by SP using a voice recorder and were documented using an exit questionnaire immediately after the visit. The exit questionnaire, referral slips, collected medicines, and any unfilled prescriptions were later checked by our research team before being entered into an electronic based data (REDCap).

3.3.5 COVID-19 context and adaptations

Figure 2 shows the alignment between COVID-19 case numbers in Bandung City against the dates of the SP visits conducted in this study. SP visits were conducted amidst three different COVID-19 restriction levels in Bandung. Restriction Level 4 was implemented when there were more than 100 cases per 100,000 population per week, and included supermarkets open at 50% capacity, non-essential sector working entirely from home, shopping centers and malls closed, restaurants open for take-away only, and places of worship closed. Restriction Level 3 was implemented when weekly confirmed cases were between 65 and 100 cases per 100,000 population, and included supermarkets open at 50% capacity, shopping centers and malls open at 25% capacity, restaurants open for dining with 25% capacity, and places of worship closed. Restriction Level 2 was implemented when weekly confirmed cases were between 40 and 64 per 100,000 population, and included supermarkets open at 75% capacity, shopping centers and malls open at 50% capacity, restaurants open for dining with 50% capacity, places of worship open with 50% capacity and strict procedures, and public facilities open with 50% capacity and strict procedures (3).

At the time of data collection, we required SPs to be vaccinated with two doses of a COVID-19 vaccine. We also screened SPs for TB using chest X-ray at the beginning of the study; we found no chest abnormalities. SPs were directed to wear masks during each visit and follow all other COVID-19 prevention directives as indicated by the facilities (physical distancing and handwashing). If any SPs developed symptoms of respiratory illness, they were directed to be tested at their local Puskesmas. Any SPs who tested positive for COVID-19 were required to self-isolate for 14 days according to government regulations.

The study team was required to make some adaptations to the methodology due to public health restrictions related to the COVID-19 pandemic. When visits began, the field team realized that doctors would refuse patients who have not been vaccinated. To mitigate this, on 26 July 2021 we changed the protocol to allow SPs to disclose to the provider that they have had one dose of a COVID-19 vaccine. Additionally, four providers visited in August and September 2021 asked patients to get tested for COVID-19 at the facility before consultation, so the decision was made in August 2021 to allow SPs to submit for this test to allow SP visits to continue.

3.3.6 Ethical considerations

This study was approved by the McGill University Health Centre (MUHC) Research Ethics Board (REB) (COVID BMGF / 2021-7197), the Research Ethics Committee of Universitas Padjadjaran, Bandung, Indonesia (No.166/UN6.KEP/EC/2021), and the local government (No.PP.06.02/5603/Dinkes/II.2021 and No.PP.09.01/410-kesbangpol/IV/2021). Bandung City Health Office was fully informed about this study and approved the method. Informed consent was waived to ensure that providers would undergo their normal routine, thus ensuring the validity of the data collected for this study. The Research Ethics Commission which supervised this study agreed to obtain informed consent from participants if a provider discovered the patient SP during a consultation.

3.3.7 Outcome definition

The main outcome of this study is correct management, judged using concordance with the 2016 NTP guidelines as the benchmark for management of presumptive tuberculosis (40). These guidelines stipulate that correct management of presumptive tuberculosis for new patients with no history of prior TB treatment, no history of close contact with rifampicin-resistant TB patients, and unknown HIV status or HIV-negative patients is clinical assessment and bacteriological examination by sputum smear or rapid molecular test (Xpert MTB/Rif (GeneXpert), Cepheid, Sunnyvale, CA). Referral to DOTS center was determined as correct management under these guidelines (Table 1).

These guidelines were updated in 2021 to stipulate that all those with presumptive tuberculosis should be examined with Xpert MTB/Rif examination (41). While we present data on the use of Xpert MTB as well as the percentage of cases that were correctly managed according to the 2021 guidelines, for our main outcome we chose to use the 2016 guidelines. This is primarily to compare the latest findings with the previous SP study conducted before the onset of the COVID-19 pandemic, and as implementation of this updated guideline has been slowed in part due to the COVID-19 pandemic.

Finally, the algorithm for expected correct management used in prior SP TB studies, as described by Kwan, et al. (2018), were used as a secondary benchmark in order to compare these results to previous SP studies conducted in other contexts (31). These guidelines stipulate that correct management of presumptive tuberculosis is recommendation for chest X-ray and/or any sputum test (Acid-Fast Bacilli (AFB) smear, Xpert MTB/Rif, Culture, Drug susceptibility testing (DST)), or referral to another provider or public TB services. These outcome measures take a lenient approach in which providers were not penalized for the use of unnecessary or even potentially harmful medicines, and thus the results presented are upper-bound estimates of clinical correctness, as measured by adherence to TB standards of care.

3.3.8 Data analysis

Descriptive analysis evaluated proportions and 95% confidence intervals (CI) of provider and facility characteristics captured in the provider mapping survey (doctor's qualification, age, sex, and whether they have attended TB management training; type of facility, facility linkage to NTP, whether the facility accepts the national insurance [Jaminan Kesehatan Nasional (JKN)], availability of chest X-rays and sputum test in the facility), duration of the SP visit, clinic patient density measured by number of other patients waiting before and after the visit, medical history taken by staff or doctor, health education, diagnosis, referral, medication prescribed by doctor, total cost of the visit, quality management concordance to NTP, and global assessment score by the SP about the provider.

Generalized linear mixed models fit with quadrature were used to understand which private provider and facility characteristics are associated with correct management of patients with TB symptoms (R version 4.1.0/R Studio version 2022.07.1). This type of model allows us to conduct logistic regression while accounting for the non-independence in our sample due to clustering. Random intercepts were included for each SP to account for the sampling structure which only randomized female SPs to visit female providers. Random intercepts were also included for each facility to account for probable clustering by facility, wherein providers from the same facility would be more similar to each other. Adjusted odds ratios (aOR) with 95% CI were reported.

3.3.9 Confounder selection

Confounding variables were chosen using a directed acyclic graph (DAG) created based on expert opinion. Figure 3a depicts the directed acyclic graph (DAG) showing relationships between relevant variables in the SP visits conducted in this study. DAGs are best practice among studies attempting to quantify causal relationships between exposures and outcomes (42).

DAGs are not typically used for confounder selection in observational studies such as this one, however, we were interested in several “exposure”-outcome relationships in our sample pertaining to our second research question (Which types of private providers are more likely to correctly manage people with TB symptoms?). Given the complex nature of the relationships among these variables, we asserted that the best way to assess these given “exposures” would be through regression models for each exposure which contain appropriate confounders chosen from a DAG, in particular to avoid what Westriech and Greenland deemed the “Table 2 Fallacy” (43). This DAG was developed in consultation with subject-matter experts in Indonesia (Bony Wiem Lestari, Kuuni Ulfah, and Panji Hadisoemarto). The DAGs depicting individual “exposure”-outcome relationships used in our modeling assumptions are found in Figures 3b-m.

The main “exposures” we were interested in studying were the effects of provider characteristics (age, sex, qualification, prior training on TB, and whether providers had commonly diagnosed TB patients), facility characteristics (facility type, whether sputum examination is available at the facility), and visit characteristics (length, cost, number of history-taking questions asked, number of cardinal TB symptoms asked, whether provider prescribed non-ATT antibiotic, and whether provider prescribed steroids) on the likelihood of adherence to NTP guidelines for presumptive TB management.

3.3.9.1 Provider characteristics

Prior evidence from other SP studies on TB have indicated that provider sex (33,34), age (44), and qualification (30,31,44,45) may be related to appropriate TB management. As older providers may be more likely to be male in Indonesia, provider sex is a confounder in the relationship between age and NTP guideline adherence (Figure 3b). SP sex is linked to provider sex in our study due to the sampling structure wherein female SPs were only assigned to visit female providers. SP sex could plausibly be related to likelihood of NTP guideline adherence if, for instance, providers know that males are more likely to have TB (9); thus, SP sex would confound the relationship between provider sex and NTP guideline adherence (Figure 3c). In Indonesia, older providers are more likely to be specialists, specialists are more likely to be male, and specialists are more common in hospitals compared to solo practices, which would make provider age, provider sex, and facility type confounders in the relationship between provider qualification and NTP guideline adherence (37,46) (Figure 3d). Since information on prior training on TB management was an available variable from the mapping study, we were interested to see if prior training on TB management was linked to NTP guideline adherence (47). We posited that provider age could be a confounder if older providers were more likely to have received the training (or if younger providers are more likely to have received this type of training in medical school), and provider qualification could be a confounder if specialists are more likely to receive this training compared to general practitioners (Figure 3e). Similarly, we were curious if providers who have seen TB in their clinics would be more likely to adhere to NTP guidelines. Provider age could be a confounder here if older providers are more likely to have seen TB in their practices due to having more years of experience practicing medicine. Additionally, provider qualification could confound the relationship between having diagnosed a TB patient and NTP guideline adherence if specialists are more likely to diagnose TB patients regularly. Finally, provider receiving training on TB management could make a provider more likely to adhere to NTP guidelines, which would make it a confounder in this relationship (Figure 3f).

3.3.9.2 Facility characteristics

Previous SP studies have shown that the type of facility visited can affect the likelihood that an SP will receive appropriate TB care (44). Provider age is a possible confounder for the relationship between facility type and NTP guideline adherence as providers who are older and more established may be more likely to have their own solo practice (Figure 3g). A provider may be more likely to refer a patient for sputum testing if the technology is available at their facility, so we were also interested in exploring the relationship between sputum testing availability and NTP guideline adherence. Sputum examination is more likely to be available at a hospital compared to a clinic or solo practice, which would make facility type a plausible confounder in this “exposure”-outcome relationship (5). Additionally, provider qualification may determine the likelihood that a provider works at a facility with sputum microscopy technology (Figure 3h).

3.3.9.3 Visit characteristics

SP studies conducted in other contexts have found relationships between visit length and appropriate management of SPs presenting with presumptive TB symptoms (33). Longer visits could imply that providers spent more time and paid more attention to an SP, or that they asked more questions, conducted more examinations, or ordered more diagnostics, which could imply stronger adherence to NTP guidelines. Number of history-taking questions would likely increase the visit length, and could itself be linked to NTP guideline adherence, therefore confounding the relationship between visit length and NTP guideline adherence (Figure 3i). Previous studies have shown that visit cost can be negatively associated with proper management of TB cases (48). Facility type and provider qualification could be potential confounders in this relationship, as costs may be different at hospitals or clinics compared to solo practices, and specialist providers would likely charge more for their services compared to general practitioners (Figure 3j). We were also interested in the relationship between the number of history-taking questions asked and the likelihood of NTP guideline adherence. Assuming that each of these variables are related to NTP guideline adherence, this relationship could plausibly be confounded by whether providers have received TB management training (providers who have received training on TB would be more likely to ask more history-taking questions) and provider qualification (providers with higher qualification may be more likely to ask appropriate questions) (Figure 3k). Similarly, we hypothesized that more cardinal TB symptoms asked about – defined as cough, blood in sputum, fever, night sweats, and weight loss – could be positively associated with NTP guideline adherence; this association has been shown in other SP studies (33). Potential confounders in this relationship are the same as those in the relationship between our outcome and number of history-taking questions asked – provider received training on TB management and provider qualification – with the addition of number of history-taking questions asked, an increase in which could increase the likelihood of asking about more cardinal TB symptoms (Figure 3l). Finally, since previous SP studies have found high rates of inappropriate prescribing of broad-spectrum non-ATT antibiotics and steroids (45,48,49), we wanted to explore if inappropriate prescribing was correlated with NTP guideline adherence in our setting. The relationship between these variables and our outcome could be confounded by provider qualification (specialists may be less likely to prescribe incorrectly) and whether the provider had received TB management training (providers who have received prior TB training could be less likely to prescribe inappropriate medications) (30,31,44,45) (Figure 3m).

3.3.10 Comparison with pre-COVID-19 SP study

As this SP study was conducted in the same geographical area as the INSTEP SP study conducted in 2018–2019, we first compared characteristics of the SP visits before and during the

COVID-19 pandemic. To determine which SP visits were conducted with the same providers in both studies, we manually cross-checked the names, health facilities, and age of doctors in both studies and created a unique ID system spanning the two studies. Comparisons were made between the 67 standardized patient visits made to the private providers in the INSTEP SP study using the presumptive TB case scenario identical to the one used in this study (292 visits). We modelled the relationship between visit characteristics and the study year using generalized linear mixed effect models fit with quadrature. As 34% (23/67) of providers visited by an SP presenting the presumptive TB case in the INSTEP study were also visited with the same case scenario in the COVET study, we included random intercepts for each provider to account for clustering by provider across the two samples. Random intercepts for each SP were also included in these models. As fewer provider and facility characteristic variables were available in the INSTEP SP dataset compared to the COVET SP dataset due to changes in the mapping survey, only provider qualification and provider age were included as confounders in all models. The exception to this was that whether the provider had prescribed any medication was included as a confounder in the model describing visit cost by study year, as prescriptions strongly influence the total visit cost. The Bonferroni-Holm multiple test procedure was used to account for multiple comparisons made among visit characteristics.

3.4 Results

3.4.1 Characteristics of the SP visits

A total of 297 visits (274 GPs and 23 specialists) were completed by 10 SPs between 9 July 2021 and 21 January 2022, out of a total of 350 visits attempted (324 GPs and 26 specialists), resulting in an overall completion rate of 85% (84.6% for GPs and 88.5% for specialists). Five visits completed at public non-NTP facilities were excluded from our analysis, resulting in a total sample of 292 visits (Figure 1). All SPs were able to complete presentation of their case and no SPs reported any provider detections. Each SP completed an average of 29 visits (Standard Deviation (SD): 3.01) which each lasted 9.7 minutes on average (SD: 6.5). A mean of four patients (SD: 6.2) were waiting at the facility when the SP arrived for the visit and three patients (SD: 4.4) were waiting when the SP left the visit. SPs paid on average IDR 121,869 (SD: IDR 75,417) [USD $8.40 (SD: $5.20)] for the total cost of the visit. One third of visits were conducted under Restriction Level 2 (34%, 100/292), 39% under Restriction Level 3 (113/292), and 27% under Restriction Level 4 (79/292).

3.4.1.1 Provider and facility demographics

The SPs visited 292 providers (Table 2) practicing at 165 facilities (Table 3). Most facilities were clinics or hospitals with more than one provider (70%), not linked to the Indonesian NTP (98%), had a pharmacy attached to the facility (81%) and 37% accepted Indonesian national insurance (JKN). Among the providers 92% were general practitioners, 61% were female and were on average 40 years old. When inquired during the provider mapping survey conducted before the SP visits, 61% of the providers indicated they had previously received TB management training and 57% diagnosed at least one TB case each month.

3.4.1.2 Provider screening behaviors

Detailed information about the SP visits can be found in Supplement 2. On average, providers asked 15 history-taking questions (SD: 6.4) and conducted five physical examinations (SD: 1.87) in each visit. Providers asked an average of 3.26 (SD: 1.12) of the five cardinal TB symptoms during history taking (cough duration, blood in sputum, fever, night sweats, and weight loss) with 13% (38/292) asking about all five symptoms. The most asked questions in the history taking portion of the visit were cough duration (99%, 289/292), fever (90%, 264/292), and whether the SP had taken any medications for their current symptoms (70%, 203/292). Most providers (89%, 260/292) seemed to take note of the information provided by the SP during consultation.

