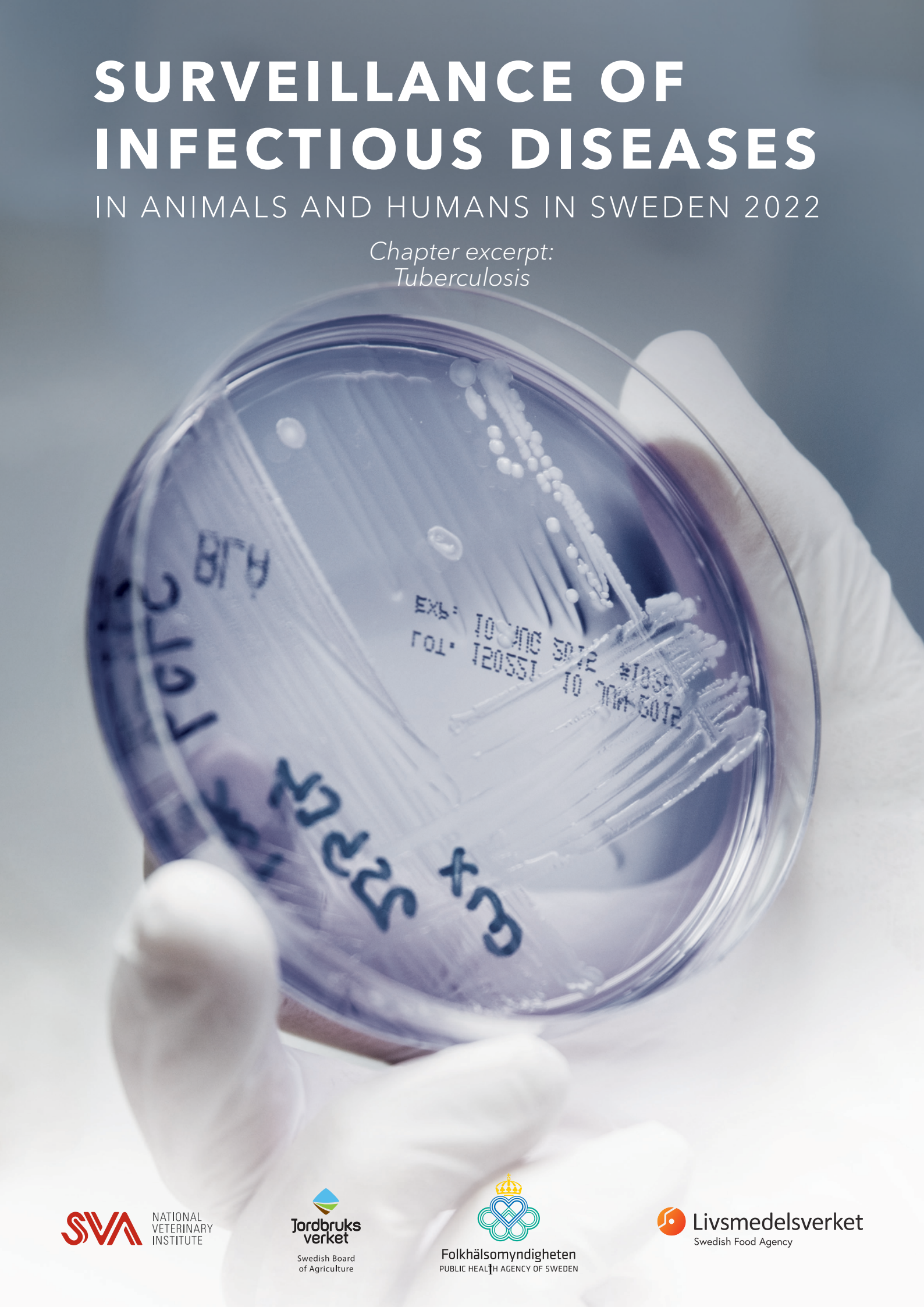
SURVEILLANCE OF INFECTIOUS DISEASES

IN ANIMALS AND HUMANS IN SWEDEN 2022

Chapter excerpt:
Tuberculosis



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Reporting guidelines: Reporting guidelines were introduced in 2018 for those chapters related to purely animal pathogens. The guidelines build on experiences from several EU projects, and have been validated by a team of international experts in animal health surveillance. The aim is to develop these guidelines further in collaboration within the global surveillance community and they have therefore been made available in the form of a wiki on the collaborative platform GitHub (https://github.com/SVA-SE/AHSURED/wiki). Feel free to contribute!

