Eamon Sheehan

A NUFFIELD FARMING SCHOLARSHIP TRUST REPORT

Microbial Management and its importance in the Dairy and Beef Industry

NUFFIELD IRELAND

Farming Scholarships

by Eamon Sheehan

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1. Personal Introduction

I am 37 years of age and a second-generation farmer. I am passionate about all things relating to agriculture, especially the area of animal health and their overall well-being.

We have a 240-acre farm in Kilkenny, south east Ireland. My father, Eamon Snr, moved to Kilkenny in 1974. After an initial purchase of 12 acres in 1982, he put our farm together allowing myself and my family the opportunities we have today.

Over the years, a herd of pedigree Charolais, Belgian Blue and Limousin cows were built up along with our commercial suckler herd of 120 cows. During this time, we bred and produced pedigree bulls for sales and commercial weanlings for export.

In 2011 I married Lois, and we now have two children, Rachel and Julia.

Having applied for and received the new entrant to dairy quota in 2012 we began milking 64 cows and are now currently milking 154 with a target of 220 cows in the coming years.

I applied for my Nuffield scholarship to enable me to further my education and allow myself and my family opportunities in the future. I had a near fatal farm accident in 2016 which allowed me to reflect and really think about my future wants and needs.

I am the current chairman of our local Irish Farmers Association (IFA) Branch and the chairman of our Teagasc dairy discussion group. I also partook in the IFA Smart Farming initiative in 2015. This involved a full analysis of the running of our farm highlighting its strengths and weaknesses in a bid to be more sustainable and profitable.

We are breeders and producers of sport horses and have horses and ponies competing at top level, both show jumping and eventing worldwide.

I am looking forward to sharing my research with Nuffield Farming Scholars and the wider farming community.

1.1 The inspiration behind choosing my topic

Having attended an Animal Health Ireland (AHI)* meeting on calf health in 2013, I had the pleasure of listening to a line-up that included Dr. Ingrid Lorenz. Dr. Lorenz focused on the scouring calf and how to treat it. What struck me at this point was a drug I used for years, unbeknown to me, was doing a lot of damage to the intestine of scouring calves. Synulox boluses were not only killing the bad bacteria in the gut that was causing the scour, they were also destroying the good bacteria and leaving the gut flora in a very poor state long term.

I left the meeting that day wondering what else I thought I was doing right, that may actually cause adverse effects long term in regard to herd health. I began looking at when, how and why I used treatments and began to plan for the coming calving season to correct and improve my animal husbandry. I learned that 85-90% of scours are non-bacterial and I was using oral antibiotics. I had been using the wrong medicine, for the wrong condition, for as long as I could remember.

*AHI was founded in 2009 as an industry-led, not-for-profit partnership between livestock farmers, processors, service providers and government, with the goal to improve the profitability, sustainability and competitiveness of Irish livestock farmers and related industries through superior animal health.

2. Background to my study objective, the importance of addressing the issue of Antimicrobial resistance (AMR)

In general, agriculture is heavily criticised for many global issues such as greenhouse gas emissions and the contribution to antimicrobial resistance (AMR). We can't deny that we have to address all of these issues but equally we cannot be a scape goat for society.

Antimicrobial Resistance has been a hot topic in recent years, and rightly so considering that, penicillin, first discovered by Alexander Fleming in 1928, now is obsolete in many cases as it is no longer effective at combating common diseases.

Having always taken great pride in breeding and producing top quality, healthy animals, I always want to do better. As every farmer knows, we take things very personally when something goes wrong and the health status of our herd is affected. This is not only a financial burden but a physical and mental drain.

We improve things year on year by learning, with help from our vets and advisors. The area that always seems to be weakest at farm level, is our understanding of medication and what it actually does. A prime example of this is Penicillin and its inappropriate use, which has contributed to the growth of resistant microbes.

I feel AMR is not caused by purposeful negligence, more so it is due to our lack of education in this area and nobody wants to solve a problem by creating a bigger one. Unfortunately, that is what we are currently doing and will continue to unless we learn from our mistakes.

I want my study to help us, as farmers, to understand and learn so we can secure our future use of antibiotics in agriculture. This can only be done if we commit to an antimicrobial stewardship.

3. My study tours

Over a period of 48 days we travelled 56,379km through 9 countries with our Global Focus Programme. Throughout this time, we were involved in all aspects of our industry, from agriculture at its most basic to global multinational firms.

During this time, I was fortunate to be able to visit dairy, beef, pig and poultry farms and get to see the differences and similarities that bring us together as an agricultural community. Similar to Irish agriculture, farming in a profitable, sustainable fashion was the main aim on the farms I visited whereas, the main difference was scale. Although scale was generally the differential in a lot of cases, the main aim was to farm in a profitable and sustainable fashion.

The Philippines

In the Philippines we saw food production at its most basic and least traceable. Unfortunately, in the less developed nations, this can be the norm. With unregulated and misinformed use of antibiotics in these countries, legislation and education need to be put in place as we are only a flight away from a new superbug**.**

(Local "Wet Market" Los Banos, Philippines. Hygiene and regulation obsolete with no traceability. Worryingly these poorer countries with lower standards in production are a serious threat to creation of new superbugs)

China

China showed me what consumer distrust can cause. After several food scares, imported produce was in the greatest demand by the growing middle class. Fonterra and Abbots have formed a partnership to improve the production of local produce for the Chinese market. This partnership has led to the building of a 3,500-cow dairy unit on a 50ha site to supply some of the in-house market just outside Jinan. In addition, plans are in place to build three further farms on the same blueprint to accommodate a further 10,000 cows. A major incentive for this development is the government tax free policy on agricultural production.

