

## EVIDENCE BRIEF

# Reducing Health Risks Associated with Backyard Chickens



2<sup>nd</sup> Edition: September 2023

## Key Messages

- Backyard chickens can be found in rural and urban residences in Ontario and elsewhere.
- Backyard chicken owners' awareness of illness risks such as salmonellosis, and biosecurity measures is limited.
- Human illnesses and outbreaks have been linked to exposure to backyard chickens.
- Backyard chicken owners can reduce their risk of illness through a variety of measures such as:
  - hand washing before and after handling chickens, feeding them, and cleaning chicken coops
  - wearing dedicated clothing and shoes to avoid cross-contamination
  - refraining from kissing and snuggling live chicken
  - maintaining cleanliness of the premises (e.g. sanitizing equipment, removing wet manure)
  - preventing contact between backyard chickens and wild birds/animals
  - reporting illnesses in chicken flocks and seeking veterinarian expertise

## Issue and Research Question

Chickens kept on residential property are commonly referred to as backyard chickens. Smith et al. define backyard chickens as domestic gallinaceous birds, excluding exotic pet birds, housed in urban, suburban or rural settings.<sup>1</sup>

Keeping backyard chickens in rural or urban residences is not a new concept. Early poultry production in the United States (US) in the 1800s usually consisted of backyard poultry.<sup>2</sup> Today, backyard chicken owners may also develop emotional attachments to their flocks, viewing them as pets and practicing closer contact in some cases.<sup>3</sup> A 2013 report from the United States Department of Agriculture (USDA) found a growing interest in ownership of backyard chickens in several US cities.<sup>4</sup> An issue brief from the University of Minnesota also reported that the number of households keeping chickens in urban backyards in the US appears to be increasing.<sup>3</sup>

Ontario public health units and Public Health Ontario (PHO) have received inquiries about health risks associated with backyard chickens. In addition, a report by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) indicates that poultry is a popular choice for urban producers who want to raise livestock in Ontario.<sup>5</sup> Services to rent backyard chickens for private homes and long-term care homes are also available in Ontario.<sup>6</sup> If this is indeed a trend, concerns about backyard chickens as sources of zoonotic diseases to humans may also increase,<sup>7</sup> as well as the need for risk reduction strategies.

This Evidence Brief updates a previous review done in 2017 and focuses on the following questions:

- Are backyard chicken owners aware of the risk of infectious disease transmission from their flocks?
- What illnesses and outbreaks are associated with exposure to backyard chickens?
- What behaviours can increase the risk of illness from exposure to backyard chickens?
- What biosecurity measures can reduce the risk of human illness and outbreaks?

This Evidence Brief addresses questions regarding health risks from backyard chickens and ways to reduce those risks. It does not include noise, odour and the possible benefits of raising backyard chickens, which may be considerations for policy.

## Methods

For the 2017 review, a literature search was conducted by PHO Library Services using MEDLINE, Embase, Academic Search Premier, Food Science Source and Scopus databases. The search was limited to literature published in English from 1946 to July 3, 2017. Search terms included: urban chicken, backyard chicken, domestic chicken, transmission, monitoring, infections, illness, outbreak, disease, biosecurity, knowledge, practice, attitude, and risk. The search yielded 1635 citations after duplicate records were removed. Titles and abstracts were screened for relevance. Additional information was identified through cited reference searching of full-text articles and through an external reviewer.

A grey literature search was also performed using Google on July 5, 2017, and the first 100 results were reviewed. Search terms included backyard chicken OR backyard poultry OR urban chicken OR backyard hen OR neighborhood poultry OR hobby hen OR hobby chickens OR household poultry. Papers were selected if they identified illnesses or outbreaks associated with exposure to backyard chicken, backyard chicken owners' awareness of health risks and risk reduction measures.

In February 2023, an updated literature search was conducted by PHO Library Services to identify new evidence on the search terms listed above, including highly pathogenic avian influenza (HPAI) and other pathogens in backyard chickens and small poultry flocks. Environment Complete was searched in addition to the same databases above. The search was limited to literature published in English from 2017 to February 2023. The search yielded 699 citations after duplicate records were removed. Titles and abstracts were screened for relevance to HPAI and other pathogens in backyard chickens/poultry or small non-commercial flocks, human cases from exposure to backyard chickens/poultry or small non-commercial flocks, and biosecurity measures. A grey literature search was also performed using a custom Google search in March 2023, and the first 50 results were reviewed.

A total of 66 records are included in this report. A detailed search strategy is available upon request.

