PNEUMONIA

Some Aspects of Treatment and Control

by

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INTRODUCTION

Muirhead (1979a) noted that respiratory diseases were *"of considerable economic importance and in many cases were serious limiting factors to efficient production."* Since that time many herds have become considerably bigger and respiratory disease in all its forms is a problem frequently encountered by the veterinary practitioner.

Not only has herd size increased, but more importantly, individual housing unit size has also increased and second stage flat deck cage rooms holding 3,000 pigs in the same airspace are not uncommon. This, of course, leads to problems of disease control (Smith, 1979).

As Smith (1986) noted, *Haemophilus pleuropneumoniae* existed in the 1950s and early 1960s as a curiosity with difficult toxonomy, but has now become a formidable primary pathogen. The constraints placed on medication by recent legislation (in some countries) concerning antibiotic use and withdrawal periods have also added to the frustration of the busy large animal practitioner. It is only natural that the farmer should desire a simple cheap and effective method of treating or controlling pneumonia and most practitioners would only be too willing to supply one if it were available.

The veterinarian will be aware that clinical normality will depend on achieving a balance between the number and virulence of invading organisms on the one hand and the immunity of the host on the other. However, this delicate balance may be easily upset by a wide variety of factors or non-infectious determinants (see Appendix 1).

Smith (1979) while discussing the definition of disease stated "*it is important to remember that in life nothing is static and clinical normality is nothing more than an expression of equilibrium between equally opposed forces*". Schultz (1985) stated "*because swine pneumonia is a complex interaction between pathogens and environmental influences, its impact varies from herd to herd. As a result we have to take steps to control the complex while ensuring that our control measures do not exceed the cost of the disease*". Hopefully the outcome would be a balance of the forces involved, resulting in clinical normality. Manipulation of those factors which play an important role in the pathogenesis of pneumonia outbreaks, might be one of the most efficient methods which a practitioner might employ to combat an outbreak.

Making an Assessment

This aspect is very important but before the practitioner can make a decision, he/she will need to be in possession of some factual data. It will be important to establish the nature of the problem. Is it real or imagined? Are productivity data available over a period of six months and especially before the problem arose? In particular, it is important that records on conversion ratio (FCR), daily liveweight gain (DLWG), cost per kg liveweight gain and other relevant financial data are available. Armed with these answers the practitioner can make sensible estimates about the cost of disease. Without such data, the practitioner can only be left to guess. Before deciding what should be done, a detailed history should be taken so that an epidemiological picture can be built up.

This data can be gathered while a clinical inspection of the herd is carried out. It is important to disturb the pigs in each pen as they are unlikely to cough or perhaps show other clinical signs while at rest. Straw et al (1986) established that the prevalence of coughing was related to the mean percentage of lung with pneumonia. A note should be taken of the type and method of ventilation and of any new buildings in the proximity. Are all the fans working? What is the tocking density (in kg/m^2)? Has it increased recently? Is there any evidence of feed vastage? Take a note of the water supply, especially the number of nipples per pen, flow rate, ıeader tank size and placement, the way the feed is delivered (meal or pelleted), number of ɔins and percentage of pigs injected for pneumonia. Examine lung inspection reports and ıbattoir comments regarding condemnations or stripping. A note should be made of any other liseases that may be affecting the pigs at the time as well as details of the present treatment in ıse. If possible, post mortem examinations should be carried out in all age groups of pigs. Make a point of euthanasing all chronically sick pigs and checking their lungs. The findings from these examinations will help to determine the nature of the problem and when pigs start to become affected. This is very important.

MANAGEMENT

Muirhead (1979a) considered that an all in/all out policy had been of most value in controlling pneumonia outbreaks. It is well known that an all in/all out policy with rest and disinfection of buildings in the immediate post-weaning phase results in less mortality, less morbidity and better performance. It is now becoming clear the a similar management technique applied to all later stages has the same overall effect. Larsson and Backstrom (1971) compared all in/all out systems with continuous throughput. They noted the prevalence of pneumonia was significantly less in the former system and there was also a significant difference in the prevalence of pneumonia between systems with solid manure and liquid manure.

Clark et al (1990) working in Indiana, USA, showed that separation of growing pigs at 8 weeks of age into cleaned separate rooms or buildings resulted in a significant increase in daily liveweight gain while the prevalence and severity of pneumonia was reduced.

In another experiment in which the treated pigs were managed by an all in/all out policy from weaning to finishing at 104.5 kg, Scheidt et al (1990) showed that the treatment had a beneficial effect, see Table 1.