Being one of the ten worst polluted cities in the world with air pollution 3-4 times above what is deemed safe, AMR was put back in line with one of many issues to be dealt with. This was worrying on a disease and welfare perspective. Water quality was also very poor, this was being used to irrigate the crops that were being harvested for human and dairy cow consumption. All of these issues combined could lead to serious health issues for animals and humans.

(Though our presence was strong throughout trade shows and supermarkets in mainland China, our produce is just one of many options for the ever-growing Chinese middle class. We cannot become complacent as our competitors are passing us out in relation to AMR.)

Germany

As would be expected, during our time in Germany I saw a very professional and streamline approach. We visited pig, poultry and dairy farms all of which made the best use of modern technology to assist them in growing and producing their food to the highest of standards. This was aided by strict biosecurity measures and state of the art housing allowing animals to reach their potential in a stress-free environment.

I noted that all this information was gathered and used to set targets to improve on the year ahead. It made me realise how much information we have readily available to us at home that goes unutilised by many such as Coop reports, milk recording results and soil tests.

The German farmers also brought society on board along the way in a bid to educate and promote the good work they were doing. They did this through open farms so people can see the animals, bill boards on field gates explaining what crops were in each field and how and why they farmed it. Food vending machines outside farms where milk and farm produce could be bought. This in turn created a demand from consumers to buy direct from farmers as they felt more comfortable knowing where their food came from and knowing how it was produced.

(Technology played an important role in the management of Germanys farms. Heat was generated through use of biodigester plants generated from the pig slurry and poultry manure while sensory technology provided "real time" data on animal health status and weight gain)

California

The scale of Californian agriculture was incredible. Large industrial scale operations professionally run on a scale that was alien to me. Harris Ranch was a prime example, an 800-acre feedlot with 120,000 beef cattle at any one time, capable of finishing 250,000 head of cattle per year. I questioned the viability and sustainability of this type of operation and the prophylactic antibiotic use; they didn't express much concern and indicated that they would address these in the future. This is extremely worrying considering 70% (by weight) of the antibiotics defined as medically important, by the US Food and Drug Administration (FDA) are sold for use in animals.

(Clauss Dairy on left milking 2,500 purebred Jerseys. Harris Ranch on the right, 120,000 finishing cattle on an 800-acre feedlot)

Holland

On my tour in Holland Selective Dry Cow Therapy was taken very seriously and has been a focus for a number of years. Cows were culled religiously at dry off if they were high cell count (> 250k) and a sealer only approach was used on all cows below a threshold of 250k. The Dutch are way ahead of us in relation to tackling AMR and we should use the Dutch as an example of how to reduce antibiotic usage on Irish farms. Worryingly, they were beginning to focus on feeding cows on a GMO-free diet

as consumers demanded this. I could not help but feel there was greater life-threatening battles to be fought other than GMO.

When compared to Dutch national statistics, Ireland's current rate of milk recording is on par with that of the Netherlands in the 1950's. *(Source Dr. Hiemke Knijn, CRV)* Considering they are one of the top players in infant formula production, we should take note.

An interesting aspect of Dutch Agriculture is how veterinary is changing to a more advisory based role. For example, veterinarians are visiting farms on a fortnightly basis to carry out routine work such as scanning and advice on animal nutrition and herd health. This led to a very good farmer/vet relationship that was built on performance-based results.

Interestingly, all vaccinations are carried out by veterinarians as farmers are not legally permitted to administer these.

(Majority of Dutch dairy farms are based on an indoor system. Monetary incentives are put in place for "minimum days at grass" at 3cent per litre. High welfare a priority)

Wales

Wales introduced me to Aled Davies and Pruex. Aled is a Nuffield scholar who was working on achieving prudent as opposed to excessive use of antibiotics. The company was formed in October 2016.

By using probiotics containing spores of food grade Bacillus subtilis, Bacillus pumilus and Bacillus megaterium (good bacteria) were used to break down the biofilm present that protects and harbours bad bacteria in pig and poultry sheds, cubicle houses and in milking parlours. Microbial cleaning is a more effective and sustainable alternative to chemical cleaning and non-specific disinfection.

Eamon Sheehan

(Aled Davies, Pruex and myself after being on farm culturing.)

Aled's company focused on limiting the introduction of infection and reducing infection pressure by:

- Identifying quickly what is causing the infection.
- Treat the livestock that have a bacterial infection effectively with antibiotics.
- Cull animals that have resistant bacterial infections.
- Hydrate the animals that have viruses.
- Ensure the water they allow their livestock to drink is at least as clean as the water they drink themselves.
- Analyse their data to determine the cause of infection.
- Develop strategies to prevent similar infections going forward.
- Record the estimated microbial loading of their livestock.
- Record the estimated intensity of attack on the immune system.
- Use their data to build hygiene and husbandry protocols to prevent disease on their farms.

Aled brought an additional thought process to my approach towards completing my scholarship and helped me understand our need for good bacteria.

4. Introduction

Microbiology is the study of microscopic organisms known as micro-organisms or microbes such as bacteria, protists, fungi and viruses together with their activities and effects, beneficial and detrimental, on plants, animals, man and the environment.

The populations of living things around us are constantly changing and evolving, in response to the environment. This is most noticeable when the changes are a threat to our health. For example, bacteria like MRSA which can't be killed by most antibiotics poses a serious threat to society.

When antibiotics are used, the most susceptible bacteria die first, leaving behind the most resistant cells. These resistant cells multiply and take over the available space. As this scenario repeats, populations of bacteria eventually become super-resistant to antibiotics. For the first time in our life time, people can die from an infection simply because antibiotics cannot kill the bacteria.

