Antibiotic Use in Food Animals: Thailand Overview

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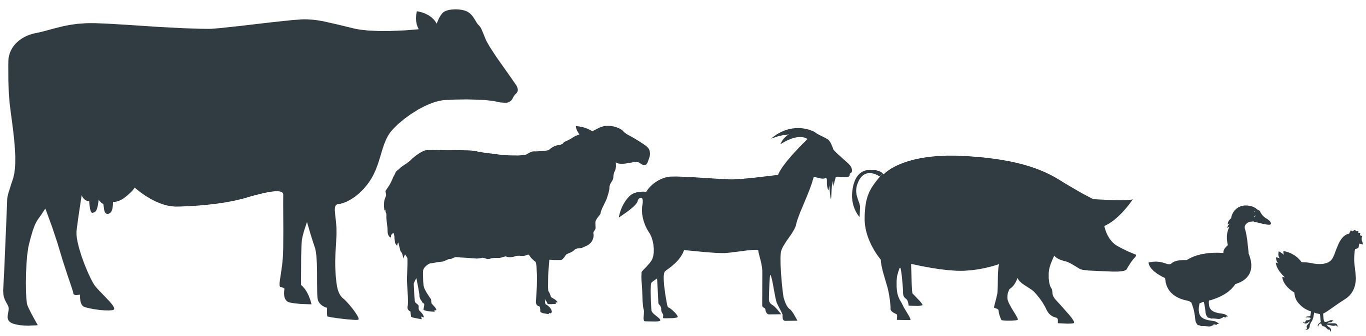
ReAct
Action on Antibiotic Resistance



Antibiotic Use in Food Animals: Thailand Overview

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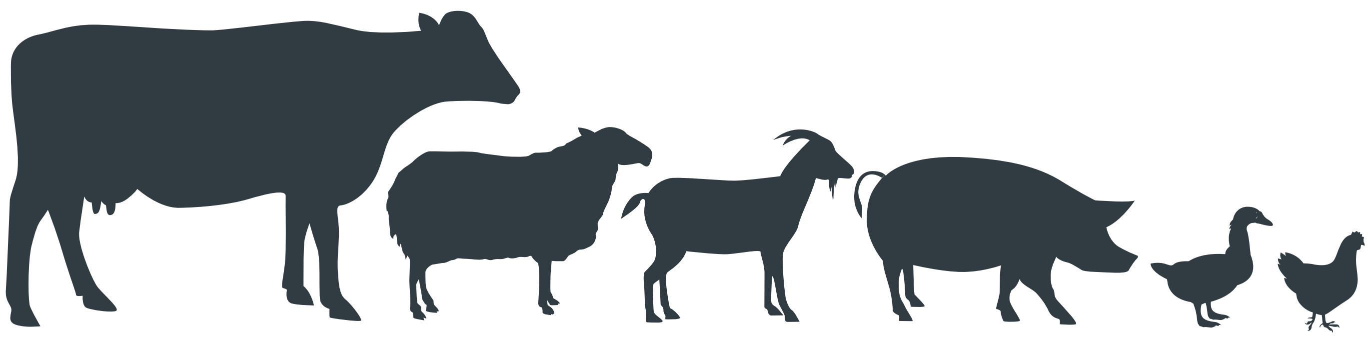


Preface

Antibiotic resistance (ABR) has been a growing problem in Thailand and places a high burden on the country's health and the economy in Thailand. The burden of ABR in Thailand has been estimated in 2010 to result in 3.24 million days of hospitalization and 38 481 deaths per annum, and to cost 0.6% of national GDP.

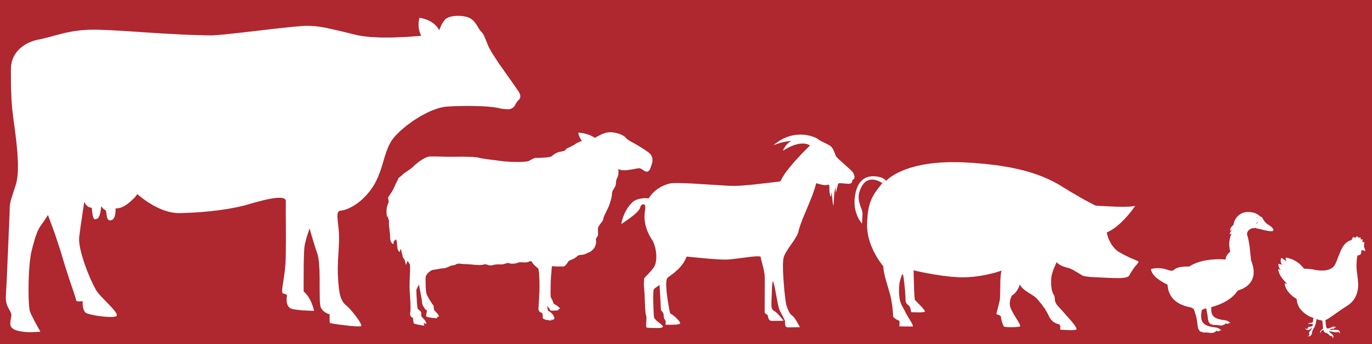
ABR is also emerging as an important concern in the food-animal farming sector. Like other countries in the region, Thailand too has developed intensive farming systems, leading to the rising consumption of fertilizers, antibiotics, and pesticides, of which many farmers have limited technical knowledge. The lack of effective regulations, appropriate policies, and poor implementation of standards for antibiotic use, together with low levels of biosecurity, hygiene, and sanitation, have accelerated the emergence and dissemination of antibiotic resistance.

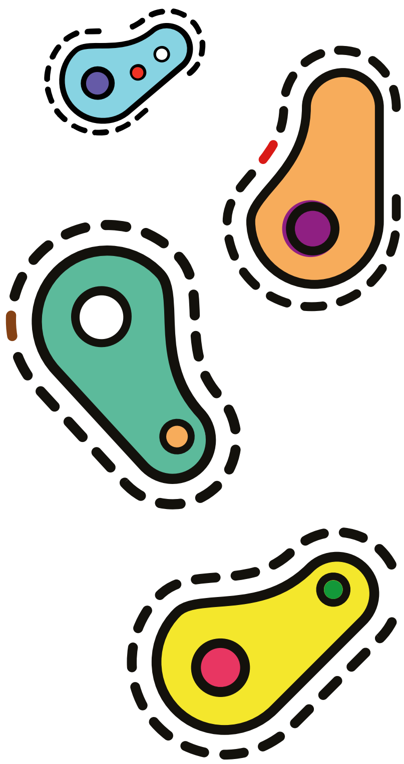
In response Thailand's National Strategic Plan on Antimicrobial Resistance 2017-21 has set targets for a 50% reduction in AMR morbidity; 20% and 30% reductions in antimicrobial use in human and animal health respectively, and a 20% increase in public knowledge about AMR, including awareness of appropriate use of antimicrobials. Among the Plan's strategies are strengthening the surveillance of AMR in livestock and crop production, better regulation of distribution of antimicrobials used in food-animal farming, reduction of use of antimicrobials and introduction of stewardship programmes in veterinary hospitals and clinics.

Reference:
1.Viroj Tangcharoensathien et al. Antimicrobial resistance: from global agenda to national strategic plan, Thailand. http://www.who.int/bulletin/volumes/95/8/16-179648/en/ (accessed on 18 February 2018).

Section A

Understanding antibiotics and its use in food animals





What are bacteria?

Bacteria are tiny single-celled organisms that can be found all over the planet, including soil, water, plants, animals, humans - except places which have been sterilised.

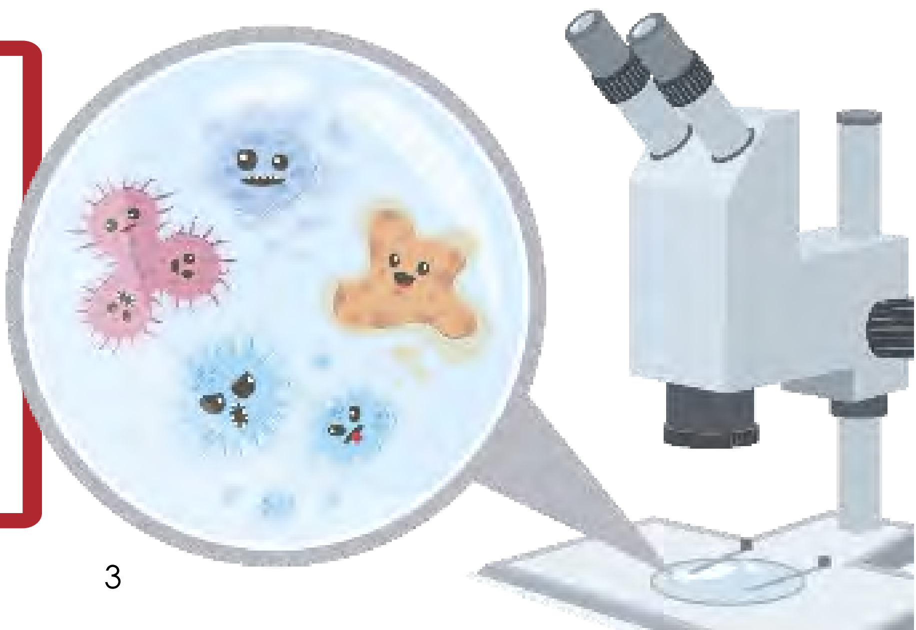
Bacteria are among the most abundant organisms on Earth. The majority of the bacteria play a positive role in nature. They help sustain the existence and continuity of all life forms on our planet.