## Main Findings

### Owners Have Limited Awareness of the Human Risk of Infectious Disease Transmission from Backyard Chickens

In general, studies have found limited awareness of the association between infectious disease risk and live poultry contact, as well as a lack of biosecurity measures among flock owners.<sup>8-14</sup> New backyard chicken owners in Ontario may not be aware of these risks as information on enteric illnesses are not typically provided at point of selling in Ontario.<sup>6</sup> This search identified a number of US and international based studies; the following highlights provide details:

- US based studies have found:
  - Inconsistent or minimal biosecurity practices. For example, a cross-sectional study of Colorado backyard chicken owners (n=317) found minimal biosecurity measures and high human contact with flocks. About 79% of individuals surveyed did not change into separate clothes before contact with chickens and about 95% did not report disinfecting or scrubbing their flock shoes before and/or after contact.<sup>1</sup> Another survey of 41 backyard flock owners in Maryland concluded that biosecurity practices were highly variable among flock owners.<sup>7</sup>
  - Variable awareness of the connection between salmonellosis and poultry,<sup>9,13,15</sup> with one study finding that those who completed the survey in English (versus Spanish), sold or gave away eggs, and/or kept chickens for educational purposes for their children were more aware of the association between salmonellosis and poultry.<sup>9</sup>
  - One study showed a discordance between biosecurity measures stated to be used by backyard chicken owners versus what they actually practiced.<sup>13</sup>

Studies based in Europe (Finland, United Kingdom) have similarly found low awareness of the link between backyard chickens and human illness, and limited application of biosecurity measures.<sup>11,12</sup>

### Illnesses and Outbreaks Associated with Exposure to Backyard Chickens Have Been Reported

Infectious disease transmission is a known human health risk associated with backyard chickens. Salmonellosis and campylobacteriosis are the most frequent infections reported in relation to backyard chickens and live poultry exposure.<sup>3,13,16,17</sup> Poultry can carry *Salmonella* in their intestines or eggs without symptoms of illness, which can be transferred onto feathers and the surrounding environment.<sup>3</sup> Table 1 summarizes literature reviews of *Salmonella* outbreaks that were identified in our literature search.

**Table 1. Outbreaks of Salmonellosis Associated with Backyard Chickens, 1990 – 2023\***

Location	Year	Outbreaks (n)	Cases (n)	Details	Reference
US	1996 – 2012	45	>1581	Resulted in 221 hospitalizations, and five deaths.	Behravesh et al., 2014 <sup>16</sup>
US	1990 – 2014	45	2057	Literature review of publicly available data sources for human infectious disease outbreaks associated with backyard chicken exposure. Authors recommended manure management, proper slaughter and disposal, veterinary care, permitting and consumer education to reduce the infectious disease risk associated with backyard poultry ownership.	Tobin et al., 2015 <sup>18</sup>
US	1990 – 2014	53	2630	Literature review and search of multiple databases including PulseNet, the National Molecular Subtyping Network for Foodborne Disease Surveillance in the US, the Centers for Disease Control and Prevention’s (CDC) National Outbreak Reporting System. Keeping poultry inside households and kissing birds were some high risk practices reported.	Basler et al., 2016 <sup>8</sup>
US	2017	10	1120	In 2017, there were 10 separate multistate outbreaks. These outbreaks included cases from 28 states and the District of Columbia. They resulted in 249 hospitalizations and one death.	US, CDC <sup>19</sup>
US	2022	13	1230	In 2022, there were 13 separate multistate outbreaks. These outbreaks reported cases from 49 states, the District of Columbia, and Puerto Rico. Of 737 people interviewed, 59% had contact with backyard poultry prior to illness. Of 726 people with health outcome data available, there were 230 hospitalizations. Two deaths were reported (where data were available).	US, CDC <sup>20</sup>

\*The peer-reviewed studies reported in Table 1 are literature reviews and may include data from the same outbreaks.

Concerns about avian influenza have increased recently with the circulation in North America beginning in late 2021 of a genetic group of H5N1 avian influenza viruses, which are highly pathogenic to chickens and can be transmitted in rare cases to humans.<sup>21,22</sup> Currently, the likelihood of sustained human-to-human transmission of Influenza A(H5N1) remains low.<sup>23,24,25</sup> However, globally, human infections with both low and highly pathogenic avian influenza have been reported from exposure to backyard flocks. The following reports summarize transmission of various avian influenza subtypes to humans following exposure to poultry:

- From 2020 to December 21, 2022, the WHO reported six human infections of HPAI (H5N1, clade 2.3.4.4b) internationally, including one case from the US in 2020 in a worker culling poultry.<sup>25,26</sup>
- A recent World Health Organization (WHO) risk assessment reported three human cases of avian influenza (H5N1) from Cambodia (clade 2.3.2.1c) and China (clade 2.3.4.4b) and one case of avian influenza (H5N6) in China between January 27, 2023 to March 2, 2023.<sup>27,28</sup>
- Previous human outbreaks of HPAI (H5N1, clade 2.2.2) from backyard poultry were recorded in Vietnam in 2007 and Thailand from 2007 to 2010.<sup>29</sup> It was found that 96% of human exposure to HPAI during the outbreak in Vietnam was through backyard poultry.
- A study assessing transmission of low pathogenic avian influenza (LPAI) influenza A (H9N2) from birds to humans in the context of backyard poultry farms in Vietnam was conducted from 2013 – 2015.<sup>30</sup> There were at least five cases of asymptomatic human infections. The authors noted that two of the five human cases were from households that experienced respiratory illnesses that coincided with study timelines.
- In 2018, LPAI (H9N2) circulated on a farm in China, infecting backyard chickens, two humans, and a cat.<sup>31</sup> Reported symptoms among the two infected individuals included diarrhea, abdominal pain, and joint pain for one of the cases.
- According to the May 31, 2023 Public Health Agency of Canada’s emerging respiratory pathogen bulletin, nine cases of influenza A (H9N2) have been detected globally in 2023. However, no cases have been reported in Canada.<sup>24</sup>

A key concern is wild bird populations transmitting avian influenza to backyard flocks.<sup>32,33</sup> HPAI (H5N1) outbreaks in backyard flocks have been reported in the US and Canada (including southern Ontario) in 2022.<sup>22,34</sup> Owners can then potentially become infected through exposure to backyard flocks.