3.4.1.3 Provider tests and referrals

Providers in 80% of visits recommended a diagnostic test. The most recommended tests were chest x-ray (70%, 204/292) and any sputum test (29%, 86/292). Xpert was only recommended in three SP visits (1%, 3/292). Providers referred SPs to other facilities in 21% of visits (61/292). The most common place for referral was a public DOTS center (72% of referrals, 44/61). Providers asked SPs to return to receive lab test results in 34% of visits (99/292), if symptoms persist in 26% of visits (76/292), and if symptoms worsen in 18% of visits (52/292).

A working diagnosis was communicated to patients in 87% of visits (255/292). More than half of diagnoses mentioned to SPs were for TB (52% of diagnosed visits, 133/255). Other diagnoses mentioned included upper respiratory infection (20%, 52/255), unspecified lower respiratory infection (15%, 37/255), and bronchitis (5.5%, 14/255).

3.4.1.4 Prescriptions

The provider prescribed or dispensed medication in 96% of visits (279/292). On average, each SP was prescribed 3.23 medications (SD: 1.17). The most prescribed drugs were over the counter symptomatic drugs (71% of visits, 207/292) and non-anti-tuberculosis treatment (ATT) antibiotics (68% of visits, 198/292), including cephalosporin and other beta lactam antibiotics (41%, 121/292), quinolones (ciprofloxacin and ofloxacin) (9.2%, 27/292), macrolide (8.9%, 26/292), and penicillin (5.8%, 17/292). Corticosteroids were prescribed in 27% of visits (78/292). Drugs with no label were dispensed in 16% of visits (48/292). While no providers prescribed first-line ATT drugs, 11% of providers (31/292) prescribed levofloxacin, a second-line ATT drug.

3.4.1.5 COVID-19 questions

Providers asked about anosmia (impaired smell) in 28% of visits (83/292) and ageusia (impaired taste) in 15% of visits (44/292). Providers told the SP they might have COVID-19 in 14% of visits (40 /292) and named COVID-19 as a likely diagnosis in 7.9% of visits (23/292). A COVID-19 test (rapid antibody, antigen, or PCR test) was recommended in 20% of visits (58/292). Detailed information about the SP visits related to COVID-19 can be found in Supplement 3.

3.4.2 Research Question 1: Are private providers in Bandung correctly managing people with TB symptoms?

Overall, 35% of interactions were managed in accordance with the 2016 Indonesia NTP guidelines (101/292, 95% CI: 29.2–40.4%) (Figure 4). However, a much higher 81% of interactions were managed correctly according to the definition of correct management used in prior SP studies (236/292, 95% CI: 75.7–85.1%).

3.4.3 Research Question 2: Which types of private providers are more likely to correctly manage people with TB symptoms?

Figure 5 and Table 4 show the adjusted odds ratios (aORs) representing the association between selected provider, facility, and visit characteristics and correct management according to the Indonesian NTP guidelines (defined as bacteriological examination by sputum smear or Xpert, or referral to DOTS center). In terms of provider and facility characteristics, the likelihood of appropriate TB management decreased with each 5-year increase in provider age (aOR: 0.76, 95% CI: 0.67–0.87, p <0.001) and among male providers, although the latter is not statistically significant (aOR: 0.52, 95% CI: 0.27–1.01, p = 0.052). There were no significant associations found between correct management and provider qualification (aOR: 0.84, 95% CI: 0.22–3.21, p = 0.8), whether the provider had received prior training on TB management (aOR: 0.95, 95% CI: 0.53–1.71, p = 0.9), whether the provider diagnoses at least 1 TB case per month (aOR: 0.88, 95% CI: 0.50–1.56, p = 0.7), the facility type (aOR: 0.78, 95% CI: 0.32–1.87, p = 0.6) or the availability of sputum examination at the facility (aOR: 0.56, 95% CI: 0.17–1.84, p = 0.3).

Specific features of the visit were also associated with 2016 NTP guideline adherence. For instance, providers asking more questions in the history-taking portion of the visit were more likely to manage the case according to NTP guidelines (aOR: 1.07, 95% CI: 1.02–1.13, p = 0.004) as were those who asked about cardinal TB symptoms during the visit (aOR: 2.78, 95% CI: 1.82–4.23, p <0.001). Providers who prescribed broad-spectrum or non-ATT antibiotics were negatively associated with appropriate TB management, though this association was not statistically significant (aOR: 0.56, 95% CI: 0.32–1.00, p = 0.051). Interestingly, visit length (aOR: 1.05, 95% CI: 0.84–1.31, p = 0.7), visit cost (aOR: 0.81, 95% CI: 0.59–1.10, p = 0.2), and whether the provider prescribed steroids (aOR: 0.74, 95% CI: 0.40–1.37, p = 0.4) were not associated with guideline adherence.

3.4.4 Research Question 3: What is the extent of changes in clinical practices in TB care during the COVID-19 pandemic?

67 SP visits made to private providers in Bandung between 6 July 2018 and 1 April 2019 were compared to the 292 SP visits made to private providers between 9 July 2021 and 21 January 2022 in the same sampling area and for the same SP case. Supplement 3 compares provider and facility characteristics between these two studies. Supplement 4 lists adjusted odds ratios comparing proportions of main outcomes across the two studies. We did not observe significant differences in the proportion of SP visits managed in concordance to the 2016 NTP guidelines (INSTEP: 28%, 95% CI: 18–41%; COVET: 35%, 95% CI: 29–40%; difference between INSTEP and COVET: 6.2%, 95% CI: -6.8–19%) nor correct management based on prior SP studies (INSTEP: 72%, 95% CI: 59–82%; COVET: 81%, 95% CI: 76–85%; difference between INSTEP and COVET: 9.2%, 95% CI: -3.4–22%). More providers measured the SP's temperature in the study conducted during COVID-19 (aOR 8.05, 95% CI: 2.96–21.9, p <0.001). Fewer providers examined the SP's throat in the study conducted during COVID-19 (aOR 0.16, 95% CI: 0.06–0.41, p = 0.002). No other statistically significant differences were observed in history-taking questions asked, other examinations conducted, recommendations for TB tests, or inappropriate prescribing practices.

3.5 Discussion

This SP study is unique in being one of the first that examines the treatment of a TB SP before and after the start of the COVID-19 pandemic in the same geographical area. The study uses random samples from the same city, Bandung, Indonesia so that the samples are comparable. We draw three main conclusions from the results.

Our first main finding is that the management of presumptive TB cases by private providers in Bandung, Indonesia, is comparable (or even better) than what is found in studies from other countries using ISTC guidelines. Specifically, adherence to expected management based on prior SP studies in this sample (81%) was notably higher than SP studies of private practitioner guideline adherence conducted in Kenya (33%), India (35% and 16%), South Africa (43%), and Nigeria (56%) (30,31,33,32,34). The fact that 70% of SPs in this sample are sent for a chest X-ray and private providers named TB as the working diagnosis in 52% of visits where a diagnosis was given (46% of all visits) is an indication that most private providers in this setting are indeed identifying that their patients have a lung infection that could be TB. Nevertheless, we also observed a high usage of unnecessary antibiotics, similar to SP studies in South Africa, India, and China (45,48,49) as well as much higher steroid use in this sample (27%) compared to private practitioners in India (2%), Nigeria (3%), China (5%), and South Africa (7.1%) (33,34,44,45). Private providers thus seem to know how to identify presumptive TB, even though they are not following the NTP guidelines and tend to overuse antibiotics and steroids.

Our second main finding is that the proportion correctly managed according to NTP standards remains much lower at 32% for private general practitioners (GPs) and 26% for private specialists. This is because the NTP standards require microbiological confirmation via Xpert testing and/or sputum tests rather than the use of chest x-rays (41). Xpert testing among private providers remains very low at 1% of all visits. One reason could be that implementation of the newer guidelines has slowed due to the COVID-19 pandemic and there is limited availability of Xpert machines in Bandung. At present, Bandung has 16 Xpert machines (source: Bandung

District Health Office, unpublished data). Nine of these are at Puskesmas, which represent just 11% of all the Puskesmas in the city. The remainder are found at public hospitals. In addition to further scale-up of Xpert machines, stronger measures for private provider engagement will be needed if this guideline is to be implemented throughout the Indonesian health system. This could include easier and free access to public-sector Xpert testing for patients managed in the private sector.

Sputum microscopy by private providers is also rare at 29%. These results contradict findings from several studies that use telephone surveys of Indonesian private providers to estimate their rate of referral for various methods of TB diagnosis. Prior surveys reported that between 62.3% and 85.7% of private providers utilized smear microscopy in diagnosing TB, including 74.1% of surveyed providers in Bandung (50–52). Conversely, our study showed 29% of private providers in Bandung (30% of GPs, 19% of specialists) referred SPs presenting with presumptive TB symptoms to smear microscopy. SP studies from other contexts including India, South Africa, and China have found similar results of low smear microscopy utilization (31,33,44,45).

The reason for this discrepancy is that providers' self-reported knowledge of TB management guidelines is often higher than their actual performance, a phenomenon called the "know-do gap" (29). The know-do gap was reported in India and Tanzania and has since been replicated in multiple SP studies (53–55). One such study by Sylvia et al. in China showed that although 26% of providers said they would recommend a presumptive TB case to receive a sputum AFB test, only 4% of those same providers made that referral when they were visited by an SP presenting with textbook TB symptoms. Again, proper engagement of private practitioners on the importance of sputum microbiological testing over chest x-ray could result in private providers diagnosing more TB cases.

Our third main finding is that the quality of TB care among private practitioners has not dropped in the COVID-19 era. On the positive side, some experts were concerned that providers would mistake TB cases for COVID-19 cases given the overlap in symptoms (56). These results provide some evidence to support this concern, as 14% of providers indeed suspected that the SPs had COVID-19. However, among these 14%, 65% (26/40) also recommended a chest X-ray or related TB test, so it does not seem like they are ruling out TB even when they suspect that the SP has COVID-19. If anything, we find that the proportion of SPs correctly managed has increased from 30% of private general practitioners (GPs) and 20% of private specialists previously (NTP guidelines) to 32% and 26% in this study, though this increase was not statistically significant.

On the negative side, we find limited evidence to support that private hospitals and clinics are engaged in bi-directional screening of TB and COVID-19, despite strong government support (22). Providers in the SP study conducted during COVID-19 were more likely to conduct temperature checks and less likely to conduct throat examinations. They were also more likely to ask about anosmia and ageusia as well as having a COVID-19 vaccine and other COVID-19 related questions. However, none of these questions was asked in more than 20% of cases and 6.5% (19/292) of providers asked 5 key COVID-19 questions (fever, shortness of breath, runny or stuffy nose, anosmia, and ageusia). The results suggest that only a small fraction of private providers have changed their practices to incorporate COVID-19 as a differential diagnosis for this case presentation.

In terms of policy, the fact that many more providers suspect that they are dealing with a patient who might have TB but are unaware of the correct NTP guidelines suggests that private providers may not be properly exposed to the NTP guidelines nor sensitized on the importance of following these guidelines. Private provider engagement has been limited in Indonesia to date, and has focused primarily on private hospital linkage to DOTS (57–60). In 2021, the Indonesia Medical Association (IDI) announced they would begin offering continuing education credits as a reward to providers who notify TB patients to the NTP (61,62). Proper engagement of private providers through initiatives like these could result in increased TB diagnoses and notifications by the private health sector, as has been seen elsewhere in Indonesia (63) and in other similar settings (64–66). Expansion of diagnostic tools into private facilities or implementation of expedited referral systems could be another way to accelerate improvement in this area, as previous studies such as Lestari et al (2017) have indicated that patients often refuse referrals to the public sector due to lack of convenience, long waiting times, and a lack of trust in the public system (63). It has been well-established that people with TB in Indonesia prefer to visit private providers, despite these services costing more than the public sector (7,67,68). Improving the quality of care among private providers and the connection of private providers to the NTP is a person-centred approach, responding to the needs and preferences of patients.

Our study has several limitations. First, SPs are simulations of real patients, not actual patients. The standardization of the case is what allows for valid inference, but with real patients we would likely see far more variation in how patients and physicians behave. The SP methodology for presumptive TB also does not allow for repeated visits, so we have not observed how providers would behave if the SP were to return for a second visit. This may not be as severe a limitation as typically believed because a previous SP study has established the validity of the single-visit protocol in this case (69).

Second, in terms of the sample, only providers who consented to the provider mapping survey were included in the SP study (14% refusal rate, Figure 1). This is a potential source of selection bias. Furthermore, only the presumptive TB case scenario was used in this study and could only be compared to a small subset of SP visits conducted in the INSTEP SP study, which limited the statistical power to detect major differences between these two samples.

Third, we present here results of a comparison of two cross-sectional studies, but the study is not designed to estimate the causal impact of COVID-19 on provider behavior as different from other general time trends, or parallel program implementation efforts. We were also limited in terms of our sample size, which only allowed detection of a 15 percentage-point change in TB management between the two studies. In addition, a provider may treat differently an SP who visits them during the COVID-19 pandemic under the assumption that anyone visiting a healthcare provider during COVID-19 restrictions may have a serious medical problem. This could lead providers to be more likely to consider an SP has TB than in the previous study, which could explain the small improvement (not statistically significant) we see in correct case management. Additionally, we did not capture information on whether the providers were masked during SP visits nor whether they implemented other COVID-19 safety protocols. This limits our ability to understand the full extent of provider behavioral changes in simulated patient visits, though we were able to capture this kind of information from provider self-reports in the provider mapping survey. Finally, the results presented here only measure provider behavior in a finite time during the COVID-19 pandemic. Due to the variable nature of the pandemic, these results cannot be generalized to the entire COVID-19 pandemic.

3.6 Conclusion

Private providers are the main gatekeepers for TB diagnosis in urban Indonesia. Findings from this study reveal severe gaps in management of presumptive TB cases by private providers in Bandung, Indonesia. We did not detect significant changes to overall management of presumptive TB cases in the SP visits conducted during the COVID-19 pandemic as compared to those conducted before the onset of COVID-19, but our conclusions here are limited due in part to the small sample size. Results from this study indicate that providers successfully identify TB in their patients yet do not manage them properly. There is great potential yet to be tapped in the Indonesian private health sector to find the missing TB cases and reduce delays in diagnosing people with TB.

3.7 Acknowledgements

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3.8 Tables and Figures

3.8.1 TABLE 1: Description of clinical case scenario

Table 1 Description of clinical case scenario

Case description	**Patient presentation**	**Expected correct management based on 2016 NTP guidelines**	**Expected correct management based on prior SP TB studies**
A classic case of suspected tuberculosis with a cough for 2-3 weeks and a low-grade fever, cold sweats, loss of appetite and other typical symptoms of TB.	A suspected case of tuberculosis was conveyed to a doctor at a private health service by saying: "Doctor, I have a cough that doesn't get better." The patient has no history of COVID-19, has never been tested for COVID-19, but has received a first dose of a COVID-19 vaccine.	Recommendations: 1. Ordered for Xpert MTB/RIF test or AFB smear 2. Referred to Public DOTS center	Recommendations: 1. Ordered for Chest X-rays and/or sputum test (AFB smear, X-pert MTB/RIF, Culture, DST) 2. Referral to another provider or public TB services.

