

Review of Antimicrobial Therapy of Preferred Bacterial Diseases of Broiler Chickens in Bangladesh

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Abstract

There is a paucity of data on the motivation for and the number of antimicrobials used in broiler chickens in Bangladesh. This paper reviews regular therapeutic applications of antimicrobials in broiler chicken manufacture in relation to Bangladeshi guidelines, observation data, and rising public health matters about antimicrobial use (AMU). *Escherichia coli* and *Staphylococcus* spp., were reviewed since of their animal health and financial implication. *Enterococcus cecorum* with *Salmonella* bacteria species were incorporated because of their significance in antimicrobial resistance (AMR) observation. This review recognized that i) antimicrobials are obtainable in Bangladesh to treat infections through these agents, except might be throughout in excess of the oppose or extra-label use, ii) occurrence rates intended for these diseases are unidentified, iii) antimicrobial apply estimates in broilers are missing, and iv) AMR has emerged in clinical isolates, although data are extremely light. This evaluation of this review highlights the require for observation of AMU and AMR in broiler chickens in Bangladesh.

Keyword: Antimicrobial, *Escherichia coli*, *Salmonella*, *Staphylococcus* spp

Introduction

Bangladesh is a country of more than 170 million people, with 70% living in rural villages [1]. About 80% of the rural households elevate plot poultry [2]. Bangladeshi backyard poultry raisers come into recurrent close contact through poultry every day, together with touching poultry even as putting them into sheds, feeding sick poultry through hand, and slaughtering poultry [3]. To discover someplace poultry raisers wanted advice and healthcare used for their ill poultry with the reasons following their events, the team conducted relaxed interviews [4] through backyard poultry raisers concerning diverse practices awaiting they reached infiltration [5]. Inspection systems in Bangladesh have tinted the significance of

poultry as a basis of food borne disease with antimicrobial-resistant microorganism [6-8]. Food borne and water diseases have continued to be a extensive and rising health issues, in equally developed as well as developing nations [9]. The World Health Organization's (WHO's) worldwide exploit arrangement on Antimicrobial Resistance (AMR) built-in recommendations used for the monitoring of antimicrobial employ (AMU) during observation and investigate to help alleviate the distribution and appearance of AMR microorganisms in together animals with humans [10]. Antimicrobial use (AMU) observation actions in animals with humans offer situation to appreciate AMR arising as of the food sequence, and are significant for measuring trends more than time, for creation comparisons among animal class, for AMR peril appraisal with used for benchmarking [11]. Food protection with biosecurity programs have been implemented to speak to these foodstuff borne hazards with communicable diseases. Veterinarians with producers might use antimicrobials for enlargement promotion, sickness prophylaxis, with treatment in fulfillment through manufacturing food security programs [6]. Prudent use guidelines are also available to veterinarians [12]. In Bangladesh, bacterial diseases of broilers are not regularly monitored. In the nonattendance of information concerning the occurrence of broiler diseases, the bacterial pathogens like *Escherichia coli*, *Clostridium perfringens*, and *Staphylococcus* spp. were strongly reviewed since of their perseverance in broiler poultry industry. This review gives a complete picture of general therapeutic AMU in Bangladeshi broilers chicken by the intention to notify careful use strategy for veterinarians with producers as well as to recognize elements for nationwide observation programs.

Materials and Methods

Information concerning the accessibility of antimicrobials intended for utilizes in broiler chickens to delicacy infections owing to pathogen like *E. coli*, *C. perfringens* and *Staphylococcus* spp., *E. cecorum*, and *Salmonella* in Bangladesh was collected as of the Compendium of Veterinary Products (CVP). These papers provide in sequence on indications, amount, period, and way of administration beneath Bangladeshi conditions. Generally, antimicrobials were grouped basis to their consequence to

human drug, using the classification system of Health Bangladesh's Veterinary Drugs Directorate (VDD) as follows: group 1, extremely High Importance; group 2, High Importance; group 3, Average Importance, with group 4, Low Importance [12]. The World Health Organization (WHO) medicine classification arrangement was also consulted [13]. Conditions for use and marketing status for each drug were summarized. A complete report pertaining to AMU system in Bangladesh was also consulted [14]. For effectiveness data, peer-reviewed text searches of PubMed, Scopus, with Agricola databases through online poultry paper sources were conducted by the subsequent search thread: "Escherichia coli and chickens (broilers or poultry) and antimicrobial (or antibiotics or therapy or prevention or control) and ceftiofur (or any of the specific antimicrobials). Added references were consulted counting pharmacokinetic studies, plus safety and toxicity studies in the nonappearance of effectiveness studies.

