



**REPORT OF THE MEETING OF THE OIE *AD HOC* GROUP ON PRIORITISATION OF DISEASES
FOR WHICH VACCINES COULD REDUCE ANTIMICROBIAL USE IN ANIMALS¹**

Paris, 21 – 23 April 2015

1. Opening

The OIE *ad hoc* Group on Prioritisation of Diseases for which Vaccines could reduce Antimicrobial Use in Animals met from 21 to 23 April 2015 at the OIE Headquarters in Paris, France.

Dr Bernard Vallat, Director General of the OIE, welcomed the participants and noted the growing importance of antimicrobial resistance. He explained that the OIE as a science-based organisation was responsible for developing intergovernmental standards on animal health and welfare and advice on animal health matters. For the 'One Health' agenda of the FAO, OIE and WHO, antimicrobial resistance was selected as one of three Tripartite flagship topics. The OIE was very supportive to the WHO in the development of the Global Action Plan on antimicrobial resistance proposed for adoption to the World Health Assembly of the WHO in May of this year, and was pleased to note that its comments on the draft plan had been accepted and that its work been recognised in the document. As part of its contribution to the international efforts to fight against antimicrobial resistance, the OIE was committed to launch a global database to collect data on antimicrobial use in animals before the end of the year, acknowledging that it will be difficult for some countries to respond. Other OIE initiatives relevant to the fight against antimicrobial resistance include an initiative, in collaboration with the World Customs Organisation, to prevent counterfeit products and the OIE initiative to improve good governance of veterinary services through the PVS pathway, contributing to the availability of quality antimicrobials and their responsible use in animals. The *ad hoc* Group represented a new approach of the OIE to address requests from several countries and organisations for information on where to invest to reduce the use of antimicrobials in animals, especially in view of the projected production growth for poultry, pigs and fish, which is most likely to happen in intensive production settings with the accompanying challenges. The outcome of the Group's work should provide direction to policy makers on where to invest in research to reduce the need for antimicrobial use in animals with a focus on vaccines. The conclusion of the Group's work might be that there are already good vaccines that are not being used. In these cases the OIE would hope for direction on what actions would be necessary to improve utilisation of such vaccines. The WHO Global Action Plan makes provision for such an approach and the Group's work, through the participants' expertise, represented the OIE's contribution to this goal.

The participants highlighted the need to not only inform investors in research but also to inform the research community.

¹ Note: This *ad hoc* Group report reflects the views of its members and may not necessarily reflect the views of the OIE. This report should be read in conjunction with the September 2015 report of the Scientific Commission for Animal Diseases because this report provides its considerations and comments. It is available at: <http://www.oie.int/en/international-standard-setting/specialists-commissions-groups/scientific-commission-reports/meetings-reports/>

2. Appointment of chairperson and rapporteurs, and adoption of the agenda

The Group appointed Dr Cyril Gay as the chairperson of the meeting and Professor Peter Borriello agreed to act as rapporteur for the joint discussions, and for the subgroup focussing on terrestrial animal species; the discussion on fish would be reported by Dr Mylrea and Dr Berthe (president of the Aquatic Animal Health Commission).

The Agenda, adopted with minor changes, and the List of Participants are presented in Appendices I and II of this report, respectively.

3. Background to the meeting

Dr Elisabeth Erlacher-Vindel, Deputy Head of the Scientific and Technical Department, provided a short introduction to the OIE, its mission, the current strategic plan, its standard setting and animal health reporting activities, and its approach to providing scientific advice. The work of this Group was part of the provision of scientific advice activities of the OIE, and is not related to its standard-setting activities. Both terrestrial and aquatic animals were considered.

The participants introduced themselves to the Group and presented relevant background information from their specific fields of expertise, and discussed commonalities for the two sectors.

4. Review and address the Terms of Reference for the *ad hoc* Group meeting

The Group heard the background information presented by the participants and considered the draft Terms of Reference (attached in Appendix III of this report).

