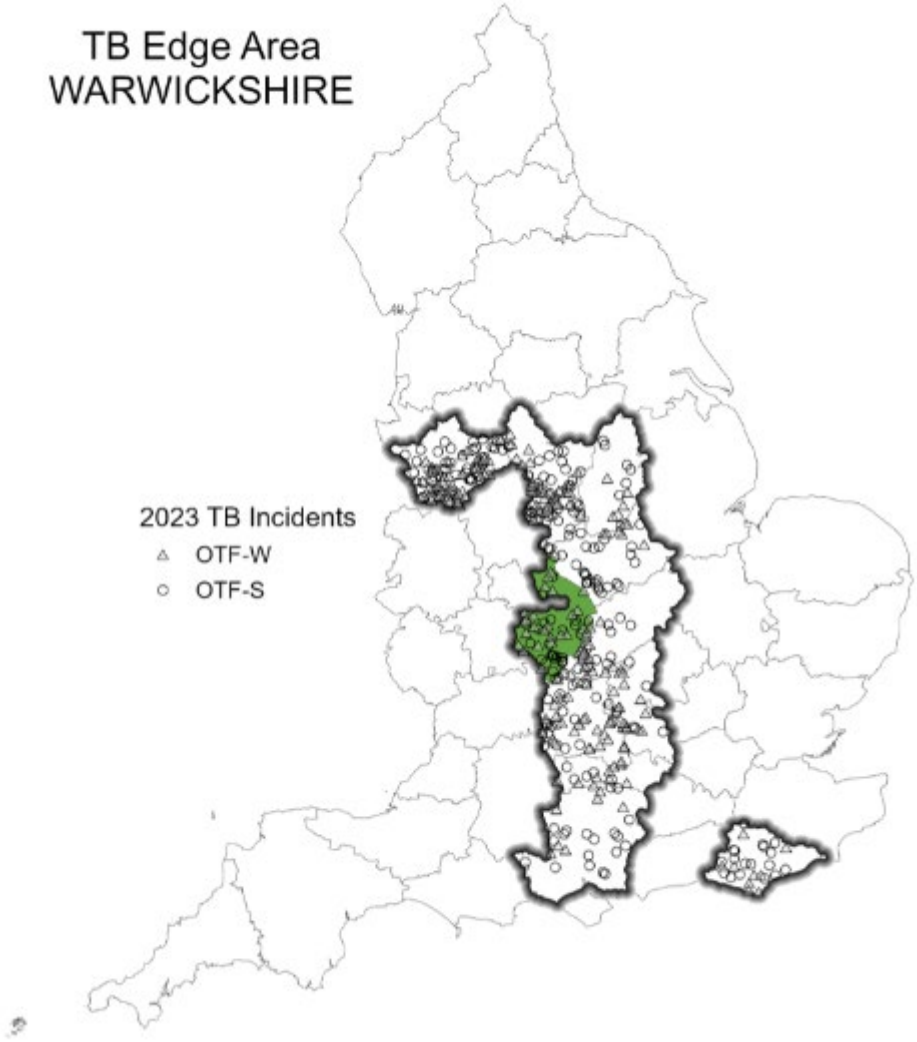
Animal &
Plant Health
Agency

Year End Descriptive Epidemiology Report: Bovine TB in the Edge Area of England 2023

County: Warwickshire



Contents

Introduction

The Edge Area was originally established in 2013, along with the Low Risk Area (LRA) and High Risk Area of England. In 2014, the 3 bovine tuberculosis (TB) risk areas were incorporated into the UK government's strategy to achieve Officially TB-Free (OTF) status for England by 2038. A key action was to recognise the different levels of TB in different parts of the country and to adjust the approaches to TB surveillance and control in each risk area accordingly. The current aim is to obtain OTF status for the Edge Area as soon as possible.

This report describes the frequency and geographical distribution of TB in cattle herds in Warwickshire, an Edge Area county, in 2023. It examines what factors are likely to be driving TB in this area, and the risks the disease in this county may pose to neighbouring areas.

TB in cattle and other mammals is primarily caused by the bacterium *Mycobacterium bovis* (*M. bovis*), and the disease is subsequently referred to in this report as TB. Although other sources may refer to TB 'breakdowns', this report will use the term 'incidents' throughout.

This report is intended for those involved in the control of TB, both locally and nationally. This includes, but it is not limited to, cattle farmers, government and private veterinarians, policy makers and the scientific community.

Details of the data handling methodology used in this report, a glossary of terms, and the TB control measures adopted in the Edge Area, can be found in the explanatory supplement for the annual reports 2023.

Types of TB incidents

Unless otherwise specified, this report includes all new TB incidents detected during the reporting period (1 January to 31 December 2023). This includes both 'Officially Tuberculosis-Free Status Withdrawn' (OTF-W) and 'Officially Tuberculosis-Free Status Suspended' (OTF-S) incidents.

OTF-W incidents are those involving at least one skin test reactor (an animal positive to the Single Intradermal Comparative Cervical Tuberculin [SICCT] test), with either:

- typical lesions of TB identified at post-mortem (PM) meat inspection,
- and/or at least one animal with an *M. bovis*-positive polymerase chain reaction (PCR) test (or bacteriological culture results in tissue samples collected from carcasses during the PM inspection).

OTF-S incidents are triggered by reactors to the skin test, but without subsequent detection of TB lesions or positive PCR test (or culture) results in any of those animals.

TB incidents in Approved Finishing Units (AFUs) without grazing are not included in the prevalence and incidence calculations in this report due to the limited epidemiological impact of these incidents.

Furthermore, the number of TB incidents and designation of those incidents as OTF-W or OTF-S may differ in this report compared to other official TB statistics due to differences in the information available at the time datasets are accessed.

Cattle industry

Small herds of up to 50 cattle continued to predominate in the county and beef animals accounted for 73% of the total cattle population of Warwickshire in 2023, as shown in Appendix 1. There were 15 AFUs in total, the latest one licensed by APHA in 2023.

The main livestock auction market in the county is Rugby Farmers' Market. This market is also licensed as TB exempt market (Green Market) to trade TB-restricted cattle. There is another livestock market in Warwickshire, Stratford Livestock Market. Other markets used are Thrapston and Thame in the adjoining Edge Area counties of Northamptonshire and Oxfordshire, respectively.

Two cattle abattoirs operate in Warwickshire.

The number of cattle markets in operation in 2023 is captured and maintained centrally by the Animal and Plant Health Agency (APHA) TB Customer Service Centre. Where possible, this data is then subject to further validation by APHA veterinarians subject to their best knowledge of the local area. Some small discrepancies may therefore exist where changes to markets were not captured in time for this report.

Warwickshire was originally divided between 2 TB risk areas. The High Risk Area (HRA) in the south and west, and the Edge Area in the north and east of the county.

The whole of Warwickshire was fully incorporated into the Edge Area in January 2018. Cattle herds in Warwickshire routinely undergo 6-monthly TB surveillance testing by default. However, 35% of cattle herds were regarded as having a lower risk of contracting TB and thus eligible for annual testing, under the earned recognition scheme, in 2023.

New TB incidents

The number of new TB incidents continued to decrease in 2023, compared to 2022: 52, down from 54 (Figure 1). This was the sixth consecutive annual decrease in the number of new incidents in Warwickshire.

Proportionately, OTF-W incidents represented the biggest decline, from 33 in 2022 to 27 in 2023. The number of OTF-S incidents increased to from 21 in 2022 to 25 in 2023.

In the original Edge Area, the number of OTF-W incidents increased from 12 in 2022 to 13 in 2023, and the number of OTF-S incidents disclosed increased to 7 in 2023 compared to 5 in the previous year.

