TRAINING & WORKSHOP

PREVENTION AND SUSTAINABILITY IN THE INDIAN DAIRY SECTOR

FOR PRODUCTIVITY, LIVELIHOOD GENERATION AND CLIMATE RESILIENCE

Fundamentals of Animal Farm Biosecurity



Dr. Pankaj Dhaka, Asst. Professor, Centre for One Health, GADVASU, Ludhiana

1

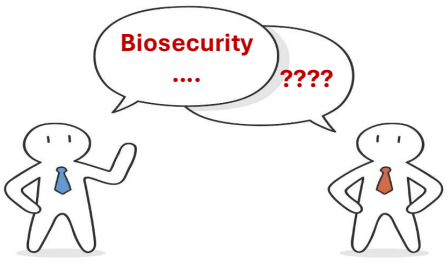
Bio- WHAT??

Are you talking about **laboratory biosecurity**?

A few **poultry experts** were only knowing the term

Is it a type of SOP or set protocol??

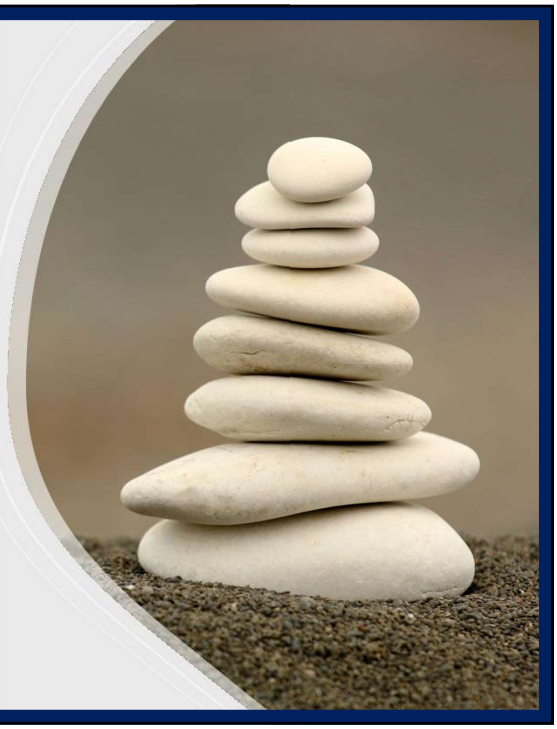




2

Expected learning outcomes!

1. Understanding the concepts of field epidemiology
2. Principles of farm biosecurity
3. Psycho-behavioural aspects of implementation of biosecurity measures- the role of vets
4. How to quantify the biosecurity implementation?



3



What is farm biosecurity?

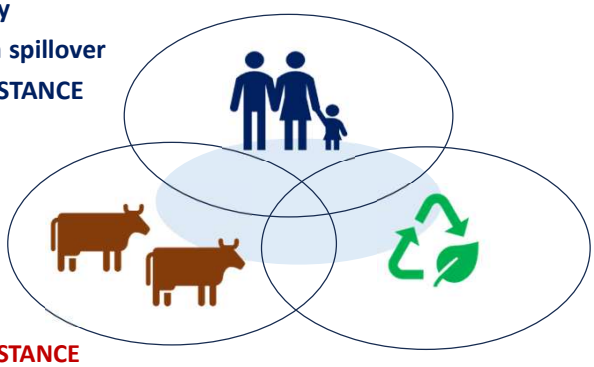
The application of a set of **physical, management,** and **behavioural** measures designed to reduce the risk of **introduction, establishment** and **spread** of pathogenic agents **to, within** and **from** an animal population.

https://www.woah.org/fileadmin/Home/eng/Health_standards/tahc/2018/en_glossaire.htm

4

Biosecurity and One Health

- Food security and safety
- Prevention of pathogen spillover
- Less Antimicrobial RESISTANCE



Less infection in animals
- High growth and production
- Feed conversion
- Less antimicrobial usage & RESISTANCE

