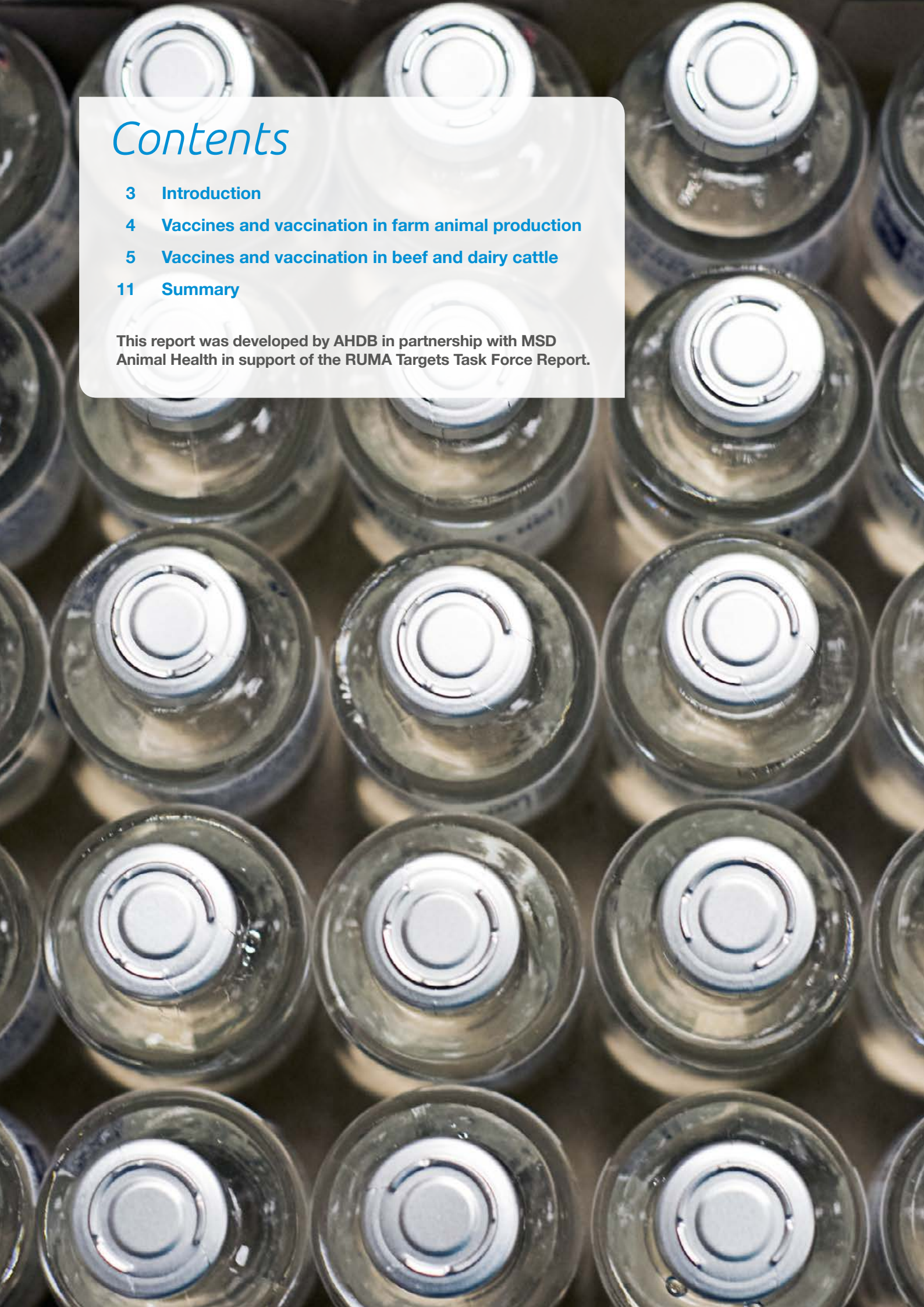
Use of vaccines in dairy and beef cattle production

2011–2017



Contents

3 Introduction

4 Vaccines and vaccination in farm animal production

5 Vaccines and vaccination in beef and dairy cattle

11 Summary

This report was developed by AHDB in partnership with MSD Animal Health in support of the RUMA Targets Task Force Report.

Introduction

The Responsible Use of Medicines in Agriculture (RUMA) Alliance was established in November 1997 to promote the highest standards of food safety, animal health and animal welfare in the British livestock industry. It is a unique, independent non-profit group involving organisations that represent all stages of the food chain from 'farm to fork'. RUMA aims to produce a coordinated and integrated approach to best practice in animal medicine use.

In October 2017, targets for further reducing, refining or replacing antibiotic use across the key livestock sectors were announced at a RUMA conference in London. The sector-specific targets were developed by a 'Targets Task Force', facilitated by RUMA, and comprising a leading farmer and veterinary surgeon from each main UK livestock sector.

The beef sector committed to monitoring use of cattle vaccinations as one of its targets. There was a commitment to work with industry stakeholders (e.g. pharmaceutical companies) to monitor use of vaccinations targeting respiratory disease in cattle, aiming for an increase year-on-year between 2017 and 2020.

It is difficult to distinguish use of respiratory vaccinations in dairy and beef cattle from product sales data. Therefore, this target and this report relate to all bovines.

Vaccines and vaccination in farm animal production

The immune system is the body's natural defence against infection. When an animal picks up an infection, the cells of the immune system respond to try to eliminate the infection. Sometimes, the immune system cannot respond quickly enough to prevent a disease from seriously harming or even killing animals. One way to give the immune system an edge in the fight against infection is to use a vaccine.