Table 1: From Scheidt et al (1990)

	Daily live weight gain	Prevalence of pneumonia %	Severity pneumonia %
Treated Pigs	772	63	3
Control Pigs	708	69	6

The same workers also noted that the severity and prevalence of *H. pleuropneumonia* was significantly higher in pigs which came from herds which were seropositive to *Actinobacillus (Haemophilus) pleuropneumoniae.*

Smith (1988) showed that when weaner pigs from a farm with serious respiratory problems were housed in either:

(a) the finishing unit of a pig unit which had been empty for 2½ years.

or

(b) in houses on another pig unit already containing diseased pigs.

those pigs reared in the previously empty unit had less pneumonia and less *Atrophic rhinitis* at slaughter, see Table 2.

Table 2: The average snout score and average lung score of pigs (derived from a farm with serious respiratory problems) reared in (a) a clean environment, or (b) a dirty environment.

Environment	Stocking Density	Number of pigs	Average Snout score	Average Lung score
Clean	$0.032\ w^{.67}/m^2$	30	1.400^a	8.04^b
Clean	$0.024\ w^{.67}/m^2$	30	1.867^a	10.0^a
Dirty	$0.27\ w^{.67}/m^2$	33	2.161^a	16.68^b

Data 'b' significantly different $P < 0.05$

An effect of stocking density on lung scores was also noted. Fifty identified pigs went to the farm with the *dirty* environment but 17 went *missing* because they were withdrawn from the group either due to poor growth rate or respiratory disease. Had these been included in the trial, the results might have been even more dramatic.

Haaring et al (1978) studied 92 finishing units over a 6-month period and showed that continuous throughput, large group size and wide temperature fluctuations were positively correlated with the prevalence and severity of pneumonia.

Straw (1990) studied pigs with pneumonia in two different environments. In both environments the rate of gain tended to decrease with increasing severity of pneumonia. When pigs with a similar extent of lung lesions were compared, pigs housed in the better environment performed better but when more than 20% of the lung tissue was involved, pigs in both environments performed equally poorly. It was concluded from the overall results of the study that the growth inhibiting effects of pneumonia were *"de-emphasised"* compared to the influence of the environment with the exception of severely affected pigs.

When a continuous throughput system is used it is common practice to place the smaller pigs with the next batch of similar sized pigs in order to reduce competition. However, these pigs are often smaller because they are diseased and this factor along with the stress of fighting until a hierarchical system evolves, may be the cause of a marked but transient immuno-suppression. (Pijoan, 1986)

Tielen (1978), noted that when pigs were moved once or twice the prevalence of pneumonia was 19% or 21% respectively, compared with a figure of 15% in those which were not moved.

It is now well accepted that farms which breed their own stock have less respiratory problems than farms which purchase stock from other sources (Aalund et al, 1976; Backstrom & Bremmer, 1978).

Pickles (1984) noted that weaners bought from an infected source always performed badly and suffered more from pneumonia. (see Table 3)

Table 3: The performance of pigs from two different sources in a finishing herd. From Pickles (1984)

Farm of Origin	FCR	DLG g/day	Lung Score
L	2.90	641	7.0
W	4.66	496	13.3

All sig. different
Start wt. 24 kg
Days on trial 77

Finishing herds are particularly vulnerable to outbreaks of pneumonia if they purchase pigs from many sources. This is in part due to the phenomenon known as interaction or synergism between organisms (Shope 1931, Degre and Glasgow, 1968, Kasza et al 1969, Wilson and Miles 1964, Harris and Switzer 1968 and Gois et al 1975). Thus the pig may remain clinically normal when infected with a particular virus on its own or a bacterium on its own. However when infected with both organisms at the same time the result may be clinical disease.

Herd Size

It has been shown by a number of workers that as herd size increased, the prevalence and severity of pneumonia also increased. (Aalund et al, 1976, Tielen, 1978 and Flesja and Solberg, 1981).

Group Size

Pigs in buildings with open pen sides through which pigs have contact, may be regarded as being in one group as far as respiratory disease is concerned. This is because the spread of respiratory disease takes place by direct contact rather than aerosol inhalation. (Pijoan, 1986) The number of possible disease transmissions increases exponentially with the number of animals according to the formula.

$$\text{Number of transmissions} = n^2 - n$$
(n = number of animals)

For example, where there are 4 animals there are 12 possibilities for disease transmission (or n x 3); when there are 20 animals the possibilities for disease transmission increase to 380 (or n x 19).

In a study by Lindquist (1974) it was noted that the prevalence of pneumonia was less in 73% of cases (60 herds investigated) when there was less than 500 animals in a building compared with buildings housing more than 500 animals. Muirhead (1979b) suggested that 150 pigs in one air space was ideal.