Layout: The production of this report continues to be accomplished using a primarily open-source toolset. The method allows the source text to be edited independently of the template for the layout which can be modified and reused for future reports. Specifically, the chapter texts, tables and captions are authored in Microsoft Word and then converted to the LaTeX typesetting language using a custom package written in the R software for statistical computing. The package uses the pandoc document conversion software with a filter written in the lua language. Most figures and maps are produced using R and the LaTeX library pgfplots. Development for 2022 has focused on generalising the R package to accommodate conversion into formats other than LaTeX and PDF, with a focus on markdown files which can be published as HTML websites using the Quarto publishing system. The report generation R package and process was designed by Thomas Rosendal, Wiktor Gustafsson and Stefan Widgren.

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Tuberculosis

BACKGROUND

Tuberculosis (TB) is a serious disease in humans and animals caused by bacteria included in the *Mycobacterium tuberculosis* complex. *Mycobacterium bovis* causes bovine TB in several animal species as well as in humans. Historically, the reservoir has been cattle, but many other wild and domestic species can also maintain the infection. Wildlife reservoirs including badgers, deer and wild boar cause persistent problems in some countries. Humans usually acquire *M. bovis* infection via unpasteurised milk or via inhalation. The predominant cause of human TB globally is however *Mycobacterium tuberculosis*. In countries where human TB caused by *M. tuberculosis* is common, this bacterium is also frequently isolated from various species of animals.

Bovine TB was introduced to the Swedish cattle population through imports in the first half of the 19th century. In 1958, after a successful control programme, Sweden was declared officially free from bovine TB. Since then, sporadic cases have occurred in cattle, the most recent in 1978. Compulsory tuberculin testing of all cattle was abolished in 1970 and the national TB surveillance in cattle has since then been based on meat inspection and clinical surveillance.

When Sweden joined the European Union in 1995, the status of OTF (officially tuberculosis free) was obtained.

In 1987, *M. bovis* infection was introduced into the farmed deer population through imports. A control programme for TB in farmed deer was introduced in 1994 and made compulsory in 2003. The last case of TB in farmed deer was identified in 1997.

The yearly incidence among humans in Sweden in the early 1940s was above 300 per 100 000 inhabitants. This was followed by a rapid decline, beginning before effective treatment was available in the early 1950s. Currently, the yearly incidence is 3.7 per 100 000 inhabitants, which is among the lowest in the world. Almost 85% of the cases are born outside of Sweden and the vast majority of them are immigrants originating from countries that still have a high incidence of TB. The yearly incidence among people born in Sweden is 0.75 per 100 000 inhabitants. A large majority of the cases detected in humans in Sweden are caused by *M. tuberculosis* and only a few cases per year are caused by *M. bovis*.

DISEASE

The clinical signs caused by TB in both humans and animals depend largely on the localisation of the infection. The disease progresses slowly, and clinical signs may take a long time to develop, even in cases with substantial lesions.

Figure 58: Due to successful eradication efforts, the probability that Swedish farmed deer are free from tuberculosis (TB) remains high. There have been no confirmed cases since 1997. Photo: SVA.

Weight loss and sometimes coughing (in cases with respiratory tract infection), ascites (due to infection in intestinal lymph nodes or liver) or mastitis (mainly in cattle with udder infection) can be seen. The incubation period varies from weeks to years.

LEGISLATION

Animals

Infection by mycobacteria included in the *M. tuberculosis* complex (here defined as *M. bovis, M. caprae* or *M. tuberculosis*) is a listed disease (category B, D and E in cattle and other bovine animals, and D and E in goats, sheep, deer, camelids and other cloven-hoofed mammals) in the Animal Health Law, (EU) 2016/429. Sweden is officially free from the disease in bovine animals in accordance with (EU) 2021/620, and surveillance to demonstrate freedom is implemented in accordance with (EU) 2020/689. Tuberculosis caused by infection with *M. bovis* or *M. tuberculosis* is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and notifiable as described in SJVFS 2021/10 (K12). Infections caused by other members of the *M. tuberculosis* complex are not covered by the Swedish Act of Epizootic diseases but are still notifiable.

