

ORIGINAL RESEARCH

Barriers and facilitators to effective tuberculosis infection control practices in Madang Province, PNG - a qualitative study

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ABSTRACT:

Introduction: Tuberculosis (TB) remains a major public health problem in many countries. There is a greater threat of exposure to TB in congregate settings including healthcare facilities, prisons and households where health workers treat patients with TB. In healthcare facilities, the key areas of risk of infection include settings where people with undiagnosed TB, including multidrug-resistant TB, congregate, such as outpatient waiting areas, pathology waiting areas, radiology departments and pharmacies, and wards where untreated patients await investigation results. With high levels of TB in the community, and symptoms leading people to seek treatment, health services can be TB 'hot spots', and in the absence of good TB infection control (TBIC) a clinical service may actually promote the spread of TB, rather than contain it. Practical and relevant control measures are, therefore, necessary to monitor the spread of TB.

Methods: The purpose of this hermeneutic phenomenological research was to explore rural health workers' perspectives of barriers and facilitators to effective TBIC practices in rural health facilities in Madang Province, Papua New Guinea (PNG). The conceptual framework was adopted from WHO policy on TBIC in healthcare facilities, congregate settings and households as a benchmark to guide the study. Qualitative individual and group interviews

(with an average time of 30 minutes) and field notes were conducted with 12 key informants comprising clinicians ($n=9$) and support staff ($n=3$) from the health facilities. Trustworthy steps were taken during the semi-structured interview to ensure data validity through member check and repeating participants' narratives to ensure accurate representation of participants' experiences. All interviews and field notes were analysed using standard phenomenological methods.

Results: The findings showed that numerous interconnected factors have influenced the implementation of TBIC measures in the rural health facilities in Madang Province. They include issues related to inadequacies in the healthcare systems, access to personal protective equipment, separation procedures, sputum status, monitoring and control, training, and health services as TB 'hot spots'.

Conclusions: The study found evidence that health system factors do impact on the capacity to implement TBIC. Further, factors beyond TBIC such as sociocultural factors have an important influence on the way TBIC is implemented. The results of this study are useful for clinicians, health administrators and policymakers to improve the interventions and application of TBIC procedures at the rural health facilities in PNG. The study is limited to health services in Madang Province, and therefore the findings cannot automatically be generalised to other district hospitals and health centres in other parts of PNG. However, the WHO TBIC is a standardised policy and the results of the findings may be useful for other health facilities that manage TB patients in PNG and for future health systems researchers to help improve the generalisability of the findings. Further research is needed to explore health workers' experiences of conditions, actions and everyday practical issues affecting the application of TBIC measures in the rural health facilities of PNG.

KEYWORDS:

barriers, district and rural hospital, facilitators, motivators, hermeneutic phenomenology, interpretive phenomenology, nurses, Papua New Guinea, qualitative study, tuberculosis infection control policy, World Health Organization.

FULL ARTICLE:

Introduction

Tuberculosis (TB) is a major public health problem, killing millions of people annually worldwide. It is a leading cause of mortality in people living with HIV. Globally, approximately 9.6 million people were infected with TB in 2014, with 12% of the 9.6 million new TB cases in 2014 being HIV-positive¹. The majority of people infected with TB live in developing countries or low-income and middle-income regions where public health systems are typically weak and poorly resourced²⁻⁵. There is a greater threat of exposure to TB in congregate settings including healthcare facilities, prisons and households where health workers treat patients with TB. In healthcare facilities, the key areas of risk of infection include settings where people with undiagnosed TB, including multidrug-resistant TB congregate such as outpatient waiting areas, pathology waiting areas, radiology departments, and pharmacies, or wards where untreated patients await investigation results.

In Papua New Guinea (PNG), TB is among the top 10 causes of morbidity and mortality in all healthcare settings^{6,7}. In addition, TB remains one of the top 10 causes of hospital and health centre admissions, and is the second highest cause of morbidity and mortality in PNG. PNG has a high incidence of TB and HIV co-infection. Recent years have seen the emergence of multidrug-resistant TB and extensively drug-resistant TB^{2,8-10}. These facts all threaten to severely erode PNG's ability to control the disease.

