SURVEILLANCE OF INFECTIOUS DISEASES IN ANIMALS AND HUMANS IN SWEDEN 2020

Chapter excerpt -
Tuberculosis

SVA NATIONAL VETERINARY INSTITUTE
Jordbruksverket Swedish Board of Agriculture
Folkhälsomyndigheten PUBLIC HEALTH AGENCY OF SWEDEN
Livsmedelsverket Swedish Food Agency

Editor: Karl Ståhl
Department of Disease Control and Epidemiology
National Veterinary Institute (SVA), SE-751 89 Uppsala, Sweden

Authors: Charlotte Axén, Mia Brytting, Ioana Bujila, Erika Chenais, Rikard Dryselius, Helena Eriksson, Eva Forsgren, Malin Grant, Gittan Gröndahl, Gunilla Hallgren, Kristina Hammarén Busch, Anette Hansen, Marika Hjertqvist, Mia Holmberg, Cecilia Hultén, Helena Höök, Cecilia Jernberg, Jerker Jonsson, Oskar Karlsson Lindsjö, Ulrika König, Elina Lahti, Emelie Larsdotter, Moa Lavander, Mats Lindblad, Anna Lundén, Margareta Löfdahl, Oskar Nilsson, Maria Nöremark, Anna Ohlson, Ylva Persson, Karin Persson-Waller, Thomas Rosendal, Karl Ståhl, Lena Sundqvist, Robert Söderlund, Magnus Thelander, Karin Troell, Henrik Uhlhorn, Anders Wallensten, Per Wallgren, Stefan Widgren, Ulrika Windahl, Joakim Wistedt, Beth Young, Nabil Yousef, Siamak Zohari, Erik Ågren, Estelle Ågren, Elina Åsbjer

Cover: Juvenile mink in hand. Photo: Elina Kähkönen

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, produced by authors, 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 using pandoc and R to the LaTeX typesetting language. Most figures and maps are produced using the R software for statistical computing and the LaTeX library pgfplots. Development for 2020 has further improved the importing of content from Excel files to automatically build figures in the pgfplots LaTeX library. The tool is available as an R-package on GitHub (https://github.com/SVA-SE/mill/). The report generation R-package and process was designed by Thomas Rosendal, Wiktor Gustafsson and Stefan Widgren. In 2020, final typsetting was done primarily by Wiktor Gustafsson with contributions from the report authors.

Print: TMG Tabergs AB.

Suggestion citation: Surveillance of infectious diseases in animals and humans in Sweden 2020, National Veterinary Institute (SVA), Uppsala, Sweden. SVA:s rapportserie 68 1654-7098.

This report may be subject to updates and corrections. The latest version is always available for download at www.sva.se.

SVA NATIONAL VETERINARY INSTITUTE

visiting address. Ulls väg 2B **address.** 751 89 Uppsala
telephone. +46 18-67 40 00 **fax.** +46 18-30 91 62
e-mail. sva@sva.se **web.** www.sva.se

Tuberculosis

Import of alpacas is identified as a potential route of introduction of tuberculosis. There is a voluntary control programme for alpacas to enable detection and confirm absence of tuberculosis in the population. Photo: norr08/iStock.

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 control in cattle is now 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 4.8 per 100 000 inhabitants, which is among the lowest in the world. Around 90% 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 1 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. 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

Suspect and confirmed cases of infection with *Mycobacterium bovis* or *M. tuberculosis*, are notifiable in all animal species according to the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments), other mycobacteria in the *M. tuberculosis*-complex are notifiable according to the Swedish act on notifiable animal diseases and pathogens (SJVFS 2012:24).

Humans

Tuberculosis in humans is a notifiable disease according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2013:634). 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 in animals or lesions detected at slaughter, surgery or postmortem of 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 for histology and bacteriology, as described above. For tissue from macroscopic lesions indicating TB, histology and direct smears are performed. If TB cannot be ruled out by histology or if direct smears are positive, culture is performed. Cultures are performed on solid media (Löwenstein-Jensen and Stonebrink's) at the National Veterinary Institute 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, e.g. to the Norwegian Veterinary Institute or the Public Health Agency of Sweden. Positive isolates are further subtyped.

Skin fold tuberculin tests are performed according to EC 1226/2002 (amending annex B of EC 64/432) and SJVFS 2003:33, (K62). 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 postmortem of animals found dead or euthanized 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) 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.

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, 2 sheep, 7pigs, 4 red deer and 3 fallow deer 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 4 red deer and 2 fallow deer (all in the same flock), and 2 pigs. No other slaughterhouse samples yielded any mycobacteria.

Due to clinical suspicions, macroscopic lesions, or findings of acid-fast bacteria, samples from one dog, one cat, one horse, and one cattle were investigated. From these samples NTM (Non-tuberculous mycobacteria), from the *Mycobacterium avium/intracellulare*-complex were isolated from one horse, one dog, and one cat. No other sample yielded any mycobacteria.

During 2020, 13 alpacas, were tested serologically in relation to export or import, and one brown fur seal (*Arctocephalus pusillus*) from a zoo was tested with PCR on a pharyngeal swab prior to export. Within the voluntary control program, 102 alpacas, 4 camels and 3 llama were tested. All with negative final results.

In 2020, there were approximately 300 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 and necropsies. TB was not detected in any farmed deer in Sweden during 2020.

Humans

The total number of detected cases of tuberculosis in humans in 2020 was 335. Out of these, six cases of *M. bovis* were reported in humans in 2020, two cases with pulmonary TB and four cases with extrapulmonary TB, and all six most probably infected in their respective country of origin: Syria (4), Afghanistan (1) and Eritrea (1). All six isolates were unique when analysed with whole genome sequencing.

DISCUSSION

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

No cases of TB were detected in Swedish livestock during 2020. The officially free status for bovine TB in cattle has been maintained during 2020. Although the surveillance is mainly dependent on inspections of slaughtered animals, this has been considered sufficient. However, the rate of submission of lesions from slaughtered ruminants has decreased over the years and work has been initiated in 2019 and continued in 2020 to increase submissions. Work is also ongoing to introduce PCR as initial analytic test. Passive surveillance based on clinical suspicions and post mortem findings will always have a low sensitivity as clinical symptoms and massive lesions are mainly seen in late stages of the infection. 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. 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.

REFERENCES

Alvarez J, Bezos J, de Juan L, Vordermeier M, Rodriguez S, Fernandez-de-Mera IG, Mateos A, Domínguez L. Diagnosis of tuberculosis in camelids: old problems, current solutions and future challenges. Transbound Emerg Dis. 2012 Feb;59(1):1–10. doi: 10.1111/j.1865-1682.2011.01233.x. Epub 2011 Jun 2

Rhodes S, Holder T, Clifford D, Dexter I, Brewer J, Smith N, Waring L, Crawshaw T, Gillgan S, Lyashchenko K, Lawrence J, Clarke J, de la Rua-Domenech R, Vordermeier M. Evaluation of gamma interferon and antibody tuberculosis tests in alpacas. Clin Vaccine Immunol. 2012 Oct;19(10):1677–83. Epub 2012 Aug 22.

Wahlström H, Frössling J, Sternberg Lewerin S, Ljung A, Cedersmyg M, Cameron A (2010) Demonstrating freedom from infection with Mycobacterium bovis in Swedish farmed deer using non-survey data sources. Prev Vet Med 94:108–118