New Zealand Food Safety

Haumaru Kai Aotearoa

Review of the *Campylobacter* Regulatory Limits for Meat Chickens

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Discussion Document: Review of the *Campylobacter* Regulatory Limits for Meat Chickens

This discussion paper provides a review of the regulatory limits for *Campylobacter* that apply to meat chickens. There are three regulatory limits for *Campylobacter* established in the Poultry National Microbiological Database Programme which are specified in the Animal Products (Specifications for National Microbiological Database Programme) Notice 2018.

New Zealand Food Safety (NZFS) of the Ministry for Primary Industries (MPI) emphasises that the views and recommendations outlined in the paper are preliminary and are provided as a basis for consultation with stakeholders. NZFS will analyse submissions and if appropriate, amend the Animal Products Notice: Specifications for the National Microbiological Database Programme for further comment or feedback. Once finalised, the notice will be issued on the NZFS website. Hard copies will be available on request.

SUBMISSIONS

All submissions must be received no later than Thursday 1 August 2019.

NZFS encourages submitters to make their submissions electronically so please email your submission to: animal.products@mpi.govt.nz.

If you choose to convey your submission in writing, it should be sent to the following address:

Consultation – Review of *Campylobacter* Regulatory Limits
Animal Products, Food Regulation
Ministry for Primary Industries
PO Box 2526 Wellington 6011

Please include the following information with your submission:

- the title and name of the discussion document;
- your name and title (if applicable);
- your organisation's name (if applicable); and
- your address.

The following points may be of assistance in preparing comments:

- where possible, comment should be specific to a particular section in the document. All major sections are numbered and these numbers should be used to link comments to the document;
- where possible, reasons and data to support comments may be provided;
- as a number of copies may be made of your comments, please use good quality type, or make sure the comments are clearly hand-written in black or blue ink.

RELEASE OF SUBMISSIONS
MPI expects to release all submissions. If you have specific reasons for wanting to have your submission or personal details withheld, please set out your reasons in the submission. All submissions are also subject to the Official Information Act 1982 and can be released (along with the personal details of the submitter) under the Act. MPI will consider those reasons when making any assessment under the Act.

Definitions

code means the Processing of Poultry: Operational Code

CPT means The *Campylobacter* Performance Target. This target consists of 2 regulatory limits tested on chicken carcass rinse samples over set processing periods. The two regulatory limits are The Enumeration Target and The Detection Target

The Enumeration Target is a regulatory limit as follows:

a) Standard throughput premises: for no more than 6 out of 45 individual carcass rinse samples taken from a 3 successive processing periods' moving window to have *Campylobacter* counts greater than 6000 CFU per carcass (3.78 $\log_{10}$CFU/carcass); or
b) Very low throughput premises: for no more than 1 out of 9 individual carcass rinse samples taken from a 3 successive processing periods' moving window to have *Campylobacter* counts greater than 6,000 CFU per carcass (3.78 $\log_{10}$CFU/carcass)

The Detection Target is a regulatory limit as follows:

a) Standard throughput premises: for no more than 29 out of 45 individual carcass samples taken from a 3 successive processing periods' moving window to have *Campylobacter* counts of 2.30 log10 CFU/carcass or greater; or
b) VLT premises: for no more than 5 out of 9 individual carcass samples taken from a 3 successive processing periods' moving window to have *Campylobacter* counts of 2.30 $\log_{10}$ CFU/carcass or greater

Detection Failure (DF) means a generated indicator of the Detection Target not being met, causing the moving window to be non-compliant

Enumeration Failure (EF) means a generated indicator of the Enumeration Target not being met, causing the moving window to be non-compliant

Meat chicken means a broiler chicken, small breed or poussin

moving window means a set of samples taken over a set period of time in which the addition of the latest set of samples to the window displaces the oldest dated set of samples

NMD means the National Microbiological Database

NMD quarter means a period of 13 or 14 weeks defined by the Animal Products Notice: Specifications for National Microbiological Database Programme

non-compliant moving window means that a moving window has an Enumeration Failure, a Detection Failure, or both

NZFS means New Zealand Food Safety of the Ministry for Primary Industries

PPT means Prevalence Performance Target. This is a regulatory target for *Campylobacter* to be detected in less than 30% of the samples taken from meat chickens and tested for a NMD quarter

'alert' response means an immediate review of the process and chicken flocks by an operator to identify and document factors that may have led to a non-compliant moving window, and as appropriate, to take corrective and preventative action. Responses escalate with each consecutive non-compliant moving window

RMP means a registered Risk Management Programme under the Animal Products Act 1999

Standard throughput (ST) premises means poultry premises at which, at the beginning of a season, it can reasonably be expected that more than 1 million (1,000,000) birds will be processed in that season

Very low throughput (VLT) premises means poultry premises at which, at the beginning of a season, it can reasonably be expected that fewer than 1 million (1,000,000) birds will be processed in that season

1 Executive Summary

New Zealand Food Safety (NZFS) of the Ministry for Primary Industries (MPI) currently has three regulatory limits for *Campylobacter* that apply to meat chickens within the National Microbiological Database (NMD) poultry programme. The *Campylobacter* testing programme includes the:

- *Campylobacter* Performance Target (CPT) which consists of:
    - the Enumeration Target; and
    - the Detection Target.
- Prevalence Performance Target (PPT) (standard throughput poultry operators only).

The *Campylobacter* testing programme provides information to NZFS and the New Zealand poultry industry, and:

- verifies the operator's control measures for *Campylobacter* during slaughter and dressing of chickens;
- assists NZFS to model whether additional control measures could achieve further reductions in human foodborne illness rates by using the NMD programme as a monitoring tool; and
- assists with the review of NZFS's *Campylobacter* Risk Management Strategy.

The CPT was established in 2008 and initially included three components (the enumeration limit, high count and quarterly limits). Following a review in 2013, the CPT was changed, the enumeration limit was retained and the detection limit added as regulatory limits following consultation. The PPT was set as an additional regulatory limit in 2016 for standard throughput operators.

The introduction of the PPT followed an assessment of risk-based performance from 2015 -2017. As part of a continuous improvement programme, MPI decided that the incidence of notified human foodborne campylobacteriosis should be decreased by 10% and this level of risk reduction should be maintained. In parallel, reducing the proportion of standard throughput poultry operators with a prevalence of *Campylobacter* detected over 30% was seen as a good measure to identify 'poorer performing' standard throughput operators of meat chickens, and to improve hygienic processing of meat chickens by helping to direct resources for improvement.

Standard throughput poultry operators not complying with the PPT are required to systematically review their processes and to take appropriate corrective actions which are reviewed by the NZFS Verification Services premises verifier and NZFS. NZFS initiated site visits with *Campylobacter* technical experts to assist operators who had exceeded the PPT during 2016 and 2017. A summary of the findings is provided in section 2.3.

Following the operation of the PPT over a two year period, NZFS has reviewed the *Campylobacter* regulatory limits and targets in the NMD programme for poultry. Although improvements have been made and maintained by the poultry industry to both the presence and levels of *Campylobacter* in chickens at the end of primary processing, the reduction to the rate of human notifications has plateaued in recent years.

MPI has met with poultry industry representatives in November 2017, August 2018 and March 2019 and received a proposal to amend the *Campylobacter* regulatory limits, from the Poultry Industry Association of New Zealand (PIANZ) in November 2018. The feedback received from the poultry industry has been taken into consideration when developing and assessing the possible risk management options for any change to these regulatory limits and associated targets. The options are presented in this paper for consultation.

NZFS's preferred position is to amend the Animal Products Notice: Specifications for National Microbiological Database:

- to remove the Performance Prevalence Target as a regulatory limit;

- to amend the *Campylobacter* Performance Target by tightening the Enumeration Target and the Detection Target applicable to standard throughput operators only; and
- to amend the reset of a non-compliant moving window following a Enumeration Failure and/or a Detection Failure.

NZFS will continue to work with the poultry industry to develop the Operational Code: Processing of Poultry to provide further assistance for poultry operators to improve process control and hygiene during primary processing. The purpose of this approach is to ensure that practical and effective actions can be taken by the poultry industry to help achieve the new regulatory limits.

While this discussion document focuses on a review of the *Campylobacter* Regulatory Limits that are applicable to standard throughput processors of meat chickens, alternative approaches for very low throughput operators of meat chickens will be considered in the future.

NZFS will analyse all the submissions received in response to this consultation and where appropriate amend the Animal Products: Specifications for National Microbiological Database Programme Notice.

2 Background

2.1 LEGAL REQUIREMENTS

The current legal requirements for the NMD Poultry Programme are found in the Animal Products (Specifications for National Microbiological Database Programme) Notice 2018. Refer to: http://www.mpi.govt.nz/dmsdocument/14110-animal-products-notice-specifications-for-national-microbiological-database-programme

2.2 HISTORY AND PURPOSE

A new regulatory requirement, the *Campylobacter* Performance Target (CPT) consisting of an Enumeration Target, High Count and Quarterly Limit: was introduced by NZFS (then NZFSA) in 2008 to verify the effectiveness of control measures in reducing levels of *Campylobacter* contamination during the slaughter and dressing of broiler chickens. The CPT is a regulatory limit measured over a moving window comprising 3 processing periods (45 samples in total). The effectiveness of the CPT has been reviewed periodically and amended as appropriate to ensure that these remain fit for purpose. Over time, the high count and quarterly limit have been removed. In 2012 the Detection Target was introduced to complement the Enumeration Target, effective from 7th January 2013, and in 2016 the scope of the CPT was expanded to apply to all meat chickens.

