

# PATHKINEX UPDATE



## Domino Effect of Microbial Coinfections in Animal Health

### What is a Coinfection?

A coinfection, also referred to as a polyinfection is the simultaneous presence of at least two infectious agents in the same host. Microbial coinfections can involve a variety of different taxonomies (e.g. viral and bacterial infections, protozoal and bacterial infections, multi-bacterial infections, and more) and can occur across all living organisms.

## The History and Continued Relevance of Coinfections

Pathogenic coinfections have likely been around since the evolution of the first microbial ecosystems, but with the advent of high throughput diagnostics and sequencing methods, they are being discovered more readily.

One estimate from human literature reports that as many as 30%-80% of infections may be coinfections [1]! But in reality, polymicrobial infections may be even more abundant, since they are not often investigated.

In livestock, coinfections are even more likely to be underreported, as current veterinary diagnostic workups often test for one pathogen at a time and stop when they have reached the first answer. Further, there remains a scarcity of information for livestock on the specific pathogens commonly involved, the dynamics of pathogen interaction, and the magnitude of downstream health and performance impacts.

Despite these knowledge gaps, compared to singular infections, the detection of multiple pathogens is associated with increased severity and duration of disease, poorer health outcomes, and altered transmission dynamics [2]. Understanding the frequency of microbial coinfection in livestock, the key microbial players, and recognizing their influence on the "tipping point" between health and disease is crucial. This knowledge will empower veterinary health teams and producers to develop proactive, comprehensive pathogen control and treatment strategies, and may allow targeting of specific "keystone" pathogens.

With global losses from livestock disease over the last decade estimated at \$200 billion [3], developing a better understanding of common coinfections may well have wide-reaching economic impacts.





PathKinex

SWABBED

**887** NURSERY  
PIGS

**1801** DAIRY  
COWS

**659** BROILER  
CHICKENS

## Why We Look at Coinfections

Our Pathkinex tool is particularly suited to examine the presence and quantity of multiple pathogens within a single sample and we are leveraging our data to answer questions about coinfections.

Through past analysis of individual smaller Pathkinex projects, we have discovered that samples from sick animals often seemed to test positive for more than one pathogen.

Piquing our curiosity, we set out to examine this phenomenon scientifically through a meta-analysis of our historical Pathkinex data. We hypothesized that the frequency of clinical disease symptoms would be greater when multiple pathogens were present at a given time.

To explore the hypothesis, we examined Pathkinex pathogen surveillance data from rectal swabs of 887 nursery pigs and 1801 dairy cows, and cecal swabs from 659 broiler chickens from commercial production operations.

Within the sick animals, symptoms commonly observed included diarrhea in nursery pigs, digestive or metabolic symptoms and reproductive infections in dairy cows, and lethargy or signs of clinical disease upon necropsy in broiler chickens.



# Pathkinex Unveiled: Findings on the Impact of Coinfections on Disease Risk

Through meta-analysis of Pathkinex surveillance data, exciting themes around coinfections across species are being unveiled:

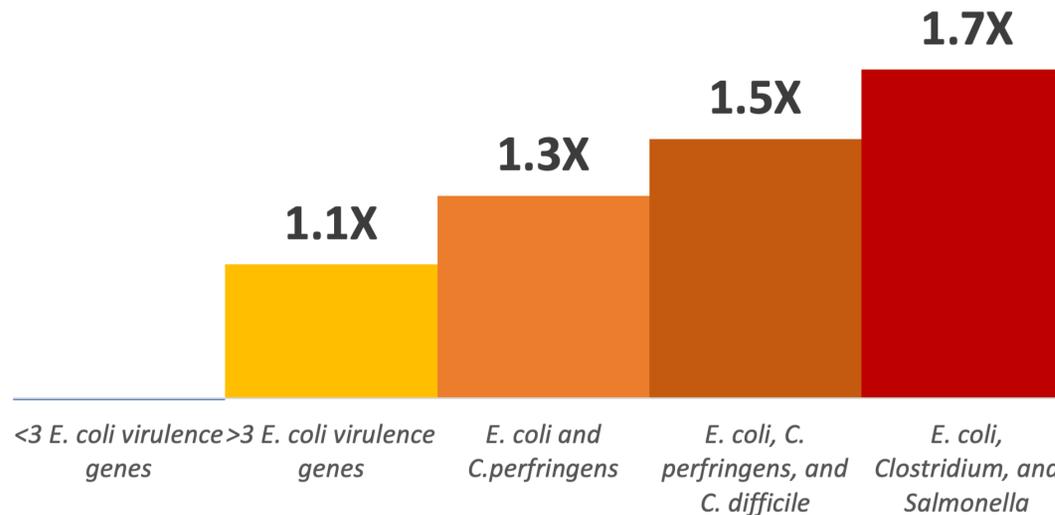
## 1. Coinfection is a common occurrence across livestock species

The Pathkinex analysis detected that 86% of the total swine samples contained more than one pathogen, while in dairy cows 58% harbored two or more key pathogen species, and in the broiler chickens, 81% of the time we detected multiple pathogenic species.

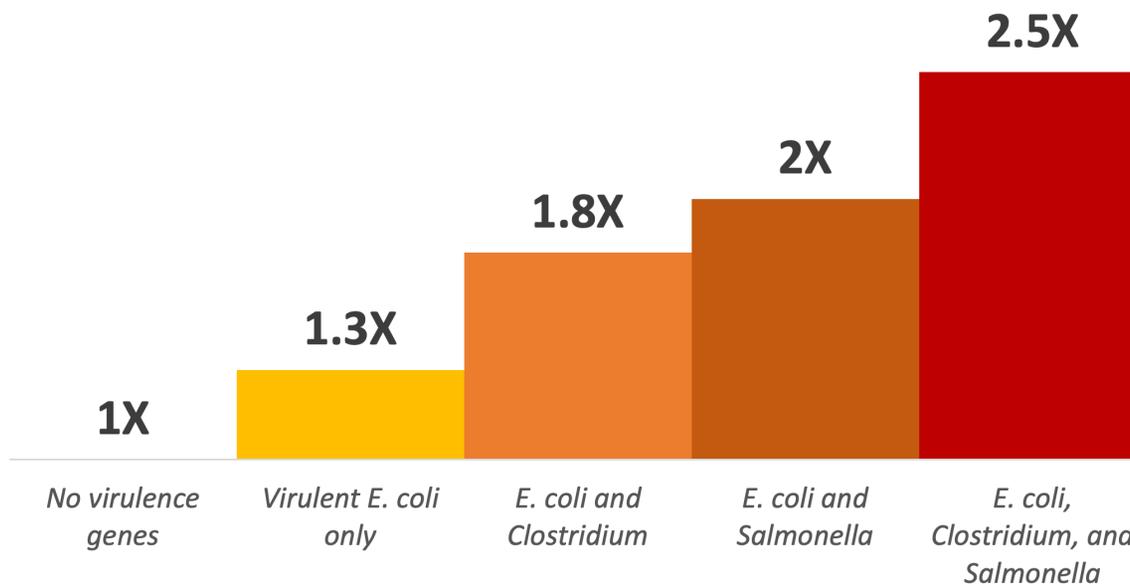
## 2. When increasing numbers of pathogens are present, disease risk is heightened

The relationship between different pathogen combinations and health status was also explored, revealing that regardless of host animal species, relative disease risk increased when combinations of virulent *E. coli*, *Clostridium* species, and *Salmonella* were present compared to samples where none of these pathogens were detected (Figures 1-3).