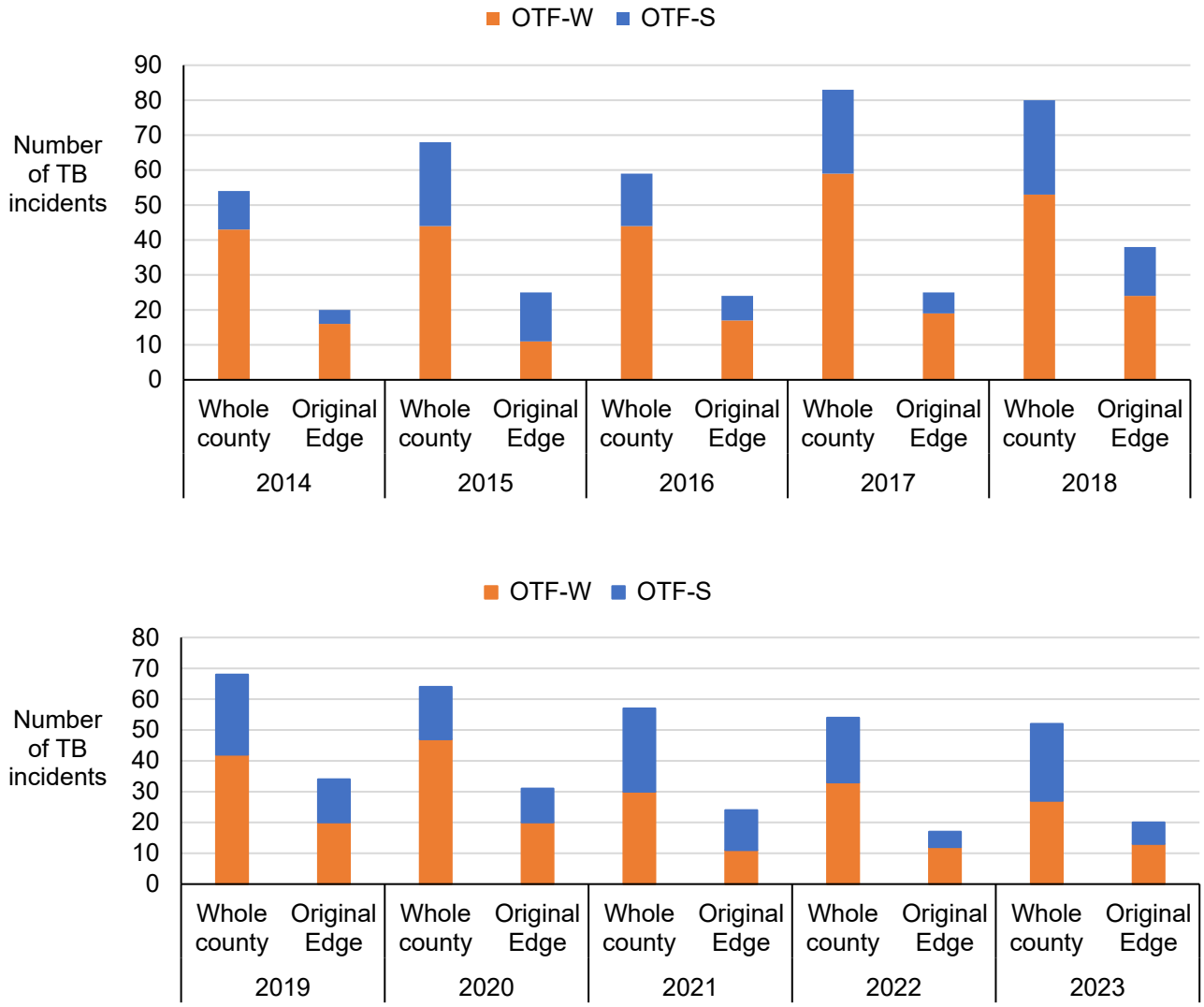


Figure 1: Annual number of new TB incidents in Warwickshire, from 2014 to 2023.

Figure 1 description: Bar chart showing the number of confirmed TB incidents (OTF-W, in orange) and suspected (OTF-S, in blue) in the whole of Warwickshire and the original Edge part of Warwickshire (prior to the incorporation of the HRA part in 2018) between 2014 and 2023. In 2023, there were 52 TB incidents in the whole county, 27 OTF-W and 25 OTF-S. Out of those 52, 13 OTF-W and 7 OTF-S were in the original Edge Area of Warwickshire.

Disclosing test types

As in previous years, whole herd tests (WHT), the surveillance test type used in 6-monthly routine surveillance, continued to detect the most incidents of TB in Warwickshire in 2023 (33). This was followed by 6-month post-incident surveillance tests (9), pre-movement tests (5), and slaughterhouse surveillance (4), as shown in Figure 2. These data show the continuing importance of 6-month post-incident tests, pre-movement tests and slaughterhouse surveillance to reduce disease spread.

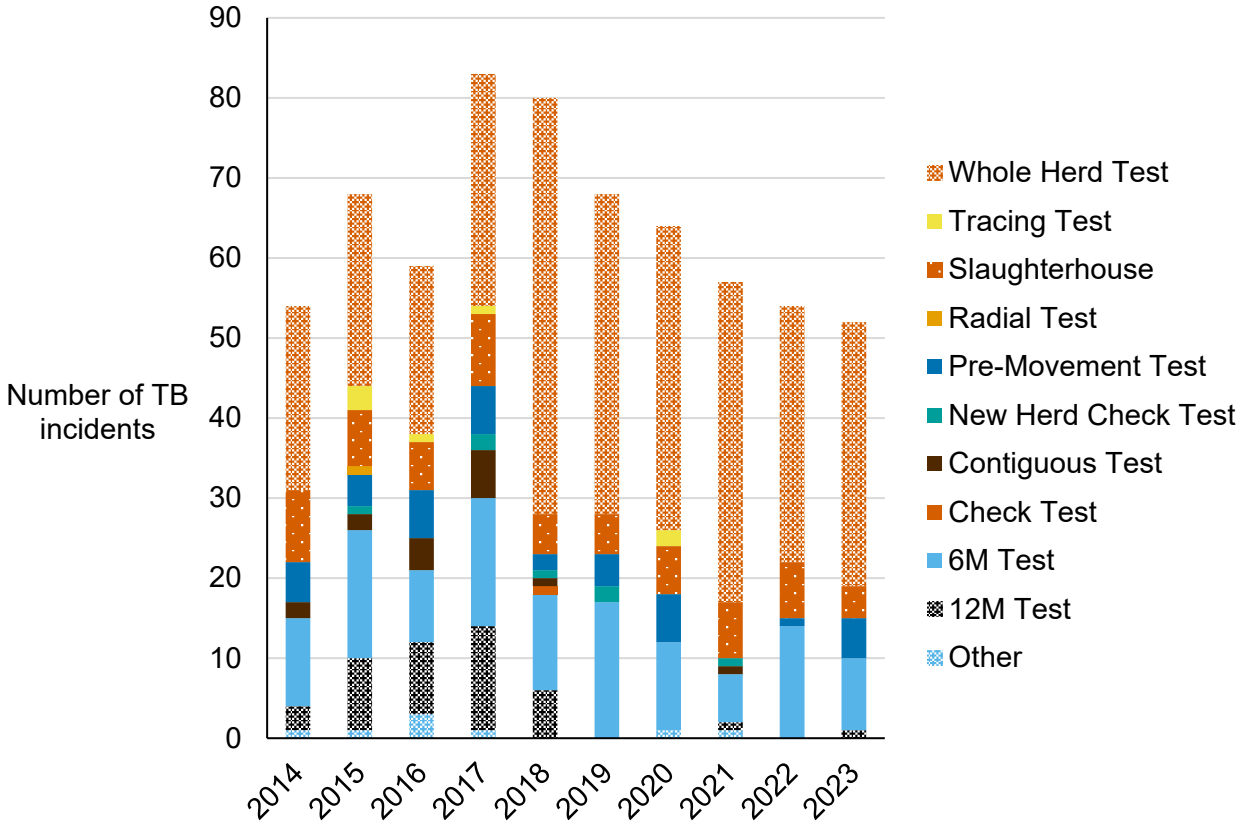


Figure 2: Number of new TB incidents (OTF-W and OTF-S) in Warwickshire in 2023, according to the surveillance methods that detected them.

Figure 2 description: A bar chart showing the number of new TB incidents disclosed by test type in Warwickshire between 2014 and 2023. In 2023, most incidents were disclosed by whole herd tests (33) – a detailed breakdown is provided in the text.

Duration of TB incidents

A total of 56 TB incidents were resolved in Warwickshire during 2023. Of these, 25 were new TB incidents that started in 2023, 28 started in 2022, 2 were from 2021 and one started in 2020.

The median duration of OTF-W incidents that ended in 2023 was 253 days, interquartile range (IQR) 186 to 337. One OTF-W incident was persistent, taking more than 550 days (18 months) to resolve. Fifteen incidents were resolved within 240 days, but the majority (17 out of 33) were resolved within 241 to 550 days.

Most OTF-S incidents that ended in 2023 (16 out of 23) were resolved within 240 days, median was 181 days (IQR 168 to 223). However, one lasted longer than 550 days.

The median duration for all incidents that ended in 2023 was 208 days (IQR 171 to 296). This is longer than the duration of incidents that ended in 2022 (187.5 days, IQR 161 to 254). For the whole Edge Area, the median duration of TB incidents that closed in 2023 was 188 days (IQR 159 to 265).

There were 28 TB incidents still open at the end of the reporting year on 31 December 2023.

Unusual TB incidents

A dairy herd in the south of the county sustained an explosive TB incident in November 2022, which was resolved in July 2023. This incident started when 39% of the cattle were disclosed as reactors at a 6-month post-incident test (342 of the 876 cattle tested). Of these, 48% had visible lesions at post-mortem examination. Follow-up testing included interferon gamma (IFN-γ) blood testing, as well as supplementary IDEXX and Enferplex testing, which resulted in a further 124 cattle being removed as reactors. Partial herd depopulation was completed following a veterinary risk assessment, leaving approximately 30% of the initial herd on the farm. A total of 228 animals were removed as direct contacts during this incident, and this accounts for the majority of the animals listed in Appendix 2, Table 4. (e.1).

The most likely pathway of infection was residual infection in the herd from the previous incident, which ended in July 2022 (4 months prior to the disclosing test for this incident). The local clade B6-62 of *M. bovis* was isolated in this incident and the previous one. However, clade B1-11 was also isolated in one of the animals slaughtered during this explosive incident in December 2022. B1-11 is not a local clade and is mostly found in Shropshire and Herefordshire area. Therefore, another likely risk pathway of infection (in addition to residual infection) was the purchase of cattle from another area in the country. This TB incident ended in July 2023 after a total of 466 animals were disclosed as reactors and slaughtered.