Because of this, 193 countries signed the World Health Assembly declaration to correct antibiotic usage in 2014. Antimicrobial resistance is an epidemic capable of killing more people than cancer by 2050.

Antibiotic resistance is a global phenomenon and a well-recognised threat to human and animal health. It needs to be seen as the greatest security threat to our lifetime and needs to be at the forefront of every Health Care and Agricultural decision by governments.

The main factors in the development of AMR are vast and complex. It originates generally from exposure of microorganisms to antibiotics. A particular focus is on the need to preserve the usefulness of existing antimicrobial drugs classes, as only a few new chemical classes have been developed in recent years. "Even if they are to be developed it would be 13 years before they would be available." (Ref Dr. Peter Borriello, Director Veterinary Medicines Directorate. IFA conference Dec 2017)

Many of the antibiotics used in the treatment of animals are the same drugs as those used in human medicine. Approximately 88% of veterinary drugs used in Ireland are from older drug classes including penicillins, tetracyclines, potentiated sulphonamides and aminoglycosides (Ref HPRA). Antibiotics have been used widely in the treatment of animals since the 1950s and are viewed by veterinary practitioners and other health care professionals as being indispensable for treating animals. We can't carry on using these antibiotics as we have done at the risk of returning to a pre antibiotic era due to AMR.

Antimicrobial stewardship needs to become a coordinated strategy among us, whereby we educate ourselves in the correct use of antibiotics to improve the use of antimicrobial medications with the goal of enhancing animal health and wellbeing. Therefore, reducing resistance to antibiotics, and decreasing unnecessary costs.

5. Objectives

5.1 To Research and discover the best practice in microbial management for the dairy and beef industry

I chose the following three topics to discuss under best practice in microbial management from the key points I saw on my Nuffield GFP travels.

- Herd Health.
- Selective Dry Cow Therapy (SDCT).
- Calf Rearing.

5.1.1 Herd Health. Best Practice is to Record and Gather.

There are two approaches regarding herd health on farms. There is a proactive approach whereby, we take precautions around health on farms, or a reactive approach when we only act when a severe problem arises.

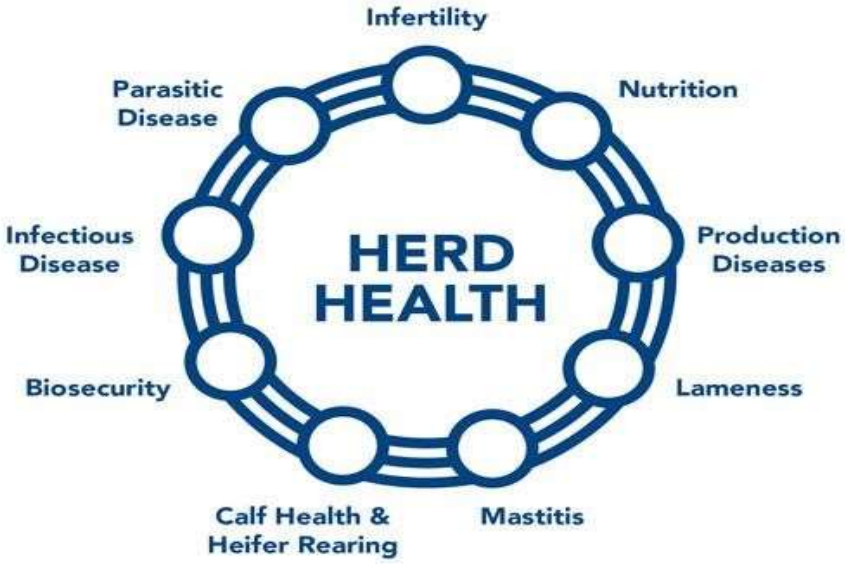
The reactive, firefighting approach, can often result in much higher cost and mortality, generally when we can neither afford the money or the time let alone the added stress.

Being proactive in our approach to animal health will often result in much reduced incidence of disease on farms and the lower likelihood of disease outbreaks with reduced financial burdens and stress.

Identify farm strengths and weaknesses by using records available via ICBF, Milk Recording, Co-op Performance reports, factory dockets and mortality rates. Analysing calving performance is a good start, are you on target? Are milk sales / carcass weights on target? Is mortality at an acceptable level? All of these areas may be somewhat compromised by genetics but more often than not there are subclinical health issues.

The first step is to create a herd health plan for the farm. Although this may sound daunting, it can be done in a few short pages. Writing out a list of past health issues in conjunction with your own vet. They will have the knowledge required, and details about the herd health history of the farm, which are necessary to create the plan. In terms of AMR this proactive approach will significantly reduce the need for any reactive methods.

Herds have expanded in recent years but facilities, especially calving pens and calf sheds, have stayed the same. This is not an issue on the Continent as they calve all year round, but for an Irish system calving 90% in 6 weeks, this is a recipe for a bacterial overload.



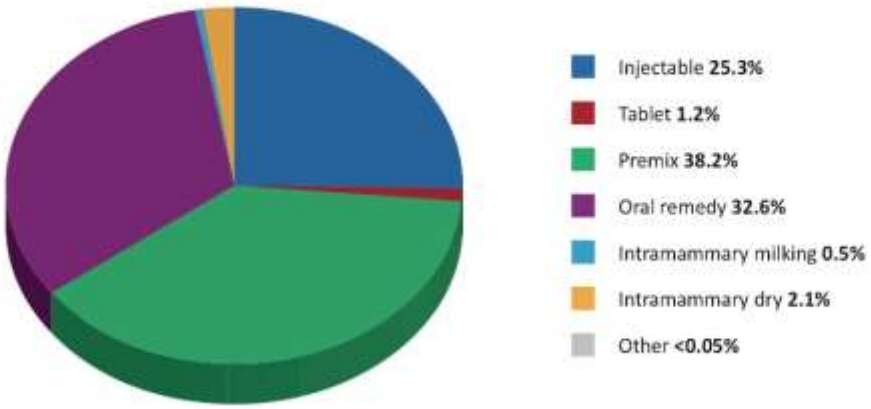
5.1.2 Selective Dry Cow Therapy (SDCT)

The objective here is to highlight the importance of this proactive practice for dairy farmers and Vets in order to reduce unnecessary antibiotic use.