3.8.2 TABLE 2: Provider characteristics

Table 2 Provider characteristics

Provider characteristics	**INSTEP study, 2018-2019, N = 67[1]**	**COVET study, 2021-2022, N = 292[1]**
Provider consented to mapping survey	56 (84%)	289 (99%)
Provider sex		
Female	37 (55%)	177 (61%)
Male	30 (45%)	115 (39%)
Provider age[2]	45 (15)	39 (12)
Provider qualification		
General Practitioner	52 (78%)	269 (92%)
Specialist	15 (22%)	23 (7.9%)
Internist	14 (93%)	18 (78%)
Pulmonologist	1 (6.7%)	5 (22%)
Provider diagnoses at least 1 TB patient per month[3]	33 (59%)	165 (57%)
Average number of TB patients diagnosed per month[3]		
0	23 (41%)	124 (43%)
< 1[*]	14 (25%)	0 (0%)
1-4	16 (29%)	129 (45%)
5 or more	3 (5.4%)	36 (12%)
Provider dispenses TB treatment to TB patients[3]	12 (21%)	74 (26%)
Provider has received TB management training[3,4]	---	175 (61%)

[1] n (%); Mean (SD)
[2] Missing age from 13 providers in INSTEP and 6 providers in COVET
[3] Missing information from providers who declined the mapping survey
[*] Option not included in COVET study
[4] Not asked in INSTEP study
Acronyms: INSTEP = Investigation of services delivered for TB by external care system - especially the private sector; COVET = COVID Effects on TB Services in the Private Sector; TB = tuberculosis

3.8.3 TABLE 3: Facility characteristics

Table 3 Facility characteristics

Facility characteristics	**INSTEP study, 2018-2019, N = 56[1]**	**COVET study, 2021-2022, N = 165[1]**
Facility type		
Clinic/hospital	44 (79%)	116 (70%)
Solo practice	12 (21%)	49 (30%)
Health sector & linkage to NTP		
Private HCF linked to NTP	1 (1.8%)	4 (2.4%)
Private HCF not linked to NTP	55 (98%)	161 (98%)
Additional services present at facility[2]		
Pharmacy	39 (70%)	131 (81%)
Laboratory	12 (21%)	34 (21%)
X-ray	6 (11%)	10 (6.2%)
Sputum examination[3]	---	8 (4.9%)
In-patient beds[3]	---	11 (6.8%)
Facility collaborates with Indonesian national health insurance (JKN) [4]	13 (23%)	59 (37%)

[1] n (%)
[2] Missing information on 3 facilities in COVET study
[3] Not asked in INSTEP study
[4] Missing information on 5 facilities in COVET study
Acronyms: INSTEP = Investigation of services delivered for TB by external care system - especially the private sector; COVET = COVID Effects on TB Services in the Private Sector; NTP = National Tuberculosis Programme; HCF = health care facility; JKN = *Jaminan Kesehatan Nasional*

3.8.4 TABLE 4: Factors associated with correct management (NTP 2016 guidelines) of presumptive TB case in COVET study

Table 4 Factors associated with correct management (NTP 2016 guidelines) of presumptive TB case in COVET study

Characteristic	Adjusted odds ratio (aOR)[1]	95% Confidence Interval (CI)[1]	P value
Provider characteristics			
Provider age increase of 5 years[2]	0.76	0.67, 0.87	<0.001
Provider sex = Male[3] (reference = Female)	0.52	0.27, 1.01	0.052
Provider qualification = Specialist[4] (reference = General Practitioner)	0.84	0.22, 3.21	0.8
Provider received training on TB management[5] (reference = no training)	0.95	0.53, 1.71	0.9
Provider diagnoses at least 1 TB case per month[6] (reference = no diagnoses)	0.88	0.50, 1.56	0.7
Facility characteristics			
Facility type = Solo Practice[7] (reference = Clinic/Hospital)	0.78	0.32, 1.87	0.6
Sputum examination available at facility[8] (reference = sputum examination not available)	0.56	0.17, 1.84	0.3
Visit characteristics			
Visit length increase of 5 minutes[9]	1.05	0.84, 1.31	0.7
Visit cost increase of $5 (USD)[8]	0.81	0.59, 1.10	0.2
Number of questions asked in history-taking[5] (continuous)	1.07	1.02, 1.13	0.004
Number of cardinal TB symptoms asked in visit[5] (continuous)	2.78	1.82, 4.23	<0.001
Provider prescribed non-ATT antibiotic[5] (reference = did not prescribe non-ATT antibiotic)	0.56	0.32, 1.00	0.051
Provider prescribed steroids[5] (reference = did not prescribe steroids)	0.74	0.40, 1.37	0.4

[1] aOR = Adjusted Odds Ratio, CI = Confidence Interval
[2] Adjusted by provider sex
[3] Adjusted by SP sex
[4] Adjusted by provider age, provider sex, and facility type
[5] Adjusted by provider age and qualification
[6] Adjusted by provider age, qualification, and provider received training on TB management
[7] Adjusted by provider age
[8] Adjusted by provider qualification and facility type
[9] Adjusted by number of questions asked in history-taking
Acronyms: TB = tuberculosis, USD = United States Dollar, ATT = anti-tuberculosis treatment

3.8.5 FIGURE 1: Study sampling

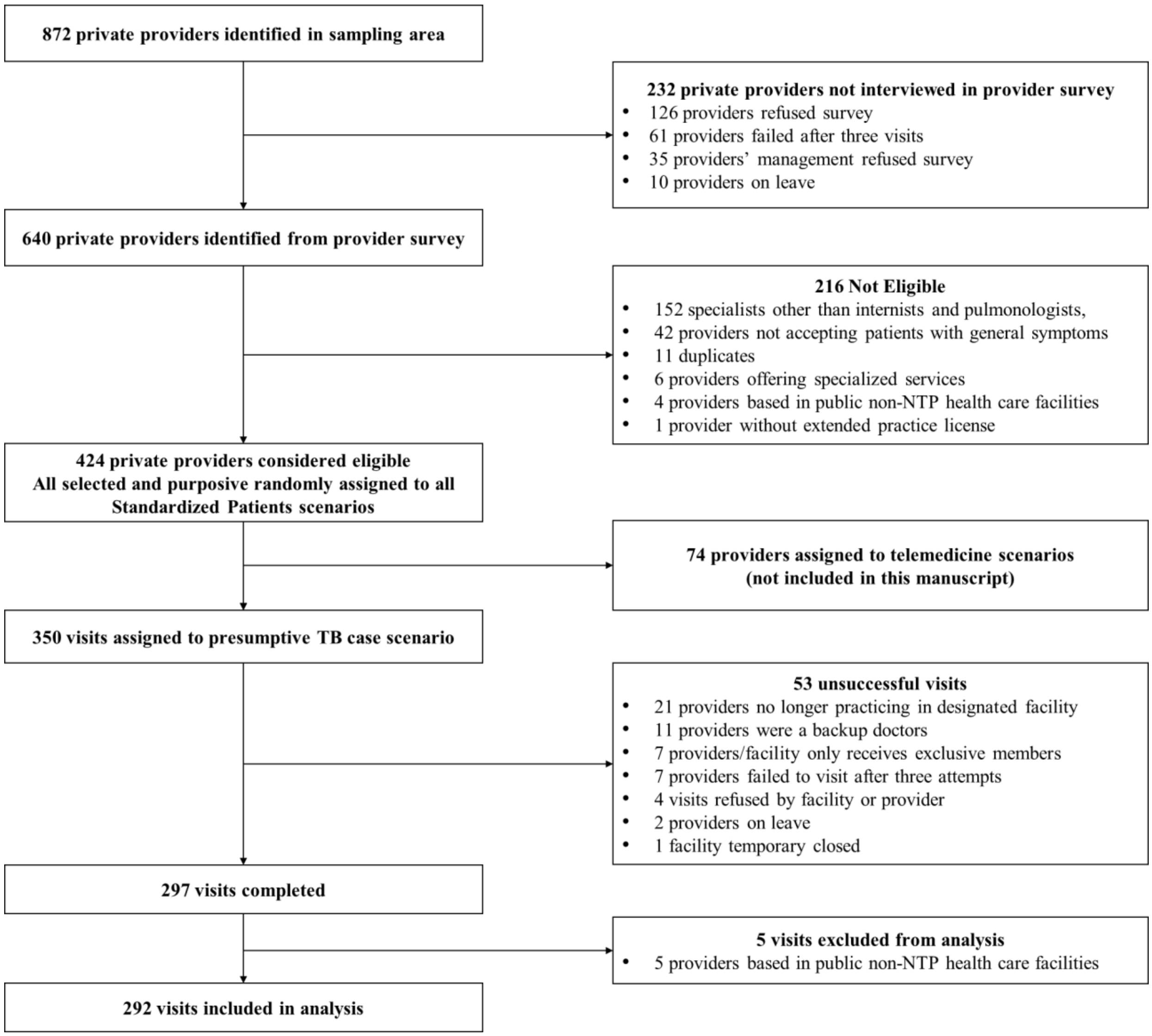

Figure 1 Study sampling

3.8.6 FIGURE 2: Timeline of SP Visits and COVID-19 statistics in Bandung City, West Java, Indonesia

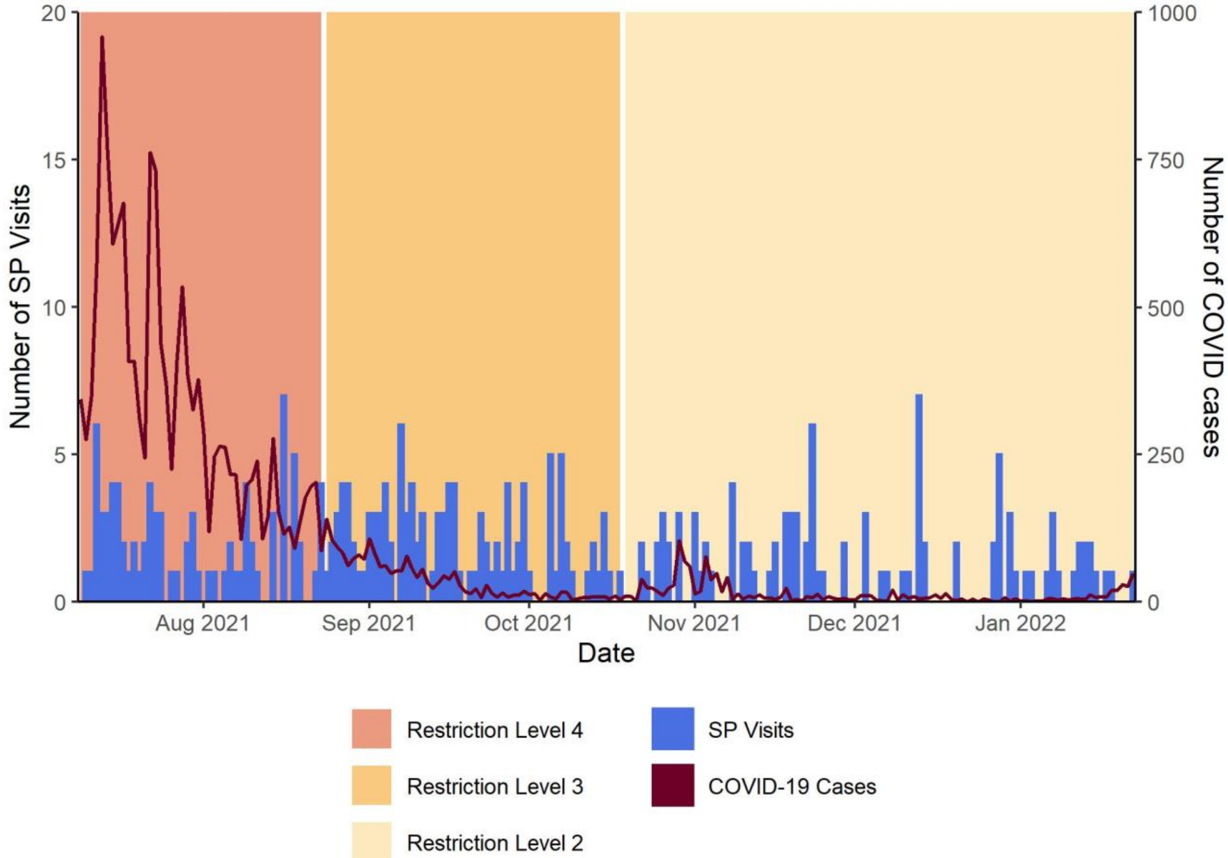

Figure 2 Timeline of SP visits and COVID-19 statistics in Bandung City, West Java, Indonesia

Caption: Restriction Level 4 was implemented when there were more than 100 cases per 100,000 population per week, and included supermarkets open at 50% capacity, non-essential sector working entirely from home, shopping centers and malls closed, restaurants open for take-away only, and places of worship closed. Restriction Level 3 was implemented when weekly confirmed cases were between 65 and 100 cases per 100,000 population, and included supermarkets open at 50% capacity, shopping centers and malls open at 25% capacity, restaurants open for dining with 25% capacity, and places of worship closed. Restriction Level 2 was implemented when weekly confirmed cases were between 40 and 64 per 100,000 population, and included supermarkets open at 75% capacity, shopping centers and malls open at 50% capacity, restaurants open for dining with 50% capacity, places of worship open with 50% capacity and strict procedures, and public facilities open with 50% capacity and strict procedures.