- Prevention of pathogen spillover
- Less Antimicrobial RESISTANCE

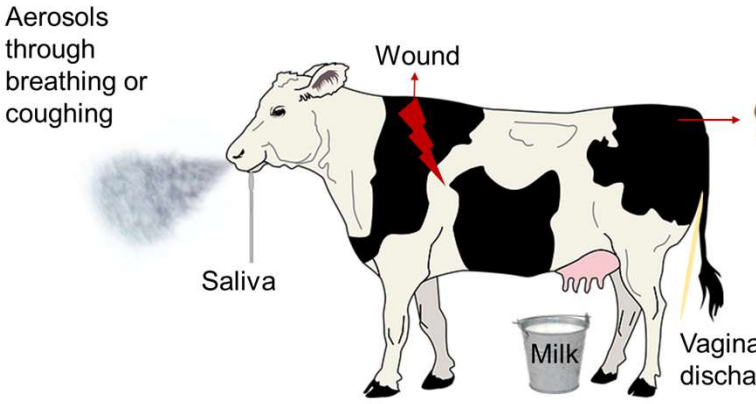
5



6

Common routes of pathogen(s) excretion in animals

Remember: it is common that a single pathogen can have more than one route



- Fomites
- Vectors
- Sexual
- Iatrogenic
- Vertical

7

How can your cattle get FMDV?



8

Which of these routes is most likely to transmit FMD?

A



Direct contact between healthy and infected animals.

B



Contact of healthy animals with the boots of a veterinarian who has visited an infected farm.

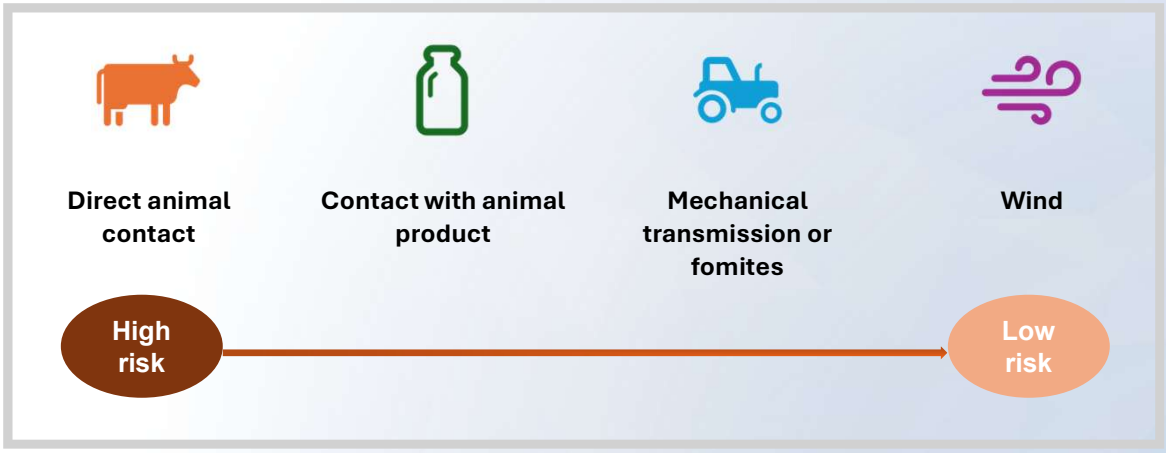
C



Carriage of the virus on the wind between an infected farm and a healthy farm some distance away.

9

Relative risk of FMDV transmission from various sources

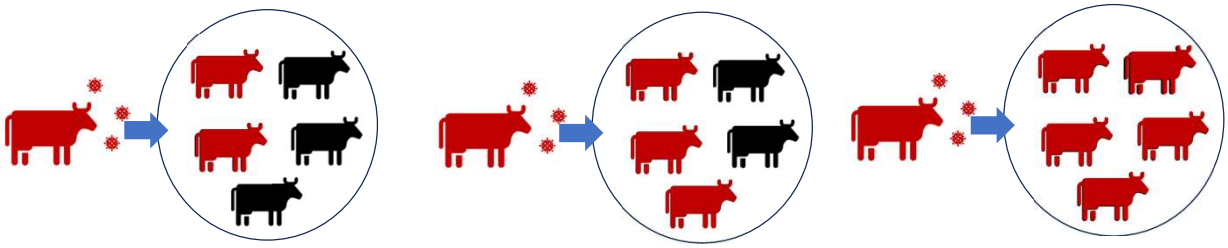


Remember: Not all transmission routes pose similar risk!