Another persistent TB incident of approximately 41 months of duration in a large beef suckler herd concluded in 2023. This incident started in June 2020 when 2 reactors and 1 inconclusive reactor out of 116 cattle were disclosed in a WHT. An IFN-γ test was also performed at the beginning of the outbreak in 2020. In 2023, a total of 26 cattle were disclosed as positive for either the skin-test, the IFN-γ blood test or both. This outbreak was considered concluded in December 2023 after more than 3 years and a total of 76

reactors disclosed and slaughtered during this time. The local clade B6-62 of *M. bovis* was isolated from the herd. The most likely risk pathway for this TB incident was thought to be exposure to infected badgers, as this was considered a closed herd, the reactors were homebred, and the cattle grazed in multiple fields on which badger setts were present and with no contact with neighbouring herds.

TB in other species

There is no statutory routine TB surveillance of non-bovine species, apart from post-mortem examination (PME) of animals slaughtered for human consumption. Targeted TB testing takes place in non-bovine herds under TB movement restrictions due to laboratory-confirmed incidents of *M. bovis* infection, and in specific herds of camelids, goats and captive deer at an elevated risk of infection.

In 2023, there were no new TB incidents reported in non-bovines in Warwickshire. This is a reduction from 2022 where 4 incidents of TB in non-bovine species were disclosed.

Incidence of TB

In 2023, Warwickshire had the second highest TB incidence per 100 herd-years at risk (HYR) in the 11 Edge Area counties. However, there was a decline between 2019 and 2022 and incidence has since remained stable compared to 2022, as shown in Figure 3.

Warwickshire's incidence rate (12.3 incidents per 100 HYR) remains above the overall incidence for the Edge Area (7.2).

A stable incidence which did not change from 2022 may be potentially explained by factors such as:

- residual infection is maintained in wildlife populations, despite the badger control measures
- not all farms or areas in the county are part of the badger control measures
- residual infection in cattle herds

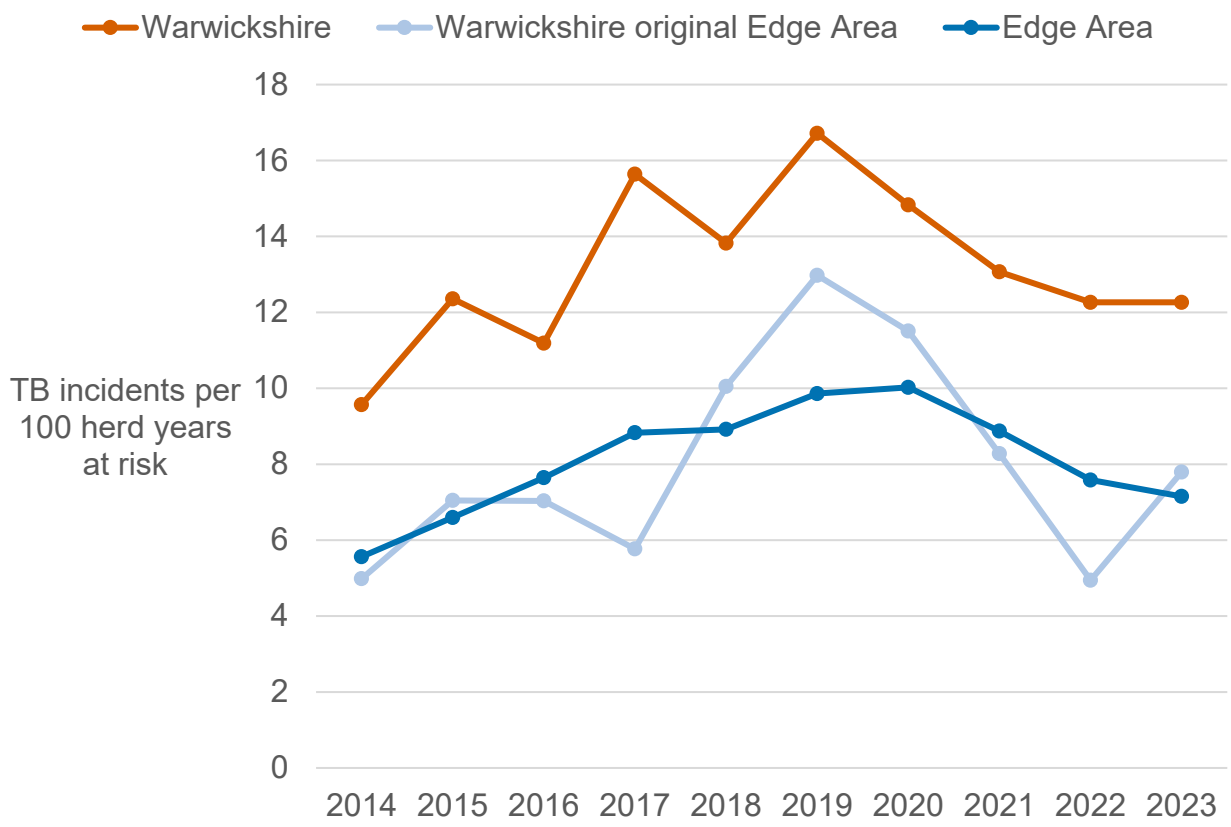


Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Warwickshire, from 2014 to 2023.

Figure 3 description: Line chart showing the incidence rate of new TB incidents per 100 herd-years at risk (100 HYR) in Warwickshire, the original Edge Area of Warwickshire, and the overall Edge Area between 2014 and 2023. Incidence in Warwickshire and in the original Edge part of Warwickshire has been declining consistently since 2020, but remains above the incidence for the overall Edge Area. Incidence in the original Edge part of Warwickshire has been broadly follows the same trend as the rest of the county, though it jumped up in 2023 from 4.9 new TB incidents per 100 HYR in 2022 to 7.8.

Prevalence of TB

Prevalence in Warwickshire decreased slightly in 2023 to 5.3% of herds under restriction, compared to 5.6% of herds in 2022. After 3 years of decreasing herd prevalence in the whole county between 2019 and 2021, the prevalence increased slightly in Warwickshire in 2022 to 5.6% from 5.4% in 2021 (Figure 4). This may have been due to a combination of factors, including an increase in OTF-W incidents in larger herds (of more than 50 cattle), which often have a longer duration, and as a result of the badger control measures introduced on the county's farms.

Warwickshire had the third highest end of year prevalence out of the 11 counties in the Edge Area. This was higher than the overall rate for the whole of the Edge Area in 2023 (3.7%).

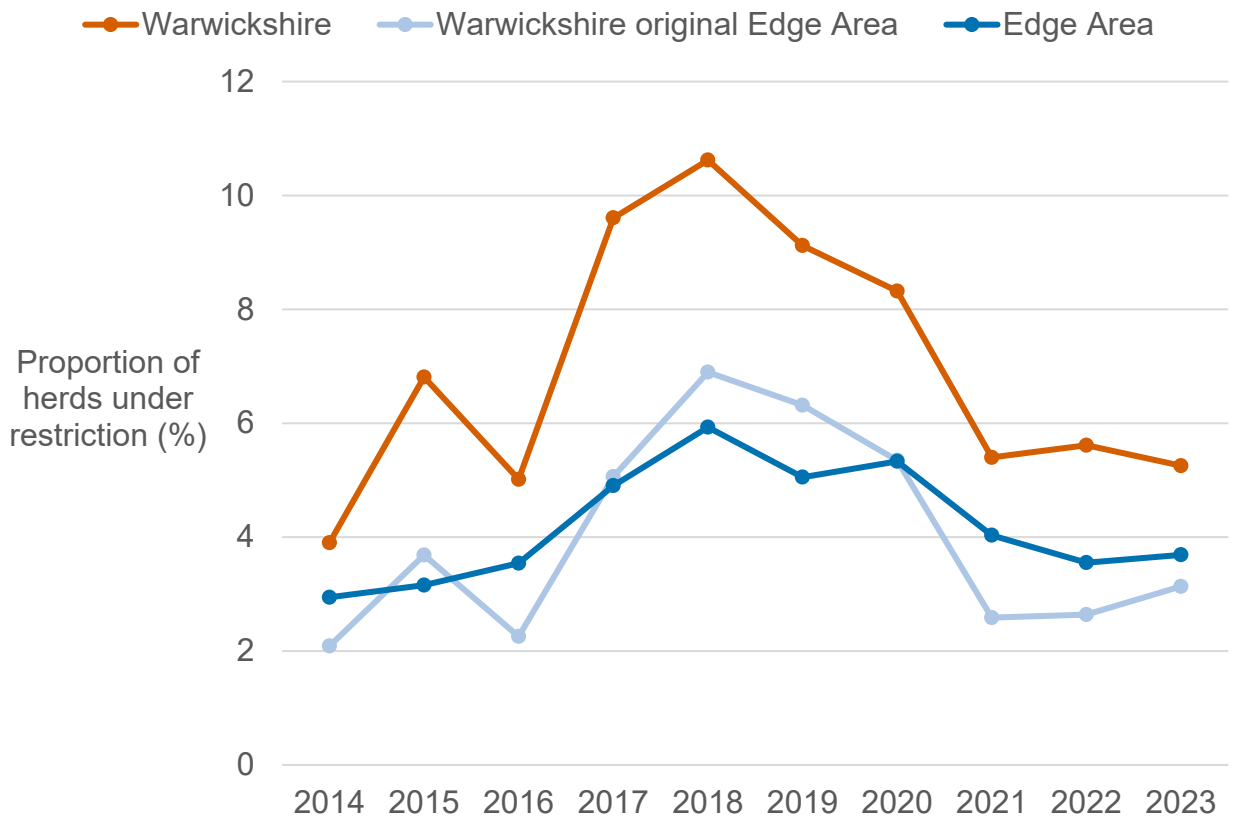


Figure 4: Annual end of year prevalence in Warwickshire, from 2014 to 2023.

