

Antimicrobial Stewardship

IN THE AUSTRALIAN CHICKEN MEAT INDUSTRY

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Version 2



The Australian chicken meat industry and antimicrobial stewardship (AMS)

The Australian chicken meat industry is an approximately \$6.6 billion (in retail value) industry, producing >665,000,000 chickens in 2020-21. It is dominated by six chicken processing companies that supply the bulk (>90%) of chicken meat consumed in Australia. The industry is highly vertically integrated and the chicken farmers are predominately contractors to the chicken processing companies, who at all times own the chickens. This dynamic means that the processing companies are responsible for the inputs to the farm that relate directly to the chickens. This includes responsibility for supplying the day-old chicks, feed, and health and nutritional management services. Each processor's health program is managed by at least one registered poultry veterinarian, often directly employed by the company, who oversees and manages disease surveillance, diagnosis and treatment, including any administration of antibiotics, for all company flocks including its breeder flocks.

The Australian chicken meat industry has a long history of appropriate use of antibiotics. It implemented antimicrobial stewardship (AMS) principles well before formal stewardship was something widely discussed and understood. Veterinarians engaged in the management of health programs for meat and meat breeder chicken flocks are members of the Australasian Veterinary Poultry Association (AVPA) and/or the Commercial Poultry Veterinarians, the latter being an AVA special-interest group. The AVPA produced their first "Code of Practice for the Use of Antibiotics" in 1987, which resulted in the poultry industry being the first livestock industry in Australia to adopt this type of code of practice (APIA, 1987). This code (the AVPA Code of Practice for the Use of Antimicrobials in the Poultry Industry) was updated in 2021. For over 40 years the chicken meat industry has played an active role in reducing the risks of antimicrobial resistance for the benefit of both human and animal health. This has involved implementing strategies to reduce the incidence of disease, refining the duration of treatment and reducing the potential environmental pressure that can create bacterial resistance, and ensuring the appropriate use of antimicrobials. From early 2017, the industry began rolling out an AMS program that was adapted to fit the operations of each chicken meat company, thereby formalising previous efforts and allowing for better analysis of areas for further refinement of antimicrobial use. These programs were independently reviewed in 2019.

The chicken meat industry is supported by an R,D&E program operated through AgriFutures Australia, which has a total annual budget of approximately \$4.5 million. This program funds projects that address priorities for the chicken meat industry, including projects related to flock health, biosecurity and AMS.

There are a very limited number of antibacterial medications available for use in chickens in Australia. Of the 41 antibacterial classes listed by ASTAG (ASTAG, 2018), only 15 classes contain actives that are approved for use in chickens, from which there are 27 antibacterials approved for use in chickens (Table 1). Only one of these (virginiamycin) is rated of 'high' importance by ASTAG and six are rated as 'medium' importance. All remaining antibiotics approved for use in chickens are rated as 'low' (Table 1).

Table 1 Antibacterial classes approved for use in Australian chickens (while registered and available for sale, they may not be used in Australian chickens)

ASTAG rating	Antibacterial class	Antibacterial Agent Used	Used in humans
High	Streptogramin	Virginiamycin	No
Medium	Aminocyclitol	Spectinomycin	Yes
Medium	Lincosamide	Lincomycin	Yes
Medium	Aminoglycoside	Apramycin	No
Medium	Sulfonamide+Diaminopyrimidine	Sulfadiazine-trimethoprim	No
Medium	Spectinomycin (aminocyclitol)	Lincomycin-spectinomycin	Yes
Medium	Sulfonamide+Diaminopyrimidine	Sulfadimidine-trimethoprim	No
Low	Aminoglycoside	Neomycin	Yes
Low	Sulfonamide	Sulfadiazine	Yes
Low	Diaminopyrimidine	Trimethoprim	Yes
Low	β lactam penicillin	Amoxicillin	Yes
Low	Macrolide	Erythromycin	Yes
Low	Polypeptide	Bacitracin	Yes
Low	Macrolide	Tylosin	No
Low	Tetracycline	Chlortetracycline	No
Low	Tetracycline	Oxytetracycline	No
Low	Pleuromutilin	Tiamulin	No
Low	Sulfonamide	Sulfaquinoxaline	No
Low	Sulfonamide	Sulfadimidine	No
Low	Orthosomycin	Avilamycin	No
Low	Glycophospholipid	Flavophospholipol	No
Low	Ionophore	Maduramicin	No
Low	Ionophore	Semduramicin	No
Low	Ionophore	Monensin	No
Low	Ionophore	Narasin	No
Low	Ionophore	Salinomycin	No
Low	Ionophore	Lasalocid	No