Results and Discussion

Antimicrobial use in the Bangladesh poultry industry

The careful utilize of antimicrobials in food animals is a joint effort connecting veterinarians, industry/commodity groups, and administration to protect antimicrobial effectiveness, and to decrease the peril of AMR-microorganisms or else antimicrobial residues incoming the food sequence. Cautious use practices must prioritize the conservation of antimicrobials measured to be significant to human being medication [15]. Accepted veterinary antimicrobials in Bangladesh are scheduled in the CVP. Table 1 lists antimicrobials cited through different researchers international for treatment of the chosen bacterial connected diseases; though, some of these antimicrobials might have to be second-hand in an extra-label way in Bangladesh since they are not accepted for 1 or extra of the subsequent: i) employ in chickens, ii) indications, iii) route of administration, and/or iv) dosage. The VDD has urbanized an extra-label drug use policy to reduce risks of this perform to customers, nature, and the surroundings [16]. Available data of inert supervision [12], laboratory reports [17, 18] and Canadian many peer-reviewed paper publications [19] [20] were consulted to decide AMR profiles of scientific isolates. Some of the antimicrobials cited need a veterinary instruction. Feed industrialized, including labeling, is monitored through the Canadian Food Inspection Agency (CFIA) beneath the Feeds Act and Health of Animals Act. Table 2 summarizes all drugs listed in the CVMA-pug and CMIB for use in broilers. Drugs intended for veterinary apply are accepted for auction through the VDD, while the provision of drugs (i.e., once accepted at the central level), instruction and over-the-counter (OTC) sales, are keeping pace at the regional level [14]. Although, gaps motionless live in AMU information like as own use introduction (OUI) and compounding of imported lively pharmaceutical ingredients (API), which are unfettered practices in Bangladesh. Broiler-specific AMU in order is engaged with the degree of OTC purchases against veterinary-prescribed purchases for breeder, hatchery even numerous broiler farm use in Bangladesh is also unidentified. A rising global distress through AMR has resulted in the completion of programs for monitoring antimicrobial employ

with resistance (AMU/R) in provisions animals with humans. A countrywide ranch observation of AMU/R in broilers chicken will be implemented by CIPARS in teamwork through the poultry industry in 2012 to meet broiler chicken in AMU estimates. Observation of vital pathogens, even if recommended by a 2002 advisory group to Health Bangladesh, is not enclosed by CIPARS or else some observations program in Bangladesh. This review gives intention to notify careful use strategy for veterinarians with producers as well as to recognize elements for nationwide observation programs.

Selected broiler diseases and antimicrobial therapy

Escherichia coli infections

references [25]. In sequence information was obtained from peer-reviewed publications conducted international as of 1976 near 2011, investigating the scientific effectiveness and/or pharmacokinetic parameters of these drugs. Broiler category chicken strains were used as models intended for these reports through the omission of a learn that used turkeys [26] and a report that used leghorn category strains [27]. Colibacillosis is solitary of the mainly vital diseases affecting broiler chickens universal with encompasses a broad range of contained and universal diseases in broiler chickens through other avian class [21]. Several avian pathogenic E. coli (APEC) strains might be zoonotic [22, 23]. The present occurrence speed of Colibacillosis in broilers chicken is unidentified. Beneficial options, grouped keen respectively first, second, and last choices, are not up till now established in Bangladesh [24]. Characteristic primary choice drugs for Colibacillosis comprise potentiated sulfas (e.g., ormethoprim-sulfadimethoxine, next choice drugs are the aminopenicillins (e.g., amoxicillin), tetracyclines (e.g., chlortetracycline), colistin, and the aminoglycosides (e.g., neomycin, and spectinomycin). The third or preceding choice medicine is enrofloxacin, suggested for use simply when all additional options contain unsuccessful. Table 3 summarizes data for 10 antimicrobials based on these choices, plus those included in other published Medicine like neomycin with spectinomycin, and the tetracyclines might be purchased OTC as well as used next label commands for per os (PO) management. Several medicines like moxifloxacin, gentamicin, sulfadiazine, sulfamethazine, and sulfaquinolone were included in the CVMA-pug list for treatment of E. coli conditions in broilers chicken; benefit other drugs like tetracycline, though there was no in-vivo data for this drug combination (Table 2). Many countries, the use of antimicrobials significant to human drug is limited. For case, in Denmark, fluoroquinolones might only exist prescribed following conducting laboratory tests confirming to the target pathogen is not vulnerable to a few other accepted antimicrobial [28]. In the face of sharp disease, treatment might be initiated awaiting laboratory consequences; though, if the pathogen is establish to be vulnerable to non-fluoroquinolone antimicrobials, after then these medicines have to be used. Likewise in the United States, the medicine of enrofloxacin is rejection longer allowable for use in chickens broilers after the US Food and Drug Administration's (FDA's) choice to remove its endorsement in July 2005 based on a peril appraisal of human

expenditure of chicken impure with fluoroquinolone-resistant *Campylobacter* spp. [29].