The basis of SDCT is “to use as much antibiotic as necessary (to cure existing udder infections), but as little as possible” (Stephen Gilkinson, Dairy Technologist, CAFRE)

2% of all veterinary antibiotics used are in relation to dry cow antibiotics, albeit a small proportion on the grand scale of things, it doesn’t make sense to use it if infection is not present. Doing so in a healthy udder is destroying the good bacteria that are present. By using SDCT we are not only being responsible in the use of antibiotics, but we are also enabling our cows to build up a natural defence system, two positives from one practice.

Figure 14: Pharmaceutical form breakdown of veterinary antibiotics sold in 2015 in Ireland (Source HPRA report 2016)



(Breaking down the overall total of antibiotics into the route of administration provides some further information and indications as to where action needs to focus in coming years (figure 14). According to the latest figures available from the HPRA, more than 70% of antibiotics being used in animals in Ireland are being used in oral medications for use in feed and water. Data at the sales level does not allow these medications to be broken down according to species.)

For the udder, the dry period is both a period of risk and an opportunity to clear up existing infections. However, without knowing what type of bacteria there is present in the herd it is impossible to know what the correct DCT is. This can be achieved by using regular milk recordings to identify cows with higher Somatic Cell Counts (SCC) and taking individual milk samples from these animals and having them milk cultured.

Selective Dry Cow Therapy is “evidence-based decision making, the more evidence you have the more successful you will be in terms of animal health and profit” (www.amr.co.uk-SDCT)

With this information at hand it is possible to make an informed decision in relation to the correct choice of antibiotic for cows that will respond to treatment, cull the cows that will not respond and use a teat sealer on cows that have a consistently low SCC milk recording throughout the year.

It is recognised that the longer an antibiotic persists for, the greater its effect on Staph. aureus which is the most commonly isolated bacteria from mastitis samples in Ireland.

Even the longer persisting antibiotics will not protect the udder during the second risk period, pre- and post-calving. Poor hygiene and stress are often the cause at this point. Often SDCT gets blamed at this point when it is not possibly the case as it is the first 2-3 weeks after drying off when this would be evident.

Once a cow is dry for a couple of weeks and the udder has contracted, inhibitory substances, such as lactoferrins and immunoglobulins are naturally produced in the udder tissue. At this stage, the cow is reliant on its natural defences and the keratin teat plug.

Internal teat sealants have been developed to assist the natural keratin plug and will usually remain present until after the cow has calved down when they can then be stripped out.

As can be seen in the above diagram, an aseptic technique is essential using best practice to prevent contamination of pathogens. It involves strict procedures and rules to prevent introduction of infection.

If best practice is not paramount at drying off it will lead to failure, increased infection and will create a disbelief in the benefits SDCT has for our herds.

Drying off cows should be a job done after milking and after breakfast, in a clean and sterile fashion with no restriction on time.

5.1.3 Calf Rearing

As a calf is born with no immunity, its start in life is the most critical of times. It is when they are at their most vulnerable and are a sponge to absorb all the surrounding bacteria, good and bad. The Colostrum 1, 2, 3 approach should be practiced by every dairy farmer. 1st Milk, within 2 hours of birth, with at least 3 litres. 66% of calves tested in regional laboratories show inadequate colostrum intake. (http://www.veterinaryirelandjournal.com/images/pdf/peer/peer_jan_2017.pdf). The performance of dairy heifer calves from birth to weaning at 8-12 weeks is the single biggest determinant of lifetime milk yield and profit in dairy farming.

“Research worldwide and numerous on-farm assessments have shown that 70% of milk yield is due to management with the remainder due to genetics,” according to Cornell Universities leading calf specialist Mike Van Amburgh. Achieving top performance in calves in the critical first weeks of life results in additional milk yield of at least 800 litres in the animal’s first lactation alone. This improves longevity of the adult cows milking life, leaving them far healthier and in turn generating a substantially higher profit.

Calf to beef farms can often suffer greater health issues due to purchase of stock from numerous sources at a high risk stage in life. This can cause a breakdown in their immune system leading to pneumonia and scours. This can be prevented by putting a health plan in place. Buying direct from a

reputable farmer that you know practices good calf husbandry, buying in batches to minimise disease. The only blanket treatment these calves should get on arrival to a new farm is an electrolyte. These are formulated to promote absorption of specific nutrients and to replace water and minerals that are lost during these stress periods. (See AHI electrolyte formula in 6.3 for recipe) This should be given 2-3 hours after arrival. Although calf management is not going to be as simplistic for the Suckler farmer, colostrum is still equally as important.

Without adequate suckling transfer of antibodies and immunoglobulins from associated vaccines for scour will not be absorbed by the new born. In this situation it is important to have access to powdered colostrum or neighbouring dairy farmers that test for, and have a Johnes free herd, could be approached to supply some excess colostrum.

How this colostrum is collected and stored is very important. It must be cooled within an hour of milking, as bacterial growth will multiply excessively otherwise.

Teagasc article on storage of colostrum: https://www.independent.ie/business/farming/dairy/whats-the-best-way-to-store-colostrum-35547118.html

5.2 To highlight the educational importance of microbiology and its link to the economics of dairy and beef farms. Through effective communication, education and training.