Despite successive initiatives designed to reduce the transmission of TB, the disease continues to claim millions of lives around the world. In 2009, the WHO recommended several types of infection control measures to be implemented in healthcare facilities and in settings where people congregate, such as prison and households with TB patients. These measures form a hierarchy: (1) administrative controls that deal with systems to ensure prompt recognition, investigation and treatment of suspected and confirmed cases; (2) environmental controls that involve isolating patients suspected or confirmed to have TB in appropriately ventilated rooms; (3) personal protective equipment (PPE), including the use of respirators to control the spread of pathogens among healthcare workers, patients and visitors in

healthcare settings¹. These measures have been found to minimise the transmission of TB in health facilities.

When TB is diagnosed, early prompt treatment and high levels of treatment adherence are essential. Directly observed treatment, short-course (DOTS) is a treatment strategy designed to improve treatment adherence by putting procedures in place to ensure that treatment is directly observed. DOTS is a major step forward in dealing with TB as it helps to overcome supply chain issues with TB drugs, supporting early diagnosis and treatment and streamlining dosing and administration. Recommended by the WHO, DOTS is highly effective in treating TB and preventing infection and drug resistance.

DOTS was introduced as a TB treatment strategy in PNG in 1997. Since then, DOTS has become widely accepted as the mainstay of TB treatment. However, there appears to be a wide gap between the number of people in PNG who are infected with TB and the numbers treated. The best estimate, according to WHO data (2014), is that PNG had a TB prevalence of 39 000 (529 per 100 000 population) and an incidence of 31 000 (417 per 100 000 population). This estimate appears to be consistent with a total of 26 170 official notifications of all forms of TB in PNG during 2014¹. However, official data from 2013 reveal that only 3617 cases were registered as having been treated, with an estimated 67% treatment success rate¹. While data collection is not strong in PNG and this is reflected in wide uncertainty intervals, the available data suggest that many more people are infected with TB than are receiving treatment (perhaps 10-fold, including 14 556 reported as having pulmonary TB and therefore potentially infectious). Thus, while it seems clear that DOTS is an excellent treatment strategy, as long as a wide gap remains between the numbers infected and treated, DOTS cannot be seen as an effective public health strategy in its own right⁹.

In the PNG healthcare system, district hospitals are the major health service provider and referral centre for rural health services. Nurses are the backbones of rural health services and constitute the majority of the workforce^{3,4,7}. Although nurses play a central role in TB infection control in PNG, there is a lack of empirical literature on nurses' experiences of TBIC measures at healthcare facilities. This study is designed to investigate nurses' everyday lived experiences of TBIC measures in health services in Madang Province, PNG.

While the literature has attempted to identify some challenges and factors influencing TBIC measures, there is a gap in evidence concerning the implementation of infection control precautions in the field in grassroots health facilities. What restraints are relevant to optimal implementation of TB control? How can these restraints be addressed to implement TBIC measures adequately in PNG health facilities? What are the implications of tuberculosis infection control studies? This hermeneutic phenomenology study attempts to fill this gap and contributes to the body of knowledge by investigating nurses' everyday grassroots experiences of how TBIC measures are implemented in health services in rural PNG. The findings may help clinicians, health managers and policymakers at district and provincial levels to better understand the multi-faceted and interconnected factors that influenced the implementation of TBIC measures at the health centres.

Methods

Data collection

To guide data collection in this qualitative study, a set of questions (rather than hypotheses) were used to collect data for this research:

- What are the personal, cultural, systemic and everyday practical factors that influence the implementation of TB infection control measures in health services in Madang Province, PNG?
- How can the restraints be overcome and facilitators leveraged to implement comprehensive TB control measures in health services in Madang Province, PNG?
- What are the implications of this work for TB control more broadly in PNG?

The present study is the first study of this kind done in PNG, and phenomenological research methods were utilised to explore rural health workers' perspectives of barriers and facilitators to effective TB control practices in rural health settings. The rationale for this study was to provide opportunity for rural health nurses and support staff, the backbones

of rural health services in PNG, to have a 'voice' because, in the past, the issues and concerns of rural nurses have not been adequately addressed at the policy level.

