



Tuberculosis control in Greenland

**Report on a country visit
30 April – 6 May 2010**

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ABSTRACT

In view of an observed tuberculosis incidence exceeding 100 cases per 100 000 population, the Minister of Health of Greenland asked the WHO Regional Office for Europe to organize a country visit jointly with the State Serum Institute of Denmark and the Danish Lung Association. The visit took place in the south of the country from 30 April to 6 May 2010. The population is scattered in several small communities, often difficult to reach, and the health service suffers from a high turnover of staff who mostly come from Denmark. The recent health reform has tried to address both challenges and to refocus the health services, introducing clear national guidelines with supervision and telemedicine to increase access to and the quality of services. Together with national colleagues, the visitors developed a number of recommendations in line with the health reform for improving the national TB strategy.

Keywords

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Glossary

AIDS	acquired immunodeficiency syndrome
BCG	bacille Calmette-Guerin (vaccine)
DOT	directly observed therapy
ECDC	European Centre for Disease Prevention and Control
HIV	human immunodeficiency virus
IGRA	interferon gamma release assay
IPT	isoniazid preventive therapy
MDR-TB	multidrug-resistant tuberculosis (resistant to isoniazid and rifampicin)
SSI	Statens Serum Institut, Copenhagen, Denmark
TB	tuberculosis
WHO	World Health Organization

Executive summary

In the last five years, an increase in the incidence of tuberculosis (TB) in Greenland to over 100 cases per 100 000 population has raised concern in the National Board of Health. The Minister of Health approached the WHO Regional Office for Europe asking for specific assistance and a country visit with experts from the WHO Regional Office for Europe, the State Serum Institute of Denmark and the Danish Lung Association. The visit took place from 30 April to 6 May 2010 and was conducted by Pierpaolo de Colombani (team leader, WHO Regional Office for Europe), Vibeke Thomsen (State Serum Institute) and Jon Torgny Wilche (Danish Lung Association). The mission visited the southern part of Greenland, where more than half of the TB cases are notified. The main recommendations arising from the visit were passed to the Minister of Health of Greenland on 6 May 2010.

Main findings

The health system in Greenland faces problems from the proportion of the population scattered in several small communities, which are often difficult to reach, and from the high turnover in health staff who mostly come from Denmark. The government is in the process of reforming the health system: a new way of delivering services was piloted in two areas in 2010 with the aim of extending it to the whole country during 2011. The existing 16 district hospitals and 64 settlement consultation posts will be streamlined into 5 regional hospitals and a number of health centres, nurse stations and settlement consultation posts. Queen Ingrid's Hospital in Nuuk will be strengthened as a national centre of reference with expanded specialized services. Clear national guidelines, effective supervision and telemedicine (to be introduced into every village and settlement with more than 50 inhabitants) will ensure good standards of care where doctors are not present. The government is committed to health and spends more than 10% of its total budget on it.

The national TB strategy for 2007–2012 includes a specific budget for TB control and the presence of a TB Group at central level with the overall responsibility for developing guidelines, coordination, training, monitoring and supervision, advocacy and communication. In addition, there are 13 TB key figures with district responsibilities. Specific attention is being given to south Greenland, with targeted information campaigns and active TB case-finding (interferon gamma release assay screening of schoolchildren and mass X-ray screening). Unfortunately, none of these interventions seem to be effective in reducing TB transmission in the communities, where there is a slow increase in new cases every year. A number of recommendations can be made to improve the implementation of the Stop TB Strategy in a country such as Greenland, which suffers from a struggling independent economy, social and ethnic challenges and, last but not least, a rough physical environment and climate.

Main recommendations

1. The WHO mission appreciates the serious efforts by the Ministry of Health to combat TB and the good implementation of the current National Tuberculosis Programme. It recommends ensuring the long-term commitment needed to control and eliminate TB.

2. The current reform in the health sector should preserve and expand access to quality diagnosis and treatment of TB. Specialized TB functions (management, diagnostics, treatment of complicated cases) should be ensured at central level and services further improved at lower levels through the maximum use of the latest developments in telemedicine and other technology. Collaboration should be formalized with centres of expertise in Denmark or in other countries. Circumpolar collaboration, sharing experience among indigenous populations, should be further enhanced.
3. The TB Group should be strengthened in its essential work of coordination, monitoring and supervision of TB interventions taken within the general health system. Managerial and technical skills should be sustained through appropriate TB training available internationally.
4. Transmission of TB is still going on, especially in the isolated communities and where socioeconomic changes in towns create pockets of vulnerability. Available resources (financial and human) should be used to strengthen TB control by earlier detection of active cases rather than identification of latent cases of TB.
5. The access to prompt and good quality diagnosis and treatment of TB should be culturally sensitive and ensured without regard to location. The use of the most appropriate technology should be considered to allow earlier diagnosis and treatment of TB cases at the lowest possible level. Some expensive transport of suspect TB patients to towns can be avoided by developing diagnostic algorithms that can use old and new tools through telemedicine.
6. At the current status of TB epidemiology and resources, population mass screening with chest X-ray or IGRA testing appears to be ineffective in identifying and treating active TB cases and latent TB infection. Passive case-finding should be promoted as the most cost-effective approach, accompanied by prompt *ad hoc* investigation in cases of TB epidemics in specific locations.
7. Quality assurance of laboratory analysis in the central laboratory should be expanded with regular monitoring of testing indicators and participation in international proficiency panels. Automation of analysis should be considered, depending on workload, in order to protect staff.
8. Chest X-ray readings from all over the country should be centralized in the Radiology Department of Queen Ingrid's Hospital (or outsourced abroad if the workload is too great) to compensate for the usual limited capacity of doctors hired temporarily to work at district level.
9. TB nurses and TB key figures are of paramount importance for the successful treatment of TB cases and should continue and intensify their activities to ensure directly observed treatment, trace treatment defaulters promptly and ensure prompt and complete reporting of treatment results to the TB Group in Nuuk. Despite the difficulties, doctors in district hospitals should be actively involved in TB case management. Trustworthy lay persons (excluding family members) should be selected to ensure directly observed therapy (DOT) in the communities where patients live.
10. Contact-tracing is important for early detection or prevention of new TB cases. It should be pursued strictly and documented for evaluation of performance. The status of active TB should be assessed for each contact and isoniazid preventive treatment given to anyone who has recently been infected. Supplies of isoniazid should be given to patients weekly at the most and compliance monitored.

11. Anti-TB drugs should be procured centrally for the whole country, following international recommendations (estimation of needs, buffer stocks, storage and distribution). Fixed-dose combination drugs should be adopted during both the intensive and continuation phases of treatment to prevent the development of drug resistance and to simplify drug management and the training of staff.
12. Recording and reporting of TB cases should be fully electronic, with the possibility of updating and consultation at peripheral levels. All services provided should be documented, including first contact with the health care services, diagnosis, treatment compliance and completion. Contact-tracing and preventive treatment should be included in the electronic registration. Regular monitoring of local Programme performance at central level should be ensured and feedback given to the districts.
13. Greenland is not a Member State of the WHO European Region and the Ministry of Health is independent of Denmark. This situation limits the forms of direct collaboration that might benefit Greenland, such as in international surveillance and for participation in coordination meetings. It is recommended that this problem should be addressed, at least at the technical level.
14. National monitoring of drug resistance surveillance and TB/HIV co-infection should be maintained and strengthened.
15. The development of human resources should be properly planned in view of the high turnover of medical and nursing staff. Medical doctors and nurses coming from abroad should be given guidance before starting their service in Greenland. On-the-job training and annual refresher training should be provided to all health workers with TB responsibilities in the field. A national TB manual, simple pocket guidelines and appropriate training material should be prepared.
16. There should be more awareness among and information for the general population and high-risk groups so as to improve health-seeking behaviour and reduce delays in self-reporting for TB diagnosis. Messages and means of communication should be designed on the basis of specific studies made in Greenland, and periodically assessed for their effectiveness. The Ministry of Social Affairs and the Ministry of Health should collaborate more closely as regards advocacy, communication and social mobilization, including on prevention and control of TB.
17. Future operational studies should give priority to understanding the factors related to delays by both patients and doctors, including in health-seeking behaviour and access to health care. Participatory rapid appraisal methods should also be considered, such as interviews with key informants, focus group discussions, questionnaires and direct observation. Qualitative studies by anthropologists should also be considered.