Acronyms: SP = Standardized Patient

3.8.7 FIGURE 3: Directed acyclic graph (DAG) depicting overall relationships among variables and individual “exposure”-outcome relationships in the cross-sectional analysis of COVET-only SP results

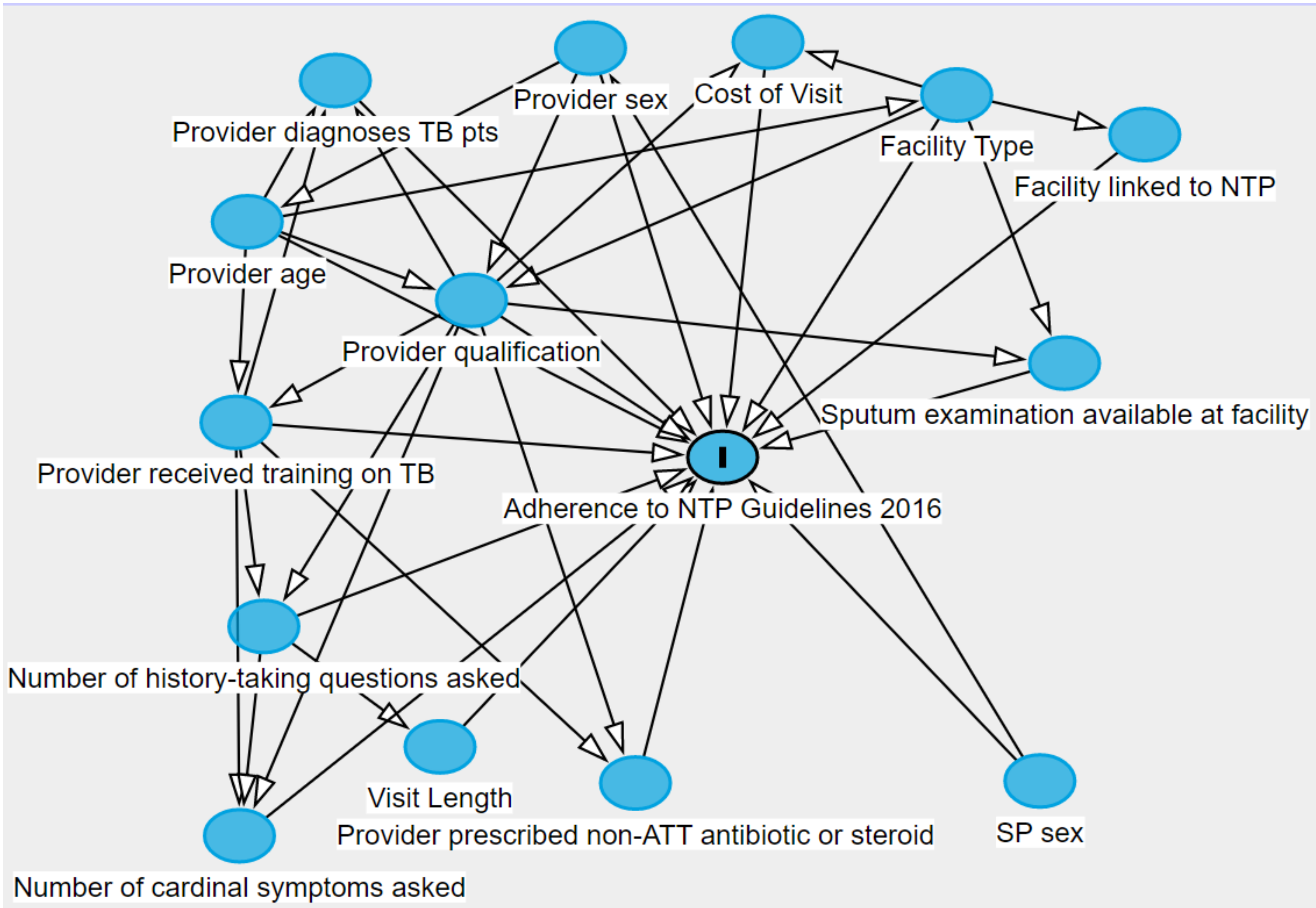

Figure 3 Directed acyclic graph depicting relationships between variables in the cross-sectional analysis of COVET-only SP results

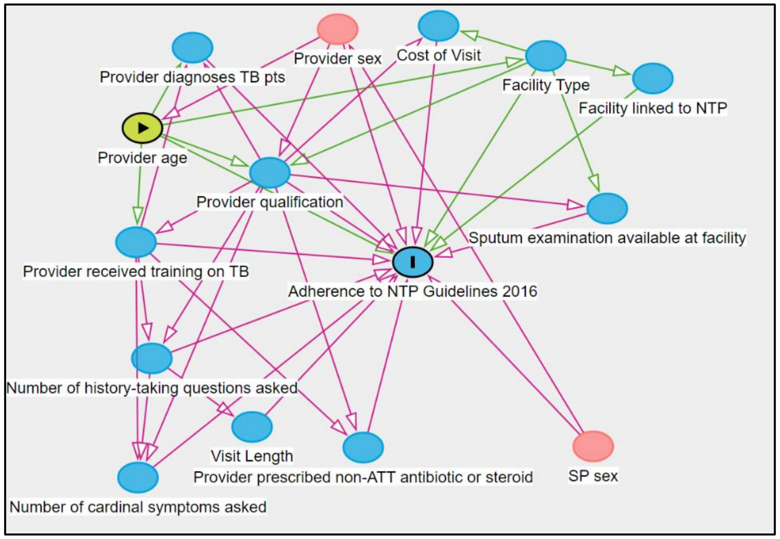

Figure 3b Exposure = Provider age. Minimal sufficient adjustment by provider sex.

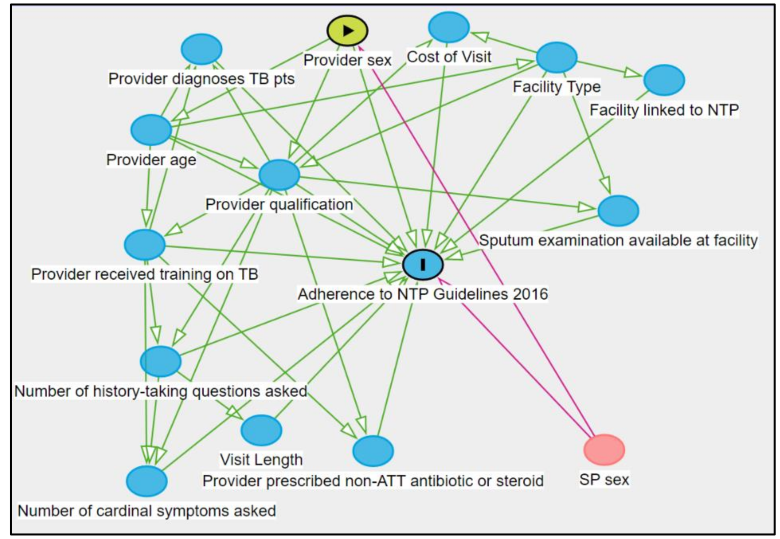

Figure 3c Exposure = Provider sex. Minimal sufficient adjustment by SP sex.

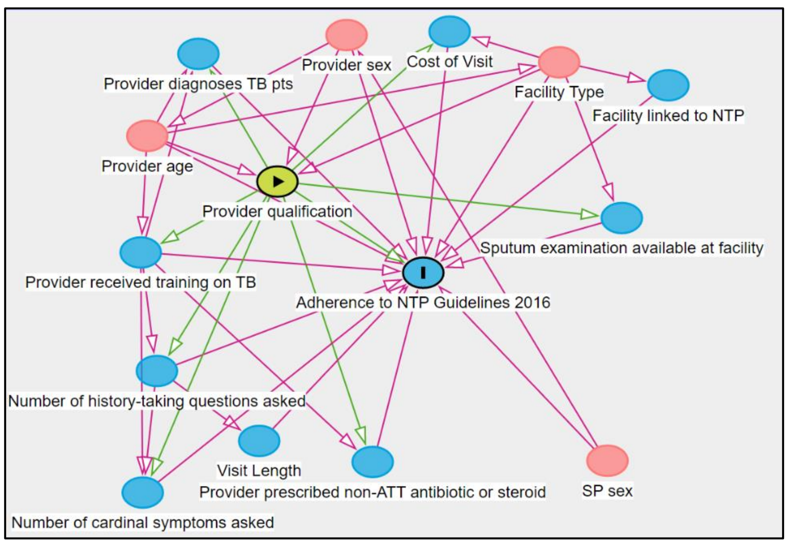

Figure 3d Exposure = Provider qualification. Minimal sufficient adjustment by facility type, provider age, and provider sex.

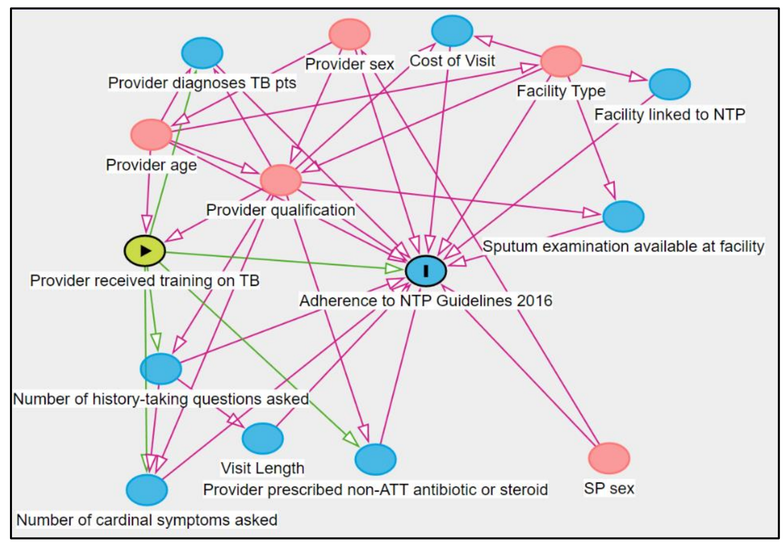

Figure 3e Exposure = Provider received training on TB. Minimal sufficient adjustment by provider age, provider qualification, and provider diagnoses at least 1 TB case per month

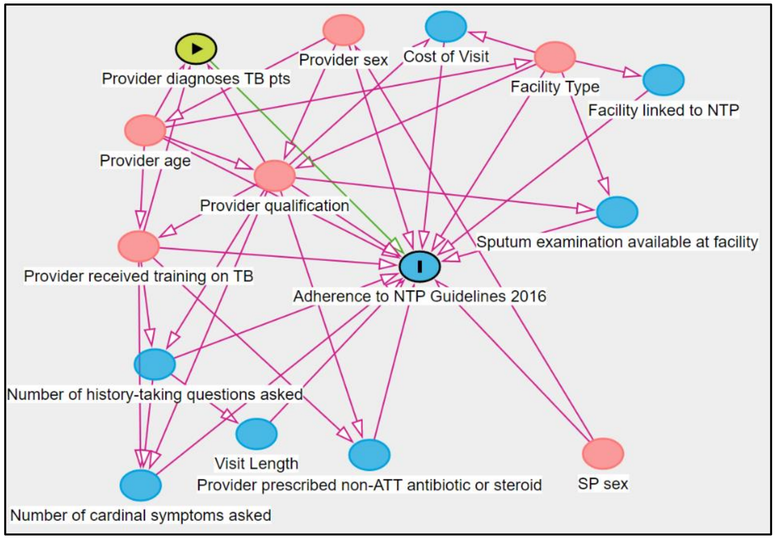

Figure 3f Exposure = Provider diagnoses at least 1 TB case per month. Minimal sufficient adjustment by provider age, provider qualification, and provider received training on TB.

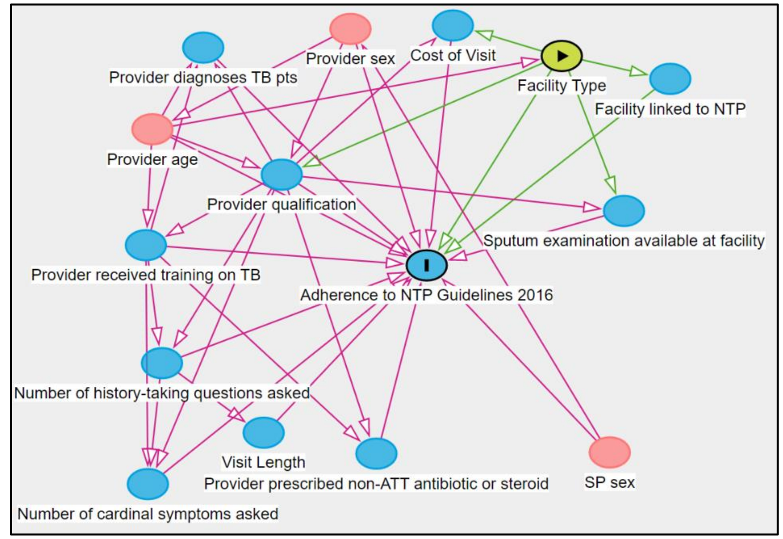

Figure 3g Exposure = Facility type. Minimal sufficient adjustment by provider age.

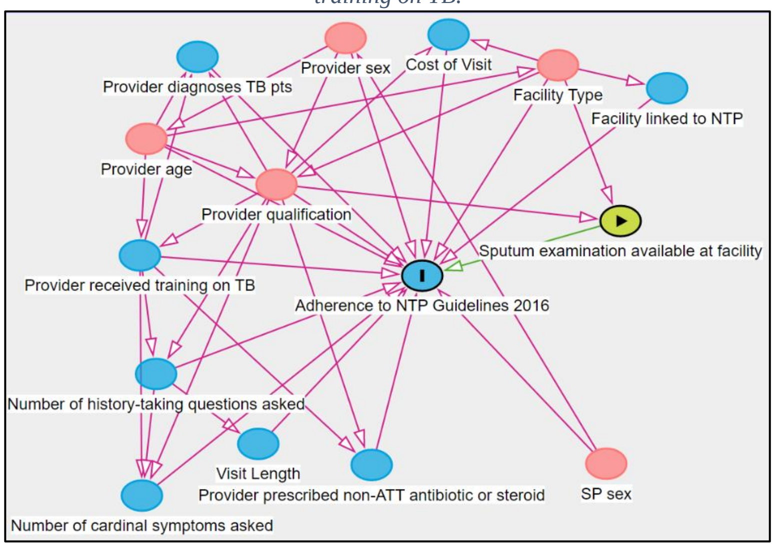

Figure 3h Exposure = Sputum examination available at facility. Minimal sufficient adjustment by facility type and provider qualification.

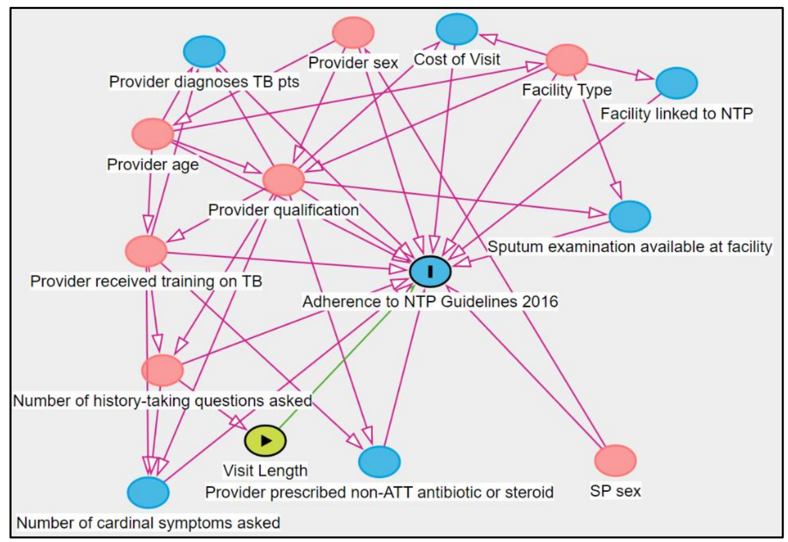

Figure 3i Exposure = Visit length. Minimal sufficient adjustment by number of history-taking questions asked.