5.2.1 Current inclusion of microbiology in secondary education.

The youth of today will be the ones living the consequences of AMR and all the other problems the planet is facing. These are the next generation of farmers and people farmers are dependent on for advice or to supply.

With Agricultural Science being a subject of choice for the majority of secondary school students with a farming background, it is disappointing that the syllabus currently being used dates back to the 1970's. This leaves teachers with no solid reference point to include AMR in the syllabus other than at their own discretion. The majority of teachers will no doubt focus on this during the topic of microbiology but for a subject of such grave importance and at a time when students are quite permeable this subject deserves more emphasis. With the introduction of a new syllabus in September 2019, hopefully this will give teachers the material to further promote and develop agriculture through education.

https://www.irishtimes.com/news/education/40-year-old-agricultural-science-syllabus-tobe-updated-1.1710261

5.2.2 Current inclusion of microbiology on the Green Certificate

The current level 5 & 6 Agricultural Certificate curriculum relating to antimicrobial use focuses on the key principles relating to feed regulations and livestock medicines and remedies as part of an overall animal husbandry module (dairy, beef or sheep). There is also a general Farm Safety and Food

Assurance module. The skills training currently involves dosing and injecting and associated best farm practice, inclusive of herd health, animal husbandry and record keeping. However, AMR while briefly covered in the resource material, does not currently have a dedicated focus in the current syllabus.

Noting the need for improving the curriculum, discussions between the Department of Agriculture and Teagasc are currently taking place to create a syllabus whereby AMR will have a dedicated learning outcome (and chapter in the resource materials of the above modules). The main focus of this learning outcome will be the understanding of AMR and its importance in curtailing it in the future.

If we don't address the issue of AMR with people who are currently focusing on and working in the Agri- industry, and those who will be in the future, the battle will be lost. They need to be educated which will enable them to have the knowledge and ability to make informed decisions in order to plan and execute preventative methods to improve herd health and reduce the mis-use of antibiotics.

No action today = No cure tomorrow.

5.2.3 How to Assist the Current Farming Community.

The one thing we can't stop is time, and it is our biggest hurdle in educating and convincing people to change their practice. The other obstacle is change, and we don't take to that readily either. But, if we don't make the time to change, our children will suffer. We need to educate ourselves in what we are doing and why.

For most of us that are currently farming, the possibility of us returning to school is as likely as AMR going away. On-farm assessments, from an outside perspective, can often point out the most obvious of areas that can be the greatest cause of health issues on farm.

Having initially met Aled Davies at the Innovation for Agriculture conference in December 2017, I travelled to spend time with him on a couple of occasions. Aled's company Pruex aims to help lead the fight against Anti-Microbial Resistance. Working alongside Farmers, regardless of species of animal farmed. This allows them to develop evidence-based strategies on their farms to enable them to demonstrate to consumers their prudent as opposed to excessive use of antibiotics. Meanwhile benefiting consumers by limiting the antibiotic use in the food chain.

On-farm consultations were held discussing the health problems and difficulties the farmer was having. This resulted in taking swabs from animals, housing, milking machines, and water sources which were cultured and the findings presented to the farmer allowing them to know what they were dealing with.

One of the main issues in all aspects of livestock was water quality in a lot of cases. Biofilms had built up over time harbouring infection creating added stress on the animal's immune system. By correcting this and reducing the infection burden on these animals it allowed them the potential to perform at their peak. Increase in milk yields, growth rates and decline in mortality. Most importantly, aiding in the reduction of antibiotic usage.

Pruex use probiotics containing spores of food grade Bacillus subtilis, Bacillus pumilus and Bacillus megaterium (good bacteria) to break down the biofilm that protects and harbours bad bacteria. Microbial cleaning is a more effective and sustainable alternative to chemical cleaning and non-specific disinfection.

5.3 The Knowledge gap, building a bridge between agriculture and the consumer.

The void between farm and fork has never been greater, we are now a society that is far removed from the family farm. Information about where our food comes from and what it contains, is sourced on the internet with questionable reliability, leading to an ever more confused consumer. This needs to be addressed at industry level by providing the factual evidence and allowing the public to make an educated and informed decision.

By putting a strategy in place for each of our individual farms to show the good work we are doing and the steps we have put in place to improve on, leaves us with a great news story that will bring the public on board. Showing leadership in the fight against AMR will also benefit our export market that we also heavily depend on.

The understanding of AMR in society is also very limited, people need to understand that it is not the person or the animal that become resistant to an antibiotic, undesirably it is the **bacteria** that becomes resistant and a greater threat to the next person or animal which contracts it. Society needs to understand that the inappropriate usage of antibiotics is not only subject to agriculture, people are one of the greatest offenders also.

Understanding that for anything other than a bacterial infection, antibiotics will not have any effect. Too often antibiotics are prescribed without a definitive diagnosis. Suggestions that in excess of 50% of prescribed antibiotics are done so unnecessarily (Jim ONeill, Review on Antimicrobial Resistance May 2016). Unfortunately, risk adverse prescriptions are given for fear of something wrong. This is because of the 36-hour timescale it currently takes to culture a bacterial sample.

Investment in “Rapid diagnostics” would greatly assist correct treatment. Prototypes that could generate a correct diagnosis within an hour are currently being worked on in the Stephens Institute of Technology in the United States.

Adjectives and health claims are used to sell food, often inadvertently suggesting other produce is of an inferior quality. Customers’ are often blamed for retailer’s requests on farmers to create more demand for sales of produce. This can be seen throughout Europe by labelling produce such as “Antibiotic Free”, this in turn suggests the alternative products contain what already is illegal and highly regulated. Retailers need to be held accountable for their labelling and **“Antibiotic Responsible”** should be the label of choice.

