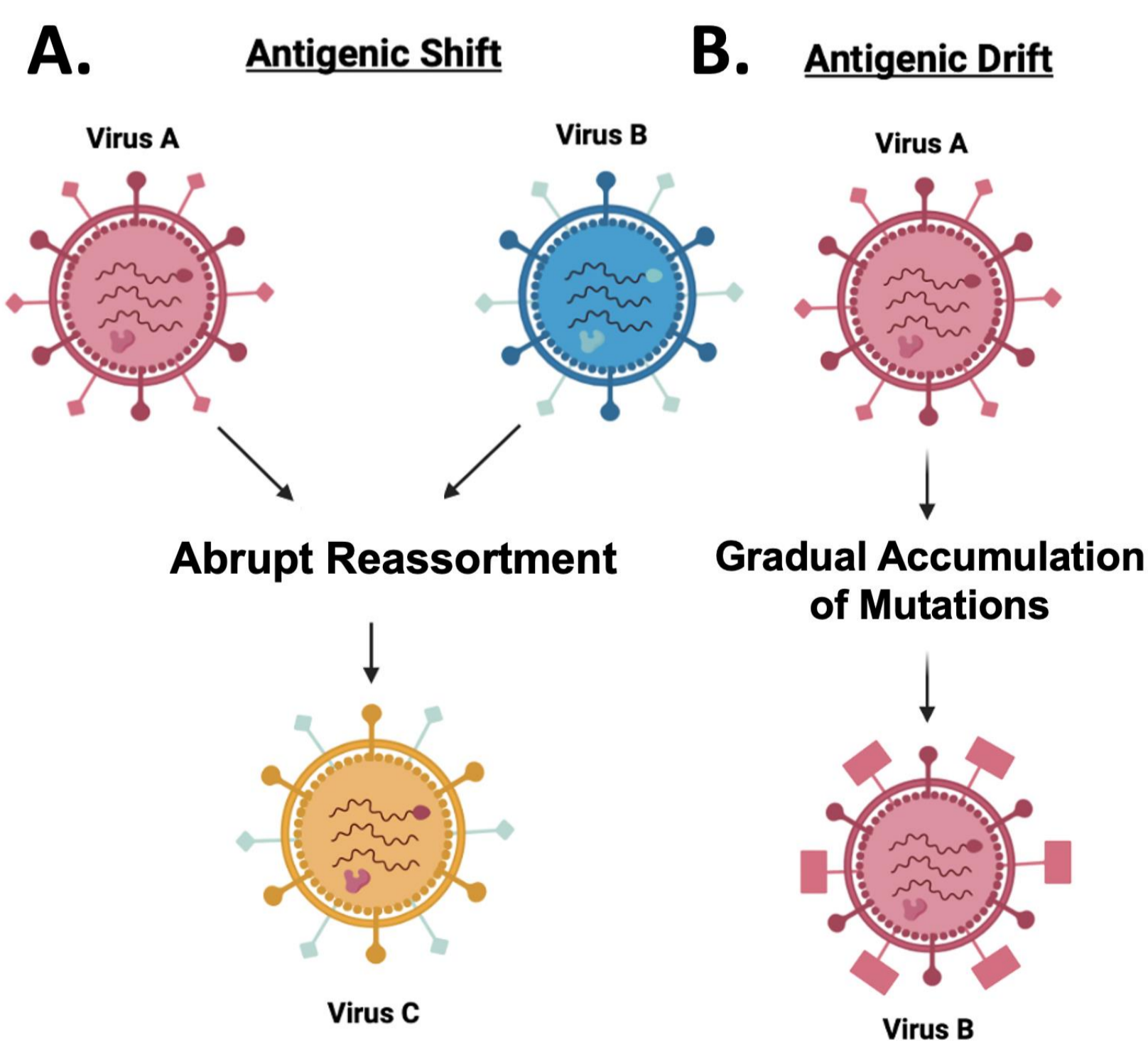


## Abstract

H5N1, or bird flu, is a major global health concern because of its widespread infection across various animal species and its high human fatality rate (48%). Understanding H5N1's pandemic potential is critical, especially given that there are currently no treatments or guidelines to prevent its transmission in the human population. The threat has grown exponentially since H5N1 switched hosts to dairy cattle. Findings show that H5N1 has already acquired pandemic potential characteristics, making human-to-human transmission inevitable in the future.

