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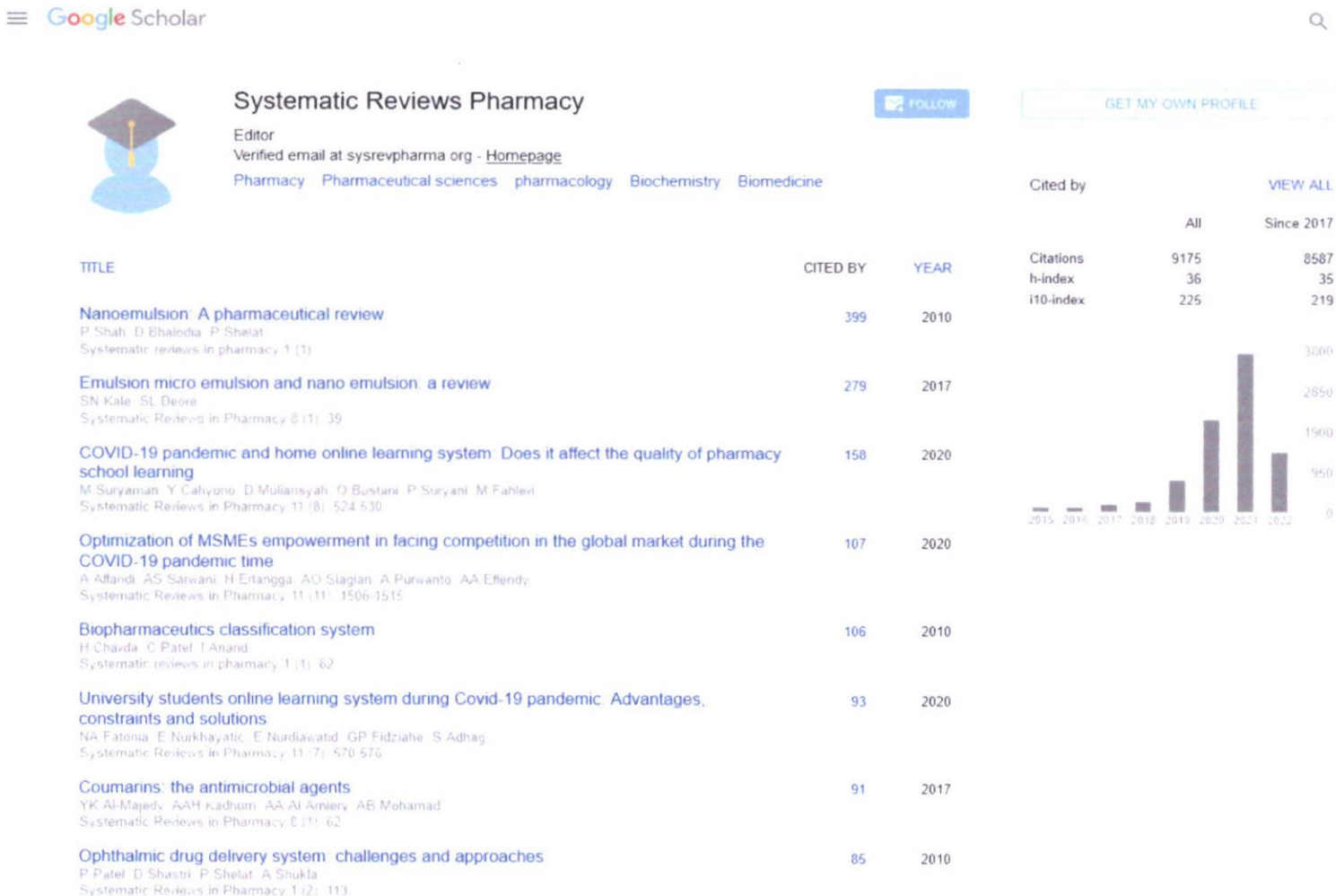

