Management and medication of pre-weaning diarrhoea in pigs

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There are a number of pathogens known to cause diarrhoea in suckling piglets. Viral infections are well documented, including TGE virus, PED virus, rotavirus and adenovirus, and others which are less well researched, such as astrovirus and calicivirus.

Treatment and control in most cases of viral infection involves supportive therapy and sometimes, in the case of TGE and PED, controlled exposure.

The bacterial infections of pre-weaned pigs have also presented a major challenge and these pathogens have been the subject of many medicinal and vaccine trials. E. coli infections have been widely explored and researched and it is probably the most widely recognised and treated enteric pathogen in the farrowing shed.

However, in recent years, there has been an increasing level of focus on clostridial infections in piglets (Clostridium perfringens Type A, Clostridium perfringens Type C, and Clostridium difficile). Recently, in some diagnostic laboratories in the USA and Europe, the clostridial pathogens have been far more commonly diagnosed than has colibacillosis. Protozoal infections in neonates are almost exclusively due to Isospora suis, with the eimeria species very rarely showing any pathogenicity at this stage.

Common infections

Before reacting to any outbreak of diarrhoea it helps if a preliminary diagnosis is made, either by the farm veterinarian, or the farm manager, hopefully in consultation with his veterinarian. Most farmers and veterinarians know what the most common pathogens in their region are, but it is worthwhile reviewing recently published data, as the situation can change and newer diagnostic methods are sometimes bringing different pathogens to our notice.

Data from USA university diagnostic laboratories give us a very good picture of the importance of these various pathogens in North American production systems.

Data from Galesburg, Illinois, from 2001 shows that 37% of diarrhoea cases in pigs less than five days of age were due to infections by Clostridial sp. Only 15% of cases were due to E. coli infections and 12 and 9% were due to TGE and rotavirus respectively (Fig. 1).

The picture changes after five days of age, with the vast majority of cases being coccidiosis (40%), but it is to be noted that clostridial infections still account for 21% of diagnosed causative agents in this older group. E. coli and TGE each account for 9% of cases and rotavirus only 6% (Fig. 2).

Mike Yaeger from Iowa State University has more recently, in 2004, published data showing some 61% of neonatal diarrhoea cases presented in 2003 and 2004 to ISU VDL were due to Clostridial sp infections.

Of note was the apparently increased importance of Clostridium difficile, but Clostridium perfringens type A was still involved in the majority of cases, at 30% of the total diagnosed cause. Rotavirus was the main agent in 23% of cases, and E. coli and TGE accounted for 12 and 4% of cases respectively.

More recently again, in 2007 Mike Yaeger published data from ISU diagnostic cases studied in 2005 and 2006, showing that clostridial infections were involved in the vast majority of cases, and the incidence of both E. coli and rotavirus was reduced. Some animals were diagnosed as being infected with more than one organism.

In the same publication is a useful chart showing the age distribution of Clostridium perfringens type A diagnoses, with infections occurring from one to five days of age and peaking at three days.

Data from Europe shows similar disease patterns in regard to neonatal and preweaning diarrhoeas. A detailed investigation utilising multiple PCR from the Czech Republic

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Fig. 1. One to five day old piglet diarrhoea. Galesburg, Illinois, Diagnostic Laboratory, 2001 (Schultz pers. comm.).

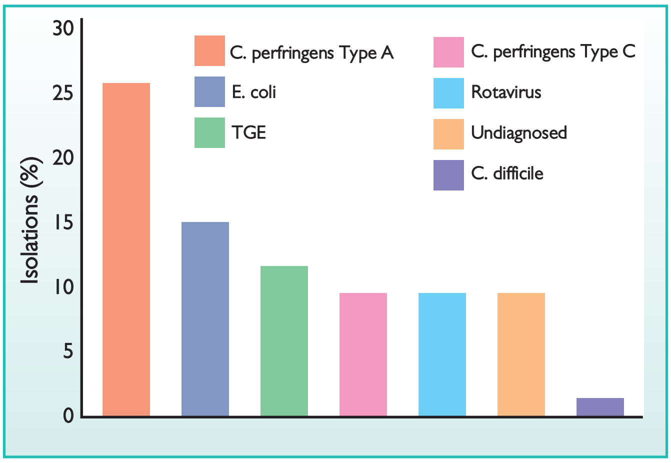
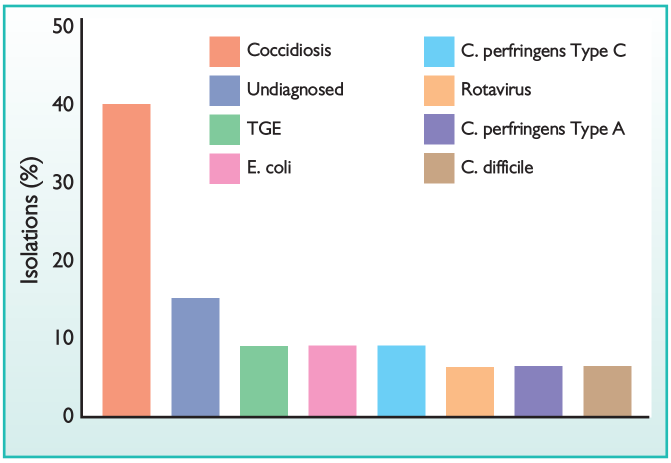