Introduction

Greenland is an autonomous country within the Kingdom of Denmark. The government is responsible for various areas of domestic policy, including health.

Tuberculosis (TB) has been a major public health problem for centuries. The number of cases fell until the late 1980s but has been rising again. With an average of 70 new TB cases per year over the last five years, incidence has exceeded 100 cases per 100 000 population, placing Greenland at the level of many countries in the developing world. The National Board of Health of Greenland was sufficiently concerned to convince the Minister of Health to approach the World Health Organization (WHO) Regional Office for Europe with a request for specific assistance and for a visit with experts from WHO, the Statens Serum Institut (SSI) of Denmark and the Danish Lung Association. The Ministry of Health and Prevention of Denmark wrote to WHO in support of this request.

The visit took place from 30 April to 6 May 2010 and was conducted by Pierpaolo de Colombani (team leader, WHO Regional Office for Europe), Vibeke Thomsen (SSI) and Jon Torgny Wilche (Danish Lung Association). The following colleagues from Greenland joined the mission: Flemming Kleist Stenz (Chief Medical Officer), Turid B. Skifte (registered nurse), Carsten Thordal (Medical Director, Queen Ingrid's Hospital), Karin Ladefoged (Medical Officer, Medical Department, Queen Ingrid's Hospital), Thomas Rendal (National TB Nurse) and Helga Pedersen (regional TB nurse). The mission visited the southern part of Greenland, where more than half of the TB cases are notified (see programme in Annex 1 and list of people met in Annex 2). Unfortunately, owing to floating ice closing the port of Nanortalik, the day boat trip to the settlement of Tasiusaq scheduled for 2 May had to be cancelled.

Country information

Greenland is the largest non-continental island in the world. Two thirds of the country are inside the Arctic Circle and without daylight for months. Less than 20% of the country is ice-free, mostly along the coast where people live. It is the least densely populated country in the world: in 2009 there were 56 194 inhabitants: 89% Inuit and the rest of Danish or other nationality. Eighty four percent of the population live in towns and the rest in more than 60 small settlements scattered along the 44 087 km coastline. These settlements vary in size from 4 to almost 600 people and are mainly composed of hunters, fishermen and miners. The capital, Nuuk, has 15 105 inhabitants. In recent years, the population of Greenland has been falling slowly (by 0.47% from 2008 to 2009) and moving from settlements to urban centres.

Greenland is a parliamentary democracy within a constitutional monarchy. The Danish government supports Greenland with an annual subsidy of DKr 3.4 billion (US\$ 633 million), or approximately US\$ 11 300 per Greenlander.

In January 2009, Greenland streamlined its administrative divisions from 18 to 4 municipalities (Kujalleq, Qaasuitsup, Qeqqata, Sermersooq). The North-east Greenland National Park and the American Air Base of Thule have the status of unincorporated areas, outside any municipal jurisdiction (Annex 3).

The economy is based mainly on fishing and fish processing, handicrafts, hides and skins, small shipyards and mining. The drastic fall in the numbers of cod in recent years has had an impact on local employment and national exports, which are 85% based on fish and fish products. The last lead and zinc mines closed in 1990. At present, the government is the most important employer, providing an important social buffer but also oversized and expensive public services. The unemployment rate was estimated at 6.8% in 2007, but is believed to have increased overall, and varies between urban centres and settlements. Recently hopes have been raised by the possibility of oilfields around Greenland and interest by multinational companies in exploiting them.

In 2007, the infant mortality rate was 8.2 deaths per 1000 live births and life expectancy was 71 years for women and 66 years for men. In the same year, an average of 12 litres of alcohol were consumed per head annually among persons older than 14 years and 44% of the population smoked tobacco.

TB epidemiology

In 1956 (the first year for which information is available), TB incidence exceeded 1800 cases per 100 000 population. After that, the number of cases reported every year fell dramatically to 1987, when it was 9 per 100 000 population. TB control began to attract less public health attention and bacille Calmette-Guerin (BCG) vaccination was no longer recommended. Subsequently, the numbers increased, with wide fluctuations due to the small number of cases but with a clear trend (Fig. 1). Most of the cases were mapped in the south of the country (Table 1).

Fig. 1. TB notification rate, 1956–2009

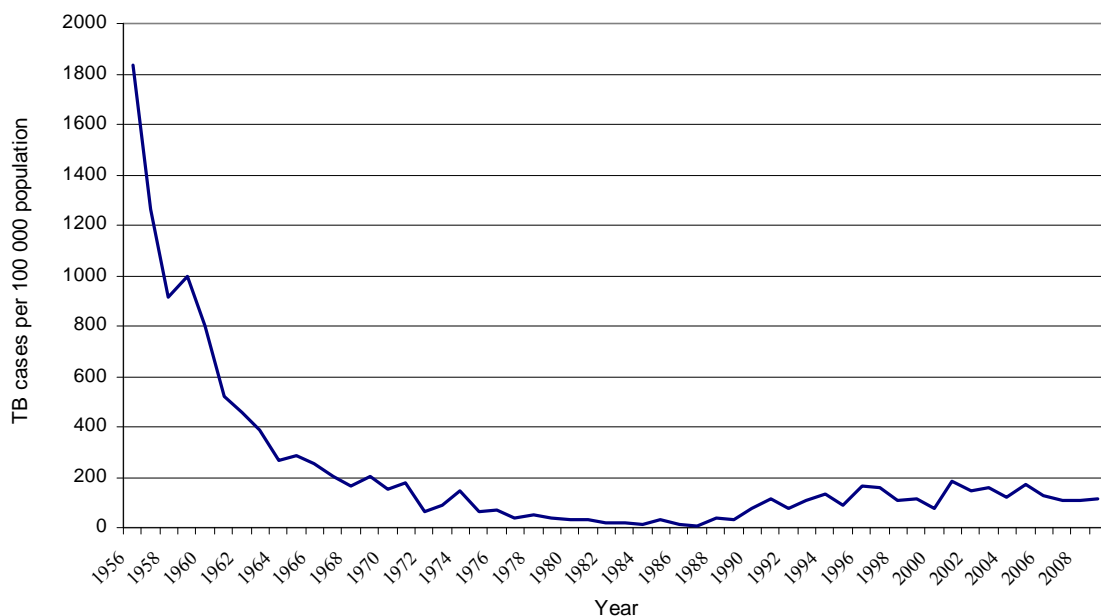


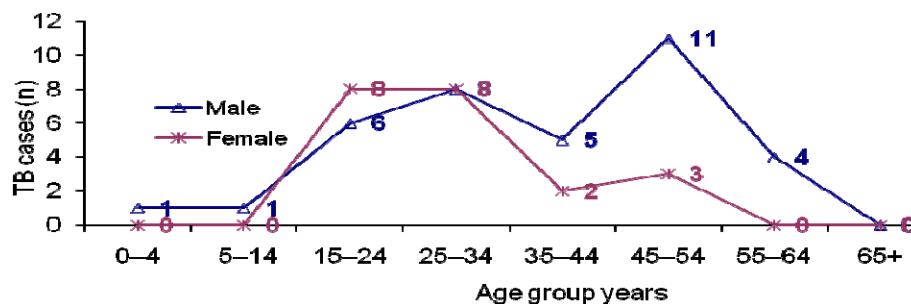
Table 1. New TB cases (all forms) notified, by district, 2005–2009