## Introduction

- H5N1, an influenza A virus (IAV) strain, originated in 1996 in Hong Kong, China, and has mutated over time via antigenic shift and drift
- Reassortment of H5N8 2.3.4.4b clade and a low-pathogenic avian influenza virus (LPAI) produced the H5N1 2.3.4.4b strain
- The H5N1 2.3.4.4b strain has host-switched from wild birds and spilled over into an assortment of marine and terrestrial mammals
- Dairy cattle pose a direct route of zoonotic transmission to humans; isolated human infections have been caused by H5N1 cattle contact
- There is concern that H5N1 2.3.4.4b may develop sustained human-to-human transmission, as supported by experimental precedent



**Figure 1. Antigenic Shift vs. Drift.** IAVs' host switching capabilities result from their ability for genetic reassortment. Antigenic shift is an abrupt genetic change, while drift is a more gradual accumulation of mutations.

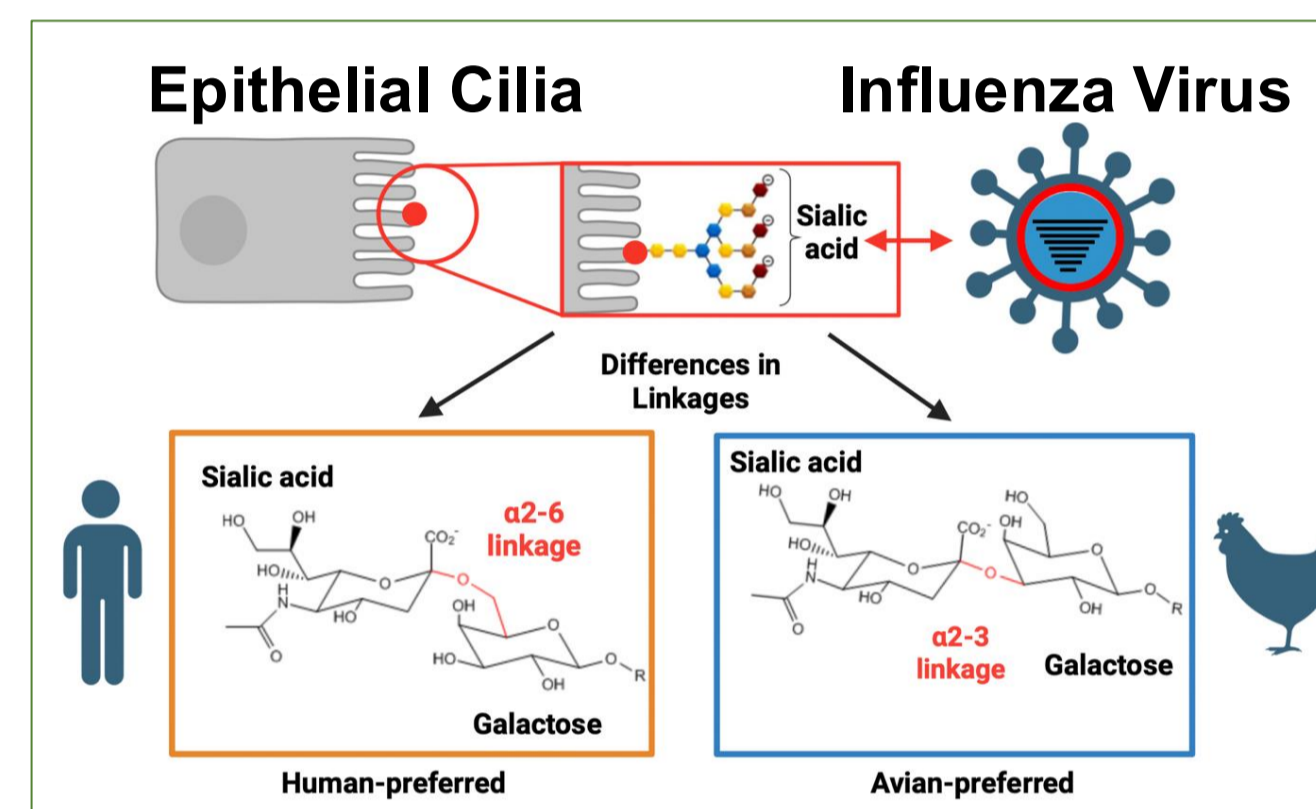
## Methods

- Conduct a literature review summarizing various published journal articles
- The findings show that H5N1 has acquired characteristics associated with pandemic potential. However, there are inconsistencies in experimental results, including variations in transmissibility and pathogenicity in animal models