Fig. 2. Five day old to weaning age piglet diarrhoea. Galesburg, Illinois, Diagnostic Laboratory, 2001 (Schultz pers. comm.).



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showed that of 153 farms suffering preweaning diarrhoea in 2001-2003, 39.2% of farms were diagnosed as clostridial cases from suckling diarrhoea.

In 2005 data gathered in Italy by Nardi et al, showed that Clostridium difficile was isolated from 44 piglets, representing 16 of the 39 submitted cases (41%), but they also demonstrated combined clostridial infections and colibacillosis.

At necropsy, pigs positive to C. difficile showed enterocolitis (100%), oedema of mesocolon (46%), distention of the abdominal wall and ascites (19%).

He described the intestinal contents as being of an intense yellow colour when C. difficile was the only isolated pathogen, while noting it was mucous and sometimes haemorrhagic when it was associated with enterotoxic E. coli.

However, it is still common in some situations for researchers to note that ETEC (enterotoxigenic Escherichia coli) are the most common cause of diarrhoea in piglets.

Yaeger (2003) details the threat that rotavirus and TGE present.

Rotavirus is very often present in mixed infections and although it can be hard to assess as a pathogen, it is known to cause acute symptoms including vomiting and profuse diarrhoea.

Asian survey data is more difficult to interpret, with more research focusing on individual pathogens. In a specific study on E. coli infections of five larger commercial piggeries in Vietnam, it is interesting to note that diarrhoea was found to affect 71.5% of the litters born during the period of study.

Of 406 faecal specimens submitted for bacteriological culture, 200 (49.3%) yielded a heavy pure culture of E. coli and 126 (31%) were confirmed by PCR to carry at least one of eight porcine ETEC virulence genes.

ETEC was responsible for 43% of cases of diarrhoea in neonatal pigs during the first four days of life and 23.9% of the remaining cases up until the age of weaning.

O149 : K91, O64, O101 and O-nontypable isolates were investigated for antigenic characteristics. In Japan, a survey by Katsuda et al revealed a single agent as being responsible in 60.8% of cases and combined agents being involved in 22.2% of cases of diarrhoea in suckling piglets.

Rotavirus was the most common agent detected in suckling piglets, being the most prevalent agent in 67.3% of affected suckling animals, and interestingly it was also the most common pathogen in affected weaned pigs. In neonatal pigs the next most common infection was coccidiosis, while colibacillosis was the second major agent involved in pigs post weaning.

The researchers conclude by noting that neonatal diarrhoea can be associated with multiple agents and this may help explain variable responses to treatment.

It is interesting also to note that rotavirus has been noted as an increasingly common

Agent	Total No. of cases	Total neonatal diarrhoea cases (%)
C. perfringens type A	100	30
Rotavirus	77	23
C. difficile	67	20
E. coli	40	12
C. perfringens type C	36	11
TGE	13	4

Table 1. Dr Mike Yaeger, retrospective study, ISU VDL, 2003-2004.

Table 2. The diagnostic frequency of various agents identified in scouring piglets submitted to the Iowa State University Veterinary Diagnostic Laboratory (Proceedings 2007 Annual Meeting American Association of Swine Veterinarians Vol 79, No 16, Mar 26, 2007).

	Retrospective data (N=273) (%)	Prospective data (N=77) (%)
C. perfringens type A	48	47
E. coli	20	3
C. difficile	10	48
Rotavirus	9	13
Coccidiosis	7	0

cause of diarrhoea in neonatal pigs in the Midwest USA by researchers.

Another important group of pathogens are the coronaviruses. TGE (transmissible gastroenteritis virus) can cause severe outbreaks on farms, resulting in acute enteric symptoms and very high mortality.

Recently, this picture has been complicated by the diagnosis of PED (porcine epidemic diarrhoea virus, usually a disease of grower pigs) being involved in acute TGE-type outbreaks in neonatal pigs in Korea, Japan and in the Philippines, although some of the widespread cases in the Philippines have been diagnosed as TGE.