The 2015 Discussion paper: Review of the Poultry NMD Programme's *Campylobacter* Performance Target (CPT) Limit(s) provided an analysis of data collected following the 2012 amendment. In response to the submissions received it was determined that the CPT would not be changed but that there would be an increased focus on operators who were not performing as well as others, in terms of meeting the detection and/or the Enumeration Target. The following changes were made:

- the scope of the NMD Poultry Programme was extended to include turkeys, ducks and all chickens intended for human consumption, such as poussin, small breeds, head-on-feet-on and end-of-lay birds which included both spent layer hens and breeder chickens beginning in 2016;
- whilst turkeys, ducks and end-of-lay chickens were included in the NMD Poultry Programme, the regulatory limits for *Campylobacter* and *Salmonella* did not apply;
- the CPT was extended to apply to all meat chickens;
- a new regulatory limit, the Prevalence Performance Target (PPT), was introduced, applying to standard throughput operators processing meat chickens; and
- the *Salmonella* Performance Standard was amended.

2.3 PREVALENCE PERFORMANCE TARGET

In 2016, the PPT was introduced as a regulatory limit in the National Microbiological Database Specifications. The purpose of the PPT was to demonstrate the effectiveness of the standard throughput operator's Risk Management Programme (RMP) in managing the microbiological risk of *Campylobacter* contamination of meat chicken carcasses. The PPT is cumulatively gathered over a NMD quarter to provide a clear picture to the operator of their premises' current performance and trends in *Campylobacter* contamination. A prevalence of 30% or greater at the end of a quarter requires the operator to identify reasons why their business operation was unable to meet the target, to determine actions to implement improvements and provide these to the Verification Services premises verifier within 30 days of the end of the last quarter. This implementation plan is reviewed by the Verification Services premises verifier and NZFS to determine its effectiveness in permitting the PPT to be achieved in future.

In 2016, in addition to the regulatory limit specified in the National Microbiological Database Specifications, MPI introduced a Key Performance Target for MPI high level internal evaluation of the *Campylobacter* Risk Management Strategy. The KPI ended at the end of 2017 and its aim of nil standard throughput operators recording quarterly percentages detected above the PPT by the end of 2017 was not achieved. During the period the KPI was in place three of the eight standard throughput operators exceeded the PPT during different quarters with one being a consistent outlier.

Implementation of the PPT

To facilitate the introduction of the PPT:

- a statistical process control chart was included in the NMD to enable each operator to keep track of the cumulative *Campylobacter* prevalence during the NMD quarter; and
- an example of a framework to enable operators to undertake a systematic review of the process was developed by NZFS and the poultry industry. The framework was included in the *Campylobacter* Troubleshooting Guidance and later transferred to the Processing of Poultry: Operational Code (Code).

The *Campylobacter* Troubleshooting Guidance provides a framework to assist poultry operators to review the current processing procedures and operation of specific control measures for *Campylobacter*. This guidance identifies the key processing steps to review in the event of failing to meet the CPT or PPT.

As part of the implementation of the PPT, NZFS technical experts undertook site visits to those standard throughput operators who had exceeded the PPT over a number of NMD quarters. Recommendations were provided that could reduce *Campylobacter* contamination on a sector- and site-specific basis. In summary, these were in relation to:

- aspects of process control and hygienic processing of chickens (i.e. is equipment along the chain working within specifications),
- feed withdrawal and possible improvements to the feed composition
- improvements to good operating practices,
- NMD sampler training, improvements to operator verification,
- understanding of the effectiveness of the different interventions applied to understand what they can and cannot achieve in terms of *Campylobacter* control, and
- operator verification identifying improvements to demonstrate compliance with the RMP procedures.

2.4 NZFS'S POSITION

An unacceptably-high rate of foodborne campylobacteriosis was seen in New Zealand in 2006. Attribution studies estimated that more than 50% of human cases were due to the handling and consumption of poultry meat. This led to the implementation of a risk management strategy for *Campylobacter* in broiler chicken meat with a target of reducing New Zealand human foodborne cases of campylobacteriosis by 50% over a five year period, 2008-2012. Control measures were applied to the primary processing of poultry and more than a 50% reduction in foodborne campylobacteriosis was achieved over this period. This included a considerable decrease in human cases attributable to poultry meat consumption.

Since 2012 the reduction in the levels of foodborne campylobacteriosis has plateaued. At the end of 2017, the incidence of total notified campylobacteriosis cases was 6,482, a rate of 135.2 cases per 100,000 people. 63.8% of the total notified cases is estimated to be foodborne. The estimated proportion of foodborne transmission for 2017 was 3,771 cases, a rate of 78.7 (54.4 – 102.6) cases per 100,000 people[1].

In 2016, a new target reducing human foodborne campylobacteriosis cases by 10% (from 88.4 to 79.6 per 100,000 per head of population) by the end of 2020 was established in the current NZFS *Campylobacter* Risk Management Strategy.

The results of NMD programme show that the New Zealand poultry industry has made significant improvements in the control of *Campylobacter* since testing began. Trend analysis of the broiler chicken carcass rinsate results and human cases have shown a strong association between the introduction of the CPT and a significant reduction in human foodborne campylobacteriosis in New Zealand (Sears et al., 2011[2]). Notwithstanding this, there is little evidence of further improvement since that established early in the risk management strategy.

Notwithstanding the successes, New Zealand still has some of the highest notified rates of foodborne campylobacteriosis in the world. Recently completed attribution studies (2017) show that whilst there are other potential sources of foodborne *Campylobacter* such as raw drinking milk, poultry meat continues as a highly significant source of human cases in New Zealand. NZFS considers that there needs to be a clear demonstration of continuous improvement in reducing human illness attributable to this food pathway in New Zealand.

NZFS has been working with the poultry industry to continue to improve the control of *Campylobacter* throughout the production and processing of meat chickens. Efforts have been focused on:

1. primary processors of poultry who are not performing as well as other operators in terms of meeting Enumeration Target and Detection Target;
2. providing additional assistance for new very low throughput operators in the NMD programme, for example, when operation commences; and addressing and improving process hygiene and control of operations;
3. publication of updated guidance for operators that undertake primary and secondary processing of poultry to help comply with the regulatory requirements specified under the Animal Products Act 1999 and to process poultry product that is fit for its intended purpose.
    a) The updated Operational Code: Processing of Poultry – Part 2 Good Operating Practice which combined and replaced the several sections of the previous code and introduced new chapters covering generic Good Operating Practices and design and Construction.

[1] Pattis, I, Cressey, P, Lopez, L, Horn, B and Roos, R. Annual Report Concerning Foodborne Disease in New Zealand 2017, 2018: ESR Client Report FW17008, Christchurch, New Zealand.

[2] Ann Sears, Michael G. Baker, Nick Wilson, Jonathan Marshall, Petra Muellner, Donald M. Campbell, Robin J. Lake, and Nigel P. French. 2011. Marked Campylobacteriosis Decline after Interventions Aimed at Poultry, New Zealand. Emerging Infectious Disease. 2011 Jun; 17(6): 1007–1015. doi: 10.3201/eid1706.101272. PMCID: PMC3358198. PMID: 21749761. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3358198/

b) The scope of the chapter on Slaughter and Dressing within the Operational Code: Processing of Poultry – Part 2 Good Operating Practice now applies to all types of poultry, including ducks, turkeys, pheasants, quail, geese, guinea fowl, partridges, poussin, pigeons and other game birds;
c) Part 3 of the Operational Code: Processing of Poultry – HACCP Application[3] is currently being co-designed by NZFS with members of PIANZ to provide a framework for the documentation, monitoring and implementation of hazards that are likely to occur in the slaughter, dressing and processing of poultry and poultry products;

4. review of the Animal Products (Specifications for the ante-mortem and post mortem examination of poultry for human or animal consumption) Notice 2005 and the Amendment Notice (2005). The notice considers alternative approach to the application of Acceptable Levels of Abnormalities to manage process control and hygienic slaughter and dressing. A draft updated notice is expected to be available for publication consultation during mid-2019;
5. working with secondary processors of poultry under the Food Act 2014. Food businesses previously working under the Food Hygiene Regulations 1974 and under the Food Act 1981 should have transitioned to the new requirements by the end of February 2019;
6. MPI has run a food safety education campaign ('Clean, Cook, Chill') for New Zealand consumers to raise awareness of safe food practice over the summers of 2017/18 and 2018/19. MPI is also investigating how to partner with food businesses and industry associations to further promote and encourage safe food practice; and
7. developed a suite of NMD regression models which estimate the number of human campylobacteriosis notifications. Poultry is shown to be an important source of the human campylobacteriosis cases. Any reduction in their numbers requires practical improvements by the poultry industry to reduce the number poultry carcasses that are contaminated with *Campylobacter.*

2.5 NEW ZEALAND POULTRY INDUSTRY'S POSITION

The Poultry Industry Association of New Zealand (PIANZ) and representatives from the New Zealand poultry industry have indicated at meetings with NZFS that they remain committed to the control of *Campylobacter* throughout production and processing, and they believe that slaughter and dressing provides a good opportunity to implement improvements.

The poultry industry has stated that they are continuing to seek further opportunities to improve controls to reduce the levels of *Campylobacter* during primary processing. They have noted that there is a difference in the performance achieved between operators as determined by the microbiological results in the NMD programme for meat chickens, with some operators who are more frequently non-compliant for *Campylobacter*. The industry has indicated that they would like to see a focus on these operators.

PIANZ commissioned an examination of the *Campylobacter* controls in place both on farm and during primary processing both in New Zealand and overseas to help to identify areas for future control and intervention. The report provided several recommendations for improvements in the New Zealand poultry industry over the short, medium and long-term time frames. Recommendations for a more cohesive approach with growers and on-farm interventions were a main theme.

Short-term recommendations included processing flocks of a similar age, introducing flock evenness and on-farm controls such as cleaning and sanitation of catching equipment, crates, truck decks and dedicated workwear for individual farms. Medium and long-term recommendations included improvement of the entry procedures on farm, reducing the times when birds are harvested from a flock, investigation of alternatives to chlorine for decontamination during processing and new methods for sample taking.