The Group noted that there was a lack of scientific research generated globally with the aim of understanding which antimicrobials are used in which animal groups, and for which diseases or syndromes they are prescribed. The background information, whilst helpful in providing some data, was generated to answer other scientific questions and did not fully address the scientific questions considered by the Group.

The Group agreed that in view of the current scale and the projected growth in production for aquaculture, poultry and swine, an initial focus on these production sectors was the highest priority.

Regarding aquaculture the Group noted that the current scale of fish farming and high antibiotic use, and projected growth of both, ruled that it should also be included. However, there is a range of different freshwater and marine farmed fish species with differences in scale of production and production methods. Particular species of fish were therefore identified on the basis of overall and projected contribution to antibiotic use. Although there was antibiotic use in shrimp, the absence of a classical immune system would not support vaccine development.

The Group did not consider it necessary to adjust the Terms of Reference for the meeting. However, the Group agreed that the focus of their activity were antibiotics (substances that destroy or inhibit growth of bacteria), not antimicrobials.

5. Development of a template and criteria for the ranking of diseases

5.1. General considerations

Vaccination has had a profound impact on the prevention of infectious diseases, perhaps equivalent to the impact of good hygiene and of the use of antibiotics to treat bacterial infections.

Arguably, vaccines represent the single most cost-effective medical countermeasure that can be used to confront the threat of antimicrobial resistance. Their effectiveness in preventing diseases has been far-reaching, and could significantly reduce the need and use of antibiotics in animal agriculture.

It was acknowledged, however, that vaccines optimally fulfil their potential when used as part of an overall programme of infection prevention and infection control. Such a programme would be inclusive of veterinary oversight, good biosecurity and husbandry practices, quality feed, and improved diagnostics to help ensure pathogen specific, targeted treatment. All of the above, when implemented optimally, will result in reduced, as well as more appropriate, antibiotic use. In particular it was acknowledged that much first line treatment is currently empirical, based on experience and in response to syndromic indications, e.g. diarrhoea. Reduction of syndromic indications through better targeted, easy to use, potentially multivalent vaccines has the potential to reduce the need for use of antibiotics.

Although diagnostic tests are often available the effective application in aquatic animals is hampered by multiple factors. Diseases usually show few specific clinical signs. In addition, the observation of clinical signs is generally difficult because of limited access to visualise sick fish. The diagnosis of a primary pathogen is often difficult due to the rapid invasion by secondary pathogens. As a result there is a significant non targeted use of antibiotics. Therefore the availability of vaccines that are well targeted may not directly result in a reduction of antibiotic use without field data demonstrating their effectiveness as part of a comprehensive disease control programme.

Increasing highly efficient animal production and providing equitable availability of food to a rapidly rising human population, while reducing antibiotic use in animal production and maintaining a sustainable environment, represent a considerable global challenge. Vaccines, in enabling the production of healthy animals, have already played a key role in expanding intensive farming practices that are providing access to high quality animal protein to a growing world population.

The aim of reduction of antibiotic use in food animal production presents a huge opportunity for vaccinology. The challenge presented by highly adaptable bacterial pathogens and by the complexity of developing effective vaccines, including the difficulties of immunization of young animals, should not be underestimated.

The research to support the development of multivalent vaccines should potentially cover a broad range of issues and disciplines, including discovery of new aetiological agents for inclusion in such vaccines, and, to close the diagnostic gap, identification of improved surrogate markers of protective immunity. It should also include an understanding of the mechanisms of interference and diminished efficacy that can be a consequence of combined vaccines. Encouragingly, new technologies and a major shift on how we approach vaccine discovery research may provide new opportunities for addressing these challenges.

5.2. Development of the template

The participants discussed in detail the development of a template and guiding criteria for the ranking of diseases for the purpose of stimulating research into new or better adapted vaccines with the aim to achieve a reduction in the use of antibiotics in animals.

The Group discussed that in many cases a reduction of antibiotic use in chickens, swine and fish could be achieved by effective vaccines against a viral or parasitic disease, as some of these pathogens provided opportunities for subsequent bacterial infections.