10

Knowledge about the pathogen

How much infectious the pathogen can be*:

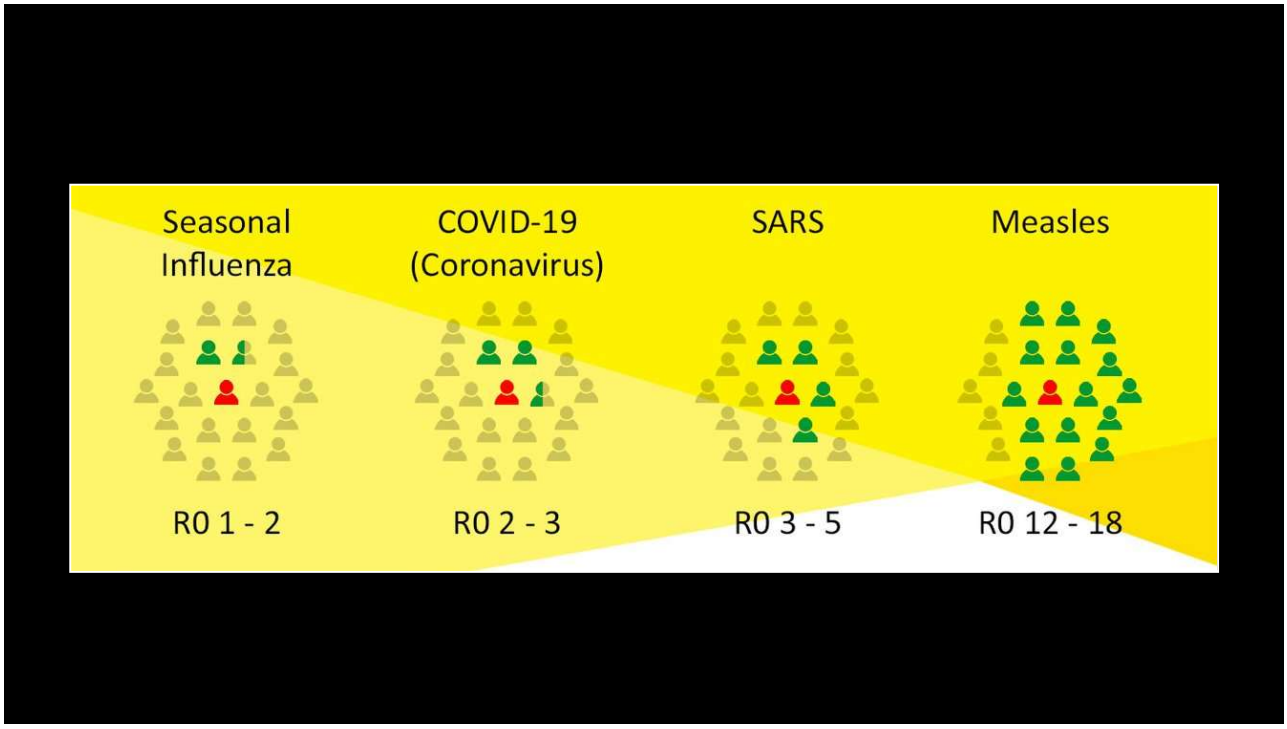


Contagiousness of a diseases is represented by **number of secondary infections** (*in an otherwise susceptible population*) **caused by a single original infection**.

……known as **basic reproduction number** (R_0).

*Underlying assumption: when no animal has any immunity and no interventions have been imposed to curb its spread.