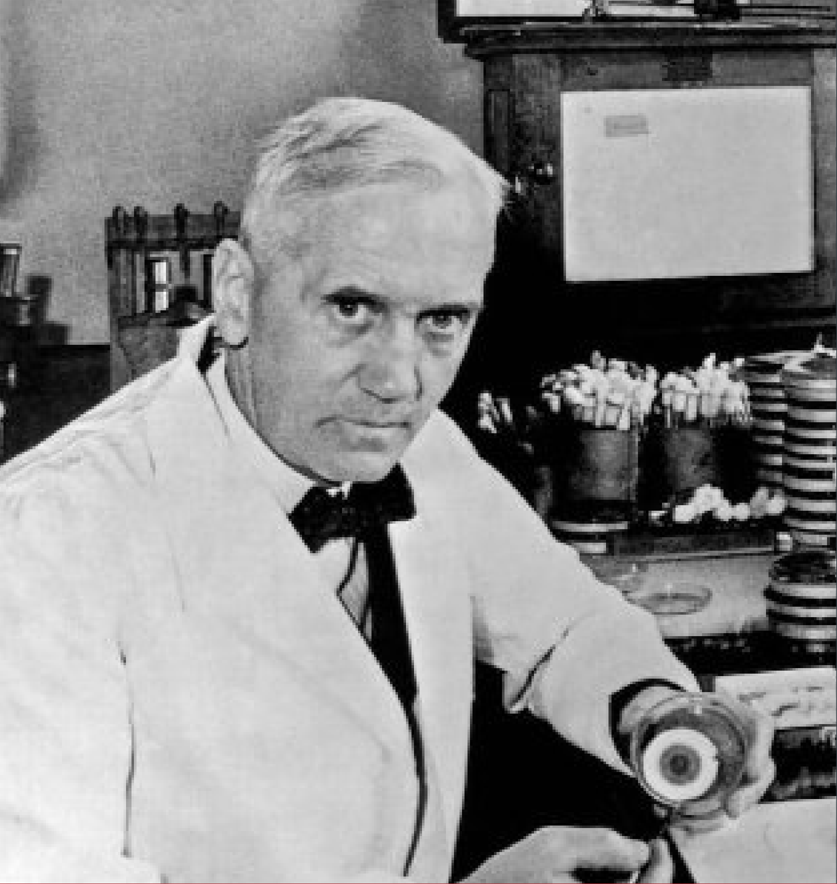
Bacteria decompose and recycle dead animals and plants; digest sewage into simple chemicals; extract nitrogen from the air for plants; and play an essential role in production of food. Scientists and industries also utilise bacteria to produce a lot of useful products.

What if bacteria enter our bodies...

Nevertheless, not all bacteria are friendly. Pathogenic bacteria cause harm to our bodies. When bacteria manage to get through our first line of defence which is our body's skin and mucous membranes and enter our bodies, they make us sick. For healthy people, the immune system will detect the presence of foreign organisms and activate different types of white blood cells in the bloodstream. Neutrophils engulf and kill the bacteria; Eosinophils and monocytes swallow up the foreign organisms and particles; Basophils help to intensify inflammation to facilitate specialised white blood cells to reach the site of the injury, protecting against a bacterial infection from worsening.

Bacteria are believed to be the first life forms on Earth, which appeared about 4 billion years ago.





"When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionize all medicine by discovering the world's first antibiotic, or bacteria killer. But I guess that was exactly what I did."

Accidental Discovery of First Antibiotic - Penicillin

In 1928, Sir Alexander Fleming was investigating staphylococcus, a type of bacteria that causes boils (infection of hair follicle causing an inflamed pus-filled swelling on the skin). Before he left for vacation, he forgot to place the petri dishes containing staphylococcus culture into incubator. When he was back to his lab, Fleming noted that a mold called Penicillium notatum had contaminated his Petri dishes. After inspecting, he was amazed to find that the mold inhibited the normal growth of the staphylococci. He named this active antimicrobial substance "penicillin."

Discovery of Antibiotics?

Antibiotics are agents with biological activities to kill or inhibit the growth of bacteria. Ever since antibiotics were discovered eight decades ago, they have been used widely in modern medicine and are extremely effective against bacterial infections, which once used to be major cause to morbidity and mortality.

Antibiotics are not only used to treat bacterial infections in humans, but also used to protect the health and welfare of animals.

Type of Antibiotics

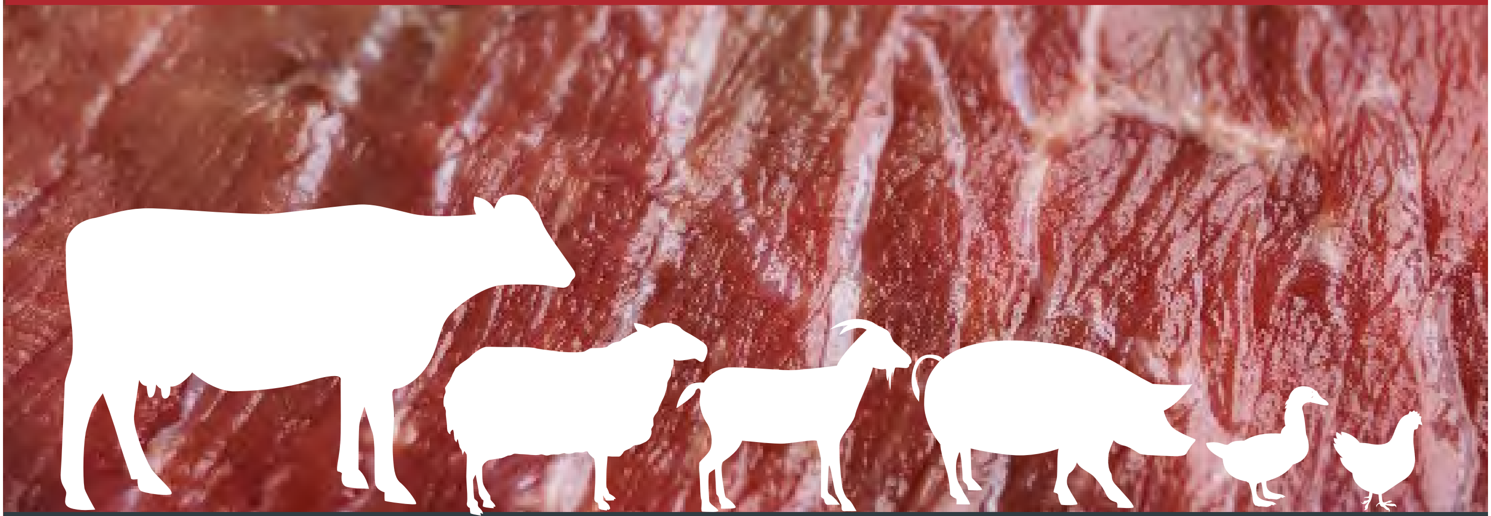
Bacteriocidal Antibiotics

Antibiotics that kill bacteria include aminoglycosides, beta lactams, fluoroquinolones, glycopeptides, lipopeptides, nitroimidazoles and nitrofurans.

Bacteriostatic Antibiotics

Antibiotics that inhibit bacterial growth include glycylcyclines, lincosamides, macrolides, oxazolidinones, streptogramins and sulphonamides.

Antibiotics use in food-animal production



What are food animals?

Animals that are raised and bred to produce food for human consumption such as eggs, meat and milk.

Example: Beef cattle, dairy cattle, goat, sheep, deer, pigs, broiler chicken, layer chicken and ducks

Why antibiotics are used in animals?

There are three main reasons why antibiotics are used by farmers:

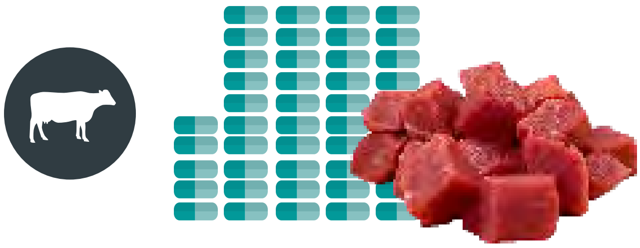
- As treatment for animals that show clinical signs of an infectious disease
- As metaphylaxis to treat a group of clinically healthy animals and minimise an expected outbreak of a disease or as prophylaxis to prevent those at risk from being infected
- As growth promoter to boost the weight of the animals.

Reference:
1. National Pharmaceutical Regulatory Agency (NPRA). Registration and Regulatory Control of Veterinary Products in Malaysia. ppt. Available at http://vam.org. my/home/wp-content/uploads/2017/11/Pn_Asnida_V MP-Registration-and-Control.pdf. (accessed on 28 December 2017)

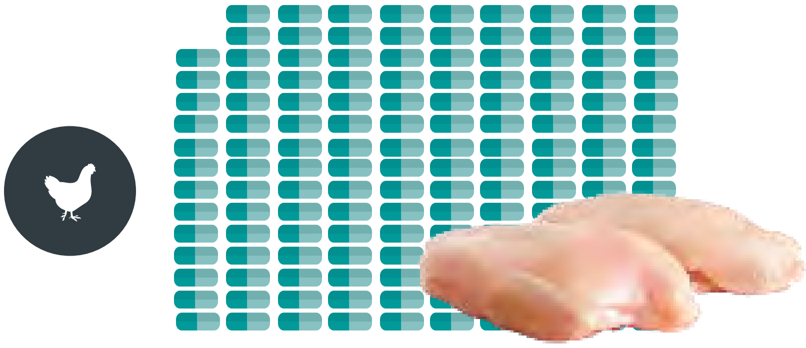
Global trends in antimicrobial use in food animals

The term "antimicrobial" refers to any agent that kills microorganisms and inhibits their growth. An antimicrobial agent can be further categorised into groups according to the microorganisms it acts against. For example, antibiotics are used against bacteria whereas antifungals are against fungi.

