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Battling tuberculosis in an island context with a high burden of communicable and non-communicable diseases: epidemiology, progress, and lessons learned in Kiribati, 2000 to 2012☆

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SUMMARY

Objectives: To examine the epidemiology of tuberculosis (TB) in Kiribati from 2000 to 2012, document lessons learned, and recommend ways to mitigate the burden of TB in Kiribati.
Methods: A descriptive study was performed using data on TB case notifications, prevalence, incidence, mortality, and treatment outcomes from global reports and data files. Progress towards meeting the Millennium Development Goal TB target (to reduce TB incidence by 2015) and the Regional Strategy to Stop Tuberculosis in the Western Pacific 2011–2015 targets (to reduce TB prevalence and mortality by half by 2015 relative to the level in 2000) was examined.
Results: TB case notifications and the estimated incidence and prevalence have increased in Kiribati since 2000. From 2000 to 2012, Kiribati reported a total of 3863 TB notifications; in 2012, the case notification rate was 343/100 000 population. The majority (89%) of TB patients complete treatment and/or are cured, and the estimated TB mortality rate has remained relatively stable at around 16/100 000 population. HIV testing of TB patients has increased over recent years from 8% of notifications tested in 2003 to 43% tested in 2012. Of all 818 tests, only four (0.5%) patients were confirmed HIV-positive. Drug-resistant TB has been detected in a small number of cases.
Conclusions: TB rates continue to increase in Kiribati and the 2015 goals for TB control are unlikely to be met. This is probably due to the complex mix of risk factors present in Kiribati, including smoking, diabetes, alcohol use, crowded living, and poverty. A comprehensive approach to address these risk factors is needed to mitigate the burden of TB in Kiribati.

1. Introduction

Kiribati is an independent republic in the central Pacific Ocean. It is spread across 3.5 million square kilometres of ocean and consists of 32 low-lying coral atolls, of which 24 are inhabited.[1] The population of Kiribati is 103 058, and the inhabitants are of Micronesian descent. There has been a significant amount of urbanization over recent years,[2] and the majority of people live in Tarawa Atoll, with 49% of the national population located in the capital, South Tarawa.[1,3] Kiribati is classified as a lower-middle-income country and has a GDP per capita of USD 5700/year (2011). The estimated life-expectancy at birth for males is 58 years and for females is 66 years (2010).[4] The infant mortality rate is 45 deaths/1000 live-births.[2]

Kiribati has a national TB programme (NTP) which has adopted the internationally recommended TB strategy – directly observed treatment, short course (DOTS) – and provides free and equitable access to treatment.[5] The World Health Organization (WHO) has a 'Stop TB' regional strategy for the Western Pacific Region (2011–2015), which is aligned to the Global Plan to Stop TB 2006–2015 and the Millennium Development Goals (MDGs).[6]

The TB case notification rate in Kiribati is among the highest in the WHO-designated Western Pacific region, and concerted efforts

☆ Dedicated to the memory to Dr Kenneth Tabutoa (recently deceased).

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are under way to reduce its TB burden. This paper is a part of those efforts and examines the epidemiology of TB, progress towards global and regional targets, lessons learned, and ways forward for mitigating the burden of TB in Kiribati.

1.1. The national TB programme in Kiribati

The Kiribati NTP uses both passive and active case-finding to identify persons with TB. Active case-finding in Kiribati includes TB contact tracing of household members and immediate neighbouring households of patients found to be smear-positive. It also screens people living with HIV, prisoners, and people with diabetes. In addition, there is a community TB screening programme in villages with a higher than average case notification of TB. The NTP has a dedicated TB laboratory, co-located with the TB Control Centre.

Pulmonary TB (PTB) is diagnosed primarily using sputum smear microscopy, which involves the collection of three sputum specimens. Patients who return a positive smear are registered and enrolled on TB treatment, and those with a negative smear have a chest X-ray and are reviewed by a clinician.