11



12

For FMD: R_0 during early stages of the disease were observed in the range of **21 to 88** for **cattle**
(Ster et al., 2012; Hayer et al., 2018)

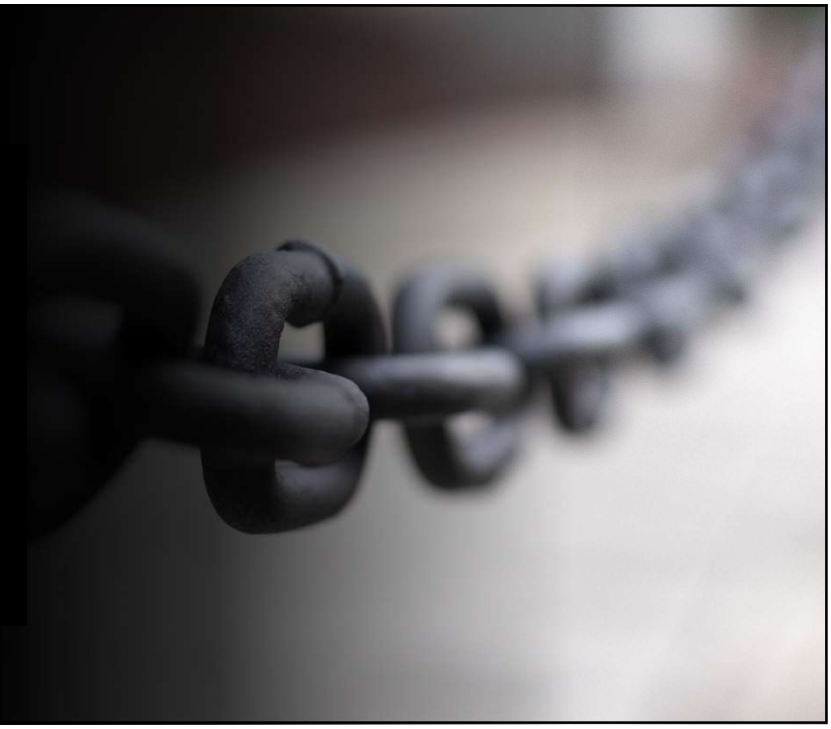
For LSD: for **indirect transmission,** the R_0 was estimated at **15.7**, compared to **0.36** for **direct transmission**
(Magori-Cohen et al., 2012)



13

Route tells us where to intervene;

reproduction numbers tell us whether the chain is expanding.



14



15

Exercise: Effective reproduction number (Re)

- Fraction of the host population that is susceptible
- Rate of contacts in the host population
- Probability of infection being transmitted during contact
- Duration of infectiousness

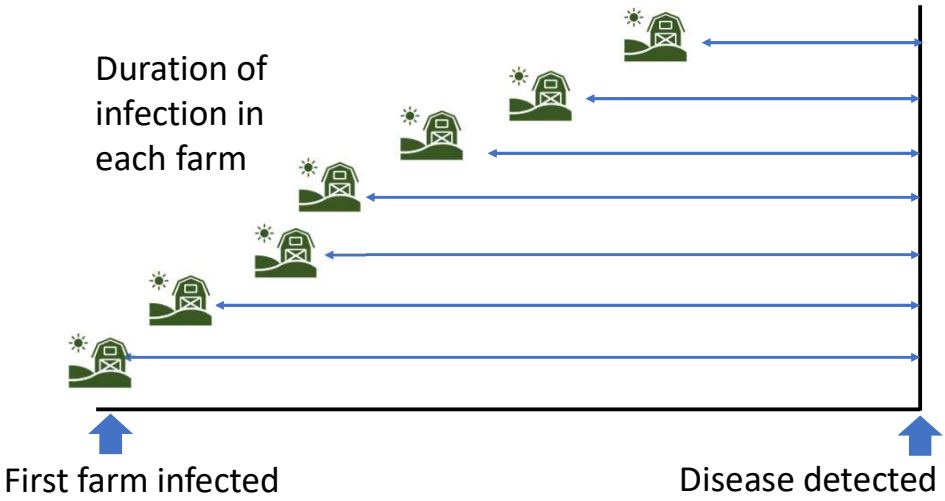
16

Effective reproduction number (Re)

Fraction of the host population that is susceptible	Vaccination, nutrition, calves, milking animals…..
Rate of contacts in the host population	Pashu melas, purchasing new animals, visitors, veterinarians, para-vets…
Probability of infection being transmitted during contact	Infectiousness of the pathogen, transmission pathways, barrier(s) to reduce the probability of contact (quarantine, C&D, isolation, fencing..)
Duration of infectiousness	Pre-clinical shedding, acute/chronic outcomes, latent infection, pathogen survival (e.g. FMDV: 6 months in slurry)