There are no products approved for use in commercial Australian meat chickens from the following classes (based on information in ASTAG, 2018):

β -lactamase inhibitor combinations	Cephamecins	Nitroimidazoles
Amphenicols	Fosfomycins	Antistaphylococcal penicillins
Antileprotics	Fusidanes	Moderate-spectrum penicillins
Antimycobacterials	Glycopeptides	Narrow-spectrum penicillins
Bicozamycins	Glycylcyclines	Broad-spectrum penicillins
Coumermycins	Lantibiotics	Polymyxins
Carbapenems	Lipopeptides	Pseudomonic acids
1st Generation Cephalosporins	Macrocyclic lactones	Quinolones
2nd Generation Cephalosporins	Monobactams	Quinoxalines
3rd Generation Cephalosporins	Nitrofurans	Rifamycins

For more information on the Australian chicken industry and antimicrobial stewardship, please visit the ACMF website: <https://www.chicken.org.au/chicken-health-welfare/>

THE 5RS FOR SUCCESSFUL AMS

RESPONSIBILITY

Due to the structure of the chicken meat industry, there are only a small number of veterinarians who oversee the administration of antimicrobials to treat, control or prevent disease in meat chickens. These veterinarians are more often than not members of both the Commercial Poultry Veterinarians (CPV), a special interest group of the Australian Veterinary Association (AVA), and the Australasian Veterinary Poultry Association (AVPA).

The AVA has a long history of established policies on the use of veterinary medicines including antibiotics¹, guidelines for prescribing, authorising and dispensing veterinary medicines² and a code of practice to support this for antimicrobials specifically³. The Australian poultry veterinarians, through the AVPA, have embraced these policies. The AVPA developed and adopted a Code of Practice for the Use of Antibiotics and Other Drugs in the Poultry Industry in 1987, with the most recent updated version released in 2021. The most recent revision of this document will see a new version of the Code released in 2021.

The antimicrobial stewards for the chicken meat industry are the veterinarians employed by, or contracted as consultants to, chicken meat processing companies. They have responsibility for overseeing flock health programs and decisions regarding prescribing of antibiotics and are supported by company executives in upholding this responsibility. As the number of veterinarians responsible for flock health programs and stewardship in the chicken meat industry is relatively small, adjustments can be made quickly when evidence is produced to support a change in practice. A recent ACMF industry survey found that while the antibiotic prescribing guidelines are relatively new, all veterinarians overseeing ACMF member production indicated that they use the guidelines to inform antibiotic selection and only prescribe antibiotics to prevent or treat infections for which antibiotic treatment provides a proven benefit and always, or usually, select antibiotics with as narrow a spectrum as possible (however due to the limited range of antibiotics available and often limited time frame in which to treat, the choice is to use or not to use the antibiotic). The industry is considering options for ongoing professional development in AMR and AMS for industry veterinarians, in conjunction with the AVA.

The responsibility of the farmer is to alert the company who they grow for when they have reason to suspect that there is a health issue in their flock or if predetermined trigger levels for mortality or clinical signs of disease are reached. They are also responsible for ensuring biosecurity measures are in place that reduce the incidence of disease, as per the National Farm Biosecurity Manual for Chicken Growers⁷ which farmers are required to adhere to as part of their contractual obligations with the processing companies. In addition, company servicemen and veterinarians visit farms on a regular basis to check on the health and development of flocks, and to monitor for adherence to company policies, procedures and industry manuals. Farmers also have a responsibility to administer the prescribed antimicrobials as per the veterinarian's instructions, and adherence to these instructions is checked regularly.

REDUCTION

More intensive production systems present a potentially greater risk of disease spread through flocks, so prevention of disease entry is of paramount importance in commercial chicken production. Implementation of tighter biosecurity controls, precise nutritional management and the development, infrastructure upgrades and implementation of vaccines against key poultry pathogens over the past 40 years has meant there has been a significant reduction in the incidence of diseases that may need antimicrobial intervention. This reduced burden of disease is reflected in the current historically low mortality levels across the industry.