Vaccines prepare animals (and people) to fight infections by pathogenic bacteria, viruses or parasites, by imitating an infection and stimulating an individual's immune system to develop adaptive immunity. A vaccine is a biological preparation and, typically, contains weakened or killed forms of the microorganism, its toxins, or some of its surface proteins (often referred to as antigens). The vaccine tricks the immune system to recognise the agent as a threat, and develop the capacity to destroy it. The immune system stores a 'memory' of the pathogen's antigen. If the animal then picks up that infection (or sometimes even closely related microorganisms) in the future, the immune system will respond more quickly and prevent or significantly reduce the impact of the associated disease. Vaccination is designed to prevent future disease – it will not necessarily prevent future infection because some vaccines are licensed to reduce shedding and clinical signs.

The two main classifications of vaccines are: live and dead vaccines. Live attenuated vaccines are derived from disease-causing 'wild' bacteria or viruses that have been weakened or 'attenuated' in a laboratory. After being injected, live attenuated vaccines grow and replicate in the animal and produce an immune response. Generally, modified live viral vaccines provoke a satisfactory immune response with a single dose.

Dead or inactivated vaccines consist of killed or inactivated forms of the pathogen or their toxins, inactivated with heat, chemicals like formalin, or radiation. The immune response to inactivated vaccines is initially not as strong as for live vaccines and usually a primary course of two doses of vaccine are needed, with a short interval between these doses.

Usually, the full response to a vaccine does not occur for about 14 days after administration of the initial course. The immune response after vaccination is usually not as strong as the immune response after a 'wild' infection, and repeated booster doses are required after a certain period of time to maintain immunity against diseases.

Vaccination is the most effective method of preventing infectious diseases, and played an important part in the worldwide eradication of smallpox from people and of rinderpest from cattle. Vaccination programmes are an important element in a comprehensive, well-planned herd health control strategy.

All vaccines used in the EU have been registered for their current uses on the basis they are effective and have a 'positive benefit-risk balance'. They help reduce incidence of disease in animals by stimulating the immune system to provide protection. Lowering the incidence of disease through vaccination can have a major impact on animal welfare by greatly reducing suffering and distress associated with disease. Vaccination also provides considerable economic benefits because animals do not become ill or signs are mild. This eliminates or reduces treatment costs and reduces the need to use antimicrobials as well as preventing the reduction in growth, milk production and/or fertility that may otherwise result.

Vaccines and vaccination in beef and dairy cattle

More than 40 vaccines are authorised for use in the UK to control or prevent disease in cattle. The use of vaccines on all farms is usually under the supervision of a veterinary surgeon. There is a legal requirement for farmers to keep a record of the administration of all vaccines in a Medicines book, which must be available for inspection. However, there is currently no national system for collating data on animals that have been vaccinated.

Data on the number of doses of vaccines authorised for use in cattle sold in the UK each year between 2011 and 2017 are based on wholesaler data supplied to MSD Animal Health by Kynetec. Sales from wholesalers don't necessarily equate to use in that year, for example, for commercial reasons or if there are potential stock availability concerns, practices may stock up one year, but then use the vaccine in the next year. The data on sales is considered the best available approximation.

Data on cattle populations in the UK have been taken from the Defra Annual statistics on the number of livestock in England and the UK in June and December. Using this data and assumptions based on standard industry practices, the proportion of cattle in the 'at risk' population has been estimated.

The figures also do not measure how effectively vaccines were used – poor storage conditions, poor timing, relative to period of risk, and inappropriate timing of booster vaccination mean the level of protection will be lower than the estimates of uptake in this report.

Bovine virus diarrhoea (BVD) virus vaccines

Bovine virus diarrhoea (BVD) virus is one of the most important viral infections of cattle. The virus infects cattle of all age groups, including the unborn calf. It can cause devastating losses in individual herds, and the cost to health and productivity of the national herd is estimated to be £40–£60million[1].

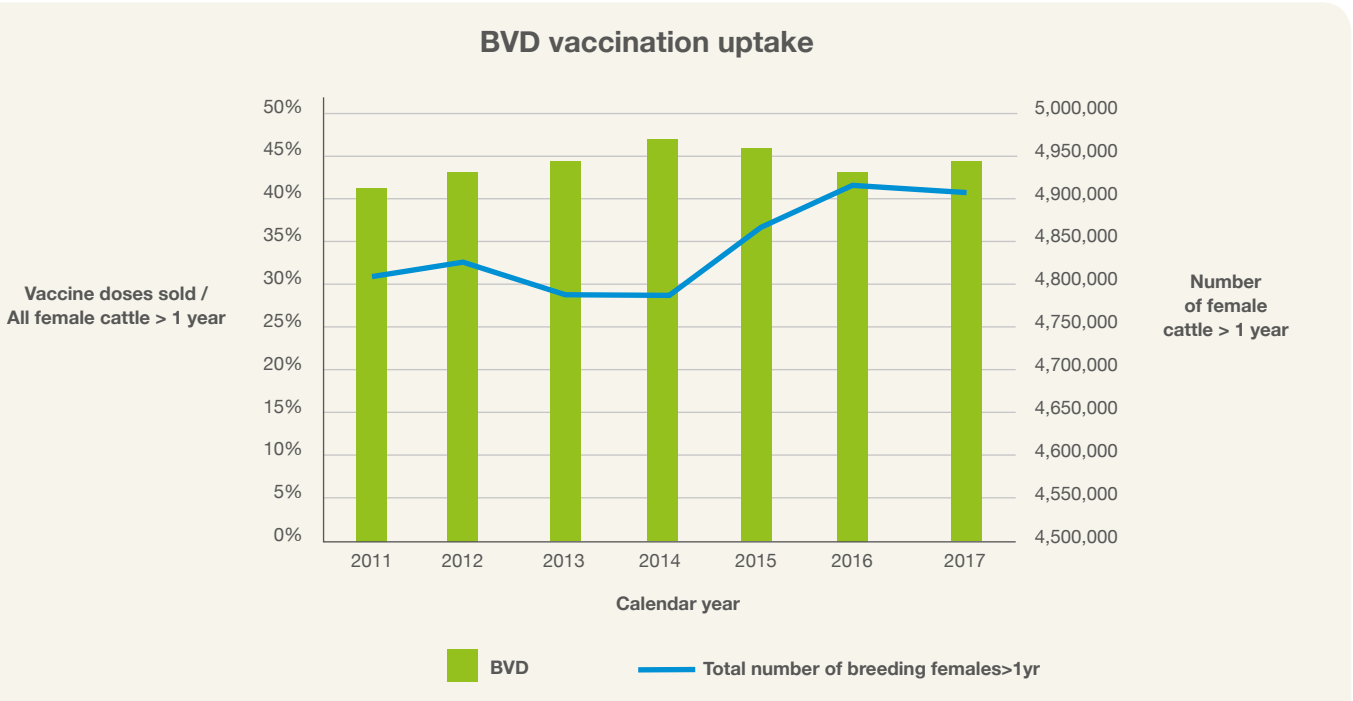
Three vaccines for BVD Virus (BVDV) were marketed in the UK between 2011 and 2017.