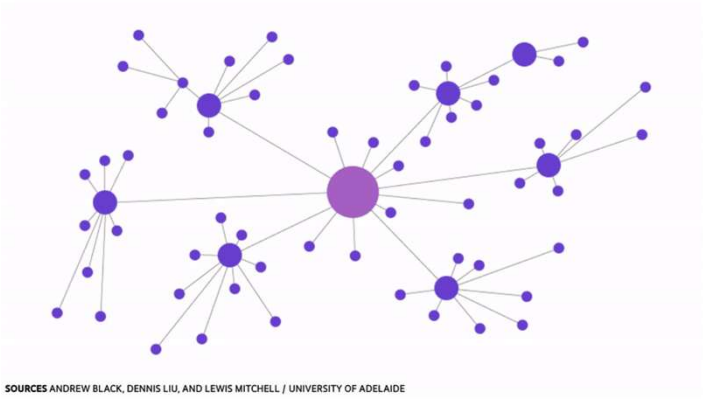
17

Since incursion until detection of any new infectious pathogens (e.g., FMD, LSD..): Several weeks



18

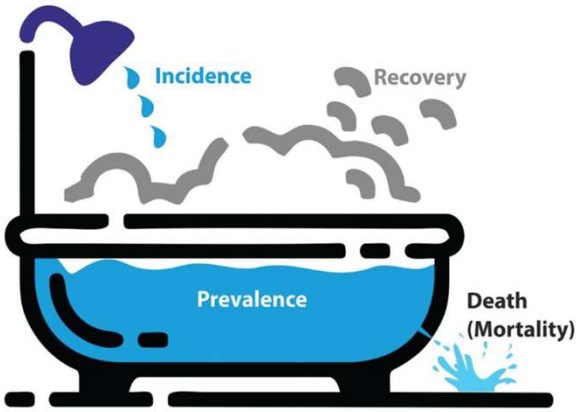
- Moreover, during that period, the pathogen can spread between farms through animal movements, contaminated vehicles, workers etc.
- **Biosecurity measures will be the only component that can minimize the spread until detection**



19

For diseases that are under **control/eradication programs,** a **lack of biosecurity** can **hamper the success of the program**

Despite huge efforts in testing and segregating/ culling of positive animals, **if new infections are not prevented, the disease will not be controlled/eradicated**

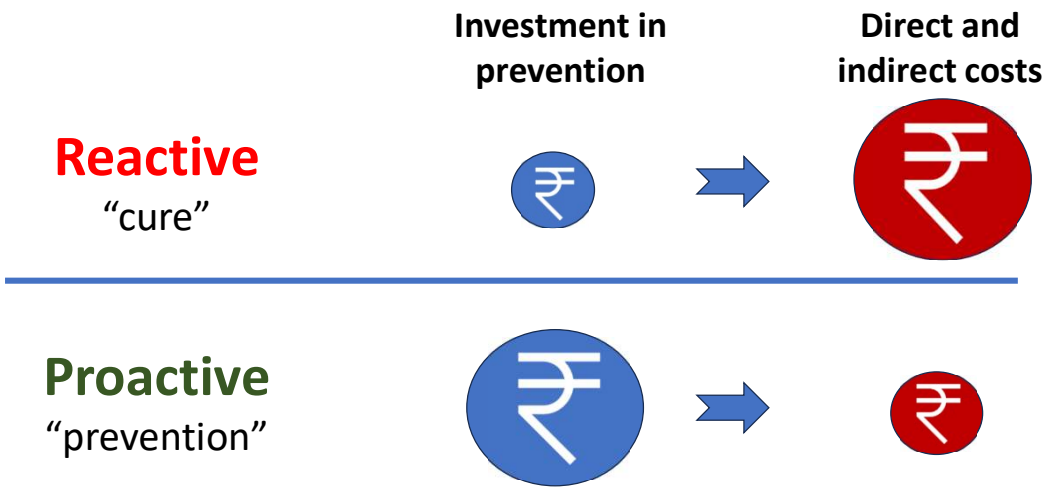


Epidemiologist's bathtub

(Figure adopted from: Impellizzeri et al., 2022)

