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# The Psychological Impacts of Avian Influenza

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**Abstract**

*Psychological factors have been neglected in preparation guidelines for an avian influenza (AVI) pandemic. To address this gap, a narrative literature review was conducted to (1) examine how AVI outbreaks—so far largely contained to livestock—have psychologically impacted people, and (2) consider the implications if an AVI pandemic were to emerge, in which large numbers of people would be infected. Findings indicate that AVI outbreaks have been characterized by fear, disgust, and avoidance of poultry products. Many of the other psychological phenomena observed in AVI outbreaks have been documented in past pandemics and other infectious outbreaks: Blame and anger, disease-related avoidance and stigmatization, xenophobia, conspiracy theories, panic buying, and personal stockpiling have all arisen in response to AVI outbreaks. These psychological phenomena may persist and intensify if AVI outbreaks evolve into a pandemic. The lessons learned from COVID-19 can be used to prepare for a possible AVI pandemic. However, additional measures may be needed. Fear, disgust, and avoidance of specific foods would likely distinguish an AVI pandemic from COVID-19. The threat of infected food triggers disgust, and so food-related disgust would likely be a prominent emotional reaction during an AVI pandemic. Public messaging from health authorities and others has the potential to either ease or exacerbate public concerns about food safety, depending on how the messages are crafted.*

**Keywords:** Avian Influenza, Conspiracy Theories, Disgust, Food Avoidance, Pandemic Panic Buying, Vaccination Hesitancy

## Introductions

Pandemics are global disease outbreaks involving person-to-person transmission of new or re-emerging pathogens. Several pandemics have occurred over the past century or so, including the 1918 H1N1 Spanish flu, the 2009 H1N1 Swine flu pandemic, and COVID-19. Concerns have been raised about the pandemic potential of avian influenza (AVI) viruses, including highly pathogenic forms of H5N1, H7N9, and others [1]. In this article, pandemic AVI refers specifically to human infections spreading worldwide via person-toperson transmission. AVI outbreaks refer to localized outbreaks that, to date, have mainly infected poultry, sometimes cattle, and occasionally humans. AVI outbreaks have occurred frequently over the past few decades, but an AVI pandemic has yet to emerge. So far, humans have been largely spared from infection. However, AVI has affected people in other important ways, as we will see.

The risk of an AVI pandemic, while currently low, is rising rapidly due to the escalating frequency of AVI outbreaks and the expanding range of affected mammalian species. AVI viruses have not yet achieved efficient human-to-human transmission. However, gain-offunction studies (discussed below) show that H5N1 can be readily transformed into an airtransmissible form, with enhanced ability to infect mammals [2]. This indicates that the emergence of a human-transmissible avian virus may be imminent. As highlighted by a recent Science editorial on H5N1, "the virus may just need more time to hit the right combination of mutations" [3].

In preparation for an AVI pandemic, several discussion papers have offered guidelines [4,5]. While useful, these guides fail to consider the role of psychological factors. To address this gap, the present article presents a narrative review of the psychological impacts of AVI. The target populations are people in the community in general, and those at high risk for AVI given their occupations (e.g., livestock workers). In AVI studies, people were typically assessed during AVI outbreaks; that is, in the context of a disease threat.

Psychology is vital for understanding and managing pandemics and will likely be important if an AVI pandemic arises. Psychological research can shed light on the following:

- Adherence to pandemic mitigation methods (e.g., hygiene guidelines).
- Societally disruptive phenomena that complicate pandemic management (e.g., panic buying).
- Mental health problems that emerge or worsen in response to pandemic-related stressors (e.g., anxiety disorders).

There is no unified theory for understanding psychological reactions to infectious threats such as AVI. However, there are several relevant theoretical perspectives, including

1. cognitive-behavioral approaches to risk perception and health anxiety,
2. the concept of disgust sensitivity, and
3. personality approaches in which traits influence stress resilience and vulnerability (e.g., trait anxiety).

According to these approaches, AVI outbreaks, as portrayed in the media, influence cognitive appraisals of threat and associated emotional and behavioral responses, with the latter including avoidance and other coping behaviors. Disgust sensitivity and personality traits modulate (increase or decrease) these reactions. These conceptual perspectives, as they apply to infectious threats in general, are reviewed in detail elsewhere [6,7].

The aims of this review are twofold. First, to examine how the avian viral threat has psychologically impacted people so far. That is, the effects of recent and past AVI outbreaks on beliefs, emotions, and behaviors. Combining this knowledge with past research on pandemics, the second aim is to consider the psychological impacts of an AVI pandemic, if one were to arise. The following section describes the methods used for the literature review. Then, we describe the disease characteristics of AVI and consider how the infectious threat has been portrayed in the media. The remainder of the article examines the following issues: Public awareness, concerns, and misconceptions about AVI; conspiracy theories about the disease; coping behaviors during AVI outbreaks; AVI-related food avoidance; panic buying and personal stockpiling; vaccination hesitancy; risk communication to the public; and issues concerning high-risk groups.

## Literature Review Methods

In terms of study identification, several databases were searched simultaneously using the EBSCO database software: APA PsycArticles, APA PsycInfo, Biomedical Reference Collection, Business Source Ultimate, CINAHL Complete, Communication and Mass Media Complete, EBSCOhost eBook Collection, Maclean's Magazine Archive, MEDLINE, Primary Search Reference eBook Collection, Regional Business News, and Social Work Abstracts. Preprint servers (PsyArxiv and MedRxiv) and reference lists from all extracted articles were also searched. To facilitate the identification of descriptive (newspaper) accounts of AVI outbreaks, the following databases were searched: ProQuest, Nexis Uni, Factiva, South Asian Newspapers, National Index to Chinese Newspapers & Periodicals, South China Morning Post archive, Times of India archive, New York Times archive, Canadian Newsstream, and News on the Web. Database search terms, applied to titles and abstracts, were used to identify relevant AVI articles.

Search terms were "avian influenza", "avian flu", "bird flu", and "H5N1", combined with each of: "review or meta-analysis" (titles only), "knowledge or attitudes or practices", "vaccine or vaccination hesitancy", "Tamiflu or oseltamivir", "anxiety or fear", "disgust", "avoid or avoidance", "stockpiling or panic or panic buying", and "media or sensationalism". Published articles from any year and any language were considered, including empirical articles, review papers, and newspaper reports. The search was conducted in August, 2025. A total of 118 eligible, non-duplicate AVI-related publications were identified, grouped as follows: Reviews or empirical articles on the spread and management of avian viruses (n = 47 articles), articles on knowledge, attitudes, and practices concerning AVI and its management (n = 20), and other articles dealing with various issues concerning the psychology of AVI (e.g., panic buying, stockpiling, conspiracy theories, avoidance, media sensationalism; n = 51). For this review, data extraction involved identifying the main findings from each article, including percentages and descriptions of other findings. Of the 118 articles, 49 were cited in the present paper. Omitted citations were either of secondary importance or provided examples of phenomena described in other articles (e.g., panic buying). A complete set of references can be found at https://osf.io/preprints/psyarxiv/3x6tg_v1?view_only=.