Name	2005	2006	2007	2008	2009
Kujalleq municipality	37	33	19	16	23
Nanortalik	13	13	4	8	5
Narsaq	10	12	5	4	6
Qaqortoq	14	8	10	4	12
Qaasuitsup municipality	16	14	16	11	8
Aasiaat	5	1	4	1	3
Illulissat	4	2	1	4	0
Kangaatsiaq	0	0	1	0	0
Qaanaaq	0	0	0	0	0
Qasigiannuit	1	0	0	1	0
Qeqertarsuag	0	0	0	0	0
Upernavik	1	3	4	2	4
Uummannaq	5	8	6	3	1
Qeqqata municipality	10	2	4	7	12
Maniitsoq	8	1	2	2	8
Sisimiut	2	1	2	5	4
Sermersooq municipality	37	25	21	28	20
Tasiilaq	18	4	2	6	10
Illoqqortoormiut	3	0	1	1	2
Nuuk	16	16	16	18	8
Paamiut	0	5	2	3	0
Outside municipalities	0	0	0	0	0
Total	100	74	60	62	63

The number of TB cases in need of re-treatment (category II treatment regimen according to WHO classification) each year also increased, representing around 7% of all cases registered: there were 7 cases in 2005, 17 in 2006, 9 in 2007, 5 in 2008 and 5 in 2009.

In 2009, there were 57 new and 6 relapsed cases, with a total incidence of 112 per 100 000 population. The highest rate was in Kujalleq municipality (301), higher overall in the settlements (319) and somewhat lower (298) in the towns (Nanortalik, Narsaq and Qaqortoq) (Annex 4). Of the 57 new patients reported to WHO, 54 had pulmonary TB (24 smear-positive and 11 with unknown smear); 36 (63%) patients were men. The distribution by age group is shown in Fig. 2.

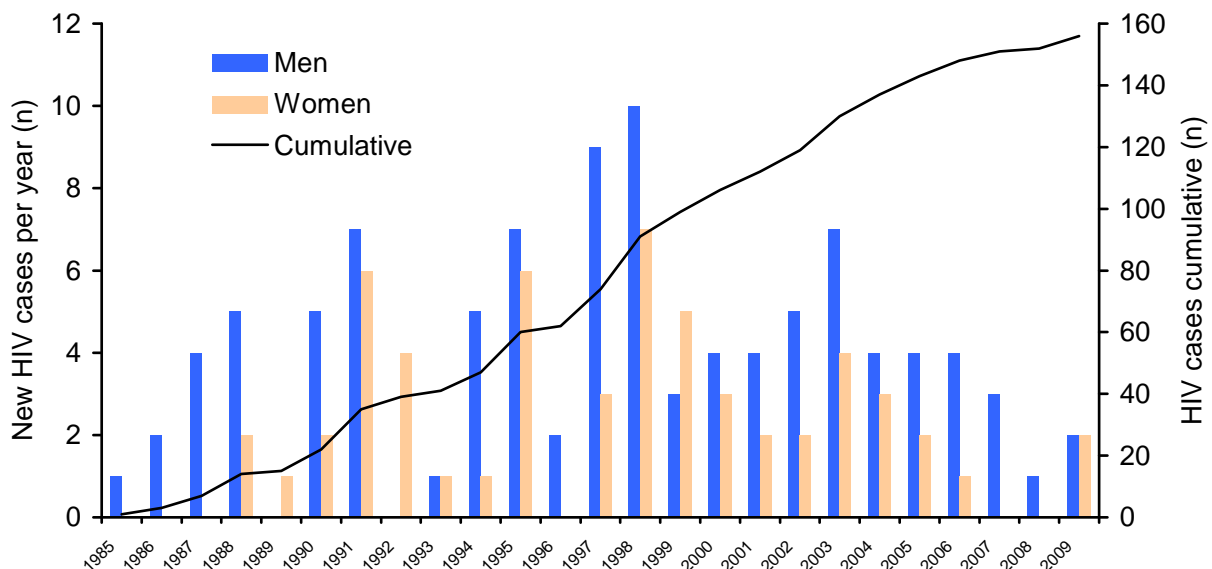
Fig. 2. New TB cases (all forms) notified by age group and sex, 2009



To measure the current burden of TB in Greenland, 1700 schoolchildren in the south and east of the country were tested with interferon gamma release assay (IGRA) from November 2005 to August 2006. High proportions of children were found positive: 9.6% in Tasiilaq, 17.9% in Narsaq, 10% in Qaqortoq and 17% in Nanortalik.

Few cases have been reported with drug resistance and none with multidrug resistant TB (MDR-TB). Despite the drug susceptibility testing carried out for all culture-confirmed cases at the SSI, MDR-TB has not been seen yet in Greenland. The first HIV-positive person was reported in 1985 (Fig. 3). The number of HIV-positive people reached a peak in 1998 and then fell to four cases in 2009 and none in 2010 (to date). Since 1985, 156 HIV-positive people have been registered in Greenland.

Fig. 3. New HIV-positive people notified by year and cumulative, 1985–2009



Health system

The first hospital was built in Nuuk in 1853 as a TB sanatorium. It was followed by the construction of hospitals and health centres in each district between 1950 and 1960. Since 1992, the government has been directly responsible for the health system (see Annex 5). In 2007, overall expenditure was DKr 8239 million, of which DKr 999 million (12%) was spent on health, almost DKr 20 000 per inhabitant.

The two major problems facing the health system are: (i) a widely scattered population living in small communities which are often difficult to reach, and (ii) the high turnover of health staff who mainly come from Denmark, are recruited from a wide range of specialities and only work in Greenland for short periods.¹

¹ In 2009, the National Board of Health issued around 2000 authorizations to cover 1200 jobs. Excluding those jobs covered by permanent staff, figures for staff turnover showed that several persons did the same job during the year.

Consistent with the new administrative structure of the country, the government decided to convert the health services, which were initially designed to cover districts, into a regional framework. This also aimed to increase the quality of health care and overcome the chronic shortage of human resources, as well as to ensure equal access to health care for all citizens, wherever they lived. The key principles of the health reform are: equal access, optimal use of resources, efficiency, human resources development, quality standards, patient safety and primary health care.

In terms of organization of service delivery, the reform foresees the conversion of 16 district hospitals and 64 settlement consultation posts into 5 regional hospitals and a number of health centres, nurse stations and settlement consultations. Queen Ingrid's Hospital in Nuuk will become the national referral centre, with strengthened specialized services expanded to cover such areas as chemotherapy and pain relief, traumatic injuries, anaesthesiology, psychiatry, diabetology and tuberculosis. Each regional hospital will have highly specialized personnel such as doctors, midwives, pharmacologists, physiotherapists, audiologist assistants, health visitors, community nurses and psychiatric community nurses. Less specialized health personnel will work in subregional facilities supported by national guidelines and supervision. In every village and settlement with more than 50 inhabitants, the health personnel will be able to communicate with regional hospitals through telemedicine – technology able to offer virtual doctor consultancies as well as transmission of digital X-rays and other medical images and electronic patient records in the national database. Each region will have a regional health management with one leading regional doctor, one leading regional nurse and one regional superintendent. The current policy of health services free of charge, including transport by air for medical referral, will be maintained under the national health insurance. These changes were introduced in January 2010 in two pilot areas, Sisimiut-Maniitsoq and Aasiaat-Qasigiannnguit-Qeqertarsuaq. This experience will be analysed during the first half of 2011 and the reform will be scaled up to the whole country, with the necessary adjustments, during the second half of the year. The Ministry of Health acknowledges that coordination with all parties (patients' associations, district health providers, etc.) and proper communication with the population will be essential for the successful implementation of the health reform.