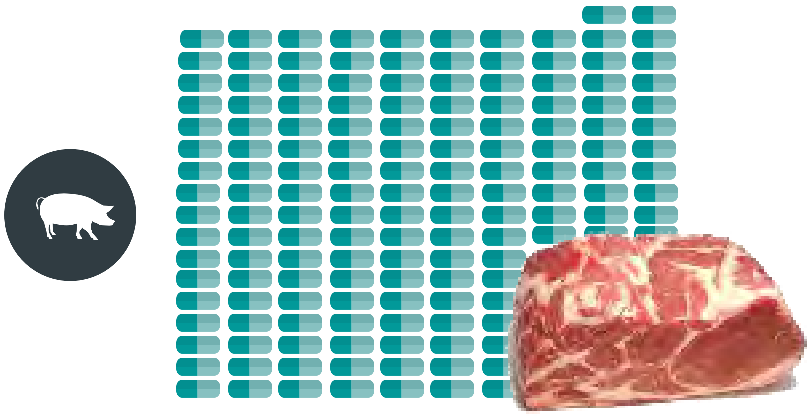
Organisation for Economic Cooperation and Deveopment (OECD) estimates that the amount of antimicrobials used in food animals will escalate globally from 63,151 tons in 2010 to 105,596 tons by 2030 - an increase of 67%. The followings are the estimated global average annual consumption of antimicrobials to produce one kilogram of meat:



45mg of antimicrobials are used to produce 1kg of beef



148mg of antimicrobials are used to produce 1kg of chicken



172mg of antimicrobials are used to produce 1kg of pork

Reference:
1. Laximinarayan, R., Van Boeckel, T., Teillant, A. 2015. Global Antimicrobial Use in the Livestock Sector. Organisation for Economic Co-operation and Development. TAD/CA/APM/WP(2014)34/FINAL.
2. Van Boeckel T.P. et. al. Global trends in antimicrobial use in food animals. PNAS. 2015: 112 (18); 5649 - 5654.

Top 5 countries with the largest shares of global antimicrobial consumption in food-animal production

1. China (23%)
2. The United States (13%)
3. Brazil (9%)
4. India (3%)
5. Germany (3%)

In the United States, 80% of annual antimicrobial consumption is used in food animals.

Reference:
1. Van Boeckel T.P. et. al. Global trends in antimicrobial use in food animals. PNAS. 2015: 112 (18); 5649 - 5654.

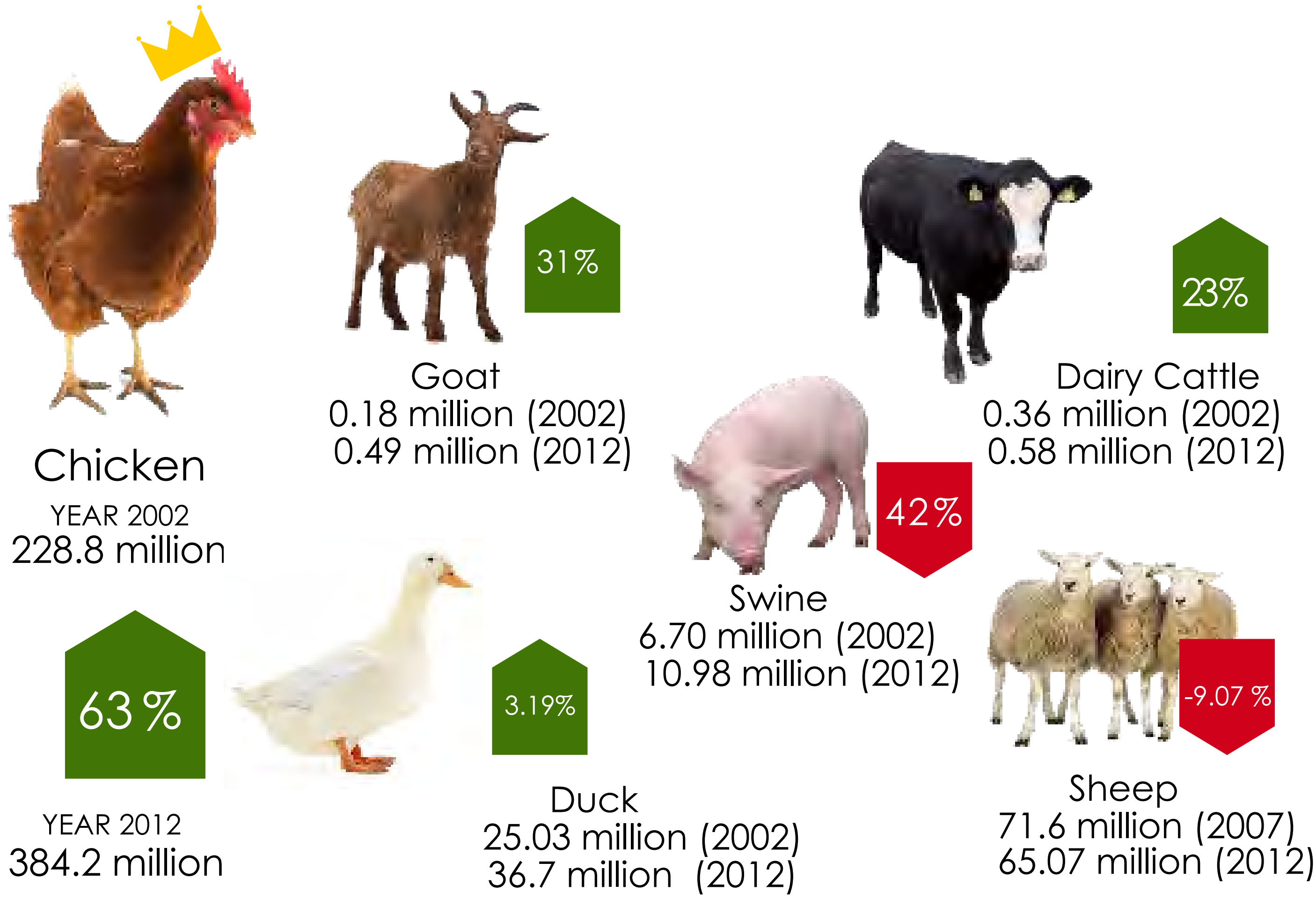
Livestock in Thailand

Thailand is one of the world's largest food producing and exporting countries. In 2014, the agricultural sector accounted for 10.25% of Thailand's GDP or around US$ 20 billion. Of this, after crop production, fisheries held the largest share at 17%, followed by livestock at 11%.

The major livestock species produced in Thailand are chicken, swine, dairy cattle and beef cattle, with goat and sheep forming only a very minor composition of national stocks.

Commercialized swine and chicken population have showed the fastest growth, rising between 2002 and 2012 from 6.70 to 10.98 million heads for swine and 228.76 to 384.18 million numbers for chicken.

This rapid growth has been in response to escalating domestic demand and growing global consumption of broiler meat and products.



Reference:
1. Thailand's agricultural exports strongly placed. Oxford Business Group. https://oxfordbusinessgroup.com/overview/worldpercentE2percent80percent99s-kitchen-despite-some-short-term-hurdles-thailand-continues-rank-among-worldpercentE2percent80percent99s-leading (accessed on 12 February 2018).
2.K. Sommart, S. Nakavisut, S. Subepang , and T. Phonbumrung. THAILAND COUNTRY REPORT—Food-feed estimation: Data, methodologies and gaps. Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand; Department of Livestock Development, Ministry of Agriculture and Cooperative, Bangkok, Thailand
http://breeding.dld.go.th/small/sansak_papers/FoodFeedEstimationDataMethodologiesAndGaps.pdf (accessed on 8 February 2018).

Fisheries in Thailand

Thailand is one of the world's leading seafood exporters with half of its production comprising crustaceans, mostly internationally traded shrimp. In 2013, Thailand exported approximately US$ 7 billion worth of fish and seafood.

Thailand's shrimp industry is the third largest in the world, accounting for one-fifth of all production globally. It is also the largest exporter of shrimp globally, primarily to the US (46%), Japan (20%) and the European Union (16%).

Most of Thailand's shrimp is cultivated in over 25 000 farms, which are then processed by 122 independent shrimp processing plants. Many Thai shrimp farmers use intensive farming methods that require inputs including industrially prepared feed, chemicals, antibiotics, aeration devices and are stocked by hatchery produced post-larvae.

One study, conducted in 2000, showed a large proportion of shrimp farmers along the Thai coast used antibiotics in their farms. Of the seventy-six farmers interviewed, 74% used antibiotics in shrimp pond management. The most commonly used antibiotics were norfloxacin, oxytetracycline, enrofloxacin and different sulphonamides. There was widespread use of fluoroquinolones, like norfloxacin and ciprofloxacin, among the farmers in this study,

Prophylactic use of antibiotics turned out to be very common. Of the farmers who used antibiotics, 86% used them in preventive management, as well as to treat disease when symptoms had arisen. Farmers either used higher doses or what they considered to be more potent antibiotics for treatment rather than for prevention.

Many of the farmers participating in the study did not have sufficient information on efficient use of antibiotics. For example, 27% of all farmers who used antibiotics used them to prevent or treat viral diseases such as white spot disease.