## Avian Influenza

AVI is currently panzootic—the animal equivalent of a human pandemic—in which vast numbers of wild birds and other animals are infected worldwide. AVI spreads to domestic animals through wild, migratory shorebirds and waterbirds. When low-pathogenicity AVI viruses are transmitted from wild birds to poultry or other animals, they can mutate into highly pathogenic forms with high mortality rates (>75% in poultry). When infection is detected on poultry farms, the entire flock is culled to thwart the spread of disease. Globally, infections with highly pathogenic forms of H5N1 and other AVI viruses led to the death or precautionary culling of over 290 million poultry from 1996 to 2007 [8]. Cattle are less affected by AVI—they become ill for a few weeks and typically recover [1]. Overall, AVI has placed a substantial economic toll on the farming industry worldwide. To illustrate, as of November 2024, the US government has spent 1.25 billion dollars in AVI-related indemnity and compensation payments to farmers [9].

From 2003 to July 2025, there have been about a thousand human infections and nearly 500 fatalities from AVI arising in 25 countries [10]. Most cases involved exposure to infected animals, as when poultry workers became ill from handling infected birds and bird waste. The reported case-fatality rates in humans are very high; over 50% for H5N1 and over 19% for H7N9 [1]. The true percentages are likely lower, given that asymptomatic and mild cases often go undetected. Nevertheless, AVI can cause serious illness and death in humans. Even an AVI pandemic with a case fatality rate as low as 2% would result in millions of human deaths and impair the global economy, with an estimated impact similar to that of COVID-19 [1].

To limit the odds of human infections during AVI outbreaks, the public is advised to (1) avoid unprotected exposure to sick or deceased animals, especially wild birds, poultry, and cattle, and (2) avoid uncooked poultry and cattle products, such as raw eggs and unpasteurized milk. It is unclear whether humans can acquire AVI by consuming infected animal products [5]. Nevertheless, thorough cooking destroys the avian viruses. Vaccines for humans and animals have been developed for H5N1 and other strains, with further work ongoing. Treatment

of infected people involves prompt medical management with antiviral medications such as oseltamivir (Tamiflu).

## Media Representations of Avian Influenza

Emotional and behavioral reactions to AVI are shaped by people's knowledge and experience concerning the disease. Most people have limited direct experience with AVI, since human infections have been uncommon to date. For disease threats such as AVI, the mainstream news and social media are the primary sources of information for most individuals. For example, a 2023 European survey found that although most respondents (81%) were not involved in raising poultry, most had previously heard of AVI (86%), mostly from stories on television or the internet (77%) [11]. AVI outbreaks regularly attract media attention. An analysis of news stories on AVI from four major US newspapers, 2000-2006, found that nearly 75% of AVI articles were located in the newspapers' first or leading section and over 20% were published as front-page news, highlighting the extent to which AVI dominated the news [12].

The news media have been criticized for exaggerating the dangers of AVI by using emotionally charged language, making misleading comparisons between AVI and the 1918 Spanish flu, selectively using statistics, and sensationalizing speculations about the death toll and economic costs [12,13]. The 2000-2006 survey of US newspapers found that most articles (73%) used emotionally evocative phrases or words, such as "killer," "attack," "vengeance," and "racing" [12]. Further examples of sensationalized portrayals included news stories claiming that AVI is "a lethal storm" and a "constant threat," representing "the biggest disease threat to humanity," with human infections arising "not as sporadic individual cases and clusters but rather as marching steadily across borders and entire contents" [13]. Other examples of media sensationalism include articles describing AVI as "an impending storm" or portraying it as a hostile enemy that "terrorizes" particular regions [14]. Commonly used was the language of invasion and war, in which AVI was portrayed as a looming, anthropomorphized enemy [13].

Speculative worst-case scenarios were depicted in over 40% of news articles, with dramatic descriptions of potential death tolls (e.g., "could kill 50 million") and economic impacts (e.g., could cause a "breakdown of global economies") [12]. News articles tended to focus on the dangers of AVI, containing less information about how to stay safe [12]. The assignment of blame was common in AVI news stories. For example, a survey of media reports on seven AVI outbreaks in South Korea from 2003 to 2017 found that 34% of news articles blamed the government [15]. Blame was more common when outbreaks were particularly severe. An analysis of Danish and Norwegian news coverage of AVI revealed evidence of a "herethere" distinction in many news stories [16]. Poultry production in Denmark and Norway was portrayed as employing clean, responsible, and knowledge-based animal husbandry.

In contrast, poultry operations in other countries were depicted as unhygienic, with poultry living in homes and children playing in poultry excrement. As AVI outbreaks drew closer to Norway and Denmark, the news media "tended to blame infection and spread on wild birds, seasonal changes, bad luck, and other factors outside of human control" [16]. In other words, as the disease loomed closer, external attributions of responsibility increasingly appeared in news stories. To summarize, evidence suggests that media coverage of AVI outbreaks has been sensationalized, with threats being exaggerated and blame readily assigned. Similar findings have been reported for other disease outbreaks, including influenza pandemics and COVID-19, and are likely to be seen in future outbreaks of novel infectious diseases [7]. If an AVI pandemic were to emerge, it would receive intense media scrutiny and sensationalism.

The media would explore the origins of AVI and examine the relationship between AVI and the human food chain. News stories would describe the occupational hazards of poultry farming and processing operations, such as exposure to organic dust containing fecal matter. Television reports would present striking images of sick and dying animals, and vivid descriptions of culling operations, evoking fear and disgust in viewers. Responsible reporting need not be devoid of disturbing details, but should be balanced with information about protective measures. In the following section, we take a closer look at community reactions evoked by reports of AVI.

## Public Awareness and Concerns During Avian Influenza Outbreaks Knowledge and Misconceptions

Community reactions to diseases are dynamic, influenced by factors such as the proximity of the hazard and how it is portrayed in the media. People tend to be more concerned and better informed about AVI when the outbreak is in their community or country, as opposed to distant places [17,18]. Community surveys from regions affected by AVI show that most residents have at least some knowledge of the disease and its management [11,17,19,20]. For instance, a 2004 study from urban Vietnam, conducted in the months following local outbreaks, found that all participants had heard of AVI [19]. Similarly, a 2006 European survey, fielded across several member states in the months following widespread media reports of outbreaks, found that most people were moderately well-informed about the health risks of AVI: 63% correctly reported it is safe to eat cooked chicken (even if the meat is infected), 70% were aware that the European Union has strict controls on poultry imports, and 84% knew that if AVI arises on a poultry farm, the entire flock is culled [17].