Humans

Tuberculosis in humans is a notifiable disease according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2022:217). Contact tracing is compulsory, and the treatment is free of charge. Refusing treatment as a patient when being contagious can lead to detention.

SURVEILLANCE

Passive surveillance

Animals

TB is notifiable both on suspicion and confirmed diagnosis and farmers and veterinarians are obliged to report suspicion of TB. Clinical signs suspicious of TB in animals or lesions detected at slaughter, surgery or postmortem in an animal prompt investigation, which may include sampling for histopathology, bacteriology, PCR, tuberculin testing of contact animals and epidemiological investigations.

Surveillance for TB is mainly performed by meat inspection at slaughter of food producing animals. Official inspectors from the Swedish Food Agency perform the inspections. Suspect lesions are sent to the National Veterinary Institute (SVA) for histology and PCR, as described above. For tissue from macroscopic lesions indicating TB, histology and PCR for *M. tuberculosis* and *M. avium* complex are performed. Samples positive for M tuberculosis-complex at PCR are cultured on solid media (Löwenstein-Jensen and Stonebrink's) at SVA and cultured for up to twelve weeks. Suspected colonies are tested with PCR and, if necessary, with sequencing of a specific gene. Isolates suspected to belong to the *M. tuberculosis* complex or where the *M. tuberculosis* complex cannot be ruled out are sent for confirmation to the European Reference Laboratory in Madrid or the Public Health Agency of Sweden. Positive isolates are further subtyped.

Skin fold tuberculin tests are performed according to (EU) 2020/689. The comparative intradermal test is used, mostly at the neck site. In case of positive tuberculin test reactors, the animal is culled and samples from organs with macroscopic lesions and lymph nodes from five different areas (retropharyngeal, submandibular, mediastinal, mesenteric and inguinal) are collected and examined as described above.

A positive finding of mycobacteria belonging to the *M. tuberculosis* complex in animals, either detected through active or passive surveillance, will generate contacts with public health representatives to ensure that possible exposure of humans can be investigated.

Humans

The surveillance in humans is mainly passive but contact tracing from diagnosed cases is compulsory and asylum seekers from high incidence countries are offered health examination where screening for TB is included, mainly with IGRA.

In humans, culture on sputum smear is the standard test when pulmonary TB is suspected. Otherwise culture from urine, faeces, blood or liquor is also a possibility, or biopsies from suspected site of infection. All isolates from humans are genotyped with whole genome sequencing, mainly to detect clustering of cases that could indicate ongoing transmission, but also to look for genetic mutations associated with resistance.

Active surveillance

Animals

The control programme in farmed deer was initially, until October 2012, based on regular whole-herd tuberculin testing, or whole-herd slaughter and meat inspection. Since October 2012, tuberculin tests are no longer performed in TB-free herds, but inspections at slaughter and post mortem of animals found dead or euthanised are still required.

A voluntary control programme in alpacas was launched by Farm & Animal Health in 2015. Testing of alpacas for TB is done using a serological test (Enferplex Bovine TB, Enfer Group, Kildare, Ireland) instead of an intradermal test as the intradermal test has a demonstrated low sensitivity in alpacas. All adult animals in the herd are serologically tested and all animal purchases and contacts with other herds are recorded and in order to maintain the current status, specific requirements must be met when purchasing new animals.

Furthermore, tuberculin tests are performed at artificial insemination centres and prior to export of animals as required according to EU-legislation (Council Directive 64/432/EEC). Positive animals are treated as suspect cases of TB as described above.

RESULTS

Animals

Due to lesions detected at slaughter, 13 animals whereof 9 pigs and 4 cattle were investigated by histology or, where relevant, by culture and/or PCR. From these samples NTM (Non-tuberculous mycobacteria), from the *Mycobacterium*

avium/intracellulare complex were isolated from 8 pigs. No other slaughterhouse samples yielded any mycobacteria.