Recommendations

The visiting team made the following recommendations.

- The WHO mission appreciates the considerable efforts of the Ministry of Health to combat TB and the good implementation of the current National Tuberculosis Programme. It recommends ensuring the long-term commitment needed to control and eliminate TB.
- The current reform in the health sector should preserve and further expand access to good quality diagnosis and treatment of TB. Specialized functions (management, diagnostics, treatment of complicated cases) should be ensured at central level and services further improved at lower levels through the maximum use of the latest developments in telemedicine and other technology. Collaboration should be formalized with centres of expertise in Denmark or in other countries. Circumpolar collaboration, sharing experience among indigenous populations, should be further enhanced.

National Tuberculosis Programme strategies, structure and resources

In 1999, a national strategy to fight TB was developed, based on the following components:

- a TB group at central level to coordinate all interventions;
- a central monitoring unit collecting TB notifications from all districts and information from laboratory investigations carried out by SSI;
- national guidelines describing all procedures for diagnosis, treatment, contact-tracing and screening;
- a national TB nurse to coordinate and train staff and supervise activities countrywide;
- a budget to finance specific interventions as needed (dealing with TB outbreaks);
- advocacy and communication to promote better living conditions and lifestyles.

Given the evidence of high rates of TB infection found in schoolchildren proving the inadequacy of past TB control measures, the National Board of Health suggested additional interventions that were approved by the government under the new 2007–2012 National TB Strategy. The additional interventions were: (i) an information campaign about TB; (ii) development of TB training material for health workers; and (iii) TB screening based on: replacement of tuberculin skin testing with IGRA blood testing, employment of a regional TB nurse for South Greenland based in Nanortalik, mass X-ray screening in south Greenland every two years and IGRA screening of all children at the start and completion of their schooling (1st and 10th grades).

The TB group, corresponding to the central unit of the national TB programme in other countries, is composed of the following staff:

- chief medical consultant (specialist in lung diseases and TB)
- national TB nurse
- chief medical officer (from the National Board of Health)
- nursing adviser (from the National Board of Health)
- executive medical officer (from the National Management of Health)
- executive nursing officer (from the National Management of Health)
- regional TB nurse (for Qaqortoq, Narsaq and Nanortalik in South Greenland).

In addition, there are 13 key figures with district responsibilities for TB located in (from north to south): Upernavik, Ummannaq, Illulissat, Qasigiannuit, Aasiaat, Sismiut, Maniitsoq, Paamiut, Narsaq, Qaqortoq and Nanortalik. They are responsible for directly observed therapy (DOT), periodic medical controls, drug management, recording and reporting.

The TB group ensures the carrying out of central functions such as policy formulation, planning and coordination, monitoring and supervision and training. However, the absence of a laboratory

expert limits its capacity in this area, which needs to be expanded to enhance early TB diagnosis and closer collaboration with the SSI.

Recommendations

The visiting team made the following recommendations.

- The TB group should be strengthened in its essential work of coordination, monitoring and supervision of TB interventions in the general health system. Managerial and technical skills should be further sustained through appropriate TB training available internationally.
- The TB group should include one laboratory expert to ensure proper coordination with the TB laboratory network in the country and closer communication and collaboration with the acting Supranational TB Reference Laboratory in SSI in Copenhagen.

Case-finding and laboratory

Case-finding

The National Board of Health has produced guidelines for the diagnosis of TB disease and infection.

Active TB disease is diagnosed when clinical signs and symptoms are supported by positive microbiology (sputum smear direct microscopy or polymerase chain reaction test or culture) or histology, abnormal X-ray (or other imaging) and positive tuberculin skin test or IGRA. In special cases, the clinical picture only can be used for diagnosis. HIV testing is offered to all TB patients.

Depending on the availability of laboratory staff, smear microscopy is performed in district hospitals. The national guidelines provide directions on the number of specimens to collect and the alternatives when the patient has difficulty producing sputum samples. The national guidelines do not, however, include recommendations regarding the collection of specimens, that is, on the requested volume, accepted quality, labelling, filling in of the request sheet, preparation for despatch (UN3373), and procedure for shipping specimens for microscopy and culture at SSI in Copenhagen. The majority of specimens are received by SSI within seven days, although delays may occur due to difficulties in shipment or with customs clearance (especially from locations other than Nuuk). In culture-positive cases, mycobacterium identification and drug susceptibility testing are carried out. In selected cases, additional microscopy is done at Queen Ingrid's Hospital in Nuuk so that the diagnosis can be made earlier. Specimens for histology are sent to Rigshospitalet in Copenhagen.

Chest X-ray investigation was digitalized in 1997. X-ray films are usually read by doctors in district hospitals, who may consult the Radiology Department of Queen Ingrid's Hospital.

By the end of 2010, telemedicine technology was to have been installed in all hospitals and settlements with more than 50 inhabitants. Known as "Pipaluk", the telemedicine equipment (AMD-400 Image and illumination system, AMD Telemedicine, Welch Allyn) offers the opportunity to record a patient's information (pictures, scans, sounds, blood pressure, pulse,

temperature, electrocardiogram, oxygen saturation, etc.) and send it for medical attention via a telephone line. It may prevent the referral for diagnosis of many patients living in remote settlements which are rarely visited by doctors (only once or twice a year, depending on the availability of staff and transport) and often only connected by helicopter twice a week.

M. tuberculosis infection is mainly verified with IGRA testing of blood specimens, which are drawn and incubated at district hospitals or in mobile incubators carried by the TB nurses. After incubation and centrifugation, the stimulated plasma is forwarded to the central laboratory at Queen Ingrid's Hospital for IGRA.

In 2007, Greenland introduced IGRA testing for TB screening of all children at the start and completion of their schooling, with the aim of detecting earlier TB cases in their families. After three years of such screening, however, the detection of new active TB cases was poor. Another attempt at active TB-finding was carried out in southern Greenland, based on visits to all settlements by boat and screening of inhabitants with questionnaires and chest X-rays. In 2008, out of a target of 7750 population, only 2622 (34%) people were reached for screening. All X-rays were examined by the district doctors, the last ones four months after the screening time and without crosschecking the X-rays with questionnaires: 456 chest X-rays were flagged as abnormal but only 7 were confirmed TB. The cost of renting the boat was DKr 260 000.

The visiting team found that from the algorithm in the TB national guidelines, it is not clear whether diagnosis of TB can be done based only on clinical signs and locally-evaluated chest X-rays or if it requires additional procedures, such as a chest X-ray confirmed by a specialist, a positive tuberculin skin test or IGRA test, sputum smear microscopy or another procedure. Moreover, the slow electronic transmission of X-ray images makes it difficult for the radiologist at Queen Ingrid's Hospital, who has the main responsibility of interpreting chest X-rays to the district doctors who do not have enough practice and can easily over- or under-diagnose TB.

It is still unclear how far telemedicine, a new and still developing technology, will improve access to health care. At present, telemedicine does not support the diagnosis of active TB disease or infection. Consequently, TB investigations are being, and will continue to be, carried out in hospitals, with unavoidable serious delays in diagnosis and starting treatment, especially for the many patients who live in settlements and have to come to the hospital by helicopter.