Despite having knowledge of some aspects of AVI, many people held misconceptions about the disease. European community surveys showed that many people overestimated the AVI threat: 36% held the misconception that humans can be easily infected, 21%-41% mistakenly believed that one could get AVI from eating infected but thoroughly cooked eggs or poultry, and 29% erroneously thought it was unsafe to eat the meat of AVI-vaccinated poultry [11,17]. A Cambodian survey found that 42% of respondents erroneously believed that AVI was transmitted by mosquito bites, in addition to being spread

by birds [21]. Similarly, a 2005 Hong Kong survey revealed misconceptions about the transmission of AVI, with many participants mistakenly believing that one could be infected with H5N1 via long-distance airborne transmission (36-48% yes) and insect bites (48-49% yes) [22]. Overgeneralization about the modes of transmission of AVI likely increased the perceived threat of the disease, as insect-borne diseases can infect people regardless of their proximity to poultry. Similar overestimations of danger were reported in other outbreaks (e.g., cholera, Ebola virus disease), in which some people believed infection could spread through numerous and unlikely routes [7].

## A Spectrum of Concerns

Knowledge and misconceptions about AVI influence a person's concerns about the disease. Community surveys reveal a spectrum of concerns about AVI, ranging from minimal concern to dire expectations [19,23,24]. People who have not been personally affected by AVI, such as those living in countries far from the outbreaks, may experience little concern and wonder whether the threat has been exaggerated. Other people become highly alarmed. Amid AVI outbreaks in a 2004-2005 Vietnam survey, 59% of respondents felt very concerned for the safety of themselves and family members because of AVI [19]. A 2025 US poll found that 44% of Americans were very or somewhat concerned that a widespread outbreak would occur, and 34% worried that they or a family member would fall ill [23].

People worried about AVI tend to report three types of concerns: Physical health, economic impacts, and unknown risks [11,14,25]. When AVI threatens livelihoods, worries about personal economic impacts may take precedence over other concerns. Consider, for example, an Indonesian H5N1 survey: Despite the threat of personal infection, poultry farmers expressed greatest fears of the economic repercussions of AVI, such as the loss of livestock [14]. Anger is a frequent response to serious infectious outbreaks in which governments, foreigners, or others are blamed [7]. To assess public sentiment regarding AVI in 2024, Cooper and colleagues (2025) analyzed 13,000 tweets about the outbreaks. The predominant emotions expressed in the tweets were anger (36%) and fear (30%) [26].

Individual difference (trait) variables likely account for some of the heterogeneity of concerns about AVI, although research is needed to fully investigate this issue. People scoring high on trait anxiety (anxiety proneness), compared to low-scorers, are more likely to overestimate the probability and severity of threats, and therefore likely to be highly anxious about AVI. High scores on other personality traits are also associated with severe distress during disease outbreaks. These traits include disgust sensitivity (the tendency to experience disgust readily and intensely), which is discussed later in this article. During the COVID-19 pandemic, individuals with high scores on trait anxiety and disgust sensitivity tended to experience significant anxiety about the coronavirus [6].

## Past Experience as a Frame of Reference

Past experiences influence how people interpret infectious threats. To illustrate, a UK survey was conducted to assess public reactions to a 2007 AVI outbreak on a turkey farm in England, which was linked to infected turkey meat imported from a Hungarian processing plant [27]. The survey found that many people used past food scares—particularly bovine spongiform encephalopathy (BSE, colloquially known as "mad cow disease")—as a reference for understanding AVI. The avian hazard was seen as similar to BSE because both were alleged to have their roots in inhumane modern farming practices and inadequate regulation of animal imports [27]. Some respondents believed that AVI broke out because turkeys were fed ground bird carcasses, similar to how BSE arose when cows were fed ground sheep carcasses infected with a prion disease known as scrapie. The UK survey suggests that if an AVI pandemic arises, conspiracy theories (discussed later) would likely emerge concerning the alleged roles of human activities in causing the disease.

Severe Acute Respiratory Syndrome (SARS) also served as a frame of reference for people's understanding of AVI. SARS outbreaks, caused by the SARS-CoV-1 coronavirus, occurred in Hong Kong and elsewhere from 2002 to 2004. According to a Hong Kong survey, SARS shaped expectations concerning future AVI outbreaks [24]. Respondents who were impacted (alarmed) by SARS were most likely to worry about AVI. In the event of an AVI outbreak involving human-to-human transmission, respondents expected: (1) A high fatality rate (74% yes), (2) severe physical harm for survivors of the disease (55%), (3) inadequate vaccines (63%), and (4) shortages of medical supplies (55%) [24]. The COVID-19 pandemic will likely serve as a frame of reference if an AVI pandemic arises when COVID-19 is still fresh in people's minds. One's COVID-19 experiences might influence, among other things, panic buying during an AVI pandemic. During the COVID-19 pandemic, pharmacy items and groceries were common targets, although there was also panic buying of items with little or no protective value, such as toilet paper. Once these items were identified in the news or on social media as targets of panic buying, shoppers rushed to make purchases, fearing shortages [7]. If an AVI pandemic were to arise within the recent memory of COVID-19, panic buying would likely include pharmacy and grocery supplies, especially items that were targets of panic buying during COVID-19 (e.g., hand sanitizer, toilet paper). AVI-related panic buying is further discussed later in this article.

## Conspiracy Theories about Avian Influenza

### Descriptive Features

Conspiracy theories are extreme kinds of rumors in which some significant event—a novel disease outbreak, for example is explained in terms of secret plots by powerful, often shadowy individuals or organizations. Such theories emerge in marked opposition to mainstream or official accounts of situations and events. Conspiracy theories tend to be recycled, with old ones modified to "explain" new threats [7]. Conspiracy theories provide simple, understandable explanations: Why something happened, who benefits, and who should be blamed. Conspiracy theories resist falsification because they postulate that conspirators employ stealth and deception to

conceal their misdeeds, implying that individuals attempting to debunk conspiracy theories may be part of the conspiracy [28]. The absence of evidence for a conspiracy theory may be taken as evidence of a cover-up. Disease outbreaks are commonly the subject of conspiracy theories. For example, during the Spanish flu pandemic, which emerged in the final year of World War I, a conspiracy theory arose in America that Bayer Pharmaceuticals—a German company—was covertly spreading influenza via contaminated aspirin tablets [29]. Testing revealed that the tablets were uncontaminated. As for AVI, two main types of conspiracy theory have emerged so far: One claiming that AVI is a bioweapon and another claiming the disease is part of a hoax.

## Bioweapon Conspiracies

A recurring conspiracy theory is that a disease outbreak is caused by a weaponized pathogen or poison, used by malefactors to gain some advantage. Amid H5N1 outbreaks in Indonesia, one of the countries hardest hit by AVI, several bioweapon theories emerged [14,30]. A widely circulated theory reflected xenophobic concerns that "the US introduced the virus to destroy the Indonesian poultry industry and promote its own poultry exports and vaccines" [30]. Variants on the theory alleged that AVI was brought to Indonesia by the US as part of a global plot to either destabilize Islamic countries such as Indonesia, or "to weaken Indonesia, to make it more dependent on international aid and loans, and therefore behoven to the Western powers in need of its natural resources" (pp. 16-17). Another theory claimed that big agricultural businesses, in league with the central government, were trying to drive small farmers out of business by claiming that backyard poultry were less safe than factory-raised birds [14,30].