In addition to outbreaks and illnesses associated with backyard chickens, a number of studies have found pathogens in backyard chickens such as *Salmonella*<sup>17,35,36</sup>, *Listeria monocytogenes*<sup>37</sup>, *C. gallinacean* (a chlamydial species with zoonotic potential)<sup>39</sup>, and *T. infestans* (insect) infected with *T. cruzi* which can lead to Chagas disease<sup>40</sup>; as well as ectoparasites (lice, fleas, mites).<sup>38</sup> Moreover, antimicrobial resistance genes have been found in *E.coli* from backyard poultry feces.<sup>41</sup>

## Risk Reduction Measures may reduce the Risk of Zoonotic Infections in Humans

The above studies on human illnesses and outbreaks noted that human behaviour can increase the risk of infectious diseases and outbreaks. High risk behaviours include keeping poultry inside the house and having close contact such as holding or kissing poultry.<sup>3,8,18,34</sup> Additionally, *Salmonella* spp. can contaminate the environment and spread infection when poultry faeces is used as fertilizer.<sup>42</sup>



A recent study in Ontario showed that 8% of survey respondents with backyard chickens raised their chickens for meat.<sup>6</sup> Slaughtering infected birds, especially in household settings, was noted to be a likely risk factor for avian influenza by the WHO.<sup>43</sup> This risk was demonstrated by sampling air in a laboratory simulation of the process of slaughtering chicken, which found release of droplets (>4 µm) and aerosols (1-4 µm) and raised the possibility of transmission if nearby individuals are unprotected.<sup>44</sup>

Table 2 summarizes risk reduction (biosecurity) strategies backyard chicken owners may implement to reduce human infectious disease risk.

**Table 2. Biosecurity Measures for Backyard Flocks**

Biosecurity strategies	Biosecurity measures
Prevent contact with wild birds and other animals <sup>29,45-52</sup>	<ul style="list-style-type: none"> <li>• Store feeds in sealed and waterproof containers</li> <li>• Ensure living space of backyard chickens is clean of feed and standing water</li> <li>• Chickens should be kept in an enclosed space such as a shed or barn</li> <li>• Avoid installing bird feeders, perches near backyard chicken space</li> <li>• Appropriately place scare devices (to repel wild birds) and replace damaged ones to ensure effectiveness</li> <li>• Keep housing secure from predators and other animals</li> </ul>
Maintain cleanliness of the premises <sup>3,8,18,29,34,36,47,48,50,52-54</sup>	<ul style="list-style-type: none"> <li>• Wash hands before and after handling backyard chickens, feeding them, and cleaning the environment</li> <li>• Regularly clean feed and water containers, ensuring that animal waste such as wild bird droppings are not present</li> <li>• Prevent and control rodents</li> <li>• Equipment that can be reused and contaminated should be cleaned and disinfected, rinsed well, and dried</li> <li>• Regularly remove manure, bedding and feed to reduce bacterial growth and flies</li> <li>• Properly compost poultry manure prior to use as a fertilizer</li> <li>• Promptly dispose of dead birds</li> <li>• Clean nest boxes regularly and ensure there is sufficient number of nest boxes and space per hen</li> <li>• Collect eggs as they are produced to minimize contamination*</li> <li>• Discard all cracked and heavily soiled eggs*</li> </ul>

Biosecurity strategies	Biosecurity measures
Avoid cross-contamination <sup>3,8,12,18,29,34,36,45,47,52,53,55</sup>	<ul style="list-style-type: none"> <li>• Acquire chickens from a reliable source</li> <li>• Keep different species of birds apart as mixing can introduce new diseases</li> <li>• Do not share equipment with other bird owners</li> <li>• When entering the space, use dedicated clothing when interacting with the flock and their living space</li> <li>• Do not slaughter poultry in the house</li> <li>• Ensure chicken roosts are away from nesting boxes and feeding stations*</li> <li>• Restrict contact between backyard chickens and pets</li> </ul>
Avoid close contact with birds <sup>3,8,18</sup>	<ul style="list-style-type: none"> <li>• Do not bring poultry inside the house</li> <li>• Refrain from kissing and snuggling poultry</li> <li>• Refrain from touching one's mouth, eating, or drinking around chickens</li> </ul>
Segregate and monitor <sup>47,51</sup>	<ul style="list-style-type: none"> <li>• Quarantine sick birds until recovered</li> </ul>
Report illnesses and deaths <sup>12,18,47</sup>	<ul style="list-style-type: none"> <li>• Contact a veterinarian or the local CFIA office if there is suspected illness in backyard chickens</li> </ul>
System-level interventions <sup>18,34,56–58</sup>	<ul style="list-style-type: none"> <li>• Educate flock owners on quarantine and hygiene measures to limit the introduction of new diseases to backyard flocks</li> <li>• Provide health-related information to potential poultry buyers before point of sale</li> <li>• Register households with poultry to enable communication in the event of outbreaks</li> </ul>