## Results

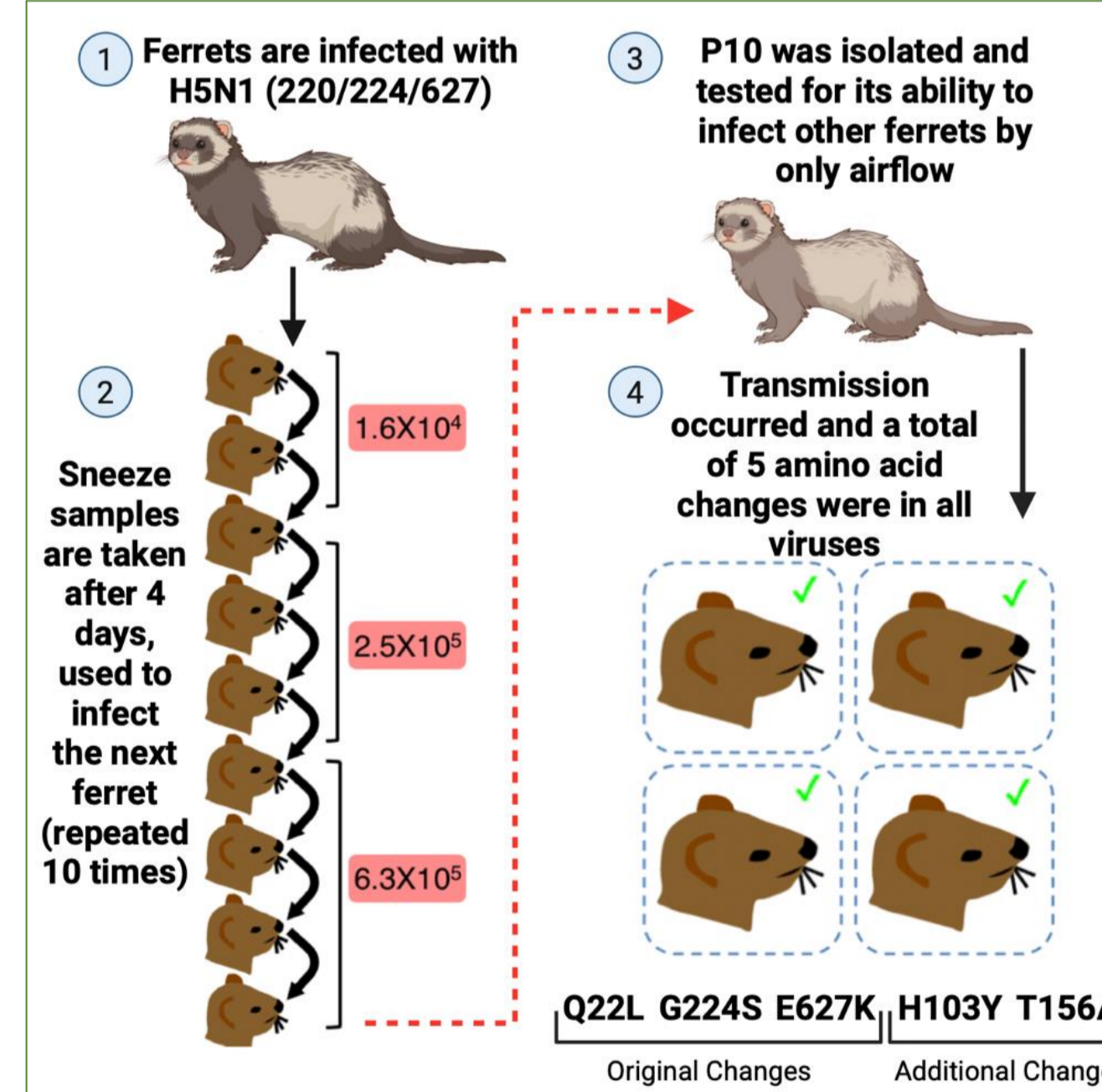
### Figure 2. SA Linkage Specificity

- For the virus to enter the host cell, the hemagglutinin (HA) must bind to sialic acid (SA)
- SA is linked to galactose by either an  $\alpha$ 2-3 or an  $\alpha$ 2-6 linkage
- Humans have a greater abundance of  $\alpha$ 2-6 linkages, while avian cells have more  $\alpha$ 2-3 linkages on their epithelial cells
- Creates a species barrier, but IAVs can overcome this (Ex, H1N1 and seasonal IAVs)