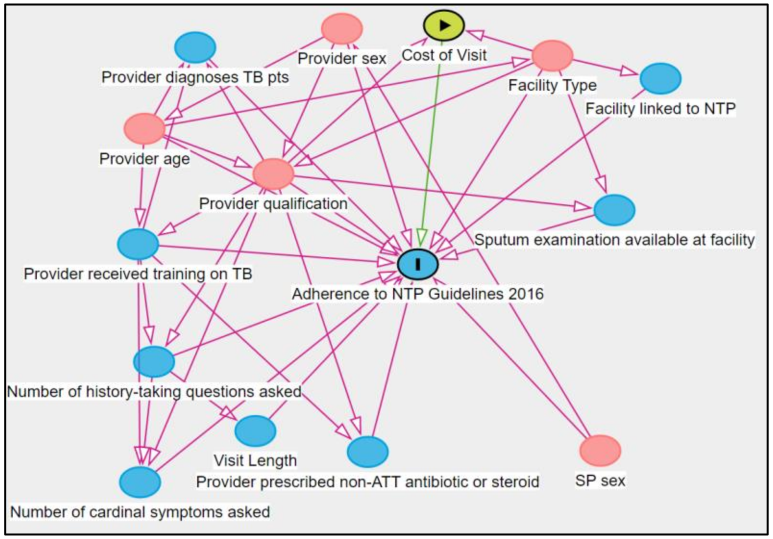

Figure 3j Exposure = Visit cost. Minimal sufficient adjustment by facility type and provider qualification.

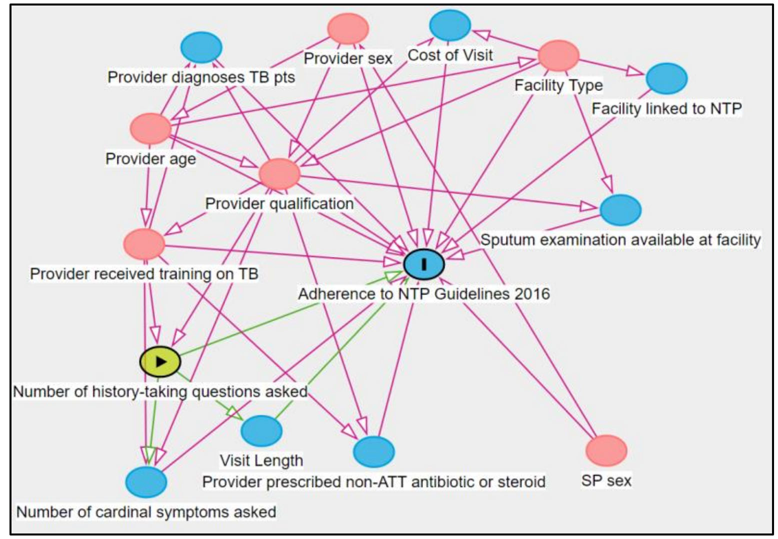

Figure 3k Exposure = Number of history-taking questions asked. Minimal sufficient adjustment by provider qualification and provider received training on TB

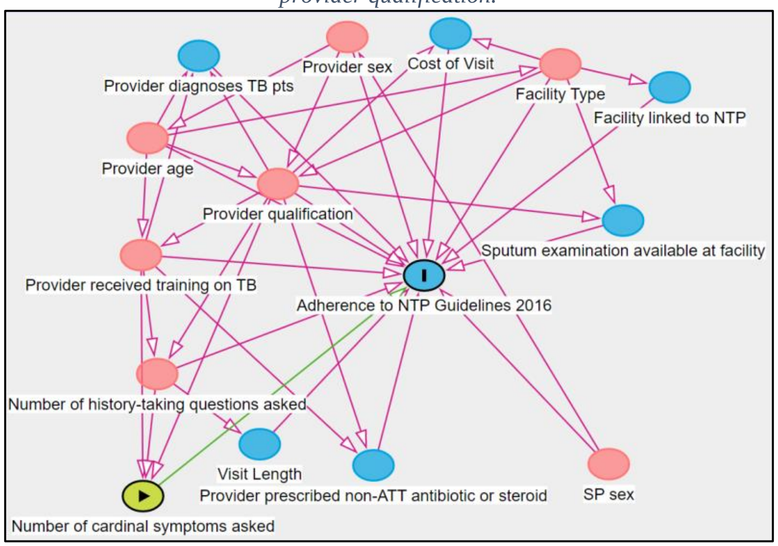

Figure 3l Exposure = Number of cardinal TB symptoms asked. Minimal sufficient adjustment by number of history-taking questions asked, provider qualification, and provider received training on TB.

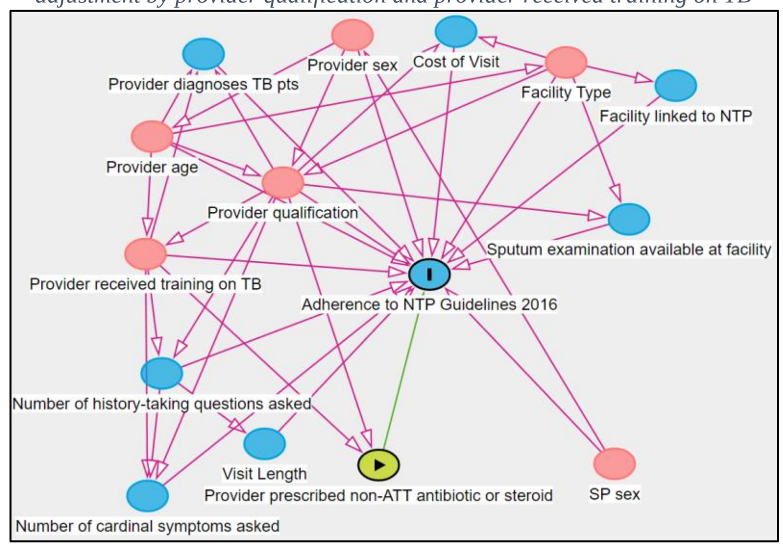

Figure 3m Exposure = Provider prescribed non-ATT antibiotic or steroid. Minimal sufficient adjustment by provider qualification and provider received training on TB.

3.8.8 FIGURE 4: Main outcomes by provider qualification (COVET study only)

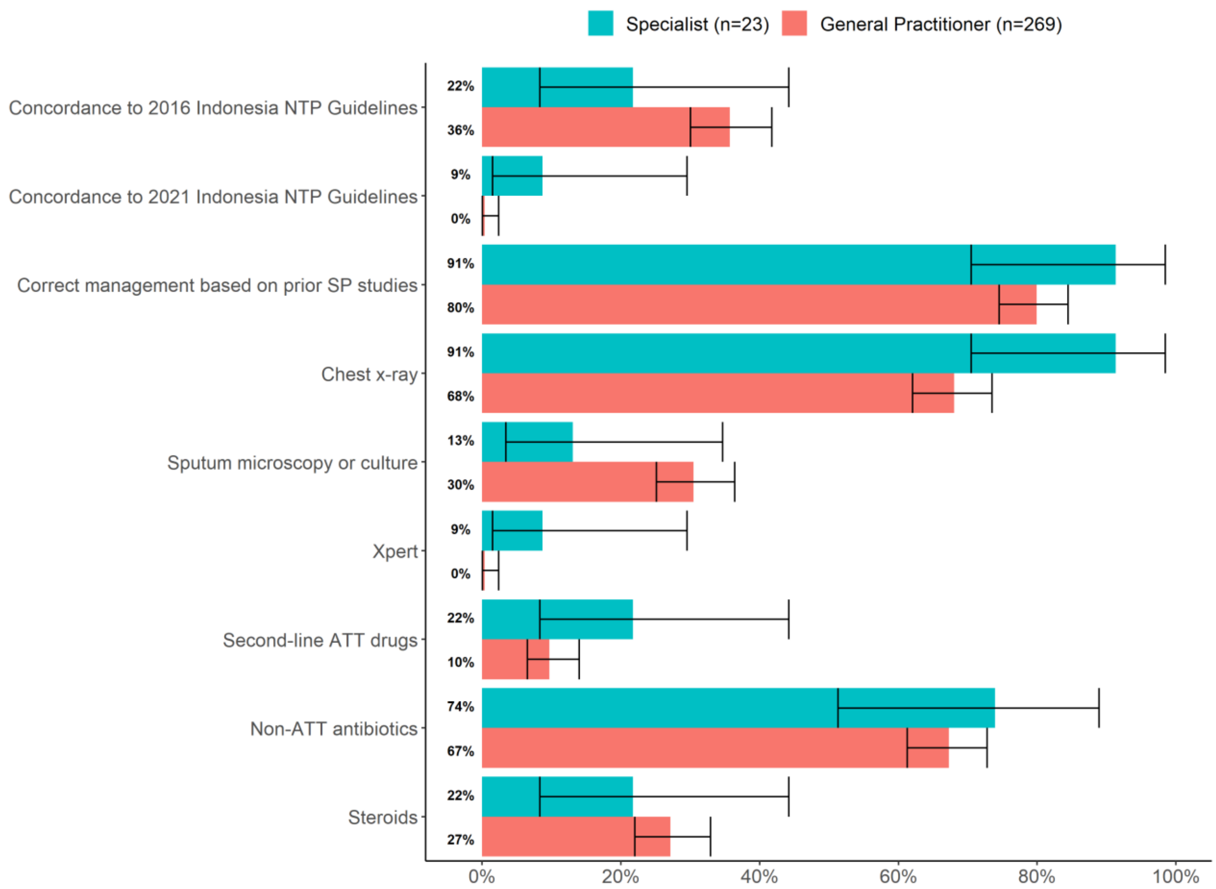

Figure 4 Main outcomes by provider qualification (COVET study only)

Caption: 2016 Indonesia NTP guidelines stipulate that correct management of presumptive tuberculosis for new patients with no history of prior TB treatment, no history of close contact with rifampicin-resistant TB patients, and unknown HIV status or HIV-negative patients is clinical assessment and bacteriological examination by sputum smear or rapid molecular test (Xpert MTB/Rif). Referral to a DOTS center was determined as correct management under these guidelines. 2021 Indonesia NTP guidelines stipulate that all those with presumptive tuberculosis should be examined with Xpert MTB/Rif examination. Correct management based on prior SP studies was defined as recommendation for chest x-ray and/or any sputum test (Acid-Fast Bacilli (AFB) smear, Xpert MTB/Rif, Culture, Drug susceptibility testing (DST)), or referral to another provider or public TB services.

Acronyms: TB = tuberculosis; NTP = National TB Programme; SP = Standardized Patient; ATT = anti-tuberculosis treatment; DOTS = Directly Observed Therapy Shortcourse; COVET = COVID Effects on TB Services in the Private Sector;

3.8.9 FIGURE 5: Characteristics related to correct management (COVET study only)

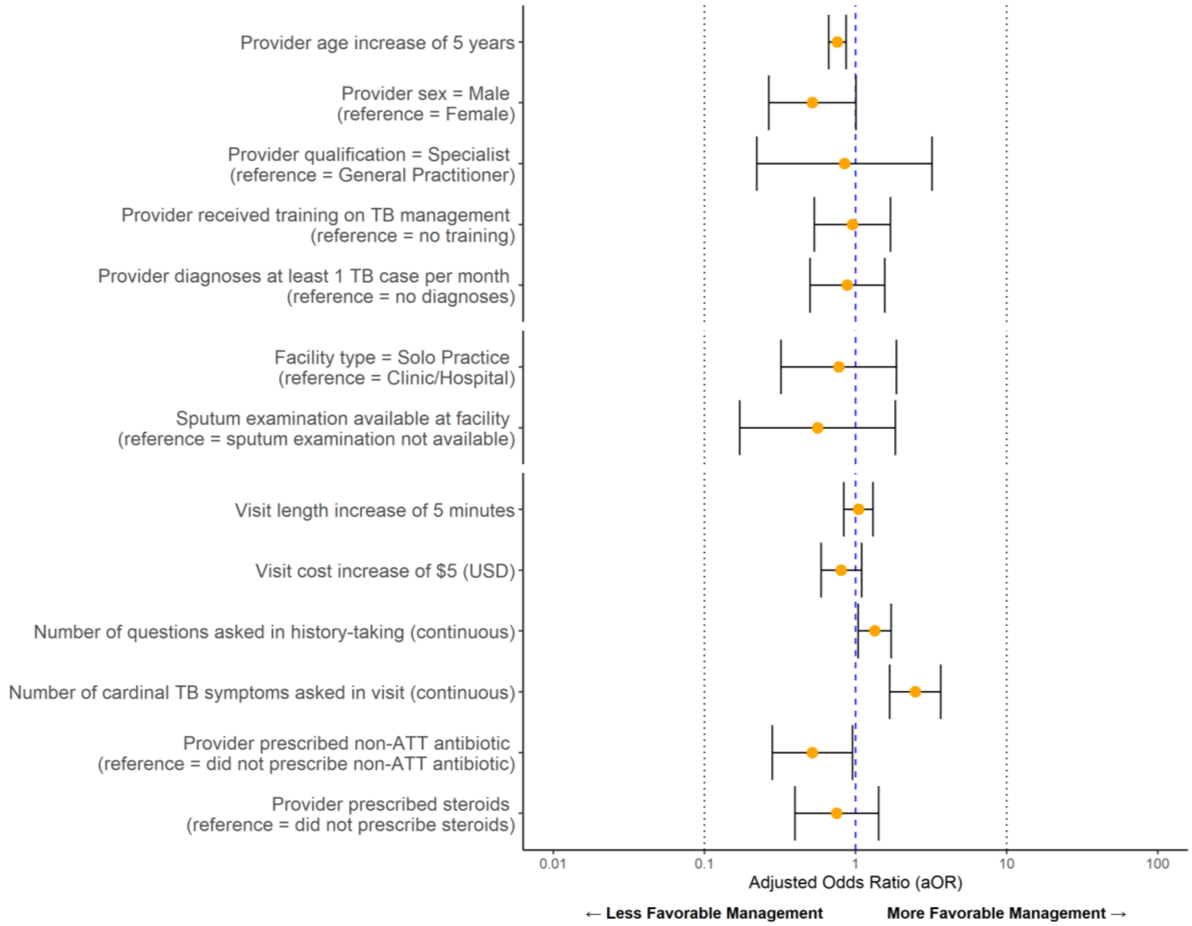

Figure 5 Characteristics related to correct management (COVET study only)

Caption: Regression of 2016 Indonesia NTP guidelines on factors of interest. The 2016 NTP guidelines stipulate that correct management of presumptive tuberculosis for new patients with no history of prior TB treatment, no history of close contact with rifampicin-resistant TB patients, and unknown HIV status or HIV-negative patients is clinical assessment and bacteriological examination by sputum smear or rapid molecular test (Xpert MTB/Rif). Referral to a DOTS center was determined as correct management under these guidelines. Provider age is adjusted by provider sex. Provider sex is adjusted by SP sex. Provider qualification is adjusted by provider age, provider sex, and facility type. Provider received training on TB management is adjusted by provider age and qualification. Provider diagnoses at least 1 TB case per month is adjusted by provider age, qualification, and provider received training on TB management. Facility type is adjusted by provider age. Sputum examination available at facility is adjusted by provider qualification and facility type. Visit length is adjusted by number of questions asked in history-taking. Visit cost is adjusted by provider qualification and facility type. Number of questions asked in history-taking, number of cardinal TB symptoms asked in visit, provider prescribed non-ATT antibiotics, and provider prescribed steroids are adjusted by provider age and qualification.