Table 1. Availability of antimicrobials for use in chickens in Bangladesh

Antimicrobials available	Microorganism and/or disease for which antimicrobial is approved	Animal species for which antimicrobial is approved	Routes of administration and dosage in approved animal species
Enrofloxacin (Baytril)	Mannheimia haemolytica, Pasteurella multocida Various Gram +/-	Beef cattle Dogs cats	SC: 7.5–12.5 mg/kg PO: 5–20 mg/kg IM: 2.5 mg/kg PO: 5 mg/kg
I Ceftiofur (Excenel)	Various Gram +/- Salmonella, E.coli	Cattle, pigs, horses, dogs, lambs, turkeys	SC: 0.17 mg/poultry as a single injection
II Ampicillin (Polyflex) Amoxicillin (Paracillin)	Various Gram +/- E. coli Salmonella	Beef cattle Dogs cats	SC: 7.5–12.5 mg/kg PO: 5–20 mg/kg IM: 2.5 mg/kg PO: 5 mg/kg
Apramycin (Apralan) Gentamicin (Gentocin)	E. coli E. coli Salmonella Typhimurium	Pigs Chickens	PO (water): 12.5 mg/kg SC: 0.2 mg/chick as a single injection
Lincomycin (L)- Spectinomycin (S) (LS 20 Premix)	Swine dysentery	Pigs	PO (feed): 22 mg/kg L, 22 mg/kg S
Penicillin G Potassium (Pot-Pen)	Clostridium perfringens	Chickens	PO (water): 297 000 IU/L
Trimethoprim-sulfadiazine (Tribrissen)	Vibrio anguillarum Various Gram +/-	Dogs, cats cats	SC: 30 mg/kg
Virginiamycin (Stafac)	Necrotic enteritis	Broilers	PO (feed): 22 mg/kg
III Bacitracin (Albac, BMD)	Necrotic enteritis (prevention only)	Broilers	PO (feed): 55 mg/kg
Spectinomycin (Spectam)	Pasteurella multocida	Turkeys	SC: 11–22 mg/kg
Sulfamethazine (Sulfa-25)	Coccidiosis	Chickens	PO (water): 35 mL/9 L
Sulfaquinoxaline (Sulfaquinoxaline 19.2% Liq conc.)	Coccidiosis Pasteurella multocida Salmonella Pullorum, Gallinarum S.	Chickens	PO (water): 90 mL/45.4 L

SC: subcutaneous; PO: per os (by mouth), im: intramuscular

Table 2: Antimicrobials included in Bangladeshi guidelines for use in broiler chickens

Disease	Antimicrobials included in the CVMA-puga	Antimicrobials (for use in-feed) included in the CMIBb
E.coli omphalitis	Gentamicin (SC route only), lincomycin-spectinomycin	
E. coli arthritis	Amoxicillin,ormethoprim-sulfadimethoxine, oxytetracycline,tetracycline, trimethoprim-sulfadiazine	
E.coli airsacculitis	Amoxicillin,ormethoprim-sulfadimethoxine, trimethoprim sulfadiazine, sulfamethazine, sulfaquinoxaline, tetracycline, tetracycline-neomycin	Chronic respiratory disease: Chlortetracycline, erythromycin, oxytetracycline
Staphylococcus arthritis	Erythromycin, ormethoprim-sulfadimethoxine, penicillin, tetracycline	
Non-specific enteritis		Chlortetracycline, oxytetracycline