Laboratory

Queen Ingrid's Hospital has a class BSL2 laboratory build in 2007. Equipment is located in separate rooms so as to limit noise and control temperature and humidity. A separate section of the laboratory is used for microbiology, including smear microscopy for acid-fast bacteria. The laboratory carries out around 700 000 tests annually, including 700 direct smear microscopy investigations and 6000 IGRA tests. As elsewhere in the country, notwithstanding the laboratory being located in Nuuk, it is difficult to recruit staff, and colleagues have to come from Rigshospitalet in Copenhagen to replace the bio-analyst during annual leave. Two people have been trained in IGRA testing (QuantiFeron® TB Gold) and one bio-analyst is being trained. IGRA tests are carried out at least once a week as part of the screening of schoolchildren, contact-tracing and in supporting the diagnosis of active TB disease. The IGRA kit (version 2.50) includes standards to run in parallel with the specimens for validation. The IGRA analysis requires a lot of manual handling, which is time-consuming and carries potential hazards.

The central laboratory does not hold formal accreditation, but it has many good routines from the standards of the International Organization for Standardization. Clear instructions for both direct smear microscopy and IGRA testing are in place, although proficiency panels are not used. Also missing is the monitoring of key indicators, such as the positivity rate. During the team's visit, the bio-analyst demonstrated good experience in reading sputum smear slides.

The Head Biotechnologist is in charge of deciding the laboratory's policy (list of tests to be carried out at the different levels of health care), training staff before deployment to their posts and supervising the district laboratories. Owing to the high workload, however, there had been no supervision for the previous two years.

The number of laboratories in district hospitals actually able to perform sputum smear direct microscopy varies a lot according to the time of year and the fluctuating availability of bio-analysts (only four district hospitals had a bio-analyst at the time of the visit). NEW staff are trained at Queen Ingrid's Hospital before they perform analyses at district hospitals.

Recommendations

The visiting team made the following recommendations.

- Transmission of TB is continuing, especially in the isolated communities and where socioeconomic changes in towns create pockets of vulnerability. Available financial and human resources should be used to strengthen TB control by earlier detection of active cases rather than identification of latent cases of TB.
- Access to prompt and good quality diagnosis and treatment of TB should be culturally sensitive and assured, without regard to location. The use of the most appropriate technology should be considered to allow earlier diagnosis and treatment of cases at the lowest possible level. Some expensive transport of suspected TB patients to towns can be avoided by developing diagnostics algorithms that consider old and new tools, possibly through telemedicine.
- With the current status of TB epidemiology and resources, mass screening of the population with X-ray or IGRA testing appears to be ineffective in identifying and treating active cases and latent infections. Passive case-finding should be promoted as the most cost-effective approach and accompanied by prompt ad hoc investigation if there is a TB epidemic in a specific location.
- Quality assurance of laboratory analysis in the central laboratory should be further expanded with regular monitoring of testing indicators and participation in international proficiency panels. Automation of analyses should be considered depending on workload, in order to protect staff.
- Chest X-ray readings from the whole country should be centralized in the Radiology Department of Queen Ingrid's Hospital (or outsourced abroad if the workload is too heavy) in order to compensate for the usual limited number of doctors hired temporarily to work at district level.
- The diagnostic criteria should be reviewed in order to prevent misinterpretation among staff in posts where there is a high turnover. Separate diagnostic algorithms may be developed for towns and settlements in order to ensure early diagnosis and start of treatment.

- Long-term objectives for TB laboratory services should be established based on considerations of biosafety, human and financial resources, infrastructure and logistics.
- The instructions for collection of specimens (number of specimens, volume, accepted specimens, alternatives to sputum, tubes), labelling, shipping and filling in of the request sheet should be revised.
- Smear microscopy could be improved with sodium hypochlorite sedimentation before staining, which inactivates the bacteria and increases laboratory staff safety. LED microscopes could also be considered to increase the sensitivity of the microscopy.
- IGRA testing should be carried out using safety practices such as the routine use of gloves when handling plasma. For the same reason, it is recommended that handling procedures be reduced and IGRA testing be fully automated.
- Laboratory internal quality control, monitoring of laboratory indicators (such as positivity rate) and external quality control (participation in proficiency panels) should be implemented in the central laboratory and in all peripheral laboratories.
- Formal collaboration should be established between the central laboratory and a supranational TB reference laboratory. The SSI laboratory, which already supports Greenland, should be preferred and have its de facto status of supranational TB reference laboratory of Greenland recognized by WHO.
- Recruitment for laboratories could include technicians, not just bio-analysts, in order to fill vacant positions. The initial training at the central laboratory should take into account the different backgrounds of the staff hired and should include both newly recruited laboratory technicians and bio-analysts.
- Supervision of peripheral laboratories needs to be reactivated and become routine practice.

Case management

The guidelines produced by the National Board of Health describe how to treat active TB cases, how to conduct TB contact-tracing and how to manage latent TB infection. They follow international standards and WHO recommendations and are well-considered and appreciated among all medical staff, including those working on temporary contract in Greenland.

Where cases are uncomplicated, treatment in hospital is normal during the first weeks, followed by outpatient treatment under the care of the doctor, TB key figure or TB nurse nearest to the patient's home. It is, however, difficult to organize DOT outside hospital owing to environmental barriers, so it is often replaced by a weekly drug supply.

Doctors in district hospitals often have limited experience of clinical management of TB since they usually come from a low-incidence country such as Denmark. They are, therefore, usually only partially involved in the treatment of TB patients and reporting of the treatment outcome. This can explain why the TB group in Nuuk receives poor and delayed reports, from which the cohort analysis shows low (and unreliable) cure and treatment completion rates (Table 2).

Table 2. Treatment outcome among new TB cases (all forms), 2005–2008

Treatment outcome	2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%
Cured	45	45.0	10	13.5	7	11.7	0	0.0
Completed treatment	19	19.0	29	39.2	6	10.0	2	3.2
Died	7	7.0	2	2.7	1	1.7	5	8.1
Defaulted	3	3.0	2	2.7	5	8.3	0	0.0
Transferred out	2	2.0	1	1.4	0	0.0	0	0.0
Unknown	24	24.0	30	40.5	41	68.3	55	88.7
Total registered	100	100.0	74	100.0	60	100.0	62	100.0

The treatment outcome among TB retreatment cases is not available. A study was carried out in 2009 to verify the actual treatment outcomes under the National Tuberculosis Programme by cross-checking the laboratory results (available at SSI) with notification data.² Of the 26 new sputum smear-positive cases registered in 2008, 4 patients were cured and 14 completed treatment (a 69.2% treatment success rate), 2 patients died (7.7%), 2 patients defaulted (7.7%), 3 patients failed (11.5%) and 1 patient was transferred out (3.8%).

Recommendation

The visiting team noted that TB nurses and TB key figures are of paramount importance for the successful treatment of TB cases and recommended that they should continue and intensify their activities to ensure DOT, trace treatment defaulters promptly and ensure the punctual and complete reporting of treatment results to the National Tuberculosis Programme central unit in Nuuk. Despite the difficulties, doctors in district hospitals should be actively involved in TB case management. Reliable lay people (excluding family members) should be selected to ensure DOT in the communities where patients live.

Vulnerable populations

In 2009, four new HIV-positive people were reported in Greenland and no AIDS cases with TB disease. Those who must be detained in prison are sent to Denmark. Vulnerability to TB is not limited to specific population groups. A case-control study of 146 TB patients during 2004–2006 revealed statistical significant vulnerability to TB among people of Greenlandic ethnicity who lived in settlements and were dependent on social funds. The usual progression to TB sickness, as described by the TB key figure of Nanortalik, is unemployment → depression → alcohol abuse → inability to pay the rent → moving to a house with many people → overcrowding, malnutrition → TB disease. At the time of the WHO mission, 15% of the population in Nanortalik were unemployed, most of whom were living on social security. Depression is not only a cause of alcohol and other abuses, it also encourages bad behaviour (including gambling – bingo clubs have opened recently) and further impoverishment. The climate and the small size of the communities promote the gathering of people in enclosed public places where coughing is normal (many smoke tobacco), drinking alcohol is socially promoted and TB is not a stigma.