It was noted that for many candidate diseases there might be pathogens for which effective vaccines existed. However, the degree, breadth, or duration of protection afforded was not optimal, thus providing a barrier to uptake of the vaccine.

For other situations the Group discussed that existing vaccines might be based on outdated production technology or delivery technology that would benefit from research investment into vaccines more adapted to the challenges of modern animal production, particularly in the light of projected production increase.

The Group agreed that the focus had to be on identification of where a new or improved vaccine would have the maximum effect on reducing antibiotic use. In doing so, it did not capture in the report vaccine development or improvement needs that were not considered as reducing antibiotic use significantly.

6. Proposed chicken, swine and fish diseases where development or improvement of vaccines would have a high impact on antibiotic use

6.1. Key principles adopted

In order to facilitate identification of infections where new or improved vaccines would have the maximum potential to reduce antibiotic use, a number of key considerations were agreed and applied:

1. Identification of the most prevalent and important bacterial infections in chickens, swine, and identification of fish species that are commonly farmed and associated with high antibiotic use, and associated prevalent bacterial infections in those species.
2. Identification of common non-bacterial infections in chicken, swine and fish (e.g. protozoal, viral) showing clinical signs that trigger empirical antibiotic treatment (e.g. for diarrhoea) and which also result frequently in bacterial co-infection.
3. An assessment of antibiotic use in response to the syndromic indication or diagnosed disease. This was categorised as high, medium or low in the context of considered use compared with the total use of antibiotics in that animal species.
4. The availability of a vaccine(s), and if available, their effectiveness.
5. The potential for a new or improved vaccine to reduce the need for antibiotic treatment.

Factors, other than vaccine design, which influence utilisation of a vaccine were considered out of scope.

Also considered out of scope were autogenous vaccines, primarily because of lack of broad applicability across time and space, registration variability and the absence of key efficacy data.

It was accepted that unless effective vaccines are available and widely used, their impact on reducing antibiotic use would be diminished.

6.2. Limitations

As a consequence of adopting the above criteria it became evident that there were many data gaps. For example, a current list of all available vaccines that have marketing authorisation, amount of antibiotic use for different infections, and relative incidence of different infections worldwide are not available. The conclusions of the report are therefore based on considerations weighted mostly on available expert opinion.

Key references consulted during the discussions are listed in Appendix IV of this report.

6.3. Poultry diseases

The Group concluded that the considerations would be restricted to chickens as this species was farmed more globally than turkeys and dominated compared to other farmed avians (e.g. ducks, game birds). Within chickens there were differences in disease prevalence, vaccine availability and optimised delivery routes, and for broilers, breeders and layers the infections were therefore considered in this context. In total, two bacterial pathogens, *Escherichia coli* (*E. coli*) and *Clostridium perfringens* (*C. perfringens*), were identified where an improvement on the current vaccines would result in an important reduction in antibiotic use (Table 1). Despite the availability of vaccines, there is still high use of antibiotics in broilers, breeders and layers to treat a range of systemic diseases caused by *E. coli*, such as yolk sac infection (omphalitis), airsacculitis, cellulitis, salpingitis, and peritonitis. *E. coli* develop resistance to antibiotics and frequently on transferable elements, making it a high value target for improved vaccine coverage. An important limitation of the current vaccines is the degree of strain coverage, and issues of ease of delivery. A challenge is to produce a fully cross-protective vaccine that is easy to administer (e.g. aerosol) with minimal adverse effects. An additional general challenge is the production of vaccines with protective immunity in the very young chicken, partly due to presence of maternal immunity.

High antibiotic use for necrotic enteritis caused by *C. perfringens* Type A remains an issue. The duration of passive immunity induced by toxoid vaccines in layers is short lasting. There remains the need for a vaccine to achieve active immunity, particularly for broilers.

Coccidial infection predisposes to secondary bacterial infections (Table 1), and improvement in the degree of cross-protection of current vaccines would result in a decrease of secondary bacterial infection and consequently diminish use of antibiotics.

