The Etiological Diagnosis of Diarrhea in Neonatal Piglets in Ontario Between 2001 and 2010

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Background
Neonatal piglet diarrhea is a major cause of pre-weaning mortality, resulting in significant economic loss for swine producers. The relative importance of different diseases contributing to neonatal piglet diarrhea appears to be changing, possibly because of changes in husbandry and management practices, advances in diagnostic techniques, and/or the emergence of new diseases. In particular, the emergence of a new disease, porcine epidemic diarrhea (PED) in the United States illustrates the importance of monitoring cases of piglet diarrhea.

Objective
The purpose of the study was to use laboratory diagnostic data to identify the frequency and trends of different pathogens contributing to neonatal piglet diarrhea on Ontario swine farms from 2001 to 2010.

Materials and methods
The data were provided by the Animal Health Laboratory (AHL) at the University of Guelph, and included laboratory submissions from Ontario swine farms from 2001-2010. The data included gastrointestinal tract (GIT) cases where live or dead piglets between 1 to 7 days of age were submitted. Multivariable logistic regression models were used to analyze the association between the diagnosis of enterotoxigenic \textit{E. coli} (ETEC), \textit{Clostridium perfringens}, \textit{Clostridium difficile}, rotavirus, and Cystisospora suis, respectively, and independent variables. The independent variables included in the analysis were the age of piglet in days, year of submission, season of submission, and diagnosis of other enteric pathogens.

Results
A total of 237 GIT cases involving the submission of live or dead piglets, 1 to 7 days of age were submitted to the AHL, from 2001 to 2010. The number of these GIT cases submitted per year ranged from 10 to 39, with an average of 24 cases per year. There were 79 (33%) GIT cases submitted to the AHL where an etiological agent was not identified. There were a total of 51 (22%) GIT cases in the fall, 50 cases in the spring (21%), 46 (19%) cases in the summer, and 90 (38%) cases in the winter.

ETEC was diagnosed as the cause of GIT disease for 63 cases that involved a single etiological agent, and 10 cases that involved multiple etiological agents (31% of total cases). ETEC was less likely recovered from a GIT case if \textit{C. difficile}, \textit{C. perfringens}, or rotavirus were detected ($P < 0.05$). ETEC was more likely diagnosed for GIT cases that occurred in the winter compared to the spring and the summer. \textit{C. perfringens} was diagnosed as the cause of GIT disease for 19 cases that involved a single etiological agent, and 9 cases that involved multiple etiological agents (12% of total cases). A total of 155 GIT cases were cultured for \textit{C. perfringens}, and the organism was isolated in 133 (86%) cases. GIT cases were less likely to be diagnosed with \textit{C. perfringens} with increasing age of the piglets and if ETEC was detected. Rotavirus was
diagnosed as the cause of GIT disease for 18 cases that involved a single etiological agent, and 10 cases that involved multiple etiological agents (12% of total cases). Rotavirus was more likely diagnosed for GIT cases that occurred in the fall compared to the spring and the summer. *C. difficile* was diagnosed as the cause of GIT disease for 10 cases that involved a single etiological agent, and 11 cases that involved multiple etiological agents (9% of total cases). *C. difficile* was less likely diagnosed with increasing age of the piglets. *C. difficile* was less likely diagnosed if ETEC was detected, but more likely diagnosed if *Salmonella sp.* was detected. *Cystisospora suis* was diagnosed as the cause of GIT disease for 13 cases that involved a single etiological agent, and 2 cases that involved multiple etiological agents (6% of total cases). *Cystisospora suis* infection was more likely diagnosed for GIT cases that occurred in the summer compared to the spring, and the winter. Transmissible gastroenteritis virus was diagnosed as the cause of GIT disease for 6 cases that involved a single etiological agent and 1 case that involved multiple etiological agents (3% of total cases).

**Discussion**

Neonatal diarrhea cases were most frequent during winter, a well-established finding in countries with harsh winters. The major known pathogens that contributed to neonatal piglet diarrhea from 2001 to 2010 were ETEC, rotavirus, *C. perfringens*, and *C. difficile*. The combined GIT cases involving these pathogens contribute to more than half of the GIT cases submitted to the AHL. In one third of the GIT cases involving piglets less than a week of age no causative agent was identified. The lack of diagnosis for some GIT cases is possibly due to inappropriate samples submitted to the diagnostic laboratory; piglets in the acute stage of disease have the highest pathogen load, and therefore are more likely to yield diagnostically useful information. There may be other unknown pathogens involved in the undiagnosed GIT cases submitted to the AHL and further investigation is required to determine the current causes of piglet diarrhea in Ontario swine farms.

**Conclusion**

This study identified several current pathogens involved in neonatal diarrhea for Ontario swine farms. *Clostridium difficile* appears to be an emerging pathogen, and ETEC and rotavirus remain as pathogens of concern for neonatal piglet diarrhea. Further research in the diagnostic method of these pathogens may be useful in improving the diagnostic rate for GIT cases. The data suggested that *C. perfringens* type A may be an important pathogen for neonatal piglet diarrhea, but the lack of specific diagnostic criteria made it difficult to determine the significance of isolating this bacteria from a pig with diarrhea.

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