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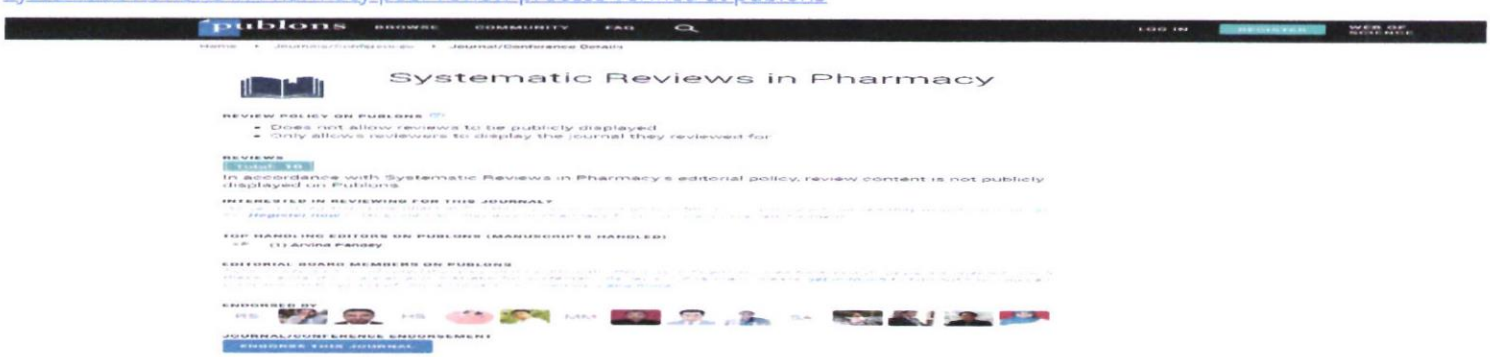

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A Review of Salmonellosis on Poultry Farms: Public Health Importance

Freshindy Marissa Wibisono[1], Freshinta Jellia Wibisono[2], Mustofa Helmi Effendi[3*], Hani Plumeriastuti[4], Akvyan Rafi Hidayatullah[1], Erwan Budi Hartadi[1], Eka Dian Sofiana[1]

[1]Postgraduate Student in Veterinary Public Health Study, Faculty of Veterinary Medicine, Airlangga University, Surabaya, Indonesia
[2]Department of Veterinary Public Health, Faculty of Veterinary Medicine, Wijaya Kusuma Surabaya University, Surabaya, Indonesia
[3]Department of Veterinary Public Health, Faculty of Veterinary Medicine, Airlangga University, Surabaya, Indonesia
[4]Department of Veterinary Pathology, Faculty of Veterinary Medicine, Airlangga University, Surabaya, Indonesia
***Corresponding author**: Mustofa Helmi Effendi. Department of Veterinary Public Health, Faculty of Veterinary Medicine, Airlangga University, Surabaya, Indonesia, Postal code: 60115. Telephone: +628175111783.
Email: mheffendi@yahoo.com

ABSTRACT
Salmonella spp. is a bacterial causative agent that can cause salmonellosis in humans and animals. Salmonellosis is categorized as an important zoonotic disease in public health. Infection can be acquired by direct contact and indirect contact with animals. Indirect transmission can occur through contact with the environment around animals or with contaminated objects around poultry farms. Salmonella in humans, which is an infectious disease, has three types of infections, namely typhoid fever, paratyphoid fever, and non-typhoid Salmonella (NTS). Typhoid fever and paratyphoid fever are caused by S. typhi and S. enterica serovar Paratyphi (S. paratyphi), in contrast, S. typhimurium, S. enteritidis, Salmonella enterica serovar newport (S. newport), and Salmonella enterica serovar heidelberg (S. heildeberg) causes non-typhoid Salmonella infection. The distribution of Salmonella is very widespread and persistent in dry environments but can persist in water for up to several months. In poultry, Salmonella can cause clinical disease or subclinical infection in asymptomatic animals which are often referred to as carriers. Infectious disease control in poultry farms always uses antibiotics. High antibiotic use can lead to increased antibiotic resistance. Raising awareness is critical to limiting the inappropriate use of antibiotics.