The TB laboratory has recently introduced TB culture, which is requested for (1) patients who have multiple negative sputum smears but clinical and radiological support for a diagnosis of TB, (2) patients with concomitant HIV, (3) patients with a moderate to strong clinical suspicion of HIV/AIDS, but for whom confirmation has not been obtained and there is a moderate to strong suspicion of TB, (4) patients who are still smear-positive at 2 months, (5) paediatric cases where respiratory secretions can be collected, and (6) symptomatic contacts of a known drug-resistant TB case. Respiratory samples from all symptomatic previously treated cases and those with PTB who are smear-positive after 3 months of treatment are sent to the Supranational TB Reference Laboratory in Adelaide, South Australia for culture and drug susceptibility testing (DST). Patients with suspected extrapulmonary TB (EPTB) are diagnosed on the basis of X-ray findings and clinical examination; samples from lymph node and ascitic fluid are occasionally examined for acid-fast bacilli (AFB).

Most TB cases are referred to South Tarawa for diagnosis, as the outer islands do not have laboratory capacity. However, if a patient cannot travel to South Tarawa, and if sputum is able to be collected, the sputum specimens are sent to South Tarawa for analysis. When diagnosed, TB patients receive treatment in South Tarawa for the initial phase of treatment (2 months). The hospital in South Tarawa has a dedicated TB ward, and patients are only hospitalized if clinically indicated. Most TB treatment in Kiribati is through community-based treatment and care. This is for the duration of the initial phase of treatment. Community-based treatment and care involves daily visits by a nurse or community DOT worker (CDW) to supervise TB treatment and monitor for clinical response to treatment and side effects. In South Tarawa, community-based treatment and care involves patients being treated at home, or, if they are in South Tarawa from the outer islands, living temporarily with family members in the South Tarawa community, or in a TB 'maneaba' (a traditional i-Kiribati meeting house).

2. Methods

2.1. Source of data

The WHO Global Tuberculosis Report 2013 was the data source for this analysis. The Kiribati NTP uses all WHO definitions and uses structured recording and reporting mechanisms to capture data from the TB laboratory and the NTP. The Programme reports case notifications (including drug-resistant and HIV-related TB) and treatment outcomes to the WHO on an annual basis and these data are published in the annual WHO global TB reports and as data files on the WHO website.[7,8] This is actual measured data.

On the other hand, actual measured data on prevalence, incidence, mortality, and case detection are unavailable, and thus estimates are made by the WHO. The details on how these are derived can be found in the global TB reports, scientific publications, and on the WHO website.[7,9] In brief, incidence is estimated through an expert opinion process facilitated by the WHO and decisions are based on the analysis of TB notification and programmatic data.[7] Prevalence is estimated using incidence and duration estimates.[7] The case detection ratio (CDR) is estimated by dividing the number of TB case notifications by the estimated number of incident cases of TB. Mortality also needs to be estimated by the WHO as Kiribati does not have a national vital registration system with adequate coverage and completeness to provide an accurate estimate.[7]

2.2. Analysis

Data (2000–2012) on case notifications, including drug-resistant and HIV-related TB, prevalence, incidence, mortality, and treatment outcomes (2000–2011) were extracted from the WHO global TB reports and data files.[7,8] For the purpose of better informing the NTP planning and policy, we worked with key members of the NTP to undertake an in-depth analysis and interpretation of these tabulated data. The case notifications included all new and relapse cases. Age-specific case notification rates per 100 000 population were calculated using the age-specific number of pulmonary smear-positive case notifications divided by the age-specific average population for the same period.[10] Prevalence, incidence, mortality, and case detection estimates were compiled from the WHO Global Tuberculosis Report 2013.