Regarding viral infections in chicken, it was recognised that several respiratory and enteric viruses may predispose to secondary bacterial infection, but the group considered both infectious bronchitis and Infectious Bursal Disease Virus (IBDV) in broilers to be particularly problematic in this context to a degree that resulted in a classification of at least medium use of antibiotics. Areas for improvement include the range of strain coverage (infectious bronchitis), maternal antibody interference, and the short window of opportunity to efficiently vaccinate (IBDV).

Table 1: Infections where new or improved vaccines would significantly reduce the need for antibiotic use in chickens

Key syndrome	Primary pathogen(s) (disease)	Antibiotic use	Commercial* vaccine exists	Major constraints to use of vaccine / vaccine development	Vaccine research priority
Systemic (Broilers)	<i>Escherichia coli</i> (Yolk sac infection, airsaccullitis, cellulitis)	High	Yes	<ul style="list-style-type: none"> • Omphalitis: secondary bacterial infection – not a disease one can immunize against • Strain coverage limited • Airsaccullitis, cellulitis: vaccines available, e.g. live aerosol vaccine. However, Serotype coverage limited and field efficacy variable 	High
	<i>Infectious Bursal Disease virus</i> (secondary bacterial infections)	Medium	Yes	<ul style="list-style-type: none"> • Issues with vaccine application • Short window of opportunity to vaccinate • Maternal antibody interference 	Medium
Systemic (Breeders, Layers)	<i>Escherichia coli</i> (airsaccullitis, cellulitis, salpingitis and peritonitis)	High	Yes	<ul style="list-style-type: none"> • Strain coverage limited 	High
Enteric (Broilers, Breeders, and Layers)	<i>Clostridium perfringens</i> , type A (necrotic enteritis)	High	Yes	<ul style="list-style-type: none"> • Toxoid vaccine for layers providing only short-lasting passive immunity • Research needed to achieve active immunity. • Improved and/or more convenient (mass vaccination) vaccine needed for broilers 	High
	Coccidiosis (secondary bacterial infections)	High	Yes	<ul style="list-style-type: none"> • Lack of cross-protection • Strains must be matched to infectious agent • Current vaccines are not attenuated and can produce low dose infection • Sub-unit vaccines have not been successful 	High
	<i>Infectious Bronchitis virus</i> (secondary bacterial infections)	Medium	Yes	<ul style="list-style-type: none"> • Issues with strain matching and strain coverage • High mutation rate of virus 	Medium

* does not cover autogenous vaccines

6.4. Swine Diseases

Eight bacterial pathogens and three viral infections (resulting frequently in secondary bacterial infections) were identified where antibiotic use was high, and one (*Haemophilus parasuis* (*H. parasuis*)) where use was considered to be medium (Table 2).

For systemic and respiratory disease authorised vaccines are available in all but one case: pneumonic disease caused by *Pasteurella multocida* (*P. multocida*), though an effective toxoid vaccine for atrophic rhinitis exists. For the bacterial infections common limitations for existing *Streptococcus suis* (*S. suis*), *H. parasuis* and *Actinobacillus pleuropneumoniae* (*A. pleuropneumoniae*) vaccines are the range of pathogen strain coverage and degrees of cross-protection. For example, it would be useful to have a vaccine to protect against *S. suis* infections that, in addition to the current strain 2, also protected against other strains (e.g. 1 and 14). Further individual vaccine specific issues are the relatively poor

immunogenicity of existing *S. suis* vaccines (in common with other capsule based vaccines), and maternal antibody interference with the *H. parasuis* vaccine. For *Mycoplasma hyopneumoniae* (*M. hyopneumoniae*), the vaccine does not eradicate the pathogen and lung lesion formation is not completely prevented. Two common viral infections causing respiratory disease were identified where secondary bacterial infection and consequential antibiotic use were considered high. These were Porcine Reproductive and Respiratory Syndrome (PRRS) virus and Swine Influenza virus (SIV). For both, current constraints are strain coverage and sub-optimal cross-protection. Further, for PRRS the rate of virus mutation and potential vaccine effectiveness evasion may be a challenge. PRRS is an important contributor to the porcine respiratory disease complex. For SIV, there are issues of limited efficacy in piglets and vaccine associated adverse reactions, in particular enhancement of respiratory disease.