[3] Current version available: Appendix IX.4: Generic HACCP Plan for Slaughter, Dressing, Portioning and Deboning of Chicken (Broilers), and NZFSA/ PIANZ Guidance and Generic Risk Management Programme for Slaughter and Dressing of Broiler Chickens.

PIANZ has established a working group that will work on-farm and with processing operations to ensure best practice and reduction of *Campylobacter* levels. Further, PIANZ and their members are working with New Zealand universities to help identify trends in the *Campylobacter* results.

In November 2018, PIANZ informed NZFS that the poultry industry had considered the options presented to change the *Campylobacter* Performance Target (CPT) and proposed a reduction from 6 to 5 out of 45 in the Enumeration Target. PIANZ considers this will give a better outcome in terms of reducing human cases than enforcing a prevalence percentage reduction on individual plants

3 Review of Data

3.1 REVIEW PROCESS

At meetings between MPI and the poultry industry the current regulatory limits for *Campylobacter* in the NMD poultry programme and the effect of these both on public health and on the prevalence and concentrations of *Campylobacter* present at the end of primary processing were discussed. A number of options were considered which are relevant to the scientific review and option identification and assessment section 4 of this paper.

3.2 CURRENT SITUATION

3.2.1 Trends in Human Notifications

Figure 1 shows the number of human cases of campylobacteriosis[4] reported in New Zealand over the last ten years. This data covers all human cases, not just those estimated to be from food. The 2017 rate for total notified cases of campylobacteriosis was estimated at 135.2 per 100,000 population[5]. Correcting for non-foodborne related cases and overseas travel, provides a foodborne estimate (63.8% of the remaining rate) for 2017 at 78.7 per 100,000. Foodborne illness data for 2018 is preliminary only and has not been confirmed to date.

[4] All cases reported in New Zealand, including those estimated to be foodborne, from overseas travel and other pathways.
[5] Pattis, I, Cressey, P, Lopez, L, Horn, B and Roos, R. Annual Report Concerning Foodborne Disease in New Zealand 2017, 2018: ESR Client Report FW17008, Christchurch, New Zealand

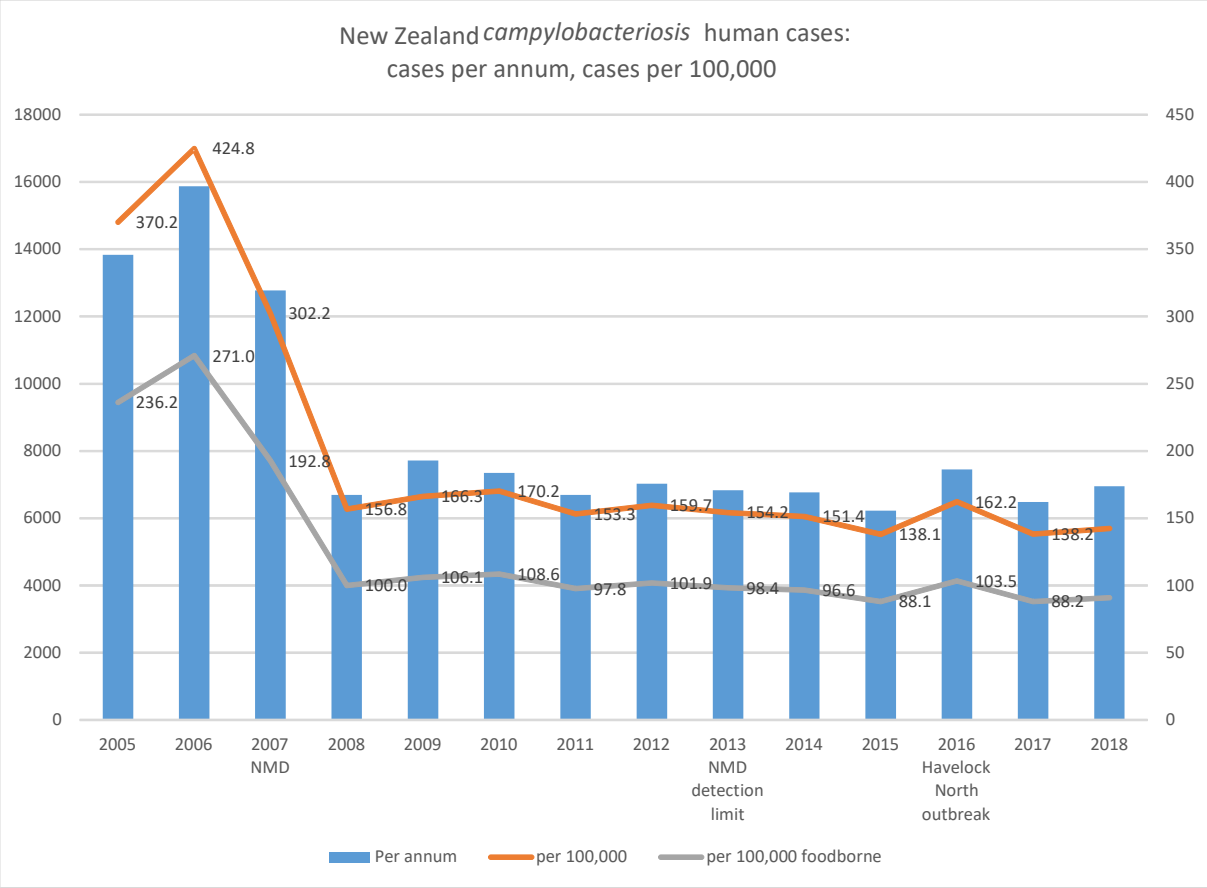


Figure 1: Number of human cases of campylobacteriosis in New Zealand, 2005 - 2017

Notes:

- *In 2016, there was a large outbreak of campylobacteriosis attributed to the consumption of drinking water in the Hawke Bay, waterborne outbreaks are not considered when determining the rate of foodborne illness.*
- *Foodborne illness data for 2018 has not yet been finalised.*

3.2.2 Evaluation of Carcass Rinsate Data

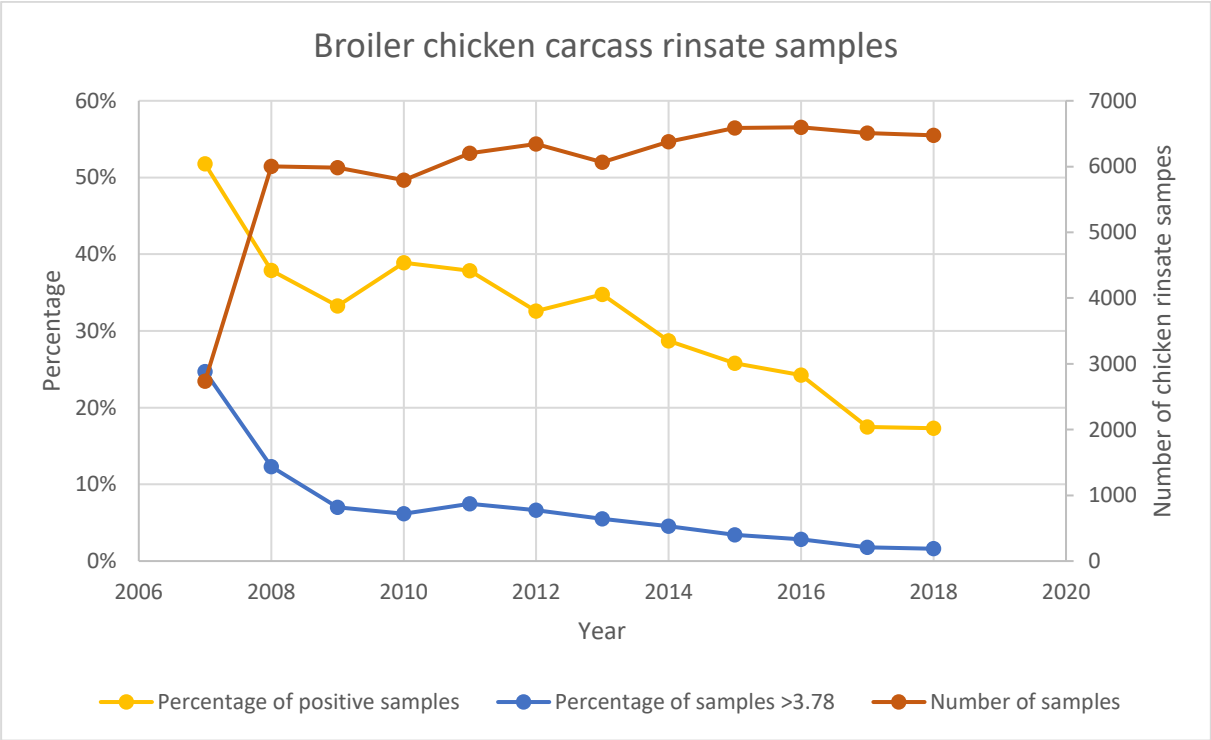
NZFS reviewed the *Campylobacter* results recorded in the NMD poultry programme for meat chickens to determine whether there were any trends, patterns or differences in the results.

21.7% of barn-raised chickens were positive for *Campylobacter* compared to 25.8% for free range chickens in the period from September 2015 to August 2017. . There was little difference between the *Campylobacter* results reported for free range and the barn raised carcasses that exceeded the Enumeration Target, 2.5% of the barn raised chickens compared to 2.4% of the free range chickens. There has been an increase in the number of free range chickens processed over the last few years (NMD demographic data 2013–2014). Over the period September 2015 – August 2017, 18% of the standard throughput broiler chicken samples were free range. These results suggest that the poultry industry is managing any contamination associated with free range birds.