Figure 4 description: Line chart showing the annual end of year prevalence in Warwickshire county overall, in the original Edge Area of the Warwickshire County, and within the overall Edge Area, between 2014 and 2023. Prevalence in Warwickshire overall has been consistently higher than that of the overall Edge Area. Prevalence in the original Edge Area of Warwickshire has been consistently lower than that of the overall Edge Area, bar in 2015 and between 2017 and 2020.

Annual end of year prevalence in Warwickshire has been decreasing consistently since 2019, with a slight increase in 2022 compared to 2021, but has fallen again in 2023. The trend in the original Edge Area of Warwickshire follows the trend of the overall Warwickshire area.

Recurring TB incidents

Three-year recurrence

In Warwickshire, a total of 30 (60%) of new TB incidents occurred in herds which had experienced another TB incident in the previous 3 years, as seen in Figure 5. The proportion of OTF-S herds which had had a prior TB incident within the last 3 years was higher than for OTF-W herds (71% and 50% respectively).

Recurrence in Warwickshire was slightly higher than in the Edge Area overall (54%) and was the third highest after Warwickshire (69%) and Berkshire (69%).

In 2023, 19 out of 52 (37%) new TB incidents in Warwickshire received a preliminary or final APHA veterinary investigation to identify the source of infection. Therefore, it is difficult to assess the most likely risk pathways for all of these incidents. They are likely to be driven by a combination of re-infection and residual infection.

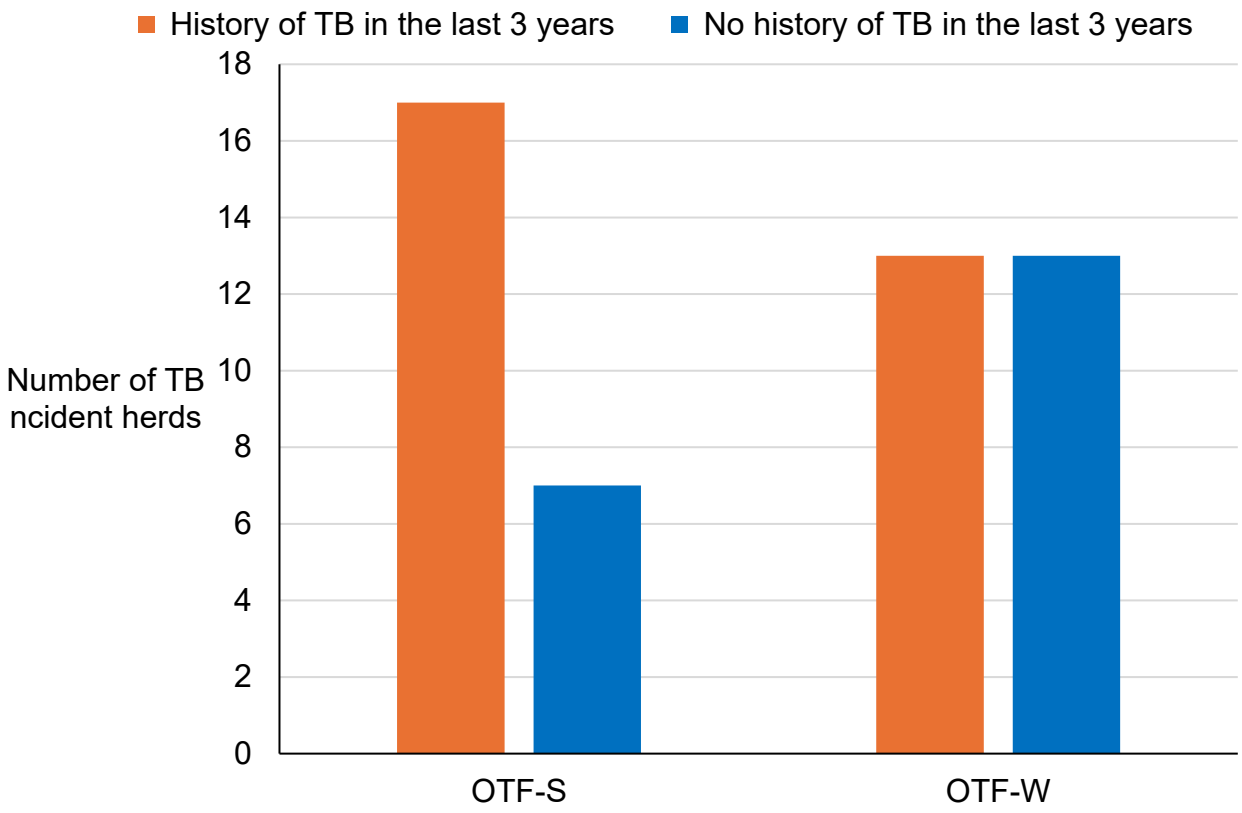


Figure 5: Number of herds with a TB incident (by OTF-W and OTF-S) in Warwickshire in 2023, with and without a history of any TB incident in the previous three years.

Figure 5 description: Bar chart showing the number of herds with (in orange) and without (in blue) a history of a TB incident in the last three years in 2023, for OTF-S and OTF-W herds. A description of the data is provided in the text.

Overall recurrence

In 2023, 84% of incidents reported across the region were in herds with a history of TB during the herd's lifetime, including more than 3 years previously (22 out of 24 OTF-S and 20 out of 26 OTF-W), as shown in Figure 6.

Overall recurrence of TB remained similar 2022 (87%, 19 out of 20 OTF-S and 26 out of 32 OTF-W).

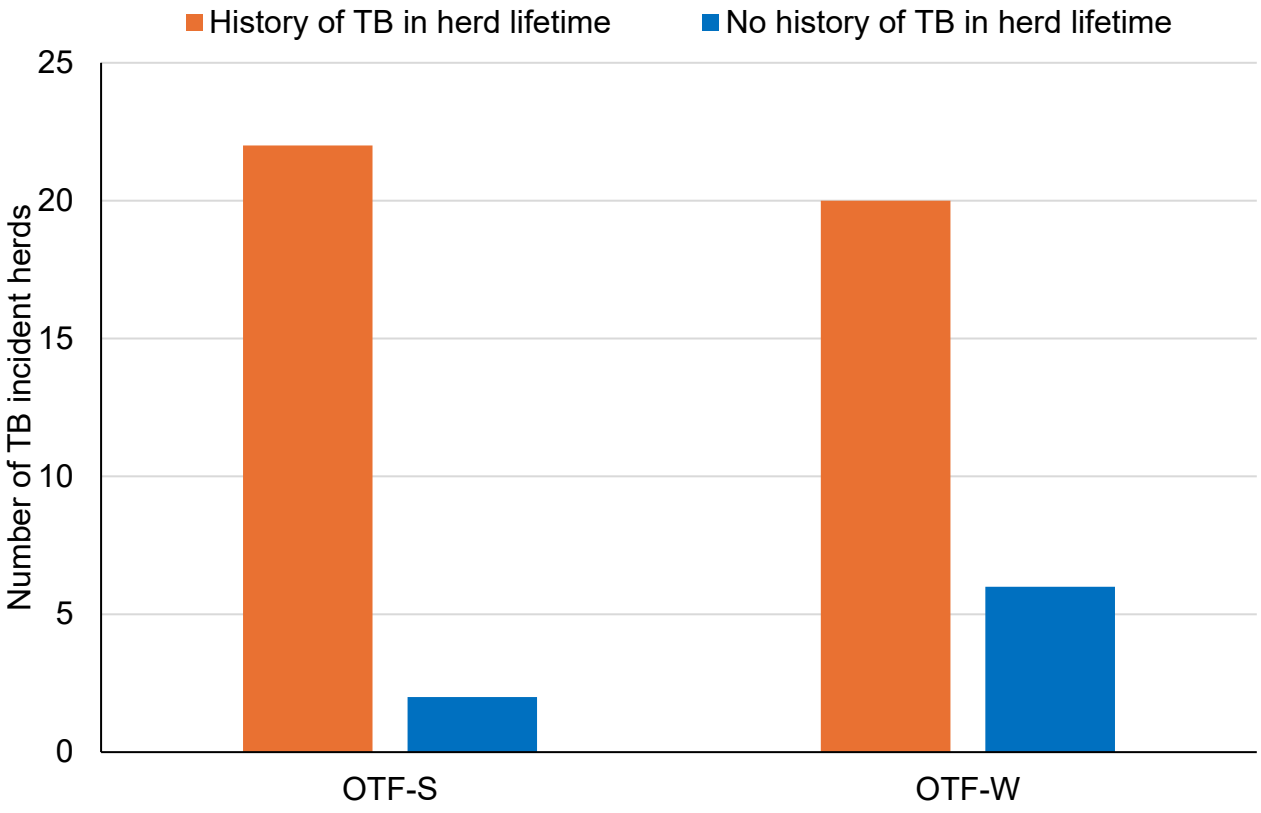


Figure 6: Number of herds in Warwickshire with a TB incident (by OTF-W and OTF-S) in 2023, with and without a history of a TB incident during the herd's lifetime.