\*Personal communication from D Schwartz, 2023; unreferenced

In addition to the biosecurity measures mentioned above, the Canadian Food Inspection Agency (CFIA), OMAFRA and the Canadian Wildlife Health Cooperative provide specific guidance for quarantine and control measures for HPAI and backyard chickens, including:<sup>47, 48,59,60</sup>

- Avoiding visiting backyard chickens for 14 days after visiting farms abroad and/or having contact with wild birds.
- New birds should be kept separate from the flock and monitored for 30 days.
- Birds that were present at shows or exhibits should be kept separate from the flock and monitored for 14 days.
- During an ongoing disease outbreak, avoid gatherings such as shows, sales, and swap meets.
- Dead wild birds on your property should be reported to the Canadian Wildlife Health Cooperative.

Bird owners should also stay vigilant and maintain hygiene measures while handling birds as it is possible to infect birds with viruses such as influenza and bacteria from humans.<sup>51</sup> If a member of the household becomes ill with symptoms such as fever, cough, or sore throat, they should seek medical advice and avoid direct contact with the backyard chickens.<sup>60</sup> Backyard chicken owners have also been recommended to obtain seasonal influenza vaccination.<sup>48</sup> Pets (e.g., cats, dogs) can also be infected with avian influenza, e.g., during hunting or scavenging. Concerns about avian influenza or illness in pets should be brought to a veterinarian.<sup>59,60</sup>

OMAFRA provides “Keeping Your Birds Healthy Resource Kits” for backyard chicken owners. It provides information on biosecurity, feed and water management, cleaning and disinfection, managing sick birds and disposal of sick birds.<sup>61</sup> In addition, [Family Food Program](#) at Chicken Farmers of Ontario (CFO) provides information for members on promotion of bird health and disease management.<sup>62</sup>

## Discussion and Conclusions

Backyard chickens can be found in urban and rural residences in Ontario. Pathogens such as *Salmonella* spp., *Campylobacter* spp., *Listeria monocytogenes*, and different strains of avian influenza A have been found in backyard chickens and linked to human exposure and infection.

Close contact with backyard chickens may contribute to infectious disease transmission from birds to humans, even in the absence of illness in poultry.<sup>8,9,12,33,34</sup> Close contact with and slaughtering of backyard chickens poses health risks to owners; education for flock owners on proper slaughtering processes may reduce this risk.<sup>8–14,63</sup> Other biosecurity practices such as preventing contact between backyard chickens and wild birds/animals, maintaining cleanliness of the premises and hygiene (including hand hygiene), avoiding cross-contamination, segregating and monitoring sick birds, and reporting illnesses can reduce the risks of infection transmission to both birds and humans.<sup>27,36,47–55,60,64–66</sup>

## Implications for Practice

Human illness has been associated with backyard poultry, however, owner attention to biosecurity measures may reduce the risk. Informing potential backyard chicken owners of the risks and reinforcement of the importance of biosecurity measures can help to reduce risks for both owners, visitors and their flocks.

In considering backyard chicken policies, authorities may also consider noise, odour, community preferences, the risk of infection, and the possible benefits of backyard chickens.



## References

1. Smith E, Reif J, Hill A, Slota K, Miller R, Bjork K. Epidemiologic characterization of Colorado backyard bird flocks. *Avian Dis.* 56(2):263-71. Available from: <https://doi.org/10.1637/9865-072811-Reg.1>
2. National Chicken Council. U.S. chicken industry history [Internet]. Washington, DC: National Chicken Council; 2012 [cited 2023 Apr 11]. Available from: <https://www.nationalchickencouncil.org/about-the-industry/history/>
3. Bailey T, Larson J. Backyard poultry: implications for public health and safety [Internet]. Minneapolis, MN: Food Policy Research Center; 2013 [cited 2023 Apr 11]. Available from: <http://conservancy.umn.edu/handle/11299/157625>
4. US Department of Agriculture. Urban chicken ownership in four U.S. cities [Internet]. Fort Collins, CO: US Department of Agriculture; 2013 [cited 2023 Apr 11]. Available from: [https://www.aphis.usda.gov/animal\\_health/nahms/poultry/downloads/poultry10/Poultry10\\_dr\\_Urban\\_Chicken\\_Four\\_1.pdf](https://www.aphis.usda.gov/animal_health/nahms/poultry/downloads/poultry10/Poultry10_dr_Urban_Chicken_Four_1.pdf)
5. Ontario. Ministry of Agriculture and Rural Affairs. Urban agriculture business information bundle: poultry [Internet]. Toronto, ON: King's Printer for Ontario; 2023 [modified 2023 Mar 07; cited 2023 Mar 27]. Available from: <http://omafra.gov.on.ca/english/livestock/urbanagbib/poultry.htm>
6. Paphitis K, Metcalf D, Weese JS. Backyard chickens - a cross-sectional survey of current and prospective backyard chicken owners in Ontario (2019-2021). *Can Vet J.* 2023;64(1):54-62. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9754136/>
7. Madsen JM, Zimmermann NG, Timmons J, Tablante NL. Evaluation of Maryland backyard flocks and biosecurity practices. *Avian Dis.* 2013;57(2):233-7. Available from: <https://doi.org/10.1637/10428-101912-Reg.1>
8. Basler C, Nguyen TA, Anderson TC, Hancock T, Behravesh CB. Outbreaks of human salmonella infections associated with live poultry, United States, 1990–2014. *Emerg Infect Dis.* 2016;22(10):1705-11. Available from: <https://doi.org/10.3201/eid2210.150765>
9. Beam A, Garber L, Sakugawa J, Kopral C. Salmonella awareness and related management practices in U.S. urban backyard chicken flocks. *Prev Vet Med.* 2013;110(3-4):481-8. Available from: <https://doi.org/10.1016/j.prevetmed.2012.12.004>
10. Elkhoraibi C, Blatchford RA, Pitesky ME, Mench JA. Backyard chickens in the United States: A survey of flock owners. *Poult Sci.* 2014;93(11):2920-31. Available from: <https://doi.org/10.3382/ps.2014-04154>
11. Pohjola L, Rossow L, Huovilainen A, Soveri T, Hänninen M-L, Fredriksson-Ahomaa M. Questionnaire study and postmortem findings in backyard chicken flocks in Finland. *Acta Vet Scand.* 2015;57(1):3. Available from: <https://doi.org/10.1186/s13028-015-0095-1>
12. Karabozhilova I, Wieland B, Alonso S, Salonen L, Häsler B. Backyard chicken keeping in the Greater London Urban Area: welfare status, biosecurity and disease control issues. *Br Poult Sci.* 2012;53(4):421-30. Available from: <https://doi.org/10.1080/00071668.2012.707309>