Analysis of the NMD programme data did not show any differences in the results across the months of the year, indicating that there is no seasonal patterns observed for *Campylobacter* rinsate results.

The total percentage of carcass rinsates exceeding either the enumeration limit and/or detection limit has decreased over time. Figure 2 demonstrates that while the number of carcass rinsate samples has remained relatively constant over 10 years the percentage of carcass samples above the *Campylobacter* detection limit has reduced from 52% in 2007 to 17% in 2018. The percentage of samples exceeding the enumeration limit has also dropped from 25% to 2%. This can be attributed to the improvements that the poultry industry has collectively made to the hygienic processing of chicken meat. The available data for the number of chickens processed and results in relation to the detection limit and the enumeration limit are provided in Appendix 1

Figure 1: Percentage of chicken carcass samples where *Campylobacter* has been detected or exceeds the enumeration limit.



Notes:

1. *Until October 2015 the Campylobacter regulatory limits in the NMD programme applied to broiler chickens after which the point the programme was expanded to apply to all meat chickens.*

2. *A positive Campylobacter sample is one where at least one Campylobacter microorganisms is detected in the carcass rinsate sample. Where the number of Campylobacter is below the limit of detection for the specified method, a result of 'Not Detected' is reported. The lower limit of detection for Campylobacter count is 2.30 $\log_{10}$ CFU/carcass. However, a not detected result (recorded as 2.00 $\log_{10}$ CFU/carcass – the nominated value to represent not detected) does not necessarily mean that the carcass was free of Campylobacter.*

3.2.3 Attribution Estimates

Source attribution studies have been conducted in the Manawatu sentinel site from 2005 to 2017 to provide an estimate of the contribution of various sources to human cases of campylobacteriosis. Poultry, ruminant and other source attribution estimates are presented in Figure 3. This figure demonstrates estimations for source only, not pathways of *Campylobacter* infection. Besides poultry, potential pathways for *Campylobacter* from sources such as ruminants and raw milk continue to be investigated by MPI, but this is outside the scope of this paper. There is a clear trend of improvement as the proportion of human cases of campylobacteriosis attributed to poultry meat has decreased.

Figure 3: Source attribution estimates

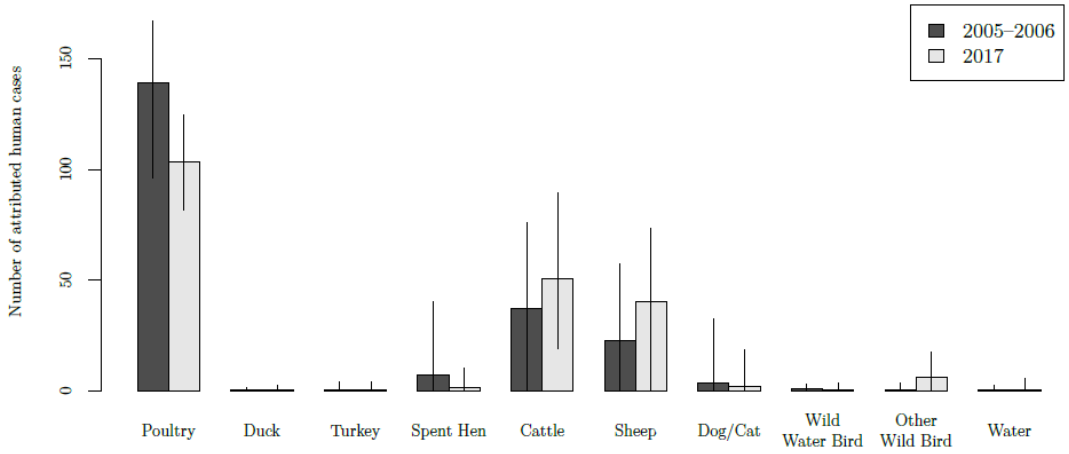


Figure 15: Source attribution for human cases in the Manawatu for cases reported between July 1st 2005 and June 30th 2006 compared to cases reported between January 1st and December 31st 2017. Error bars represent 95% confidence or credible intervals.

Notes:

- *The separate cattle and sheep categories should better be seen as one category, i.e. ruminants.*

3.2.4 Dose Response Models

The commonly used dose-response model specifies that the lower the ingested dose, the smaller the probability of disease. However if a large proportion of product has *Campylobacter* present, even at low numbers, there may be a possibility of illness in the human population.

3.3 COMPLIANCE AGAINST THE CAMPYLOBACTER REGULATORY LIMITS

3.3.1 Enumeration Target

Figure 4 provides the percentage of carcass rinsate samples that exceeded the enumeration limit (3.78 Log_{10} CFU/carcass) on a standard throughput poultry operator basis. The processing performance of the premises has improved over time so that for 2018, less than 5% of total carcass rinse samples from all standard throughput premises exceeded the enumeration limit. In comparison, in 2007 there was a wide distribution in results between the standard through put operators, six operators exceeded the enumeration limit of which one operator had over 45% of samples above the enumeration limit. The introduction of the Enumeration Target reduced the variation between the results from different poultry operators and delivered more consistent results with fewer outliers.

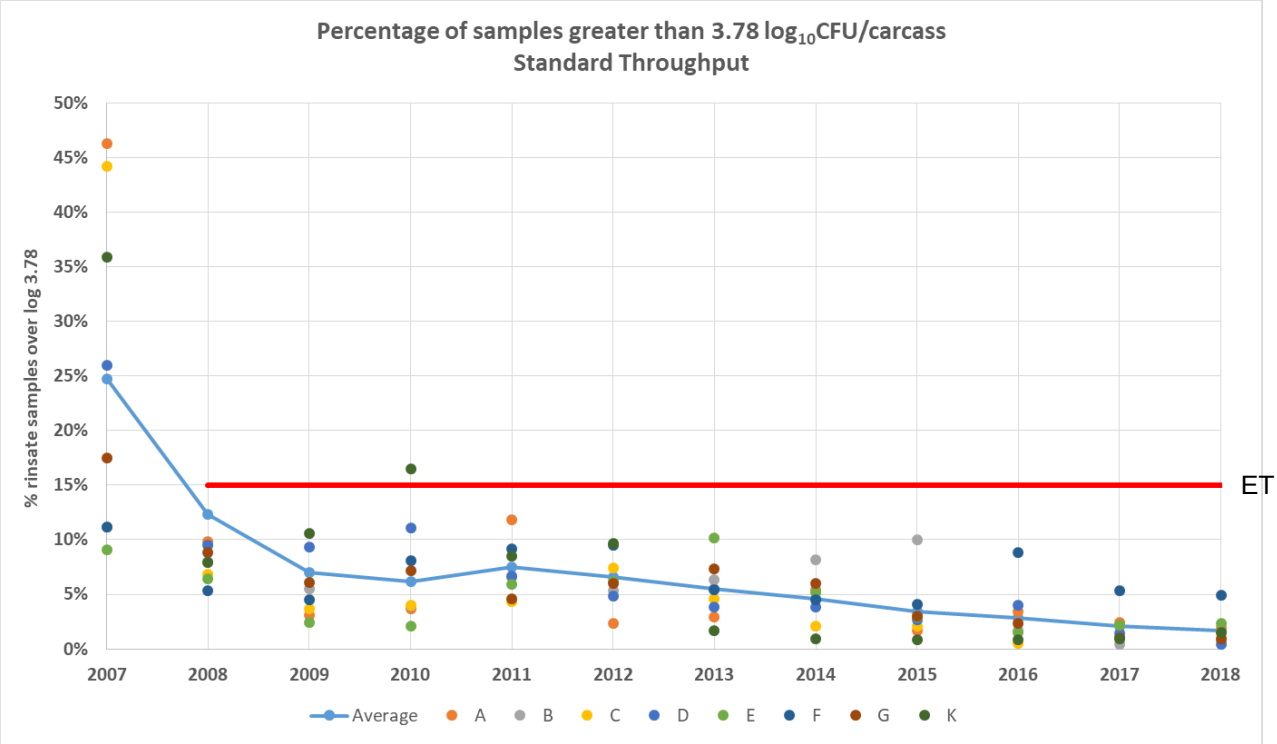


Figure 4: Percentage of carcass rinsate samples that exceed the Enumeration Target.

Note:

ET = Enumeration Target of 6 out of 45 carcasses expressed as a percentage of samples, 15%.

3.3.2 Prevalence Performance Target (PPT) and Detection Target

The Detection Target was established as a regulatory limit in 2013. It stipulated that maximally 29 out of 45 samples were allowed to show *Campylobacter*. The reason for this new regulatory limit was that a tightening of the Enumeration Target from 6 to 5 samples permitted to exceed the enumeration limit in a moving window period was deemed too difficult for the industry as a whole to achieve. The introduction of a detection limit for positive samples was considered as a strong incentive to improve process hygiene and reduce *Campylobacter* and it was practically feasible at the time.

The requirement to comply with the PPT, came into effect at the start of the second quarter of 2016 for standard throughput premises. Monitoring was commenced by industry at the start of the fourth quarter (October) 2015. The intent was that the PPT would identify operators with the highest percentage of carcasses with detectable *Campylobacter* and focus on improvements that could be made to reduce the prevalence. It also provides a means to identify outliers in terms of process control and performance.

An alternative means to Figure 2 of expressing those samples that are positive is shown in Figure 5. The percentages of positive samples are shown by standard throughput operators per annum that exceed the detection limit and/or the PPT. This figure shows how the percentage of positive carcass rinse samples and the variation between results has reduced over time. Recent data indicate that the differences between standard throughput operators are minimal with most operators complying with the PPT. There have been no Detection Failures as defined by the NMD programme.