## Hoax Conspiracies

During H5N1 outbreaks in Indonesia, there were hoax conspiracy theories claiming that the threat had been deliberately exaggerated or fabricated. For example, one theory suggested that the government was exaggerating AVI to attract foreign aid, while another theory posited that the press sensationalized AVI to sell newspapers [14,30]. Found that 18% of AVI-related tweets, posted in English from any country, contained references to AVI as a scam or hoax intended to control the populace [26]. This is illustrated by the following tweet: "Bird flu is not a thing! They just want to take away your food, your farms, your stability, your jobs, your way of life, your freedom!" (p. 3). These and other examples show that AVI attracted both hoax and bioweapon conspiracy theories, as was the case with COVID-19 [7]. A common thread in these theories concerns fears of harm from AVI. That is, either physical harm (infection), economic harm (job loss), or social harm (oppression in the name of disease containment).

## Future Conspiracies

Fear of harm will likely be prominent in future AVI conspiracy theories, especially if a pandemic emerges. Gain-of-function (GOF) research, in which the virulence of a pathogen is experimentally manipulated, is likely to attract the attention of conspiracy theorists should an AVI pandemic emerge. GOF refers to the gain of new functions by organisms through genetic mutations, which may occur naturally or by experimental modifications. GOF research aims to provide insights into viral mechanisms and to enhance vaccine development. Such research demonstrates that avian viruses, such as H5N1, can be easily transmuted into highly pathogenic, air-transmissible forms with enhanced ability to infect mammals [2]. GOF research is highly controversial, with critics arguing that the risks outweigh the benefits. Key criticisms include concerns that "while there are indisputably certain questions that can be answered only by gain-of-function experiments in highly pathogenic strains, these questions are narrow and unlikely to meaningfully advance public health goals such as vaccine production and pandemic prediction" [31]. Moreover, progress in virology and pandemic preparation "can be achieved without undertaking experiments that, if an accident occurs, could start a new pandemic" [31]. A further concern is that findings from this kind of research "could be misused by rogue states, terrorist organisations, or individuals to pose a biological threat to public health or national security" [32].

GOF experiments on H5N1 and other viruses were subject to a US funding moratorium from 2014 to 2017 until new oversight rules were established. A few years later, COVID-19 emerged, along with circumstantial evidence—but no definitive proof—that the coronavirus was an experimentally created strain that escaped from a laboratory [33]. Given this context, in the event of an AVI pandemic there will likely be conspiracy theories that the pathogen was created in a lab, from which it accidentally escaped or was intentionally released for nefarious purposes. Belief in conspiracy theories can be difficult to correct. Lewandowsky and colleagues offered useful guidelines for addressing disease-related conspiracy theories [34,35]. Recent research further suggests that dialogues with artificial intelligence programs (e.g., ChatGPT) can reduce conspiratorial thinking when the programs are instructed to convincingly refute the theories [36]. In the event of an AVI pandemic, such methods could be used to refute beliefs that AVI is a hoax or a deliberately created biohazard. Further research is needed to evaluate the use of artificial intelligence for addressing conspiracy theories.

## Coping Behaviors During Avian Influenza Outbreaks

As we have seen, AVI is associated with a spectrum of beliefs and concerns. Accordingly, public adherence to food safety and other health guidelines varies widely, as illustrated by research conducted when Hong Kong was threatened with H7N9 due to outbreaks in mainland China [37]. Latent class analysis identified three groups of Hong Kong residents, defined according to their adherence to hygiene guidelines (e.g., handwashing, facemasks, and avoiding sources of infection such as live poultry markets):

1. Moderate adherence (48% of sample),
2. high adherence (35%), and
3. very high adherence (16%).

People in the first group tended to be young men who saw themselves as having low susceptibility to H7N9. At the other extreme, individuals in the third group were highly anxious about the virus [37]. When people feel threatened by a potentially lethal infectious disease, they look for cues

to safety and danger—seeking the former and avoiding the latter. For example, according to an Indonesian survey, sickly butchers were potent danger signs, with people believing that "if avian flu was truly in their community, the first people to be infected would be butchers in the wet market" [14].

Once detected, danger cues can prompt various coping behaviors, depending on how the threat is interpreted. During AVI outbreaks, even those involving few or no human casualties, people have sought safety by adopting various coping strategies, including the following [38,39,40]:

- Poultry avoidance (e.g., refraining from purchasing poultry and avoiding live bird markets).
- Seeking food quality assurance (e.g., checking the labels on packages of chicken or eggs for evidence that the food is safe).
- Hygiene behaviors (e.g., washing hands often and thoroughly cooking poultry and eggs).
- Crowd avoidance (e.g., avoiding crowded public places and wearing masks in public places).
- Procuring medications and folk remedies.

To illustrate, several of these coping responses were evident in a survey of food production workers in China, three months after an H7N9 outbreak. Most workers (70%) worried about getting infected with H7N9. Several coping responses were identified: 81% washed their hands more often than before, 68% ventilated rooms by opening windows and doors, 49% cancelled or postponed social engagements, 40% brought drugs in preparation, and 37% were no longer buying poultry [39]. A person's beliefs about AVI influence their choice of coping method [40]. For people believing that AVI symptoms resemble food poisoning, seeking food quality assurance was the most common coping strategy. For those believing that AVI can be transmitted via cooked food products, food avoidance was a frequent coping response. For people who thought that AVI is transmitted by physical contact or respiratory secretions, avoiding animals was a common coping behavior. The people most frightened of AVI were most likely to use all three coping strategies [40].

## Selective Avoidance of Foods

### Poultry Products

Food avoidance by consumers has been a prominent coping response during AVI outbreaks and so merits detailed analysis. Research shows that AVI outbreaks on poultry farms tend to be associated with short-term reductions in nearby communities in the purchase and consumption of poultry products [17,19]. For example, in a 2006 European survey, regions with more AVI outbreaks had greater reductions in poultry consumption [17]. In those regions, 18% of respondents reported eating less poultry, and 12-13% reported consuming fewer eggs and egg-based products because of concerns about AVI. Of those who reduced their consumption, 48% said they were exercising caution, given the uncertainties concerning the health risk, while another 15% were "convinced that it is dangerous to eat poultry meat at the present time" [17].

During AVI outbreaks in Vietnam, most respondents (74%) had temporarily stopped or reduced their poultry consumption [19]. Of those who reduced or ceased consumption, 90% said they did so for fear of AVI. Participants were especially wary of chickens raised in large-scale farming operations, fearing, among other things, that the birds' feed "might contain contaminated poultry remains" [19]. High levels of anxiety were associated with low trust in the authorities to control the disease. The effects of AVI on consumers tended to be short-lived, affecting poultry consumption "briefly but intensely" (p. 450), resolving once the outbreaks were over. However, a substantial minority of individuals (20%) remained anxious about AVI [19].