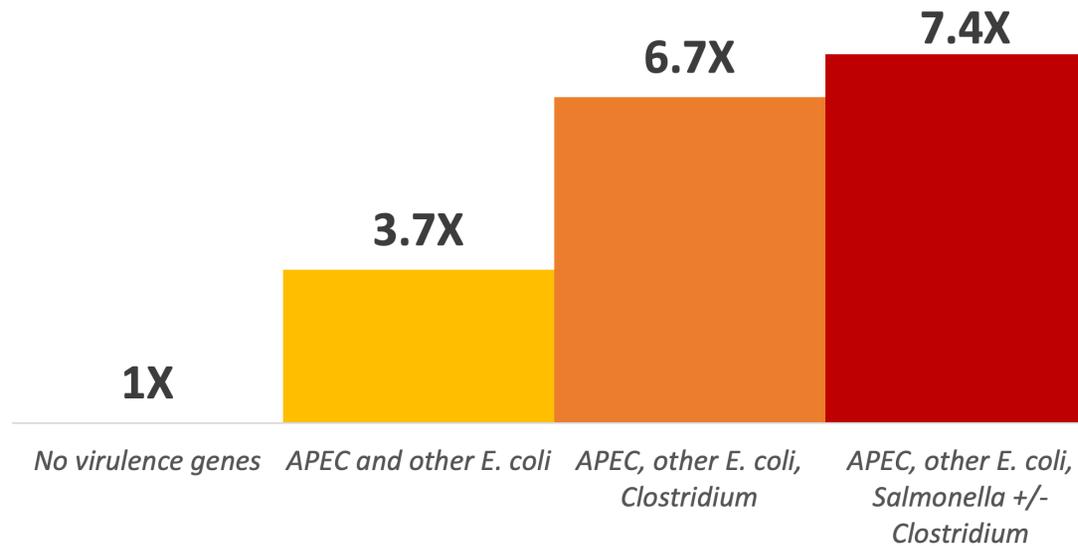
These findings indicate that most of the time, the disease may be more complicated than a single pathogenic insult, implying that the host response is also likely to be more complex and recovery outcomes less straightforward. Prevention and treatment strategies must be structured to take this added complexity into account and be prepared to address coinfection situations.



**Figure 1.** The relative risk of symptoms in nursery pigs when one or more pathogen marker genes were detected in rectal swab samples. (n=887 pigs from approximately 40 nursery sites; 422 pigs were classified as symptomatic and 465 as healthy)



**Figure 2.** The relative risk of symptoms in dairy cows when one or more pathogen marker genes were detected in rectal swab samples. (n= 1801 dairy cows from 93 farms; 557 cows were classified as symptomatic and 1244 as healthy)



**Figure 3.** The relative risk of symptoms in broiler chickens when one or more pathogen marker genes were detected in cecal swab samples. (n=659 broiler samples from 122 farms; 117 were classified as symptomatic and 542 as healthy)



# What Can We Do About Coinfections?

Managing multi-pathogen situations requires a multi-faceted approach that considers environmental and host-specific factors that may also contribute to disease. There is no silver bullet. Using interventions that “disrupt” disease complexes through pathogen reduction and immune activation may be effective tools in a comprehensive program. Our *Bacillus*-based DFM products have demonstrated pathogen inhibitory and immunomodulatory activities that may be good options as part of a program approach along with good sanitation and biosecurity procedures, feed quality management, diagnostic monitoring, vaccination programs, and early intervention.



**What strategies are your customers using to help manage pathogens?  
Do these strategies take Coinfections into account?**

**Interested to Learn More on the Topic of Coinfections?**

Consider reviewing these additional resources:

Seismic>Collections>ProVent ECL>All Content>  
ProVent ECL PPT – Co-Challenge Situations

[www.unitedanh.com/provent/](http://www.unitedanh.com/provent/)

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Is there a topic you'd like to learn more about in a future newsletter? We enjoy hearing from you! We welcome your questions, comments, and suggestions on PathKinex updates. Please contact us at [AnimalAg@mdgbio.com](mailto:AnimalAg@mdgbio.com)

## References

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