Stocking Density

When an outbreak of pneumonia occurs, food intake goes down, the efficiency of feed conversion decreases and this results in poor growth rate. As the pigs are still being produced at the same rate in the farrowing house, the sequel to a pneumonia outbreak will usually be overcrowding, i.e. an increase in stocking density.(kg liveweight/m^2) It has been shown by several workers that increased stocking density will result in poor FCR (Kornegay and Notter, 1984, Meunier-Salaun et al 1987, Moser et al 1985 and Zimmerman 1986). However, poor growth rate due to pneumonia has a more insidious effect, as the number of pigs/pen will have increased and this in turn will reduce trough space per pig which will in turn reduce feed intake and so the DLWG. As stocking density increases the challenge by disease organisms will increase. A pig infected with *Actinobacillus* (*Haemophilus*) *pleuropneumoniae* will shed billions of bacteria in its nasal secretions, yet only 10,000 of these same organisms will kill a 50 kg pig in 8 to 12 hours (Schultz, 1985).

It has been shown that feeding antibiotics to pigs which are deliberately heavily stocked will not improve DLWG or FCR (Zimmerman, 1986). Thus, one must consider whether a better response, not only in terms of DLWG and FCR but also in terms of overall health, might not be obtained by simply reducing stocking density to below what it was before the outbreak began.

In one farm in the North-East of Scotland, pigs had to be continuously medicated with antibiotics because of pneumonia problems. When stocking density was reduced by finding a market for all pigs between 70 and 90 kg and by selling some weaners, FCR and DLWG improved so markedly that the farmer did not have to sell weaner pigs thereafter because so much space had been released by the more rapidly growing pigs. (Smith, 1989)

Lindqvist (1974) and Haaring et al (1978) showed that increasing the stocking density increased the prevalence of pneumonia. The latter workers compared stocking density between large herds with either high or low prevalence of pneumonia and noted that pigs from low prevalence herds had 32.2%, 3.6% and 9.1% more space in the nursery, growing and finishing areas respectively.

Flesja et al (1982) noted that when the stocking density in affected herds was reduced, the prevalence and severity of pneumonia also fell.

Daily
Live
Weight
Gain

Done (1990) concluded that association of pneumonia with environmental variables was largely a reflection of stocking density. The optimum stocking density will probably be above the level in the following equation.

$$S = 0.30\, W^{0.67}$$

S = space in m^2

W = weight (kg)

Air Space

There is a significant association between the air space per pig and the risk of pneumonia (Haaring et al, 1978, Pointon, 1985 and Muirhead, 1970b) (see Table 4).

Table 4: Occurrence of affected lungs with the volume of house

% of affected lungs	Number of houses	Av. volume per animal m^3/pig
<25	30	3.6
25-35	20	3.3
>35	16	3.1

(Haaring et al 1978)

In Australia, Pointon (1985) showed that pigs in low prevalence herds had 30%, 16% and 17% more airspace per pig in the nursery, growing and finishing accommodation respectively compared with pigs in high prevalence herds. In continuous throughput systems a minimum of 3 m^3/pig is recommended (Larsson and Backstrom, 1971).

Madec (1984) also considered less than 3 m^3 air space per pig to be a high risk factor in relation to pneumonia.

Temperature

Tielen (1978) studied the effects of temperature fluctuation and draughts and noted that the percentage of severely affected lungs increased as those parameters increased. (see Table 5)

Table 5: The percentage of severely affected lungs in pigs submitted to varying temperatures and draughts (Tielen et al, 1978 adapted).

% of severely affected lungs	26	14	6
Temperature-fluctuation index	0.78	0.60	0.48
Draughtiness index	137	130	114

Stambaugh (1986) noted that variation in temperature of more than $12^{o}F$ over a 24-hour period was associated with outbreaks of pneumonia. Done (1990) noted increasing levels of pneumonia in outdoor housed pigs when temperature levels fell. Wide variation in temperature was also associated with increasing levels of pneumonia. The same author also studied pigs housed indoors and noted that increasing outdoor temperatures increased pneumonia levels. This was related to the fact that indoor temperatures rise and even extra ventilation can only reduce it by $2\text{-}3^{o}C$ at the most. Pneumonia levels in housed pigs also increased as minimum temperatures fell and variation in temperature arose.