- **Bovilis BVD** contains inactivated Bovine Viral Diarrhoea Virus. The primary vaccination course is two doses of vaccine separated by a four-week interval. A booster dose is recommended four weeks before the start of the next gestation for individuals. For herds, the recommendation for boosters is one vaccination, six months after primary vaccination with next revaccinations at an interval no greater than 12 months
- **Bovidec** contains inactivated BVDV. The primary vaccination course is two doses of vaccine, separated by a three-week interval. A single annual booster dose is recommended
- **Bovela** (launched March 2015) contains modified live BVDV. The primary vaccination course is one dose of vaccine. A single annual booster dose is recommended

In addition, inactivated BVD virus is also a component of three vaccines targeted at pneumonia – Bovalto Respi 4, Rispoval 3 and Rispoval 4. These are targeted mainly at stock under one year of age. These combination vaccines have not been included in the estimate of uptake of BVD vaccines and are included in the estimated uptake of vaccines targeted at calf pneumonia.

Assumptions

Numerator: The common industry practice is to give breeding heifers a primary course of vaccination before



1 Bennett, R, IJpelaar, J 2005. Updated estimates of the costs associated with thirty four endemic livestock diseases in Great Britain: a note. Journal of Agricultural Economics 56, 135–144.

first service between one and two years of age and to give all breeding females over two years of age an annual booster vaccination. The primary vaccination course for vaccines containing inactivated BVDV is two doses of vaccine separated by a three- or four-week interval. The primary vaccination course for the vaccine containing modified live BVDV is one dose of vaccine.

Denominator: It was assumed that only female breeding animals were vaccinated and that the at-risk population was all female cattle over one year of age.

Vaccination uptake

BVD vaccine uptake peaked in 2014 when it was estimated that almost 48% of breeding females over the age of one year were vaccinated for BVD, up from 42% in 2011. In 2017, 45% of breeding females over the age of one year were vaccinated for BVD.

Over one in six adult breeding cows are in herds that are either accredited free of BVD or working towards accredited-free BVD status by cattle health schemes operating to CHeCS standards, which are not allowed to use BVD vaccines. If the breeding females in these herds were removed from the population of cattle over one year of age that could have been vaccinated, the proportion of those females in the national herd eligible for vaccination that were vaccinated, was estimated at 54% in 2017.

Infectious Bovine Rhinotracheitis (IBR) virus vaccines

Infectious Bovine Rhinotracheitis (Infectious Pustular Vulvovaginitis; IBR/IPV), is an infectious disease of cattle, caused by infection with Bovine Herpesvirus-1. The virus can infect the upper respiratory tract or the reproductive tract. Mortality is low but the economic loss can be significant. The severity of symptoms highly depends on the strain of the virus and the susceptibility of cattle. IBR causes severe respiratory disease, which can lead to fatal pneumonia. In adult cows, infection is associated with a severe and prolonged drop in milk yield, reduced fertility and abortions, and inflammation of the vulva/prepuce. The cost to health and productivity of the national herd is estimated to be £5–£7 million[2], although this is probably conservative.

Seven vaccines for IBR Virus (IBRV) were marketed in the UK between 2011 and 2017.

- **Bovilis IBR marker live** contains modified live bovine herpesvirus type 1 (BHV-1). Primary vaccination is a single dose intranasal or intramuscular. The first revaccination should be given six months after primary vaccination. All following revaccinations should be given at an interval no greater than 12 months
- **Bovilis IBR Marker Inac** contains Inactivated bovine herpesvirus type 1 (BHV-1). The recommended primary vaccination course is two vaccinations with an interval of four weeks with a booster vaccination every six months
- **Hiprabovis IBR Marker Live** contains live gE-tk- double-gene deleted Bovine Herpes Virus type 1 (BoHV-1). The recommended initial dose for cattle over three months of age is one injection of 2 ml given intramuscularly. The animal should be revaccinated three weeks later with the same dose. Thereafter, a single booster dose of 2 ml should be administered every six months
- **Rispoval IBR-Marker Inactivated** An inactivated Infectious Bovine Rhinotracheitis Marker (gE negative) vaccine. The primary vaccination scheme consists of two doses, three to five weeks apart. Booster vaccinations at six-monthly intervals
- **Rispoval IBR-Marker Live**, a live, freeze-dried, Infectious Bovine Rhinotracheitis Marker (gE negative) vaccine. The primary course for cattle over three months of age is one intramuscular vaccination. Booster vaccinations should be administered every six months. If a live vaccine is given initially, followed by an inactivated vaccine six months later, revaccination with the inactivated vaccine can take place at 12-month intervals
- **Tracherine** contains live attenuated Infectious Bovine Rhinotracheitis (IBR) virus. The primary course for cattle over 10 weeks of age is a single dose of vaccine. Booster vaccinations should be administered every six months