Acronyms: TB = tuberculosis; NTP = National TB Programme; SP = Standardized Patient; ATT = anti-tuberculosis treatment; DOTS = Directly Observed Therapy Shortcourse; COVET = COVID Effects on TB Services in the Private Sector

3.9 Supplementary Information

3.9.1 Supplement 1: Standardized patient case scenario and script

NARRATIVE CASE 1 (SUSPECTIVE TB)

Chief Complaint: Cough

A classic case of suspected tuberculosis with a cough lasting 2-3 weeks, low-grade fever, cold sweats, loss of appetite and other typical symptoms of TB. The patient has no history of COVID-19 and has never been tested for COVID-19.

CASE SCENARIO 1:

A (name according to Kartu Tanda Penduduk [KTP, Indonesia ID card]), a male/female (age according to KTP), is a high school graduate who works as an employee in a plastic shop (customized) at the kosambi market in Bandung. Currently A lives in a boarding house in the Ahmad Yani area (adjusted to the area of the visit).

A is not married and lives at A's parents' house in Majalaya. A earns a monthly salary of IDR 2,150,000 from the shop where he works. A does not carry an ID card/other identity card and does not have health insurance (BPJS or private insurance).

Since the last 2-3 weeks, A has a persistent cough. Cough with yellowish phlegm. Sputum is not accompanied by blood. A also complains of body heat that is not too high, intermittent and irregular. A feels sweaty at night so he has to get up and change clothes. In addition, there are complaints such as fatigue, decreased appetite and weight loss so that A's clothes feel looser.

A does not experience sore throat, runny nose/stuffy nose, wheezing when breathing, shortness of breath, chest pain, headache, muscle aches, nausea, vomiting, diarrhea, or decreased ability to smell and taste.

A has treated his complaint by taking OBH Combi® cough medicine plus panadol for 1 week but the cough has not reduced. After taking Panadol the fever disappeared and then reappeared. A does not take antibiotics.

Previously, A had no health problems or other chronic diseases, nor did his family. A started smoking when he was about 18 years old. In one day, A can smoke up to half a pack. Since the onset of cough 2-3 weeks, A began to reduce smoking habits, from half a pack to 2-3 cigarettes per day, sometimes not smoking for a whole day. However, the complaint of cough was still felt by A.

At work, since the pandemic, A always wears a mask and keeps a distance from other employees. The shop's work schedule is always divided into 2 morning and evening shifts (one day at most 2 employees, usually 4 employees). A has never been in contact with a confirmed case of covid. There is no history of traveling in the last 2 weeks outside the city or COVID red zone area. A does not feel sore throat, flu, muscle aches, reduced smell or taste. A has never done a swab test, neither antigen nor PCR.

No one has similar complaints in the family or at work. However, A's roommate is known to have frequent coughs and has been receiving treatment for pulmonary TB at the Puskesmas for the last 3 months.

A has good relationships with his family and friends. Previously, A was a man with a pleasant personality, but today, A's face looks tense due to worry about the cough and fever he is experiencing, which makes him go to an independent practice doctor.

The following dialog is based on case scenario 1:

Opening: The standardized patient (SP) complains: "Doctor, I have a cough."

Supplement Table 1 Standardized patient script

Question Number	**Speaker**	**Line**
MAIN COMPLAINT		
P1	Doctor	How long has the cough been?

	Standardized Patient	It's been about 3 weeks, Doc.
P2	Doctor	Does the cough have phlegm, sir?
	Standardized Patient	There is.
P3	Doctor	What color is the phlegm?
	Standardized Patient	The color is a bit yellow, Doc.
P4	Doctor	Are there blood clots/spots in the sputum?
	Standardized Patient	There isn't any.
P5	Doctor	Does the cough feel continuous/all day?
	Standardized Patient	Yes, Doc.
	P6	
P6	Doctor	Any fever?
	Standardized Patient	There is , Doc
P7	Doctor	How long has the fever been?
	Standardized Patient	It's been 2-3 weeks, Doc.
P8	Doctor	How's the fever? With chills, high, just warm?
	Standardized Patient	Just warm, Doc
P9	Doctor	Did the fever come on suddenly or does it get high?
	Standardized Patient	Not sure, Doc
P10	Doctor	Is the fever constant (all day) or does it come and go?
	Standardized Patient	Coming and going, Doc, before sunset to night.
P11	Doctor	Do you have night sweats even when you're not active?
	Standardized Patient	Yes, Doc, sometimes I have to change clothes.
P12	Doctor	How's your appetite now? (Appetite reduced?)
	Standardized Patient	Less appetite now, Doc. (Yes Doc)
P13	Doctor	Have you lost weight recently?
	Standardized Patient	I don't know Doc, I've never weighed it, but I think so, Doc, because lately my pants have been feeling looser.
P14	Doctor	Do you feel weaker/tired easily than usual?
	Standardized Patient	Yes, Doc, it's easier to get tired.
HISTORY OF CURRENT DISEASE		
P15	Doctor	Do you have a sore throat?

	Standardized Patient	No, Doc.
P16	Doctor	Do you have a runny nose/stuffy nose?
	Standardized Patient	No, Doc
P17	Doctor	Do you have wheezing / breath sounds / wheezy?
	Standardized Patient	No, there isn't any.
P18	Doctor	Do you have shortness of breath?
	Standardized Patient	No shortness of breath
P19	Doctor	Do you have chest pain?
	Standardized Patient	No, Doc.
P20	Doctor	Are you having a headache?
	Standardized Patient	No, Doc.
P21	Doctor	Do you have muscle pain?
	Standardized Patient	No, Doc
P22	Doctor	Are you experiencing nausea and vomiting?
	Standardized Patient	No, Doc
P23	Doctor	Do you have digestive disorders such as diarrhea?
	Standardized Patient	No, Doc.
P24	Doctor	Are you experiencing any loss of smell?
	Standardized Patient	No, Doc.
P25	Doctor	Are you experiencing any loss of taste?
	Standardized Patient	No, Doc.
TREATMENT HISTORY		
P26	Doctor	Did you take medicine before coming here?
	Standardized Patient	Yes, Doc
P27	Doctor	What's the name of the medicine?
	Standardized Patient	I bought OBH with panadol.
P28	Doctor	How long have you been taking the medicine?
	Standardized Patient	One week, Doc.
P29	Doctor	Are you taking antibiotics?
	Standardized Patient	No, Doc.

P30	Doctor	Are you taking certain drugs for a long time for other diseases or not?
	Standardized Patient	No, Doc.
HISTORY OF EXPOSURE TO COVID		
P31	Doctor	Have you ever been to an area with high COVID cases/Red Zone?
	Standardized Patient	Never, Doc.
P32	Doctor	Have you been in close contact with a person who is positive for COVID? (eating together, staying overnight, gathering in a closed room for more than 15 minutes without a mask)
	Standardized Patient	Never, Doc.
P33	Doctor	Have you ever had a swab test?
	Standardized Patient	Not yet, Doc.
P34	Doctor	Have you ever had COVID?
	Standardized Patient	Never, Doc.
HISTORY OF EXPOSURE TO TB		
P35	Doctor	Is there a family member who has lung disease/TB/lung spots/wet lungs (experiencing the same complaint as you)?
	Standardized Patient	Nothing, Doc. But a friend from my boarding house has a lung disease. Now being treated at the Puskesmas, it has been three months.
P36	Doctor	Have any family members and/or close people ever suffered from TB/spots/wet lung disease?
	Standardized Patient	No, Doc.
P37	Doctor	Who do you live at home with? There are no children?
	Standardized Patient	I live in a boarding house, if I have a toddler at home, it's my nephew visiting.
HISTORY OF PREVIOUS DISEASES		
P38	Doctor	Have you ever had TB/lung spots/wet lungs before?
	Standardized Patient	Never.
P39	Doctor	Have you ever been treated for TB/lung spots/wet lungs before (drugs that have to be taken for 6-9 months and make urine red)?

	Standardized Patient	Never.
P40	Doctor	Do you have any drug allergies? If you take medicine, you will get itchy red
	Standardized Patient	Never, Doc.
P41	Doctor	Do you have diabetes?
	Standardized Patient	Don't know.
P42	Doctor	Have you ever been told by a doctor that you have HIV/AIDS?
	Standardized Patient	Don't know.
P43	Doctor	Do you have hypertension/high blood pressure?
	Standardized Patient	Don't know.
P44	Doctor	Do you suffer from other illnesses besides the current complaint?
	Standardized Patient	No Doc, just healthy before.
P45	Doctor	Do you smoke?
	Standardized Patient	Yes, I smoke.
P46	Doctor	How much do you smoke in one day?
	Standardized Patient	Usually half a pack a day, but since this illness I have reduced it to 2-3 cigarettes per day.
P47	Doctor	Do you have a habit of consuming alcoholic beverages?
	Standardized Patient	No, Doc.
P48	Standardized Patient	Sorry, doc, let me ask, so what do you think I'm sick of?
	Doctor	For a while I can't be sure, I'm suspicious towards TB…….

3.9.2 Supplement 2: Descriptive comparison of characteristics of the SP visits in INSTEP and COVET studies

Supplement Table 2 Descriptive comparison of characteristics of the SP visits in INSTEP and COVET studies

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
Basic Visit Information								
Time spent with provider (min)	10.9 (7.6)	9.0, 13	9.7 (6.5)	9.0, 10	-1.2	-3.2, 0.84	0.3	>0.9
Number of patients when SP arrived at facility	3.1 (3.9)	2.1, 4.1	3.7 (6.2)	3.0, 4.4	0.62	-0.57, 1.8	0.3	>0.9
Number of patients when SP left facility	2.3 (2.7)	1.6, 2.9	2.7 (4.4)	2.2, 3.2	0.44	-0.38, 1.3	0.3	>0.9
Correct Management (outcome)								
Visit managed in concordance to NTP 2016 guidelines	19 (28%)	18%, 41%	101 (35%)	29%, 40%	6.2%	-6.8%, 19%	0.4	>0.9
Visit managed in concordance to NTP 2021 guidelines	0 (0%)	0.00%, 6.8%	3 (1.0%)	0.27%, 3.2%	1.0%	-1.0%, 3.1%	>0.9	>0.9
Visit managed correctly based on prior SP studies	48 (72%)	59%, 82%	236 (81%)	76%, 85%	9.2%	-3.4%, 22%	0.13	>0.9
Symptoms and History-Taking								
Number of history-taking questions asked	11.0 (4.3)	9.9, 12	10.5 (4.2)	10.0, 11	-0.53	-1.7, 0.62	0.4	>0.9
Number of cardinal TB symptoms asked in history-taking (cough duration, blood in sputum, fever, night sweats, weight loss)	3.39 (1.13)	3.1, 3.7	3.26 (1.12)	3.1, 3.4	-0.13	-0.43, 0.17	0.4	>0.9
Provider asked about cough duration	64 (96%)	87%, 99%	289 (99%)	97%, 100%	3.5%	-2.6%, 9.5%	0.14	>0.9

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
Provider asked about cough with sputum	59 (88%)	77%, 94%	244 (84%)	79%, 88%	-4.5%	-14%, 5.3%	0.5	>0.9
Provider asked about sputum color	33 (49%)	37%, 62%	121 (41%)	36%, 47%	-7.8%	-22%, 6.3%	0.3	>0.9
Provider asked about blood in sputum	21 (31%)	21%, 44%	69 (24%)	19%, 29%	-7.7%	-21%, 5.3%	0.2	>0.9
Provider asked about cough intensity (number of times per day)	25 (37%)	26%, 50%	122 (42%)	36%, 48%	4.5%	-9.3%, 18%	0.6	>0.9
Provider asked about fever	57 (85%)	74%, 92%	264 (90%)	86%, 93%	5.3%	-4.8%, 15%	0.3	>0.9
Provider asked about fever type (severe, moderate, mild)	29 (43%)	31%, 56%	94 (32%)	27%, 38%	-11%	-25%, 2.8%	0.11	>0.9
Provider asked about appetite	28 (42%)	30%, 54%	130 (45%)	39%, 50%	2.7%	-11%, 17%	0.8	>0.9
Provider asked about weight loss	39 (58%)	46%, 70%	175 (60%)	54%, 66%	1.7%	-12%, 16%	>0.9	>0.9
Provider asked about night sweats	46 (69%)	56%, 79%	154 (53%)	47%, 59%	-16%	-29%, -2.5%	0.026	>0.9
Provider asked about wheezing	19 (28%)	18%, 41%	55 (19%)	15%, 24%	-9.5%	-22%, 3.1%	0.12	>0.9
Provider asked about shortness of breath/difficulty breathing	33 (49%)	37%, 62%	182 (62%)	56%, 68%	13%	-1.0%, 27%	0.067	>0.9
Provider asked about chest pain	23 (34%)	23%, 47%	73 (25%)	20%, 30%	-9.3%	-23%, 4.0%	0.2	>0.9
Provider asked if SP had taken any medications for current symptoms	43 (64%)	51%, 75%	203 (70%)	64%, 75%	5.3%	-8.2%, 19%	0.5	>0.9
Provider asked the name of the medications	38 (57%)	44%, 69%	174 (60%)	54%, 65%	2.9%	-11%, 17%	0.8	>0.9

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
Provider asked how long the SP had taken the medications	12 (18%)	10.0%, 30%	47 (16%)	12%, 21%	-1.8%	-13%, 9.2%	0.9	>0.9
Provider asked if SP had taken any antibiotics for current symptoms	2 (3.0%)	0.52%, 11%	46 (16%)	12%, 21%	13%	6.0%, 20%	0.010	0.9
Provider asked if SP takes long-term medications for other diseases	0 (0%)	0.00%, 6.8%	9 (3.1%)	1.5%, 6.0%	3.1%	0.18%, 6.0%	0.3	>0.9
Provider asked about drug allergies	40 (60%)	47%, 71%	177 (61%)	55%, 66%	0.91%	-13%, 15%	>0.9	>0.9
Provider asked SP's family/close contacts have similar symptoms	17 (25%)	16%, 38%	114 (39%)	33%, 45%	14%	0.92%, 26%	0.051	>0.9
Provider asked about SP's TB history	4 (6.0%)	1.9%, 15%	28 (9.6%)	6.6%, 14%	3.6%	-3.9%, 11%	0.5	>0.9
Provider asked about family history of TB	14 (21%)	12%, 33%	66 (23%)	18%, 28%	1.7%	-10%, 13%	0.9	>0.9
Provider asked if SP lives at home with children	4 (6.0%)	1.9%, 15%	12 (4.1%)	2.2%, 7.3%	-1.9%	-8.9%, 5.2%	0.7	>0.9
Provider asked about anti-TB drug history	1 (1.5%)	0.08%, 9.1%	9 (3.1%)	1.5%, 6.0%	1.6%	-2.8%, 6.0%	0.8	>0.9
Provider asked about history of diabetes	0 (0%)	0.00%, 6.8%	26 (8.9%)	6.0%, 13%	8.9%	4.7%, 13%	0.023	>0.9
Provider asked about history of HIV	0 (0%)	0.00%, 6.8%	2 (0.7%)	0.12%, 2.7%	0.68%	-0.95%, 2.3%	>0.9	>0.9
Provider asked about history of hypertension	3 (4.5%)	1.2%, 13%	33 (11%)	8.0%, 16%	6.8%	-0.23%, 14%	0.15	>0.9
Provider asked about other disease history	8 (12%)	5.7%, 23%	35 (12%)	8.6%, 16%	0.05%	-8.6%, 8.7%	>0.9	>0.9