The consumption of beef and milk has been less affected by AVI, which is not surprising given that cattle typically experience mild illness, and infected animals are usually not culled because they recover after a few weeks. AVI outbreaks among cattle might lead consumers to avoid beef and milk products, but research is needed to investigate this issue. To summarize, during AVI outbreaks, many people become anxious and avoid consuming poultry, eggs, and related products. In the event of an AVI pandemic, we can expect a significant fraction of the community to become anxious and avoidant of perceived sources of infection, including potentially contaminated foods and potentially infected people. Food avoidance is likely to distinguish an AVI pandemic from the COVID-19 pandemic, given that infection of the food supply is likely to be a greater public concern for AVI.

## Seeking Safety in Food Selection

**Free-range poultry**. Cost aside, consumers commonly prefer free-range poultry. This is for various reasons, including the beliefs that free-range birds are healthier and taste better than those raised in conventional, large-scale, confined barns. Supermarket packaging labels such as "free-range" (and "organic") alert shoppers to the purported benefits of such foods. Some of the perceived health benefits may be illusory. Free-range birds are less stressed and crowded than their caged counterparts, which could lessen disease transmission. However, free-range poultry have a greater opportunity to interact with wild birds and thereby acquire infections. Research suggests that raising poultry in free-range settings with outdoor access is associated with an increased risk of AVI [41]. In the event of an AVI pandemic, free-range and conventional farming methods are likely to be discussed and debated in the media to address consumer concerns about their relative safety.

**Organic foods.** Consumers commonly believe that organically grown foods are safer and healthier—in terms of pathogens, pesticides, antibiotics, and growth hormones—than foods produced by conventional methods. Organic production methods may be associated with a lower prevalence of antimicrobial-resistant bacteria [42]. However, there is no evidence that organic foods offer protection against viruses, including those causing AVI. Regarding pathogens in general, "most studies reveal that meat produced under

organic conditions is more often contaminated with foodborne pathogens than meat from conventionally produced animals" [42]. Nevertheless, organic foods have acquired a reputation for safety and are likely to be preferentially sought by some consumers during an AVI pandemic.

**Imported versus locally sourced foods.** The food supply chain is globalized, meaning that people regularly consume products imported from other countries. Many consumers prefer locally sourced foods over imports, believing the former are safer and of higher quality [43]. Countries commonly impose temporary bans on poultry imports during AVI outbreaks, possibly reinforcing consumer beliefs about the safety of locally produced foods. However, it is unclear whether AVI outbreaks are associated with an increased demand for local poultry products over imported ones. Further research is needed. The location of the outbreaks is likely crucial; outbreaks in foreign countries may lead consumers to prefer domestic products, whereas local outbreaks may lead to a preference for imports.

## Disgust Sensitivity and Food Avoidance

**Disgust.** Disgust is an important determinant of food avoidance. Disgust is a basic human emotion characterized by aversion, revulsion, and repugnance in response to particular objects, animals, or people. Disgust-evoking stimuli are often associated with disease, contamination, or bodily secretions. Disgust is a significant driver of food choices, motivating people to avoid cues that signal the presence of pathogens, toxins, or other noxious stimuli [44]. For foods, sensory cues concerning appearance, smell, and taste can trigger disgust. However, there is more to disgust than mere distaste. Disgust entails a reaction to the idea of what a food represents [45]. During an AVI outbreak, people may avoid eating chicken because of disgust, arising from concerns that the food might be infected, even though the food's texture and taste have not changed. Although the tendency to experience disgust appears to be innate, people may learn to associate disgust with particular foods or other stimuli, which can involve vicarious learning, which involves observing the reactions of others [46]. In the event of an AVI pandemic, in which people would learn to associate poultry products with infectious disease, we can expect to see an increase in the prevalence of disgust reactions toward those products. These reactions are modulated by individual differences in the tendency to experience disgust.

**Disgust sensitivity.** Disgust sensitivity is the tendency to experience disgust readily and intensely [47]. People who are highly disgust-sensitive are less likely to consume foods past their expiration date and are more likely to be worried during disease outbreaks. Individuals with high levels of disgust sensitivity also tend to prefer organically farmed foods [48]. During the COVID-19 pandemic, disgust sensitivity was positively correlated with

1. fear of infection,
2. stockpiling of non-perishable foods (e.g., canned goods and pasta),
3. avoidance of close contact with strangers, and
4. more frequent personal hygiene behaviors, such as hand washing [7].

Longitudinal research shows that people with elevated disgust sensitivity are more likely to see food-borne pathogens as dangerous, even after controlling for nutritional knowledge [49]. Building on this, if an AVI pandemic were to occur, research suggests that people scoring highly on disgust sensitivity would be especially likely to

1. avoid potentially contaminated foods and potentially infected people, and
2. stockpile "safe" foods (e.g., eggs and chicken obtained from uninfected regions) [7,49].

## Panic Buying and Personal Stockpiling

### Descriptive Features

Panic buying and personal stockpiling are instrumental efforts to exert control over a threatening situation. Panic buying is the rushed purchase of supplies driven by fear of impending shortages. Personal stockpiling is the progressive collection and storage of food, medicine, or other essential supplies. Personal stockpiling may be rushed, as when a person engages in panic buying, or it may be a process of steady accumulation. Panic buying of disinfectants, medications, herbal remedies, and foodstuffs has been documented in many disease outbreaks, including the Spanish flu and COVID-19 pandemics [7]. A striking example of AVI-related panic buying occurred in Cairo in 2006. At that time, people were advised not to drink the water because, as widely reported in the news, farmers had begun dumping infected, dead chickens into the Nile River, which is a source of drinking water for millions of Egyptians. These reports led to panic buying and stockpiling of bottled water, despite government assurances that purification chemicals in public water supplies would kill the H5N1 virus [50]. Thus, fears about contamination can override government assurances, leading to panic buying and stockpiling.

### Panic Buying versus Food Avoidance

Two seemingly contradictory reactions—egg avoidance and panic buying of eggs—have been observed during AVI outbreaks. AVI causes a decline in egg production. The threat of impending shortages can trigger panic-buying of "safe" foods, such as eggs from regions where AVI is not active or eggs laid before the outbreak. Egg shortages due to AVI have triggered panic buying in many countries. For example, in the US, the 2023-2025 outbreaks of AVI in poultry farms led to egg shortages, which drove up prices and triggered nationwide panic buying of eggs [51]. Panicked consumers purchased larger quantities than usual—for example, four dozen eggs instead of one dozen—temporarily depleting grocery stores. Panic buying of eggs or other food items is unlikely when consumers worry that these items might be contaminated with avian viruses. Under these conditions, food avoidance is more likely. Further research is needed to better understand the contextual and psychological factors that lead to food avoidance versus panic buying.