In addition, inactivated IBR virus is also a component of two vaccines targeted at pneumonia – Imuresp RP and Rispoval 4. These are targeted mainly at stock under one year of age. These combination vaccines have not been included in the estimate of uptake of IBR vaccines but are included in the estimated uptake of vaccines targeted at calf pneumonia.

Assumptions

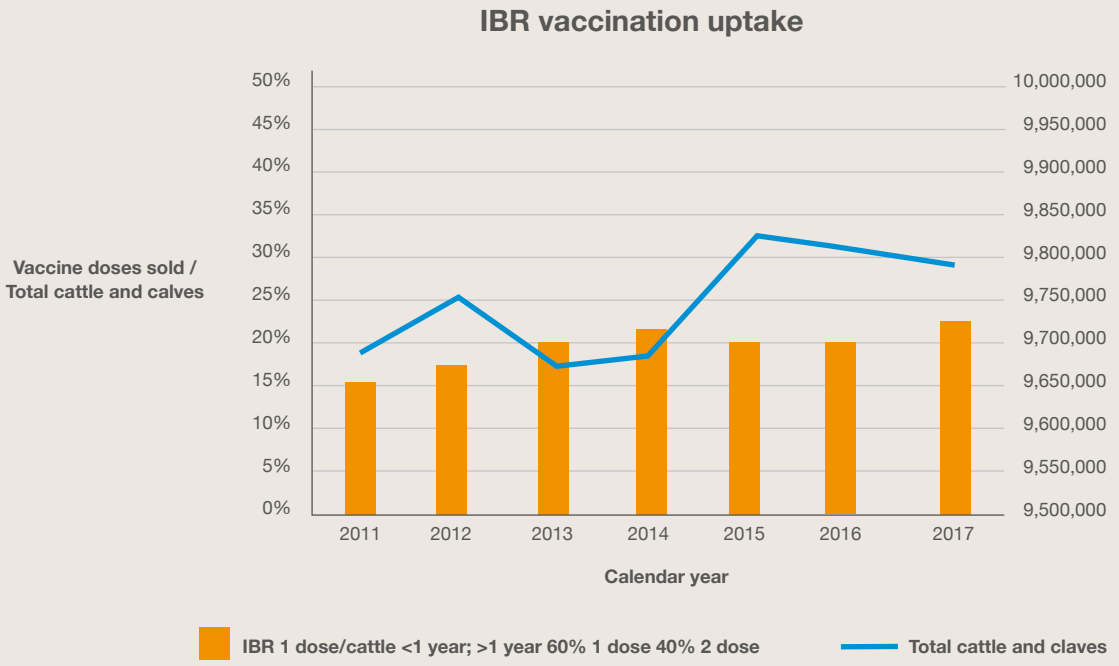
Numerator: All cattle are potentially at risk of IBR infection, and common industry practice would be for cattle to be vaccinated for the first time before one year of age and that *c*.40% of those using IBR vaccines in cattle over one year of age give two boosters annually and *c*.60% only give one IBR booster vaccine per year.

Denominator: It was assumed that cattle of all ages are vaccinated and that the at-risk population was all cattle and calves in the UK.

Vaccination uptake

IBR vaccine uptake increased from 16% in 2011 to a high in 2017, when it was estimated that almost one in four (23%) of all cattle in the UK were vaccinated for IBR. This is an estimate of vaccine uptake and if, for instance, all cattle over one year of age are getting one annual booster vaccination (instead of 60% of these animals receiving only one annual booster vaccination), the vaccination uptake in 2017 would be closer to one in three (32%) of all cattle.

[2] Bennett, R, IJpelaar, J 2005. Updated estimates of the costs associated with thirty four endemic livestock diseases in Great Britain: a note. Journal of Agricultural Economics 56, 135–144.



The proportion of adult breeding cows in herds in IBR programmes run by cattle health schemes operating to CHeCS standards was just over 2% in 2017. Some of these herds will be in the Vaccinated Monitored free Programmes and using IBR marker vaccines. Excluding the breeding females in these herds from the population of cattle that could have been vaccinated, would have made little difference to the figures for vaccine uptake and would have been within the margins of error for the current estimate.

Leptospirosis vaccines

Leptospirosis is a zoonotic disease, caused by bacteria of genus Leptospira. It is a common infection in dairy and beef herds, causing infertility, abortion and poor milk yield. In the UK, the two most important types of Leptospira hardjo are Leptospira borgpetersenii serovar Hardjo and Leptospira interrogans serovar Hardjo. Infection arises from contact with infected urine or the products of abortion. The cost to health and productivity of the national herd is estimated to be £5–£25 million[3].

Two vaccines for leptospirosis were marketed in the UK between 2011 and 2017.