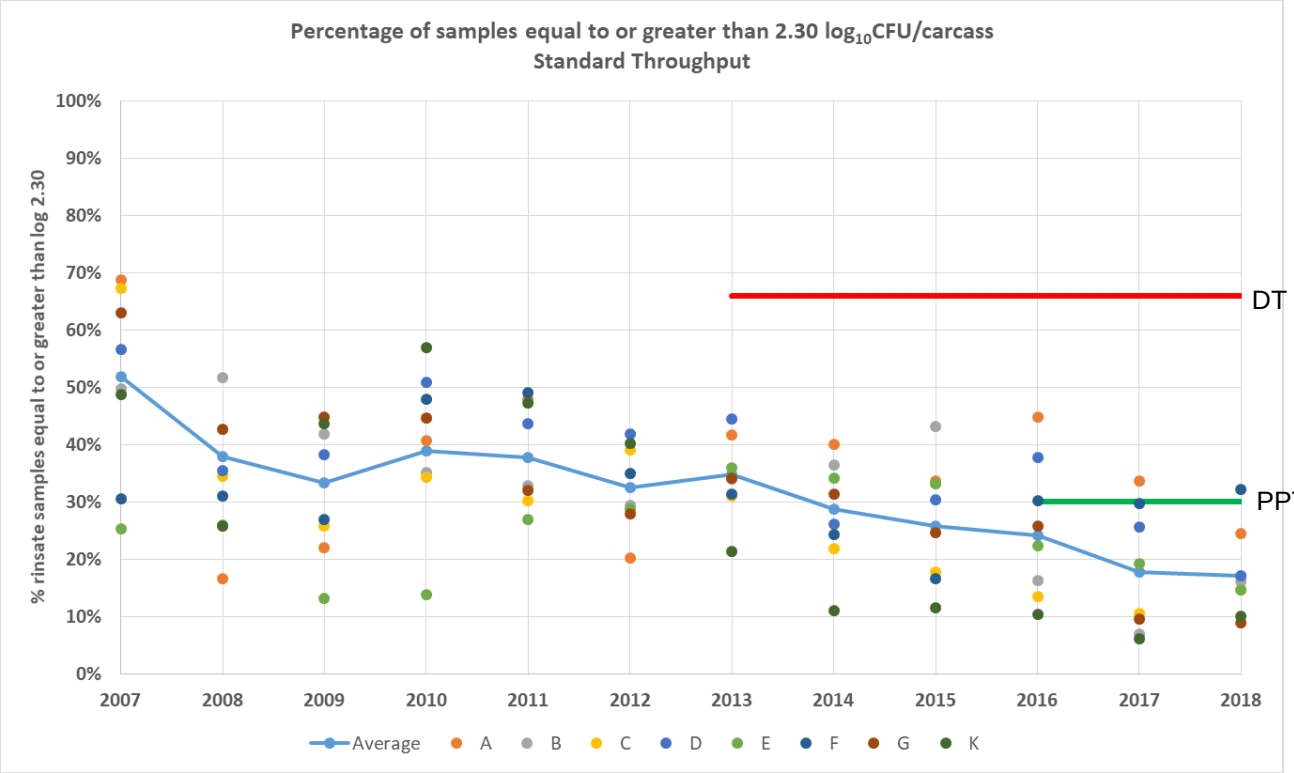


Figure 5: Percentage carcass rinsate samples that exceed the Detection Target and the Prevalence Performance Target.

Notes:

1. *DT = Detection Target 29 of 45 carcass rinse samples in a 3 processing period moving window results greater or equal to the lowest limit of detection (2.30 log10CFU/carcass) expressed as a percentage of 64%,*

2. *PPT = the prevalence performance target (PPT) limit per quarter of 30%*

To date (April 2016 to end of the first quarter 2019) three operators have exceeded the PPT several times. There has only been two of the 12 quarters since the PPT came into force in April 2016 where there were nil recorded exceedances by any of the standard throughput operators, Table 1.

Table 1: Number of standard throughput premises that exceed the PPT per NMD quarter

Number of standard throughput premises exceeding the PPT per quarter											
2Q16	3Q16	4Q16	1Q17	2Q17	3Q17	4Q17	1Q18	2Q18	3Q18	4Q18	1Q19
3	2	1	2	0	2	2	1	1	1	1	0

3.4 DISCUSSION OF THE SCIENTIFIC REVIEW

The introduction of the CPT was shown to have resulted in a reduction in the number of human cases of campylobacteriosis (Sears et al, 2011; MPI models). Despite the considerable improvements that have occurred in the poultry industry since the introduction of the CPT, the latest *Campylobacter* attribution studies demonstrate that chicken meat remains an important source of human campylobacteriosis.

There has been a trend of ongoing improvement in the reduction in the percentage of samples of meat chickens that exceed the enumeration limit and/or the detection limit.

NZFS has focussed on reducing the number of meat chicken carcasses that exceed the enumeration limit as a means to reducing the rate of foodborne cases of campylobacteriosis per 100,000 population in New Zealand. However, those meat chickens contaminated with lower levels of *Campylobacter* (equal to or above 2.30 $\log_{10}$ CFU/carcass and lower levels that may go undetected on carcasses registering a 'not detected' result). The introduction of the PPT provided operators with a tool to review results over a NMD quarter and observe longer-term trends.

The *Campylobacter* regulatory limits are outcome based requirements enabling flexibility within an individual premises process, provided that the limits are not exceeded. However there are differences between the performance of the various operators as measured by the NMD poultry programme in terms of the number of non-compliant moving windows in comparison to the average prevalence of *Campylobacter* reported per month (Figure 1 and Figure 5**)**.

The large scale commercial processing of meat chickens is carried out using specialist equipment. This equipment must be:

- operate according to the manufacturer's specification (e.g. at the correct speed) and process birds within a specified weight range
- set correctly for the weight of the birds
- maintained properly and replaced when no longer able to be processed hygienically.

It would seem that even when the above conditions are met that a certain proportion of carcasses will still have *Campylobacter* present and that it is possible for a poultry operator to have a higher number of samples that exceed the detection or enumeration limit and for this not to trigger a non-compliant moving window. The variation between operators suggest that further analysis of the operation of equipment and processes at individual premises might be beneficial. This may be especially so for those operators who are seeking to improve and optimise their performance.

It should be noted that the analytical method prescribed in the NMD programme may not detect low numbers of *Campylobacter* present. Various studies including the Attribution Study for the Manawatu Sentinel Site have identified higher percentages of *Campylobacter* in chickens at retail than identified through the NMD programme at the end of primary processing. Since *Campylobacter* is detected at retail it is possible that cross-contamination after the end of primary processing is the cause of the presence of *Campylobacter*.

4 Option Identification and Assessment

New Zealand Food Safety has identified the following options applicable to standard throughput operators unless otherwise stated:

- Option 1 Maintain status quo for the regulatory limits
- Option 2 Require reduced detections
- Option 3 Remove the PPT
- Option 4 Require tighter Enumeration Target
- Option 5 Amend the reset of the non-compliant moving window

These options which may not be mutually exclusive, are described briefly below with pros and cons for each approach.

4.1 OPTION 1: MAINTAIN STATUS QUO FOR THE REGULATORY LIMITS

There are three regulatory limits in place that apply to the primary processing of meat chickens for *Campylobacter*. The regulatory limits that apply for *Campylobacter*:

- the *Campylobacter* Performance Target (CPT) that comprises:
    - the Enumeration Target; and
    - the Detection Target; and

- the Prevalence Performance Target (PPT) that only applies to standard throughput operators of meat chickens.

For details of these limits see section 4.14–4.15 in the following document: http://www.mpi.govt.nz/dmsdocument/14110-animal-products-notice-specifications-for-national-microbiological-database-programme

For the CPT - Over 15 processing days (3 processing periods/weeks) a standard throughput operator is allowed to have a maximum of 29 out of 45 rinsates in which *Campylobacter* is detected (equal to or above the detection limit of 2.30 $\log_{10}$CFU/carcass) and 6 out of these 45 rinsates in which *Campylobacter* counts cannot exceed more than 3.78 $\log_{10}$ CFU/carcass (enumeration limit).

There is a similar system in place for Very Low Throughput premises (maximum of 5/9 detections and 1/9 with *Campylobacter* counts of more than 3.78 $\log_{10}$ CFU/carcass).

The PPT is triggered for a standard throughput operator when greater than 30% of carcass rinsate samples have counts equal to or above the detection limit over a NMD quarter. The Detection Target and PPT are not aligned. The majority of standard throughput operators consistently meet the Detection Target which allows 64% of samples to be equal to or above the detection limit. This suggests that it is possible to be non-compliant with the PPT whilst still meeting the Detection Target.

Under Option 1 there would be no change to the existing CPT or PPT that are currently used in the NMD Programme Notice for standard throughput operators.

Pros:

- Industry knows what is required and would not need to change.
- A review of existing data from the NMD programme by individual companies encourages improvements.

Cons:

- This option will not result in any further reduction of foodborne campylobacteriosis attributed to the consumption of poultry meat
- The poultry operator may not be driven to look for improvements in the operation of their equipment.
- Some premises may take just enough action to enable them to stay just within the limits whilst not making any significant improvements to process hygiene and control.
- The Detection Target and the PPT are not aligned and therefore premises can be non-compliant with the PPT whilst remaining within the CPT Detection Target.

4.2 OPTION 2: REQUIRE REDUCED DETECTIONS

This option considers tightening the Detection Target by reducing the number of samples permitted to exceed the detection limit may result in a greater number of non-compliant moving windows if there was no improvement in process hygiene during slaughter and dressing. An increase in the number of non-compliant moving windows would alert the operators to increase their efforts to reduce *Campylobacter* on their product.