Participants

Participants were key informants from rural health centres in three districts including Madang, Middle Ramu and Usino-Bundi in Madang Province. Recruitment for the study was conducted through emails, postage mail and follow-up by telephone with health administrators of health facilities to identify potential study participants. After establishing initial contact with potential study participants, regular visits to rural health facilities were conducted over the course of the study. To increase the sample of study participants, regular communication with health facility staff was conducted.

Design and procedure

The hermeneutic phenomenology was used as a methodological framework for this study because the researcher was interested in accomplishing deep insights into the experiences of rural nurses regarding barriers that influenced the implementation of TBIC practices at rural health facilities in Madang Province. The study participants, study sites and sample size were selected based on established criteria^{11,12}. A suitable sample size for a phenomenological study may range from 6 to 12, depending on the quality of the text and the phenomenon being studied^{13,14}.

Purposive sampling, using heterogeneous sample or maximum variation sampling and key informant strategies, was used to recruit 12 participants: nine male and three female clinicians and support staff^{14,15}. Participants aged 18 years or more who had worked in rural health 'facilities' for more than 2 years were recruited.

Data collection methods

The data for the study were collected and analysed using standard phenomenological methods including individual and group semi-structured interviews and field notes^{11,16-19}. All 12 participants were interviewed and audio-taped with permission from the participants. The duration of each interview was 30–35 minutes in a private setting selected by the participants. In this hermeneutic study, semi-structured interviews played an important role in collecting a broad array of data. These data include issues that influence the implementation of TBIC measures and what can be done to improve the restraints affecting TBIC measures at the rural health facilities in Madang Province, PNG.

Field notes were used to supplement taped interviews with data that cannot be recorded by a tape recorder. Furthermore, field notes are useful for recording important notes in point form, which were rewritten in detail later the same day. Field notes are written records of what the researcher hears, sees and experiences during data collection process in a qualitative study¹⁵.

Data analysis

A phenomenological hermeneutic approach inspired by Kafele¹⁵ was used to interpret the clinicians' narratives. First, the texts were read as open-mindedly as possible to get a general understanding of the grassroots, everyday experiences of being a nurse or member of support staff working at a district health service and implementing TB infection control measures. The researcher compiled field notes and a short summary of each interview, including lessons learned and meanings conveyed. The relevant transcripts are grouped according to the three major research questions. The researcher then read each transcript line-by-line to identify codes, themes and overarching categories. The researcher constantly and iteratively checked and rechecked data to confirm and refine the emerging themes. Member check and paraphrasing participants' narratives were conducted to ensure actual representation narratives. This checking and cross-referencing helped to enhance the credibility and sense validity of the analysis. Grouping of themes into larger constitutive patterns representing the three major questions facilitates the generation of conclusions and recommendations concerning TB praxis in the context in PNG. Quotes are used to describe the major themes emerging from the study throughout the transcripts.

Ethics approval

All ethical protocols associated with participant safety and protection were followed, and the study was reviewed and

permission granted by Divine Word University Faculty of Health Science Research Committee (FRC-21112013).

Results

The findings are presented in the following emerging overarching themes: (1) healthcare systems, (2) training (3) sociocultural factors and (4) health services as TB 'hot spots'. The data analysis was adapted from the hermeneutic circle to interpret the data and find meaning in the clinician's experience and identify barriers that could be improved and the facilitators that could be leveraged for TB control procedures in Madang Province, PNG.

Healthcare systems

Lack of facilities: The TB wards and isolation rooms are recognised as the primary areas of risk where TB patients congregate. Clinicians reported that inefficient planning and organisation of these primary physical structures in the health service compromised TB control. In Madang Province, TB control procedures were not entirely applied because of inadequate spacing, overcrowding and poor ventilation systems. Clinicians were concerned about the lack of space and ventilation systems and about overcrowding in the key areas of risk where patients congregated, including outpatient areas, wards, isolation rooms and pathology.