Treatment outcomes were defined by the WHO as follows: (1) cured: a patient who was initially sputum smear-positive and who was sputum smear-negative in the last month of treatment and on at least one previous occasion; (2) completed treatment: a patient who completed treatment but did not meet the criteria for cure or failure; (3) died: a patient who died from any cause during treatment; (4) failed: a patient who was initially sputum smear-positive and who remained sputum smear-positive at month 5 or later during treatment; and (5) lost to follow-up: a TB patient who did not start treatment or whose treatment was interrupted for two consecutive months or more.[7]

The progress made in Kiribati was then assessed against the MDG for TB and the Regional Strategy to Stop Tuberculosis in the Western Pacific 2011–2015 goals.[11,12]

3. Results

3.1. Case notifications

Over the 13-year period, Kiribati reported a total of 3863 TB notifications; 3797 (98%) were newly diagnosed and 66 (2%) were relapse cases.[13] The number of notifications increased slightly from 2000 to 2012, with some fluctuations in-between (Table 1; Figure 1). The case notification rate followed a similar pattern and increased from 304 per 100 000 population in 2000 to 343 in 2012.

Of all new TB notifications, 1481 (38%) were pulmonary sputum smear-positive, 948 (25%) were pulmonary sputum smear-negative, and 1268 (33%) were classified as extrapulmonary; the remaining 4% were classified as smear unknown/not done, other new cases, or relapse cases. The number of new sputum smear-positive cases increased from 54 in 2000 to 134 in 2012, as did the new sputum smear-negative cases (from 30 in 2000 to 122 in 2012). The number of EPTB cases decreased from 106 in 2000 to 73 in 2012 (Table 2; Figure 2).

Table 1
Numbers and rates of case notifications, prevalence, incidence, and mortality for tuberculosis in Kiribati, 2000–2012

Year	Population	Notifications[a]		Prevalence		Incidence		Mortality[b]	
		Number	Rate, /100 000	Number	Rate, /100 000	Number	Rate, /100 000	Number	Rate, /100 000
2000	82 788	252	304	400	483	310	374	13	16
2001	84 261	189	224	360	427	280	332	11	13
2002	85 799	196	228	380	443	290	338	14	16
2003	87 371	284	325	480	549	340	389	15	17
2004	88 936	310	349	590	663	400	450	15	17
2005	90 468	332	367	680	752	440	486	15	17
2006	91 953	378	411	740	805	470	511	15	16
2007	93 401	334	358	590	632	420	450	16	17
2008	94 832	335	353	590	622	420	443	16	17
2009	96 272	278	289	440	457	350	364	16	17
2010	97 743	286	293	470	481	360	368	16	16
2011	99 250	343	346	660	665	430	433	17	17
2012	100 786	346	343	630	625	430	427	17	17

[a] New and relapse.
[b] Estimated number of deaths from TB (all forms, excluding HIV).

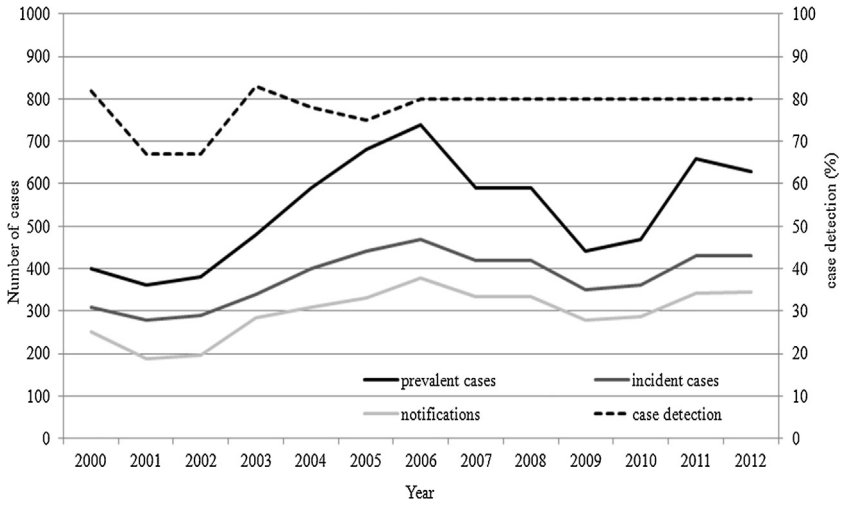

Figure 1. Estimated case detection rate and number of prevalent, incident, and notified cases of tuberculosis in Kiribati, 2000–2012.