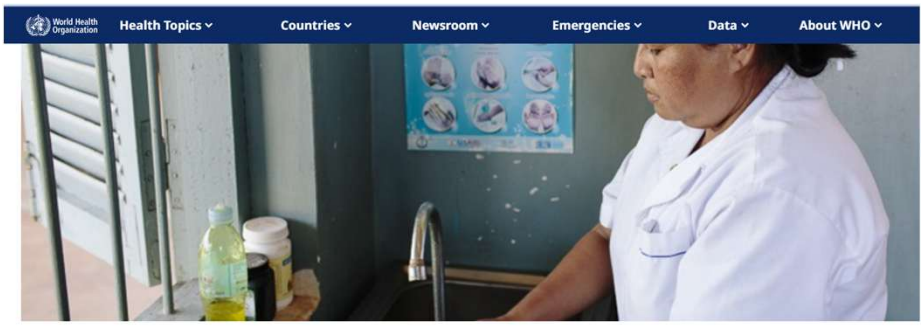
20

Preventive measures also support economics



21

"Hand hygiene is a truly 'no-regrets' investment: Estimates show that for every $1 invested, countries can save $15



Investing $1 per person per year in hand hygiene could save hundreds of thousands of lives

22



23

Economic Impacts of Foot and Mouth Disease

	Disease Outbreak		Disease Risk
National or regional level	Livestock trade restrictions (live animals, genetic material, meat and dairy products) and production losses	Effect on macroeconomy: Multiplier effect, producer-consumer price, foreign exchange	Risk management: • Preventive measures (fencing, zonation, compartmentalization, movement control) • Logistic and manpower
	Containment measures, logistic and manpower	Effect on industrial earnings	
		Export oriented losses Local market losses	
Farm-level	**Livestock production losses:** • Mortality, weight loss, milk loss, hide damage • Treatment and containment costs • Other (timing of sales, price effects etc.)	**Effect on livelihoods** • Loss of insurance • Effect on crop production (manure application and other restrictions) • Disruption of social networking functions • Increase vulnerability	Risk management: • Treatment costs • Compulsory control measures (vaccinations, movement control) • Traceability • Price discrimination by zoning

Other **ecological impacts**, including wildlife health, can also be there in case of spillover events

Early detection of FMD outbreaks is the KEY for reducing its impact

Reference: Perry, B.D., Randolph, T.F., Ashley, S., Chimedza, R., Forman, T., Morrison, J., Poulton, C., Sibanda, L.M., Stevens, C., Tebele, N. and Yngstrom, I., 2003. The impact and poverty reduction implications of foot and mouth disease control in southern Africa with special reference to Zimbabwe.

24

Do you know the socio-economic impact of 2001 United Kingdom FMD outbreak

- 1st case of FMD was reported on 19 Feb. 2001. More than **six million** pigs, cattle and sheep were slaughtered before FMD was brought under control by the end of Sept. 2001.
- It has been observed that FMDV was circulating for ~3 weeks, with 50 infected premises, before it was detected.
- Total economic impact was estimated > **£8 billion**. The outbreak **devastated Britain's dairy industry**.
- Most evidences indicated that **infected animal products** had been imported from far east and had been used as animal feed on pig farms, passing on the virus.



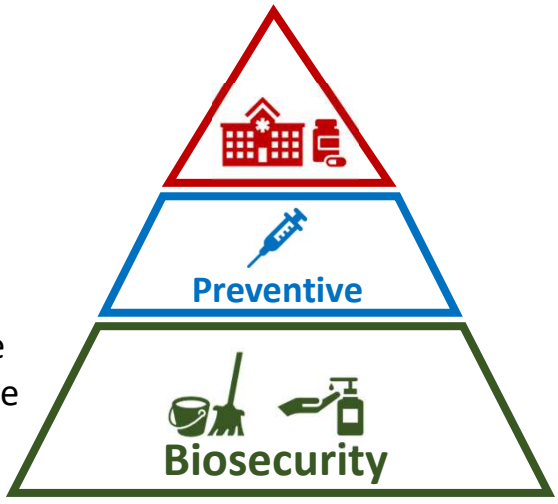
Source: https://www.theguardian.com/science/2021/feb/21/foot-and-mouth-20-years-on-what-an-animal-virus-epidemic-taught-uk-science

25

Biosecurity is the foundation of animal health!