### Medications and Herbal Remedies

Medications (prescription and non-prescription) and herbal remedies are frequent targets of panic buying during pandemics and other infectious outbreaks. Panic buying of these items has occurred during AVI outbreaks. To illustrate, consider ban

lan gen, a root from the Isatis plant, from which tea is brewed and widely sold in China as a cold remedy. As H7N9 surged in China in 2013, mainly affecting poultry but also involving numerous human infections, there was panic buying of ban lan gen. Many stores sold out, and prices rose sharply amid heightened demand [52]. Panic buying was precipitated when a government official declared, without evidence, that ban lan gen could prevent AVI. The herb was also a target of panic buying in China during the 2003 SARS epidemic, the 2009 Swine flu pandemic, and H5N1 outbreaks [52].

Prescription medications have been targets of personal stockpiling. In 2005, amid AVI outbreaks in Europe, the antiviral drug Tamiflu was sold online, including auctions on eBay [53]. Fears that the drug would not be available to the general public led to a brisk online trade. Although the drug was available by prescription for £25, bidding on eBay quickly took the asking price up to £104 [53]. In the US, the demand for Tamiflu increased dramatically from 2004 to 2005 during the non-flu season, rising from 27 to 134 filled prescriptions per 100,000 [54]. There were numerous reports of healthy but worried adults pressing their doctors to write prescriptions for Tamiflu in the event of an H5N1 outbreak. The demand arose following increased media coverage of AVI. According to a 2005 study of 109 Tamiflu prescriptions, only 33% were prescribed for patients with appropriate indications [55].

People who sought prescriptions "reported greater worry about avian influenza and more often expect avian influenza to spread to the United States" [55]. Thus, the largest proportion of Tamiflu prescriptions filled in 2005 was from "those categorized as the healthiest patients" [54]. Not all prescriptions were filled—many were obtained as a precaution [55]. A concern is that stockpiling by worried individuals could lead to shortages for those needing the drugs. Panic buying and personal stockpiling of drugs commonly occurred during past pandemics and are likely to arise during an AVI pandemic, especially among people who are anxious about infection. Medical practitioners should be alert to the possibility of anxious people pressuring them for unwarranted prescriptions. Strategies for addressing the concerns of health-anxious patients are discussed elsewhere [56,57].

## Public Messaging for Managing Panic Buying, Personal Stockpiling, and Food Avoidance

### Risk Communication and Public Trust

Risk communication is when health authorities or other groups issue public messages about disease risk and actions people should take. Risk communication provides people with the knowledge to make informed choices concerning their health and safety. Important information includes advice on hygiene, wearing masks, and vaccination. Good risk communication is clear, concise, practical, and evidence-based. For risk communication to be effective, messages must be convincing and credible. Public trust in health authorities is essential for adherence to health measures and for easing fears about disease threats. Mistrust frequently arises amid disease outbreaks. For example, a survey of Chinese food production workers after an H7N9 outbreak found several types of mistrust in government [39]:

- Concerns that information about the disease was not released in a timely manner (20% of respondents).
- Belief that the government intentionally concealed some information (21%).
- Doubts about whether the government could control the outbreak (32%).

Other research showed that greater public anxiety about AVI was associated with greater mistrust of government and with doubts about the capability of healthcare services to deal with an influx of infected individuals [25]. Risk communication for hazards like AVI faces a key challenge: Alerting the public to potential danger without causing undue alarm. It is important to encourage appropriate precautions, but not engage in extreme or disruptive behaviors such as panic buying, excessive stockpiling, or unnecessary food avoidance. Two main types of risk communication have been used for AVI: One emphasizes the absence of danger, and the other highlights ways to attain safety. The following sections examine these approaches.

### Messages Emphasizing the Absence of Danger

Poorly crafted messages from leaders can trigger widespread problems. Messages from health authorities or other leaders may inadvertently encourage panic buying and personal stockpiling. Panic buying was precipitated during the COVID-19 pandemic when the public was advised to stock up on groceries in preparation for "lockdown" (shelter-at-home directives). In an attempt to control panic buying, frustrated community leaders issued "don't panic!" messages in the news media, but this failed to dissuade anxious shoppers from over-purchasing supplies [7]. During AVI outbreaks, risk communication has focused on food safety, especially regarding eggs and poultry. When making announcements concerning AVI outbreaks, government officials and health experts frequently emphasized the absence of danger with the message, "don't panic!" [58,59]. To illustrate, in response to a significant drop in poultry sales due to AVI, an Austrian agricultural minister declared that now "is not the time for panic" [59].

Cash inducements were sometimes added to "don't panic" messages. In Thailand in 2004, AVI resulted in two human deaths and the culling of 10.7 million poultry. To boost consumer confidence during the crisis, the Thai Prime Minister vowed "to pay $75,000 if anyone dies from eating properly cooked chicken" [60]. It is unclear whether the cash inducement had any impact, positive or negative, on consumer behavior. Elsewhere in the media, the same Prime Minister described AVI as an "enemy… no less deadly than SARS" [61]. The mixed messages—AVI is a deadly enemy versus nothing to panic about—were likely a source of confusion. "Don't panic" messages from community leaders can be ineffective or counterproductive, making people wonder whether there is something worth panicking about. In the social psychological research literature, the relevant phenomena are known as innuendo effects or ironic effects of negation [62]. Consider

the following statements: "Jim is not guilty" versus "Jim is innocent." When asked to make evaluations of Jim based on what they're told about him, research participants are more likely to have a more negative evaluation of Jim when presented with the first statement as compared to the second [62]. Although the cognitive mechanisms remain to be fully elucidated, it appears that when people process negations, they automatically link the subject and object (e.g., "Jim" + "guilty") and then, via additional, more effortful cognitive processing, add the negation ("not"). Despite the presence of a negation, the subject and object become linked [62].

This has been demonstrated in numerous studies. For example, "No smoking" signs can prime smoking behavior, motivating smokers to smoke, despite the negation [63]. Thus, messages that contain a negation (e.g., "Don't panic about AVI") can have an ironic effect, producing the opposite of the intended outcome. "Don't panic" messages can also be sensationalized in news stories, giving a misleading impression of widespread panic. Alternatives to messages like "don't panic" sometimes focus on communicating the degree of threat rather than addressing emotional reactions. During AVI outbreaks, some authorities issued reassuring statements that acknowledged the threat but emphasized its low level of risk, such as describing "little danger" or "no immediate threat" to the public [13]. These messages still referenced danger and so may have been prone to the innuendo effect. Research is needed to investigate this issue.