Gases

Christiaens (1984) made recommendations for allowable gas concentrations. (see Table 6)

Table 6: Recommendations for allowable gas concentrations (Christiaens, 1984)

Gas	Maximum conc. ppm	Remarks
Carbon dioxide	3000	
Ammonia	20	Measured as a mean in the dwelling zone of animals.
Hydrogen sulphide	0.5	Intermittently when removing slurry.
Carbon monoxide	10	Fossil fuel burners usually in use..

The effect of ammonia at various concentrations has been well documented (Curtis, 1979, Quarles and Caveny, 1979 and Stombaugh et al 1969).

Pointon (1985) compared the average ammonia concentration between herds with a high prevalence of pneumonia (more than 70% of the pigs affected) and herds with a low prevalence (less than 30% of pigs affected). The mean ammonia concentration in the high prevalence herds was 11.3 ppm compared to 5 ppm in low prevalence herds. Likewise Kivacs (1967) noted that the most severe cases of pneumonia were found in pens with the highest concentration of ammonia.

Dust

The sources and measurement of dust in piggeries was reviewed by Welch (1987).

Straw et al (1986) reviewed the role of dust in respiratory disease and concluded that there was little evidence to incriminate it as a contributor to swine pneumonia. In four trials, Chiba et al (1985) found that dust either had no effect on the severity of pneumonia or the effect was not significant.

Curtis et al (1975) and Doig and Willoughby (1971) found that dust had no effect on the respiratory tract structure and daily liveweight gain.

Clinically, dusty environments have been associated with pneumonia. (Kivacs 1967, Jericho and Harries, 1975).

However in combination with other pollutants, dust has been shown to damage the respiratory epithelium (Martin, 1970, Martin and Willoughby, 1972), and dust particles may harbour infectious agents and toxins. A recent study in the North-East of Scotland showed a significant positive correlation between the severity of pnéumonia and level of dust and bacteria in the air in second stage rearing accommodation and the finishing accommodation. In addition, rising levels of NH_3 in the finishing accommodation also had an effect.

Intercurrent Disease

In the North-East of Scotland it was noted that mortality due to broncho-pneumonia in a herd, fell dramatically after paratyphoid was controlled by vaccination. The presence of another respiratory disease, *Atrophic rhinitis*, does not make the animals more susceptible to pneumonia. However, herds with a high incidence of *Atrophic rhinitis* also tend to have high prevalence of pneumonia indicating that common environmental conditions affect both diseases in a similar manner (Wilson et al, 1986).

Halgaard (1981) studied herds with and without diarrhoea in the unweaned and weaned pigs. He noted that 3% of pigs raised in litters with diarrhoea developed pneumonia while only 1.7% of pigs raised in litters without diarrhoea developed pneumonia.

It has been shown experimentally that ascarid migration will significantly increase the severity of *Enzootic pneumonia* or *Swine Influenza*. (Underdahl and Kelley, 1957, Underdahl, 1958).

MacPherson (1960) noted that outbreaks of scouring and coughing occurred in which the pigs failed to improve until they had been treated for mange.

Done (1990) noted that there was a steady significant increase in days *on test* with increasing number of treatments for pneumonia. When pigs were treated for both pneumonia and scour there was a further decrease in production efficiency. In fact most infectious diseases will make the pig more susceptible to pneumonia. Therefore, avoid buying pigs from several sources or from a diseased source.

TACKLING THE PROBLEM

Besides the time honoured method of treating pneumonia with antibiotics in various ways, the practitioner can do much to decrease the prevalence and severity of outbreaks by manipulation of management, husbandry and environment.

Firstly, irrespective of whether the herd is a breeder/weaner, breeder/finisher or finisher it has been shown that buying in stock from many sources, especially diseased sources will either precipitate outbreaks or ensure a continuing high prevalence and severity of the disease. Swiss researchers have incriminated boars as predominant transmitters of *Haemophilus pleuropneumoniae* between herds. (cited by Schultz, 1985). It follows that breeding herds buying in boars only should be careful about the health of the source stock. With regard to possible sources of stock, do not ask the question *"is the herd free of Actinobacillus (Haemophilus) pleuropneumoniae?"* A more relevant question would be *"is there any evidence of the disease pleuropneumonia?"* Apart from the pig there are no known natural carriers of the organism.

The next step should be the examination of the herd management. Can the buildings be adapted to an all in/all out policy without too much cost? This can easily be achieved in some cases by erecting dividing walls to roof height, making sure that each sub-division has its own controlled ventilation system. The smaller the total group size the better. An old building may be used as extra accommodation if it is available. The effect of an all in/out policy is to improve the cleanliness which was the only factor of importance in the multivariate model of Tuovinen et al (1990).