Table 2
Case notifications (and %) of tuberculosis, by type, in Kiribati, 2000–2012

Year	New pulmonary smear-negative cases	New pulmonary smear-positive cases	New extrapulmonary cases	New pulmonary smear unknown/ not done cases	Other new cases	Relapse cases	Sum
2000	30 (12%)	54 (21%)	106 (42%)	17 (7%)	42 (17%)	3 (1%)	252 (100%)
2001	24 (13%)	64 (34%)	74 (39%)	21 (11%)	0 (0%)	6 (3%)	189 (100%)
2002	27 (14%)	82 (42%)	77 (39%)	7 (4%)	0 (0%)	3 (1%)	196 (100%)
2003	71 (25%)	99 (35%)	110 (39%)	0 (0%)	0 (0%)	4 (1%)	284 (100%)
2004	59 (19%)	142 (46%)	107 (35%)	0 (0%)	0 (0%)	2 (1%)	310 (100%)
2005	79 (24%)	124 (37%)	126 (38%)	0 (0%)	0 (0%)	3 (1%)	332 (100%)
2006	117 (31%)	129 (34%)	124 (33%)	4 (1%)	0 (0%)	4 (1%)	378 (100%)
2007	78 (23%)	103 (31%)	147 (44%)	0 (0%)	0 (0%)	6 (2%)	334 (100%)
2008	71 (21%)	147 (44%)	107 (32%)	0 (0%)	0 (0%)	10 (3%)	335 (100%)
2009	70 (25%)	145 (52%)	59 (21%)	0 (0%)	0 (0%)	4 (1%)	278 (100%)
2010	91 (32%)	118 (41%)	71 (25%)	0 (0%)	0 (0%)	6 (2%)	286 (100%)
2011	109 (32%)	140 (41%)	87 (25%)	0 (0%)	0 (0%)	7 (2%)	343 (100%)
2012	122 (35%)	134 (39%)	73 (21%)	0 (0%)	9 (3%)	8 (2%)	346 (100%)
Total	948 (25%)	1481 (38%)	1268 (33%)	49 (1%)	51 (1%)	66 (2%)	3863 (100%)

Fifty-two per cent ($n = 774$) of all new pulmonary smear-positive TB notifications were for males and 8% ($n = 121$) were for children aged 0–14 years. The number of new notifications of pulmonary smear-positive TB peaked in the 15–24 years age group, and this was consistent for males and females.[13] However, the rate of new notifications was highest in the age group 55–64 years and this was substantially higher in males (Figure 3). For EPTB, there was no clear pattern according to age group; the rate of notifications ranged from 525/100 000 population in the 25–34 years age group to 788/100 000 population in the 65+ years age group (the 0–14 years age group was 727/100 000).

3.2. Incidence

The estimated number of incident cases increased between 2000 (310; 95% confidence interval (CI) 250–380) and 2012

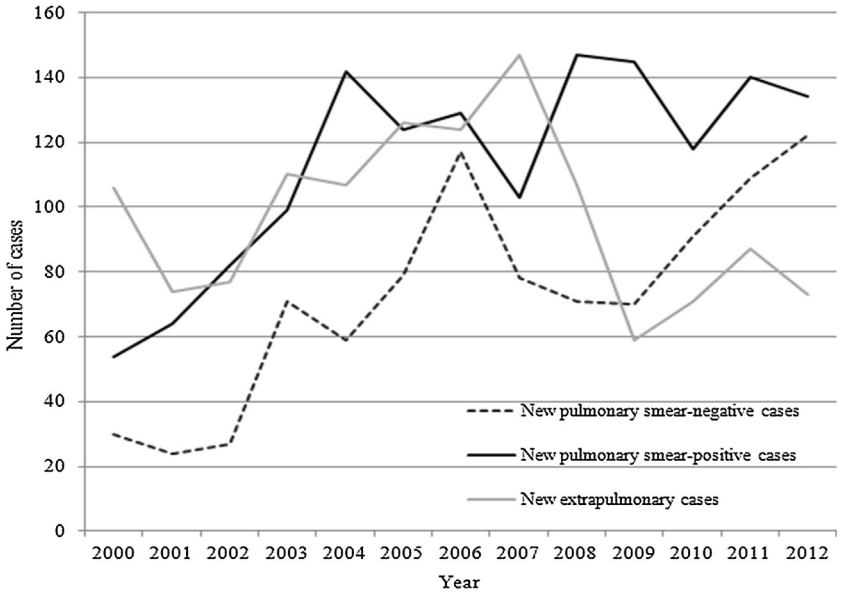

Figure 2. Case notifications of tuberculosis by type; Kiribati, 2000–2012.