### Messages Emphasizing Safety

In contrast to "don't panic" messages, with their focus on danger, the poultry industry and fast-food corporations sought to emphasize safety by highlighting that safety can be attained by simply cooking poultry meat and eggs [64]. Responding to AVI outbreaks, Kentucky Fried Chicken (KFC), the National Chicken Council, and the US Poultry and Egg Association reassured consumers that cooked chicken and eggs were safe. In 2006, fastfood chains such as McDonald's, El Pollo Loco, Popeyes, Subway, and KFC, launched a "massive marketing-communications program … to reassure consumers that eating chicken is safe" [64]. In the US, KFC added "food safety assurance" labels to chicken containers, promising rigorous inspection and thorough cooking. These labels were designed to "purposely avoid mentioning bird flu" [65]. In China, KFC outlets used tray liners and posters to assure customers that their chicken came from highquality suppliers and was cooked at high temperatures. These "stay-calm advertising campaigns" emphasized the easy attainment of safety ("cook and it's safe") rather than the absence of danger ("don't panic!") [64].

### Implications for an Avian Influenza Pandemic

An AVI pandemic—involving sustained person-to-person transmission of infection in communities—will likely involve risk communication messages concerning personal hygiene (e.g., washing hands, covering coughs, as per COVID-19), as well as food preparation guidelines. Compared to the COVID-19 pandemic, an AVI pandemic is more likely to be complicated by (1) food supply chain problems (e.g., egg or milk shortages due to livestock sickness and death), and (2) heightened public concerns about food-borne contamination (e.g., concerns about infected eggs or poultry meat). Panic buying of specific foods is likely to occur during an AVI pandemic, in which people rush to purchase limited supplies of "uncontaminated" eggs and poultry meat. Compared to poultry, beef is less likely to be affected by shortages and panic buying, since most cattle recover from AVI after a few weeks of illness. However, milk production is compromised by AVI, since infected milk is excluded from the human supply chain. Accordingly, panic buying and stockpiling of milk may occur in response to an AVI pandemic affecting dairy cattle. To avoid exacerbating panic buying, public announcements should refrain from using "don't panic" messages, focusing instead on how to attain safety. Panic buying can be further managed by imposing quotas on purchases (e.g., grocery stores imposing limits on the number of eggs that consumers can purchase per day).

## Issues Concerning Vaccination

### Livestock Vaccination

Conventional measures for managing AVI in poultry and cattle include biosecurity procedures, such as livestock culling and the use of personal protective equipment by farm laborers [5]. These measures are helpful but insufficient for managing AVI, so vaccination has been explored in many countries. Both humans and livestock can be vaccinated against the viruses causing AVI. In this section, we consider livestock vaccination. For a livestock vaccine to be licensed, it must be shown to be safe and effective for both the target species and human consumers. The use of livestock vaccines has increased markedly in the past few decades, partly because of AVI [66]. Vaccines exist or are being developed for H5N1, H7N9, and other strains causing AVI. However, livestock vaccination remains controversial [67].

Not all countries vaccinate livestock, and some only do so during eradication campaigns [66]. Some nations hesitate to vaccinate due to concerns that trading partners may avoid or ban imports of vaccinated poultry or cattle. A further issue, which remains to be fully investigated, is that subclinical infections may be harder to detect in vaccinated animals, potentially perpetuating AVI [66]. Despite these concerns, many countries have vaccinated their poultry against AVI, including China, Indonesia, Mexico, Vietnam, Egypt, and France [66]. To illustrate one such vaccination campaign, from 2013 to 2017 in China, there were five epidemics of H7N9, with the number of infected people ranging from 117 to 766 [68]. Most human cases had a history of exposure to poultry, typically from live bird markets. Nationwide compulsory vaccination of chickens with an H5/H7 bivalent vaccine was implemented in 2017. The prevalence of H7N9 in poultry was dramatically reduced, indirectly protecting humans from infection [68]. The number of human cases of H7N9 dropped from 766 in 2017 to only four cases in 2018-2019 and none in 2020. The drop in cases was attributed to the joint effects of poultry vaccination and the periodic closure of live markets during AVI outbreaks, which reduces human exposure to infected birds [68].

## Public Acceptance of Vaccinated Foods

In commercial farming operations, including organic farming, livestock may be vaccinated against a range of diseases. For example, poultry may be vaccinated against Newcastle disease, infectious bronchitis, and Marek's disease. Grocery store packaging labels for poultry and cattle products may provide information about antibiotics, but typically do not contain information about vaccines. Regarding AVI, surveys indicate that many people are apprehensive or uncertain about consuming poultry vaccinated against AVI. For instance, only 36% of Taiwanese respondents recognized that eating chickens vaccinated against AVI was safe [38]. A Europewide survey showed that only 47% understood that meat from vaccinated chickens was safe to consume. The remaining respondents either believed the meat was unsafe (29%) or were uncertain (24%) [17]. If an AVI pandemic were to emerge, the biosecurity of the food chain would likely receive intense scrutiny in the media, resulting in greater public awareness that livestock are frequently vaccinated against various diseases. Food-related vaccination hesitancy may emerge, where some people avoid purchasing food that might contain either vaccines or viruses. Acceptance of vaccinated foods may increase when consumers are provided assurances of vaccine safety, although this requires further investigation.

## Human Vaccination

Several AVI vaccines for humans have been developed or are under development. While vaccines are critical for reducing morbidity and mortality for various forms of influenza, vaccination hesitancy is a significant obstacle. Vaccination hesitancy is a broad term encompassing indecision, reluctance, or refusal to receive vaccination despite evidence of vaccine safety and efficacy. Vaccination-hesitant people include adamant refusalists and those who are amenable in principle but, for various reasons, are reluctant or slow to accept vaccination. Vaccines have aroused mistrust and nonadherence since the earliest vaccination procedures for smallpox in the 18th century. The problem has persisted despite efforts to improve vaccine uptake. Measles was eliminated through vaccination in the US in 2000, only to re-emerge some years later, mainly due to parental opposition to vaccines. Notably, objections against vaccination raised in the past are similar to those today [7]. Opposition to vaccines in general may arise from any of the following:

- Concerns that the risks outweigh the benefits.
- Belief that vaccination is unnecessary or unimportant.
- Preference for natural immunity.
- Belief in vaccination conspiracy theories (e.g., the belief that vaccination is a moneymaking scam perpetrated by the pharmaceutical industry).
- Concerns that mandatory vaccination is a threat to personal autonomy and civil rights.
- Cost, where the public is required to pay to be vaccinated.

Regarding AVI in particular, a 2024 US survey found that almost a third of respondents (29%) were reluctant to be vaccinated against AVI, even if recommended by health authorities [20]. Evidence suggests that vaccination hesitancy specifically about AVI is associated with

1. concerns about vaccine safety,
2. lack of concern about the dangers of AVI, and
3. a history of vaccination hesitancy [20,39]. Furthermore, in America, the issue of AVI vaccination has become politicized. Similar to COVID-19, AVI vaccination hesitancy is greater among Republicans than Democrats [20]. Vaccination hesitancy will likely hinder disease containment if an AVI pandemic emerges. Low vaccination rates were a problem in the 2009 Swine flu pandemic (< 40% vaccinated), whereas the vaccination rate for COVID-19 was considerably higher, with 72% of people worldwide receiving at least one vaccine dose [69].