For enteric diseases, three key bacterial pathogens, *E. coli*, *Lawsonia intracellularis* (*L. intracellularis*) and *Brachyspira hyodysenteriae* (*B. hyodysenteriae*) were identified as being associated with high or moderately high antibiotic use. For *B. hyodysenteriae* associated dysentery, it was recognised that other *Brachyspira spp.* may also be aetiological agents (e.g. *B. pilosicoli*). This disease appears to be re-emerging following a long period of active control through changed husbandry practices. The reasons for the re-emergence are unknown. The fact that the genus is anaerobic with additional non-routine culture requirements, and that more than one species can cause disease, are issues that may complicate effective vaccine development. Although currently antibiotic use is not as high as for some of the other causes of swine enteric disease, it is a growing problem which is further complicated by emergence of resistance to antibiotics authorised for use in pigs.

Despite the availability of an effective *L. intracellularis* vaccine there are other limitations which may prevent more widespread adoption. These include the need for an antibiotic free window for vaccination (it is a live attenuated vaccine), and that in the face of increasing *Brachyspira* infection antibiotic coverage to deal with both pathogens would be more pragmatic. The development of a vaccine for *brachyspira* infection may further support uptake of the vaccine for *L. intracellularis*.

E. coli is a common cause overall for diarrhoea in swine, but particularly for weaners/finishers. Effective maternal vaccines which provide passive immunity to neonates exist, but for *E. coli* vaccines in weaners/finishers complications are maternal antibody interference and the relatively short window for induction of immunity.

Of the viruses that cause enteric disease in pigs, rotaviral infection was considered as a significant cause of empirical antibiotic use in response to diarrhoea. An authorised vaccine is available, however its adoption is limited and currently the reasons limiting wider adoption are unknown.

A common feature of respiratory and enteric infections in pigs is that despite the availability of authorised vaccines antibiotics are still frequently used to treat various pathogens. This indicates that research which addresses the current limitation of the vaccines and the need for improved diagnostics has potential to remarkably reduce the need for and use of antibiotics in pigs.

Table 2: Infections where new or improved vaccines would significantly reduce the need for antibiotic use in swine

Key syndrome	Primary pathogen(s) (disease)	Antibiotic use	Commercial* vaccine exists	Major constraints to use of vaccine / vaccine development	Vaccine research priority
Systemic (respiratory)	<i>Streptococcus suis</i>	High	Yes	<ul style="list-style-type: none"> Strain coverage too narrow Lack of cross-protection Poor immunogenicity due to being a capsule based vaccine 	High
	<i>Haemophilus parasuis</i>	Medium	Yes	<ul style="list-style-type: none"> Serotype specific with variable cross-protection Maternal antibody interference 	Medium
Respiratory	<i>Pasteurella multocida</i> (for pneumonic disease)	High	No	<ul style="list-style-type: none"> No vaccine with approved label claim for pneumonia (There is a vaccine for atrophic rhinitis) 	High
	<i>Mycoplasma hyopneumoniae</i>	High	Yes	<ul style="list-style-type: none"> Does not completely prevent lung lesions Animals continue to shed pathogen Diagnostics not always accurately done 	Low
	<i>Actinobacillus pleuropneumoniae</i>	High	Yes	<ul style="list-style-type: none"> Limited coverage Good immunity only if serotype specific Sub-unit vaccine which affords cross-protection 	High
	Porcine Reproductive and Respiratory Syndrome virus (secondary bacterial infections)	High	Yes	<ul style="list-style-type: none"> Strain coverage limited High virus mutation rate Modest cross-protection Vaccine evasion 	High
	Swine Influenza Virus (secondary bacterial infections)	High	Yes	<ul style="list-style-type: none"> Strain matching Vaccine-associated enhanced respiratory disease (VAERD) Lack of cross-protection Efficacy in piglets limited 	High
Enteric – neonatal	<i>Escherichia coli</i>	High for the syndrome, Low for <i>E. coli</i>	Yes	<ul style="list-style-type: none"> Maternal vaccine provides effective lactogenic immunity Coverage of enterotoxigenic <i>E. coli</i> may occasionally need to be updated 	Low
Enteric (weaners/finishers)	<i>Escherichia coli</i>	High	Yes	<ul style="list-style-type: none"> Maternal antibody interference Short window for induction of immunity 	High
	<i>Lawsonia intracellularis</i>	High	Yes	<ul style="list-style-type: none"> Other pathogens in the syndrome (<i>Brachyspira</i>) not included Antibiotic-free window for vaccination required (live attenuated oral vaccine) 	Low (see also <i>Brachyspira</i>)
	<i>Brachyspira</i> spp <i>B. hyodysenteriae</i> , <i>B. pilosicoli</i>	Medium-high	No	<ul style="list-style-type: none"> Low current research investment as changes in husbandry largely eliminated the disease Technical barriers to vaccine development 	High
	Rotaviruses (secondary bacterial infections)	High	Yes	<ul style="list-style-type: none"> Reasons limiting wider adoption unknown 	High