(430; 95% CI 350–520), although this was not significant at the 0.05 level (Figure 1). The incidence rate followed a similar trend.

3.3. Prevalence

Estimated prevalence followed a similar trend as incidence (Figure 1). The estimated number of prevalent cases increased between 2000 (400; 95% CI 140–790) and 2012 (630; 95% CI 270–1100), although this was not significant at the 0.05 level. The estimated number of prevalent cases per 100 000 population followed the same trend.

3.4. Mortality

The estimated number and rate of deaths from TB (excluding HIV) was relatively consistent over the 13-year period. There were 196 deaths in total (mean 15.1 deaths/year). The mean mortality rate was 16 deaths per 100 000 population.

3.5. Case detection rate (CDR)

The CDR fluctuated from 2000 (81%) to 2005 (75%), and has been stable at approximately 80% since 2006 (Figure 1).

3.6. HIV-associated TB

From 2000 to 2012, 818 cases of TB (21% of all notifications) were tested for HIV. The testing rate increased, with 734 cases tested between 2009 and 2012, which was 59% of the notifications over the same 4-year period. Of all 818 tests, only four (0.5%) patients were confirmed positive: two in 2005 and two in 2009. Both cases from 2009 were put on co-trimoxazole preventive treatment (CPT); both were eventually cured of TB.[7]

3.7. Drug-resistant TB

Since 2006, there have been 156 samples from Kiribati sent to a reference laboratory for DST. These were from relapse cases and

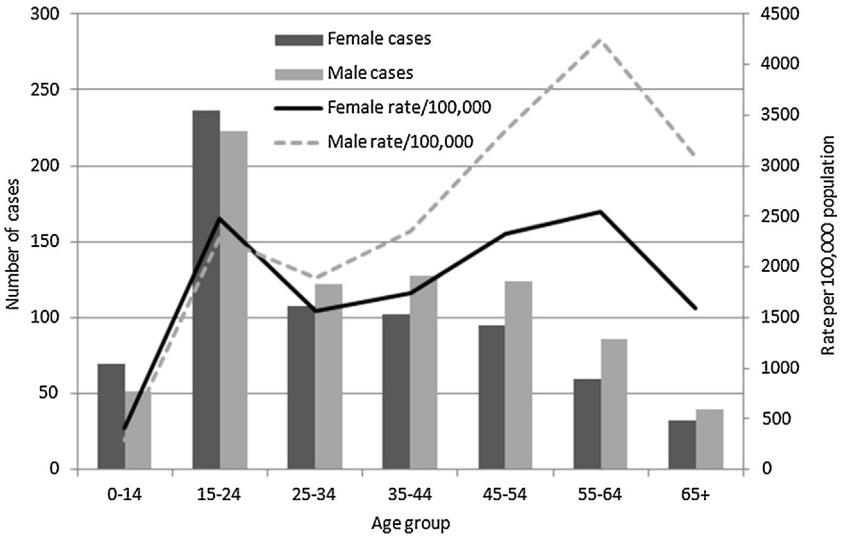

Figure 3. Number and rate (per 100 000 population) of new pulmonary smear-positive tuberculosis notifications by age group; Kiribati, 2000–2012.

cases smear-positive after 2 months of treatment. Six of these samples were drug-resistant: three were mono-resistant to streptomycin, two had mono-resistance to rifampin, and one was resistant to isoniazid and rifampin, i.e. multidrug-resistant TB (MDR-TB). Despite treatment, the patient with MDR-TB died.[13]