To encourage people to be vaccinated against COVID-19, governments made unprecedented efforts, using a combination of reassuring information about the safety and efficacy of vaccines, nudges, appeals to altruism, and mandates. Public health messaging strategies were widely used to target different sources of vaccination hesitancy. For example, campaigns appealing to altruism (e.g., "Do it for your community") encourage vaccination among people who regard it as unnecessary for themselves. Similar measures should be considered for enhancing vaccine uptake in the event of an AVI pandemic.

## High Risk Groups

In addition to considering how communities have responded to AVI outbreaks, it is essential to consider groups at high risk for infection. Farm and processing plant laborers, especially poultry workers, face various occupational hazards, including heightened risk of exposure to the viruses causing AVI. Consequently, these workers are at higher risk of transmitting infection to others. In the event of an AVI pandemic, public health authorities should prioritize these workers for vaccines and antiviral medications. A further concern is the mental health of workers in livestock farms and processing plants during AVI outbreaks. For farmers, losing livestock to disease can be devastating. Beyond financial losses, livestock epidemics and culling "may severely impact farmers' mental health by challenging their identity and sense of purpose, as they may experience feelings of personal failure, diminished self-esteem, and a loss of control over their farm's future" [70].

In the event of an AVI pandemic in which culling is widely used, the mental health of workers involved should be closely monitored. Culling livestock can be traumatizing for workers engaged in these operations, especially when there are vast numbers of livestock to be destroyed. According to a study of 200 workers performing culling in South Korea due to AVI, 75% had symptoms suggestive of posttraumatic stress disorder, according to cut-off scores on a validated screening questionnaire [71]. Culling was especially distressing for workers with heightened concerns about animal welfare. Most of those involved in culling (70%) expressed interest in receiving counseling for their disturbing experiences.

Stigma is a further concern. During the COVID-19 pandemic and SARS outbreak, people in high-risk jobs (e.g., frontline healthcare workers) were stigmatized and avoided by

infectionfearful people [7]. Stigmatization is a stressful experience that can undermine mental health. During an AVI pandemic, the stigmatization of livestock laborers and healthcare workers would likely need to be addressed. Along with occupationally-defined groups, other demographic groups are at heightened risk for mental health problems should an AVI pandemic emerge. During the COVID-19 pandemic, women, gender minorities, and ethnic minorities were at heightened risk for anxiety and depression [6]. Such groups may be at elevated risk of mental health problems during an AVI pandemic.

## Conclusions

### Key Findings

The risk of an AVI pandemic is currently low but rising. Over the past decade, AVI outbreaks have increased in frequency, and avian viruses have expanded their range of hosts, infecting a growing number of mammalian species. GOF research shows that avian viruses such as H5N1 can readily mutate into air-transmissible forms, with enhanced ability to infect mammals, including humans. Infected foods are a potential source of AVI, which has triggered public alarm and food avoidance. So far, however, food-borne transmission has been insufficient to precipitate a pandemic. If avian viruses acquire the ability to transmit efficiently through the air between humans, the risk of a pandemic would increase substantially.

The threat of an AVI pandemic has prompted government agencies and others to develop guidelines for AVI pandemic preparation. The findings reviewed in the present article highlight the importance of psychological factors, which have received little attention in pandemic planning guides. Many of the psychological phenomena observed in AVI outbreaks have been documented for other infectious diseases. Fears, anger, avoidance, disease-related stigmatization, xenophobia, conspiracy theories, panic buying, personal stockpiling, and vaccination hesitancy have all arisen in response to AVI outbreaks, exacerbated by media sensationalism. These psychological phenomena are likely to persist and intensify if AVI outbreaks evolve into an AVI pandemic. Indeed, such phenomena have been frequently observed in past pandemics and other outbreaks, including COVID-19, SARS, and the Spanish flu. The research on consumer reactions during AVI outbreaks suggests that the fear, disgust, and avoidance of particular foods would likely distinguish an AVI pandemic from past influenza and coronavirus pandemics. The threat of infected food triggers disgust, and so food-related disgust would likely be a prominent emotional reaction during an AVI pandemic.

### Implications for Policy and Risk Communication

The lessons learned from COVID-19 can inform preparations for an AVI pandemic. These lessons include strategies to

1. increase compliance with pandemic-mitigation measures such as vaccination and mask-wearing,
2. mitigate the negative psychological impact of infection containment measures (e.g., mobility restrictions such as lockdown), and
3. address the mental health and other needs of both the general population and high-risk groups [7].

Additional actions may be necessary for an AVI pandemic, including the provision of information and guidelines concerning food safety. Public education—and public trust—can be enhanced when health authorities provide information that is authoritative, clearly stated, reliable (consistent), empirically supported, and readily accessible (freely available). Surveys indicate that a community's knowledge about AVI tends to increase as the threat looms near. A community's initial low level of knowledge may be largely self-correcting: People seek information when infections arise in their community. Public messaging campaigns can facilitate this process.

Public communication from disease experts and others has the potential to ease or exacerbate public concerns about foods, depending on how the messages are crafted. Guidance highlighting straightforward safety steps ("cook and it's safe") is more likely to reassure consumers than advice focusing on the absence of risk ("don't panic!"). Panic buying and personal stockpiling can be managed in various ways, including public education and the imposition of restrictions (e.g., purchasing quotas) on the targets of panic buying and stockpiling. Vaccination hesitancy for vaccines in general is a longstanding, growing problem that will almost certainly be an issue during an AVI pandemic. Various methods have been used to improve vaccine uptake for vaccines in general. These methods, along with a further discussion of policy and communication issues for pandemics in general, can be found elsewhere [6,7].

### Limitations and Priority Areas for Future Investigation

Research into the psychology of AVI is still in its early stages. Some of the phenomena described in the present article were based on anecdotal reports (e.g., newspaper reports of panic buying), and other findings were limited to a small number of studies (e.g., studies of the mental health effects of livestock culling). More research is needed, particularly quantitative studies using large, representative samples and validated assessment instruments. Studies are needed to better understand AVI-related food avoidance, panic buying, and personal stockpiling, including their relationships to (1) personality variables such as trait anxiety and (2) specific feared expectations concerning AVI (e.g., fears concerning threats to physical health, economic well-being, or other factors). Beliefs about the causes of AVI also require more investigation, including studies of transmission overgeneralization; that is, misguided beliefs that AVI can be spread in all kinds of unlikely ways (e.g., insect bites).

Further research is needed concerning the packaging labels for poultry, eggs, milk, and beef products. Studies are needed to identify the types of accurate labels that best reassure anxious consumers. Available information suggests that effective labels emphasize the attainment of safety. Studies are needed to evaluate the effects of these and other types of public messages concerning AVI. Further research is also needed to determine whether psychological responses to AVI systematically vary with sociocultural, demographic, and economic factors.

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