In a bid to inform and educate society, we need to educate people from an early stage on how our food is produced, where it comes from and how to use it. This should be done through school on a mandatory basis. A healthy lifestyle and diet will in turn lead to less illness and require less medical intervention in later life.

Building this bridge between farm and fork is up to every one of us involved in agriculture. Every time someone asks us what we do for a living we must take the opportunity to sell our story. The general trend when you tell someone you are a farmer leads to the follow-on question of what type. Use this opening to tell a great a great story, because we have one.

This can be achieved through:

- National awareness campaigns telling OUR story.
- On-Farm open days giving farmers and consumers an opportunity to connect.

- Farm consultations with vets taking on an advisory role in educating farmers.
- “Facetime A Farmer” initiative which is very successful in the UK.
- Preschool and primary school farm tours.

6. Case Study, A focus on Bawnlusk Dairy Farm. Putting theory into practice.

I have chosen to use my own farm as a case study to illustrate what an individual farmer can achieve with education and motivation to succeed and improve.

I am by no means an expert but I do my best and have succeeded in the reducing antibiotic usage on my farm with no adverse effects.

National changes need to start on an individual basis.

6.1 Herd Health.

Good records are key to a good plan. I used my Co-op Performance records, ICBF Data and Milk Recording records to set a base. This allowed me to set targets for improvement each year on mortality, calving interval, milk solids sold and general herd health.

Like a lot of herds, we had a few lingering subclinical herd health issues present. In conjunction with our vet, we put a herd health plan in place. This enabled us to take a more proactive rather than reactive approach to our herd health. It targeted areas that previously caused issues on the farm.

The fact that the dairy herd was bought in over a number of years we took extra precaution to prevent a health breakdown. A vaccination policy was introduced for the herd and improvements were also made to housing and the implementation of stricter bio-security measures especially at calving. (See Herd Health Plan below)

HERD HEALTH PLAN

	Cows & In-Calf Heifers	**Calves**	**1-2 Year Olds**
January	Lice treatment	Calving starts	Fluke dose as needed/ after 8 weeks
February	Late calvers – Scour vaccine (Rotavec Corona)		1st leptospirosis vaccine IBR vaccine
March	Leptospirosis booster IBR vaccine		
April	Scan non-cycling cows		Leptospirosis booster
May	Start breeding		
June		Monitor worms (faecal egg count) – dose as needed	Dose for worms
July	Worm dose – 1st calvers		
August	Pregnancy scan		Pregnancy scan
September	Herd test Salmonella vaccine	Herd test Salmonella vaccine	Herd test Salmonella vaccine
October		Worm dose	Worm dose

November	Clip tails and backs @ housing		Fluke dose as needed
December	Early calvers - Scour vaccine (Rotavec Corona)	Clip tails and backs @ housing	Clip tails and backs @ housing
	Fluke and worms dose Lice treatment	Lice treatment Fluke dose as needed	Lice treatment

6.2 Practising Selective Dry Cow Therapy SDCT on farm.

My Results:

2016 was my first year to practice SDCT. Our herds cell count ran at an average of 99,000 SCC for 2016. Having selected 20 cows (20% of the herd) with a consistent sub 100,000 SCC throughout the year without any case of mastitis during lactation, I made the switch to sealer only. Nervously following best practice procedure, I approached this task in a surgical fashion. Time was dedicated to the sole purpose of doing this task correctly leaving no room for error.

None of our cows which were dried off using SDCT in the 2016/2017 winter presented with any breakdown of mastitis within the dry period or resulted in any issue at calving down. This was a positive outcome in terms of confidence and motivation to continue.

Having built confidence from my first-year trial, I selected all cows sub 150,000 SCC to be dried off with sealer only for the 2017 dry period. This resulted in 88 out of 125 cows receiving SDCT (70% of the herd). Strict protocol was followed at all times, always after breakfast in a sterile as possible environment, with no time limit being put in place (ref to 5.1.2). This generally took between 8/10 minutes per cow.

Again, none of these cows presented with mastitis during the 2017/2018 dry period. 1 cow from the 88 presented with mastitis 3 weeks post calving and had a repeat case in the same quarter twice after. I don't feel this can be deemed as a failure.

As can be seen by the graph below, our 2018 cell count is even better than the previous two years with 154 cows milking our SCC averaged at 95,000 for 2018. Considering the weather-related stress this current year (2018) has put on cows I would deem it a major success.

6.3 Calf Rearing

Calf-rearing was a particular management area that I thought could be improved on every dairy farm that we visited on our travels and therefore is my chosen area of focus. At birth, calves are born with a functional but immature immune system that needs to be cared for. How calves are reared reflects their future health and lifetime immunity. Setting them up with a healthy start influences long term health and performance.

As can be seen by the charts below, 2015 was a difficult year. We had losses due to calving difficulty and disease. Having great pride in what I do, it was quite difficult to accept. As per my Herd Health plan and calf rearing section above, a vaccination and calf health plan were put in place. The national average for calf deaths from birth to 28 days is 4% (Ref ICBF Database). Our farm was running at 5.7% at this point.

With help from my Vets and AHI open days, I updated our vaccination programme and committed to giving every calf colostrum within the first hours of life. It is the most critical time to give an animal a head start in life. Attention to detail regarding biosecurity (foot baths and staff access only) and general hygiene improved during the calving period. You wouldn't get access to a piggery or poultry farm without strict hygiene and disinfectant protocol, so why should dairy farms be any different at this most critical time of year.