We do have an isolation room in the wards but the ventilation system is not really good. (participant (P) 6)

There is a TB ward where all patients are kept and in some health sub-centres there is an isolation room and suspected patients are kept in this room for relatives to visit them, but there is not enough space in both the ward and isolation room and it is overcrowded. (P2)

The employees indicated that patients with a cough were not separated in outpatient areas due to limited spacing.

There is not enough space at the outpatient areas, so separation is not done. (P1)

The TB patients were admitted to the general wards with other patients because of limited beds.

We have an adult ward, and children's ward. The facility I worked is not a big facility to separate TB patients from other patients, so all patients are admitted to one ward. (P3)

Lack of finance: In rural health centres in Madang Province, clinicians experienced a funding gap that severely eroded their efforts to control TB. They reported that lack of funds has affected many public health programs including health education and community awareness, follow-up visits and community mobile patrols into the villages. An improvement of the funding through a sustainable budget for TB programs would improve TB control. Participants argued that TB programs should have designated budgets separate from other operational costs.

There is no money to conduct TB programme ... the donor fund from Germany has withdrawn their support. The biggest problem I observed is with funding. (P1)

Lack of financial support is a major problem. A separate budget for TB program and adequate funds would really boost TB control programmes in the villages TB. (P5)

Access to PPE: The majority of the participants (10/12) acknowledged the importance of the reliable supply of personal respirator equipment to control TB. They reported that there was a shortage of PPE including face masks and gowns in the TB wards, isolation room, and pathology and radiology rooms.

We do not have face masks at the workplace so this has contributed to some staff infected with TB. We are at greater risk of contracting TB during interview with patients at the outpatient areas without a mask. It is likely that staff will be infected at this time. (P5)

From my experience, the lack of preventive measures including face masks when attending to patients is a major problem. (P9)

Participants revealed that PPE, used correctly, should substantially reduce staff and patients' chances of contracting TB. Even others perceived the lack of equipment as a primary concern posing a greater health risk to health centre staff. Furthermore, the hospital's financial constraints have placed more burden for health workers.

There are no protective equipment at the workplace, that is why I am scared of being infected with TB. (P5)

Separation procedures: Coughing is the primary mode of TB transmission and is really the only mode of any importance for public health. Patients with a cough should be promptly identified on arrival at a health centre and separated from other patients to minimise the risk of transmission to both staff and vulnerable patients. According to the clinicians' experiences, separations procedures may significantly contribute to stigmatisation and discrimination, therefore separation was not done. Also, preventive measures were not applied in part because of the sensitivities involved (see also 'Wantok system' below).

We don't normally separate patients because we give preference to those that come earlier to take the front seat. If we separate patients with a cough and attend to them first, it may discourage other patients that came early. (P2)

Sputum status: In Madang Province, clinicians considered access to rapid diagnostic tests a challenge in many rural health facilities. Many participants reported a need for quality laboratory equipment and diagnostic facilities to fast-track investigation results. They asserted that there was an absence of good quality laboratory diagnostics, leading to poor sputum results and tests being repeated several times or needing confirmation by chest x-ray.

Sometimes sputum tests are unreliable so they are repeated or did x-ray test. (P1)

Furthermore, numerous interconnected health systems and structural conditions have a significant influence on the quality of laboratory diagnostics including intermittent power outages; shortage of water supply, staff availability and commitment; lack of diagnostics materials; poor physical and working environment; and inadequate remuneration.

Sputum results take 2–3 hours depending on medical laboratory assistance, workload, power and water supply. Patients are also referred to Modilon General Hospital weekly for x-ray test. (P1)

There is no fume cupboard or dryer where the sputum is dried and air is extracted from the room, and the workplace is small. We experienced frequent shortage of 3% alcohol saline. We normally get them from Modilon General Hospital. Currently I have no risk provision for my work. (P4)

Quality diagnostic facilities: The provision and availability of quality laboratory facilities are necessary for the effort against TB. A quality laboratory facility is particularly essential for diagnostic procedures, from the time samples are collected to confirmation of diagnosis and treatment. For patients living in remote settings, it is challenging to travel to the health centre for medical care, and to return if necessary to collect the test results and have treatment. These conditions reduced the efficient and prompt treatment and may lead to infection of others. These events imply that rapid diagnostic tests are important for TB monitoring and control activities, specifically in rural health services.