Keywords: Public health, Antibiotic resistance, Salmonella spp, Salmonellosis, Poultry farms

Correspondence:
Mustofa Helmi Effendi
Mustofa Helmi Effendi. Department of Veterinary Public Health, Faculty of Veterinary Medicine, Airlangga University, Surabaya, Indonesia, Postal code: 60115. Telephone: +628175111783.
Email: mheffendi@yahoo.com

INTRODUCTION
QuillBot is going to re-write your email. Start by writing or pasting here something, and then press the paraphrase button. is a bacterial agent that can cause human and animal salmonellosis (1,2). In terms of public health, salmonellosis is regarded as a significant zoonotic disease (3,4). Salmonellosis is a natural, Salmonella spp enteric disease. Acid and chronic diarrhoea disease and even death in human and animal patients are typically induced (5–7) A total of 16 million cases of inflammatory fever include salmonellose, 1.3 billion cases of gastroenteritis and 3 million deaths from Salmonella. Worldwide (8) each year. There were 1.2 million cases of non-type salmonellosis, 19,000 in hospital, and 370 deaths last year. Apply salmonella to salmonella. Known as one of the primary causes of foodborne disease (4,9), 11% being due to animal contact (10,11). Direct contact and indirect contact with animals can be used to acquire infection. Indirect transmission may occur through interaction with the animals' environment or contaminated items at farms. Salmonella spp infected poultry. It looks good, but can contaminate the surrounding environment and animals (12). Salmonellose is one of Salmonella spp's most common enteric pathogenic diseases. Has a high degree of morbidity and preventive issues (10,13).
Poultry is an important reservoir of bacterial agents. Infected poultry can be a source of disease transmission. Pathogenic microorganisms can cause infectious disease, which is the main disease and the highest cause of death in animals and humans (14). The increasing incidence of infectious diseases causes the use of antibiotics to be the most dominant in health services (15,16).
The high use of antibiotics can lead to increased antiboytic resistance. Antibiotics as prevention are used routinely in most cases. The combination preparation of amoxicillin and colistine (60.8%) was the most widely used preparation in several farms. Farmers do not even realize the purpose of using antibiotics. The high use of antibiotics without a prescription is due to the perception of farmers that the use of antibiotics has no side effects and at a low cost as an effort to prevent disease (17). During the last two decades, there has been increasing awareness of the factors causing the incidence of antibiotic resistance in livestock as food of animal origin for health. Thus, antibiotic resistance in one country is currently a problem for all countries (18).
The need for safe and quality animal protein is a consumer demand. Incidence of Salmonella sp in ducks (19), cattle (20), broilers (21), fish (22). Pathogenic microorganisms in the food chain are transmitted to humans through a variety of foods including beef, poultry and eggs (23,24). Bacterial contamination of food can occur at all stages of production so that it can affect the quality of poultry products (25). Despite awareness of the risks of Salmonellosis from handling raw poultry, the public is generally unaware that Salmonella can also spread between live birds and humans (12). This emphasizes the need for a global initiative with a control and monitoring system to control antibiotic resistance in order to protect public health related to Salmonella spp. from poultry farms. This review article aims to describe the importance of Salmonella which grows from poultry farms in terms of public health.

OVERVIEW OF SALMONELLA

Salmonella was initially discovered and isolated by Theobald Smith in 1855 from pigs infected with Hog cholera or Classical Swine Fever (CSF). Dr. Daniel Elmer Salmon, an American pathologist with Smith, identified the bacterial strain. The nomenclature of Salmonella is still very controversial and growing. The Centers for Control and Prevention of Diseases (CDC) currently uses the World Health Organization (WHO) recommended name scheme of Salmonella (6.26). The Salmonella genus belongs to the family Enterobacteriaceae, with two species, S. enterica and s. enterica. (3,4) bongori. S. Enterica consists of six sub-species, namely I, S, written in Roman numerals. enterica subs. enterica subsp. enterica, II, p. ent. enterica subsp enterica subsp. Petrus; IIIa, S. enterica subs. enterica subsp. 3. Arizonae; 3.24, S. enterica subs. enterica subsp. Cryptody; IV, p. enterica subs. enterica subsp. The fucks; and VI, S. enterica subs. enterica subsp. indica. indica. Enterica subsp, salmonella subsp. Enterica (I) occurs primarily in mammals. In humans and warm blood-blooded animals, about 99 per cent of salmonella infections. In comparison, Salmonella and S were the other five subspecies. Bongori are predominantly found in cold-blooded and environmentally friendly animals and seldom infect humans (6.27).

Salmonella spp. is a Gram-negative rod-shaped bacteria which is one of the most common infectious agents in the tropics, especially in areas with poor hygiene (23). The source of infection with Salmonella spp. Comes from human or animal feces or urine which contaminates drinking water and food so that it becomes a source of infection, besides fish, flies and dust can also act as intermediaries for salmonellosis (7,8,28).