² Thomsen, VØ. *Assessment of the Greenlandic tuberculosis programme by application of outcome indicators* [thesis]. Copenhagen, University of Copenhagen, 2009.

Outbreak management and infection control

For each active TB case, the close contacts are traced by the TB key figure, evaluated clinically and IGRA-tested and eventually prescribed six-month isoniazid preventive treatment (IPT). The tracing of defaulters is, however, usually delayed and IPT is given through a full six-month supply of isoniazid without considering the patient's compliance. Most patients probably do not comply with the IPT prescription.

The SSI is working on a new method for sub-typing *M. tuberculosis* complex from patient specimens, which will allow the tracing of clusters of TB transmission. Previous experience with restriction fragment length polymorphism has demonstrated a high rate of clustering in Greenland.

Infection control is the responsibility of the National Board of Health and the Hygiene Commission in Greenland in coordination with the Centralised Unit for Hospital Hygiene at the SSI in Denmark. Guidelines regarding isolation procedures for TB patients in Greenland were issued by the National Board of Health in October 2005.

The national guidelines describe which TB infection control measures should be adopted in hospitals and the procedures to be followed for the collection of specimens for laboratory investigation and for their handling, processing and shipment to the SSI. Unfortunately, leaks of organic material have been reported in the past. TB patients must be isolated when they are suspected of being, or found to be, sputum smear-positive or when a chest X-ray shows they have extensive parenchyma lesions with caverna. The isolation should continue for at least two weeks from the start of effective TB treatment. The national guidelines also describe which cleaning procedures should be followed and the hygiene precautions to be taken by patients, visitors and health care workers. The guidelines also request TB suspects to wear face masks when being flown to a district hospital. MDR-TB has not yet been observed in Greenland, but the national guidelines may need to be revised from this perspective.

The climate and social norms lead most people to spend a significant amount of time indoors in close contact with each other. Information campaigns could play an important role through messages such as recognition of TB-indicative signs and symptoms for early medical consultation, cough and spitting etiquette and the importance of ventilation at home and in public places.

Recommendations

The visiting team made the following recommendations.

- Contact-tracing is important for early detection or prevention of new TB cases. It should be done strictly and documented for evaluation of performance. Active TB status should be assessed for each contact and IPT given to all those recently infected. A supply of isoniazid should be given to patients weekly (at the most) and their compliance monitored.
- The Hygiene Commission should evaluate all health facilities for TB infection control, and formulate and implement the most appropriate administrative, personal and environmental measures.

- The use of diagnostic algorithms for the settlements should be considered in order to reduce the risk of transmission while patients are being transported to and staying at health care facilities.
- The use of particulate respirators (FFP2 or N95) should be clearly defined. In particular, respirators are recommended during high-risk aerosol-generating procedures and when caring for confirmed or suspected MDR-TB patients. Staff should be trained to use and check the fitting of the respirators.
- IGRA-testing of all health care workers should be considered at the beginning and end of their employment and after possible exposure and/or annually. IPT should be provided to workers recently infected, after exclusion of active TB disease. Voluntary testing and counselling for HIV should also be available.

Drug supply and management

Apart from a few drugs kept at Queen Ingrid's Hospital in Nuuk, there is no central procurement and storage facility. Each district hospital receives drugs several times a year, including anti-TB drugs, directly from the pharmacy at Herlev Hospital near Copenhagen. This system is described not expensive, as the drugs are shipped by sea with other goods, and it spares the central pharmacy in Queen Ingrid's Hospital the need to increase its storage capacity. The Head Pharmacist did, however, report to the WHO mission that some shipments had been delayed in the past, fortunately without causing any interruption in the treatment of TB patients.

Anti-TB drugs are usually prescribed in four fixed-dose combinations during the intensive phase of treatment. For the continuation of treatment, isoniazid and rifampicin are given in separate tablets, usually placed inside a small plastic bag for a patient's daily consumption. As DOT cannot always be ensured outside hospitals, patients have opportunities to switch to monotherapy even though it brings a high risk of developing drug resistance. Fixed-dose combination drugs are recommended to prevent this happening.

Recommendation

The visiting team recommended that anti-TB drugs should be procured centrally for the whole country, following international recommendations for estimation of needs, buffer stocks, storage and distribution. Fixed-dose combination drugs should be adopted during both the intensive and continuing phases of treatment to prevent the development of drug resistance and to simplify the management of drugs and training of staff.

Recording and reporting and surveillance

The Individual Notification of Tuberculosis form was introduced in 1999. It is the pillar of the TB recording and reporting system and includes all information about the patient: social security number, name, age, place of residence, sex, weight at diagnosis, disease (new case/retreatment, localization, date of symptoms), diagnosis (date of contact with health care system, X-ray description, microbiological results, date of diagnosis, drug susceptibility result), treatment (start date, doses, stop date, treatment outcome result) and controls (microbiology, weight, X-ray).

HIV status is not, however, included. The form is simple and appreciated by all staff, with the exception of its section for contact-tracing, which is considered too small.

Usually, the doctor initiating the treatment starts to fill in the form, which is then updated by the TB key figure during follow-up treatment. Each new event is recorded on the form and faxed to the TB group in Nuuk, where the National TB Nurse enters the information manually into a national TB individual database. The database is analysed every two months in order to identify geographical settings where urgent action may be needed. Most of the internationally recommended definitions and indicators are used, with some exceptions (e.g. including pleurisy among pulmonary forms of TB). The SSI sends the results of the first positive laboratory investigation (sputum smear microscopy, culture and drug susceptibility testing) to the requesting doctor in Greenland, with a copy to the TB group, thus giving the group the opportunity to cross-check the data received through the notification system.

The National Board of Health publishes an annual report that includes sections on TB and HIV/AIDS. The National Tuberculosis Programme also submits consolidated data to the Regional Office, which appear as footnotes in the Global TB Control Report and the TB Surveillance in Europe Report jointly prepared by WHO and the European Centre for Disease Control. Greenland is not a Member State of the WHO Region for Europe and negotiations are under way with Denmark as to how to include the Greenland data in these publications.

Unfortunately, the Individual Notification of Tuberculosis forms are often not filled in properly and there is a lot of communication between Nuuk and the notifying units to complete the information on individual patients. As in many other countries, notification is prompt when a new TB case is detected, but delayed or even missing when the treatment ends. The wide availability of the internet in Greenland and the recent introduction of telemedicine are opening up the opportunity to computerize TB recording and reporting which, with proper use, can decentralize data entry, facilitate the cross-checking of data, share data analysis and produce feedback. This should increase the capacity of The National Tuberculosis Programme to assess and monitor treatment outcomes. The Programme has already been working on an internet-based TB notification system based on Eskolab (the TB portal, TB manual and TB profile), which is almost finalized.

Surveillance for anti-TB drug resistance is carried out at the SSI, which holds ISO17025 accreditation and refers to the Supranational TB Reference Laboratory in Stockholm, Sweden. Drug susceptibility testing is routinely done for all culture positive isolates. In 2008, all 43 patients investigated were susceptible to all drugs (rifampicin, isoniazid, ethambutol and pyrazinamide). In 2009 (until April), only 1 of the 50 patients investigated had detectable drug resistance, specifically a previously-treated TB case with isoniazid mono-resistance.