- **Leptavoid-H** contains inactivated Leptospira interrogans serovar Hardjo and Leptospira borgpetersenii serovar Hardjo. The primary course consists of two doses, with an interval of four to six weeks between them. Revaccination with a single dose should be given annually
- **Spirovac** contains inactivated Leptospira borgpetersenii serovar Hardjo type hardjobovis. The primary course consists of two doses with an interval of four to six weeks between them. Revaccination with a single dose should be given annually.

Assumptions

Numerator: Common industry practice is to give breeding heifers a primary course of vaccination before first service between one and two years of age and to give all breeding females over two years of age an annual booster vaccination.

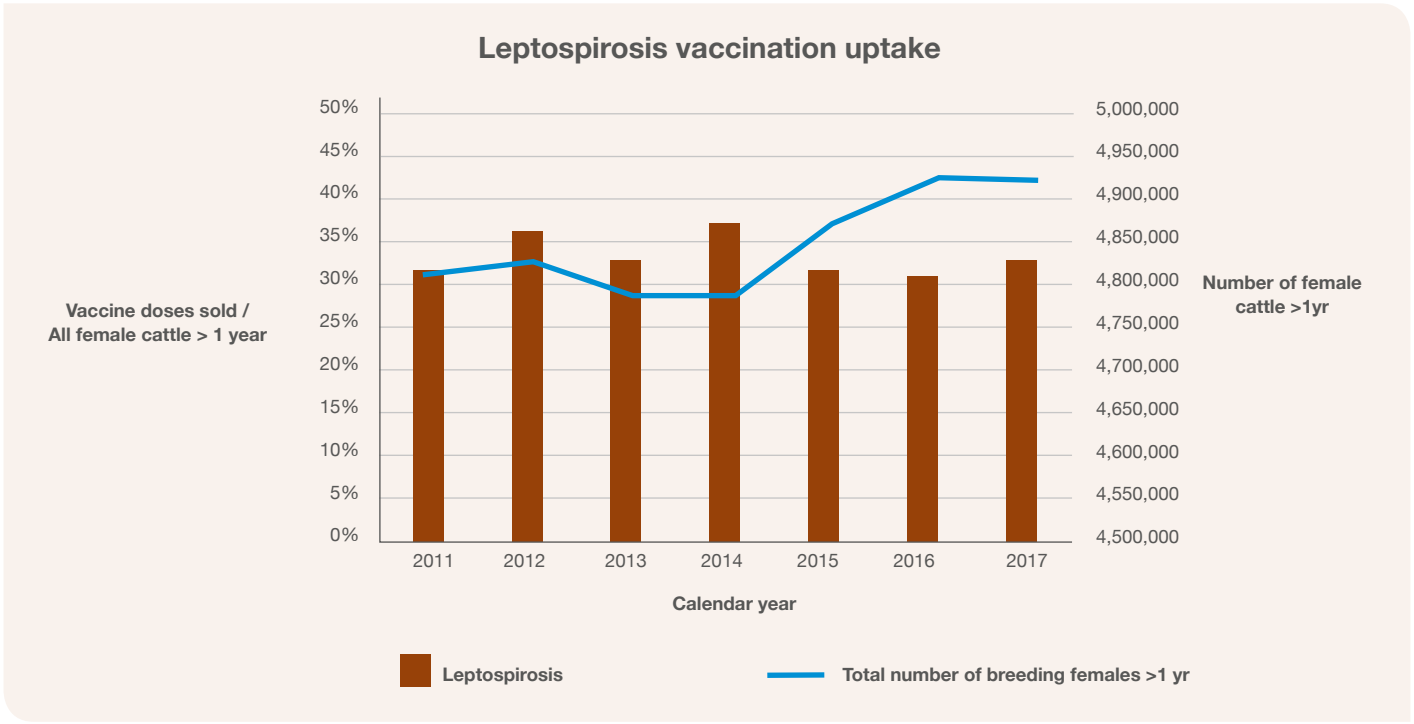
Denominator: It was assumed that only female breeding animals were vaccinated and that the at-risk population was all female cattle over one year of age.

Vaccination uptake

Leptospira vaccine uptake was generally around 1 in 3 breeding cattle over one year of age between 2011 and 2017 but was slightly higher in 2012 and 2014 (36% and 37%, respectively).

The proportion of adult breeding cows in herds in Leptospirosis programmes run by cattle health schemes operating to CHeCS standards was just over 1.7% in 2017. Excluding the breeding females in these herds from the population of cattle of over one year of age that could have been vaccinated, would have made little difference to the figures for vaccine uptake and would have been within the margins of error for the current estimate.

[3] Bennett, R, IJpelaar, J 2005. Updated estimates of the costs associated with thirty four endemic livestock diseases in Great Britain: a note. Journal of Agricultural Economics 56, 135–144.



Calf enteritis vaccines

Calf enteritis or calf scour is a common problem, which is found on most cattle farms in the UK. It can be a major cause of poor growth and calf mortality. The cost to health and productivity of the national herd of E. coli infections was estimated to be £2 million to £12 million and of enteric disease between £9 million and £12 million[4] but this is probably conservative because it may not include all forms of calf enteritis.

The incidence and severity of disease is highly dependent upon the level of colostral protection that a calf receives within the first six hours of life. A number of vaccines have been developed for the active immunisation of cattle against the antigenic components included in the vaccine, to induce serological and colostral antibody production. The antibodies in colostrum provide passive immunity to the new-born calf, provided the calf quickly gets an adequate quantity of quality colostrum.

Five vaccines for calf enteritis were marketed in the UK between 2011 and 2017.