We get patients' contact details and contact them if the results are positive. How effective are these contacts? Yeah, some did turn up on time but others delay and don't come because of network problem or if their phone battery is low they don't normally get the information quickly. (P6)

The rural hospital pathology and radiology had limited working and physical facilities to provide adequate diagnostic services. The participants reported that there is limited spacing and poor ventilation systems in these departments and posed a greater risk of exposure to TB.

There is no fume cupboard or dryer to dry the sputum, and extract air from the room, and the workplace is small. I am a victim of positive TB and admitted at Modilon hospital with three other staff. (P4)

In the x-ray room we do not have proper equipment such as gowns and physical infrastructures. (P12)

As a result, the laboratory worker has contracted TB.

We have direct communication with patients and so we contracted TB. I am a victim of TB. (P4)

Training

Scaled-up and sustainable staff training: Training and teaching are the primary sources of knowledge for the staff apart from knowledge attained through work experience and observation. In Madang Province, the Provincial Health Administration is responsible for formal TB training and education for health workers. The majority of the participants reported that TB officers attended the TB training, not everyone.

TB training is not for all employees; it is only conducted for TB officers. (P1)

There was a training last year on TB monitoring and evaluation for TB officers and not for general staff. (P5)

The majority of participants stated that they have never attended any training on TB. This lack of training has implications for delays in patient management and tension among facility staff. The participants perceived that TB training could be beneficial to all clinical staff as they managed all patients on arrival at the health centre. \

I have not attended any training on TB. (P6)

The other issue is that there must be TB training for all employees. (P5)

Other participants cited TB as professional work and regard TB officers as having more knowledge than others.

TB is a specialised field so specific staff is allocated for this work and other staff only attend to TB patients during their absence. (P7)

This behaviour has caused social tensions among staff and may impact negatively on TB program.

... because on several occasions when I am off duty and in town they would call me to see TB patients and I argued with them. I am not happy with the staff because I am the only one who had the training, so other general staff had no idea about TB. (P5)

In other cases, the health managers in the district selected employees for training. Participants indicated that the district health managers selected staff for training based on their performance and commitment to work with the TB program.

Regarding training, respective health programme managers selected officers that work with TB programme. These officers are selected to attend training and not all staff. (P3)

In general, continuous professional staff training and teaching is important and does improve workers' skills and performance. The participants claimed that knowledge and skills attained from the training is helpful with their work.

I attended a training last year and has been very useful to my work. (P4)

Sociocultural factors

Sorcery, magic and witchcraft: The traditional belief about causation of health and illness may significantly affect the prevention and control of TB. Participants explained that one of the reasons for non-compliance and refusal of medical treatment was the persistent influence of traditional healers about causation of health and disease. Participants claimed that on many occasions patients refused to take the treatment and went home to seek treatment from traditional healers in their villages. Unfortunately, some patients died, and others readmitted at a late stage after their attempt with traditional healers failed. Participants reported that patients associated the cause of their ill health with sorcery and poison from other neighbours in their communities resulting in high mortality in the area.

Patients believe in traditional causes of ill-health such as sorcery and poison. They went home to seek help

despite our explanations and died while others returned to the hospital at a very late stage. (P5)

Masks: Covering a cough with a mask is a significant form of preventing TB transmission. However, masks have deep and longstanding cultural significance in PNG. PNG has produced a variety of masks, each reflecting its region of origin. A famous face mask in PNG comes from the Sepik Province²⁰. In PNG, masks are predominantly worn by men after being initiated by traditional leaders who produce the masks. These masks are kept secret from women when not in use²⁰. Richard (2017) explained that when men wear the masks, they represent the spirit the mask represents²⁰. Currently, masks are still being used in many traditional occasions in PNG. Applying face masks questions the important relationships between families and friends. Personal relationships with people caring for TB patients and wearing masks are potentially disrupted. Participants reported that wearing masks may lead to behaviour such as exclusion by relatives, and gossip.