13. Kauber K, Fowler H, Lipton B, Meschke JS, Rabinowitz P. Salmonella knowledge, attitudes and practices: a survey of backyard poultry owners residing in Seattle, Washington and the surrounding metropolitan area. *Zoonoses Public Health*. 2017;64(1):21-8. Available from: <https://doi.org/10.1111/zph.12274>
14. Sultana R, Rimi NA, Azad S, Islam MS, Khan MSU, Gurley ES, et al. Bangladeshi backyard poultry raisers' perceptions and practices related to zoonotic transmission of avian influenza. *J Infect Dev Ctries*. 2012;6(2):156-65. Available from: <https://doi.org/10.3855/jidc.2242>
15. Nicholson CW, Campagnolo ER, Boktor SW, Butler CL. Zoonotic disease awareness survey of backyard poultry and swine owners in southcentral Pennsylvania. *Zoonoses Public Health*. 2020;67(3):280-90. Available from: <https://doi.org/10.1111/zph.12686>
16. Behravesh CB, Brinson D, Hopkins BA, Gomez TM. Backyard poultry flocks and salmonellosis: a recurring, yet preventable public health challenge. *Clin Infect Dis Off*. 2014;58(10):1432-8. Available from: <https://doi.org/10.1093/cid/ciu067>
17. Manning J, Gole V, Chousalkar K. Screening for Salmonella in backyard chickens. *Prev Vet Med*. 2015;120(2):241-5. Available from: <https://doi.org/10.1016/j.prevetmed.2015.03.019>
18. Tobin MR, Goldshear JL, Price LB, Graham JP, Leibler JH. A framework to reduce infectious disease risk from urban poultry in the United States. *Public Health Rep*. 2015;130(4):380-91. Available from: <https://doi.org/10.1177/003335491513000417>
19. Centers for Disease Control and Prevention. Human salmonella infections linked to live poultry in backyard flocks [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; 2017 [cited 2023 Jul 26]. Available from: <https://www.cdc.gov/salmonella/live-poultry-06-17/index.html>
20. Centers for Disease Control and Prevention. Salmonella outbreaks linked to backyard poultry [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; 2022 [cited 2023 Apr 20]. Available from: <https://www.cdc.gov/salmonella/backyardpoultry-06-22/details.html>
21. Public Health Agency of Canada. Avian influenza A(H5N1): for health professionals [Internet]. Ottawa, ON: Government of Canada; 2023 [modified 2023 Jul 31; cited 2023 Apr 03]. Available from: <https://www.canada.ca/en/public-health/services/diseases/avian-influenza-h5n1/health-professionals.html>
22. Centers for Disease Control and Prevention. Technical report: highly pathogenic avian influenza A(H5N1) viruses [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; 2023 [updated 2023 Mar 17; cited 2023 Apr 03]. Available from: <https://www.cdc.gov/flu/avianflu/spotlights/2022-2023/h5n1-technical-report.htm>
23. World Health Organization. Human infection with avian influenza A(H5) viruses [Internet]. Geneva: World Health Organization; 2023 [cited 2023 Apr 24]. Available from: [https://www.who.int/docs/default-source/wpro---documents/emergency/surveillance/avian-influenza/ai\\_20230414.pdf?sfvrsn=5f006f99\\_113](https://www.who.int/docs/default-source/wpro---documents/emergency/surveillance/avian-influenza/ai_20230414.pdf?sfvrsn=5f006f99_113)
24. Public Health Agency of Canada. Human emerging respiratory pathogens bulletin: issue 77, May 2023 [Internet]. Ottawa, ON: Government of Canada; 2023 [modified 2023 Aug; cited 2023 Jun 23]. Available from: <https://www.canada.ca/en/public-health/services/surveillance/human-emerging-respiratory-pathogens-bulletin/2023/may.html>

