Prevalence and antimicrobial resistance of *Salmonella* in broiler chicken and turkey flocks in Canada from 2013-2018

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Introduction

- Non-typhodial *Salmonella* spp → foodborne illness.
- Elderly and immuno-compromised persons possibly life threatening and require antibiotic therapy.
- Drugs of choice → very high importance → fluoroquinolones and extended spectrum cephalosporins.
- Antimicrobial resistance (AMR) → global concern → requires monitoring through AMR surveillance programs.
- The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) monitors antimicrobial use (AMU) and AMR and monitor trends.
- CIPARS report 16% & 4% of 2,405 non-typhoidal *Salmonella* isolates from humans in 2016 were resistant to NAL & CRO respectively (1).

Objectives

Compare the prevalence of different *Salmonella* serovars and AMR between chicken and turkey flocks across Canada by year and region to gain an understanding of the prevalence of AMR to categories of antimicrobials of importance to human health.

Materials and Methods

- On-farm surveillance: chicken and turkey flocks in British Columbia (BC), the Prairies (Alberta & Saskatchewan) (PR), Ontario (ON) and Québec (QC) from 2013-2018.
- 1 production unit › 1 flock › 4 pooled faecal samples › 10 droppings.
- Chickens › approx. 30 days old.
- Turkeys › last week of growth (marketing weight).
- Broth-micro-dilution › Clinical and Laboratory Standards Institute (CLSI).

Results

Chickens

1,596 *Salmonella* isolates from 514 flocks › 56 serovars (Figure 1).

Resistance:

- Resistance to quinolones only among *S*. Kentucky and *S*. Ohio.
- Resistance to *β*-lactams and quinolones was higher in chicken than turkey flocks (Figure 2).

Top three:

S. Kentucky (n = 573)

- Most frequent isolate from QC (Figure 3).
- 27% resistant to AMC, CRO & AMP.
- 88% resistant to STR & TET.
- 7% resistant to NAL & AMC.
- 7% resistant to four classes.

S. Enteritidis (n = 314)

- Just one isolate resistant to any antimicrobial (Isolated in BC in 2018 and exhibited resistance to AMP, STR, SSS, TET).

S. Heidelberg (n = 127)

- Resistance to *β*-lactams ranged from 15-20%.
- Resistance to TET and folate pathway inhibitors 4-7%.

Turkeys

659 *Salmonella* isolates from 217 flocks › 40 serovars (Figure 1).

Resistance:

- No resistance to quinolones. No *S*. Uganda or *S*. Muenchen resistant to any *β*-lactams.
- Resistance to aminoglycosides, folate pathway inhibitors and fluoroquinolones higher in turkey than broiler flocks (Figure 2).

Top three:

S. Uganda (n = 109)

- Most frequent isolate from ON (Figure 3).
- 91% resistant to STR, SSS & TET.
- 82% resistant to three classes of antimicrobials (aminoglycosides, folate pathway inhibitors, tetracycline).

S. Hadar (n = 85)

- 94% resistant to STR & TET.
- 38% resistant to three classes.
- Resistance to AMP, STR & TET ↑

S. Muenchen (n = 66)

- 20% resistant to STR, SSS and TET.
- Resistance to GEN ↑

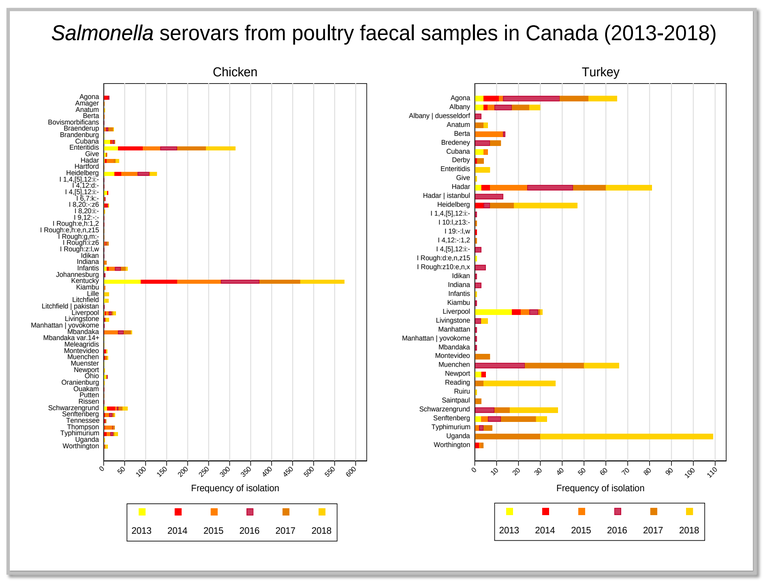

Figure 1: The prevalence of Salmonella spp. isolated from chickens and turkey faecal samples from 2013-2018.