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
Provider asked about alcohol consumption	0 (0%)	0.00%, 6.8%	2 (0.7%)	0.12%, 2.7%	0.68%	-0.95%, 2.3%	>0.9	>0.9
Provider asked about smoking status	29 (43%)	31%, 56%	93 (32%)	27%, 38%	-11%	-25%, 2.5%	0.10	>0.9
Provider seemed to take note of the information provided by SP	59 (88%)	77%, 94%	260 (89%)	85%, 92%	1.0%	-8.5%, 10%	>0.9	>0.9
Physical Examinations Conducted								
Number of exams conducted	3.75 (1.74)	3.3, 4.2	3.77 (1.54)	3.6, 3.9	0.02	-0.43, 0.48	>0.9	>0.9
Provider measured pulse rate	46 (69%)	56%, 79%	218 (75%)	69%, 79%	6.0%	-7.1%, 19%	0.4	>0.9
Provider measured temperature with thermometer	17 (25%)	16%, 38%	193 (66%)	60%, 71%	41%	28%, 53%	<0.001	<0.001
Provider measured blood pressure	56 (84%)	72%, 91%	254 (87%)	82%, 91%	3.4%	-7.2%, 14%	0.6	>0.9
Provider conducted throat examination	37 (55%)	43%, 67%	53 (18%)	14%, 23%	-37%	-51%, -23%	<0.001	<0.001
Provider conducted cervical lymph node examination	18 (27%)	17%, 39%	38 (13%)	9.5%, 18%	-14%	-26%, -1.6%	0.008	0.7
Provider conducted chest examination with a stethoscope	60 (90%)	79%, 95%	248 (85%)	80%, 89%	-4.6%	-14%, 4.7%	0.4	>0.9
Provider measured body weight	17 (25%)	16%, 38%	90 (31%)	26%, 37%	5.4%	-7.2%, 18%	0.5	>0.9
Provider measured body height	0 (0%)	0.00%, 6.8%	7 (2.4%)	1.1%, 5.1%	2.4%	-0.27%, 5.1%	0.4	>0.9
Tests and Examinations Recommended								
Any diagnostic test	48 (72%)	59%, 82%	234 (80%)	75%, 84%	8.5%	-4.1%, 21%	0.2	>0.9

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
Any TB test (Chest x-ray/Sputum test)	48 (72%)	59%, 82%	216 (74%)	68%, 79%	2.3%	-10%, 15%	0.8	>0.9
Any TB sputum test	19 (28%)	18%, 41%	86 (29%)	24%, 35%	1.1%	-12%, 14%	>0.9	>0.9
Chest x-ray	44 (66%)	53%, 77%	204 (70%)	64%, 75%	4.2%	-9.3%, 18%	0.6	>0.9
Xpert	0 (0%)	0.00%, 6.8%	3 (1.0%)	0.27%, 3.2%	1.0%	-1.0%, 3.1%	>0.9	>0.9
Sputum microscopic examination/Acid Fast Bacilli test	19 (28%)	18%, 41%	81 (28%)	23%, 33%	-0.62%	-13%, 12%	>0.9	>0.9
Sputum culture	0 (0%)	0.00%, 6.8%	4 (1.4%)	0.44%, 3.7%	1.4%	-0.88%, 3.6%	0.8	>0.9
Drug Sensitivity Testing	0 (0%)	0.00%, 6.8%	1 (0.3%)	0.02%, 2.2%	0.34%	-0.67%, 1.4%	>0.9	>0.9
Routine hematology test	7 (10%)	4.7%, 21%	44 (15%)	11%, 20%	4.6%	-4.7%, 14%	0.4	>0.9
Erythrocyte Sedimentation Rate	3 (4.5%)	1.2%, 13%	17 (5.8%)	3.5%, 9.3%	1.3%	-5.2%, 7.9%	0.9	>0.9
TB Serology test (IGRA, etc.)	0 (0%)	0.00%, 6.8%	1 (0.3%)	0.02%, 2.2%	0.34%	-0.67%, 1.4%	>0.9	>0.9
Diabetes test/glucose test	2 (3.0%)	0.52%, 11%	4 (1.4%)	0.44%, 3.7%	-1.6%	-6.8%, 3.6%	0.7	>0.9
Other test	4 (6.0%)	1.9%, 15%	9 (3.1%)	1.5%, 6.0%	-2.9%	-9.8%, 4.0%	0.4	>0.9
Type of facility recommended for TB test referral								
This HCF	16 (5.5%)	3.3%, 8.9%	5 (7.5%)	2.8%, 17%				
Private HCF not linked to	64 (22%)	17%,	27 (40%)	29%, 53%				

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
NTP		27%						
Public HCF linked to NTP	27 (9.2%)	6.3%, 13%	6 (9.0%)	3.7%, 19%				
Public HCF not linked to NTP	8 (2.7%)	1.3%, 5.5%	0 (0%)	0.00%, 6.8%				
Private HCF linked to NTP	2 (0.7%)	0.12%, 2.7%	1 (1.5%)	0.08%, 9.1%				
More than one HCF type	32 (11%)	7.7%, 15%	5 (7.5%)	2.8%, 17%				
Not specified	67 (23%)	18%, 28%	4 (6.0%)	1.9%, 15%				
Not applicable	76 (26%)	21%, 32%	19 (28%)	18%, 41%				
Type of facility recommended for all test referrals								
This HCF	20 (6.8%)	4.3%, 11%	5 (7.5%)	2.8%, 17%				
Private HCF not linked to NTP	56 (19%)	15%, 24%	26 (39%)	27%, 52%				
Public HCF linked to NTP	29 (9.9%)	6.9%, 14%	6 (9.0%)	3.7%, 19%				
Public HCF not linked to NTP	7 (2.4%)	1.1%, 5.1%	0 (0%)	0.00%, 6.8%				
Private HCF linked to NTP	2 (0.7%)	0.12%, 2.7%	1 (1.5%)	0.08%, 9.1%				
More than one HCF type	49 (17%)	13%,	6 (9.0%)	3.7%, 19%				

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
		22%						
Not specified	71 (24%)	20%, 30%	4 (6.0%)	1.9%, 15%				
Not applicable	58 (20%)	16%, 25%	19 (28%)	18%, 41%				
Diagnosis and Counseling								
Working diagnosis given by the provider								
Tuberculosis	40 (60%)	47%, 71%	133 (46%)	40%, 51%				
Upper respiratory infection	6 (9.0%)	3.7%, 19%	52 (18%)	14%, 23%				
No diagnosis given	16 (24%)	15%, 36%	37 (13%)	9.2%, 17%				
Lower respiratory infection, unspecified	1 (1.5%)	0.08%, 9.1%	37 (13%)	9.2%, 17%				
Lower respiratory infection, bronchitis	2 (3.0%)	0.52%, 11%	14 (4.8%)	2.7%, 8.1%				
Allergy	2 (3.0%)	0.52%, 11%	10 (3.4%)	1.7%, 6.4%				
Lower respiratory infection, COVID-19	NA	NA	7 (2.4%)	1.1%, 5.1%				
Heart disease	0 (0%)	0.00%, 6.8%	1 (0.3%)	0.02%, 2.2%				
Occupational fatigue	0 (0%)	0.00%, 6.8%	1 (0.3%)	0.02%, 2.2%				
Provider asked SP to return...	51 (76%)	64%, 85%	164 (56%)	50%, 62%	-20%	-33%, -7.3%	0.004	0.4
...if symptoms persist or worsen	22 (43%)	30%, 58%	83 (51%)	43%, 58%	7.5%	-9.4%, 24%	0.4	>0.9

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
...to take medication	7 (14%)	6.2%, 27%	6 (3.7%)	1.5%, 8.2%	-10%	-21%, 1.1%	0.022	>0.9
...to receive lab test results	41 (80%)	66%, 90%	99 (60%)	52%, 68%	-20%	-35%, -5.5%	0.014	>0.9
...for another reason	3 (5.9%)	1.5%, 17%	26 (16%)	11%, 23%	10.0%	0.15%, 20%	0.11	>0.9
Provider explained the duration of treatment given	36 (54%)	41%, 66%	147 (50%)	44%, 56%	-3.4%	-18%, 11%	0.7	>0.9
Provider explained the importance of taking medicine regularly	28 (42%)	30%, 54%	101 (35%)	29%, 40%	-7.2%	-21%, 6.7%	0.3	>0.9
Provider explained the importance of undergoing treatment to completion	22 (33%)	22%, 46%	99 (34%)	29%, 40%	1.1%	-12%, 14%	>0.9	>0.9
Provider explained the side effects that could arise from the prescribed medication	5 (7.5%)	2.8%, 17%	15 (5.1%)	3.0%, 8.5%	-2.3%	-10%, 5.4%	0.7	>0.9
Provider explained cough etiquette	5 (7.5%)	2.8%, 17%	13 (4.5%)	2.5%, 7.7%	-3.0%	-11%, 4.6%	0.5	>0.9
Provider explained the importance of quitting smoking	16 (24%)	15%, 36%	52 (18%)	14%, 23%	-6.1%	-18%, 6.0%	0.3	>0.9
Provider advised SP to register for Indonesia national health insurance	9 (13%)	6.7%, 24%	17 (5.8%)	3.5%, 9.3%	-7.6%	-17%, 1.9%	0.057	>0.9
Prescriptions								
Provider prescribed and/or dispensed medication	60 (90%)	79%, 95%	279 (96%)	92%, 98%	6.0%	-2.6%, 15%	0.10	>0.9
Number of medications prescribed	3.23 (1.01)	3.0, 3.5	3.38 (0.96)	3.3, 3.5	0.15	-0.14, 0.43	0.3	>0.9

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
Provider prescribed non-ATT antibiotics	49 (73%)	61%, 83%	198 (68%)	62%, 73%	-5.3%	-18%, 7.5%	0.5	>0.9
Cephalosporin and other beta lactam antibiotics	17 (25%)	16%, 38%	121 (41%)	36%, 47%	16%	3.3%, 29%	0.022	>0.9
Penicillin	12 (18%)	10.0%, 30%	17 (5.8%)	3.5%, 9.3%	-12%	-23%, -1.6%	0.002	0.2
Quinolones: ciprofloxacin, ofloxacin	8 (12%)	5.7%, 23%	27 (9.2%)	6.3%, 13%	-2.7%	-12%, 6.7%	0.7	>0.9
Macrolide	8 (12%)	5.7%, 23%	26 (8.9%)	6.0%, 13%	-3.0%	-12%, 6.3%	0.6	>0.9
Sulfonamide and trimethoprim	1 (1.5%)	0.08%, 9.1%	3 (1.0%)	0.27%, 3.2%	-0.47%	-4.1%, 3.1%	>0.9	>0.9
Tetracycline	0 (0%)	0.00%, 6.8%	1 (0.3%)	0.02%, 2.2%	0.34%	-0.67%, 1.4%	>0.9	>0.9
Other antibiotics	3 (4.5%)	1.2%, 13%	4 (1.4%)	0.44%, 3.7%	-3.1%	-9.2%, 2.9%	0.2	>0.9
Provider prescribed First-Line ATT antibiotics (Rifampicin, Isoniazid, Ethambutol, or Pyrazinamide)	2 (3.0%)	0.52%, 11%	0 (0%)	0.00%, 1.6%	-3.0%	-8.0%, 2.0%	0.040	>0.9
Provider prescribed Second Line ATT antibiotics (Levofloxacin)	3 (4.5%)	1.2%, 13%	31 (11%)	7.4%, 15%	6.1%	-0.86%, 13%	0.2	>0.9
Provider prescribed anti-inflammation medication (Corticosteroids)	21 (31%)	21%, 44%	78 (27%)	22%, 32%	-4.6%	-18%, 8.5%	0.5	>0.9
Provider prescribed vitamin	7 (10%)	4.7%, 21%	110 (38%)	32%, 44%	27%	17%, 37%	<0.001	0.003
Provider prescribed	59 (88%)	77%, 94%	207 (71%)	65%, 76%	-17%	-27%, -	0.006	0.5

	INSTEP study, 2018-2019		COVET study, 2021-2022		Difference between studies			
Characteristic	**N = 67[1]**	**95% CI[2]**	**N = 292[1]**	**95% CI[2]**	**Difference[3]**	**95% CI[3,2]**	**p-value[3]**	**q-value[4]**
symptomatic/over the counter medication						6.9%		
Provider dispensed drug with no label	5 (7.5%)	2.8%, 17%	48 (16%)	12%, 21%	9.0%	0.46%, 17%	0.094	>0.9
Costs								
Total cost of entire visit (IDR)	119,413 (84,544)	98,791, 140,035	121,869 (75,417)	113,182, 130,555	2,456	-19,853, 24,765	0.8	>0.9
Total cost of entire visit (USD)	8.3 (5.9)	6.9, 9.8	8.4 (5.2)	7.8, 9.0	0.13	-1.4, 1.7	0.9	>0.9
Global Assessment Score								
"On a scale of 1(lowest) to 10 (highest), how much would you rate the doctor?"	6.46 (1.46)	6.1, 6.8	7.03 (1.51)	6.9, 7.2	0.58	0.18, 1.0	0.005	0.4

[1] Mean (SD); n (%)
[2] CI = Confidence Interval
[3] Welch Two Sample t-test; Two sample test for equality of proportions
[4] Bonferroni-Holm correction for multiple testing
Acronyms: INSTEP = Investigation of services delivered for TB by external care system - especially the private sector; COVET = COVID Effects on TB Services in the Private Sector; TB = tuberculosis; SP = Standardized Patient; NTP = Indonesian National Tuberculosis Programme; HIV= human immunodeficiency virus; IGRA = Interferon-Gamma Release Assay; COVID-19 = coronavirus disease 2019; ATT = anti-tuberculosis treatment; IDR = Indonesian Rupiah; USD = United States Dollar

3.9.3 Supplement 3: Characteristics of the SP visits related to COVID-19 (COVET study only)

Supplement Table 3 Characteristics of the SP visits related to COVID-19 (COVET study only)