25. World Health Organization. Assessment of risk associated with recent influenza A(H5N1) clade 2.3.4.4b viruses [Internet]. Geneva: WHO; 2022 [cited 2023 Apr 3]. Available from: [https://cdn.who.int/media/docs/default-source/influenza/avian-and-other-zoonotic-influenza/h5-risk-assessment-dec-2022.pdf?sfvrsn=a496333a\\_1&download=true](https://cdn.who.int/media/docs/default-source/influenza/avian-and-other-zoonotic-influenza/h5-risk-assessment-dec-2022.pdf?sfvrsn=a496333a_1&download=true)
26. World Health Organization. Avian influenza A (H5N1) – the United States of America [Internet]. Geneva: World Health Organization; 2022 [cited 2023 Apr 04]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON379>
27. World Health Organization. Influenza at the human-animal interface summary and assessment, 3 March 2023 [Internet]. Geneva: World Health Organization; 2023 [cited 2023 Mar 27]. Available from: <https://www.who.int/publications/m/item/influenza-at-the-human-animal-interface-summary-and-assessment-3-march-2023>
28. World Health Organization. Avian Influenza A (H5N1) - Cambodia. Geneva: World Health Organization; 2023 [cited 2023 Apr 03]. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON445>
29. Samanta I, Joardar SN, Das PK. Chapter 14: biosecurity strategies for backyard poultry: a controlled way for safe food production. In: Holban AM, Grumezescu AM, editors. Food control and biosecurity: handbook of food bioengineering. London: Academic Press; 2018. p. 481-517. Available from: <https://doi.org/10.1016/B978-0-12-811445-2.00014-3>
30. Hoa LNM, Tuan NA, My PH, Huong TTK, Thi N, Chi NTY, et al. Assessing evidence for avian-to-human transmission of influenza A/H9N2 virus in rural farming communities in northern Vietnam. *J Gen Virol*. 2017;98(8):2011-6. Available from: <https://doi.org/10.1099/jgv.0.000877>
31. Yang J, Yan J, Zhang C, Li S, Yuan M, Zhang C, et al. Genetic, biological and epidemiological study on a cluster of H9N2 avian influenza virus infections among chickens, a pet cat, and humans at a backyard farm in Guangxi, China. *Emerg Microbes Infect*. 2023;12(1):2143282. Available from: <https://doi.org/10.1080/22221751.2022.2143282>
32. Zheng T, Adlam B, Rawdon TG, Cork SC, Hope V, et al. A cross-sectional survey of influenza A infection and management practices in small rural backyard poultry flocks in New Zealand. *N Z Vet J*. 2010;58(2):74-80. Available from: <https://doi.org/10.1080/00480169.2010.65086>
33. Yendell SJ, Rubinoff I, Lauer DC, Bender JB, Scheftel JM. Antibody prevalence of low-pathogenicity avian influenza and evaluation of management practices in Minnesota backyard poultry flocks. *Zoonoses Public Health*. 2012;59(2):139-43. Available from: <https://doi.org/10.1111/j.1863-2378.2011.01427.x>
34. Ontario. Ministry of Agriculture, Food and Rural Affairs. Animal health update: avian influenza for small flock owners and bird fanciers [Internet]. Toronto, ON: Queen’s Printer for Ontario; 2022 [cited 2023 Feb 28]. Available from: <https://www.ontario.ca/files/2023-01/omafra-animal-health-update-avian-influenza-small-en-2022-03-27.pdf>
35. Lebert L, Martz S-L, Janecko N, Deckert AE, Agunos A, Reid A, et al. Prevalence and antimicrobial resistance among *Escherichia coli* and *Salmonella* in Ontario smallholder chicken flocks. *Zoonoses Public Health*. 2018;65(1):134-41. Available from: <https://doi.org/10.1111/zph.12381>