Another management procedure which nearly always reaps benefits, is reduction in stocking density. This procedure will either require more accommodation or the sale of weaners. Sometimes it may be possible to market pigs over a much wider weight range so creating more space. It is often difficult to convince the farmer that such a move is worthwhile. The most telling way is to quote from published work and give an example of the saving that would probably be achieved. Assume that the food conversion ratio might be improved by 0.25 over 30-90 kg liveweight with food costing £170/tonne. The farm is a 600 sow unit selling 12,000 finishers/year.

Possible Annual Saving = weight gain x FCR x No. of pigs x cost of feed

$$= \frac{60 \times 0.25 \times 12{,}000 \times 165}{1000}$$

$$= £29{,}700$$

As stocking density is reduced there will be an improvement in productivity (Edwards et al, 1988, Petherick, 1983 and Kornegay and Notter, 1984) but a stage is reached where the cost of housing fewer pigs (in kg/m^2) overcomes the benefits of reduced stocking density. The complexity of the situation has been discussed in detail by Edwards et al (1988) As the growth rate increases in a herd the need to drop stocking density drops because of the increased throughput.

↑ hygiene vs. temp. ↓

Improving air hygiene is also likely to have beneficial effects, but how can this be achieved on the farm? Increasing ventilation rate rarely achieves the sort of result expected. (Gustafsson, 1989). It does tend to reduce the number of large particles over a short period but the very small particles of 5 microns or less tend to stay in suspension and these can be breathed right into the alveoli. In many instances increased ventilation rates will reduce temperatures below the lower critical level of the pigs, especially in the winter. When this happens the temperature has to be raised, by either improving the insulation values, or by supplying heat - both of which may be costly methods. Air hygiene may also be immediately improved by enlarging the air space/pig. However, this is never easy to achieve in practice. Reducing stocking density is a negative way of achieving this. Raising the roof and increasing volume is another method but will be too costly in the majority of cases. Another method of improving air hygiene is to utilise large empty buildings such as cattle barns or potato stores which are usually empty in summer and this has proven a successful method in the North-East of Scotland. Air filtration is another method of improving air quality and a number of reports have shown a decrease in the prevalence and severity of pneumonia as well as improved FCR and DLWG. (Pearson, 1989, Rutter et al, 1986, Pritchard, et al, 1981, and Carpenter and Moulsley, 1985).

Air cleaning with devices such as water foggers, vacuum cleaners, ionizers, electrostatic precipitators and oil spraying have been shown to reduce dust levels (Pedersen, 1989). However, they have not, as yet, been demonstrated to reduce respiratory disease in commercial units on a **cost effective basis**. Pedersen (1989) concluded that the most effective means of removing dust was spraying with rape oil. Even though it has been shown that filtration will reduce the severity of pneumonia, there are, as yet, no commercially viable units on the market (Pearson, 1991). Although the mechanical removal of air pollutants looks attractive, it would seem that the practitioner will have to wait some time before a suitable cost-effective practical device is available for on-farm use. More recently in the UK, trials have been carried out with a special aerial disinfectant agent, Virkon-S (Antec International). In a herd with *Enzootic pneumonia,* treated groups showed a significant improvement in the severity of pneumonia, but on the other hand they also required more treatments for clinical pneumonia (Muirhead, 1991).

Davidson (1991), the manager of three herds of 1800 sows, 1300 sows and 750 sows respectively, which had serious respiratory problems (*Enzootic pneumonia, Haemophilus pleuropneumonia* and *Streptococcus suis* II) stated categorically that the most important managemental factor was ensuring a minimum weaning weight of 5 kg before moving to the first stage flatdecks and a minimum weight of 15 kg before moving to the second stage flatdecks which were run on a continuous throughput basis in the same air space. Previous attempts at moving pigs at less than these weights resulted in severe respiratory problems and high mortality. As these observations were made over five years and involved many thousands of pigs, they must have some significance. As he put it *'the pig must suit the environment if the environment cannot be modified'*. Schultz (1985) advocated the use of the fogging agent chlorine dioxide (2%), combined with the maintenance of high humidity and low temperature to encourage larger aerosal droplet size. This results in larger particles being retained in the nose. In the U.K. and Ireland, a very high humidity system (sweat box system) was noted to reduce the prevalence of pneumonia (Gordon, 1963).

Pneumonia problems are likely to have several infectious causes and will be influenced in prevalence and severity by many non-infectious determinants. Those professionals who are actively involved in giving advice to the pig industry would do well to forget about getting too involved in finding the cause, supported by expensive investigations in bacteriology, virology and serology and pay more attention to management, husbandry and environmental aspects. The simple solution, providing it is practical will often be more cost effective in the final analysis.