This option seeks to more align the Detection Target with the PPT for Standard Throughput operators. The Detection Target was initially set at 29 out of 45 samples exceeding the detection limit to encourage the poultry industry to perform better. It was to result in a practical and manageable increase in the number of non-compliant moving windows if no improvements in process control took place. It may be timely to reduce the Detection Target do that it becomes more in line with the PPT. Currently a detection failure occurs when greater than 29 out of 45 samples (64%) are equal to or exceed the detection limit compared to the PPT which is set at 30% prevalence.

The percentage *Campylobacter* positive broiler chickens (52,343 birds) tested prior to the introduction of the PPT, from Jan 2012 to Dec 2015, was 35%. The percentage of positive broiler chickens reduced to 22% over the two year period, Jan 2016 to Dec 2017, with a figure of 18% reported for 2017. A Detection Failure would occur, when a value between 12 and 20 out of 45 samples are equal to or exceed the detection limit and this would replace the current PPT. An amendment to section 4.14 (6) Detection Target would then read 'Standard throughput premises: for no more than X of 45 carcass samples taken from a 3 successive processing periods 'moving window to have *Campylobacter* counts of 2.30 $\log_{10}$CFU/carcass or greater'.

Pros:

- Tightening of the Detection Target would serve as an incentive for the industry and in particular the poor performers to improve their slaughter and dressing procedures.
- Tightening the target will encourage operators to improve hygienic processing if required. Some operators will already be compliant and other will try improve.
- Tightening the target may result in exposure to fewer *Campylobacter* positive chicken carcasses at retail
- Tightening the Detection Target to align more with the PPT would be provide a more consistent approach.
- Would continue to provide a systematic means of measuring process control.

Cons:

- A decrease in the number of meat chicken-derived human campylobacteriosis may not eventuate.
- Tightening the acceptance number may result in a greater number of non-compliant moving windows.
- The tightening of the Detection Target may result in a greater cost and resource burden for the operators to respond to any moving window non-compliance.

4.3 OPTION 3: REMOVE THE PPT

PPT was introduced to help improve process control and process hygiene and to remove outliers in terms of performance. The PPT was adopted by industry at the start of the fourth NMD quarter (October) 2015 and applied in practice from the second quarter 2016. Thus the principles of the PPT have been in place for over 2 years and it is timely to consider if this means of examining data cumulatively over the course of 3 months has served its purpose.

Three options are considered:

a) Remove the PPT as a regulatory limit and no replacement, or
b) Remove the PPT as a regulatory limit and revise the Detection Target for standard throughput premises, or
c) Remove the PPT as a regulatory limit and include as a voluntary operator defined limit for process control.

Option 3 a) Remove the PPT as a regulatory limit and no replacement

This option would remove the PPT as a regulatory limit and would not to introduce any alternative regulatory limit or to amend the Detection Target in the CPT.

Pros:

- Since January 2016 the standard throughput operators with poorer performance have been identified and significant investments have been undertaken by the industry to improve the process.

- Industry are now in a position to continue to implement long term performance plans to meet the objectives of their RMP and monitoring their performance in this manner would provide no further long term benefit.
- Data would continue to be reported to MPI which helps to populate processing models.
- Industry have found PPT beneficial for a review of quarterly data in this manner to identify systemic process issues.

Cons:

- Not all standard throughput operators have achieved consistent performance against the PPT to date.

Option 3 b) Remove the PPT as a regulatory limit and replace with a revised Detection Target for standard throughput premises.

This option would remove the PPT as a regulatory limit and would amend the Detection Target. As per Option 2, an amendment to section 4.14 (6) Detection Target would then read 'Standard throughput premises: for no more than X of 45 carcass samples taken from a 3 successive processing periods 'moving window to have *Campylobacter* counts of 2.30 $\log_{10}$CFU/carcass or greater'.

Pros:

- Would continue to provide a systematic means of measuring process control.
- Adjusting the Detection Target would be expected to augment the process control achievements already made by industry since the introduction of the PPT in 2016.
- The operator would respond as sooner which could ensure issues are identified and addressed earlier to a CPT non-compliant moving window than to a non-compliant PPT. The CPT is calculated by reviewing the past 3 processing periods compared to 3 months of results in an NMD quarter.
- This option may help to reduce the percentage of chicken carcasses with *Campylobacter* present at the end of primary processing which may help to reduce consumers' exposure to this bacterium.
- Data would be reported to MPI which would help to populate processing models and become a useful resource for identification of process improvements.

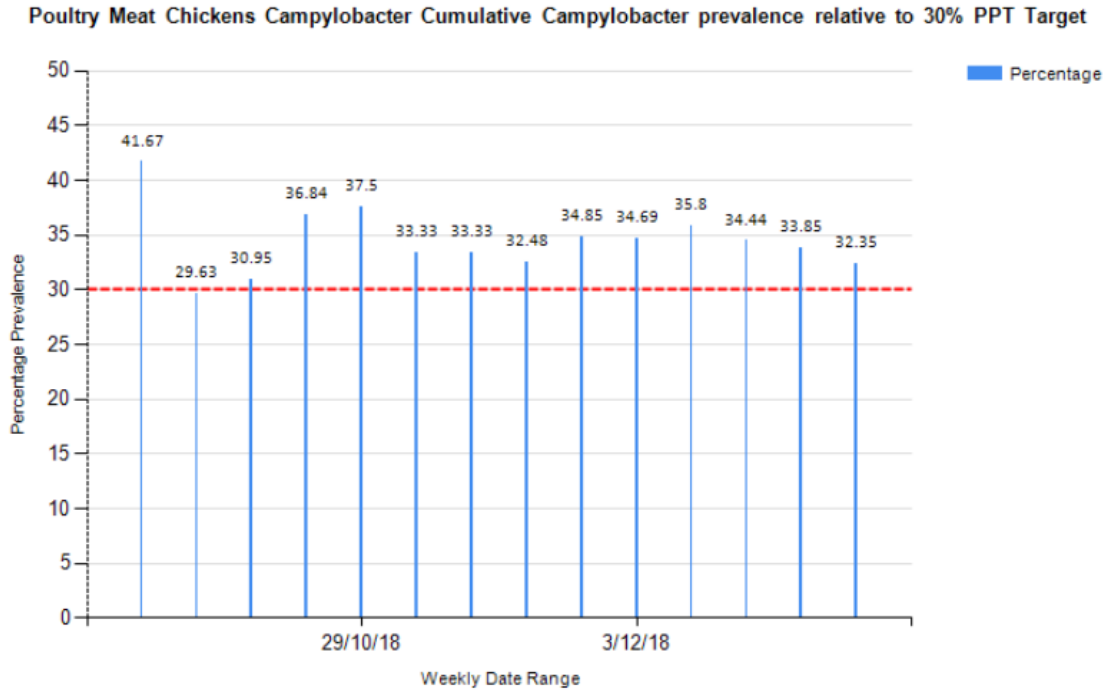
Cons:

- The actions taken by operators following a non-compliance for CPT are more routine and less comprehensive than the review and follow-up required for the PPT.
- More non-compliant moving windows during to a detection failure may be triggered which could drain resources and detract from a full review of process issues at the poultry premises.
- Capital expenditure by the poultry operators may be required to address maintenance and/or any new equipment to meet microbiological standards. It can take a sometime to procure the resources and complete the project. PPT may be more meaningful to support such business decisions.
- It is possible for standard throughput operators to comply with the CPT but be non-compliant with the PPT. The PPT has provided the poultry industry and MPI with an indication of process control and process hygiene by looking at results over a longer period of time than 3 weeks (moving window). Removing the PPT may allow the operators to loosen control on the process operation of the slaughter and dressing equipment.

Option 3 (c) – Remove the PPT as a regulatory limit and include as a voluntary operator defined limit for process control

This option proposes that the PPT would no longer be a regulatory limit. Standard throughput operators would be able to use the PPT as a tool for process control which would enable the monitoring of trends over a specific time frame.

The PPT graphs available on MPI NMD E-STAR for each poultry operator to observe their processing would remain to support this. An example of the information available is presented below:



Pros:

- PPT would be voluntary for industry to apply for their own benefit.
- There are other ways of systematically measuring process control within a poultry processing operation.
- Incentivises industry to determine the commercial benefits of self-regulation.
- This option recognises the willingness of the New Zealand poultry industry to assist other operators to improve performance throughout the industry.

Cons:

- Removes one regulatory means of targeting poor performers.
- Does not provide operators with a systematic approach or support from the regulator to establish where in the process there is opportunity for improvement.
- Does not bring to the fore the cost of capital investment required for substantial improvements necessary to reduce the burden of disease.
- May not result in a reduction in the percentage of chickens carcasses with *Campylobacter* present at the end of primary processing which would not reduce the exposure of consumers to this bacterium.

4.4 OPTION 4: REQUIRE TIGHTER ENUMERATION TARGET

This option proposes to tighten the Enumeration Target by reducing the number of carcass rinse samples that may exceed the enumeration limit in a moving window period. The data shows that good progress has been made over time with regard to the proportion of samples greater than the enumeration limit. In the current NMD Programme an Enumeration Failure for standard throughput operators is triggered when more than 6 out of 45 samples exceed the enumeration limit ($Log_{10}3.78$ CFU/carcass). The proposal is to reduce the number of samples that can exceed the enumeration limit, for example from 6 to 4 or 5 samples out of 45 samples.

Pros:

- The industry is managing *Campylobacter* contamination on the meat chicken carcasses. Updating the Enumeration Target reflects the current performance of standard throughput operators.
- Standard Throughput operators provide the majority of meat chickens sold in New Zealand and less *Campylobacter* present should contribute to a reduction in the number of cases of human foodborne campylobacteriosis.
- This should serve as an additional encouragement for poultry operators to perform to a standard that is similar to other operators.
- This option may result in reduced numbers of *Campylobacter* present on chicken carcasses at the end of primary processing and may result in a smaller probability of disease if ingested.