Salmonella spp classification. Serotype dependent on 3 major antigens, i.e., somatic (O), capsule (K), and flagellum (H). Somatic antigen (O) is positioned outside the membrane of the bacterial cell and has stable heat to form the lipopolysaccharide (LPS) oligosaccharide portion of the bacterial cell .. A unique salmonella serotype can express more than one O antigen. The thermally-labile H antigen is used to activate the immune response of the host and is found mainly in bacterial flagellas. Much of the spp. Salmonella. It has two different genes that flagellar encode. These bacteria can be diphasic (phase I and II), so they can release one protein at a time only. Immunologically responsible Phase I H antigen can be expressed in many serotypes, whereas phase II antigen does not have the same characteristics and is present in several other serotypes (9,29).

The K antigen surface is rarely found between most serotypes of Salmonella and heat sensitive polysaccharides mainly located on the surface of the bacterial capsule. Only Paratyphi C, Dublin and Typhi serotypes were found for the K antigen subtype virulence (VI). In literature, the term serovar, synonymous with serotype, is widely used. In general, the subspecies in the specific classification Salmonella serotype are omitted. Reading literature like S, for example. Typhi enterica sub-species Typhi is generally reduced to Salmonella ser. S, or S. Typhi. Typhi (26,50). Typhi. There were currently 2 500 serotypes, each of which has a somatic (O) antigen combination with flagellular antigenes H1 and H2 .. More than 50 percent of these serotypes are S. S. enterica. enterica, enterica. It accounts for the majority of human Salmonella infections (30,31).

SALMONELLOSIS

In humans, Salmonella, which is an infectiity, has three distinct infections: typhoid, paratyphoid and non-typhoid Salmonella (NTS). In human beings it is a disease. S is the cause of typhoid and paratyphus fever. S, and typhi. S. Enterica serovar Paratyphi, a fever characteristic and complications, including septicemia, immunological symptoms, leukopenia, and neurology. Typhoid and paratyphoid complications may cause death (32). In the reverse, S. Murinum typhimurum, S. enteritidis, salmonella entica serovar newport (Newport S.), and salmonella entica serovar Heidelberg (H.), cause gastro-enteritis-limited, non-typhoidal infections of Salmonella, such as nausea , vomiting , diarrhoea, and bacteremia. But not (2) lethal.

There can be no distinctive clinical signs of typhoid fever and paratyphoid fever, which renders 'enteric fever' a mixture of both. Also S, too. typhus and s. typhus. Paratyphi called typhoid Salmonella (5,6). Two forms of Salmonella typhoid are stored in humans. Bacteria are spread by food or water intake. Enteric fever is typically characterised by a period of incubation of a week or more accompanied by symptoms such as headache, stomach pain and oral (or constipation) diarrhoea (6,33). Aside from fever, myalgia, bradycardia, hepatomegaly, splenomegaly and chest and stomach rashes can be encountered in infected men (6,34).

Salmonella strains other than S. typhi and S. paratyphi are often referred to as non-typhoid Salmonella (NTS) and the main reservoir is animals. NTS infection is characterized by gastroenteritis in which there is an inflammatory condition in the digestive tract accompanied by symptoms such as bloodless diarrhea, vomiting, nausea, headache, stomach cramps, and myalgia. Symptoms such as hepatomegaly and splenomegaly are rare in patients infected with NTS (6,35). Gastroentestinal complications from NTS infection such as cholecystitis, pancreatitis, and appendicitis, whereas terminal ileal perforation was not associated with NTS infection (35).

Chronic carriers are characterised as bacteria that are carried through the heat for more than one year following the acute Salmonella infection. Since people are the Salmonella typhoid source, S. S and typhoid. Paratyphoid can be transmitted to human beings through common routes of transmission, such as water consumption or food contaminated by carrier faeces (33). In addition , people as NTS carriers are rare at 0.1% concentrations, since animals are the main stockpile of NTS (35). NTS is a disease that is prevalent in the entire world and is self-restricted diseases. Salmonella infection is the most common cause of this disease. Enteric fever, by comparison, is highly morbid and mortal and is widespread particularly in underdeveloped countries (1) due to salmonella typhoid.