While, at the moment, there is no publicly available aggregated data on antimicrobial usage across the industry, every company, as part of its AMS program, records and monitors usage of all antimicrobials.

The National Farm Biosecurity Manual for Chicken Growers underwent an extensive review between 2017 and 2019, with every recommendation scrutinised for currency and relevance to the latest industry best practice for on-farm biosecurity measures. The final version of the updated manual was released in 2020 and presents a substantial strengthening of biosecurity recommendations for the chicken industry⁷. Efforts are underway to quantify the level of on-farm adoption of the practices defined in the new biosecurity manual, however, given the contractual obligations to adhere to the Biosecurity Manual, the level of adoption is expected to be high.

Vaccination is widely practiced where appropriate, effective vaccines are available, and AgriFutures Australia and the ACMF work continuously with the companies that supply current vaccines to ensure there are viable, and sustainable, options available for preventing disease in chickens. Significant improvements to disease prevention and management of poultry health have resulted in reduced use of preventative treatments.

REFINEMENT

The industry has made, and continues to make, substantial investments in identifying gaps and improving biosecurity to reduce introduction and spread of pathogens. This has reduced the need for treating, or indiscriminately trying to prevent, illness in chickens with the use of antimicrobials. This is a process that the industry has been undertaking for a number of years, to the point where most of the focus now is on refinement of use.

Each of the major chicken meat companies have had formal AMS programs in place since 2017 and are reporting that they can better focus their efforts on appropriate antimicrobial use by assessing different methodologies for treatment and prevention⁸.

The ACMF established a policy in 2007 that antibiotics should not be used for growth promotion purposes and has been actively working with the product registrants since then to have growth promotion claims for chickens removed from labels⁹. If the products could not substantiate a therapeutic claim for their use, it was made clear that there would be no future for those products in the Australian market. Currently there remain only two products registered for use in chickens that have growth promotion claims. One of these products is an avilamycin formulation that is registered for use in Australian chickens but is not actually available for sale in Australia. The second is flavophospholipol, which has no registered therapeutic claim but may be used to prevent enteritis when other preventative and treatment measures have failed to control the disease.

Almost three quarters of Australia's meat chickens are produced under veterinary health programs in which diagnostic tools are always used to confirm bacterial infection to inform veterinary treatment of flocks demonstrating clinical signs of bacterial disease. The majority of chickens produced in Australia are grown without the preventative use of categories of antibiotics that have a use in humans. For the remainder, zinc bacitracin is the primary antibacterial used. In two thirds of the cases where antibiotics are used preventatively, microbiological analysis and diagnostic testing are used to support this use at least sometimes.

Improved vaccination strategies have also allowed for further refinement of antimicrobial use by reducing the burden and impacts of immunosuppressive diseases (such as Marek's disease, chicken anaemia virus and infectious bursal disease) and secondary bacterial infections, or vertically transmitted diseases (e.g. mycoplasmosis).

The industry AMS program has put mechanisms in place to identify areas where further refinement of antimicrobial use, within the restrictions of withholding periods, can be made for all antimicrobials including those that are not used in human medicine. This was further supported by the completion of industry antimicrobial prescribing guidelines in collaboration with the Australian Veterinary Association in 2020⁶. In an ACMF 'appropriateness of use' survey conducted in 2021, all veterinarians responsible for overseeing 90% of Australian chicken meat production indicated that they always, or usually, use the shortest possible evidence-based duration of the antibiotic regimen and always, or usually, administer antibiotics in a timely manner. Any delay in administering antibiotics is as a result of disease testing to inform treatment; however, in some instances the disease may be allowed to progress for a day or so to inform whether treatment is warranted. In severe cases treatment may be progressed before results are available, based on clinical evidence.

REPLACEMENT

The Australian poultry industry is a world leader in identifying and implementing alternatives to antibiotics. Major advances in science and the development of vaccines have occurred in Australia which have significantly reduced the use of antimicrobials in Australia and internationally. For example, the development of vaccines to prevent mycoplasma-associated diseases¹⁰ has meant macrolide antibiotics are rarely indicated, or required, and these Australian vaccines are also sold internationally to benefit the global poultry industry. Indeed, chronic respiratory disease (CRD) complex used to be the biggest contributor to disease and secondary bacterial infections in meat chicken production, requiring treatment with antimicrobials. With the use of Australian-developed Mycoplasma vaccines in breeding flocks, this disease complex is rarely seen today, and this development has probably made the single biggest contribution to the reduction in the need for antimicrobial treatments in the chicken industry.