With this is in place, colostrum (or biestings) is our most important focus to give each calf a start in life. Minimum of 3-4 litres of colostrum (aim to feed 10% of calf birthweight) within 2 hours of life, milked from the cow ASAP post calving using a portable milking machine gives the calves immune system all it needs to build a good defence system. The excess colostrum was fed again 6-12 hours

later. By giving each calf its own mother's colostrum the risk of spreading Johnes disease was eliminated. This disease was an issue that has gone beyond eradication in Holland due to poor colostrum management and it is gone beyond possibility of eradication according to vets I spoke to there.

As a result of this, our calf loss rate since spring 2016 have been well below the national average leaving us in the top 20% of the national herd and still room to improve. This highlights that things can and will go wrong but with constant updating of protocols, vaccinations and calf health plans problems can be averted.

2015

88 Calving's	3 still born	3.4%
Losses 0-28 days	2	2.3%
Losses 28days-6 months	4	4.5%
Total	9	10.2%

2016

109 Calving's	2 still born	1.8%
Losses 0-28 days	1	0.9%
Losses 28days-6 months	1	0.9%
Total	4	3.6%

2017

138 Calving's	1 still born	0.7%
Losses 0-28 days	0	
Losses 28days-6 months	1	0.7%
Total	2	1.4%

2018

161 Calving's	4 (2still born 2 premature)	2.5%
Losses 0-28 days	0	
Losses 28days-6 months	0	
Total	4	2.5%

This was accomplished through a variety of processes starting with the dry cow period. With milk quota restrictions lifted it enabled us to dry cows off at optimum timing with the help of scanning results. This meant that each cow was treated individually, allowing a 60 days dry period, prior to calving. This benefitted us because cows calving later in the season did not get an excessive dry period, thereby preventing them from gaining too much condition leading to calving difficulty. Equally, 1st lactation cows and cows with low BCS were allowed 20 days extra helping them gain an additional

body score. This was achieved in conjunction with a tailored diet with the help of Keenan Intouch and a formulated high spec pre-calving mineral.

Having cows “fit” not fat, at the point of calving meant they were able to calve quickly, passing afterbirth within hours and producing high quality colostrum.

After calves were given their initial feed and had their navel treated, they were removed to a group pen with calves of the same age. Thus, preventing them from being in a contaminated environment. From this point calves stay in the same group apart from the Friesian heifers which are put on an automatic feeder.

Feeders are washed after each feed and any calf that is slow to drink has its temperature taken, given electrolytes and marked on a white board for attention (See Diagram below for AHI electrolytes). Only if a calf has a high temperature are antibiotics considered. Generally, electrolytes are sufficient to keep them hydrated and allow their immune system to operate and fight any infection.

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CalfCare Electrolyte Solution

For Oral Use only

Mix in **2 litres** of warm water:

- 8 grams (half a tablespoon) of Low Salt
- 12 grams (one tablespoon) of bread soda
- 40 grams (2 to 3 tablespoons) of glucose

Feed by bucket or nipple feeder alternating with milk feeds

It is not by any means one area that solves a problem. It is by implementing all of these procedures that creates a full circle that allows for a healthy herd.

7. Discussion

The use of antibiotics in agriculture has allowed us as farmers to optimise the welfare of our livestock for the last 70 years. In this time, the function of antimicrobials was misunderstood and bacterial resistance was not considered a threat. Antibiotics became a cover up for an overwhelmed immune system that had been put under pressure due to poor housing, ventilation, increased stock and in some cases, poor stockmanship.

Today as an industry we are lucky to have access to information through AHI, ICBF and our vets that offers us information that we can use to make better decisions in regards to how we approach our herd health. Milk recording is at levels comparable to Holland in 1950 with less than 40% of herds performing this invaluable procedure. Without milk recording, SDCT is impossible for 60% of Irish herds.

We must reduce the unnecessary us of antibiotics in agriculture by setting out farm targets. Put a plan in place so there is something to work towards. No other business is running without this and farming is a business now more than ever. A health plan setting out a vaccination programme not only will protect your herd; it will also protect our industry.

We need to protect our social licence to farm and this will require the approval of the agricultural industry by the consumer. With new regulations concerning anti-microbial use, maintaining our social license is a priority for Irish agriculture and this must be supported by evidence of microbial stewardship.

We have seen media worldwide campaign to label agriculture bad for the environment.

Irish dairy farmers must ensure they have a social licence to farm by showing the public what good stewards of both land and herd health they are.

According to ICAR, Ireland currently has one of the lowest levels of milk recording in Northern Europe (bottom third in 2016) which potentially jeopardises its national and international brand, and its future capacity to export without interruption.

One sector alone is not going to achieve the standard of stewardship that we require to tackle AMR. Environmental regulators need to also monitor and control some of the other areas that are responsible for the release of antimicrobials into the environment, through water contamination from sewage plants, including hospitals and from the factories that manufacture antibiotics. How these are affecting nearby water systems is not policed to the extent that we need.

Alexander Flemming received a Nobel Prize for his influential work in 1945. At this time, he predicted antimicrobial resistance, he gave an example of what would happen when penicillin became affordable:

“Mr X has a sore throat. He buys some penicillin and gives himself, not enough to kill the streptococci but enough to educate them to resist penicillin. He then infects his wife.

“Mrs X gets pneumonia and is treated with penicillin. As the streptococci are now resistant to penicillin the treatment fails. Mrs X dies. Who is primarily responsible for Mrs X’s death? Why Mr X whose negligent use of penicillin changed the nature of the microbe.”

We are all responsible for Mrs X.

8. Conclusions

Actions have been taken by many stakeholders in the animal health sector in the last number of years as concerns grow with regard to development and spread of AMR across all sectors.