Biosecurity should be the basis of all disease control programs



26

Why We NEED farm biosecurity?

- To improve the **farm productivity**
- To obtain **farm stability**
- To improve **quality** & **safety** of farm products
- To reduce risk of **zoonotic infections**
- To improve **animal welfare**
- To reduce **antimicrobial usage** & **resistance**

27

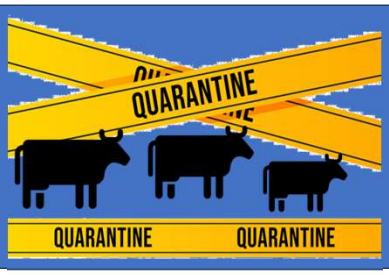


28

Segregation: Separation of infected & diseased animals



CLEAN
(Susceptible animals)





Dirty
(Direct or indirect source of infection)

29

What we are doing here..

Infection risk = Susceptibility * Transmissibility * Contact time/rate * Consequences

- Likelihood of a contact that could lead to infection
- The probability of transmission given a contact

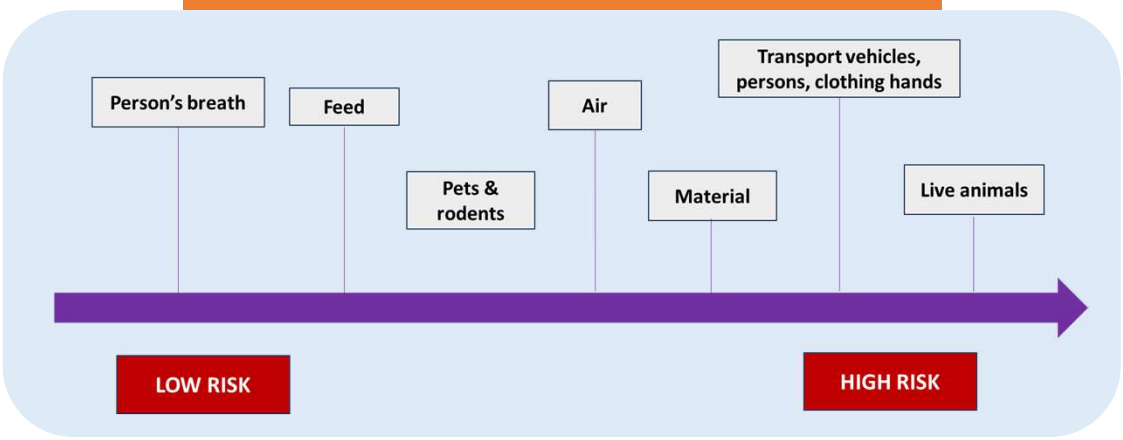
Segregation reduce the likelihood of a contact that could lead to an infection

Examples:

- **Quarantining** animals that have been purchased before adding them to the herd.
- Asking **visitor** to park their bike outside the gates to the farm.
- Not **sharing equipment** with neighbouring farms.

30

Not every measures is equally important: Prioritize it



Always understand the transmission pathways of the pathogen!

31

Biosecurity is all about reducing risk !!

Remember: *Although we can't completely eliminate risk*, **we can take steps to reduce it by choosing to focus on reducing the highest risks.**



- Identify **areas where disease transmission is most likely to occur**, such as high-traffic zones like milking parlors or areas where animals congregate (common water source?)
- **Assess the vulnerability** of feed and water sources to contamination. **Prioritize measures** to safeguard these essential resources, such as ensuring **proper storage and handling practices**, **preventing access by wildlife or pests**, & **regularly testing** for contaminants.