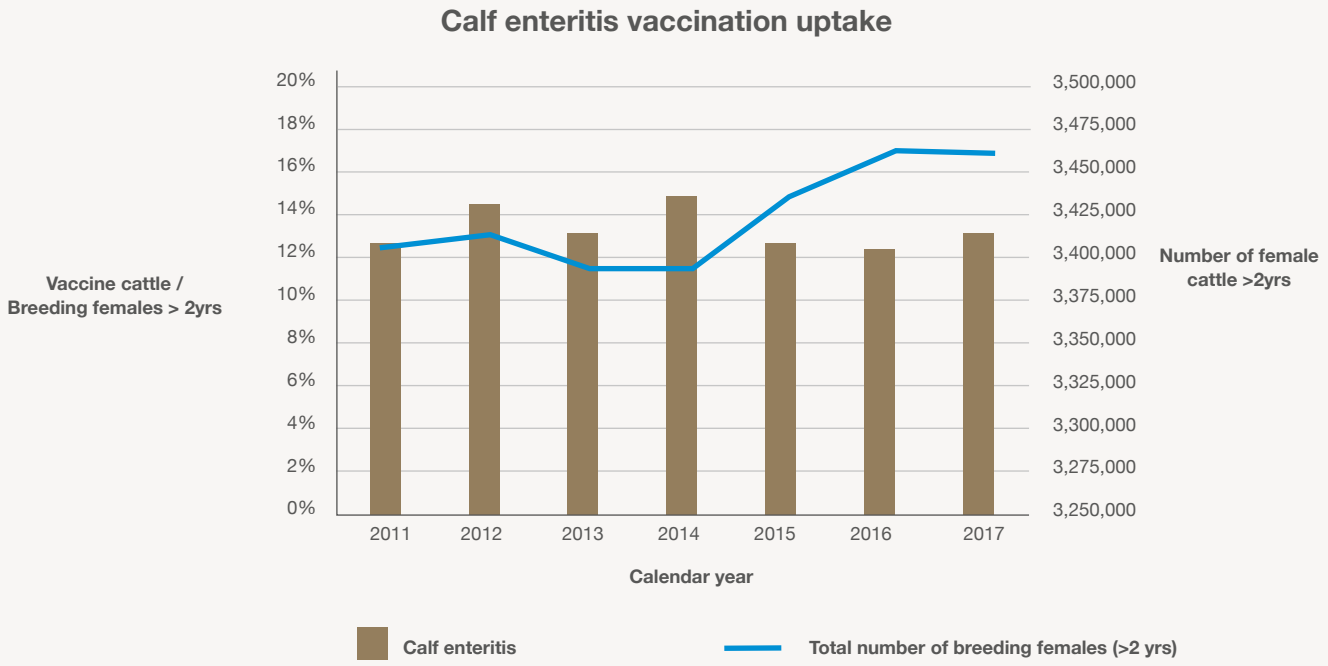
- **Bovigen Scour** contains E. coli F5 (K99) adhesin antigen and inactivated rotavirus and coronavirus. One dose in the course of each pregnancy, given in the twelve to three-week period before calving is expected
- **Lactovac** contains E. coli K99/F41 and inactivated rotavirus and coronavirus. Primary vaccination course is two injections separated by an interval of four to five weeks between doses and allowing two to three weeks from the time of the second dose until the predicted date of calving. Revaccination is recommended during each subsequent pregnancy
- **Rotavec Corona Emulsion** contains E. coli F5 (K99) adhesin and inactivated rotavirus and coronavirus. A single injection should be given during each pregnancy between twelve and three weeks before calving is expected
- **Trivacton 6** contains E. coli K99, Y, 31A and F41 antigens and inactivated rotavirus and coronavirus. Primary vaccination course is two injections separated by an interval of two to four weeks between doses and allowing two weeks from the time of the second dose until the predicted date of calving. Revaccination is recommended during each subsequent pregnancy two weeks before calving

Assumptions

Numerator: Only one of these vaccines requires two doses as a primary vaccination course and, as common industry practice with these vaccines is to give only a single injection as the primary course and one injection per pregnancy thereafter, it was assumed that each pregnant animal should get one dose per year.

Denominator: It was assumed that only female breeding animals were vaccinated and that these vaccines were only given to pregnant female breeding cattle. As most cattle calve down after 24 months, and vaccine is given in late pregnancy, only cattle over two years of age were included in calculation. The mean age of dairy cattle at first calving is falling[5] and a recent paper reported almost one in eight dairy heifers calved for the first time at 24 months of age or younger[6]. However, the majority of dairy heifers joining the national herd will be replacing dairy cows being culled, which will not need to be

[4] Bennett, R, IJpelaar, J 2005. Updated estimates of the costs associated with thirty four endemic livestock diseases in Great Britain: a note. Journal of Agricultural Economics 56, 135–144.
[5] Fourth Report GB Cattle Health and Welfare Group, September 2018.



vaccinated, and the calving interval for UK-bred pedigree Holstein females was 405 days in 2017[7]. For ease of calculation, it was assumed that using the population of all female cattle over two years of age as the target population for this vaccine, was acceptable.

Vaccination uptake

The uptake of vaccines for calf enteritis was the lowest for the categories in this report with just under one in six breeding cows vaccinated, on average, between 2011 and 2017, ranging from a low of 12% in 2013 to over 18% in 2017.

Pneumonia vaccines

Respiratory disease is an infection of the respiratory tract and is caused by infectious agents (virus and/or bacteria). Respiratory disease occurs when bacterial/viral agents are combined with poor air quality and ventilation, poor husbandry and stress. Respiratory disease is conservatively estimated to cost the UK cattle industry £60 million each year and is a major cause of mortality in the first year of life. This is calculated on the basis of £30 for mild cases, rising to £500 when the animal dies. Financial losses result from mortality, extra labour and treatment costs, but the greatest loss is from weight loss during illness and recovery.