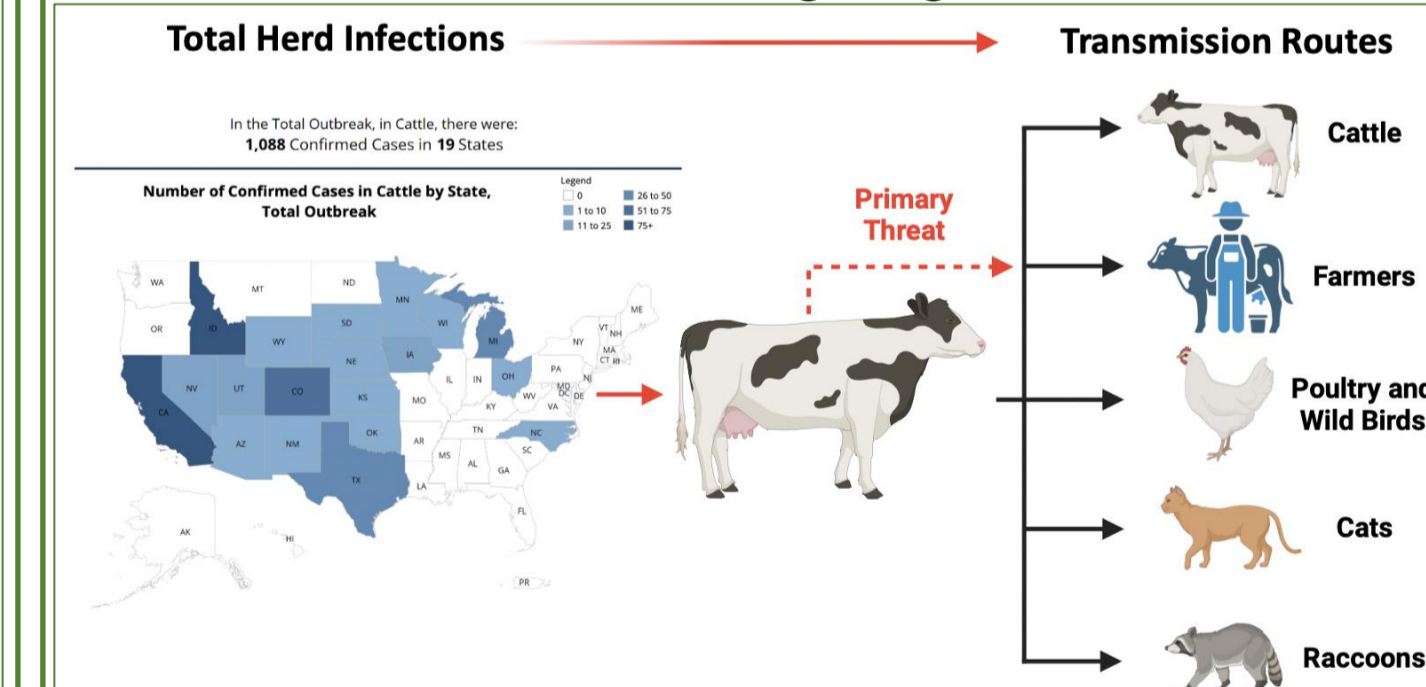
### Figure 3. Mutations Needed For Transmission

- In the Herfst et al. (2012) study, ferrets were infected with a mutated H5N1 HA
- Repeated infections led to ferrets being infected only by the airborne route; no direct contact
- Two additional mutations in the HA were shown to have taken place (H103Y and T156A)
- All five changes were found in each successful infection strain



## Conclusion

- H5N1 already possesses pandemic potential due to its ability to infect a range of animals, which increases the risk of transmission to humans
- The most pressing concern is the adaptation to dairy cattle, which has led to isolated cases of human infection
- High likelihood that further changes of 2.3.4.4b H5N1 will occur to allow sustained human-to-human transmission, widely regarded as inevitable
- Immediate action and mitigation measures are critical, given the lack of an H5N1 vaccine; efforts are ongoing



**Figure 4. H5N1 Infection of Cattle.** H5N1 has been able to infect dairy cattle, which provides a potential direct route of transmission of H5N1 to humans

## References

- Bouvier, N.M. and Palese, P. 2011. The biology of influenza viruses. *Vaccine*. [Online]. 12(26), pp. 49-53. [Accessed 12 October 2025]. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC3074182/>
- Herfst, S., Schrauwen, E.J.A., Linster, M., Chutinimitkul, S., de Wit, E., Munster, V.J., Sorrell, E.M., Bestebroer, T.M., Burke, D.F., Smith, D.J., Rimmelzwaan, G.F., Osterhaus, A.D.M.E. and Fouchier, R.A.M. 2012. Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets. *Science*. [Online]. 336(6088), pp.1534-1541. [Accessed 17 October 2025]. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC4810786/>
- U.S. Department of Agriculture. 2026. *HPAI Confirmed Cases in Livestock*. [Online]. [Accessed 3 March 2026]. Available from: <https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/hpai-confirmed-cases-livestock>

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