* does not cover autogenous vaccines

6.5. Fish Diseases

Aquaculture deals with a very large number of species (>200 species). According to latest FAO statistics (FishStat. 2015), global production of cultured aquatic animals is 72 million tonnes in 2013. Of this total, 57% were freshwater fish, which accounted for 38% cyprinids (mainly carps), 6% cichlids (mainly tilapias) and 1% freshwater salmonids (mainly trout and salmon smolts). Among the marine aquaculture production, 4% accounts for salmonids, while 3.2% accounted for other marine fish.

In keeping with the guiding criteria agreed by the Group, there was a focus on species that are most produced and in which antibiotic use is believed to be most used. Considering the current production statistics and future forecast, combined with experience and knowledge on the use of antibiotics in production systems, the following categorisation was considered important for the analysis: cyprinids (mainly carps), cichlids (mainly tilapias), freshwater salmonids, marine salmonids, other marine fish.

It was also noted that not all species will equally contribute to the continuing growth of aquaculture and efforts should be focused on those species that are likely to become dominant in the future considering the expected development of aquaculture; the likely predominance of tilapia was recognised, identifying this as a priority species to be addressed.

The Group recognised that in freshwater salmonids penetration of the different markets with a number of commercially available vaccines is limited. The significant registration and application costs limit their use because the majority of production systems are scattered production units producing low total biomass.

The Group noted the contrasting picture where the use of antibiotics in freshwater cyprinids per kilogram of biomass is less than in marine fish aquaculture, however the volume of freshwater cyprinid aquaculture is much greater than the volume of marine fish production. As a result the total antibiotic usage volume in cyprinid aquaculture on the global scale is high.

Fish are poikilothermic, cultured in different environments (covering a wide range of water temperatures and salinity), which has implications on the immunological response to vaccines. In fish, an additional constraint is that they are normally exposed to the pathogen before vaccination is technically possible. For example, hatcheries implement strategies for pathogen exclusion which often includes water treatment with antibiotics.

In some of the major fish species, there are practical constraints to the application of classical injectable vaccines in large numbers of individual fish. These constraints include the need to bring fish out of the water which requires handling and anaesthesia, skilled staff, dedicated equipment, and application costs. In addition, the procedure induces stress so when not carried out properly the procedure itself may be detrimental to individual fish. Because of these constraints the practice of mass vaccination has been almost exclusively applied to high value fish species. The Group recommended that research be undertaken to address the safe and affordable application of vaccination to large populations.

Oral and bath vaccination are available only to a limited extent because the protective immune response induced is of short duration and dosing is not as controllable as injectable vaccines. A recommendation is that research be undertaken to address the question of adjuvants in support of alternative application technologies.