The development and implementation of vaccines for Newcastle disease virus, infectious bronchitis virus, infectious laryngotracheitis virus and Marek's disease virus has greatly reduced the incidence of secondary bacterial infections and similarly significantly reduced the use of antimicrobials (particularly amoxicillin, oxytetracycline, trimethoprim and macrolides) in Australian chickens. Many of these vaccines have been developed in Australia. These vaccines have been successfully applied either directly to meat chickens or to breeder stock to ensure that meat chickens have adequate early immunity and to break the infection cycle. Vaccines for the control of coccidiosis are also available and are being trialled widely, however manufacturing,

supply chain and market complexities reduce the reliability of supply. There are a number of new vaccines under development, with some close to market and others currently in the R&D pipeline.

The Australian industry has funded the development and licencing of a vaccine candidate for necrotic enteritis prevention which looks promising and, if ultimately viable, implementation would significantly reduce the need for some preventative antimicrobial use in Australian poultry, and internationally. The industry is also continually assessing the viability of alternative treatment options such as the use of pre- and pro-biotics and other feed supplements that do not have direct antimicrobial action but may improve gut health and function and are effective replacements for antimicrobial use.

REVIEW

There is no generic, industry-wide quality assurance program in the chicken industry. This means that every company has a different approach and different requirements depending on their customers and specific markets. The elements of each company's AMS program have been adopted voluntarily and integrated into standard business operations, which means that independent verification of the program is vital to ensuring the industry as a whole is able to continue refining appropriate use practices. Therefore, independent review and verification of the industry AMS programs implemented by each of the major companies was conducted in 2018/19 to help further support the industry's overall AMS objectives¹¹. This review found that three of the six organisations interviewed have in place mature, formal AMS programs covering all aspects of the 5Rs (Responsibility, Review, Reduce, Replace and Refine). These have been reviewed at least once since implementation. For the remaining organisations (all of whom scored highly in the verification review scoring at least 21 out of the 25 possible points for maturity of AMS implementation), while they did not have formal AMS programs developed, their animal health plans covering antimicrobial use were significantly robust, mature and the subject of regular reviews. Consequently, they also scored highly on the principles of Reduce, Replace and Refine.

Antimicrobial use is historically low in the Australian chicken meat industry and this was evident in the current antimicrobial use practices of each organisation that participated in the AMS verification project. Diseases for which antimicrobials were indicated included coccidiosis and necrotic enteritis (for which preventative approaches were adopted), and occasional treatments in meat chickens for *E.coli* or treatment in breeders for *E. coli* and *Staphylococcus* infections and spotty liver disease. For these infections, only antimicrobials rated of low importance¹², such as amoxicillin or tetracyclines, are used and no resistance issues were noted. The project also found that alternatives to antimicrobials, in particular for maintaining gut health and including probiotics, prebiotics, enzymes, organic acids and essential oils, have been investigated by each organisation¹¹. This verification project also included the development and implementation of an industry self-assessment tool, so that companies can conduct formal reviews of their own programs on a more regular basis. Industry-level verification will also be repeated periodically.

As part of the commitment to appropriate antimicrobial use, the Australian poultry industry reviewed the efficacy of AMR surveillance methodologies back in the 1980s to ensure that AMR detection and surveillance approaches were consistent¹³. Since then, there has been greater alignment of techniques used by laboratories used by the industry for detection and reporting of AMR, however improvements can still be made. A review of the testing capacity for AMR in laboratories servicing the Australian chicken meat industry

was completed in 2020¹⁴. The aim of this review was to determine if the possibility existed to develop a framework for future AMR surveillance using existing capabilities and to identify areas that require further support. Of the seven laboratories that perform identification of bacterial cultures sourced from Australian chicken flocks and who responded to the survey, three are NATA accredited, and three additional laboratories operate to similar standards but without formal accreditation. While there was considerable variability between the laboratories for the type of bacteria subjected to AMR susceptibility testing, this project demonstrated that there are opportunities to develop a national network of services to improve the collation of national AMR data, particularly for poultry bacterial diseases.