SALMONELLA TRANSMISSION FROM POULTRY

Salmonella 's spread is very normal and persistent in dry environments, but it can last for up to several months in water. S. S. Serobar. Enterica has a complex host / reservoir that can cause both human and animal diseases (30). In animals that are sometimes considered "carriers," Salmonella can cause clinical or sub-clinical infection in asymptomatic animals. Previous studies have found that chickens can suffer from subclinical infection over 22 weeks (30,36). Transports in farm and climate, in which bacteria can constantly and routinely be excreted in faeces without clinical symptoms, are of great importance to the transmission of Salmonella (30,37).

Salmonella's mode of transmission can be horizontal or vertical. The transmission of bacteria from the parent to

the infant is vertical transmission. In Salmonella infection in poultry which is caused by serovar entitidis with a particular preference for the chicken reproductive system, vertical transmission is of great concern. In this case it happens by transovarian infection when the mother bird has a systemic infection that results in ovary infection and egg production in the oviduct. Bacteria migrating from cloaca into reproductive organs (4) contribute to serovar enteritidis gaining access to eggs. Additional evidence indicates that Salmonella may be transferred in dairy cows vertically from the foetal site in the uterus (39). Horizontal transmission takes place through aerogens and/or fecooral transmission. Salmonella is clearly transmitted horizontally by fomite, polluted drinking water, polluted feed, dirty cages, no signs of infected animals and faeces of infected livestock (38, 40). (38).

Some of the investigations of Salmonellosis outbreaks apart from those related to contact with live poultry there are also indirect contact of infected or contaminated food vendors (28). Another example of an epidemic caused by indirect contact with live poultry is foodborne disease which originates from workers who are infected by direct contact with chickens from the farm (41). Animals are the main reservoir for transmission of NTS infection. Transmission of NTS infection to humans can occur through consumption of food or water contaminated with infected animals, as well as by direct contact with infected animals or consuming infected animals. The incidence of NTS around the world is high, bacteria can be found in the environment. It is this diversity of reservoirs that creates significant difficulties for public health authorities in infection control (42).

The risk of Salmonellosis in humans after contact with live birds is well reported through large outbreaks (12). Since the last report on May 20, 2020, 368 people have been infected with Salmonella. As of now as of June 23, 2020, a total of 465 people were infected with Salmonella in 42 US states (43). According to Loharikar et al., (2012), there were 4 outbreaks of Salmonellosis in the United States with the number of laboratory confirmed cases of Salmonella infection in humans from four outbreaks associated with live poultry contact, by the United States in 2009. Outbreak 1: cases infected with the Salmonella montevideo strain, United States on January 20 - December 1, 2009 (n = 96). Outbreak 2: Cases infected with the Salmonella Thompson strain, United States on February 16 - July 11, 2009 (n = 26). Outbreak 3: cases infected with Salmonella typhimurium, United States on May 21 - August 14, 2009 (n = 36). Outbreak 4: cases infected with the Salmonella johannesburg type outbreak, United States in May 2009 (n = 7). The reports represent four human outbreaks of Salmonella infection associated with contact with live poultry during 2009. Poultry on farms are the main source of Salmonella spread, however birds often appear healthy despite Salmonella infection. This outbreak highlights the need to focus on strategic efforts to reduce and prevent salmonellosis in humans associated with contact with live birds. (44).

ANTIBIOTIC RESISTANCE

The treatment of infectious disease includes antibiotics and can improve the quality of life by reducing bacterial-related deaths. The selectivity of antibiotics against bacterial interference is able to reduce harm to patients while ensuring the target bacteria are eradicated maximally (45). In the veterinary sector, inaccurate antibiotic use can promote antibiotic resistance in different bacteria types (46, 47) including Gram-positive bacteria (48, 49, 50, 51) and Gram-negative bacteria (52, 53, 54, 55). NTS infection does not normally need antibiotic therapy, but complications including meningitis and septicemia need antibiotic treatments such as ciprofloxacin, ceftriaxone and ampicillin (56). S-causing infections. S and typhi. Paratyphi usually have complications and need serious treatment with antibiotics such as cefixime, chloramphenicol, amoxicillin, trimethoprim / SMX, azithromycin, aztreonam, cefototaxime or ceftriaxone to avoid death (2,57). Paratyphis are usually complications and need serious treatment.