Reference:

1. Global supply chains: insights into the Thai seafood sector. Errighi et al; ILO DWT for East and South-East Asia and the Pacific. ILO, 2016. (apmigration.ilo.org/resources/global-supply-chains-insights-into...seafood.../file1, accessed on 1 March 2018).
2. http://www.seafish.org/media/publications/thailandethicsprofile_201509.pdf (accessed on 27 February 2018).
3. Holmström, Katrin & Gräslund, Sara & Wahlström, Ann & Poungshompoo, Somlak & Bengtsson, Bengt-Erik & Kautsky, Nils. (2003). Antibiotic use in shrimp farming and implications for environmental impacts and human health. Int J Food Sci Technol.38:255–266.10.1046/j.1365–2621.2003.00671.x.

Poultry in Thailand

Over the past four decades, Thailand's poultry sector has transformed itself from backyard farming into a leading poultry exporter. Today, the poultry sector occupies more than half of Thailand's total meat and feed production, ranking number four in Asia's poultry meat production, with a total of almost 1.8 million tons in 2015.

Early in 2000, the European Union (EU) detected nitrofurans (a banned group of antibiotics) and dioxin in some broiler imports from Thailand. This finding, in addition to new animal welfare standards in the EU, brought about a set of export restrictions that led many firms to shift to vertically integrated production in order to ensure quality standards. It is now commonplace for medium- to large-scale companies to own feed mills.

Apart from the need to meet standards set by EU export controls, Thailand's poultry sector has also transformed towards higher biosecurity following the outbreak of the Highly Pathogenic Avian Influenza (HPAI) H5N1 virus in 2004 that devastated the industry.

Reference:
1.K. Sommart et al. THAILAND COUNTRY REPORT, Food-feed estimation: Data, methodologies and gaps. Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Khon Kaen Thailand; Department of Livestock Development, Ministry of Agriculture and Cooperative, Bangkok, Thailand. http://breeding.dld.go.th/small/sansak_papers/FoodFeedEstimationDataMethodologiesAndGaps.pdf
2.The poultry sector in Thailand. Netherlands Embassy in Thailand. 2016. https://www.rvo.nl/sites/default/files/2016/12/FACTSHEET-POULTRY-SECTOR-IN-THAILAND.PDF .
3. Supply Chain Auditing for Poultry Production in Thailand. S. Heft-Neal et al. 2008, http://www.fao.org/3/a-bp271e.pdf .

Antibiotic use in animals

The use of antibiotics for animals has been regulated by the Thai Department of Livestock Development since 2003, but compliance among farmers has been found to be varying.

A recent study shows how farmers directly access active pharmaceutical ingredients (API) in order to mix it with the feed given to their livestock.

Thailand imports API for local manufacturing into finished products. API are imported either by manufacturers or by licensed importers who then sell the ingredients to manufacturers. It also imports medicated premix for the manufacture of medicated feed by feed mills.

The antibiotics produced by the manufacturers are sold to distributors, retail outlets and/or wholesalers. The imported finished products are distributed, by importers licensed to distribute or by distributors, to drugstores, farms, feed mills, health facilities, veterinary facilities and/or wholesalers. The import and manufacture of human medicines is very similar to those of veterinary medicines, both coming under the Thai Food and Drug Administration regulations.

Interviews with regulators, retailers and wholesalers indicated illegal distribution of both finished products and certain API. The 1967 Drug Act stipulates that all API must be used by manufacturers to produce finished products. However, a few informants reported how drug inspectors had confiscated API that was being used directly on livestock in farms.

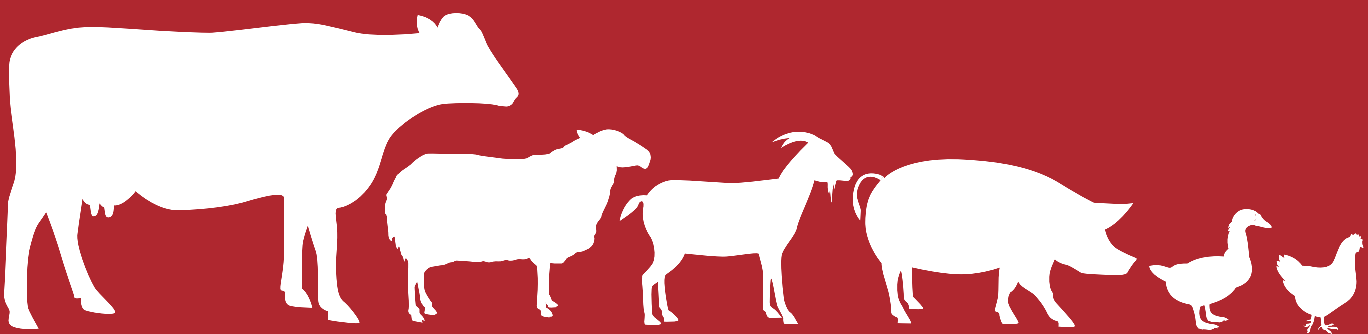
Informants representing animal feed companies also reported how feed mills mostly purchased medicated premix, from importers, manufacturers or distributors, to produce medicated feed that was then sold to farms either directly or via feed stores.

According to the key informants from the farming industry, most of the antibiotics that farmers used were given to livestock in medicated feed, either for treatment or for prophylaxis during periods of increased vulnerability, e.g., when livestock were transferred to new environments.

Reference:
1. Sommanustweechai A, Chanvatik S, Sermsinsiri V, et al. Antibiotic distribution channels in Thailand: results of key-informant interviews, reviews of drug regulations and database searches. Bulletin of the World Health Organization. 2018;96(2):101–109.

Section B

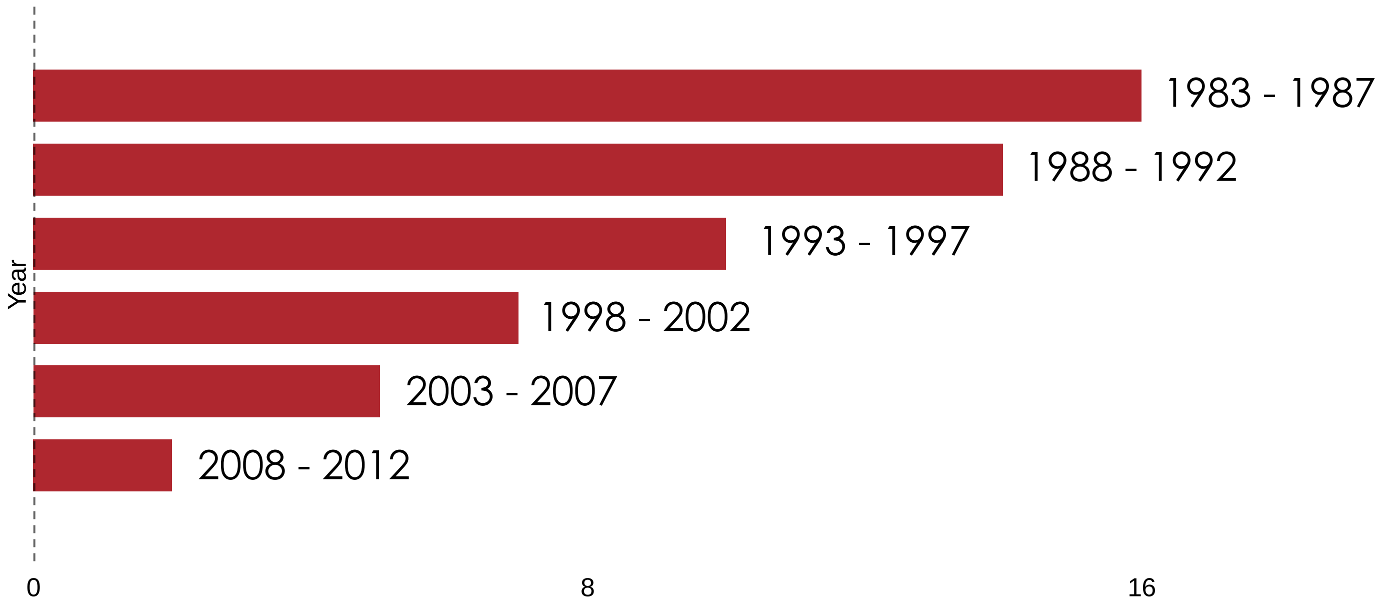
The emergence of antibiotic resistance



Antibiotics Begin to Fail

The post-World War II period witnessed a 'golden era' of antibiotic discovery. New antimicrobial agents were discovered, developed and marketed from the late 1940s to the early of 1970s. Nevertheless the discovery rate started dwindling 1980s onwards, leaving a discovery void. This is because of an increasingly arduous discovery process and declining interest by companies and government in the research and development of antibiotics due to less promising returns on investment (ROI). Around the same time, antibiotic resistance began to emerge due to primarily rampant misuse of antibiotics. Today antibiotic resistance could be detected nearly as quickly as newer antibiotics were developed.

Total Number of New Antibacterial Agents



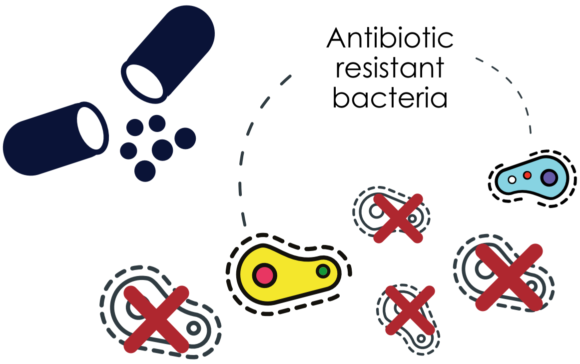
Similarly, overuse and inappropriate use of antibiotics in the food-producing animals have also given rise to antibiotic resistance in animal pathogens. Antibiotic regimes no longer work on sick animals. Worse still, the resistant bacteria can spread from animals to humans through the food chain.