3.8. Treatment outcomes

The total size of the treatment cohort of all TB cases was only available for the years 2004 to 2011; over this period, the proportion of diagnosed patients who commenced treatment was 95%. The majority of TB patients in Kiribati complete treatment and/or are cured (Table 3). From 2000 to 2011, 89% were successfully treated (i.e., completed treatment and/or were cured). Of smear-positive cases, 94% were successfully treated from 2000 to 2011 – this ranged from 90% in 2003 to 97% in 2004 and 2009. Of re-treatment cases, the mean annual proportion successfully treated was 83%.

3.9. Progress towards regional targets

The MDG target for TB is 'to reduce TB incidence by 2015'. In Kiribati, the estimated number of incident cases increased from 310 in 2000 (95% CI 250–380) to 430 in 2012 (95% CI 350–520). When population growth was taken into account through the calculation of incidence rates, there was still an increase, though not to the same extent: 372/100 000 population in 2000 (95% CI 296–456) and 429/100 000 population in 2012 (95% CI 349–517). These results suggest that the MDG target is unlikely to be met by 2015.

The Regional Strategy to Stop Tuberculosis in the Western Pacific 2011–2015 has two overarching targets. The first is to reduce TB prevalence by half by 2015 relative to the level in 2000. The estimated number of prevalent cases of TB in Kiribati in 2000 was 400 (95% CI 140–790); this increased to 630 (95% CI 270–1100) in 2012. Similarly, the prevalence per 100 000 population was 487 (95% CI 174–957) in 2000, and increased to 628 (95% CI 270–1132) in 2012. These trends suggest that this goal is unlikely to be achieved by 2015.

The second target of the regional strategy is to reduce TB mortality by half by 2015, relative to the level in 2000. The estimated number of TB deaths in Kiribati in 2000 was 13 (95% CI 9.3–16), and this increased to 17 in 2012 (95% CI 9.6–26), although the confidence intervals overlap substantially. The rate of TB deaths per 100 000 population was 15 in 2000 (95% CI 11–20) and increased to 17 in 2012 (95% CI 9.5–26). Reducing the number of deaths per year to six or less by 2015 would achieve the target. This is possible, although the number of deaths has been consistent over the past 13 years.

4. Discussion

At the global level, there has been a reduction in the TB incidence, prevalence, and mortality from 2000 to 2012.[7] However, the estimated TB prevalence and incidence in Kiribati are increasing. This is mirrored by an increase in cases notifications, much of which is due to enhanced TB case-finding efforts and the introduction of liquid culture in recent years. The MDG target for TB and the two overarching targets of the Regional Strategy to Stop Tuberculosis in the Western Pacific 2011–2015 are unlikely to be met in Kiribati by 2015. The estimated CDR was variable between 2000 and 2005, which is likely to be due to changes in practice regarding TB case-finding in Kiribati, and has not improved since 2006. Case notifications and estimated incidence and prevalence of TB have increased slightly since 2000. While these declined for a few years after 2006, they have increased again in recent years. Below, we discuss potential reasons for these trends, explore lessons learned, and make recommendations that we believe will improve progress towards these global and regional targets.

Table 3
Treatment outcomes for new pulmonary smear-positive cases and re-treatment cases, Kiribati 2000–2011