Recommendations

The visiting team made the following recommendations.

- Recording and reporting of TB cases should be fully electronic, with the possibility of updating and consultation at peripheral levels. All services provided should be documented, including first contact with the health care system, diagnosis, treatment compliance and completion. Contact-tracing and preventive treatment should be included. Regular monitoring at central level of the performance of local programmes should be ensured and feedback given to the districts.

- Greenland is not a Member State of the WHO Region for Europe and the Ministry of Health is independent from Denmark. This situation limits direct forms of collaboration that could benefit Greenland, such as in international surveillance and participation in coordination meetings. This problem should be addressed, at least at the technical level.
- National monitoring of drug resistance surveillance and TB/HIV co-infection should be maintained and strengthened.
- The capacity of the National Tuberculosis Programme at central level should be optimized in order to ensure the regular monitoring of local Programme performance and prompt reaction to TB epidemic outbreaks.
- The TB notification form should be revised to accommodate all the services provided, including contact-tracing.
- For the purpose of computerizing TB recording and reporting, it could be considered cost-effective to create a subset of TB entries in application software already in use for health statistics and telemedicine. Standardized data entry can feed the national TB database via the internet.
- The list of TB indicators for monitoring should be revised in order to make possible international comparisons of Greenland with other countries. As in Denmark, it should be possible for Greenland to report individual data through the European Surveillance System (TESSy) and for these data to be reported in the annual tuberculosis surveillance report from WHO and the European Centre for Disease Prevention and Control.

Human resources development

Greenland depends heavily on Denmark to run its health facilities. There is no medical school in the country and all doctors are authorized by the National Board of Health of Denmark. A knowledge of Danish is essential to ensure communication with other staff and patients. In the past, the few Inuit medical doctors who graduated in Denmark usually preferred to settle there, where they could enjoy better living conditions. It is only recently that more Greenlandic doctors have come back after graduation. As a consequence, most doctors working in Greenland are from Denmark, with varying medical experience and usually on short-term contracts. Many of them are not familiar with diseases common in Greenland but rare in Denmark, such as TB. Since 1992, Greenland has had its own school of nurses from which an average of seven nurses a year graduate.

To overcome the shortage and high turnover of staff, it is essential to introduce simple, short and clearly written guidelines. It may be possible to organize specific training in TB management, even for doctors staying for a short time. A strong TB group and TB staff at peripheral level may provide support for and supervision of them.

Recommendations

The visiting team made the following recommendations.

- The development of human resources should be properly planned, taking into account the high turnover of medical and nursing staff. Orientation should be provided to medical doctors and nurses coming from abroad before starting their service in Greenland. On-the-job training and annual refresher courses should be provided to all health workers with TB responsibilities in the field. A national TB manual, simple pocket guidelines and appropriate training material should be prepared.
- There should be formal back-up for hospital doctors with Danish institutions, such as Gentofte Hospital's Department of Lung Medicine, where most TB patients in Denmark are seen.
- Short, intensive courses for new doctors should be organized in Greenland or Denmark before their deployment. TB should be included in such training.

Advocacy, communication, social mobilization

The Ministry of Health is active in promoting good health and healthy lifestyle behaviour. The Inuuneritta Public Health Programme 2007–2012 under the Ministry of Social Affairs specifically monitors and combats behaviour such as tobacco-smoking and abuse of alcohol and drugs, which all create serious risks for diseases, including TB. It seems, however, that messages promoting better lifestyles are not clearly matched with the risk of diseases such as TB. The Ministries of Social Affairs and of Health should work together to improve this situation.

Recommendation

The visiting team recommended that awareness and information should be improved among the population in general, and high-risk groups in particular, in order to encourage health-seeking behaviour and reduce delays in self-reporting for TB diagnosis. Forms of communication should be designed based on specific studies made in Greenland, and assessed periodically for effectiveness. The Ministry of Social Affairs and the Ministry of Health should collaborate more closely in the areas of advocacy, communication and social mobilization, including for the prevention and control of TB.

Research

The Greenland Institute of Circumpolar Health Research was established in 2008. Researchers in Greenland collaborate with the International Union for Circumpolar Health, the International Network for Circumpolar Health Research, the Infectious Disease Working Group and the International Circumpolar Surveillance System. There is also collaboration with several institutes in Denmark, including the SSI in Copenhagen, the National Institute of Public Health of the University of Southern Denmark, the Centre for Arctic Environmental Medicine of Aarhus University and the Arctic Health Research Centre of Aalborg Hospital.

Research projects are approved by the Scientific and Ethical Committee of Greenland. Some funding is available through the Commission for Scientific Research in Greenland.

A number of TB studies have been finalized recently or are in progress in Greenland. Laboratory studies in collaboration with the SSI include: IGRA testing (QuantiFERON® TB Gold), genotypic drug resistance testing with Line Probe assays, MIRU24 VNTR genotyping of *M. tuberculosis*, and evaluation (planned) of GeneXpert® assay (Cepheid). Population-based studies in collaboration with universities in Denmark include: the TB infection rate in children, risk factors for TB infection in schoolchildren, TB and vitamin D status, and risk factors for TB disease among the adult population.

Recommendations

The visiting team made the following recommendations.

- Future operational studies should give priority to understanding the factors related to delays by patients and doctors, including health-seeking behaviour and access to health care. Participatory rapid appraisal methods should also be considered, such as interviews with key informants, focus group discussions, questionnaires and direct observation. Qualitative studies by anthropologists should also be considered.
- Studies should be undertaken of the use of modern communication technologies, such as telemedicine and its potential use for the decentralization of TB diagnosis (for example, in sputum collection, sputum microscopy, tuberculin skin test and GeneXpert®).
- Studies should be undertaken of the risk factors for TB and interventions to address social determinants.
- Studies should be undertaken of the most effective advocacy, communication and social mobilization interventions to reduce the stigma of TB, promote self-reporting by patients and eventually improve case detection and treatment outcomes.
- Studies should be undertaken of the biological vulnerability to TB infection and disease among the Inuit population.

Annex 1

PROGRAMME

30 April	Kangaatsiaq	Arrival from Copenhagen Departure by aeroplane
11:15	Nuuk	Arrival
14:00		Briefing with Ministry of Health at Hotel Hans Egede
1 May		
06:50		Departure by aeroplane and helicopter
10:40	Nanortalik	Arrival
2 May	Nanortalik Hospital	Interview with a TB patient Meeting with a focus group of inhabitants
3 May		
10:00	Local municipality	Meeting with Director of Social Services Meeting with preventive worker
13:30	STI/Piareersarfik	Meeting with hospital management
4 May		
10:00		Visit to the hospital
13:00		Meeting with head teacher of the public school
14:30		Visit to the old people's home
18:10		Departure by helicopter
5 May	Narsarsuaq	Arrival Visit to the nursing station Return to Nuuk
09:00		
11:00		
6 May		
10:00	Queen Ingrid's Hospital	Visit to the hospital
13:00		Discussion of the recommendations among the members of the mission
15:00	Ministry of Health	Debriefing with Minister of Health
7 May		
09:05		Return to Copenhagen

Annex 2

LIST OF PEOPLE MET

Agathe Fontain, Minister of Health
Ann Birkekær Kjeldsen, Permanent Secretary of Health
Kent Kleinschmidt, Senior Consultant, National Health Service

Inge-Lise Kleist, Laboratory Manager
Per Lyster Pedersen, Chief Statistician
Bodil Karishøj Poulsen, Head of Paarisa