TREATMENT AND CONTROL

The important aspects of treatment will include such deliberations as:

when to treat

what to treat with

how to give it

constraints on treatment efficacy

Introduction

In many cases both the farmer and veterinarian will be satisfied with feed medication. However, when profit margins become narrow and costs have to be contained as much as possible, the farmer often questions the need for the continuous medication of feed to some age groups, or questions the cost of the drug. Could a cheaper alternative be found? Does it need to be used continuously? But usually the farmer knows from past experience that as soon as drugs are removed completely problems with pneumonia and all its sequels will return. There are alternative ways of delivering antibiotics to the pig (see Figure 3) some of which are better than others. But these are simply different methods of juggling with the same basic approach to a problem by using antibiotics only. There is no doubt that there are many farms in which the pigs cannot be raised to finishing weight without either strategic or continuous use of antibiotics, otherwise pneumonia would be a serious problem. These are the types of herds which will require the practitioner to find alternative answers.

Figure 3: Methods of delivering antibiotics

Feed	Continuous Strategic
Water	Continuous Pulse
Top Dressing	Continuous Strategic
Parenteral	24 Hour 72 Hour

What Treatment?

In theory the drug of choice for pneumonia treatment will depend on:

(a) the causal organism and its sensitivity;

(b) the method of drug delivery.

In most cases of pneumonia the lungs will have been attacked by a variety of organisms some of which may be viruses. Unless the pneumonia is caused by one single organism e.g. *Bordetella bronchiseptica*, much time can be wasted by sending samples (taken at the abattoir) to the laboratory in the hope of finding the cause. Two points are of importance here. Firstly, the organism isolated may only be playing a minor role in the pathogenesis of the disease or frequently no role at all. Secondly, Little (1975) noted that *"Progressive respiratory diseases are dynamic processes, the initial causes of which may be observed, or may be no longer detectable, when diagnostic examinations are carried out in single or small numbers of affected animals."*

Most antibiotics will achieve high lung tissue levels because of the high degree of lung blood perfusion. The antibiotics which characteristically concentrate in the lung are the macrolides which are lipophilic, weak organic bases and the tetracyclines which are amphoteric and which have variable lipid solubility (McKellar, 1990).

Oxytetracycline may not only concentrate in lung tissue, but may also reach equal levels in both pneumonic and normal lungs (Baxter and McKellar cited by McKellar 1990). When faced with an acute outbreak, then the antibiotic of choice should either be one that will probably work, based on past experience or a broad spectrum antibiotic with good lung penetration such as one of the tetracyclines.

Actinobacillus (Haemophilus) pleuropneumoniae is susceptible *in vitro* to a range of drugs including penicillin and semi-synthetic penicillin, chloramphenicol, tetracyclines, trimethoprim and sulphamethoxazole, tiamulin, gentamycin, lincomycin and spectinomycin, cephalosporins and neomycin (Schultz 1985 and Nicolet 1986). Many reports from countries throughout the world suggest that most of these antibiotics can be useful for both prevention and treatment of pneumonia including *pleuropneumonia.*

If an acute outbreak of *Haemophilus pleuropneumonia* is suspected, the method of drug delivery must initially be by injection, with either one of the penicillins or tetracyclines. Experience of an acute outbreak of the disease in a minimal disease herd in the North-East of Scotland, indicated, that although the organism was sensitive to penicillin, the inclusion of phenoxymethyl penicillin in the feed at 400 ppm and in the water at 300 ppm failed to prevent high mortality. Schultz (1984) noted an acute outbreak of pleuropneumonia decreased both the **food intake** and the **water intake**, and this observation was confirmed by Henry (1986).

Desrosiers and Martineau (1984) and Desrosiers (1986) concluded that both in-feed and water medication were **not suitable methods** of medicating pigs in acute outbreaks of *pleuropneumonia* (despite high inclusion levels of the correct drug).

In another farm, with a serious pneumonia problem (including *Actinobacillus pleuropneumonia* and *Enzootic pneumonia*) requiring continuous medication of the rearing pigs, the productivity results appeared to be very creditable when compared with MLC figures. (see Table 7)

Table 7: Daily liveweight gain and food conversion efficiency in the feeding herd 35-85 kg and % mortality (12 months results to January 1991)

	Farm	MLC Top Third	MLC Average
DLG	706	679	632
FCR	2.82	2.67	2.88
% Mortality	1.1	1.9	2.3
Feed cost per kg liveweight	36.44	36.23	40.23

MLC = Meat and Livestock Commission, Year Book 1990, Milton Keynes

However, in order to reach this standard, no less than 1,063 pigs were injected because of clinical pneumonia in the last 6 months. These figures also demonstrate the importance of a thorough clinical inspection of all pigs on a twice daily basis.