Characteristic	N = 292[1]	95% CI[2]
Symptoms and History Taking		
Provider asked about runny nose/stuffy nose	165 (57%)	51%, 62%
Provider asked about nausea and/or vomiting	100 (34%)	29%, 40%
Provider asked about sore throat	144 (49%)	43%, 55%
Provider asked about impaired smell (anosmia)	83 (28%)	23%, 34%
Provider asked about indigestion and/or diarrhea	75 (26%)	21%, 31%
Provider asked about fatigue	61 (21%)	16%, 26%
Provider asked about headache	51 (17%)	13%, 22%
Provider asked about taste disturbance (ageusia)	44 (15%)	11%, 20%
Provider asked about close contact with people who are positive for COVID-19 (eating together, staying overnight, gathering in a closed room for more than 15 minutes without a mask)	35 (12%)	8.6%, 16%
Provider asked about muscle ache	32 (11%)	7.7%, 15%
Provider asked if the SP has had a swab test (PCR/Antigen/Antibody)	60 (21%)	16%, 26%
Provider asked if the SP had gone outside the city or area with high COVID-19 case numbers (red zone)	16 (5.5%)	3.3%, 8.9%
Provider asked if the SP has a previous history of suffering from COVID-19	13 (4.5%)	2.5%, 7.7%
Tests/Examinations Recommended		
Any COVID-19 test	58 (20%)	16%, 25%
Antigen/Rapid antigen swab test	41 (14%)	10%, 19%
PCR swab test	28 (9.6%)	6.6%, 14%
Rapid antibody test	1 (0.3%)	0.02%, 2.2%
COVID-19 Diagnosis and Counseling		

Provider told SP they might have COVID-19	40 (14%)	10%, 18%
Provider identified COVID-19 as the working diagnosis	23 (7.9%)	5.2%, 12%
Provider recommended SP to take the COVID-19 test offered at this facility	27 (9.2%)	6.3%, 13%
Provider explained the importance of wearing masks	39 (13%)	9.8%, 18%
Provider explained the importance of avoiding crowds	14 (4.8%)	2.7%, 8.1%
Provider explained the follow-up actions needed to be done if COVID-19 test result is positive	12 (4.1%)	2.2%, 7.3%

[1] n (%)

[2] CI = Confidence Interval

Acronyms: COVET = COVID Effects on TB Services in the Private Sector; COVID-19 = Coronavirus disease 2019; SP = Standardized Patient; PCR = Polymerase Chain Reaction

3.9.4 Supplement 4: Regressions on outcomes of interest comparing INSTEP and COVET studies

Supplement Table 4 Regression on outcomes of interest comparing INSTEP and COVET studies

Binary Outcomes	**N[1]**	**aOR[2]**	**95% CI[3]**	**p-value[4]**
NTP 2016 Guidelines	340	0.97	0.44, 2.14	>0.9
Correct management based on prior SP studies	340	0.74	0.00, 113	>0.9
Recommendation for any TB test	340	1.09	0.53, 2.24	>0.9
Recommendation for chest x-ray	340	1.35	0.67, 2.71	>0.9
Recommendation for any sputum test	340	0.73	0.33, 1.60	>0.9
Prescribed steroids	340	0.74	0.34, 1.58	>0.9
Prescribed other non-ATT antibiotics	340	0.70	0.35, 1.42	>0.9
Checked SP's temperature	340	8.05	2.96, 21.9	<0.001
Conducted throat examination	340	0.16	0.06, 0.41	0.002
Examined SP's lymph nodes	340	0.41	0.18, 0.94	0.43
Referral to public DOTS	340	0.70	0.27, 1.83	>0.9
Request to come back	340	0.43	0.20, 0.94	0.43
Linear Outcome	**N[1]**	**Beta**	**95% CI[3]**	**p-value[4]**
Length of visit (minutes)	340	-0.32	-2.5, 1.9	>0.9
Number of questions asked	340	-0.91	-2.2, 0.37	>0.9
Number of exams	340	0.01	-0.52, 0.54	>0.9
Cost of visit (USD)[5]	340	1.6	0.39, 2.9	0.15

[1] 19 observations removed due to missing age (13 in INSTEP and 6 in COVET)

[2] aOR = Adjusted Odds Ratio of outcomes described by study year, controlled by provider qualification and age (reference = 2018 INSTEP study)

[3] CI = Confidence Interval

[4] Adjusted using the Bonferroni-Holm method

[5] Additionally controlled by whether the provider prescribed medication

Acronyms: INSTEP = Investigation of services delivered for TB by external care system - especially the private sector; COVET = COVID Effects on TB Services in the Private Sector; NTP = National Tuberculosis Programme; SP = Standardized Patient; TB = tuberculosis; ATT = anti-tuberculosis treatment; DOTS = Directly Observed Treatment Shortcourse; USD = United States Dollar

3.10 References to Chapter 3

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4 Discussion

4.1 Summary of findings

Findings from this study indicate that management of presumptive TB cases by private providers in Bandung, Indonesia remains sub-optimal. Fewer than half of private providers correctly managed SPs presenting with presumptive TB symptoms according to the Indonesia NTP guidelines. Correct TB management was positively associated with more history-taking questions asked and more main TB symptoms inquired about, and negatively associated with older providers and providers who prescribed unnecessary antibiotics. Our study did not detect any significant changes to overall management of presumptive TB cases in the SP visits conducted during the COVID-19 pandemic as compared to those conducted before the onset of COVID-19. We also saw little evidence of bi-directional screening for COVID-19 and TB among private providers in this setting.

Although we observed low adherence to Indonesian NTP guidelines, most private providers (70%) referred the SP to receive a chest x-ray, which is defined as proper management for TB by other guidelines such as the ISTC 2014 guidelines. The WHO recommends the use of microbiological testing methods for diagnosing TB over chest x-ray, though it can be used as an indication for a full diagnostic evaluation (1). The high level of recommendations for chest x-ray seen in this sample is an indication that most private providers in this setting are identifying that their patients have a lung infection that could be TB. Additionally, private providers named TB as the working diagnosis in 52% of visits where a diagnosis was given (46% of all visits). These results indicate that private providers know how to identify presumptive TB, even though they are not following the NTP guidelines for microbiological diagnosis of TB. One reason for this disconnect is that private providers may not be properly exposed to the NTP guidelines nor sensitized on the importance of following these guidelines. Private provider engagement has been limited in Indonesia to date and has focused primarily on private hospital linkage to DOTS (2–4). In 2021, the Indonesia Medical Association (IDI) announced they would begin offering continuing medical education credits as a reward to providers who notify TB patients to the NTP (5). Proper engagement of private providers through initiatives like these could result in increased TB diagnoses and notifications by the private health sector, as has been seen elsewhere in Indonesia (6) and in other similar settings (7–9). Expansion of diagnostic tools into private facilities or implementation of expedited referral systems could be another way to accelerate improvement in this area, as previous studies such as Lestari et al (2017) have indicated that patients often refuse referrals to the public sector due to lack of convenience, long waiting times, and a lack of trust in the public system (6). It has been well-established that people with TB in Indonesia prefer to visit private providers, despite these services costing more than the public sector (10–12). Improving the quality of care among private providers and the connection of private providers to the NTP is a person-centred approach, responding to the needs and preferences of patients.

Results from this study also show low rates of referral for sputum microscopy by private providers. These results contradict findings from several studies that use telephone surveys of Indonesian private providers to estimate their rate of referral for various methods of TB diagnosis. Prior surveys reported that between 62.3% and 85.7% of private providers utilize smear microscopy in diagnosing TB, including 74.1% of surveyed providers in Bandung (13–15). Conversely, our study showed just 29% of private providers in Bandung (30% of GPs, 19% of specialists) referred SPs presenting with presumptive TB symptoms to smear microscopy. SP studies from other contexts including India, South Africa, and China have found similar results of low smear microscopy utilization (16–19). Prior SP studies have demonstrated that providers' self-reported knowledge of TB management guidelines is often higher than their actual performance, a phenomenon called the "know-do gap" (20). One such study by Sylvia et al. in China showed that although 26% of providers said they would recommend a presumptive TB case to receive a sputum AFB test, only 4% of those same providers made that referral when they were visited by an SP presenting with textbook TB symptoms (18). Again, proper engagement of private practitioners on the importance of sputum TB testing over chest x-ray could result in private providers diagnosing more TB cases.

As in the previous study, we also observed very low rates of referral for Xpert testing among private providers (0% of visits in INSTEP, 1% of visits in COVET). The 2021 updated NTP guidelines stipulate that all presumptive TB cases must be referred for Xpert testing (21), however implementation of these guidelines has slowed as a result of the COVID-19 pandemic. The findings from this study indicate that uptake of Xpert testing by private providers is almost non-existent. One possible explanation for the low referral of SPs to Xpert testing could be the limited availability of Xpert machines in Bandung. At present, Bandung only has 16 Xpert machines (source: Bandung District Health Office, unpublished data). Nine of these are at Puskesmas, which represent just 11% of all the Puskesmas in the city. The remainder are found at public hospitals. In addition to further scale-up of Xpert machines, stronger measures for private provider engagement will be needed if this guideline is to be implemented throughout the Indonesian health system.

Findings from this study indicate that quality of TB screening among private practitioners is low in this setting but was not found to be significantly worse in the COVID-19 era. However, our study is limited by its small, fixed sample size, which only allowed us to detect a difference of 15 percentage points in our main outcome across the two SP studies. Some experts were concerned that providers would mistake TB cases for COVID-19 cases given the overlap in symptoms (22). These results provide some evidence to support this concern, as 14% of providers suspected that the SPs had COVID-19. We also found a lack of evidence to support that bi-directional screening of TB and COVID-19 is occurring at private hospitals and clinics, despite strong governmental support for bi-directional screening (23). Providers in the SP study conducted during COVID-19 were more likely to conduct temperature checks (aOR 8.05, 95% CI: 2.96–21.9, $p < 0.001$) and less likely to conduct throat examinations (aOR 0.16, 95% CI: 0.06–0.41, $p = 0.002$) compared to the pre-COVID-19 study. This is likely due to the increased emphasis on temperature checks as a means of COVID-19 screening and infection control at health facilities, and the increased emphasis on social distancing measures and other means to prevent COVID-19 from spreading in health facilities, respectively. More studies will be needed to determine if changes in provider behavior due to COVID-19, e.g., increased temperature checks, are temporary or long-lasting.

These results agree with those found in the SP study conducted before the onset of COVID-19 in this sampling area. In the prior study, 30% of private general practitioners (GPs) and 20% of private specialists correctly managed SPs presenting with presumptive TB symptoms according to Indonesian national guidelines (24), compared to 32% and 26%, respectively, in this study. The results in this study also agree with those found in other similar contexts. Similarly high usage of unnecessary antibiotics was found in SP studies in South Africa, India, and China (19, 25, 26). We observed an association with provider age similar to that found in an SP study conducted in China (18), and an association with number of main TB symptoms asked similar to that found in an SP study conducted in South Africa (17). Some previous SP studies have found associations with correct management and certain factors that we did not observe in our study, such as provider qualification, facility type, presence of sputum smear technology in the facility, prior training on TB, and whether the provider reported diagnosing at least one TB case per month (16, 18, 19). SP studies conducted in China and India found positive associations between higher provider qualification, defined as having a practicing physician certificate in China and at least an MBBS in India, and correct management of SPs presenting with presumptive TB symptoms. In this study, provider qualification was instead dichotomized as general practitioner or specialist. It is possible that if informal providers had been included in our sample, we may have seen a difference by provider qualification more akin to what was seen in the previous SP studies. Similarly, the facility type variable used in our study compared multi-provider practice settings to solo practices, which may not provide fundamentally different care, unlike county hospitals vs. village clinics observed in Sylvia et al 2017 (18). Previous provider training in TB, availability of sputum examination at the facility, and whether the provider diagnoses at least one TB case per month were collected via facility and provider surveys conducted during the mapping exercise that preceded SP visits. Associations between our outcome and these self-reported variables could be masked by information biases; further studies may need to be conducted to appropriately estimate the importance of these factors on correct management of presumptive TB cases.

4.2 Strengths and Limitations

This thesis presents the results from a unique comparison of two identical SP studies conducted in the same geographic area before and during the COVID-19 pandemic. We offer here insight into provider behavior related to TB care during a time of immense importance for the future of TB. The SP methodology allows for us to observe provider behavior in a simulated environment without being subjected to reporting bias or the Hawthorne effect (20). Thus, we can more closely estimate what is happening in practice, which can vary vastly from how providers self-report their behavior.

Our study has several limitations. First, as SPs are simulations of real patients, not actual patients, we can only view these results as an approximation of what may occur in a real patient visit. The SP methodology for presumptive TB does not allow for repeated visits, so we cannot observe how providers would behave if the SP were to return for a second visit. Thus, observed practice only reflected what private providers did when they came across a completely unknown or new patient seeking medical care in their first visit to the health care provider. Additionally, in this study SPs were only screened for TB and COVID and could have had other diseases that may have affected provider behavior. For this reason, we included random intercepts for each SP which would have captured some of this variation. Lastly, in both studies only providers who consented to the provider mapping survey were included in the SP study. This is a potential source of selection bias.

Second, we present here results of a comparison of two cross-sectional studies. There is the potential for unmeasured changes due to time trends, parallel program implementation efforts, or other variables that could have caused the differences we are seeing other than the COVID-19 pandemic. However, as COVID-19 has been such a shock to the Indonesian Health System, and COVID's impact on TB services has been substantial, we can be reasonably sure that the changes we're seeing are due to the COVID-19 pandemic and related public health measures. There is also the possibility that a provider may treat differently an SP who visits them during the COVID-19 pandemic under the assumption that anyone visiting a healthcare provider during COVID-19 restrictions may have a serious medical problem. This could lead providers to be more likely to consider an SP has TB than in the previous study, however we did not see major differences in the proportion of providers suspecting that SPs have TB between the two studies. Furthermore, only the presumptive TB case scenario was used in this study and could only be compared to a small subset of SP visits conducted in the pre-COVID study, which limited the statistical power to detect major differences between these two samples. Finally, the results presented here only measure provider behavior in a finite time during the COVID-19 pandemic. Due to the variable nature of the pandemic, these results cannot be generalized to the entire COVID-19 pandemic.

While our study was designed to investigate the likelihood of private providers identifying, diagnosing, and properly managing a classic case of TB, it was not designed to investigate provider notifications of TB. It has been well established that TB notifications declined globally and in Indonesia during the COVID-19 pandemic. This drop in notifications is hypothesized to be caused by several factors, including lockdowns, travel restrictions, fear of contracting COVID-19 in health care settings, overwhelmed health care systems, and diversion of TB labs and workers to COVID-19 (27–29). As the SP scenario in this study was not designed to prompt a notification of a positive TB case to the relevant health authorities, we cannot use this study to make inferences about whether quality of care was a factor in the drop of notifications in Indonesia. Nevertheless, the fact that we did not observe a significant change in correct management in our study is a positive indication that worsened quality of care was not an additional factor in the observed drop in TB notifications in this setting.

4.3 Conclusions

Private providers are the first stop for many people with TB symptoms in Indonesia. Thus, it is crucial that private providers identify TB in their patients, diagnose them properly, and avoid prescribing unnecessary or harmful medication to reduce patient delays, reduce risk of drug resistance, and find the missing TB cases. This study demonstrates that there remains a severe gap in proper TB management by private providers, even without definitive evidence supporting the hypothesis that the COVID-19 pandemic made TB management worse in this setting. An acceleration of private provider engagement efforts in Indonesia is sorely needed, especially if the nation is determined to reduce the gap between TB incidence and notifications that has grown since the COVID-19 pandemic began.

4.4 References to Chapter 4

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