TB patient, Nanortalik Hospital
Members of the local community, Nanortalik
Frank Hedegaard Jørgensen, Director of Social Services, Nanortalik
Poul Raahauge, head teacher, Nanortalik
Akisooq Isaksen, preventive worker, Nanortalik
Helge Bønlykke, doctor, Nanortalik Hospital
Stine Korneliussen, head nurse, Nanortalik Hospital
Helga Petersen, regional TB nurse
Dorthe Ludvigsen, TB key figure, Nanortalik
Birgitte Christensen, nurse, Narsarsuaq
Anne Marie Holm, dentist, Nanortalik

Annex 3

MAP OF GREENLAND



Annex 4

NUMBER AND RATE OF NEW TB CASES (ALL FORMS) BY TOWNS AND
SETTLEMENTS, 2009

Towns				Settlements				Total		
Name	Popu- lation	New TB cases		Name	Popu- lation	New TB cases		Popu- lation	New TB cases	
		No.	Rate /100 000			No.	Rate /100 000		No.	Rate /100 000
Kujalleq municipality	6 379	19	297.9		1 252	4	319.5	7 631	23	301.4
<i>Nanortalik</i>								<i>2 147</i>	<i>5</i>	<i>232.9</i>
Nanortalik town	1 430	3	209.8	Nanortalik settlements	717	2	278.9			
				Aappilatq	135	0	0.0			
				Alluitsup Paa	329	1	304.0			
				Ammassivik	71	0	0.0			
				Narsaq Kujalleq	100	1	1 000.0			
				Tasiusaq	82	0	0.0			
<i>Narsaq</i>								<i>1 952</i>	<i>12</i>	<i>614.8</i>
Narsaq town	1 637	12	733.0	Narsaq settlements	315	0	0.0			
				Igaliku	58	0	0.0			
				Narsarsuaq	165	0	0.0			
				Qassarsuk	84	0	0.0			
				Other settlements	8					
<i>Qaqortoq</i>								<i>3 532</i>	<i>6</i>	<i>169.9</i>
Qaqortoq town	3 312	4	120.8	Qaqortoq settlements	220	2	909.1			
				Egalugaarsuit	141	2	1 418.4			
				Qassimiut	33	0	0.0			
				Saarloq	46	0	0.0			
Qaasuitsup municipality	13 272	4	30.1		4 406	4	90.8	17 678	8	45.3
<i>Aasiaat</i>								<i>3 131</i>	<i>3</i>	<i>95.8</i>
Aasiaat town	2 947	3	101.8	Aasiaat settlements	184	0	0.0			
				Akunnaaq	102	0	0.0			
				Kitsissuarsuit	82	0	0.0			
<i>Ilulissat</i>								<i>4 958</i>	<i>0</i>	<i>0.0</i>
Ilulissat town	4 528	0	0.0	Ilulissat settlements	430	0	0.0			
				Ilimanaq	80	0	0.0			
				Ogaatsut	45	0	0.0			
				Qeqertaq	132	0	0.0			
				Saqqaq	173	0	0.0			
<i>Kangaatsiaq</i>								<i>1 360</i>	<i>0</i>	<i>0.0</i>
Kangaatsiaq town	631	0	0.0	Kagaatsiaq settlements	729	0	0.0			
				Attu	241	0	0.0			
				Ikerasaarsuk	103	0	0.0			
				Niagornaarsuk	294	0	0.0			
				Iginniarfik	91	0	0.0			
<i>Qaanaaq</i>								<i>802</i>	<i>0</i>	<i>0.0</i>
Qaanaaq town	645	0	0.0	Qaanaaq settlements	157	0	0.0			
				Moriusaq	5	0	0.0			
				Qeqertat	22	0	0.0			
				Savissivik	58	0	0.0			
				Siorapaluk	72	0	0.0			
<i>Qasigiannuit</i>								<i>1 230</i>	<i>0</i>	<i>0.0</i>
Qasigiannuit town	1 142	0	0.0	Qasigiannuit settlements	88	0	0.0			
				Ikamiut	88	0	0.0			
<i>Qeqertarsuag</i>								<i>957</i>	<i>0</i>	<i>0.0</i>
Qeqertarsuag town	925	0	0.0	Qeqertarsuag settlements	32	0	0.0			
				Kangerluk	32	0	0.0			

Towns				Settlements				Total		
Name	Popu- lation	New TB cases		Name	Popu- lation	New TB cases		Popu- lation	New TB cases	
		No.	Rate /100 000			No.	Rate /100 000		No.	Rate /100 000
<i>Upernavik</i>								2 901	4	137.9
Upernavik town	1 158	0	0.0	Upernavik settlements	1 743	4	229.5			
				Aappilattoq	177	0	0.0			
				Innarsuit	164	0	0.0			
				Kangersuatsiaq	192	0	0.0			
				Kujalleq	206	1	485.4			
				Kullorsuag	446	3	672.6			
				Naajaat	61	0	0.0			
				Nutaarmiut	42	0	0.0			
				Nuussuaq	213	0	0.0			
				Tasiusaq	242	0	0.0			
<i>Uummannaq</i>								2 339	1	42.8
Uummannaq town	1 296	1	77.2	Uummannaq settlements	1 043	0	0.0			
				Ikerasaq	243	0	0.0			
				Illorsuit	83	0	0.0			
				Niagornat	66	0	0.0			
				Nuugaatsiaq	82	0	0.0			
				Qaarsut	197	0	0.0			
				Saatitut	211	0	0.0			
				Ukkusissat	161	0	0.0			
Qeqqata municipality	8 238	11	133.5		1 448	1	69.1	9 686	12	123.9
<i>Maniitsoq</i>								3 408	8	234.7
Maniitsoq town	2 741	7	255.4	Maniitsoq settlements	667	1	149.9			
				Atammik	213	0	0.0			
				Kangaamiut	362	1	276.2			
				Napasoaq	92	0	0.0			
<i>Sisimiut</i>								6 278	4	63.7
Sisimiut town	5 497	4	72.8	Sisimiut settlements	781	0	0.0			
				Itilleq	116	0	0.0			
				Kangerlussuaq	558	0	0.0			
				Sarfannuguit	107	0	0.0			
Sermersooq municipality	19 164	14	73.1		1 827	6	328.4	20 991	20	95.3
<i>Tasiilaq</i>								3 000	10	333.3
Tasiilaq town	1 893	5	264.1	Tasiilaq settlements	1 107	5	451.7			
				Isortoq	107	0	0.0			
				Kulusuk	292	0	0.0			
				Kuummiut	358	5	1 396.6			
				Sermiligaag	216	0	0.0			
				Tiniteqilaq	134	0	0.0			
<i>Illoqqortoormiut</i>								485	2	412.4
Illoqqortoormiut town	485	2	412.4	Illoqqortoormiut settlements	0	0	0.0			
				-	0	0	0.0			
<i>Nuuk</i>								15 439	8	51.8
Nuuk town	15 107	7	46.3	Nuuk settlements	332	1	301.2			
				Kangerluarsorseq	4					
				Kapisillit	82	0	0.0			
				Qeqertarsuatsiaat	246	1	406.5			
<i>Paamiut</i>								2 067	0	0.0
Paamiut town	1 679	0	0.0	Paamiut settlements	388	0	0.0			
				Arsuk	156	0	0.0			
				Kangilinnguit	160	0	0.0			
				Ivittuut	60	0	0.0			
				Other settlements	12					
Other municipalities	0	0	0.0		243	0	0.0	243	0	0.0
Other towns	0	0	0.0	Other settlements	243	0	0.0			
Total	47 053	48	102.0		9 176	15	163.5	56 229	63	112.0

Annex 5

GOVERNMENT OF GREENLAND, ORGANIZATION CHART, NOVEMBER 2009