An effective vaccination strategy for the most common causes of pneumonia on a farm can be an important part of the herd health plan to prevent respiratory disease, in combination with good management and appropriate building design and ventilation.

Twelve vaccines for pneumonia were marketed in the UK between 2011 and 2017.

- **Bovalto Pastobov** contains Mannheimia haemolytica type A1 antigen. Primary vaccination course is two injections separated by an interval of three to four weeks between doses. Revaccination is recommended before each risk period and no more than 12 months after previous vaccination
- **Bovalto Respi 3** contains inactivated Mannheimia haemolytica A1 and inactivated bovine respiratory syncytial and parainfluenza 3 viruses. Primary vaccination course is two injections, separated by an interval of three weeks between doses. Revaccination is recommended six months after primary vaccination course
- **Bovalto Respi 4** contains inactivated Mannheimia haemolytica A1 and inactivated bovine respiratory syncytial, parainfluenza 3 and bovine viral diarrhoea viruses. Primary vaccination course is two injections, separated by an interval of three weeks between doses. Revaccination is recommended six months after primary vaccination course
- **Bovalto Respi Intranasal** contains modified live bovine respiratory syncytial virus and parainfluenza 3 virus. The vaccination course is one dose of the vaccine intranasally
- **Bovilis Bovipast RSP** contains inactivated Mannheimia haemolytica A1 and inactivated bovine respiratory syncytial and parainfluenza 3 viruses. Primary vaccination course is two injections, separated by an interval of c. four weeks between doses. If needed, revaccination is recommended two weeks before each risk period

[6] Eastham et al. (2018) Associations between age at first calving and subsequent lactation performance in UK Holstein and Holstein-Friesian dairy cows. PLoS ONE 13(6): e0197764. https://doi.org/10.1371/journal. pone.0197764.
[7] Fourth Report GB Cattle Health and Welfare Group, September 2018.

- **Hiprabovis SOMNI/Lkt** contains inactivated Mannheimia haemolytica leukotoxoid and inactivated Histophilus somni. Primary vaccination course for cattle over two months of age is two injections, separated by an interval of three weeks between doses
- **Imuresp RP** contains modified live parainfluenza 3 virus and Infectious Bovine Rhinotracheitis (IBR) virus. The primary course of vaccination for cattle over 10 weeks of age is a single dose. Revaccination every six months is recommended
- **Rispoval 3** contains modified live bovine respiratory syncytial virus and parainfluenza 3 virus and inactivated BVD virus. The primary course of vaccination for cattle over 12 weeks of age is two doses, three to four weeks apart. If needed, revaccination every six months is recommended
- **Rispoval 4** contains modified live bovine respiratory syncytial virus and parainfluenza 3 virus and inactivated bovine viral diarrhoea virus and Infectious Bovine Rhinotracheitis (IBR) virus. The primary course of vaccination for cattle over 12 weeks of age is two doses, three to four weeks apart. If needed, the same vaccination scheme is recommended at least 14 days prior to the period of expected disease challenge
- **Rispoval Pasteurella** contains inactivated Mannheimia haemolytica. The primary course of vaccination for cattle over 12 weeks of age is a single dose. If needed, more than 17 weeks after previous vaccination, a single vaccination is recommended at least seven days prior to the period of expected disease challenge
- **Rispoval RS** contains modified live bovine respiratory syncytial virus. The primary course of vaccination for cattle over four months of age is two doses, three to four weeks apart
- **Rispoval RS+PI3 Intranasal** contains modified live bovine respiratory syncytial virus and parainfluenza 3 virus. The vaccination course is one dose of the vaccine intranasally

Assumptions

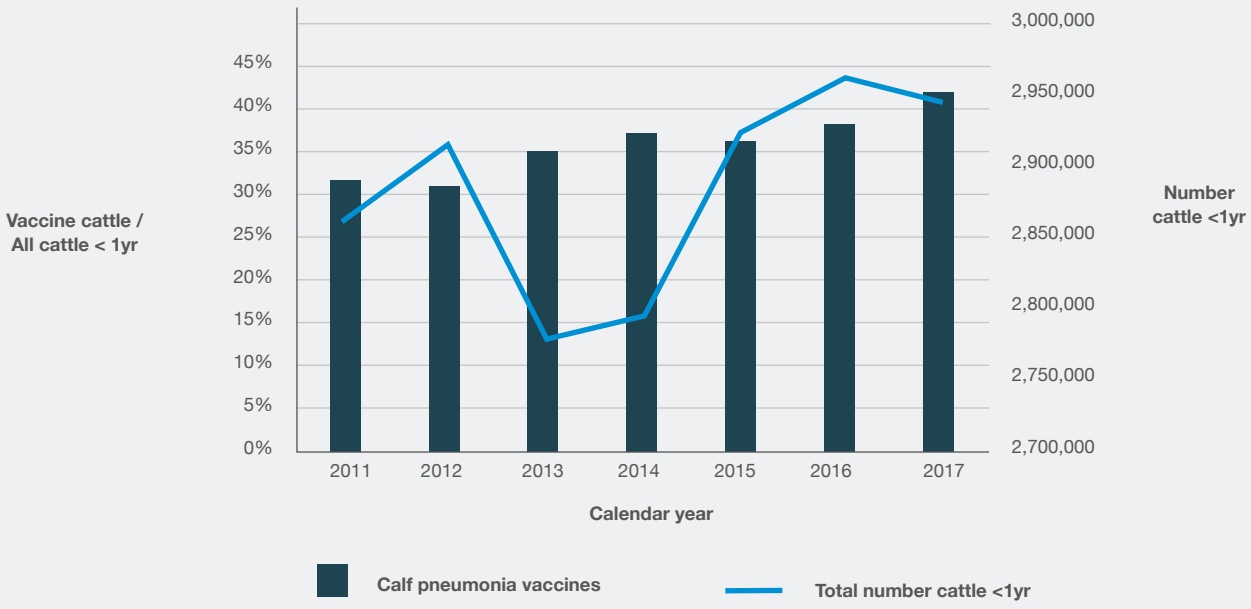
Numerator: Common industry practice with these vaccines is to vaccinate animals only in the first year of life. The recommended primary vaccination course for these vaccines was used to estimate the number of cattle doses sold in each calendar year.