Done (1990), after a study of pneumonia in national testing stations, concluded that under conditions of good management, nutrition and hygiene, clinical disease is not a serious problem with prompt treatment.

However, there are many instances where in-feed or water medication is necessary on a continuous basis, otherwise the effects of pneumonia would be devastating. In-feed medication through to finishing weight has been ruled out by the law in some countries. However, this problem can be circumvented by pulse medication in the water (Kavanagh 1990) or by top dressing. The latter method is achieved by simply computing the daily dose of drug required by the pigs in a pen and sprinkling the requisite amount of drug on to the feed in the trough or hopper. The latter method may be crude but it works and can target specific pens in a house. In addition, when the feed for all the finishing pigs is supplied from one bin and water medication is not available, it is a useful method of drug medication. On the whole, water medication is the method of choice, but has several disadvantages (Pickles, 1984). Two of the more important are wastage through nipple drinkers and the fact that most header tanks are too small and tend to supply all the pigs in one house. However, devices (water proportioners) which monitor and supply the correct amount of medication to a pen or pens are available and have been used widely in the poultry industry.

Where it is felt that water medication is vital and the header tank is too small to hold at least a third of a day's water supply, a more crude method of water medication may be used in some cases. This involves computing the total daily dose of drug required (based on the total bodyweight of pigs supplied by the water) and dividing it into 4 equal parts given first thing in the morning, mid day, late afternoon and evening. This method works well and in practice does not lead to drug toxicity with most antibiotics given at therapeutic doses.

Problems of Drug Medication

One of the major constraints on the proper use of in-feed medication is the law relating to licensed medicines. It is important to note that an **inclusion rate** is not synonymous with a **dose rate.** In many instances the inclusion rate indicated in the data sheet will not supply the therapeutic dose rate indicated for small pigs and sows especially, or in cases where pigs have a poor appetite due to disease. Therefore it is important to determine the average **feed intake** before computing the correct **inclusion rate.** In other cases drug failure may be traced to the use of inferior products. It has been shown that some sources of chlortetracycline contain 30% epichlortetracycline which is a totally inactive product but will show on chemical assay to be chlortetracycline (Cyanamid technical information TIS 84/1).

In addition chlortetracycline may be sold as chlortetracycline hydrochloride (soluble) or chlortetracycline calcium complex (insoluble in water). The latter is soluble in the acid environment of the stomach but the former is subject to degradation, hence the preferred use of the calcium complex for in-feed medication. Absorption of tetracycline from the gut may be decreased due to binding with calcium, iron, aluminuim or bismuth. (Kunesh 1981).

Potassium penicillin level in feed may be reduced by 48% after 4 weeks storage. (Cyanamid Technical Information Sheet 87/8). Procaine benzylpenicillin is rapidly destroyed by acid in the stomach while phenoxymethylpenicillin may be destroyed by the heating process used in making pelleted feed. Johnston et al (1990) noted that the in-feed level of phenoxymethylpenicillin fell from 200 ppm to 60 ppm in 14 days but the latter level was still adequate for treating meningitis due to *Streptococcus suis* II.

Vaccination

Vaccines have been produced by many methods and it would seem that a really good vaccine has yet to be produced. However, much work is being undertaken with sub-unit vaccines, conjugate vaccines, live attenuated vaccines, aerosal vaccines and toxoid vaccines. It is likely that a good vaccine will be produced in the near future. However, where there are no good vaccines, the best alternative is an autogenous vaccine. Davidson (1991) came to the conclusion that autogenous pleuropneumonia vaccines were very effective in protecting non-immune stock of all ages from mortality but usefulness in herds with chronic disease was debatable. An effect can often be shown in small scale experimental trials, but this finding should be interpreted with caution. A useful cost effective vaccine against *Mycoplasma hyopneumoniae* has yet to be produced.

Conclusion

The control and treatment of pneumonia presents many difficulties to some practitioners. However the disease can be tackled successfully by a combination of controlled antibiotic input and manipulation of the non-infectious determinants. The most important of these are stocking density, volume of air per pig, pig movement (all in/all out or continuous throughput) source of stock, group size and air hygiene. The optimum solution will vary widely from herd to herd. Whatever measures are used to combat the disease, the success of treatment should always be measured by the profitability.

