Control of salmonella infections in animals and prevention of human foodborne salmonella infections*

WHO Consultation

In many countries the incidence of human salmonella infections has markedly increased in recent years. To discuss recent developments and current understanding on the control of salmonella infections in animals, WHO organized a Consultation on the Control of Salmonella Infections in Animals: Prevention of Foodborne Salmonella Infections in Humans, held in Jena, Germany, on 21–26 November 1993. The present article summarizes the recommendations made by the participants on the patho-immunogenesis, diagnosis, epidemiology, and control of salmonella infections and contaminations in animal production.

In view of the increase in human salmonella infections in many countries, WHO organized a Consultation on the Control of Salmonella Infections in Animals, held in Jena, Germany, on 21–26 November 1993. Recent developments and current knowledge on the patho-immunogenesis, diagnostics, epidemiology, and control of salmonella infections and contaminations in animal production were reviewed. Particular attention was given to Salmonella enteritidis because of its current predominant role in poultry production in conjunction with salmonella cases in humans.

Below are presented the recommendations made by the participants.

Recommendations

Patho-immunogenesis and diagnosis of salmonella infections

- Work should continue on the determinants of salmonella virulence and on the pathogenesis of salmonella infection as well as on the interactions of Salmonella spp. with the host immune system in all farm animals.
- The genetic improvement of farm animals, including resistance to salmonellosis, is desirable, and research in this area should continue.
- In order to improve vaccines against salmonellosis, efficacy studies should continue or be instigated on the interaction between currently available and potential vaccines.
- Comparative studies should be carried out on the...
several culture methods available for selective isolation of Salmonella spp. from clinical and environmental samples, where large numbers of other organisms may be present.

- Further studies are desirable on the comparative sensitivity and specificity of animal sampling by serology and environmental sampling to determine whether a flock is infected with Salmonella spp.
- Work should continue to improve on a rational basis the selective growth of Salmonella spp. in culture media.
- Further research on rapid isolation and identification procedures for Salmonella spp., including the use of DNA technology, should be directed towards their use in veterinary medicine and related areas in addition to food microbiology.
- Harmonization of currently used enzyme-linked immunosorbent assays (ELISAs) for serological detection of salmonella infections in farm animals should continue.
- The application of newly developed ELISA serology for salmonella serogroups B, C, and E should be assessed in livestock for diagnosis and control of serotypes other than S. dublin.
- A better exchange of information is required for the sampling and isolation techniques used in monitoring salmonella infections in animals in order to improve the comparability of results; this should eventually lead to a standardization of methods and techniques. Egg yolk serology, in particular, requires further evaluation as a matter of some urgency.
- The participants recognized and referred to the recommendations made by the European Community Workshop on ELISA Technology for Serological Monitoring of Salmonella Infections in Poultry.\(^a\) Particular reference was made to the effects of vaccination on serological responses.
- There is no currently available assay that is particularly recommendable. The most appropriate way to proceed would be that WHO should provide a set of reference sera against which assays may be standardized.

**Epidemiology of salmonella infections**

- In order to identify practical control procedures, particularly at the farm level, there is a need for greater trust between the food animal production industry and veterinary and other relevant sectors. This is the main prerequisite for reasonable cooperation and regular exchange of epidemiological information. Possibly, this could be achieved by creating professional links (formal or informal) between representatives of the poultry industry, feed production, food processing, and veterinary services, both nationally and internationally.
- Experience in some countries has shown that there are possible conflicts between gathering epidemiological data and maintaining commercial confidentiality. Without the cooperation of the industry, the practical application of surveillance and control may not be successfully achieved.

More information should be collected to elucidate the pathways of transmission of Salmonella spp. within the poultry industry.

- More intensive monitoring of the farm environment is required, including screening of rodents and other wildlife, to identify critical control points for introducing more effective control measures at all levels.
- Routine monitoring of Salmonella spp. should be extended to abattoirs, “egg-breaking” plants, and human sewage effluents.
- Professional liaison between veterinarians, physicians and other important partners along the food chain, including industry and consumer organizations, should be further developed. This needs to be complemented by integrated interdisciplinary salmonella surveillance programmes (nationally and internationally), as exemplified by SALM-NET (network to promote international collaboration in the surveillance of human salmonella infections). National interdisciplinary teams are required to coordinate the collection and analysis of epidemiological data relating to salmonella contamination and infection in animals and humans.
- The results of epidemiological studies emanating from successful and unsuccessful control schemes should be compared to try to identify epidemiological factors that may have been overlooked in developing control schemes.

**Control measures**

- Improved genetically defined attenuated vaccines need to be developed that will allow, if possible, serological differentiation between vaccinated animals and those infected naturally.
- Cross-protection between salmonella serovars needs to be further defined.
- Systems for producing salmonella-free elite, great-grandparent, and grandparent flocks need to be developed. Suitable protocols should be prepared through discussions with appropriate sectors of the poultry industry.

\(^a\) Recommendations of the EEC Workshop on ELISA for serological diagnosis of salmonella infections in poultry, 8–9 June 1993, Brussels, Belgium.
Control and prevention of salmonella infections

- Systems for raising *S. enteritidis*-free parent poultry flocks need to be developed.
  - For routine treatment of eggs and progeny, only those antibiotics should be used that do not cause microbial resistance against drugs widely used in humans. Resistance of *Campylobacter* spp. and *Salmonella* spp. to fluoroquinolones may become a public health risk. This does not exclude well-targeted and transient use of antibiotics as essential measures in salmonellosis control programmes.
  - Vaccination of birds is recommended for an additional decrease of the salmonella infection pressure.
  - Such measures should be monitored especially at the progeny farm level.
- Systems need to be developed for raising *S. enteritidis*-free broilers and commercial egg layers when a flock is positive (infected):
  - eggs from infected layer flocks should be pasteurized whenever possible; and
  - other measures (e.g., vaccination of breeder flocks) may be used as needed.
- The effect on flock salmonella status of continuous serological (ELISA) and bacteriological monitoring of individuals followed by culling of positive birds needs to be studied further.
- The efficacy and safety of combinations of control techniques such as vaccination, competitive exclusion (CE), antibiotics, and sanitation should be assessed.
- Governments are requested to permit the use of CE products for large-scale field trials.
- Research in the use of a *S. dublin* control programme for dairy cows should be promoted. Such a programme should assess serological ELISA monitoring and bacteriological monitoring, removal of carriers, vaccination, and isolation of sick animals, and establish clean calving areas and optimal farm hygiene.
- The provision of salmonella-free feed is of the utmost importance for the prevention of salmonella infections of poultry flocks, in particular of elite, great-grandparent, and grandparent flocks. For parent flocks, layers and broilers, feedstuff may be decontaminated using heat, chemical treatment, or irradiation.
- The evaluation should continue of existing and innovative farm sanitation procedures using microbiological methods.
- Educational programmes covering pre- and post-harvest food safety procedures, especially salmonella control, should be initiated in the animal and food production sectors.