Paensart (2005) noted that PED outbreaks resulted in the deaths of some 39,000 neonatal piglets in Japan in a 1996 outbreak and was responsible for 50.4% of 1,258 neonatal diarrhoea cases in Korea in 1998.

From the producer's point of view, there is very little difference between TGE and the acute neonatal form of PED. More recently, there have been reports of severe PED outbreaks in neonatal piglets in Thailand and it is interesting to note that Clostridium perfringens was also isolated from all cases.

Control and management

In all cases of diarrhoea, early medical treatment, rehydration therapy, hygiene and disinfection must be of the highest priority, and treatment is almost always initiated well before any precise diagnosis is available.

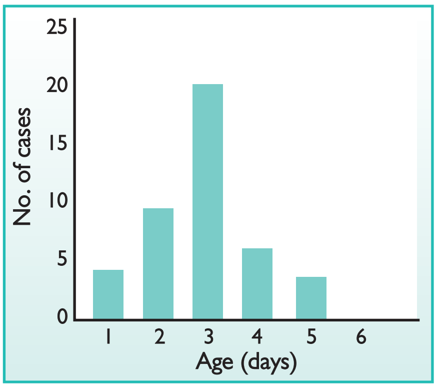
The immediate response to a severe outbreak at a farm level is to provide antibiotic treatments, and while we are aware that viruses may be involved, complicated infections are common and the correct choice of antibiotic can give a rapid response.

It is important for an early decision to be made whether the target pathogen is likely to be Clostridium perfringens, Clostridium difficile, Escherichia coli or coccidiosis.

Rademacher (2007) published a useful table showing the age of onset of diarrhoea problems in his operations and relegates E. coli and rotavirus to weaner problems, while clostridia and coccidiosis are regarded as neonatal/preweaning problems.

Early attention to hygiene and to precise environmental temperature and airflow control is probably the next major step to be taken immediately following initial antibiotic treatment and rehydration therapy.

Fig. 3. Distribution of C. perfringens type A diagnoses by days of age.



Daniels (2007) lists the following as possible strategies for controlling neonatal diarrhea problems (specifically in regard to C. perfringens type A, but applicable in general):

- Increase hygiene. Target the suspected pathogen with suitable disinfectants when farrowing crates are empty, but before weaning keep the environment as dry and clean as possible.
- Control of concurrent disease. Ensure all vaccination programmes are up to date and overall medication programmes are targeting known pathogens present on the farm with broad spectrum antibiotics. Viral infections may be complicated by bacterial pathogens
- Feedback. This must be considered and managed very carefully, and requires careful diagnostic work. Basically, it involves feeding diarrhoea from piglets to breeding sows due to farrow, at least three weeks before the due date, in order to provide some maternal immunity to the piglets via the colostrum. It may be useful in controlling acute TGE or PED outbreaks and has been tried in attempts to control E. coli infections, but is perhaps counter productive in clostridial cases.
- Antibiotics are always the farmer's preferred option, and probably rightly so, as

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viral infections may often be complicated by bacterial pathogens. Again, precise diagnostics are required, bearing in mind that MIC results must be interpreted carefully.

1 Electrolytes. Provision of drinkers containing electrolyte mixtures is very important in severe outbreaks to counter dehydration, but it is equally important to ensure plentiful water is available via a piglet level drinker.

1 Autogenous biologics. These have sometimes proven useful in both E. coli cases and Clostridium perfringens cases and, in fact, Peansart cites good results in Poland from a combined vaccine, but results vary widely and this is obviously not an immediate response.

1 Conditionally licensed biologics. There are an array of licenced vaccines available for other species (particularly in regard to Clostridial vaccines) but they are not regarded as widely successful in pigs.

1 Direct fed microbials are becoming of more interest and more trial work is being done, but at this stage they are perhaps not ideal in an outbreak situation.

1 Parity segregation can help to resolve problems in older sows, as the majority of cases tending to occur in the parity one herd, due to the lower levels of maternal immunity generated by the younger sows.

Medications

Correct diagnosis is critical for treatments to successfully target the most common pathogens involved in preweaning diarrhoea cases.

1 Viral infections (TGE, PED, rotavirus).
TGE, PED and rotavirus are all important pathogens of neonatal pigs and antibiotic medications are frequently used in a supportive role but, in general, these diseases are controlled via exposure, vaccination and supportive therapies such as electrolytes.

Note that there is a risk of combined infections with C. perfringens, C. difficile and E. coli infections being reported and initial medical treatments will involve a decision on which bacterial pathogen is likely to be present and attention must be paid to maintaining hydration, improving hygiene and precisely regulating the environment.

