ATA Presentation

My presentation outlines the results of a 4-year study that I undertook to look at the problem of pigs arriving dead at an abattoir after having been transported by road.

I spent my last 35 years in veterinary practice as a specialist in pig medicine.

Much of my time as a consultant was spent at an abattoir where I monitored the progress of various health programmes on my client's farms.

During that time I noticed that, despite my clients having very well managed farms and high health stock, pigs occasionally arrived at the abattoir dead or died in the yards soon after arrival.

Postmortem examinations undertaken at the abattoir failed to show any unusual pathology.

Because I was very busy during my consultancy, I didn't have time to investigate the problem, so I decided to begin a study when I retired. The study became the basis of the thesis for my Doctoral degree.

I should first briefly describe the area where the study was conducted. **XXXX**

New Zealand, for those of you who are not familiar with our country, it is very small; roughly a 1,000 miles from top to bottom. It has two principal islands, The North and the South Islands, separated by a strait that is roughly 14 miles across at its narrowest point.

Stock are regularly transported across the strait in both directions. A practice that is causing some concern, because of the number of stock deaths that have occurred.

The climate in New Zealand is very mild with snow falls being rare in the winter except in the mountains. Overall, apart from a few very hot days in summer, stock transport conditions in New Zealand should be ideal. **XXXX**

New Zealand is largely hilly with a lot of steep winding roads and has a population of nearly 5 million people with 80% of them living in the North Island. As a result, traffic density in the South Island is light except for holiday periods.

The area where the study was conducted was in the South Island's Canterbury Plains and the more hilly Otago region. The abattoir is here, and the two farms used during the study are here and here.

As a result of the hilly nature and the unsealed roads in our farming communities, all of our stock-trucks are articulated. **XXXX**

Also, because there are strict regulations on vehicle length, and weight; all are of a COE design.

Catalytic converters are required on all large stock-trucks and are generally slung under the front of the truck's crate.

Because of the large numbers of smaller animals, sheep, very young calves ('Bobby calves') and pigs that are transported by road, four-deck crates are used; the exception being for the transport of deer where single-deck trucks are the norm. Cattle are transported in the four-deck stock-truck by latching the intermediate floors against the walls, creating a two-deck environment. However, this practice is causing concern because larger animals can injure themselves by rubbing their backs against structures above them.

The boarding-up of ventilation openings in the winter is not required and though regulations require stock-trucks to have adequate ventilation, and fines are imposed on vehicles that allow effluent to escape from the vehicle on to the road, wall opening designs vary considerably. **XXXX XXXX XXXX**

Bedding materials are not required to be used.

The size of our pigs differs from many countries in that their weights range from 90-100kg that is up to 200lbs. Loads normally range between 200 – 210 pigs so only the lower two decks of the four-deck crates are used.

There is relatively little genetic variation amongst commercial market-weight pigs in New Zealand. The two major breeding companies have ensured that all market-weight pigs are free of the pig stress genes.

Stock densities in pens tends to vary because drivers usually reduce the number of pigs in each pen during the summer and increase their numbers during winter months, a practice that may be creating a problem as I will explain later.

Stock densities are assessed by the number of pigs per pen. This practice is based on the assumption that there would be little variation in the size of the pigs being sent for slaughter, so overall, pen weights would be consistent from one load to the next.

I have been told that the density was initially calculated against the number of pigs per available floor area so that all pigs could lie down comfortably. However, the number of pigs per pen has changed over time as pigs have increased in size. As a part of my study I calculated the weight of the pigs in a standard pen and related that to the floor area and found that the densities were within international guidelines.

However, I believe that more work needs to be done on assessing the most appropriate stock densities, particularly with reference to head room.

The first part of the study involved establishing the extent of the problem and whether it was related to specific farms.

Prior to the commencement of my study, I had the workers in the abattoir's yards collect data on the place in the truck or yards where the pigs were found dead, the farm of origin, the trucking company that transported the pigs, the sex of the dead pigs, the date and time of day.

From this data I found that on average, over the four-year period, the death rate was 17 pigs per 10,000 transported. I found that there was no relationship to specific farms or whether the pigs had been reared in confinement housing or free-range barns.

There was no discernable association with the transport companies that had delivered the pigs, and that the majority of the farms had transport times of from 1-6 hours with the bulk being from 2 – 2.5 hours.

There was no discernable relationship to the sex of the dead pigs, the length of travel or the month of the year; there were as many pigs found dead during the winter months as there were in the summer. **XXXX**

I believe that part of the problem was the habit of drivers increasing the number of pigs per pen during cold days. Whilst temperatures may start at -5°C in the morning they are often > 15°C in the afternoon when they are being unloaded.

However, there did appear to be a greater incidence of deaths when pigs arrived at the abattoir in the afternoon or had prolonged waiting times before unloading.

Looking at the data collected over that four-year period, I found that the majority of deaths occurred amongst pigs in the bottom front pen of the truck's crate. **XXXX** It is worth noting that pigs in that pen are the first to be loaded and the last to be unloaded so they spend more time in their pen that other pigs.

The next part of my study was to have a look at the published literature.

The search showed that there are a wide range of factors that can lead to stress to stock during road transport. **XXXX**

However, the literature indicates that heat stress (or more accurately 'Heat Stroke') was the most likely cause of the pig deaths even during the winter months.