The emergence of antibiotic resistance progressively undermines the viability of many antibiotics. Resistant bacteria cause thousands of deaths every year. If there[2] is no immediate and radical actions taken collectively against this trend, soon humans will be running out of options to save lives and the world will go backward to a pre-antibiotic era.

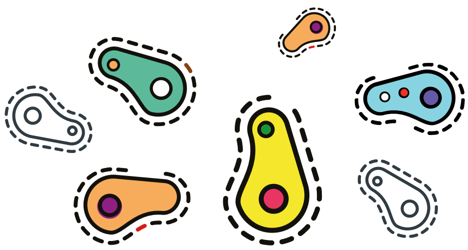
Reference:
1. The Epidemic of Antibiotic-Resistance Infections, CID 2008: 46 (15 January) Clin Infect Dis. (2011) May 52 (suppl 5): S397-S428.
2. WHO. Tackling antibiotic resistance from a food safety perspective in Europe, World Health Organisation, Geneva, 2011. 2011.

What is antibiotic resistance?

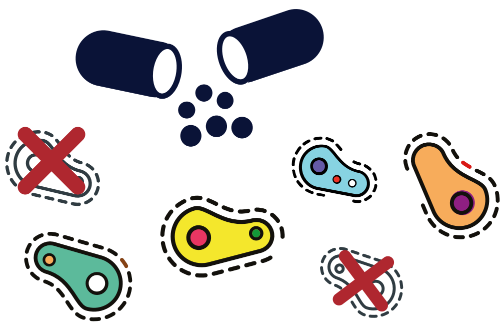
Antibiotic resistance (ABR) is the ability of some bacteria to protect themselves against the effects of an antibiotics. Clinical resistance means that a bacterium can grow in the antibiotic concentrations reached in the body during therapy resulting in treatment failure.



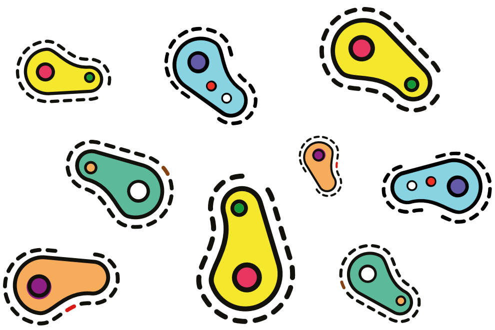
When an antibiotic is used it disables or kills only the susceptible bacteria but not the ones that have become resistant due to genetic mutations or variation.



Resistant bacteria now grow and multiply. Some bacteria even transfer their "drug-resistance" to other bacteria.



When antibiotics are used again they confront larger numbers of resistant bacteria.



Eventually antibiotic resistance results in treatment failure.

Reference:
1. ReAct. Antibiotic resistance. Available at https://www.reactgroup.org/toolbox/understand/antibiotic-resistance/ (accessed on 31 January 2018)

Spread of antibiotic resistance through food animals

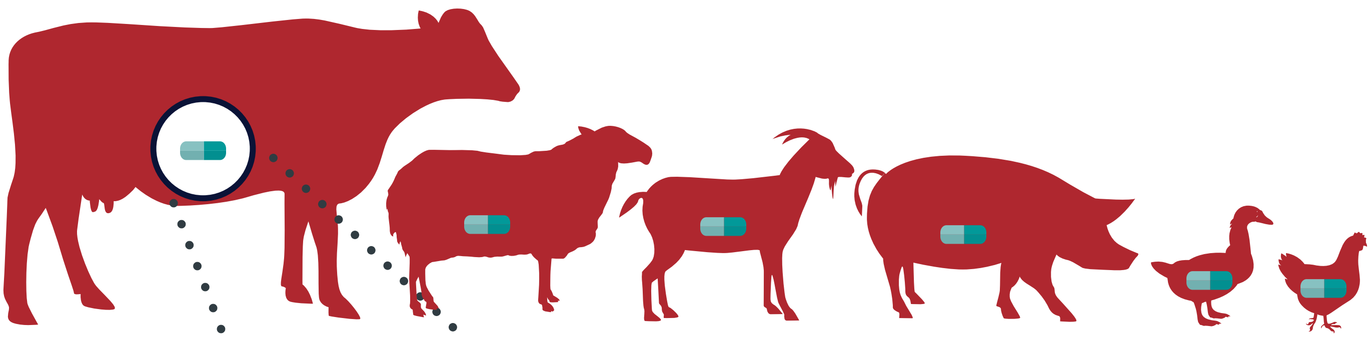
Many classes of antimicrobials that are used for humans are also being used in food animals. Apart from the use of these medicines for treatment of sick animas many food-animal producers also use them to promote growth or for routine disease prevention in crowded and unsanitary industrial conditions.

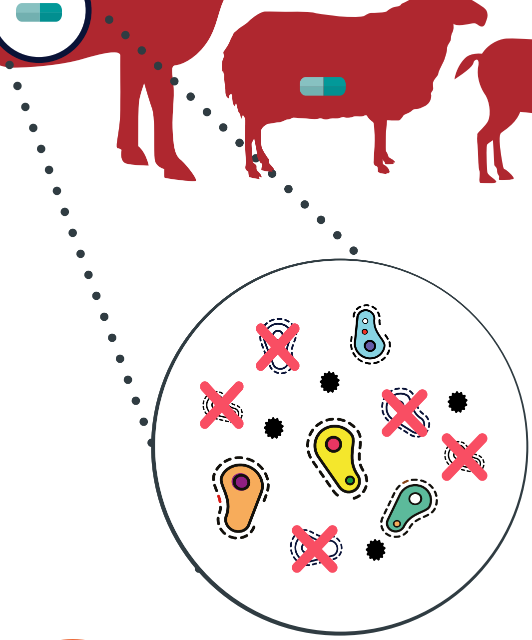
Such indiscriminate use of antibiotics accelerates the development of antibiotic resistant bacteria, which then escape and spread into communities. Farm and slaughterhouse workers, and veterinarians, who come in close contact with colonised or infected animals, are also at risk of carrying such resistant bacteria and passing them on to others.

Bacteria as well as antibiotic residues from food-animal production are also spread widely in the environment, mainly through manure, where it affects bacteria in the environment as well as in wild fauna.

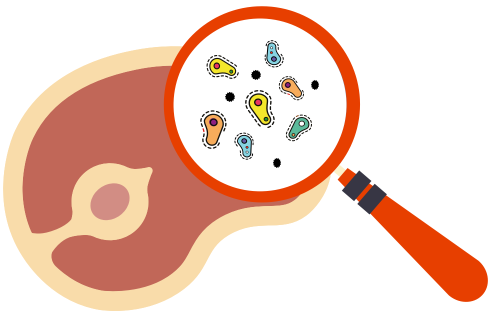
When people are exposed to these resistant bacteria from animals, this leads to resistant infections in humans. Multiple studies show an association between the use of antibiotics in animals and the spread of antibiotic resistance-related bacteria in humans.

Antibiotic resistance: from animals to humans

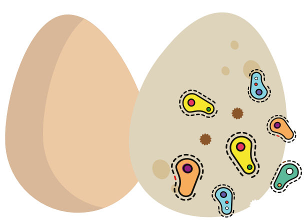




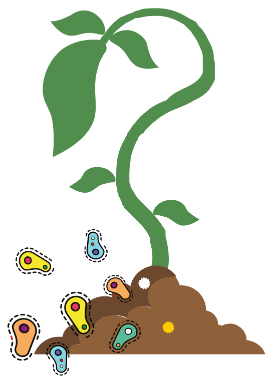
Antibiotics kill susceptible bacteria but resistant bacteria are left to grow and multiply



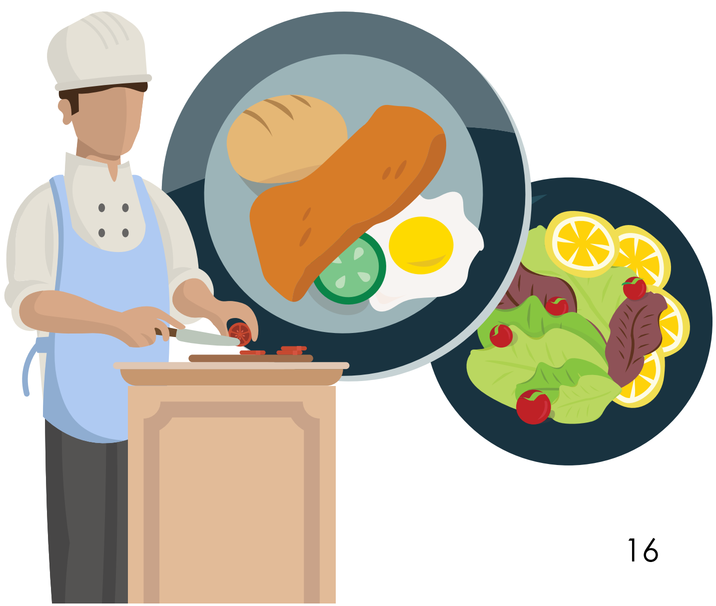
Resistant bacteria spread to animal meat



Resistant bacteria contaminate the eggs via animal faeces



Resistant bacteria contaminate environment e.g. soil and plants



Resistant bacteria can spread to humans from raw or inadequately cooked food when the raw materials are contaminated or cross-contaminated with other food and environment during preparation

Antibiotic use in Thailand

Overall, 5371 antibiotics were registered in the Thai Food and Drug Administration's database for 2016.[34] Of these, two-thirds are for humans and the remainder for animals, some as medicated premix.