36. Brochu NM, Guerin MT, Varga C, Lillie BN, Brash ML, Susta L. A two-year prospective study of small poultry flocks in Ontario, Canada, part 1: prevalence of viral and bacterial pathogens. *J Vet Diagn Invest.* 2019;31(3):327-35. Available from: <https://doi.org/10.1177/1040638719843577>
37. Crespo R, Garner MM, Hopkins SG, Shah DH. Outbreak of *Listeria monocytogenes* in an urban poultry flock. *BMC Vet Res.* 2013;9:204. Available from: <https://doi.org/10.1186/1746-6148-9-204>
38. Murillo AC, Mullens BA. Diversity and prevalence of ectoparasites on backyard chicken flocks in California. *J Med Entomol.* 2016;53(3):707-11. Available from: <https://doi.org/10.1093/jme/tjv243>
39. Li L, Luther M, Macklin K, Pugh D, Li J, Zhang J, et al. *Chlamydia gallinacea*: a widespread emerging *Chlamydia* agent with zoonotic potential in backyard poultry. *Epidemiol Infect.* 2017;145(13):2701-3. Available from: <https://doi.org/10.1017/S0950268817001650>
40. Provecho YM, Fernández M del P, Salvá L, Meli S, Cano F, Sartor P, et al. Urban infestation by *Triatoma infestans* (Hemiptera: Reduviidae), an overlooked phenomena for Chagas disease in Argentina. *Mem Inst Oswaldo Cruz.* 2021;116:e210056. Available from: <https://doi.org/10.1590/0074-02760210056>
41. Salinas L, Loayza F, Cárdenas P, Saravia C, Johnson TJ, Amato H, et al. Environmental spread of extended spectrum beta-lactamase (ESBL) producing *Escherichia coli* and ESBL genes among children and domestic animals in Ecuador. *Environ Health Perspect.* 201;129(2):027007. Available from: <https://doi.org/10.1289/EHP7729>
42. Keerthirathne TP, Ross K, Fallowfield H, Whiley H. Examination of Australian backyard poultry for *Salmonella*, *Campylobacter* and *Shigella* spp., and related risk factors. *Zoonoses Public Health.* 2022;69(1):13-22. Available from: <https://doi.org/10.1111/zph.12889>
43. World Health Organization. Influenza (Avian and other zoonotic) [Internet]. Geneva: World Health Organization; 2018 [cited 2023 Mar 27]. Available from: [https://www.who.int/news-room/fact-sheets/detail/influenza-\(avian-and-other-zoonotic\)](https://www.who.int/news-room/fact-sheets/detail/influenza-(avian-and-other-zoonotic))
44. Bertran K, Balzli C, Kwon Y-K, Tumpey TM, Clark A, Swayne DE. Airborne transmission of highly pathogenic influenza virus during processing of infected poultry. *Emerg Infect Dis.* 2017;23(11):1806-14. Available from: <https://doi.org/10.3201/eid2311.170672>
45. Martin W, Schuft A.. Avian influenza basics for urban and backyard poultry owners [Internet]. St Paul, MN: Regents of the University of Minnesota; 2022 [cited 2023 Feb 28]. Available from: <https://extension.umn.edu/poultry-health/avian-influenza-basics-noncommercial-poultry-flock-owners>
46. Powers L. Introduction to backyard poultry [Internet]. Cranbury, NJ: DVM 360; 2015 [cited 2023 Apr 11]. Available from: <https://www.dvm360.com/view/introduction-backyard-poultry-proceedings>
47. Canadian Food Inspection Agency. How to prevent and detect disease in small flocks and pet birds [Internet]. Ottawa, ON: Government of Canada; 2011 [modified 2022 Jan 24; cited 2023 Feb 28]. Available from: <https://inspection.canada.ca/animal-health/terrestrial-animals/diseases/backyard-flocks-and-pet-birds/eng/1323643634523/1323644740109>

48. Canadian Food Inspection Agency. Protect your flock from bird flu [Internet]. Ottawa, ON: Government of Canada; 2023 [modified 2023 May 05; cited 2023 Feb 28]. Available from: <https://inspection.canada.ca/animal-health/terrestrial-animals/diseases/reportable/avian-influenza/protect-your-flock/eng/1614352583029/1614352660146>
49. Indiana State Board of Animal Health. What hobby poultry owners should know about preventing avian influenza [Internet]. Indianapolis; IN: Office of the State Veterinarian; 2022 [cited 2023 Feb 28]. Available from: <https://www.in.gov/boah/files/BYB-Biosecurity-Advisory-2-16-22.pdf>
50. US Department of Agriculture. Prevent avian influenza at your farm, improve your biosecurity with simple wildlife management practices [Internet]. Sacramento, CA: California Department of Food and Agriculture; 2015 [cited 2023 Feb 28]. Available from: [https://www.cdfa.ca.gov/ahfss/Animal\\_Health/pdfs/AI/HPAIFactsheet\\_WildlifeBiosecurity.pdf](https://www.cdfa.ca.gov/ahfss/Animal_Health/pdfs/AI/HPAIFactsheet_WildlifeBiosecurity.pdf)
51. Ontario. Ministry of Agriculture, Food and Rural Affairs. Raise healthy small flock poultry [Internet]. Ottawa, ON: King's Printer for Ontario; 2022 [updated 2023 Mar 20; cited 2023 Sept 18]. Available from: <http://www.ontario.ca/page/raise-healthy-small-flock-poultry>
52. Derksen T, Lampron R, Hauck R, Pitesky M, Gallardo RA. Biosecurity assessment and seroprevalence of respiratory diseases in backyard poultry flocks located close to and far from commercial premises. *Avian Dis.* 2017;62(1):1-5. Available from: <https://doi.org/10.1637/11672-050917-Reg.1>
53. US Department of Agriculture. Defend the flock - biosecurity 101 [Internet]. Washington, DC: US Department of Agriculture; 2021 [modified 2021 Apr 25; cited 2023 Feb 28]. Available from: <https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/defend-the-flock-program/df-biosecurity/bird-biosecurity>
54. Queensland Government. Preventing diseases in backyard poultry [Internet]. Brisbane, QL: State of Queensland; 2023 [updated 2023 Jan 30; cited 2023 Feb 28]. Available from: <https://www.qld.gov.au/families/government/pets/backyard-poultry>
55. Correia-Gomes C, Henry MK, Reeves A, Sparks N. Management and biosecurity practices by small to medium egg producers in Scotland. *Br Poult Sci.* 2021;62(4):499-508. Available from: <https://doi.org/10.1080/00071668.2021.1894635>
56. Centers for Disease Control and Prevention. Multistate outbreak of human salmonella hadar infections linked to live poultry in backyard flocks [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; 2012 [cited 2023 Apr 13]. Available from: <https://www.cdc.gov/salmonella/hadar-live-poultry-07-12/index.html>
57. Centers for Disease Control and Prevention. Multistate outbreak of human salmonella montevideo infections linked to live poultry in backyard flocks. Atlanta, GA: Centers for Disease Control and Prevention; 2012 [cited 2023 Apr 13]. Available from: <https://www.cdc.gov/salmonella/montevideo-06-12/index.html>
58. Centers for Disease Control and Prevention. Multistate outbreak of human salmonella infections linked to live poultry in backyard flocks. Atlanta, GA: Centers for Disease Control and Prevention; 2012 [cited 2023 Apr 13]. Available from: <https://www.cdc.gov/salmonella/live-poultry-05-12/index.html>