If their families and relatives see patients wearing face masks, they might be scared and go home with no one to care for them. (P1)

Wantok system: Complying with international precautions such as TBIC measures is a sociocultural event. Social standards and culture including the wantok system (pronounced in English pronounced as 'one talk') can affect health workers' attitudes towards TB control measures.

The wantok system has been a significant part of people's lives in Melanesia for many centuries. It is established in every aspect of people's lifestyle. The main idea of this system is to provide support to people that share the same language, culture and values²¹. Therefore, every member of the community is obliged to support others in terms of business transactions, personal and family needs such as paying for school fees, paying a bride price, compensation, care for the sick, death and other special community ceremonies.

The wantok system has important traditional values and meanings and strengthens the Melanesian people and their culture. In a true Melanesian culture, everyone from PNG is treated with respect and regarded as close relatives. The wantok system impacts way of life, benefits and relationships²¹.

The wantok cultural system emphasises mutual obligation, including caring and concern for others, sometimes at the expense of applying rules and maintaining standards. This system has inadvertently become entrenched in the healthcare system as evidenced by this study. Nurses' respect and concern for patients' feelings and humanity have significantly influenced their decisions to implement TB control measures.

We give preference to patients that come first to the facility. We do not separate patients with a cough from other patients simply to avoid negative feelings. (P2).

Several participants acknowledged that taking precautions is the correct thing to separate patients presenting with a cough at the health centre but they never actually separated them, and this undermined disease prevention.

Some of the staff knew that patients with a cough will be separated and seen separately from other patients, but we never did [separate them]. Some of us are ashamed to separate patients with a cough. (P1)

Participants claimed that some patients stay with 'wantoks' in town while seeking medical treatment at the provincial hospitals. This system works in close collaboration with a belief of reciprocity and a sense of duty and obligation, and may have both positive and negative influences on health prevention programs. While the system reduces the social and economic burden for the patients, it increases the risk of TB transmission to the household that accommodates the patients. This situation is aggravated with patients treated with antibiotics such as amoxicillin while awaiting investigation results from the hospital, because amoxicillin is ineffective against TB and can lead to the delay in diagnosing and treating TB.

Sometimes we send the patients to general hospitals and they stay with 'wantoks' and seek treatment. (P3)

Health services as TB 'hot spots'

Seeking help: Late admission to health facilities for medical attention is a barrier to active TB control. Participants reported that many patients who are presumed to have TB arrived late at the health centre for medical treatment. It was alleged that patients often did not bother to seek treatment unless the problem was life threatening and usually at a very late stage. Several issues including dishonesty and competing family needs and responsibilities influenced their behaviour to present late to the health centre.

People with TB are not honest to seek medical treatment at the health centre and are busy with their personal work until it is very late. They expect [a] miracle at the health centre. However, only few patients come to the health centre for medical care. (P2)

This situation reflects the medical model concept of healthcare where individuals depend on a passive healthcare system as the solution to illness rather than interactive public health approach. This study suggested that public health approaches such as health promotion and teaching are critical to a sustainable healthcare system in PNG.

Increased risk of TB infection: In effect, illness is a 'push factor' for people with TB to attend health services, and DOTS is a 'pull factor'. In combination, these factors lead to the concentration of ill patients with TB in clinics, which effectively become TB 'hot spots'. In the absence of effective TBIC procedures, far from helping to overcome the TB epidemic in PNG, clinics could potentially concentrate and amplify the problem, including worsening the spread of resistant organisms. From the participants' experiences, TB remains a major public health problem in the community as more patients seek medical care at the health centres.

Currently there are more patients seeking treatment at the hospital. TB is a big issue in this area. (P5, 6 and 7)

Discussion

This article has demonstrated that multifaceted issues influenced the implementation of TBIC policies in rural health centres in PNG. While these data are from clinicians and support staff in three districts, they are representative of staff throughout the six districts of Madang Province, and provide useful information about implementation of TBIC in rural health centres more generally. These data are relevant to the implementation of TBIC practices in PNG and the developing world.