Year	Case type	Notifications	Cohort[a]	Cured	Completed	Died	Failed	Lost to follow-up	Treatment success rate[b]
2000	Smear-pos	54	54	45	4	4	1	0	91%
	Re-treatment	3	9	8	0	1	0	0	89%
2001	Smear-pos	64	64	56	5	2	1	0	95%
	Re-treatment	6	2	2	0	0	0	0	100%
2002	Smear-pos	82	82	71	6	3	2	0	94%
	Re-treatment	3	3	1	2	0	0	0	100%
2003	Smear-pos	99	97	73	14	10	0	0	90%
	Re-treatment	4	2	2	0	0	0	0	100%
2004	Smear-pos	142	138	124	10	2	1	5	97%
	Re-treatment	3	3	2	0	0	1	0	67%
2005	Smear-pos	124	123	76	38	8	0	2	93%
	Re-treatment	10	3	3	0	0	0	0	100%
2006	Smear-pos	129	126	77	36	12	0	4	90%
	Re-treatment	5	15	3	9	1	0	2	80%
2007	Smear-pos	103	100	79	14	7	0	3	93%
	Re-treatment	24	5	5	0	0	0	0	100%
2008	Smear-pos	147	146	136	4	6	0	1	96%
	Re-treatment	17	17	9	4	2	0	2	76%
2009	Smear-pos	145	144	121	19	4	0	1	97%
	Re-treatment	4	6	5	1	0	0	0	100%
2010	Smear-pos	118	117	103	6	6	2	1	93%
	Re-treatment	14	20	5	9	6	0	0	70%
2011	Smear-pos	140	140	103	29	6	1	1	94%
	Re-treatment	18	19	4	10	1	0	4	74%

[a] The number of annual re-treatment cases totals more than the number of relapse cases in Table 2. The category of re-treatment includes TB patients with an outcome of relapse, treatment failed, treatment after loss to follow-up, and other patients who have been treated previously. In some instances there is a difference between the number of notifications and the number in the cohort; these figures reflect those reported to the WHO by member countries and areas, and are usually due to the fact that TB patients notified in any given year may not have their TB treatment outcomes assessed in cohort analysis, for a number of reasons.

[b] Treatment success rate = % cured + % completed.

4.1. Risk factors slowing progress

TB risk factors comprise a complex mix of socio-economic conditions, biological risk factors, and opportunities for TB exposure.[14] The key risk factors described in the literature include HIV, a poor diet high in fats and sugars, childhood malnutrition, obesity, smoking, diabetes, alcohol use, indoor air pollution, crowded accommodation, and unemployment.[14–18] It is clear that a number of these risk factors are present in Kiribati and are likely to be driving the TB epidemic. A recent study assessing the association between TB and diabetes in Kiribati estimated that approximately one quarter of all TB is attributable to diabetes.[19] HIV prevalence is significantly lower in Kiribati than in many areas of the world, and it appears that the epidemic in Kiribati is largely being driven by poverty, poor nutrition, poor living conditions resulting from high population density, diabetes, and smoking.

Rates of diabetes and smoking in Kiribati are among the highest in the Pacific. Thirty percent of men and 27% of women have diabetes. Seventy-four percent of men and 45% of women smoke daily. Forty-five percent of men and 6% of women identify themselves as current drinkers, i.e., those who had consumed alcohol within the past 12 months. Of these, 83% of men and 51% of women consume, on average, 6+ drinks on a drinking day.[20] In addition, 22% of children aged <5 years are underweight – the second-highest proportion in the Pacific.[2]

Another substantial challenge for the control of TB in Kiribati is crowded living. Tarawa Atoll is a thin strip of land bordered by a lagoon on one side and the Pacific Ocean on the other. Due to both economic and environmental factors, there has been a substantial amount of migration to South Tarawa from outer islands in recent years[2,21] (Figure 4). Consequently, South Tarawa has the highest annual urban growth rate in the Pacific and is one of its most densely populated cities, with 3184 people per square kilometre.[3,21] In 1947, the population was estimated to be just 1671; this increased to 25 380 in 1990, to 36 717 in 2000, and to 50 182 in 2010.

Another confounder is the relatively large proportion of women who have unmet family planning needs, resulting in a high fertility rate (3.9 live-births/woman), a figure that has increased over recent years.[2] Moreover, Kiribati is vulnerable to the effects of climate change. Sea-level rise is an issue of particular concern; in Kiribati, the sea-level is rising at the rate of 3.9 mm per year, which is three times the global average.[23] Over the long term, this will reduce available land, resulting in a further increase in population density.