1 Coccidiosis medications.
The protozoan Isospora suis is very common in untreated litters in all areas of the world. Dosing with Totrazuril at three to four days of age, however, acts as a very useful preventative. In most areas, such routine preventative treatment is certainly advisable.

It is worth noting the data published by Mundt (2005) showing the percentage of positive farms surveyed in each of 12 countries across Europe ranged between 40 and 100% of the surveyed farms in each country.

Experimental treatments with salinomycin and lasalocid in sow feeds have been explored, but there are few reports of successful programmes.

1 E. coli infections.
Apramycin, neomycin, trimethoprim sulphonomide combinations, ampicillin, amoxicillin, tetracyclines, spectinomycin, fluoroquinolones, and ceftiofur are commonly used as treatments for E. coli infections in neonatal pigs.

Medications available as oral dosers (apramycin, neo-mycin, trimethoprim sulphonomide combinations) are usually used first, and the injectables may be resorted to within one or two days if the initial response is poor.

Newly introduced medications are often highly effective, as is evident in the successful use of apramycin against clinical E. coli in post weaning pigs, where a 67% increase in growth rate was recorded.

Resistance certainly plays a role in porcine E. coli therapeutics and it is becoming a focus of attention, particularly in Europe.

Diagnostics can play an important part in the control of this disease. Typing can assist with the sourcing and manufacture of autogenous and/or commercial vaccines targeted specifically against specific adhesion factors.

Pathogen	Age at onset of diarrhoea
C. perfringens Type A	0-4 days of age
Rotavirus	3-7 days of age
Coccidiosis	8 days of age or older
E. coli	First weeks post weaning

Table 3. Age at onset of diarrhoea of common neonatal/postnatal pathogens (Rademacher 2007).

Much published research in porcine E. coli infections focuses on the antigenic properties of various pili antigens and the various vaccine issues related to these.

Some research indicates that the frequencies of the various virulence factors have undergone constant change and it is likely that the widespread use of vaccines has played a part in this change.

1 Clostridial infections.
Clostridial infections are now much more frequently diagnosed in most areas of the world and, fortunately, such infections respond very well. Taylor (1999) describes how bacitracin, tylosin and penicillins are all reported to be useful in controlling clostridial infections in preweaning piglets.

There are numerous reports describing successful treatment of C. perfringens type A and C with the use of BMD in sow diets in the period around farrowing.

Leiting (2002) reported good control of neonatal diarrhoea due to Clostridial perfingens type A when the sow herd was treated at 250g/tonne BMD (275ppm) for two weeks before farrowing and for three weeks of lactation.

High neonatal mortality reduced immediately the sow medication programme commenced.

Antibiotics tested	MIC of CTC vs. C. difficile (ug/ml)
Chlortetracycline (CTC)	4
CTC (+ 33ppm BMD)	2
CTC (+ 275ppm BMD)	0.25

Table 4. Synergistic effect of BMD and CTC vs. Clostridium difficile.

Dudley (2000) also reported control of mixed E. coli and Clostridium perfringens type A infections and used a similar programme with BMD at 275ppm.

Trials clearly demonstrate the benefits of sow medication programmes using BMD, even when clinical signs of clostridial infections are not evident. The percentage of sows positive to C. perfringens reduced from 77 to 17%, and while the improvement in preweaning mortality was not significant, the adjusted 21 day weaning weights improved by 54.6%. The return on the cost of the medication was nine to one.

Australian data on a mixed infection (clostridium perfringens type A and coccidiosis) showed that introduction of an oral coccidiostat to piglets, as well as introducing BMD to the sow diets, reduced the preweaning mortality from 20 to 8% (Richards 2007).

C. difficile is becoming more common and can be more difficult to control, showing marked resistance to a number of antibiotics. Post and Songer IPVS (2002) showed high MICs to bacitracin, ceftiofur and tilmicosin, but do note that MICs may not accurately reflect field responses and concluded that tetracycline, tylan, tiamulin and virginiamycin may be useful.

In some cases combinations of Aurofac and BMD have shown promising synergy against C. difficile. After exposure to sub-MIC bacitracin, membrane inclusions were visible, apparently due to cell wall damage by BMD, and in the presence of BMD, Aurofac MICs were dramatically reduced.

Conclusion

The first response to neonatal diarrhoea at a farm level is almost always medicinal. The correct choice of antibiotic, based on clinical signs and knowledge of the prevalence of the various diseases, will have major economic effects.

The oral dosers and injectables are extremely useful, but the most dramatic results have been seen in the face of clinical and subclinical clostridial infections, when addition to 275ppm of BMD to sow diets for two weeks prior to, and three weeks post farrowing improves both sow and piglet health, resulting in less sow weight loss during lactation, lower preweaning mortality and increased weaning weights. ■