Over the years, animals have often been debated on the contribution of the cattle, which has been an important storage facility for antimicrobial resistance with public health impacts, but in particular some supporting evidence has been given that poultry farms cause human NTS disease (18). More than 3,000 people in America die every year due to antimicrobial resistance (58, 59), according to the CDC, per year more than 48 million cases of foodborne disease occur in the US where at least 70 per cent of the pathogens are immune with at least one antimicrobial. (58, 59). Antibiotics are used for the prevention , treatment and control of infectious diseases as drugs for people and animals. Excessive use of antibiotics can, however, cause antibiotic resistance. The role of cattle in emerging and propagating medicinally resistant antimicrobial bacteria and the proliferation of antimicrobial resistance is poorly understood among humans (60, 61). The development of antibiotic-resistant Salmonella primarily results from the use of antibiotics for feed-based animals to facilitate growth and antibiotics in veterinary medicine for the treatment of bacterial infections (62). This can establish an increased risk of the transmission, through direct contact and food intake of infected animals, of zoonotic diseases with the salmonella MDR strain from animals to humannens via contaminated animal feces' food or water (6, 63).

Antibiotic resistance of Salmonella spp. isolated from broiler chicken meat in Central Surabaya Traditional Market, showed 27 out of 30 positive samples contaminated with Salmonella spp. with the results of the sensitivity test to antibiotics, 0% resistant to the antibiotics meropenem and amikacin; 3.7% resistant to the antibiotic ampicillin sulbactam; 11.1% were resistant to ofloxacin and 44.4% were resistant to nalidixic acid (21). Addressing this challenge will require efforts from various sectors to successfully control the spread and emergence of AMR in the country. Actions should include active surveillance to monitor the emergence and spread of AMR. Infection prevention and control must also be optimized to limit further spread. Raising awareness is critical to limiting the inappropriate use of antibiotics, and antibiotic stewardship programs in hospitals, outpatients, and community pharmacies, should regulate ongoing use of antimicrobials (64).

CONTROL AND PREVENTION OF SALMONELLOSIS

Salmonellosis is a major concern in food safety. The European Union has enacted regulations since January 2006 covering control measures implemented throughout the poultry production chain, including production levels, biosecurity measures, and prohibiting the use of antibiotics as growth promoters (65). Poultry and poultry products are frequently associated with outbreaks of Salmonellosis and therefore, are generally recognized as a major source of disease spread (66). Salmonella prevention and control can be achieved by adopting the

principles of HACCP (Hazard Analysis Critical Control Point) (67).

Hygiene and biosecurity should be part of the overall management of the farm. These steps are very important in infection control. Incoming poultry must have a high health status and must be purchased from reliable suppliers that have quality-assured breeding and hatchery facilities. Furthermore, Salmonella can be transmitted in chicken farms through vehicles, workers, clothing, footwear, equipment, water, food, garbage, insects, rodents, wild birds, pets, equipment, and many other factors. To prevent the entry of Salmonella into the farm can be done by limiting people who enter the farm, wearing protective clothing, and wearing boots that have been disinfected. In addition, workers must know basic hygienic principles, such as keeping hands and feet clean. In planning the management of the whole farm, cleaning and disinfection must be carried out regularly. The success of disinfection of chicken farms needs to be tested by taking samples on floors, walls, drinking water, eating places, and the environment, it is hoped that public awareness of the dangers of antimirobial resistant if an antibiotic use approach is used. (68, 69, 70).

Integrated surveillance with collaboration between human health, food safety and animal health and One Health approaches and contamination strategies including livestock, retail, catering and consumers to minimize contamination and reduce transmission of Salmonella. In addition, continuous monitoring of the level of Salmonella resistance globally is very important for clinicians to support the best treatment options for Salmonellosis, especially for patients receiving antibiotic therapy (71, 72).

CONCLUSION

Salmonella spp. has always been a major public health problem that occurs worldwide. The spread of Salmonella is very widespread and persistent in the environment, it increases the difficulty in reducing the spread of Salmonella spp. Salmonella spp. it can even cause death in humans and animals. Apart from this, the emergence of antibiotic resistance in Salmonella is a major challenge in terms of effective treatment for the Salmonella infection. Limiting the use of antibiotics in feed is an effective measure to stop the spread of antibiotic resistance in poultry production.

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