Individual farmers have worked proactively to implement non-statutory disease control programmes and higher bio-security measures, aimed at reducing the total quantities of antibiotics being used in their animals. At the same time, certain intensive production systems, for example poultry, have made very significant progress in reducing antibiotic use in recent years, indicating that progress is possible. Such situations create the opportunity to identify best practice at farm and sectoral level, that can then be shared with other farmers sectors.

That said, significant challenges still remain. Both the experience of other countries, and data available in Ireland indicated that significant quantities of antibiotics are being used in intensive production sectors.

Further work in relation to how to reduce overall quantities of antibiotics being used and how to prevent outbreaks of disease occurring in the first place.

Improvements in the availability of antibiotic consumption data are needed so that progress in reducing the overall quantities of antibiotics can be demonstrated in individual sectors. Availability of data ensures policy is evidence based and individual farmers and veterinary practitioners can benchmark their antibiotic use.

- Communication – Improve awareness of AMR through campaigns, education and data.

- Education.

- Reduce – use tailored vaccination programmes to reduce infection and disease spread through prevention and control and biosecurity measures.

- Optimisation of the use of antibiotics - through development and implementation of antimicrobial stewardship programmes, promotion of prudent prescribing practices and access to rapid diagnostics.

- Promotion of research and investment in new diagnostic equipment, vaccines and other alternatives.

- Set targets for the future

9. Recommendations

A. Removal of the term "Dry Cow Tubes"

This is because it has no correlation with suppressing milk production at the end of lactation. The purpose of the antibiotic tube is to treat any infections that may be present in the cow's udder. If there is no infection there, antibiotic treatment is unnecessary.

B. Government Backing

With Food Harvest 2025 in sight, it is paramount that the Government steps up and removes the 23% VAT rate that it currently has on vaccinations. The use of vaccination is recognised as an effective measure to improve herd health and to tackle Anti-Microbial resistance. VAT on non-oral animal medicines, including vaccines, is applied at the standard rate, while animal medicines that are administered orally are zero-rated for VAT.

IFA has been canvasing government, that to encourage increased use of vaccination as a means to improve herd health and to proactively assist with AMR, the VAT rate on non-oral animal medicines should be reduced to 0%. This is capable of saving farmers in excess of €10 million per annum.

C. Milk Recording

If you do not measure, you cannot improve your herd performance. Although having a low somatic cell count will benefit the farmer financially it also benefits the processor. Incentives need to be put in place to improve the current uptake in milk recording. Not only will it assist farmers by identifying high SCC cows, it will also weed out the lower performing cows and improve herd efficiency and production. Processors will in turn benefit as the composition of the milk will be easier to process and will give a greater financial return.

Co-op involvement by subsidisation of milk recording costs would be one alternative. This would benefit both parties financially. Otherwise a bonus scheme should be put in place for milk with low SCC, similar to what Lakeland Dairies currently has, which would incentivise farmers with a monetary reward for having a low somatic cell count.

D. Milk Sensitivity Testing

Having gone to the effort of milk recording, use the information you receive to identify your high cell count cows and have their milk samples cultured for antibiotic sensitivity. It will identify the correct antibiotic to use at end of lactation and also a list of non-effective drugs.

E. **Vet Scope**

The majority of veterinary practices use "Vet Scope", a package which is capable of liaising with on farm herd apps. This would remove the double entry approach currently done by many farmers and would make the traceability of medication easier and more accessible for record keeping.

F. On Farm Culturing

On farm culturing would allow for immediate testing of a sample of milk or mastitis and give readings of the correct bacteria between 24-36 hours.

G. Retailer rebranding

Engagement with retailers to front an "antibiotic responsible" rather than an "antibiotic free" campaign. Irresponsible branding causes consumer confusion and distrust.

10. Executive Summary

The issue of antibiotic use in agriculture and its impact on drug resistance has been recognised by WHO as part of its Global Action Plan, due to an increasingly robust consensus, that the use of antibiotics in agriculture is a significant concern for human health.

Since the 1950's farmers have had access to the use of antibiotics to treat infections in livestock. Something which has been fundamental in the day to day management of farms worldwide. This in turn has led to it is misuse in a lot of areas by way of prophylactic treatment in the farming industry.

The pig and poultry sector have shown exemplary steps in decreasing their usage of antibiotics well ahead of targets that have been set for them with no adverse effect in production. This is down to improved animal husbandry, but it also would suggest that a lot of the prophylactic use was more of a crutch than a necessity.

Vaccinations are the first step in the reduction of antibiotic usage. Preventing a health breakdown in the first place will not only decrease usage of antibiotics, it will also show a greater return in profit for the farmer. The only issue with vaccines is the excessive cost to an already marginal bottom line.

Husbandry is the next area that needs to be addressed, young animals are most at risk as their immune system develops. Prevention of disease at this early stage determines their production potential in life and their longevity in the herd. Youngstock are often overlooked at this critical time.

To achieve this as an industry, we need to grasp a better understanding of what exactly Anti-Microbial Resistance is. This needs to be addressed from an early stage at school level across all sectors and at an in-depth level in agricultural college.

On farm meetings between Veterinarians and farmers to explain and communicate what we are challenged with and how our access to Antibiotic usage could be removed with devastating effects if we are not seen to be proactive and address the issue of AMR.

The return to a pre-antibiotic era is the greatest threat to agriculture and would have devastating effects for us as an industry. We can show example through leadership in our industry by developing strategies for our own farms and getting involved in current strategies already put in place by industry.

Although AMR is a massive challenge, I believe it is one that is well within our ability to tackle effectively. Failure will compel us to act for the sake of our loved ones and our children who will otherwise bear the brunt of our negligence. Minor surgeries or infections could be more serious than cancer.

11. Acknowledgements and thanks

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