Denominator: It was assumed that only animals under one year of age were vaccinated and the total population of cattle under one year of age was used as the denominator for the target population.

Vaccination uptake

The uptake of vaccines for pneumonia rose steadily from 29% in 2011 to 38% in 2017, an increase of 30%. This was the largest increase in vaccine uptake for the vaccines in this report.

Pneumonia vaccination uptake



Summary

The total number of vaccine doses sold increased by 14.6% between 2011 and 2017, although sales of vaccines peaked in 2014 and only recovered that level in 2017. The drop in uptake in 2015 and 2016 may be related to the collapse in milk prices and in dairy farmer incomes. The biggest drop in uptake was seen in Leptospirosis (37% in 2014 to 31% in 2016). When farmers have money, they are prepared to spend it on products to protect the health and welfare of their animals, but when incomes fall and overdrafts are under pressure, vaccines may be a victim of cost-cutting. However, other factors may contribute to fluctuations in vaccine sales and are outside the scope of this report.

It should be noted that sales from wholesalers don't necessarily equate to use in that year, for example, for commercial reasons or if there are potential stock availability concerns, practices may stock up one year, but then use the vaccine in the next year. The data on sales is considered the best available approximation.

The estimates of vaccine uptake are necessarily crude and there will have been some use of vaccines in animals outside the denominator population, against which vaccine uptake was measured. However, it is still a useful measure of the likely level of protection in the target group, although there could be benefits from wider uptake.

The analysis does not include any estimate of how effectively vaccines were used in cattle – for example, in one survey only 48% of respondents stated they administered the second dose in the primary course within the recommended timeframe, and 14% of respondents stated they vaccinated earlier than the youngest recommended age[8]. The majority of fridges in which vaccines were stored in another study would have failed to keep any stored live vaccines within the recommended storage temperature range[9].

It is interesting to note that only calf pneumonia vaccine uptake did not fall in 2015 and 2016 and there was also little change in the uptake of IBR vaccines. The biggest increase in vaccine uptake between 2011 and 2017 was also for IBR (43%) and calf pneumonia (30%). Pneumonia in cattle is thought to be responsible for a significant, but unknown, proportion of the antibiotic use in cattle. Given the focus on responsible use of antibiotics, it is good to see that farmers may have prioritised spend on these vaccines.

The highest level of estimated uptake was for BVD vaccines. If the 18% of breeding cattle in herds accredited free of BVD to CHeCS standards, which cannot use vaccine, are excluded, then sufficient vaccine doses were potentially used to cover over 50% of breeding cows. This suggests that about 70% of herds are engaged either in vaccination or accreditation to protect their herds from BVD, which supports the efforts being made across the UK to eliminate BVD.

Vaccines have an important part to play in helping both the beef and cattle sectors to meet the industry targets to use antibiotics more responsibly and this report provides a baseline against which to follow trends in vaccine uptake on farms.

Table 1. Vaccine uptake and the relevant 'at risk' cattle populations

Vaccine uptake	2011	2012	2013	2014	2015	2016	2017
Total number cattle <1yr	2,881,500	2,925,500	2,807,500	2,821,000	2,939,000	2,970,500	2,948,000
Calf pneumonia vaccines	29%	31%	35%	36%	36%	37%	38%
Total cattle and calves	9,691,954	9,749,341	9,682,307	9,693,111	9,815,554	9,806,302	9,786,733
IBR	16%	18%	20%	21%	20%	20%	23%
Total number of breeding females >1yr	4,809,000	4,819,500	4,787,000	4,785,000	4,861,500	4,911,500	4,908,500
BVD	42%	44%	45%	48%	45%	43%	45%
Leptospirosis	32%	36%	33%	37%	32%	31%	33%
Total no. of breeding females (> 2yrs)	3,447,000	3,425,500	3,382,000	3,415,000	3,470,500	3,472,000	3,462,000
Calf enteritis	15%	18%	12%	17%	17%	16%	18%
Total doses of vaccine sold	8,462,739	9,348,562	9,325,950	10,135,160	9,694,725	9,557,830	10,133,805

[8] Cresswell E, et al. A questionnaire-based survey on the uptake and use of cattle vaccines in the UK. Vet Rec Open 2014;1:e000042. doi:10.1136/vropen-2014- 000042.
[9] Williams and Paixão On-farm storage of livestock vaccines may be a risk to vaccine efficacy: a study of the performance of on-farm refrigerators to maintain the correct storage temperature BMC Veterinary Research (2018) 14:136.

Further information on vaccinating cattle

AHDB Dairy Vaccination video

Vaccination quiz

AHDB Beef & Lamb manual Using medicines correctly for Better Returns

Produced for you by:

AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7669 2051
E comms@ahdb.org.uk
W ahdb.org.uk
@TheAHDB

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**