I found that all countries where studies have been undertaken have recorded similar road transport deaths with rates ranging between 10 and 100 pigs per 10,000 transported.

It appeared that the majority of deaths reported in northern hemisphere countries were either during the winter months when extreme cold occurred, or during the heat of summer. Some authors indicated that there was an increase in the number of dead pigs when unloading at packing plants was prolonged.

The literature indicated that heat stress conditions could be predicted by using a mathematical formula that combined temperature and humidity – the Temperature Humidity Index or THI. Charts have been produced for pigs that indicate that heat stress conditions are comfortable between values of 60 – 70 but progressively worsen above 70, becoming critical at values above 80. Cold stress is considered to occur at THIs below 60, with levels as low as 35 having been recorded.

My study involved mounting temperature/humidity sensors and a camera in a stock-truck and monitoring what happened during transport – *over two hundred journeys were monitored*. **XXXX XXXX XXXX**

Very few stock-crates have solid roofs. The majority of crates have a flexible cover that can be rolled across the top of the top deck to prevent sunburn and to stop animals from attempting to climb out of their pens.

To reduce some of the potential variables in the study I used the same vehicle and same driver throughout and monitored the same two farms during the four-year study.

During the study I looked at

- The temperature and humidity changes, and the resulting THI changes, at the different stages of a journey. I looked at what happens from the time the vehicle was started first thing in the morning to arriving at the farm and them from loading through to unloading.
- I looked at the impact of different stocking densities.
- I looked at the effect that different locations within the stock-truck had on meat quality.
- And the differences between the two farms, to examine the impact of the differences in the countryside over which the pigs were transported.

Since pigs can't sweat, they are an ideal species for examining the effect of heat stress. However, despite having no functioning sweat glands pigs can lose up to 30 litres of moisture per hour by evaporation through the skin surface.

Once a pig's internal temperature reaches a critical point, they start breathing through their mouths, cooling themselves by evaporating moisture from their mouths and nose. **XXXX**

The findings from the study indicated that pigs commenced open-mouth breathing at around a THI of 70 with two or more pigs open-mouth breathing at a THI of 72; this was consistent with the findings of other researchers.

The appearance of open-mouth breathing therefore allows for the ability to identify a reasonably precise point at which pigs experience heat stress.

The camera also raises an interesting point. **XXXX** Many people infer that when pigs are seen lying down in a vehicle, that they are comfortable. It would appear possible that by lying down pigs are providing more air space above them, thereby providing better ventilation. They are also lying on a cooler metallic surface that allows for greater loss of heat by conduction through the metallic surface. Thus, pigs lying down may be doing so to improve their comfort rather than as a simple means of relaxation.

The study showed that the process of loading the truck was the major contributor to the heat stress conditions but that, while the truck was moving, heat stress was reduced. **XXXX XXXX**

As can be seen in the graph, temperature in the pen rose rapidly once the vehicle became stationary. This led to a corresponding rise in the THI, ***indicating that stationary periods lead to heat stress conditions.*** **XXXX** ***Thus, a significant problem occurs when a loaded vehicle becomes stationary.***

Since most countries require drivers to have a rest after a period of continuous driving, this could raise a problem during long-distance stock transport.

I note that in the international regulations that I have cited, whilst rest periods for drivers have been required, no corresponding requirements seem to have been made to address the potential heat stress problem. It would appear that positive pressure ventilation systems and/or the misting of the animals during prolonged stationary periods, may be needed to ensure the welfare of the animals.

Overall, I found that heat stress occurred frequently at some point during a journey but was rarely found to occur when the vehicle was moving. **XXXX** In the chart I have used a THI of 72 so the figures relate to when two or more pigs were breathing through their mouths.

No deaths occurred during the study.

The results of the study suggested that ventilation was inadequate in the bottom front pen of the truck's stock-crate and that heat from the vehicle's motor and catalytic converter could be a contributing factor.

As a consequence, I designed, with the help of a ventilation expert and an electrical engineer, a novel ventilation system in an attempt to improve the ventilation in the front pens of the truck's stock-crate. **XXXX**

You will note that I had had an insulating layer fixed to the front wall of the truck's stock-crate. The insulation reduced the heat in the front pen by approximately 1.5° C.

To save drainage of the truck's battery an independent 12-volt, dry cell battery was used to power the fan.

The fan was set to start when the truck's 24-volt battery was inactive for more than three minutes. This avoided the fan operating when the vehicle stopped at intersections during travel through townships.

A major consideration related to the stock-trucks that crossed the strait between the two islands. It was calculated that stoppages at the wharves and the actual time taken to cross the strait would be no more than four hours.

To ensure that the 12-volt battery would last long enough to cover the crossing, the fan was set on a cycle of 3-minutes on and 3-minutes off.

The fan used was a car's radiator fan and was set to flow at 50kph, at that rate the flow in the pen was barely discernable and the camera showed that it did not disturb the pigs in the pen.

The stock-crates that are currently in use in New Zealand were originally designed some thirty years ago.

Since then both sheep and pigs have increased in size thereby reducing the available air space in the pens. **XXXX**

My conclusion from the study was that the design of the New Zealand-style stock-trucks, of the design of the vehicle used in my study, do not give adequate ventilation for the larger, modern pigs, and that further studies are warranted to look at what head-room and ventilation openings are required to provide appropriate animal welfare..

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