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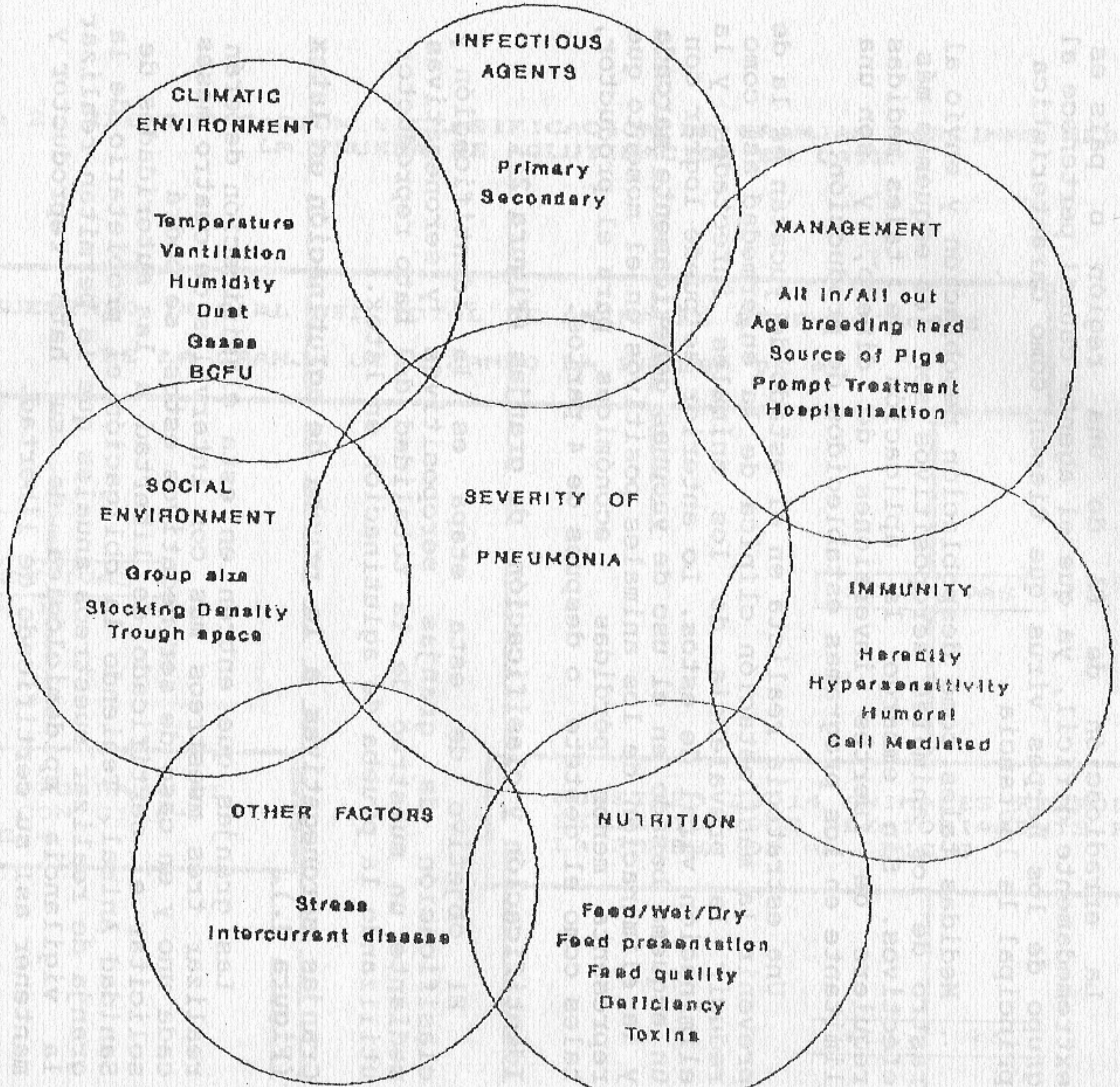
APPENDIX I


CLIMATIC ENVIRONMENT
Temperature
Ventilation
Humidity
Dust
Gases
BCFU
INFECTIOUS AGENTS
Primary
Secondary
MANAGEMENT
All In/All out
Age breeding herd
Source of Pigs
Prompt Treatment
Hospitalisation
SOCIAL ENVIRONMENT
Group size
Stocking Density
Trough space
SEVERITY OF PNEUMONIA
IMMUNITY
Heredity
Hypersensitivity
Humoral
Cell Mediated
OTHER FACTORS
Stress
Intercurrent disease
NUTRITION
Feed/Wet/Dry
Feed presentation
Feed quality
Deficiency
Toxins