Figure 6 description: Bar chart showing the number of herds with (in orange) and without (in blue) a history of a TB incident in the herd's lifetime in 2023, for OTF-S and OTF-W herds. A description of the data is provided in the text.

Geographical distribution of TB incidents

High-density cattle population areas are generally associated with greater numbers of incidents, especially when combined with proximity to endemic areas, such as south Warwickshire. New TB incidents in 2023 were disclosed mainly in the south and south-west parts of the county, particularly on the borders with Oxfordshire, Gloucestershire, Worcestershire and Northamptonshire, as shown in Figure 7.

As in previous years, the strain of *M. bovis* identified in most OTF-W incidents in Warwickshire was WGS clade B6-62. The majority of these incidents occurred towards the south and south-west of the county in areas where previous OTF-W incidents were located.

There were 5 OTF-W incidents (2 x WGS clade B6-62, 2 x WGS clade B3-11 and 1x B6-11) in the north and north-east of Warwickshire, which had no OTF-W incidents in 2022. In comparison, in 2022, there were 2 OTF-W incidents with clade B6-62 and B3-11 in Leicestershire close to the Warwickshire border.

The WGS clade was undetermined for 2 OTF-W incidents.

In 2023, OTF-S incidents were mainly distributed throughout the south and south-west area of Warwickshire.

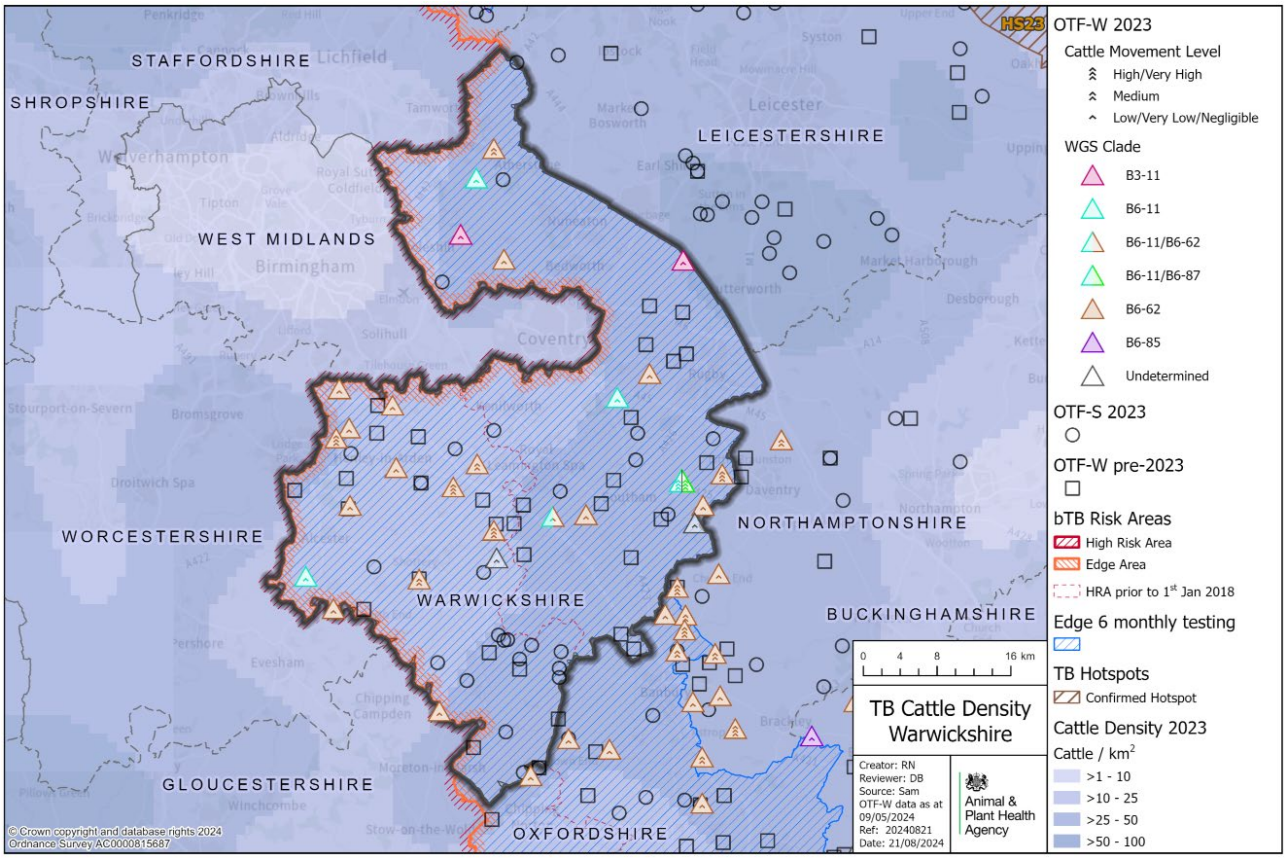


Figure 7: Location of cattle holdings in Warwickshire with new TB incidents (OTF-W and OTF-S) in 2023 and cattle holdings with pre-2023 OTF-W incidents still ongoing at the beginning of 2023, overlaid on a cattle density map. The movement score for each farm is symbolised with 3 chevrons for cattle movements associated with a high likelihood of infection, 2 chevrons for a medium likelihood and one chevron for a low likelihood.

Figure 7 description: Map of the Warwickshire county showing the locations of cattle holdings in Warwickshire with new TB incidents (OTF-S and OTF-W) in 2023 and pre-2023 OTF-W incidents on the map. 2023 OTF-W incidents are shown as triangles, 2023 OTF-S as circles and pre-2023 OTF-W as squares. The 2023 OTF-W incidents are also coloured by WGS clade and contain chevrons to show the cattle movement algorithm score allocated to the incident (low, medium or high risk of cattle movements). Incidents occurred throughout the county – further detail provided in the text.

Skin test reactors and interferon gamma test positive animals removed

Appendix 2 provides a summary of headline cattle TB statistics in Warwickshire. In 2023, a total of 252 test positive animals were identified in Warwickshire, as shown in Figure 8. This is a decrease compared to 699 animals in 2022, where the spike in the number of reactors were due an explosive incident, and following a steady decline since the previous peak of 758 animals in 2018.

Of the 252 test positive animals in 2023, 82% were skin test reactors, compared to 79% in 2022. However, only 18% were IFN-γ test positive, compared to 21% in 2022. Changes to the eligibility for IFN-γ testing introduced in July 2021 meant that only recurrent and persistent OTF-W incidents are now automatically eligible for mandatory IFN-γ testing. This includes herds which have had a new OTF-W incident within 18 months of a previous incident. Previously, all new OTF-W incidents were eligible for sampling.