A Bangladeshi Veterinary Medical Association Prudent Use Guidelines. Italicized antimicrobials are extra-label drug use (ELDU) for species, dose, or indications. b Compendium of Medicating Ingredient Brochure. Alternatives to decrease APEC and thus potentially AMU comprise strict grading of hatching eggs for location, and effectual onslaught of laying gear/egg storage space facilities and hatchery premises. *Escherichia coli* might infect broiler chickens during their natural life [21]; the most suitable and sensible route of administration ought to be measured along by equipped/ industry factors [21]. The foundation for hatchery apply has not been completely recognized, with this is an existence phase where there is the attendance of other pathogens like environmental or upright transmitted with chicks are extremely vulnerable to disease [30]. Ceftiofur was investigated intended for the treatment of neonatal bacterial infections with was found to be effective [31]. Obtainable third generation cephalosporin's are indicated for parenteral administration. In poultry, ceftiofur is regularly co-administered SC through Marek's Disease vaccine [32]. In the US, ceftiofur was accepted through the FDA as a solitary SC inoculation in day-of-age broiler chickens at the suggested rate of 0.08 to 0.20 mg/chicken [6]. In-ovo management at daytime 18 of embryogenesis is an option to SC, other than ceftiofur is not labeled for in-ovo applications in moreover Bangladesh otherwise the US. More newly, the US FDA issued a docket elimination sure extra-label uses of cephalosporin's in food animals, counting in-ovo management [33]. Other antimicrobial accepted for SC management in broiler chicks in Bangladesh is gentamicin. The 35-day removal period necessary for gentamicin restrictions its use in broilers chickens because of their comparatively small natural life. Numerous feed-grade antimicrobials give cheap healing alternatives; though, other routes of management are suggested, as feed expenditure throughout neonatal stages is inadequate to attain sufficient smallest amount inhibitory concentrations. Other obtainable

data like as AMR in abattoir isolates point to vulnerability to gentamicin with trimethoprim-sulfa [34], other than there are limits for the employ of this medicine in broiler chickens: gentamicin needs a long removal period and present are no trimethoprim-sulfonamide arrangements obtainable for hatchery application. Conversely, the potentiated sulfas have been used to luxury older nature [35, 36] thus, extending their indications to comprise action of CRD with arthritis in broilers chicken might be explored through manufacturers. The AMR category of APEC strains, as of 2 reports conducted in the US and [37] China, point to that APEC have become opposed to the majority antimicrobials at present used in poultry.

Table 3: Review of antimicrobials for treatment of *Escherichia coli* infections in chickens and turkeys

Antimicrobial	Type of study	nb	Duration and dose	Route	Comments	Year (Reference)
Ic Ceftiofur	In-vivo/dose-finding, broilers	-	Once: 0.08–0.20 mg/chick	SC	↓ mortality, ↓ lesions	1992 (32)
II Amoxicillin	In-vivo/efficacy, leghorns	360	5 d: 10 mg/kg 5 days	PO (Water)	Mortality and lesions persisted	2011 (26)
Apramycin	In-vivo/efficacy, broilers	922	1 to 2 d: 0.5 g/L	PO (Water)	↓ colonization	2001 (81)
Lincomycin (L)- Spectinomycin (Sp)	In-vivo/efficacy, broilers	2365	Once: 2.5 mg L, 5.0 mg Sp	SC	mortality, ↓ bacterial recovery	1979 (37)
Ormetoprim (O)- Sulfamethoxine (Sm)	In-vivo/efficacy, broilers	201	24 d: 68.1 g O and 113.5 g Sm/lb of feed base	PO (feed)	Prophylactic and therapeutic activity confirmed	1979 (38)
Trimethoprim (Tm)- Sulfadiazine (Sd)	In-vivo/efficacy, pharmacokinetics, broilers	~600	4 d: 66–330 mg/L Tm, 250 mg/L Sd	PO (Water)	Ratio of 1:3 to 1:5 was optimal	1984 (83)
III Chlorotetracycline	In-vivo/efficacy, broiler breeder males	480	3 d: 4.5 g/L	PO (Water)	↓ mortality, ↓ lesions	1977 (84)
Oxytetracycline	In-vivo/efficacy in leghorns	360	3 d: 20 mg/kg	PO (Water)	↓ mortality, ↓ lesions	2011 (26)
Sulfamethoxine	In-vivo/comparative	1600	6 d: 1875 mg/gal	PO (Water)	Mode mortality/lesion	2004 (87)

	efficacy, broilers				rate ↓ in	
Spectinomycin	In-vivo/efficacy, broilers	~600	5 d: 51.1 mg/L	PO (Water)	↓ lesions	1988 (86)
Sulfaquinoxaline	In-vivo/pharmacokinetics, broilers In-vivo/potentiating and synergistic mixtures, broilers	~600 ~176	4 d: 200 mg/L 7 d: 333 mg/L	PO (Water) PO (Water)	Confirmed optimal dose Lesions persisted without Tm mixture	1984 (83) 1983 (27)

SC, subcutaneous, PO, per os (by mouth) a Cited by various authors and are available in Bangladeshi for veterinary use.