Cons:

- The performance of the poultry industry has improved and it may be perceived that NZFS is penalising good performance by changing the goal posts.
- There is no similar approach being taken for VLT operators and it could be perceived as an uneven playing field.
- There may be an increase in the number of non-compliant moving window due to enumeration failures which require additional resources from the poultry industry to address.
- It may no longer be possible for operators to improve on their current performance based on the current processing methods and equipment.

4.5 OPTION 5: AMEND THE RESET OF THE NON COMPLIANT MOVING WINDOW

This option considers amending how a non-compliant moving window is reset. At present a non-compliant moving window is reset if the samples meet the Detection Target and/or the Enumeration Target within a single moving window period (15 processing days over 3 processing periods). This proposal would amend how the non-compliant moving window is reset and seeks to partially replace the PPT by facilitating the review of results over an extended period of time.

Pros:

- This option targets those operators who inconsistently meet the CPT.
- This option may provide an additional incentive for operators that have recently become compliant to maintain their improved hygienic dressing performance. Further non-compliant moving windows will result in more severe corrective action by being placed on a higher ‘alert’ response than what would have occurred in the past.
- This would help to highlight that capital investment is necessary for consistent processing.

Cons:

- This option would require poultry processing operators to undertake an additional review of their data.
- It may take longer for operators to move from ‘alert’ response due to the occurrence of non-compliant moving windows.
- It may no longer be possible for operators to improve on their current performance based on the current processing methods and equipment.

4.6 NEW ZEALAND FOOD SAFETY'S PREFERRED APPROACH

New Zealand Food Safety's preferred approach is a combination of the discussed options. These would include revising the Animal Products Notice: Specifications for National Microbiological Database to

a. removing the PPT as a regulatory limit,
b. amending the *Campylobacter* Performance Target by:
    i. tightening the Enumeration Target, and
    ii. tightening the Detection Target, and
    iii. to revising the reset of the non-compliant moving window following a Enumeration Failure and/or a Detection Failure

In addition, NZFS will continue to work with the poultry industry to develop the Operational Code: Processing of Poultry. This will provide further guidance to all poultry operators to assist with improvements to process control and hygiene during primary processing. The purpose of this approach will help to ensure that the poultry industry can take practical and effective actions to help achieve the new regulatory limits.

4.6.1 How Would Amending the Campylobacter Performance Target Work

NZFS preferred option is to revise the Enumeration Target, Detection Target and how a non-compliant moving window is reset.

NZFS analysed the NMD programme results from all of the individual standard throughput operators for the period from October 2017 to May 2019 to determine the theoretical effect of changing the Detection Target and/or the Enumeration Target. Using historical data it was possible to determine the theoretical number of non-compliant moving windows and how frequently a non-compliant moving window would have occurred for the standard throughput poultry operators as a whole. A range of different scenarios is explored in Table 2. The scenarios considered theoretical effect of changing the Detection Target and Enumeration Target and compared this to the actual number of non-compliant moving windows that occurred.

Applying the current Detection Target (29/45 samples exceed 2.30 Log_{10} CFU/carcass) and Enumeration Target (6/45 samples exceed 3.78 Log_{10} CFU/carcass) over this period resulted in:

- no detection failures, and
- two enumeration failures, and
- two non-compliant moving windows in total (as a result of a either a detection failure and/or an enumeration failure), and
- a non-compliant moving windows would occur once every 294 weeks.

A worked example to show what the effect would be if the Enumeration Target and Detection Target had been amended is shown below. In this example, a Detection Target of 18/45 samples exceed 2.30 Log_{10} CFU/carcass) and Enumeration Target (5/45 samples exceed 3.78 Log_{10} CFU/carcass) is shown. The theoretical number of non-compliant moving windows that would have occurred has been calculated:

- 26 Detection Failures
  5 Enumeration Failures
- 28 Any non-compliant moving window (Detection Failure and/or Enumeration Failure)

Note that there is a difference between the numbers of non-compliant moving windows because an enumeration failure and a detection failure may occur concurrently. In this example there would have been three non-compliant moving windows due to both an enumeration failure and a detection failure.

- A non-compliant moving window would be predicted to occur once every 21 weeks at any of the standard throughput poultry operators.

Example: Demonstrating the theoretical difference between the current proposed *Campylobacter* Targets (October 2017 to May 2019)

Target	Detection Target (X/45 samples exceed 2.30 Log_{10} CFU/carcass)	Enumeration Target (Y/45 samples exceed 3.78 log_{10} cfu/carcass)	Number of non-compliant moving windows due to a Detection Failure, Enumeration Failure or both				Frequency of a non-compliant moving window every Z weeks
			Detection Failure	Enumeration Failure	Any non-compliant moving window	Difference	
Current	29	6	0	2	2	0	294
Proposed	18	5	26	5	28	-3	21

In this example there would have been 26 more non-compliant moving windows if the Enumeration Target and the Detection Target had been amended as described.

Table 2: The theoretical effect on the number of non-compliant moving windows

Detection Target (X/45 samples exceed 2.30 Log_{10} CFU/carcass)[1]	Enumeration Target (Y/45 samples exceed 3.78 log_{10} cfu/carcass)[2]	Number of non-compliant moving windows due to a Detection Failure, Enumeration Failure or both				Frequency of a non-compliant moving window every Z weeks[7]
		Detection Failure[3]	Enumeration Failure[4]	Any non-compliant moving window[5]	Difference[6]	
Current CPT						
29	6	0	2	2	0	294
Proposed CPT (Detection Target remains the same and Enumeration Target is tightened)						
29	5	0	5	5	0	118
29	4	0	13	13	0	45
29	3	0	21	21	0	28
29	2	0	49	49	0	12
Proposed CPT (Detection Target and Enumeration Target are tightened)						
20	6	16	2	17	-1	35
20	5	16	5	19	-2	31
20	4	16	13	24	-5	25
20	3	16	21	30	-7	20
20	2	16	49	58	-7	10
19	6	20	2	21	-1	28
19	5	20	5	22	-3	27
19	4	20	13	27	-6	22
19	3	20	21	33	-8	18
19	2	20	49	60	-9	10
18	6	26	2	27	-1	22
18	5	26	5	28	-3	21
18	4	26	13	32	-7	18
18	3	26	21	38	-9	15
18	2	26	49	62	-13	9
17	6	32	2	33	-1	18
17	5	32	5	34	-3	17
17	4	32	13	37	-8	16
17	3	32	21	42	-11	14
17	2	32	49	65	-16	9
16	6	41	2	41	-2	14
16	5	41	5	42	-4	14
16	4	41	13	44	-10	13
16	3	41	21	48	-14	12
16	2	41	49	71	-19	8
15	6	57	2	57	-2	10
15	5	57	5	57	-5	10

15	4	57	13	58	-12	10
15	3	57	21	60	-18	10
15	2	57	49	82	-24	7
14	6	72	2	72	-2	8
14	5	72	5	72	-5	8
14	4	72	13	73	-12	8
14	3	72	21	75	-18	8
14	2	72	49	96	-25	6
13	6	88	2	88	-2	7
13	5	88	5	88	-5	7
13	4	88	13	89	-12	7
13	3	88	21	91	-18	6
13	2	88	49	109	-28	5
12	6	106	2	106	-2	6
12	5	106	5	106	-5	6
12	4	106	13	107	-12	5
12	3	106	21	109	-18	5
12	2	106	49	124	-31	5

Notes:

- *For information on the operation of the Campylobacter Performance Target refer to the Animal Products Notice: Specifications for National Microbiological Programme.*

1 Current or proposed Detection Target (X/45 samples exceed 2.30 Log_{10} CFU/carcass)

2 Current or proposed Enumeration Target (Y/45 samples exceed 3.78 log_{10} cfu/carcass)

3 Number of non-compliant moving windows due to a Detection Failure based on the proposed Detection Limit

4 Number of non-compliant moving windows due to an Enumeration Failure based on the proposed Enumeration Target

5 Number of non-compliant moving windows due to both a Detection Failure and an Enumeration Failure based on the proposed Detection Target and Enumeration Target

6 The difference between the sum of non-compliant moving windows identified as a result of a detection failure or an enumeration failure compared to the number of non-compliant moving windows due to both a Detection Failure and an Enumeration Failure

7 Shows how often a non-compliant moving window may occur in weeks throughout all standard throughput operators

The results suggest that if stricter targets had been in place that there would have been an increase in the number of non-compliant moving windows over all of the standard throughput operators as a whole. However, this does not take into account the improved *Campylobacter* results achieved by the poultry industry over this period. If tighter targets had been in place NZFS expects that there would have been fewer non-compliant moving windows than predicted in Table 1. This difference would be due to any improvements that the poultry industry would have put in place to achieve the stricter standards which producing better product.

Note that the results do not consider the differences between individual poultry operators and that the variation in performance may be seen more clearly.

Any regulatory limit for *Campylobacter* must be both practical, effective and manageable,

5 Recommendations for Further Research

Options for further research include:

1. Monitoring and surveys have identified that there the presence of *Campylobacter* on chicken (whole birds and parts and portions) is greater at retail than found at the end of primary processing. Therefore the cause of the higher percentage of *Campylobacter* detected may be due to cross-contamination following the end of primary processing. This is an area for further investigation by New Zealand Food Safety.

2. To determine whether there are further improvements that can be made to the current methods and equipment for processing of chicken meat:
   a) a comparison with other countries of presence of *Campylobacter* on the chickens at the end of primary processing could be undertaken to determine relative performance. This comparison would need to take place with samples taken at the same processing step and handled and analysed using the same or comparable methods.
   b) to undertake a longitudinal mapping study of *Campylobacter* on poultry carcasses by collecting samples at various stages of primary processing.