Antimicrobials account for 15–20% of the total human drug costs in Thailand, and 50% of antimicrobial consumption is antibiotics; the other 50% are antiviral, antifungal, and other drugs. US$ 315 million was spent on antibiotics in 2009, which is higher than on medicines for cardiovascular diseases (US$ 260 million) and cancer (US$ 225 million). Penicillins, cephalosporins and carbapenems are the top three antibiotics consumed.

One study identified about 24 000 distributors, retailers and wholesalers who were fully licensed for pharmaceutical sales in 2017. As a result of proliferation of such drug sale outlets, most antibiotics are easily available in both the human and animal health sectors, leading to frequent inappropriate use.

Most antibiotics are classified as "dangerous drugs" that can only be dispensed by licensed pharmacists in pharmacies, but can be obtained, legally, without a prescription. The quality of dispensing is largely reliant on the competences of the doctors, pharmacists and veterinarians involved. Only a few antibiotics, e.g., colistin are classified as special-control drugs because of the high prevalence of resistance to them. Such drugs cannot be obtained, legally, without a prescription and are reserved for hospital use.

Reference:

Sumpradit N, Wongkongkathep S, Poonpolsup S, et al. New chapter in tackling antimicrobial resistance in Thailand. The BMJ. 2017;358:j3415. doi:10.1136/bmj.j2423.

Sommanustweechai A, Chanvatik S, Sermsinsiri V, et al. Antibiotic distribution channels in Thailand: results of key-informant interviews, reviews of drug regulations and database searches. Bulletin of the World Health Organization. 2018;96(2):101–109.

Antibiotic use in poultry

Even though Thailand is a major exporter of chicken meat, for several reasons, there are few published quantitative data on antibiotic use in Thai livestock production.

In a survey or rural poultry farms in 2016, a group of Thai researchers attempted to estimate the total amount of antibiotics used annually for prophylaxis in the production of chicken nationally. Using both quantitative and qualitative methods, they extrapolated the data collected from eight farms in a single province. None of the farms reportedly used antibiotics as growth promoters and had a median capacity of 15 000 chickens.

The regimen used by several of the farms, based on recommendations from the company supplying the broiler stock, included amoxicillin, colistin, doxycycline, oxytetracycline and tilmicosin. According to WHO, amoxicillin is a critically important antimicrobial, colistin is one of the highest priority critically important antimicrobials and doxycycline and oxytetacycline are highly important antimicrobials.

The mean total weight of antibiotics used per chicken was 303 mg, allocated daily for 31 days and typically mixed with drinking water and distributed via a pipe system. The last 10 days on the farm no antibiotics was given to the chicken, representing an attempt to eliminate antibiotics from the chicken meat reaching consumers.

This translates into around 101 mg of antibiotics per kilogram of chicken meat produced. In meat production (not exclusively chicken) within 30 European countries in 2015, antibiotic use per so-called population correction unit, i.e., per kg of biomass produced, varied from 2.9 mg in Norway to 434.2 mg in Cyprus.

Using this data, the researchers estimated that each year, over eight cycles, a farm with a capacity of 14 000 chickens could raise 112 000 chickens and use 34 kg of antibiotics. If 62% of the 1.4 billion meat chickens raised in Thailand in 2016 had been raised without the use of any antibiotics and 38% had been given only the antibiotic prophylaxis the total amount of antibiotics used on those 1.4 billion chickens would have been about 161 tonnes.

Reference:
1. Antibiotic use in poultry: a survey of eight farms in Thailand. Direk Limmathurotsakul et al. Bulletin of the World Health Organization 2018;96:94-100.

AMR in food animals

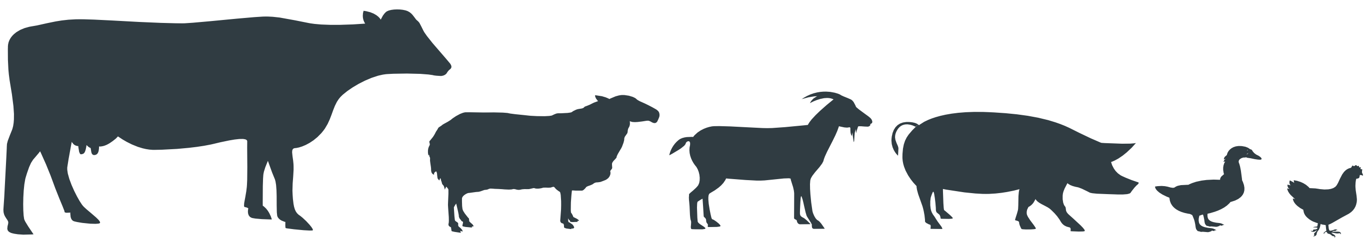
Antibiotic resistant bacteria are a widespread phenomenon in livestock and animal products throughout the Greater Mekong Subregion (GMS), of which Thailand is a part. Common human enteric pathogens such as Salmonella, E. coli and Campylobacter are found in both live animal samples and meats for purchase, and these strains exhibit extensive antibiotic resistance, often to multiple drugs.

Antibiotic resistance results from the use of antibiotics as growth promoters in animal feeds and inappropriate use of antibiotics for treatment of livestock in systems of any scale. In addition, a review of studies on antibiotic resistance in the GMS highlighted the contribution of livestock intensification to the transmission of resistant strains through the food chain.

A study conducted in Sangkhla Buri, Kanchanaburi province, Thailand in 2002/2003 found enteric bacterial pathogens in 97% of raw food samples of chicken, pork and fish from a local market. The two most common bacteria identified in this study were Salmonella (84%) and Arcobacter butzleri (74%), followed by Campylobacter (51%), Plesiomonas (27%) and Aeromonas (5%).

In 2003, another study from Khon Kaen province, Thailand, found the rates of antibiotic specific resistance of Salmonella in pork, chicken, and human patients to be closely related, suggesting a transfer of resistant bacteria through the food chain to the consumer.

Finally, a study conducted on meats from supermarkets and open markets in Bangkok in 2007 found Listeria monocytogenes in 15.4% of all samples. Of these isolates, 95.5% were resistant to cefotaxime, ceftazidime and ceftriaxone.



Reference:
1.Padungtod P, Kaneene JB, Hanson R, Morita Y, Boonmar S. Antimicrobial resistance in Campylobacter isolated from food animals and humans in northern Thailand. FEMS Immunol Med Microbiol. 2006;47(2):217–25.
2. Bodhidatta L, Srijan A, Serichantalergs O, Bangtrakulnonth A, Wongstitwilairung B, McDaniel P, et al. Bacterial pathogens isolated from raw meat and poultry compared with pathogens isolated from children in the same area of rural Thailand. Southeast Asian J Trop Med Public Health. 2013;44(2):259–72.
3. Angkititrakul S, Chomvarin C, Chaita T, Kanistanon K, Waethewutajarn S. Epidemiology of antimicrobial resistance in Salmonella isolated from pork, chicken meat and humans in Thailand. Southeast Asian J Trop Med Public Health. 2005 Nov;36(6):1510-5.
4. Indrawattana N, Nibaddhasobon T, Sookrung N, Chongsa-nguan M, Tungtrongchitr A, Makino S, et al. Prevalence of Listeria monocytogenes in Raw Meats Marketed in Bangkok and Characterization of the Isolates by Phenotypic and Molecular Methods. J Health Popul Nutr. 2011;29(1):26–38.

AMR and environmental pollution

Waste Water

One study, carried out in 2011 and 2012, collected water samples from five wastewater treatment plants (WWTPs), six canals, and in mainstream Chao Phraya River of Bangkok.

Hazard quotients estimated for acetylsalicylic acid, ciprofloxacin, diclofenac and mefenamic acid in most of the canals and that of ciprofloxacin in the river, were greater than or close to 1, suggesting potential ecological and health risks. The study reported levels of ciprofloxacin up to 0.2 μg/L in wastewater treatment plants and receiving waters.

In another study, up to 3 μg/L of oxytetracycline and up to 1.6 μg/L of enrofloxacin were detected in a conventional treatment plant effluent.

Pesticides

Studies on the composition of soil microorganisms revealed that the widespread use of the herbicide glyphosate promoted the relative abundance of gram-negative bacteria, such as Burkholderia spp., which have been linked to the regional emergence of human melioidosis.

A group of Thai researchers have made the novel recommendation of developing global standards to measure the 'antibiotic footprint' of meat products. This will involve display of all antibiotics used in the production process, through labels on the food products.

This they say will allow consumers to choose meat produced with minimal use of antibiotics and overcome the confusing and ambiguous nature of labels like 'antibiotic-free' or 'raised without antibiotics' that are being used by some producers currently.

Reference:
1.Antibiotic use in poultry: a survey of eight farms in Thailand. Direk Limmathurotsakul et al. Bulletin of the World Health Organization 2018;96:94-100.
2. Tewari S, Jindal R, Kho YL, Eo S, Choi K. Major pharmaceutical residues in wastewater treatment plants and receiving waters in Bangkok, Thailand, and associated ecological risks. Chemosphere 2013;91:697–704. doi:10.1016/j. chemosphere.2012.12.042.
Rico A, Oliveira R, McDonough S. Use, fate and ecological risks of antibiotics applied in tilapia cage, the bmj | BMJ 358:Suppl1 45 Antimicrobial Resistance in South East Asia farming in Thailand. Environ Pollut 2014;191:8-16. doi:10.1016/j.envpol.2014.04.002.
Intensified food production and correlated risks to human health in the Greater Mekong Subregion: a systematic review. Richter et al. Environmental Health (2015) 14:43.