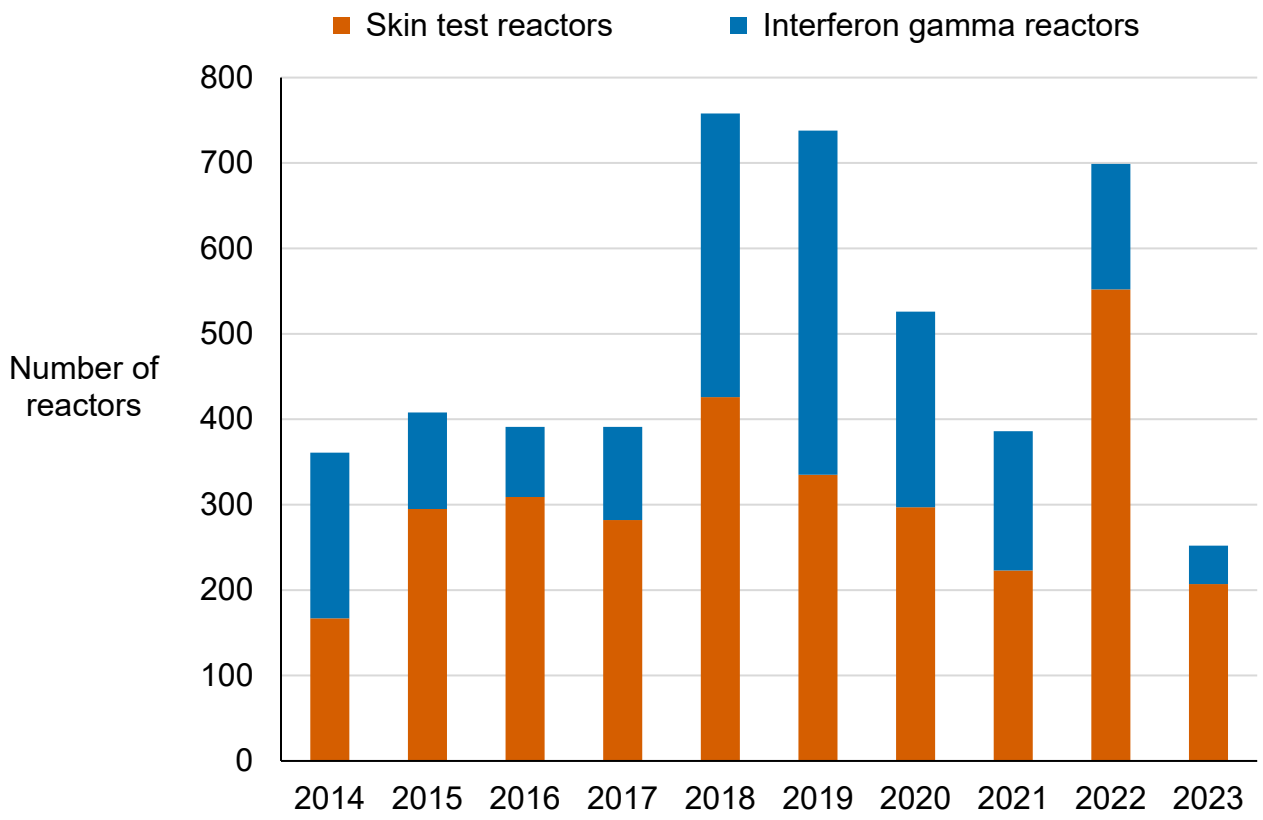


Figure 8: Number of skin test reactors (SICCT) and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Warwickshire, from 2014 to 2023.

Figure 8 description: Bar chart showing the number of skin test reactors and interferon gamma test reactors removed for TB control reasons in Warwickshire between 2014 and 2023. In 2023, 207 skin test reactor cattle and 45 interferon gamma reactors were removed in Warwickshire, the lowest number in the last ten years.

Main risk pathways and key drivers for TB infection

It is important to try to understand the risk pathways and key drivers that are likely to have introduced TB infection into a herd. This information can help identify biosecurity measures that may reduce the TB risk for individual businesses.

Implementing practical measures can help to reduce the risk of TB incursion into a herd that is TB free (biosecurity), as well as slowing disease spread within a herd where TB is present (biocontainment).

Furthermore, the ibTB online mapping tool can be used to inform purchasing choices, reducing the risk of introducing undetected infection when moving cattle into a herd.

In 2023, 19 out of 52 (37%) new TB incidents in Warwickshire received a preliminary or final APHA veterinary investigation to identify the source of infection. The findings from this investigation are reported in Appendix 3. The small number of investigations carried out in

2023 was due to the continued impact and diversion of field resources as part of the 2022 to 2023 avian influenza outbreak which continued into spring 2023, in addition to the Bluetongue virus outbreak from summer 2023 onwards.

New data-driven methods to quantify the likelihood of risk pathways for TB infected herds have been developed by APHA. These include the:

- cattle movement algorithm

WGS local transmission of infection indicator The cattle movement algorithm uses cattle movement data to identify individual animals that were moved into a TB incident herd as having a negligible, very low, low, medium, high or very high likelihood of being the source of the TB infection. At the herd level, the cattle movement score is dictated by the animal with the highest ranked movement into that herd. Herds are classified as having either:

- cattle movements associated with a high likelihood of infection (a herd with any movements scored as a high or very high likelihood)
- no cattle movements with a high likelihood of infection (the highest likelihood score was negligible, very low, low or medium)

The WGS local transmission of infection indicator uses whole genome sequence (WGS) data from cattle *M. bovis* isolates to identify TB incidents that are linked by genetics, time and space. A TB incident where at least one other TB incident is identified that satisfies all the following 3 criteria is considered to have evidence of a local transmission event:

- it has a WGS with no more than 3 single nucleotide polymorphism (SNP) differences relative to the TB incident of interest
- it is within 4 years before or 6 months after the start date of the incident of interest
- it is within a 9km radius of the incident of interest

Further details about the methodology used can be found in the explanatory supplement to the annual reports 2023.

There is always a degree of uncertainty about the estimated true routes of TB infection into a herd. The absence of a WGS indicator of local transmission, or cattle movements associated with a high likelihood of infection does not completely negate these pathways. Nonetheless, the evidence provided by the cattle movement and WGS data, when combined, can provide valuable insights into the possible risk pathways. Figure 9 provides the percentage of herds where each risk pathway combination was identified. The spatial distribution of these categories is presented in Figure 10. Each category is described in greater detail in the following text.

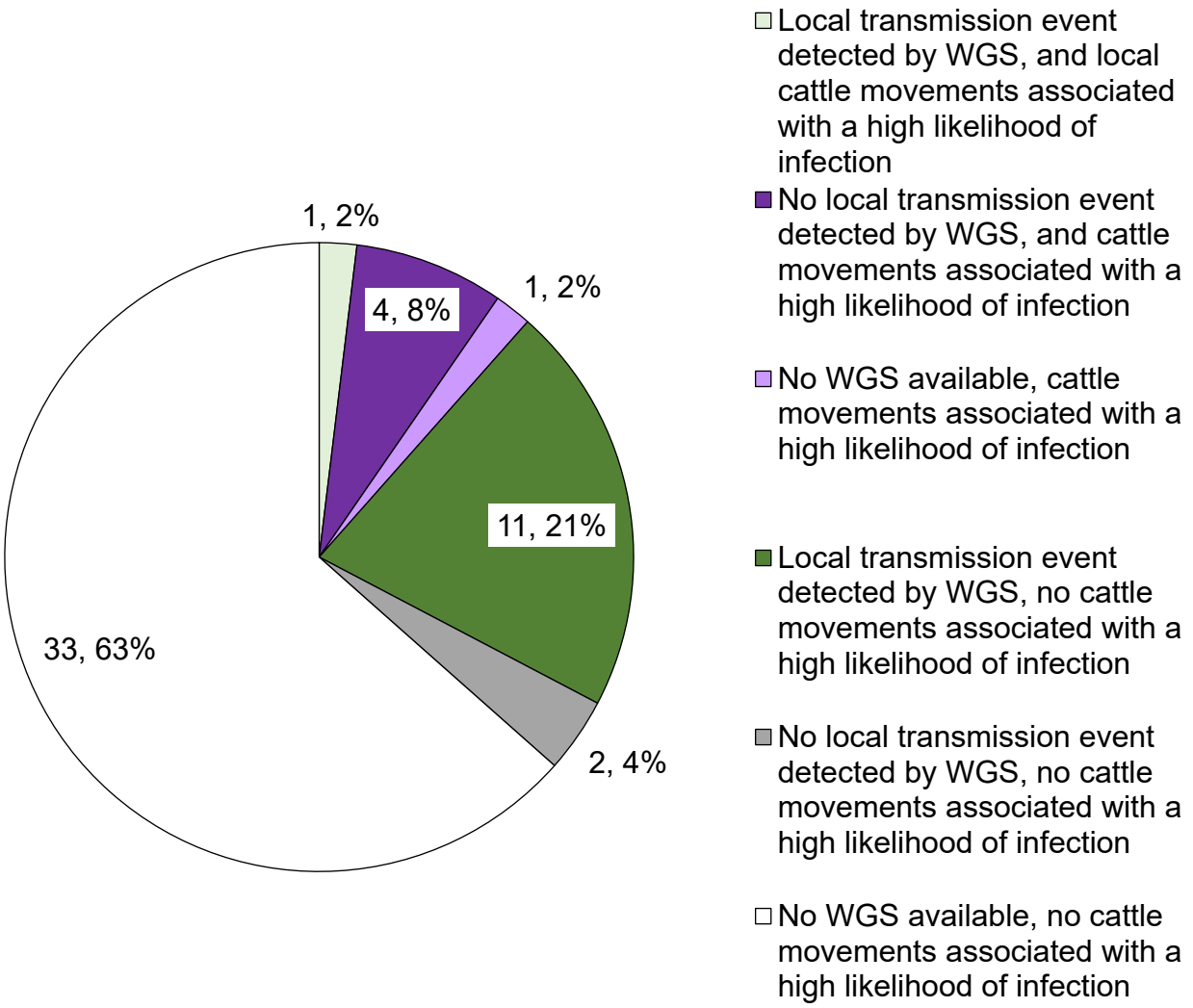


Figure 9: Risk pathway combinations identified by the WGS local transmission of infection indicator and cattle movement algorithm for all 52 new TB incidents starting in Warwickshire in 2023.

Figure 9 description: Pie chart showing the risk pathway combinations identified by the WGS local transmission of infection indicator and cattle movement algorithm for all 52 new TB incidents in Warwickshire in 2023. Most (33, 63%) did not have any WGS and no cattle movements were identified with a high likelihood of infection. Further description provided in the text.

WGS data was available for 16 (31%) of all new TB incidents in Warwickshire. The WGS local transmission of infection indicator identified a local transmission of infection event for 12 (23%) new TB incidents in 2023.