Issues related to health systems

The rural health workers revealed that issues associated with health systems have a major influence on the implementation of TBIC practices in rural health facilities. They reported that inadequate health system infrastructure resulted in poor TBIC. Similar results have been reported for Africa. Wynne et al. (2014) argued that low staffing and lack of financial support for TB programs has adverse impact on TB control programs. They maintained that lack of essential drugs at the health facilities to treat patients affects patients' ability to receive evidence-based treatment²².

The lack of basic diagnostic facilities and vital infrastructures in health facilities in Madang Province represents the situation more generally in PNG. Wynne et al. (2014) and Prideaux (2014) and discuss how a breakdown in the health system is a huge impediment to TB control programs in Africa^{22,23}. As is also the case in Madang Province, the basic diagnostic facilities available, including sputum-smear microscopes, are obsolete and laboratories do not have essential equipment to detect multidrug-resistant TB.

The first recommendation of this study is to strengthen health systems as a key element in developing effective TBIC. The current PNG National Health Plan 2011–2020 also affirms that strengthening PNG health systems is one of the key areas for improvement.

Issues related to health professional training

This study shows that the majority of the health workers are ill prepared to address emerging public health issues

including TB as they have not participated in any training program on TB. Consequently, they have little understanding of national TB policies about infection control measures^{24,25}. Similarly, the study identifies major gaps between knowledge of TBIC measures and health workers' implementation in practice. All the participants reported that they had colleagues living with TB while also working at the health facility. Participants also discussed the high burden of TB in the province. However, surprisingly few, if any, critical actions have been taken to prevent further TB transmission including separating coughing patients at the outpatient area; providing adequate respirators; improving ventilation systems in wards and pathology; providing adequate preventive equipment such as boots, gowns and goggles; and wearing face masks when interviewing patients

In contrast, a few selected staff in TB programs benefit from TB training elsewhere in the province. This has created a knowledge gap between health workers. These training inequalities should be adequately considered by health managers at the district and provincial levels to improve TB control programs at local health facilities. As Nassazi (2013) points out, employees are an important asset of any organisation and their role should be carefully considered and compensated; developing these unique assets through effective training is imperative to organisational effectiveness²⁶.

Issues related to social and cultural factors

Health beliefs in traditional causes is a global occurrence. It is evident in this study that PNG is not different from the rest of the world. Participants reported that patients left health centres to seek traditional treatment despite adequate explanations. This situation indicates that patients have a world view of TB that is not consistent with biomedical explanations. Gelmanoa et al. (2007) found similar health beliefs in a study in the Solomon Islands, exploring the reasons why patients presented late to health centres¹⁰. They discovered that cultural issues, including seeking care from traditional healers, are among the primary causes for the delay in seeking treatment at health facilities. Gelmanoa et al. argued that developing a health system that is culturally appropriate would encourage active health-seeking behaviour in the communities¹⁰.

The findings in this study revealed that health facilities in the three districts in Madang Province lack proper facilities and are not supported to implement key national health policies to address TB burden in the country more broadly. This study confirms a study done by Prideaux in 2014 that the health services in Madang Province are generally weak and lack coordinated leadership and health services management²³. This situation may impede health workers' abilities to apply TBIC practices at the rural health centres. It is evident in this study that national TB policy may be inadequately applied, leading to increased TB infections and low national outcome. Therefore, there is a need to conduct implementation research to evaluate the extent to which key national health policies are implemented at the district level in PNG.

Conclusions

This study reveals numerous interconnected issues and factors influencing effective implementation of TBIC measures in rural health facilities in Madang Province, PNG. It argues that with high levels of TB in the community, illness leading people to seek treatment, health services can be TB 'hot spots' and, in the absence of good TBIC, a clinical service may actually promote the spread of TB, rather than contain it. It is, therefore, vital that local TBIC policies align with international and national policies and guidelines, to ensure that local practices are consistent with current best practices. Investing in health infrastructure and medical equipment, TBIC training for health employees and community, and adherence towards TBIC measures, may facilitate effective implementation of TBIC at rural health facilities in PNG. Equally importantly, health service managers should address conditions and issues in wider contextual matters that are beyond the abilities of the healthcare workers. Systematic implementation research is required to investigate the extent to which key national health policies are implemented at the health facility level and how key health systems, structural and sociocultural issues influence the application of TBIC policy.

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