Due to clinical suspicions, macroscopic lesions, or findings of acid-fast bacteria, samples from four cats, three dogs, one fallow deer and one forest hare were investigated. From these samples NTM from the *Mycobacterium avium/intracellulare* complex were isolated from two cats, one dog and one forest hare. No other sample yielded any mycobacteria.

One herd was investigated due to a suspicious contact with a human with open TB considered highly contagious after sputum samples. In this case the farm worker had worked in a dairy herd with close contact with the cattle while having clinical signs later shown to be due to open TB (*M. Tuberculosis*). Comparative intradermal tests (tuberculin test) were performed on all animals in the herd, all with negative results. A retest of all animals in the herd is planned in 2023, 4–6 months after the first testing.

During 2022, 1 alpaca, 3 goats, 4 camels, 8 vicuñas and 2 llamas were tested serologically in relation to export or import, and within the voluntary control programme 238 alpacas from 19 herds and 3 llamas from 2 herds were tested, all with negative final results.

In 2022, there were approximately 245 holdings with farmed deer that were considered active. All except one had obtained TB free status. The remaining herd was exempted from regular testing and following the alternative track to obtain a free status; slaughter of at least 20% of the herd yearly, for 15 years, without findings of TB at meat inspections or necropsies. TB was not detected in any farmed deer in Sweden during 2022.

Humans

The total number of detected cases of tuberculosis in humans in 2022 was 386. Out of these, six cases were caused by *M. bovis*, two cases which presented with pulmonary TB and four cases presented with extrapulmonary TB. One case was born in Sweden in the 1930s and most likely infected during childhood or youth. The other five cases were most probably infected in their respective country of origin: Eritrea, Iran, Somalia and Syria. Five of the isolates were unique when analysed with whole genome sequencing. One isolate clustered with an isolate from 2020 from a case with the same country of origin. There was no connection in Sweden between the two cases while infectious.

DISCUSSION

In summary, the overall TB situation in animals and humans in Sweden remains favourable.

No cases of TB were detected in Swedish livestock during 2022. The officially free status for bovine TB in cattle has been maintained during 2022. Although the surveillance is mainly dependent on inspections of slaughtered animals, this has been considered sufficient. However, the number of submissions of lesions from slaughtered ruminants has decreased over the years and work has been initiated in 2019 to increase submissions. At the end of 2021 SVA started to use PCR as initial analytic test. Passive surveillance based on clinical suspicions and post mortem findings will always have a low sensitivity as clinical signs are unspecific and also because clinical symptoms and massive lesions are mainly seen in late stages of the infection Therefore, to assure early detection, a dairy herd was tested when a suspicious contact with a human case was reported. This was a new situation for Swedish circumstances. It highlights the importance of close collaboration between the public health and veterinary sectors. In December 2022 bovine tuberculosis (*M. bovis*) was confirmed in a herd with cattle in Norway. The suspicion arose due to lesions detected at slaughter in November. The farm was placed under restrictions. A following investigation showed a positive animal in a contact herd. Workers who had been in contact with the infected animals were also tested for the disease, and some tested positive. The suspicion is that people could have become infected when working at the slaughterhouse, but earlier onset of infection could not be ruled out. The source of the infection has not yet been identified.

The eradication efforts in farmed deer have been successful and the probability that Swedish farmed deer are TB free is high. The aim is to eventually declare all deer herds officially free. This aim together with the implementation of the Animal Health Law, (EU) 2020/688, implies that a review of TB surveillance in farmed deer is needed. Livestock imports to Sweden are very limited, and TB is an internationally regulated disease which means that precautionary measures are taken.

The rapid decline of TB in humans in the 1940s coincided with the eradication of TB in cattle and started before the introduction of effective treatment in the 1950s. A much larger part of the human population lived in close contact with domestic animals at the time, and the successful control of TB in cattle is likely to have contributed to the decline in human incidence of TB. Today, Sweden has one of the lowest incidences of human TB in the world and there are no signs of ongoing transmission between humans and animals, neither from animals to humans nor from humans to animals.

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