Consequences of antibiotic resistance

Antibiotic resistance poses great threat to food safety and public health when the resistant bacteria spread from food animals to humans through the food chain. Antibiotics used in the first line treatment are no longer effective to eradicate common food-borne disease-causing bacteria such as Salmonella and Campylobacter.

Infections which used to be common become more difficult to treat

The length of hospital stay increases to, on average, more than 25 days

Treatment cost is higher

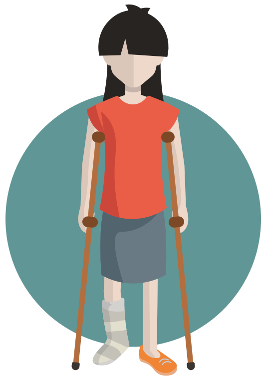
Risk of bloodstream infections and death is higher

Who are at risk?

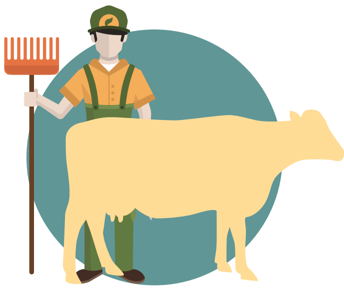
In general, certain groups of people whose immune systems are week and who have an increased risk for getting infections are at a higher risk of being infected by antibiotic resistant bacteria.

Infants, especially premature babies

Seniors, particularly those living in long term care facilities



People with weakened immune systems due to illnesses or injury

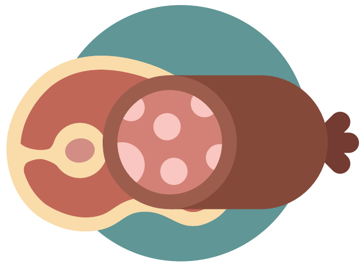


Farmers who may have direct contact with sick animals

People who are living in a crowded and unhygienic place

People who do not practice good hygiene habits like hand hygiene

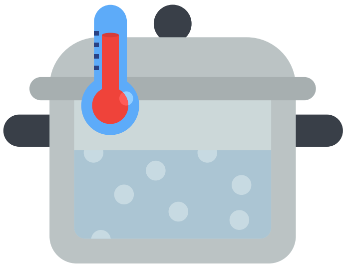
Personnel who work in healthcare facilities and day care centres such as doctors, nurses etc.



Slaughter house and meat processing plant workers or butchers

Reduce the chances of infection

Follow simple food safety tips: COOK, CLEAN, CHILL, SEPARATE [1]



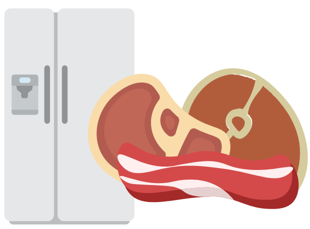
COOK

Food should be cooked to a safe internal temperature.

- 68°C for whole beef, pork, lamb, and veal (allowing the meat to rest for 3 minutes before carving or consuming) or 72°C for ground meats
- 74°C for for all poultry, including ground chicken and ground

CLEAN

- Wash hands before handling raw foods to avoid contamination especially after contact with animals or animal environment.
- Wash hands after touching raw meat, poultry or seafood.
- Wash the work surfaces, cutting boards, utensils and grill before and after cooking.



CHILL

Keep the temperature of the refrigerator below 4°C and refrigerate foods within 2 hours of cooking.

SEPARATE

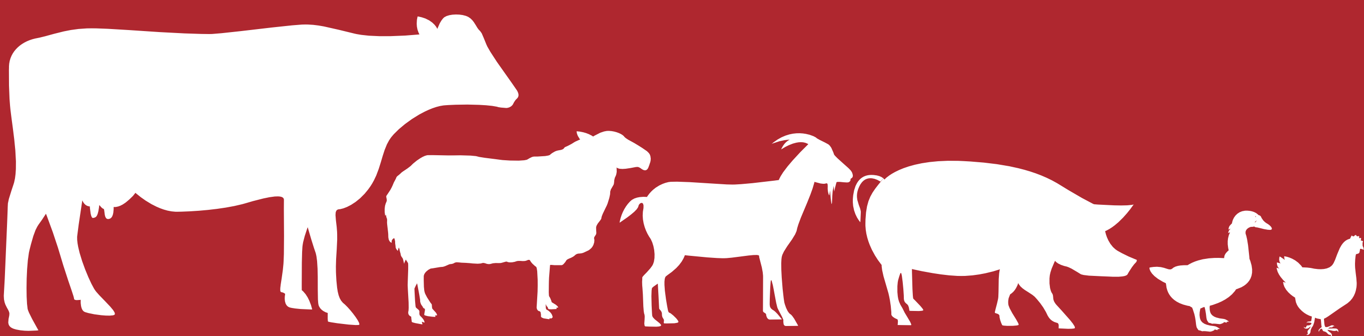
Bacteria from raw meat, poultry, seafood, and eggs may spread to ready-to-eat foods.

- Do not store raw and cooked food in the same space.
- Handle raw meats and ready-to-eat foods separately Use different cutting boards to prepare raw meats and any food that will be eaten without cooking.

Reference:
1. Centers for Disease Control and Prevention. Antibiotic Resistance, Food and Food-producing Animals. Available at https://www.cdc.gov /features/ antibiotic-resistance-food/index.html (accessed on 10 January 2018)

Section C

Responding to antibiotic resistance



Thailand's National Strategic Plan on AMR 2017–2021

Vision:

Reduction of mortality, morbidity and economic impacts from AMR.

Mission:

Establish policies and national multi-sectoral mechanisms which support effective and sustained AMR management system.

Actions:

- Strengthen surveillance of resistance, using One Health approach Regulate antimicrobial distribution
- Prevent infection in humans while controlling and optimizing use of antimicrobial drugs
- Prevent infection in livestock and pets while controlling and optimizing use of antimicrobial drugs
- Increase public knowledge and awareness of antimicrobial resistance

Targets:

- 50% reduction in morbidity attributable to antimicrobial resistance
- 20% reduction in mean consumption of antimicrobial drugs by humans
- 30% reduction in mean consumption of antimicrobial drugs by livestock and pets
- 20% increase in the proportion of the population shown to have a pre-defined basic level of knowledge and awareness of antimicrobial resistance
- Capacity of the national plan's implementation to have reached level 4 – as measured by the World Health Organization's Joint External Evaluation tool for the 2005 International Health Regulations

Reference:
1. Tangcharoensathien V, Sattayawutthipong W, Kanjanapimai S, Kanpravidth W, Brown R, Sommanustweechai A. Antimicrobial resistance: from global agenda to national strategic plan, Thailand. Bulletin of the World Health Organization. 2017;95(8):599-603. doi:10.2471/BLT.16.179648.25

Livestock

The Department of Livestock Development (DLD), Ministry of Agriculture and Cooperatives, is the major organization that plays a very important role in regulations and control of all matters regarding livestock and livestock products. DLD works in cooperation with Food and Drug Administration (FDA), Ministry of Public Health, in regulation of veterinary drugs through the Drug Act of 1967.

FDA is responsible for licensing and registrations of veterinary medicinal products and authorizes relevant officials of DLD to enforce legislation relating to post-marketing of veterinary drugs/biologics. DLD is responsible for controlling the usage and post-marketing surveillance of veterinary medicinal products.

Since 2005 the FDA has prohibited registration of antibiotics for use as growth promoters and also rejected any application of new antimicrobials that are used in humans (e.g. carbapenems) for use in animals. Antimicrobials have also been reclassified and their distribution controlled under the Act.

The DLD, on its part in 2009 put out a list of drugs and chemicals that are not allowed to be used in food animals. Under the Feed Quality Control Act 2015 DLD banned all antibiotics used for growth promoters in food animals. DLD also issues importation standards of livestock and livestock products, which among other things also addresses environmental and animal welfare concerns.

The National Bureau of Agricultural Commodity and Food Standards (ACFS) is another governmental agency under the Ministry of Agriculture and Cooperatives that is involved in standards and policies of the country.

ACSFs issued a Code of Practice for Control of Use of Veterinary Drugs, which describes good practices for the use of veterinary drugs for food producing animals to avoid excess of maximum residue limits of veterinary drugs in animals, animal produce and animal products for human consumption. Recently, ACF has drafted guidelines for judicious use of antimicrobials in broiler farms.

Reference:
1. Perspectives on Antimicrobial Resistance in Livestock and Livestock Products in ASEAN Countries
2. Amornthep Archawakulathep et al. Thai J Vet Med. 2014.44(1):5–13.
Policy of Antimicrobial use (AMU) in Livestock in Thailand, Julaporn Srinha Division of Animal Feed and Veterinary Products Control (AFVC) Department of Livestock Development (DLD) Ministry of Agriculture and Cooperatives (MOAC). http://www.favamember.org/wp-content/uploads/2017/05/Policy-of-AMU-in-livestock-in-Thailand.pdf
3. ACFS, 2009. http://www.acfs.go.th/eng/general_standard.php?pageid=2

Fisheries

The Thai Department of Fisheries (DOF), in the Ministry of Agriculture and Cooperatives, is the principal government agency responsible for development and management of fisheries and aquaculture in Thailand.

The Thai Frozen Foods Association (TFFA) plays an important role in shrimp exports. To gain access to international markets, all producers and exporters need to be registered with TFFA, which now represents the interests of over 300 processors and traders.