Since 2018, the ACMF has coordinated an antimicrobial usage survey of the 6 Australian chicken companies that produce approximately 90% of Australian chicken. The purpose of this program is to provide companies with national data against which they can benchmark their own internal company usage, and as such, the results are not published. It has also helped to capture baseline data against which future usage patterns can be compared. Once a baseline of acceptable usage is achieved, variations above and below this baseline would be expected. Understanding what the baseline is, and what 'normal' variations are, is required to establish thresholds that can help indicate whether a variation is 'abnormal' which will improve industry's ability to identify priority issues and further refine antimicrobial use. Development and implementation of meaningful thresholds will not be possible for at least another three years.

'How much' antimicrobials are used is meaningless without context to inform whether the usage was 'appropriate'. Therefore, in 2020 the ACMF developed a tool to provide a measure of the appropriateness of use of antimicrobials across the industry. An exhaustive list of elements and associated best-practice descriptions that define 'appropriate' or 'responsible' use of antibiotics¹⁵ was converted by the ACMF into a survey to be conducted on an annual basis by ACMF members companies (90% of Australian chicken meat production). The results help clarify national AMS practices and priorities in the meat chicken industry and captures many elements of AMS in place in the industry that are taken for granted. For example, it was clarified that there is full documentation of all antibiotic regimens for chickens produced by ACMF member companies and 64% of chickens are grown under programs in which the company implements a system for checking compliance with application of the antibiotic prescription at both the feedmill and farmer levels, and 82% of chickens are grown under programs where the veterinarian always undertakes AMR surveillance to inform prescribing. The survey also identified some gaps and opportunities for improvement and has been instrumental in informing future industry AMS activities.

In 2016, the Department of Agriculture and Water Resources funded an AMR surveillance pilot study for the meat chicken industry that aligned with similar studies undertaken in the pork and cattle industries. The full report is available online¹⁶ and key aspects have been published open access in peer review journals^{17, 18, 19}. To summarise, the results found 92.5% of *Salmonella*, 63% of *C. jejuni* and 86.5% *C. coli* isolates were susceptible to all the antimicrobials tested. Out of the hundreds of isolates analysed, no *Salmonella*, and only four isolates of *C. coli* and one isolate of *C. jejuni* were classified as multi-drug resistant. Surprisingly, given that fluoroquinolones are not used in the Australian poultry industry, fluoroquinolone resistance was found in 14.8% *C. jejuni* and 5.2% *C. coli* isolates; however, this is similar to levels found in other countries that also don't use fluoroquinolones in poultry production. Comparison (as far as possible) with previous studies in 2000²⁰ and 2003²¹ found generally that resistance levels had decreased. All these efforts are underpinned by the industry's position statement⁹ on antimicrobial resistance that has provided industry with a policy framework

for continuous efforts to minimise the impact of the chicken industry on the development of antimicrobial resistance.

FUTURE EFFORTS

The ACMF and the Australian chicken meat industry plan to continue progressing various initiatives including the industry AMS plan verification and self-assessments, the capture of antimicrobial usage data for internal benchmarking purposes and the development of thresholds to better clarify 'abnormal' variations. The industry-wide AMR surveillance project will be repeated in 2021, to provide information on how the presence of AMR in key bacteria has changed, if at all, during the past 5 years. This project will provide direction on how to best continue industry level AMR surveillance in the future, including better utilisation of laboratories that service the industry, for informing animal and human health.

The industry's position statement and accompanying antimicrobial use policies are in the process of being updated to further refine industry's AMS efforts, along with continuing efforts to support adoption and refinement of biosecurity practices and development of professional development opportunities for industry veterinarians. Further, the industry has benefited from inclusion in the Animal Industry AMS RD&E Strategy, and plans to co-ordinate ongoing activities through this Strategy in collaboration with other Australian livestock industries and stakeholders.

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This report is part of a contribution to the 'National Livestock Antimicrobial Stewardship' report coordinated by the Animal Industries' Antimicrobial Stewardship RD&E Strategy (aiasrdestrategy.com.au), of which the ACMF is a member.

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