Of the TB incidents with WGS data available, 11 had a local transmission event identified without strong evidence of cattle movements (dark green symbols in Figure 9).

For these incidents, a broad spectrum of local pathways cannot be ruled out, including:

- residual infection in the herd
- contiguous contact with infected cattle
- direct or indirect contact with potentially infected wildlife

One TB incident had evidence of both a local transmission event and cattle movements (within 25km) associated with a high likelihood of TB infection. For this incident, local cattle movements may have played a part in the spread of local infection, in addition to the previously listed local pathways. This incident is symbolised in light green. Note that one additional light green incident appears on Figure 10, on the border with Northamptonshire – this is from an incident from a county parish herd holding (CPHH) which was registered in Northamptonshire which had animal holdings where the cattle were housed based over the border in Warwickshire. This incident was counted in the Northamptonshire, not Warwickshire, risk pathway totals.

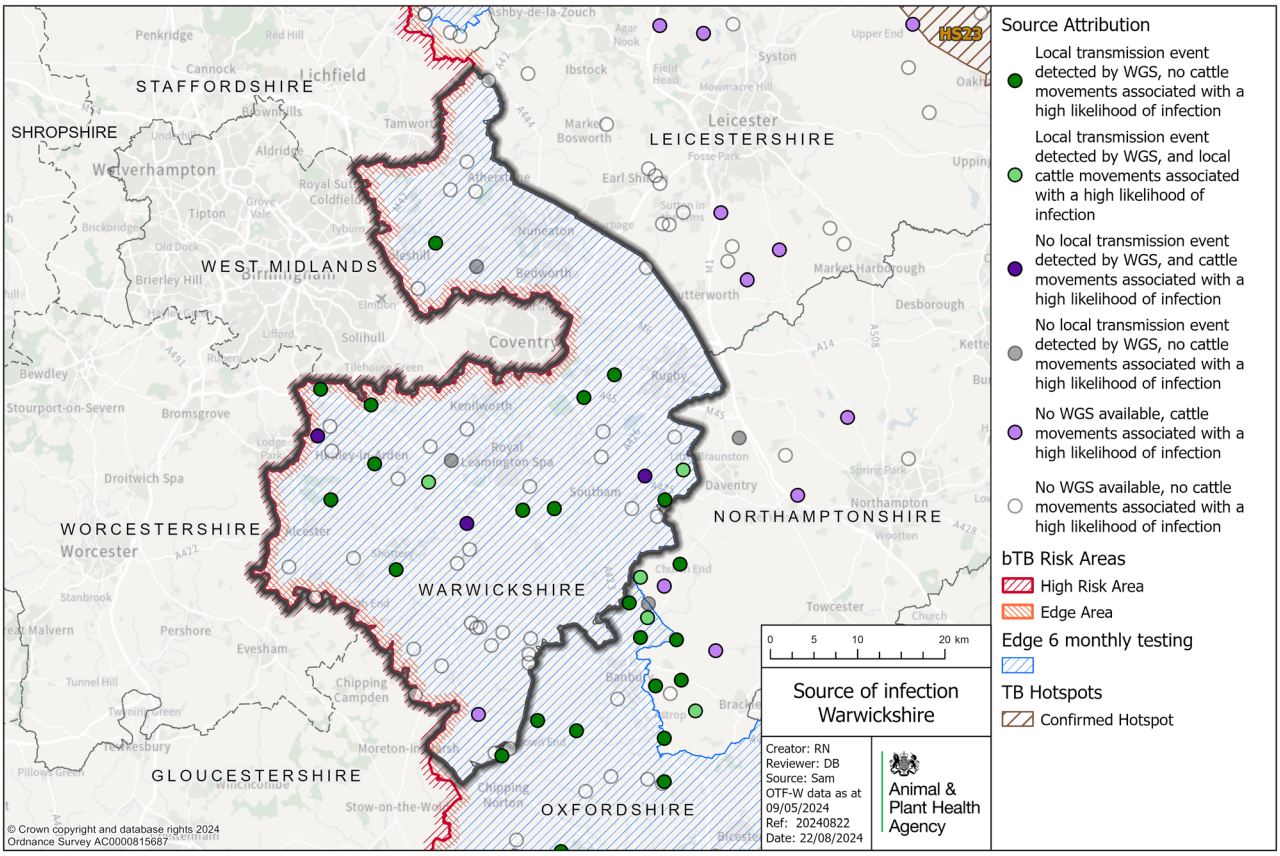


Figure 10: Map of the available evidence for risk pathways of TB infection into the herd, for all TB incidents (OTF-W and OTF-S) in Warwickshire that started in 2023. Note the additional light green incident on the border with Northamptonshire was counted in the Northamptonshire, not Warwickshire, risk pathway totals.

Figure 10 description: Map of the Warwickshire county showing the locations of the 52 new TB incidents in Warwickshire, coloured by the risk pathway identified for the incident.

Dark green are herds with a local transmission event was identified from WGS and no cattle movements with a high likelihood of infection were identified in the herd; light green represents incidents where local transmission event was identified from WGS and cattle movements with a high likelihood of infection were identified in the herd. Dark purple represents incidents where no local transmission event was identified from WGS and there were cattle movements identified with a high likelihood of infection in the herd. Light purple represents incidents with no WGS available and where there were cattle movements identified with a high likelihood of infection in the herd. Grey shows incidents where no local transmission event was identified from WGS and there were no cattle movements with a high likelihood of infection were identified in the herd either. White shows incidents with no WGS available and where there were no cattle movements with a high likelihood of infection were identified in the herd either. A breakdown of the incidents by group is provided in the text.

Genotyping was replaced with WGS of *M. bovis* isolates at APHA in 2021.

In Warwickshire, 4 TB incidents (8%) had evidence of cattle movements associated with a high or very high likelihood of TB infection, without no evidence supporting local transmission of infection events. For those herds it was considered more likely than not that cattle movements played a part in the introduction of infection (purple symbols, Figure 10).

For 2 TB incidents (4%) the WGS local transmission of infection indicator did not find any local transmission events, and there was no evidence of cattle movements associated with a high likelihood of TB infection. The source of infection was unclear for these TB incidents (grey symbols).

There was no evidence of cattle movements associated with a high likelihood of TB infection, and no WGS available to explore local transmission of infection events for 33 of the 52 (64%) TB incidents. These are shown as white dots in Figure 10, as there was insufficient evidence to determine a likely infection pathway.

New TB incidents in 2023 were disclosed mainly in the southern part of the county, particularly on the borders with Oxfordshire, Gloucestershire and Northamptonshire. There was also a cluster in the west of Warwickshire near the border with Worcestershire, as shown in Figure 10.

APHA moved to WGS of *M. bovis* isolates in 2021. Stable clusters of WGS clades tend to be found in areas where there is an established reservoir of infection. Previous annual reports refer to spoligotypes or genotypes. In this context there has been no change in the predominant strain of TB found in Warwickshire in recent years. Consistent with findings since 2019, and shown in Figure 11, the most commonly detected WGS clade of *M. bovis* was B6-62, associated with 72% of the OTF-W incidents (18 out of 25). Additional information provided by WGS of *M. bovis* isolates from OTF-W incident herds shows that disease has become established in the south of Warwickshire.