In aquatic animals there is a general lack of registered, efficient anti-parasitic drugs. As a result parasitic infections are widespread which often result in secondary bacterial infections. Secondary bacterial infections also arise from viral and fungal infections, and stress resulting from handling fish (sorting, transport, vaccinating). Therefore, availability of vaccines for viral infections and improved management of parasitic infections would also likely reduce the need for antibiotics, in keeping with terrestrial animals.

Worldwide, commercial vaccines are available for 18 bacterial infections (Pridgeon and Klesius, 2012). The majority of these vaccines are commercially available in only a limited number of countries. Vaccination is a common practice for only a limited number of marine species e.g. salmonids, yellow tail and flounder, sea bass and sea bream. Among the freshwater species vaccination in tilapia is being introduced.

It was noted that reduction in the use of antibiotics in the Norwegian salmon industry as a result of the use of vaccines is a frequently used example. The Group also reviewed the success of the yellowtail industry in Japan where vaccination has also been successful in reducing use. The success of vaccination also depends on the broader context where it is applied. There are limitations in the extrapolation of these

examples to other countries where aquaculture is based on multi species, industry is scattered into small production units, and where new emerging bacterial diseases are common and require antibiotic use as first line management.

Table 3: Infections where new or improved vaccines would significantly reduce the need for antibiotic use in fish

Key syndrome or disease	Primary pathogen(s)	Antibiotic use	Commercial* vaccine exists	Major constraints to use of vaccine / vaccine development	Vaccine research priority
Freshwater cyprinids					
Systemic bacterioses	<i>Aeromonas hydrophila</i> and other species	High	No	<ul style="list-style-type: none"> Disease is caused by a wide range of serotypes 	High
Dermal bacterioses / red spot disease	<i>Pseudomonas</i> spp.	High	No	<ul style="list-style-type: none"> Disease is caused by a range of species and wide range of strains and serotypes 	High
Columnaris	<i>Flavobacterium columnare</i>	Medium	Yes	<ul style="list-style-type: none"> Limited uptake by some countries for unknown reasons 	Low
Freshwater cichlids					
Systemic/dermal bacterioses	<i>Aeromonas hydrophila</i> and other species	Medium	No	<ul style="list-style-type: none"> Disease is caused by a range of species and wide range of strains and serotypes 	Medium (not low because of projected increase in production)
	<i>Streptococcus inae</i> , <i>S. agalactiae</i>	Medium	Yes	<ul style="list-style-type: none"> Industry awareness of need is low (first vaccine only became recently available) 	Medium
Freshwater salmonids					
Systemic bacterioses	<i>Aeromonas salmonicida</i> , <i>Yersinia ruckerii</i> , <i>Flavobacterium psychrophilum</i> , <i>Vibrio anguillarum</i>	Medium	Yes (multivalent, injectable)	<ul style="list-style-type: none"> cost of vaccine is high relative to harvest value 	Low
Marine salmonids					
Salmon Rickettsia Syndrome	<i>Piscirickettsia salmonis</i>	Medium	Yes	<ul style="list-style-type: none"> Multivalent vaccine which provides low protection for <i>P. salmonis</i> compared to other pathogens included in the vaccine. 	Unknown because the recent introduction of an oral monovalent vaccine booster may improve the level of protection
Other marine fish					
Systemic / dermal bacterioses	<i>Vibrio</i> spp., <i>Photobacterium</i> spp.	Medium	Yes	<ul style="list-style-type: none"> Disease is caused by a wide range of serotypes Industry awareness is low in some countries 	High
	<i>Streptococcus</i> spp.	Medium	Yes	<ul style="list-style-type: none"> Disease is caused by a wide range of serotypes Industry awareness is low in some countries 	High
Catfish					
Systemic	<i>Edwardsiella ictaluri</i> , <i>E. tarda</i>	Medium	Yes (for Channel catfish)	<ul style="list-style-type: none"> Vaccines are not available for African catfish (an important farmed species) Vaccines have very recently become available for Tra catfish and yet to be adopted by the industry 	High (for African catfish)
Systemic	<i>Aeromonas hydrophila</i> and other species	Medium	No	<ul style="list-style-type: none"> Disease is caused by a wide range of serotypes 	High