Otherwise indicated, n refers to the total number of animals used in the study. c Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate, Health Bangladesh.

Staphylococcus

Staphylococcus spp. have been connected through yolk sac infection with omphalitis in recently hatched chicks, and septicemia, osteomyelitis, arthritis, synovitis, and gangrenous dermatitis in older birds [38]. These circumstances impact presentation, censure rates with welfare. No information have connected scientific disease in Bangladeshi broilers to occupationally transmitted human illness; quite, the community health peril is connected to the expenditure of meats impure through enterotoxigenic *S. aureus* strains raising food poisoning [39] with contact through meat impure with methicillin-resistant *S. aureus* [40]. Staphylococcal septicemia might guide to joint infections/ arthritis [41]. Combined infections in broilers chickens are therapeutically demanding. Therapeutic schemes inside mammalian class might include surgical elimination of sequestrate, extended parenteral antimicrobial treatment, and limited antimicrobial administrations [42] except these interventions are not practical for broilers chickens since of the low financial worth of the individual bird. Management pains to decrease septicemia with joint infections comprise culling of chicks through unhealed navels like as *Staphylococcus* [38]. Extremely few in-vivo studies on antimicrobial effectiveness were established, even if 1 skin exposure study that is proposed instrument of admission tip of *Staphylococcus* leading to universal infections was renowned [43]. Susceptibility difficult of scientific isolates with appraisal of the achievement of earlier action are suggested, as a few antimicrobials like as penicillin are recognized to be efficient next to *Staphylococcus* but have been recognized to have wide MIC sharing ranges in-vitro [44]. It is well reported in US isolates composed from 1998 to 2000 exhibited confrontation to antibiotic of tetracycline, lincomycin except were vulnerable to gentamicin with streptomycin [45]. It

is well reported that in Denmark, isolates as of sick birds starting 1994 to 1998 exhibited confrontation to antibiotic of ciprofloxacin, sulphamethoxazole, with erythromycin other than were vulnerable to mainly antimicrobials experienced [46]. Known the animal wellbeing with benefit impacts of Staphylococcus, this life form might be incorporated in the observation of animal pathogens. The human physical condition collision of poultry-derived staphylococci in high-risk groups also wants to be mentioned.

Salmonella

Salmonellosis in broiler chickens is uncommon, and if birds are impure through certain serovars with phage types, sickness that is clinically alike to Colibacillosis might occur [21]. Antibiotic enrofloxacin, in mixture through spirited exclusion crop has been effectual in eliminating *S. Enteritidis* as of experimentally impure broiler chickens [47], but stipulation used in broiler breeders this might consequence in the broadcast of fluoroquinolone-resistant *Campylobacter* in broilers chickens [48]. Another attempt to extravagance Salmonellosis has established unsuccessful. For instance, propagation of *Salmonella* in the burn up occurred following neomycin treatment [49] and murder of intracellular *Salmonella* that is in vitro unsuccessful through another antibiotic like gentamicin action [50]. Ceftiofur [51] has also been investigated in-vitro next to *Salmonella*, but as before described, its employ in poultry industry has gained a public health anxiety in North America. Safeguarding of unenthusiastic disease rank in multiplier flocks is significant for *Salmonella* manage with is best approved out through abolition of optimistic flocks [52]. In Bangladesh, the abolition of flocks positive through *S. Enteritidis* as well as *S. Typhimurium* DT104 is not enclosed beneath any central recompense agenda, although an indemnity rule that covers wounded owing to flock abolition is obtainable in a number of provinces [25].

Conclusion

Actually Actually, this review has included at present obtainable information on AMU for the treatment of usually diagnosed bacterial diseases in Bangladeshi broiler chickens. This review establish that first, Bangladeshi AMU rule exist for treating the ordinary bacterial diseases of broilers chicken as well as antimicrobials are accessible to producers/veterinarians for management to their flocks. As a result, prudent AMU practices are dependent on the veterinarian's appraisal of the scientific state as well as ought to think creature health, wellbeing, with public health concerns. Secondly, occurrence in sequence concerning broiler chicken diseases requiring antimicrobial treatment is mainly unidentified or engaged during publicly nearby means. Third, present is no quantitative in sequence obtainable concerning antimicrobials used in broilers chicken in Bangladesh that is moving understanding of experimental resistance category. This information break might be packed by extra hatchery AMU information and purposive example of together home and imported chicks for AMR difficult. Chicken is a significant product in Bangladesh; integrated observation that informs together prudent AMU

practices with human health peril examination are necessary to the conservation of efficient antimicrobials significant to veterinary in addition to human drugs.

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