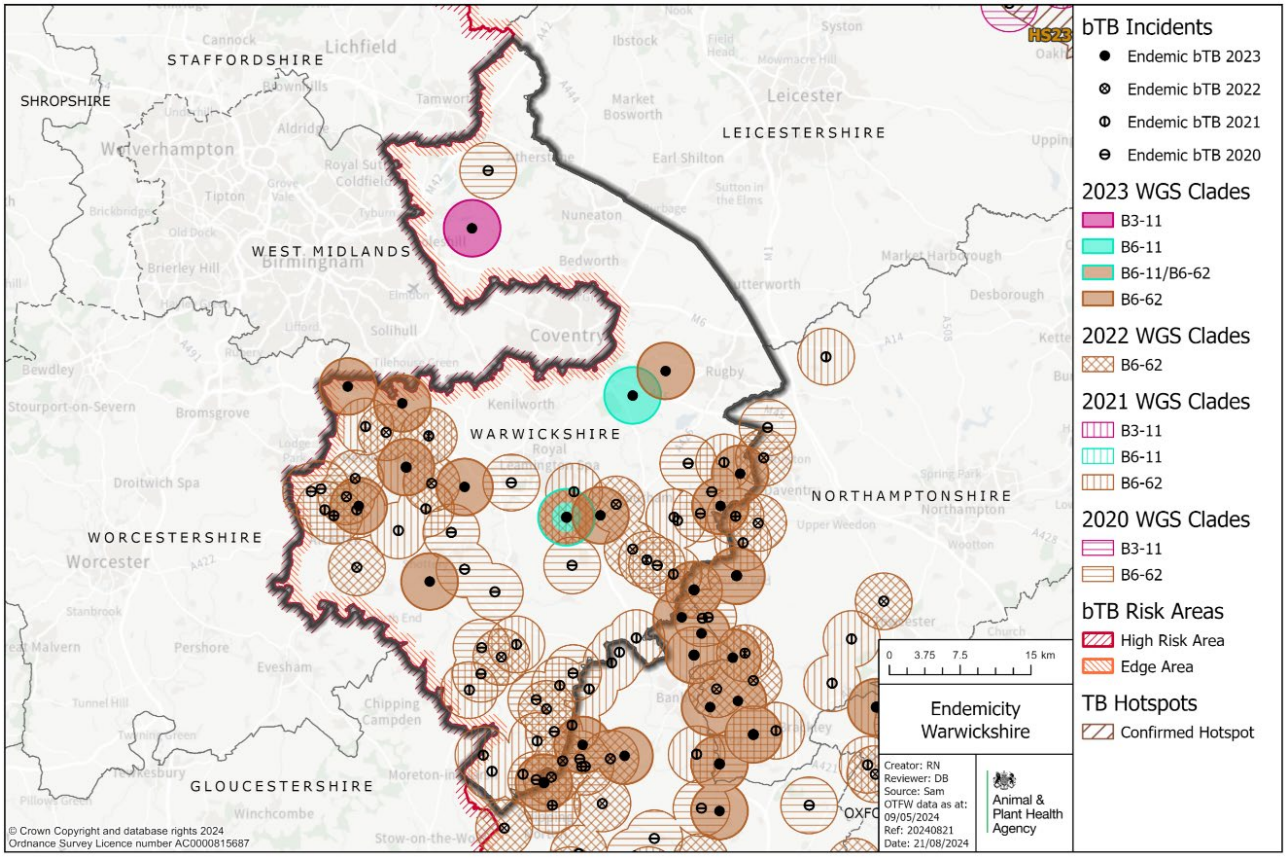


Figure 11: WGS clades of *M. bovis* detected in Warwickshire between 2020 and 2023, where the WGS identified in the infected herd was within 3 SNPs of another TB incident in the past 4 years and 9km (OTF-W incidents only).

Figure 11 description: Map of Warwickshire showing the WGS clades of *M. bovis* detected in Warwickshire between 2020 and 2023, where the WGS identified in the infected herd was within 3 SNPs of another OTF-W incident in the past 4 years and within 9km of it. Clades are shown as circles on the map with each clade represented by a different colour. The year from which the clade was identified is shown by either having the colour be solid (2023) or different types of hash (2022 to 2020). Most incidents show in the southern parts of Warwickshire. Further detail is provided in the text.

Forward look

Compared to the numbers seen in 2022, incidence of TB is stabilising in Warwickshire. The 6-monthly routine surveillance testing of most cattle herds in Warwickshire supports the early detection of TB, reducing the potential for lateral spread of infection.

Official-TB-Free status (OTF) for Warwickshire will not be achieved by 2025, as set out in the '[Strategy for Achieving OTF Status for England]', published in 2014. However, progress is being made and the outlook is positive.

There are several measures that would help address the most common risk pathways for TB infection in Warwickshire. These include:

- encouraging the uptake of effective biosecurity measures, including the uptake of TB Advisory Service visits
- explaining the risk of TB spread posed by cattle movements to keepers, to reduce the risk of spread of TB within and between farms
- continuation and further adoption of disease control measures to prevent the spread of TB between cattle and wildlife, including biosecurity, badger culling or vaccination, and local control of the wild deer population
- increased sensitivity of cattle testing to help reduce residual infection in herds and recurrent infection rates which are still high within the county

Appendix 1: cattle industry demographics

Table 1: Number of cattle herds by size category in Warwickshire as of 31 December 2023 (RADAR data on the number of holdings in the report year)

Size of herds	Number of herds in Warwickshire
Undetermined	2
1 to 50	235
51 to 100	85
101 to 200	84
201 to 350	44
351 to 500	19
Greater than 500	16
Total number of herds	485
Mean herd size	110
Median herd size	53

Table 2: Number (and percentage of total) of animals by breed purpose in Warwickshire as of 31 December 2023

Breed purpose	Number (and percentage of total) cattle in Warwickshire
Beef	39,366 (73%)
Dairy	11,824 (22%)
Dual purpose	2,273 (4%)
Unknown	12 (0.022%)
Total	53,475

Appendix 2: summary of headline cattle TB statistics

Table 3: Herd-level summary statistics for TB in cattle in Warwickshire between 2021 and 2023 (Sam data showing the number of herds flagged as active at the end of the report year).

Herd-level statistics	2021	2022	2023
(a) Total number of cattle herds live on Sam at the end of the reporting period	587	584	548
(b) Total number of whole herd skin tests carried out at any time in the period	875	811	822
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	472	462	454
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of TB movement restrictions)	520	519	494
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	550	545	513
(f.1) Total number of new OTF-S TB incidents detected in cattle herds during the report period	27	21	25
(f.2) Total number of new OTF-W TB incidents detected in cattle herds during the report period	30	33	27
(g.1) Of the new OTF-W herd incidents, how many can be considered the result of movement, purchase or contact from or with an existing incident based on current evidence?	4	3	3
(g.2) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or twice-inconclusive reactors (2xIRs) at routine herd tests?	21	18	15

Herd-level statistics	2021	2022	2023
(g.3) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or 2xIRs at other TB test types (such as forward and back-tracings, contiguous or check tests)?	9	15	12
(g.4) Of the new OTF-W herd incidents, how many were first detected through routine slaughterhouse TB surveillance?	7	7	4
(h.1) Number of new OTF-W incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	0	0	0
(h.2) Number of new OTF-S incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	0	0	0
(i) Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W incidents that began in a previous reporting period)	20	23	17
(j) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	1	3 (1 alpaca, 2 pigs, 1 sheep)	0
(k.1) Number of grazing approved finishing units active at end of the period	0	0	0
(k.2) Number of non-grazing approved finishing units active at end of the period	13	14	15
(k.3) Number of grazing exempt finishing units active at end of the period	0	0	0
(k.4) Number of non-grazing exempt finishing units active at end of the period	0	0	0

Table 4: Animal-level summary statistics for TB in cattle in Warwickshire between 2021 and 2023

Animal-level statistics (cattle)	**2021**	**2022**	**2023**
(a) Total number of cattle tested with tuberculin skin tests or additional IFN-γ blood tests in the period (animal tests)	101,942	97,086	97,802
(b.1) Reactors detected by tuberculin skin tests during the year	223	552	207
(b.2) Reactors detected by additional IFN-γ blood tests (skin-test negative or IR animals) during the year	163	147	45
(c) Reactors detected during year per incidents disclosed during year	6.8	12.9	4.8
(d) Reactors per 1,000 animal tests	3.8	7.2	2.6
(e.1) Additional animals slaughtered during the year for TB control reasons (dangerous contacts, including any first time IRs)	9	2	239
(e.2) Additional animals slaughtered during the year for TB control reasons (private slaughters)	2	0	4
(f) Slaughterhouse (SLH) cases (suspect tuberculous carcasses) reported by Food Standards Agency (FSA) during routine meat inspection	12	13	11
(g) SLH cases confirmed by *M. bovis* PCR testing or bacteriological culture	9	12	6

Note (c) Reactors detected during year per incidents disclosed during year, reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count in the table above.

Note (g) SLH cases confirmed by culture of *M. bovis*, not all cases reported are submitted for culture analysis. All cases reported are from any period prior to or during restrictions.

Appendix 3: suspected sources of *M. bovis* infection for all the new OTF-W and OTF-S incidents identified in the report period

In 2023, 19 out of 52 (37%) new TB incidents in Warwickshire received a preliminary or final APHA veterinary investigation to identify the source of infection. Not all Disease Report Form (DRF) investigations were carried out in 2023. This was due to the continued impact and diversion of field resources as part of the 2022 to 2023 avian influenza outbreak which continued into spring 2023, in addition to the Bluetongue virus outbreak from summer 2023 onwards.

Each TB incident could have up to 3 potential risk pathways identified. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd. The score is recorded as either:

- definite (score 8)
- most likely (score 6)
- likely (score 4)
- possible (score 1)

The sources for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely, or possible can contribute towards the overall picture for possible routes of introduction into a herd. If the overall score for a herd is less than 6, then the score is made up to 6 using the ‘Other or unknown source’ option. Buffering up to 6 in this way helps to reflect the uncertainty in assessments where only ‘likely’ or ‘possible’ sources are identified.

Table 5 combines the data from multiple herds and provides the proportion of pathways in which each source was identified, weighted by the certainty that each source caused the introduction of TB. The output does not show the proportion of herds where each pathway was identified (this is skewed by the certainty calculation). WGS of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however WGS clades are not determined for OTF-S herds. As a result of varying levels of uncertainty, only broad generalisations should be made from these data. A more detailed description of this methodology is provided in the explanatory supplement for the annual reports 2023.

Table 5: Suspected sources of *M. bovis* infection for the 19 incidents with a preliminary or a final veterinary assessment in Warwickshire, in 2023

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	3	9	11	1	52.8%
Cattle movements	1	2	3	0	15.5%
Contiguous	0	2	0	0	3.4%
Residual cattle infection	1	3	4	0	15.3%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	5	1	0	0	4.6%
Other wildlife	4	3	0	0	6.9%
Other or unknown source	0	1	0	0	1.5%

Each TB incident could have up to 3 potential pathways so totals may not equate to the number of actual incidents that have occurred.

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