* does not cover autogenous vaccines

7. Agree on an overall priority list of animal diseases where availability of vaccines could reduce the use of antimicrobials taking into account technical and financial constraints to vaccine usage

The Group agreed that effective vaccines for the diseases listed in Table 1-3 could significantly reduce the use of antibiotics in swine, poultry, and fish farming. It was acknowledged that significant scientific and technical hurdles exist. However, an overarching investment in vaccine research could have a significant impact, particularly if the research addressed the following four priority gaps:

1. Maternal antibody interference
2. Cross-protection or inclusion of relevant strains in vaccine formulations
3. Occurrence of immunological interference in multivalent vaccines
4. Innovative delivery systems to enable mass-vaccination

8. Any other issues

The Group suggested that the report be distributed for consideration to funders of research, global animal health research organizations (e.g., STAR-IDAZ), and that global vaccine research networks be created to pull resources and expertise to address gaps for each of the priority diseases listed in Table 1-3..

9. Finalisation and endorsement of the draft report

The Group adopted the report.

.../Appendices

**AD HOC GROUP ON PRIORITISATION OF DISEASES
FOR WHICH VACCINES COULD REDUCE ANTIMICROBIAL USE IN ANIMALS
Paris, 21 - 23 April 2015**

Agenda

1. Opening
2. Appointment of chairperson and rapporteurs
3. Background of the meeting
4. Review and address the Terms of reference for the *ad hoc* Group meeting
5. Refine template and criteria for the ranking of diseases
6. Rank diseases for the three focus areas
 - a. Poultry diseases
 - b. Swine diseases
 - c. Fish diseases
7. Agree on an overall priority list of animal diseases where availability of vaccines could reduce the use of antimicrobials taking into account technical and financial constraints to vaccine usage
8. Any other issues
9. Finalisation and endorsement of the draft report

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Terms of Reference

Background

To address the threat of antimicrobial resistance, the WHO with the support of the OIE and FAO is drafting a Global Action Plan on Antimicrobial Resistance. In the development of this plan, the use of vaccines to prevent diseases and to reduce the prevalence of infections was considered as being one of the possible options to reduce the use of antimicrobial agents at the global level. The OIE has agreed to convene an *ad hoc* Group to identify animal diseases for which availability and use of vaccines could reduce the use of antimicrobial agents in animals as well as to make recommendations for targeted research programmes for improved and new vaccines.

Purpose

The *ad hoc* Group will provide guidance on prioritisation of diseases for which the use of already available and new vaccines could reduce antimicrobial use in animals, focussing at a first step on pigs, poultry and fish.

Terms of Reference

1. Consider diseases for which the availability and use of appropriate vaccines could reduce antimicrobial use in animals.
2. Rank bacterial diseases in terrestrial (pigs and poultry) and aquatic (fish) animals by animal group, which cause the highest use of antimicrobials in the animals concerned.
3. Refine the ranking by considering relevant factors impacting vaccine development, effectiveness or implementation of vaccination (examples could include but are not limited to the feasibility to develop vaccines, factors affecting the effectiveness of vaccines, such as number of bacterial strains, specific host immune reactions, general immune status related factors, or other factors that might reduce implementation of vaccination, such as current vaccine costs).

Expected output of the *ad hoc* Group

The development of a list of ranked priority diseases to guide research on vaccine development or improvement for terrestrial (pigs and poultry) and aquatic (fish) animals with the overall aim of decreasing the use of antimicrobial agents at the global level.

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**AD HOC GROUP ON PRIORITISATION OF DISEASES
FOR WHICH VACCINES COULD REDUCE ANTIMICROBIAL USE IN ANIMALS
Paris, 21 - 23 April 2015**

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