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Calf Note 184 – What are the odds?

Introduction

Epidemiology is the branch of medicine that deals with the incidence, distribution, and possible control of diseases and other factors relating to health. When we calculate and use statistics such as rates of failure of passive transfer (**FPT**) or percent mortality, we rely on calculations and interpretations of epidemiologists and the science of epidemiology. The valuable reports on calf management and health practices published by the National Animal Health Monitoring System (**NAHMS**) are great examples of epidemiological research and reporting.

What value might such a branch of science have for calf raisers? A lot.

Risk ratios

One calculation that is commonly reported for conditions such as FPT is something called the "relative risk ratio". To explain the concept of risk ratios, consider Table 1.

	Sick	Healthy	Total
FPT	50	20	70
SPT	50	80	130
Total	100	100	200

Table 1. Hypothetical frequencies of disease ("sick") in calves with failure (FPT) or successful (SPT) passive transfer.

In this table, we have a hypothetical farm with calves that fall into two groups – either successful (SPT) or failure (FPT) of passive immunity. For this discussion, we'll define FPT as calves that have a serum total protein concentration measured within the first 72 hours of age as <5.2 g/dl. As you can see from Table 1, 70 calves of the 200 measured had FPT. So, the rate of FPT on this farm is 70 / 200 = 35%. While this may seem high, many published statistics suggest that rates of FPT for all calves (not just those fed colostrum and were healthy) can range from 20-50%.

Most calves (130 out of 200) were fed sufficient colostrum and achieved SPT. These calves – according to most published research – are more likely to remain healthy and less likely to die. The proportion on this farm is 130 / 200 = 65%. Since we have only two groups, then 35% FPT + 65% SPT = 100% of the calves.

Within each of the two groups, we measured the number of calves that developed diarrhea (defined as one or more days calves were treated for abnormally liquid feces). Within the FPT group, 50 calves were treated whereas 20 calves remained healthy and didn't require treatment. Within the SPT group, the same number of calves (50) were treated, but 80 calves stayed healthy.

Using these data, we can calculate the overall disease rate (100 calves became sick out of 200 = 50%).

So, to summarize, this farm's FPT rate is 35% and disease rate is 50%. Not stellar, but somewhat typical for many farms.

By performing some arithmetic, we can calculate something called the "relative risk ratio" – which is defined as the chance that an outcome (e.g., diarrhea) will occur in one group (e.g., FPT) compared to another (e.g., SPT). Relative risks can be useful in understanding factors that influence outcomes such as mortality. Calf Note #154 discusses relative risks for mortality on a NY dairy farm.

Using the data in the table above, we calculate the relative risk as 1.86 (for those interested in the math, please contact me directly). While the actual calculation might not be important for our purposes, the number is useful. We interpret the relative risk ratio to mean that calves with FPT are 1.86 times more likely to develop diarrhea compared to calves with SPT.

While the numbers in Table 1 show that the same number of calves in each passive immunity group were treated (i.e., 50 calves), there were far fewer calves born in the FPT group (70 compared to 130). The percent of FPT calves treated (50 / 70 = 71%) compared to SPT calves (50 /130 = 38%) indicates clearly that FPT calves on this hypothetical farm were far more likely to require treatments compared to SPT calves. If we assume that each day a calf is treated costs about $15 (antibiotics + electrolytes + labor) and we treat for 3 days for each calf, you can see the dramatic difference in costs for each group. Each group cost 50 x 3 x 15 = $2,250 for treatments; however, the smaller FPT group in inordinately represented in treatment costs.

Using published values

Most farms don't record numbers (or proportions) of calves with FPT or SPT and many don't keep track of which calves are treated more often than others. However, it's instructive and useful to consider maintaining records such as those above as it will show the difference in treatments (or mortality) caused by FPT vs. SPT.

We can create a table like that in Table 1 using mortality instead of morbidity if we make a few assumptions. Let's say our second hypothetical farm has 1,000 calves born alive (i.e., not stillborn) that are monitored until weaning. So, the criterion we're monitoring is preweaning death loss and partitioning between FPT and SPT groups.

The farm periodically monitors serum total protein concentration, though not on every calf. They estimate that about 25% of calves (both heifers and bulls) have total protein <5.2 g/dl when samples are measured. Also, based on herd record data, they lose 8% of all calves prior to weaning at 60 days.

Regarding relative risks – many published studies suggest that FPT increases the risk of mortality by 3-6 times compared to calves with SPT. For the sake our this example, the farm doesn't know their relative risk, so we'll use a risk of 4.5 – that is, calves with FPT are 4.5 times more likely to die than calves that have enough colostral antibodies.

Prior to partitioning mortality, we can construct a 2x2 table as in Table 2. You can see that FPT (20%) amounted to 250 calves with low blood serum total protein. Also, the 8% death loss is allocated to 80 calves that died and 920 live calves.

	Died	Lived	Total
FPT			250
SPT			750
Total	80	920	1,000

Table 2. Hypothetical frequencies of mortality in calves with failure (FPT) or successful (SPT) passive transfer.

Using the relative risk of 4.5, we then can do some "fancy" math that allows us to estimate the groupings of calves within each group. Table 3 partitions groupings between live and dead groups for each group.

As we can see in Table 3, the proportion of calves that die from the FPT group is proportionally much higher than the SPT group. Using the risk ratio of 4.5, this means that FPT calves are 4.5 times more likely to die.

When we calculate the percent of calves that die in each group, the numbers are startling. Of all mortality that occurred on this farm, 60% was from the calves in the FPT group. Additionally, of the 250 live calves with FPT, 48 calves (48 / 250 = 19%) of these calves died. Conversely, only 32 / 750 = 4% of calves in the SPT group died prior to 60 d of age.

	Died	Lived	Total
FPT	48	202	250
SPT	32	718	750
Total	80	920	1,000

Table 3. Hypothetical frequencies of mortality in calves with failure (FPT) or successful (SPT) passive transfer.

This information shows quite clearly the magnitude of losses occurring from FPT and reinforces the value of early and aggressive colostrum feeding.

Tables such as the contingency tables reviewed here can be a valuable tool in improving management and educating workers on every dairy. Tables are not difficult to construct and can be updated routinely to review. Remember, you manage what you measure.

An example Excel spreadsheet is available to calculating relative risk and partitioning morbidity or mortality on calf raising operations. For more information, please contact me.

Written by Dr. Jim Quigley (28 March 2015)
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