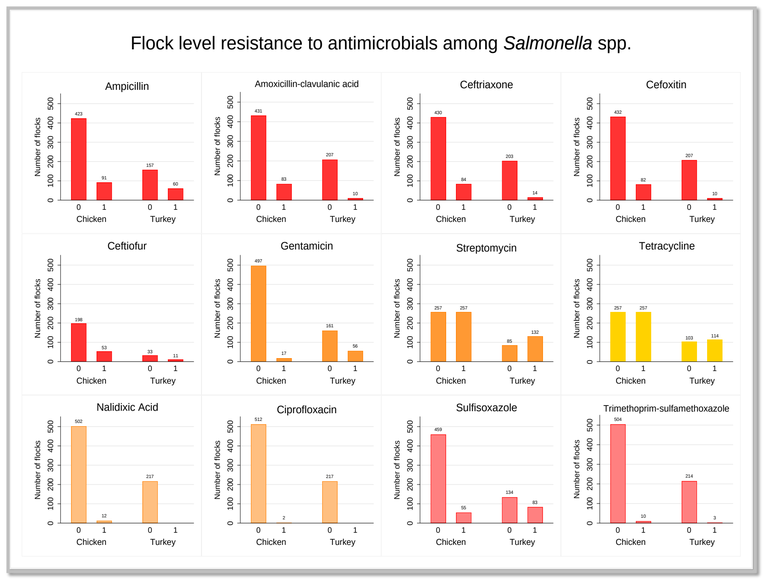

Figure 2: Resistance to antibiotics among Salmonella spp. from chicken and turkey flocks in Canada, 2013-2018.

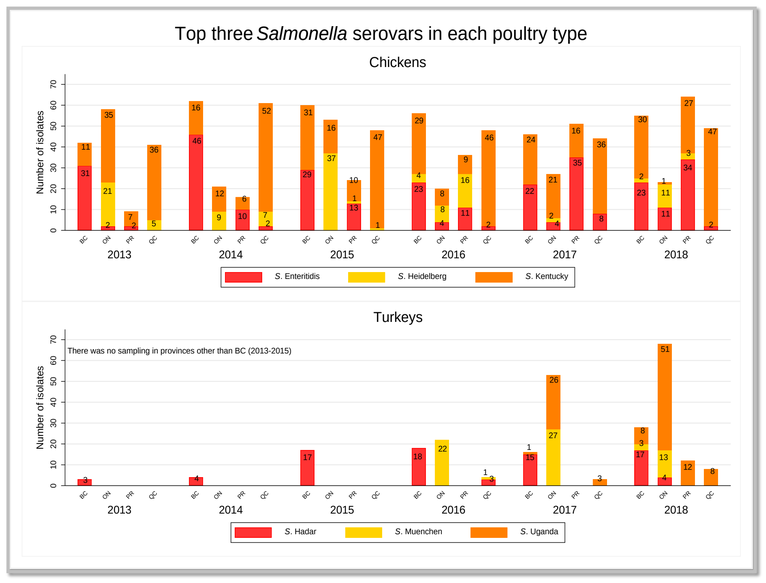

Figure 3: The number of isolates of the top three serovars from chicken and turkey faecal samples found in each region in each year (2013-2018).

AMC: amoxicillin-clavulanic acid, TIO: ceftiofur, CRO: ceftriaxone, AMP: ampicillin, FOX: cefoxitin (*β* lactam classification), GEN: gentamicin, STR: streptomycin (aminoglycoside classification), TET: tetracycline (tetracycline classification), CIP: ciprofloxacin, NAL: nalidixic acid (quinolone classification), SXT: trimethoprim-sulfamethoxazole, SSS: sulfisoxazole (folate pathway inhibitor classification).

Discussion

Diverse range of *Salmonella* serovars present in faecal samples from chicken (n = 56) and turkey (n = 40) flocks in Canada. The top three serovars for each poultry type were different, with a number of serovars exclusive to each poultry type.

- Less diversity of serovars reported than in Europe (2016, 100 serovars from chickens) (2).
- *S*. Heidelberg among top 3 from chickens in Canada, which is not among the top 6 in Europe (2).

Resistance in human samples versus poultry samples:

Both *S*. Heidelberg and *S.* Enteritidis were also among the top three serovars isolated from human samples from Canadians in 2016.

- Among human samples *S*. Enteritidis resistance to AMP & NAL was 3% & 27% respectively. The recent emergence of resistance in *S*. Enteritidis in chickens is concerning.
- Among 315 human samples of *S*. Heidelberg in 2016, 16% were resistant to CRO. Resistance to CRO in chickens has fluctuated, from 43% in 2015 to 12% in 2018.

Emerging resistance among *S*. Enteritidis, and resistance to *β*-lactams and fluoroquinolones among *S*. Kentucky from chickens are cause for concern as these classes of antimicrobials are important for treatment of salmonellosis.

Conclusions

- *Salmonella* serovars and resistance profiles present in chicken and turkey flocks in Canada are different, highlighting the need for continued surveillance of both poultry types.
- The resistance profiles seen in poultry faecal isolates are also somewhat different to those presenting in human clinical isolates.
- The acquisition of AMR among human isolates likely comes from a number of different pathways. Continued monitoring of AMU and AMR in poultry flocks across Canada is warranted.

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