Given increasing pressures from high-income importers, export processors have taken steps to improve labour conditions and environmental threats in their supply chains. This has in turn encouraged their direct and indirect suppliers to improve compliance to the relevant standards.

Processing export facilities are highly concentrated and regulated, as they need to register with the DOF and must be members of the TFFA, complying with Hazard Analysis and Critical Control Points (HACCP) standards to export. However, there is a lack of proper regulation and enforcement in the processing of shrimp products for the domestic market, due to the absence of pressure from overseas buyers.

Policy and regulation

Antibiotic production, distribution and dispensing

Two Acts regulate the use of antibiotics and medicated feed through inspection, licensing and marketing:

- The 1967 Drug Act; and
- The 2015 Animal Feed Quality Control Act.

The 1967 Drug Act, enforced by the Food and Drug Administration of the Thai Ministry of Public Health, regulates the finished products used in human and veterinary medicine and active pharmaceutical ingredients.

The 1967 Drug Act divides antibiotics into a large group of "dangerous drugs not requiring prescriptions" and a much smaller group of "special-control drugs requiring prescriptions".[30]

Unfortunately, this categorization meant that most antibiotics could be dispensed, by licensed pharmacists in retail pharmacies, without a prescription. However, the Thai FDA is currently in the process of upgrading regulation needed to plug this loophole and restrict the quantity of antibiotics that could be distributed to any individual or to control the excessive use of antibiotics in livestock.

The 2015 Animal Feed Quality Control Act is enforced by the Department of Livestock Development of the Thai Ministry of Agriculture and Cooperatives. This Act prohibited direct use of active pharmaceutical ingredient in animal feeds. However, a recent study indicates that many Thai farmers were, illegally, adding active pharmaceutical ingredients to animal feeds, probably as a cost-saving measure.

Following a series of public consultations, the Thai Food and Drug Administration is currently working on a reclassification of antibiotics in which a larger proportion of the drugs will be categorized as special-control/prescription-only, in line with the recommendations made by the World Health Organization in its 20th Model List of Essential Medicines.

Reference
1. Sommanustweechai A, Chanvatik S, Sermsinsiri V, et al. Antibiotic distribution channels in Thailand: results of key-informant interviews, reviews of drug regulations and database searches. Bulletin of the World Health Organization. 2018;96(2):101–109.
2. Viroj Tangcharoensathien et al. Antibiotic distribution channels in Thailand: results of key-informant interviews, reviews of drug regulations and database searches. Bull. World Health Organ. 2018;96:101–109.

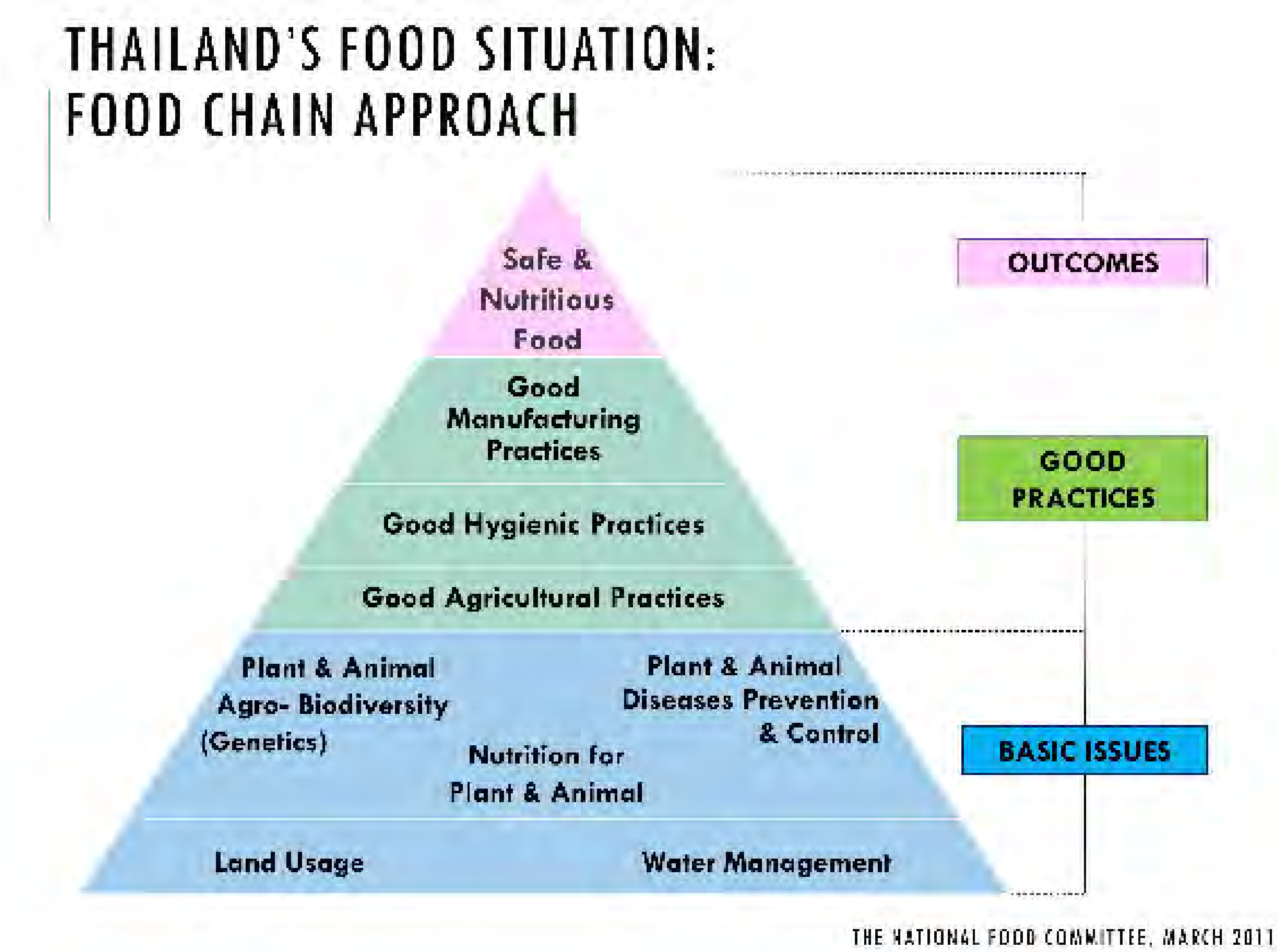
Policy and regulation

Thai agricultural standards related to AMR

- General Standards (39 items):
  - Code of practice for control of the use of veterinary drugs, safety requirements for agricultural commodity and food.
  - Manual of diagnostic tests for animals.

- Production Standards (1144 items):
  - Good Agricultural Practices for livestock farming, aquaculture and crop production, Good Manufacturing Practices for milk collection centers.
  - Guidelines for animal health and welfare management, farm veterinarian, disease treatment, sanitation etc.

- Commodity Standards (1102 items):
  - Meat, beef, shrimp, egg, milk, honey etc.



Monitoring

Concerns about the health and safety of consumers have led to imposition of minimum standards for aquaculture products by importers such as the USA and European Union (EU). Thailand is one of the largest exporters of aquaculture and fisheries products, and has responded to these food safety concerns over the entire chain of production.

The Thai Department of Fisheries (DOF) is the competent authority for inspection and certification of all fish and fishery products. The strategy of the DOF in order to improve food safety related to shrimp production is the "Farm-to-Table" approach. As part of this, controls have been placed on the use of prohibited substances in farms, feed production, fishery imports, and processing and finished product levels.

Processing plants, for example, are required to implement Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Points (HACCP), a systematic preventive approach to food safety from biological, chemical, and physical hazards in production processes. DOF has also developed fundamental guidelines—Good Aquaculture Practices (GAP)—for hygienic shrimp production.

The Code of Conduct (CoC) programme for the marine shrimp industry, which began in 1998, emphasizes traceability from retailers or consumers to the farm through a coding system for product recall purposes. DOF introduced Movement Documents (MD) as a paper-based tool to accomplish traceability of the control and monitoring programme on the use of drugs and other chemical agents. Feed manufacturers are also required to implement GMP and HACCP system in their production so that this can be traced back to the feed ingredient supplies.

There have been however problems encountered in the implementation of this traceability system. Following are some of the shortcomings identified:

Lack of resources: It is not an easy task to change the habits of farmers where record keeping used to be outside their interest and can add more cost to maintain records for their products.

Lack of awareness: Lack of knowledge about the benefits and advantages of having a traceability system.

Reference:
1.Traceability of aquaculture products in relation to feed and feed ingredients. Laddawan Krongpong | 8 March 2017 . https://enaca.org/?id=906 (accessed on 2 March 2018).

Recommendations

- A system for recording antibiotic dispensing at retail pharmacies should be established and then carefully audited by pharmacists.

- The continued professional education of retail pharmacists should be promoted, as a means of reducing the inappropriate use of antibiotics, and other drugs.

- The sales of large quantities of antibiotics to individuals need to be restricted by differentiating wholesalers from retailers in the licensing system. This includes prohibiting wholesalers from selling large quantities of antibiotics to farmers, or others who are not licensed retail outlets, and carefully restricting the sale by retailers of large quantities of such drugs to individuals.

- The ongoing policy to reclassify more antibiotics as special-control/prescription-only drugs in Thailand should be rapidly implemented.

- A national system for tracking active pharmaceutical ingredients should be established immediately, to prevent the direct use of such ingredients on farms.

Antibiotic Use in Food Animals:
Thailand Overview