3. To better understand the sources and pathways of *Campylobacter* attributed to human cases of campylobacteriosis.

4. To review the pathways of *Campylobacter* transmission on farm.

6 Next Steps

This document was developed by New Zealand Food Safety with input from industry. Public consultation will take place over a six week period. A final position will then be determined and any proposed changes incorporated into an amendment to the Animal Products Notice: Specifications for National Microbiological Database.

New Zealand Food Safety will continue to review the NMD programme results, human foodborne campylobacteriosis data and available science on an ongoing basis. New Zealand Food Safety may revise its position on the NMD Poultry Programme in the light of this data. The poultry industry will be fully consulted in the normal manner should this occur.

7 Conclusion

Although improvements have been made and maintained by the poultry industry to both the presence and levels of *Campylobacter* in chickens at the end of primary processing has, the reduction to the rate of human notifications has plateaued in recent years. There may be scope for further improvements which is borne out by the exceedances to the PPT by three of the standard throughput operators from 2016 to date. It is expected that lowering of all the Targets (Enumeration, Detection and PPT) to some degree will prompt further actions by industry to reduce the levels of *Campylobacter*, and achieve nil detections of *Campylobacter* in a much more significant number of the total chickens processed in New Zealand. This in turn should reduce the numbers of Campylobacter ingested and reduce the probability of illness.

8 Appendix 1: Carcass rinsate data from the NMD Programme

Table 2: The number of carcass rinsate samples recorded in the NMD programme for broiler chickens for standard through put operators to 15th January 2019

Year	Number of carcass rinsate samples recorded per month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2007	-	-	2	258	333	295	320	324	288	307	318	290	**2,735**
2008	305	426	466	509	519	500	558	513	542	581	511	572	**6,002**
2009	526	475	514	490	506	501	539	469	496	490	473	502	**5,981**
2010	435	444	528	473	482	484	494	497	502	450	501	502	**5,792**
2011	455	447	525	495	551	532	525	591	540	497	532	510	**6,200**
2012	490	513	552	486	582	492	561	564	506	555	546	498	**6,345**
2013	513	462	297	504	567	480	579	552	524	557	516	515	**6,066**
2014	473	477	522	510	543	505	588	546	558	570	510	575	**6,377**
2015	517	495	568	519	540	541	596	558	577	551	543	584	**6,589**
2016	506	515	561	534	579	558	542	602	570	522	569	539	**6,597**
2017	522	495	584	464	591	549	551	585	536	543	562	529	**6,511**
2018	541	481	568	510	589	509	557	576	513	563	554	512	**6,473**
Total	**5,403**	**5,230**	**5,687**	**5,752**	**6,382**	**5,946**	**6,410**	**6,377**	**6,152**	**6,186**	**6,135**	**6,128**	**71,788**

Table 3: The number of positive carcass rinsate samples for *Campylobacter* recorded in the NMD programme for broiler chickens at standard through put operators to 15th January 2019

Year	Number of *Campylobacter* positive carcass rinsate samples recorded per month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2007			0	138	203	164	188	169	145	153	126	130	**1,416**
2008	130	225	182	194	138	158	164	164	202	193	220	303	**2,273**
2009	284	226	196	171	162	144	122	108	144	117	132	184	**1,990**
2010	178	172	243	176	166	185	191	178	151	151	199	262	**2,252**
2011	162	167	194	198	187	199	231	199	189	202	179	239	**2,346**
2012	218	189	170	153	180	121	148	164	132	207	204	182	**2,068**
2013	208	189	118	148	219	194	181	184	149	112	184	222	**2,108**
2014	161	178	173	137	153	126	179	118	173	151	119	163	**1,831**
2015	156	153	142	137	158	139	127	117	148	117	133	171	**1,698**
2016	152	151	187	125	125	117	103	157	131	115	137	98	**1,598**
2017	106	83	115	59	68	62	91	117	93	118	116	109	**1,137**
2018	116	87	103	82	90	80	109	103	91	93	74	93	**1,121**
Total	**1899**	**1820**	**1823**	**1718**	**1849**	**1689**	**1834**	**1778**	**1748**	**1729**	**1823**	**2156**	**21,866**

Table 4: The number of broiler chicken carcass rinsate samples in the NMD programme at standard through put operators that exceeded the enumeration limit to 15th January 2019

Year	Number of broiler chicken carcass rinsate samples in the NMD programme that exceed the Enumeration Limit per month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

2007	-	-	0	63	93	89	89	95	81	70	49	47	**676**
2008	47	90	71	61	36	35	34	55	54	56	102	98	**739**
2009	55	41	52	39	37	41	26	14	39	18	22	36	**420**
2010	29	23	48	28	31	26	38	25	27	20	38	25	**358**
2011	41	27	32	47	39	37	49	39	36	32	46	39	**464**
2012	53	34	29	33	40	25	25	31	25	43	46	36	**420**
2013	38	30	18	30	32	20	26	24	27	26	30	34	**335**
2014	30	36	35	16	18	15	32	21	27	21	13	27	**291**
2015	25	19	14	18	18	19	22	21	22	12	20	14	**224**
2016	12	16	20	15	17	15	15	20	15	19	7	15	**186**
2017	18	9	16	4	7	2	3	8	12	14	11	13	**117**
2018	12	4	9	4	16	4	11	15	8	6	10	5	**104**
Total	**361**	**329**	**344**	**358**	**384**	**328**	**370**	**368**	**373**	**337**	**394**	**389**	**4,335**

Table 5: The percentage of positive carcass rinsate samples for *Campylobacter* recorded in the NMD programme for broiler chickens at standard through put operators to 15th January 2019

Year	**Percentage of positive carcass rinsate samples for *Campylobacter* recorded in the NMD programme for broiler chickens per month**												**Total**
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
2007			0%	53%	61%	56%	59%	52%	50%	50%	40%	45%	**52%**
2008	43%	53%	39%	38%	27%	32%	29%	32%	37%	33%	43%	53%	**38%**
2009	54%	48%	38%	35%	32%	29%	23%	23%	29%	24%	28%	37%	**33%**
2010	41%	39%	46%	37%	34%	38%	39%	36%	30%	34%	40%	52%	**39%**
2011	36%	37%	37%	40%	34%	37%	44%	34%	35%	41%	34%	47%	**38%**
2012	44%	37%	31%	31%	31%	25%	26%	29%	26%	37%	37%	37%	**33%**
2013	41%	41%	40%	29%	39%	40%	31%	33%	28%	20%	36%	43%	**35%**
2014	34%	37%	33%	27%	28%	25%	30%	22%	31%	26%	23%	28%	**29%**
2015	30%	31%	25%	26%	29%	26%	21%	21%	26%	21%	24%	29%	**26%**
2016	30%	29%	33%	23%	22%	21%	19%	26%	23%	22%	24%	18%	**24%**
2017	20%	17%	20%	13%	12%	11%	17%	20%	17%	22%	21%	21%	**17%**
2018	21%	18%	18%	16%	15%	16%	20%	18%	18%	17%	13%	18%	**17%**
Total	**35%**	**35%**	**32%**	**30%**	**29%**	**28%**	**29%**	**28%**	**28%**	**28%**	**30%**	**35%**	**30%**

Table 6: The percentage of carcass rinsate samples that exceed the enumeration limit (3.78 Log10 CFU/carcass) for *Campylobacter* recorded in the NMD programme for broiler chickens at standard through put operators to 15th January 2019

Year	**The percentage of carcass rinsate samples that exceed the enumeration limit (3.78 Log_{10} CFU/carcass) for *Campylobacter* recorded in the NMD programme for broiler chickens per month**												**Total**
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
2007			0.0%	24.4 %	27.9 %	30.2 %	27.8 %	29.3 %	28.1 %	22.8 %	15.4 %	16.2 %	**24.7 %**
2008	15.4%	21.1 %	15.2 %	12.0 %	6.9%	7.0%	6.1%	10.7 %	10.0 %	9.6%	20.0 %	17.1 %	**12.3 %**
2009	10.5%	8.6%	10.1 %	8.0%	7.3%	8.2%	4.8%	3.0%	7.9%	3.7%	4.7%	7.2%	**7.0%**
2010	6.7%	5.2%	9.1%	5.9%	6.4%	5.4%	7.7%	5.0%	5.4%	4.4%	7.6%	5.0%	**6.2%**
2011	9.0%	6.0%	6.1%	9.5%	7.1%	7.0%	9.3%	6.6%	6.7%	6.4%	8.6%	7.6%	**7.5%**
2012	10.8%	6.6%	5.3%	6.8%	6.9%	5.1%	4.5%	5.5%	4.9%	7.7%	8.4%	7.2%	**6.6%**

2013	7.4%	6.5%	6.1%	6.0%	5.6%	4.2%	4.5%	4.3%	5.2%	4.7%	5.8%	6.6%	**5.5%**
2014	6.3%	7.5%	6.7%	3.1%	3.3%	3.0%	5.4%	3.8%	4.8%	3.7%	2.5%	4.7%	**4.6%**
2015	4.8%	3.8%	2.5%	3.5%	3.3%	3.5%	3.7%	3.8%	3.8%	2.2%	3.7%	2.4%	**3.4%**
2016	2.4%	3.1%	3.6%	2.8%	2.9%	2.7%	2.8%	3.3%	2.6%	3.6%	1.2%	2.8%	**2.8%**
2017	3.4%	1.8%	2.7%	0.9%	1.2%	0.4%	0.5%	1.4%	2.2%	2.6%	2.0%	2.5%	**1.8%**
2018	2.2%	0.8%	1.6%	0.8%	2.7%	0.8%	2.0%	2.6%	1.6%	1.1%	1.8%	1.0%	**1.6%**
Total	6.7%	6.3%	6.0%	6.2%	6.0%	5.5%	5.8%	5.8%	6.1%	5.4%	6.4%	6.3%	**6.0%**