59. Canadian Food Inspection Agency. Protecting your flock from influenza – have you got it right? [Internet]. Ottawa, ON: Government of Canada; 2016 [modified 2022 Jan 20; cited 2023 Feb 28]. Available from: <https://inspection.canada.ca/animal-health/terrestrial-animals/biosecurity/standards-and-principles/avian-biosecurity/protecting-your-flock-from-influenza/eng/1461799560842/1461801401264>
60. Ontario. Ministry of Health and Long-Term Care. Highly pathogenic H5N1 avian influenza: frequently asked questions [Internet]. Toronto, ON: Queen’s Printer for Ontario; 2022 [cited 2023 Mar 22]. Available from: <https://www.health.gov.on.ca/en/pro/programs/emb/avian/faq.aspx#12>
61. Ontario. Ministry of Agriculture, Food and Rural Affairs. Poultry biosecurity preparedness initiative guidelines [Internet]. Toronto, ON: King’s Printer for Ontario; 2023 [modified 2023 Sept 18; cited 2023 Apr 11]. Available from: <https://omafra.gov.on.ca/english/livestock/urbanagricul.html>
62. Chicken Farmers of Ontario. Bird health and disease management [Internet]. Burlington, ON: Chicken Farmers of Ontario; 2022 [cited 2023 Apr 21]. Available from: <https://www.familyfoodgrower.ca/Bird-Health-and-Disease-Management>
63. Burns TE, Ribble C, McLaws M, Kelton D, Stephen C. Perspectives of an underrepresented stakeholder group, backyard flock owners, on poultry health and avian influenza control. *J Risk Res.* 2013;16(2):245-60. Available from: <https://doi.org/10.1080/13669877.2012.726244>
64. Alam MU, Rahman M, Abdullah-Al-Masud, Islam MA, Asaduzzaman M, Sarker S, et al. Human exposure to antimicrobial resistance from poultry production: Assessing hygiene and waste-disposal practices in Bangladesh. *Int J Hyg Environ Health.* 2019;222(8):1068-76. Available from: <https://doi.org/10.1016/j.ijheh.2019.07.007>
65. Environment and Climate Change Canada. Avian influenza in wild birds [Internet]. Ottawa, ON: Government of Canada; 2015 [modified 2023 Jun 02; cited 2023 Sept 18]. Available from: <https://www.canada.ca/en/environment-climate-change/services/migratory-game-bird-hunting/avian-influenza-wild-birds.html>
66. Sutherland M, Baron H, Llinas J. Recommended health care and disease-prevention programs for herds/flocks of exotic animals. *Veterinary Clin North Am Exot Anim Pract.* 2021;24(3):697-737. Available from: <https://doi.org/10.1016/j.cvex.2021.05.003>



## Acknowledgements

Christine Navarro, Public Health Physician, Health Protection, PHO

Csaba Varga, DVM, MSc, DACVPM, Lead Veterinarian, Disease Prevention – Poultry, Ontario Ministry of Agriculture, Food and Rural Affairs

Dean Middleton, DVM, Epidemiologist Specialist, Chronic Disease and Injury Prevention, PHO

Richard Mather, Public Health Physician, Health Protection, PHO

## Citation

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reducing health risks associated with backyard chickens. 2<sup>nd</sup> ed. Toronto, ON: King's Printer for Ontario; 2023.

## Disclaimer

This document was developed by Public Health Ontario (PHO). PHO provides scientific and technical advice to Ontario's government, public health organizations and health care providers. PHO's work is guided by the current best available evidence at the time of publication. The application and use of this document is the responsibility of the user. PHO assumes no liability resulting from any such application or use. This document may be reproduced without permission for non-commercial purposes only and provided that appropriate credit is given to PHO. No changes and/or modifications may be made to this document without express written permission from PHO.

## Publication History

Published: 2017

2<sup>nd</sup> Edition: September 2023

## Public Health Ontario

Public Health Ontario is an agency of the Government of Ontario dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, front-line health workers and researchers to the best scientific intelligence and knowledge from around the world.

For more information about PHO, visit [publichealthontario.ca](https://publichealthontario.ca).