4.2. Lessons learned and recommendations for improving progress

This analysis highlights the unique set of challenges faced in an island setting with a double burden of disease and vulnerability to climate change. On a positive note, testing of TB cases for HIV has increased over recent years, and very few were found to be seropositive. Despite this, further efforts are needed to improve the proportion of TB patients who are tested for HIV, especially those who are at particularly high risk for HIV. MDR-TB is a major challenge for TB control in some areas of the Pacific, such as the Republic of Marshall Islands and Federated States of Micronesia; however, this is not yet a significant public health problem in Kiribati. The majority of TB patients complete treatment and/or are cured, and the good treatment success rates appear to have been achieved through a system of community-based DOT.

Greater focus is needed on identifying people with TB early and preventing TB. The CDR indicates that approximately 20% of TB cases are missed. While this is quite high by global standards, particularly given currently available diagnostics in Kiribati, it should be borne in mind that a large proportion of diagnosed cases are not bacteriologically confirmed, and thus over-diagnosis may be masking a large undiagnosed TB burden. Active methods of TB case detection are required to detect additional cases and detect them early, thereby reducing the opportunity for ongoing transmission of TB in the community. Population-wide as well as targeted behaviour change campaigns are needed to reduce the risk of TB from a range of related risk factors, including smoking, diabetes, alcohol use, and crowded living. This requires a concerted, multi-sector approach.

Surveillance of TB in Kiribati needs to incorporate broader indicators such as smoking, diabetes, alcohol use, and number of people in the household. This will help to validate and/or update the focus of targeted campaigns. People with diabetes should be screened routinely for TB, and TB patients should continue to be screened routinely for diabetes.

Improving diagnostic capacity through the implementation of technologies such as Xpert MTB/RIF should also improve case detection. Behaviour change campaigns should also promote the importance of early testing, and research is needed to explore barriers and facilitators to accessing health care for people with suspected TB, as well as people suspected of diabetes.

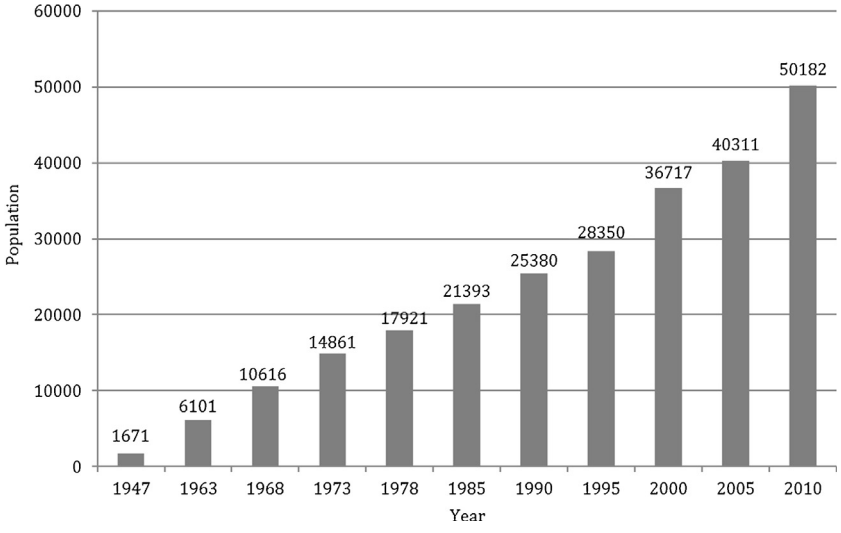

Figure 4. Population growth in South Tarawa, 1947 to 2010.[3].

4.3. Conclusions

While there have been some successes with TB treatment in Kiribati over the past 13 years, case notifications and estimated incidence and prevalence of TB have increased. The TB-related MDG and the high order goals of the regional strategy to stop TB are unlikely to be met for Kiribati by 2015. A chief reason for this is likely to be the complex mix of TB risk factors present in Kiribati, including relative poverty, smoking, diabetes, alcohol use, crowded living, high unemployment, and stress levels associated with rising sea levels, causing loss of their homeland. Greater focus is needed on preventing TB, and particularly on reducing people's vulnerability to it. Further research is needed to better understand the risk factors and health care-seeking behaviours related to TB in Kiribati.

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