32

Reduction of the infection pressure



- Breaking the infection cycle
- Reduce the burden on immune system

33

What it does: **It reduce the infection pressure →**
mitigate the probability of transmission given a contact

Cleaning involves **removing all of the organic material** (faeces, urine, saliva, dirt, etc.) from a surface or contaminated object.

- Providing all of the organic material can be removed, *the amount of pathogen on the surface should be significantly reduced.*



Disinfectants are chemicals which **kill pathogens.**

- *Different disinfectants are needed for different pathogens.*
- To be effective, the **correct disinfectant** must be used, at the **correct concentration** and for the **correct contact time.**

IMPORTANT: Most disinfectants are inactivated by organic matter.

- Dipping dirty boots into a bucket of disinfectant **DOES NOT WORK**. Boots must be thoroughly cleaned before disinfection.

34

Scale of farm operations does matter!





Biosecurity **must be evolved** according to the **variability of the threat**

Level of farm production, available structural components, future expansions plans etc…

35

Frequency does matter

Thousand times a small chance becomes a large chance

Risk transmission route (p)

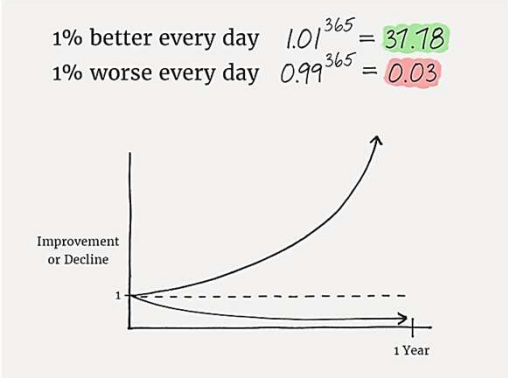
Frequency transmission route (n)

$P = 1-(1-p)^n$

E.g., at individual level, the visitor may not pose high risk, but too frequent visits by different visitors may pose a high risk!

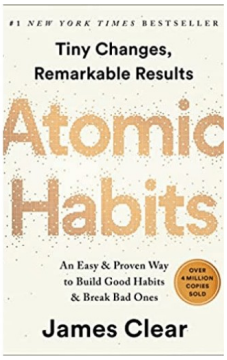
36

The POWER of tiny gains



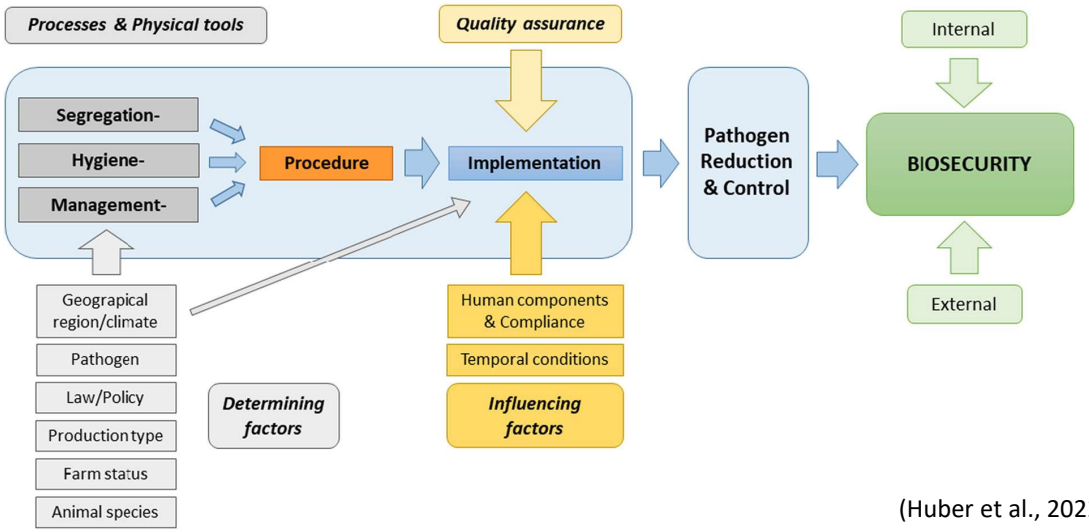
Changes that seem small and unimportant at first will compound into remarkable results if you're willing to stick with them for years.

JAMES CLEAR



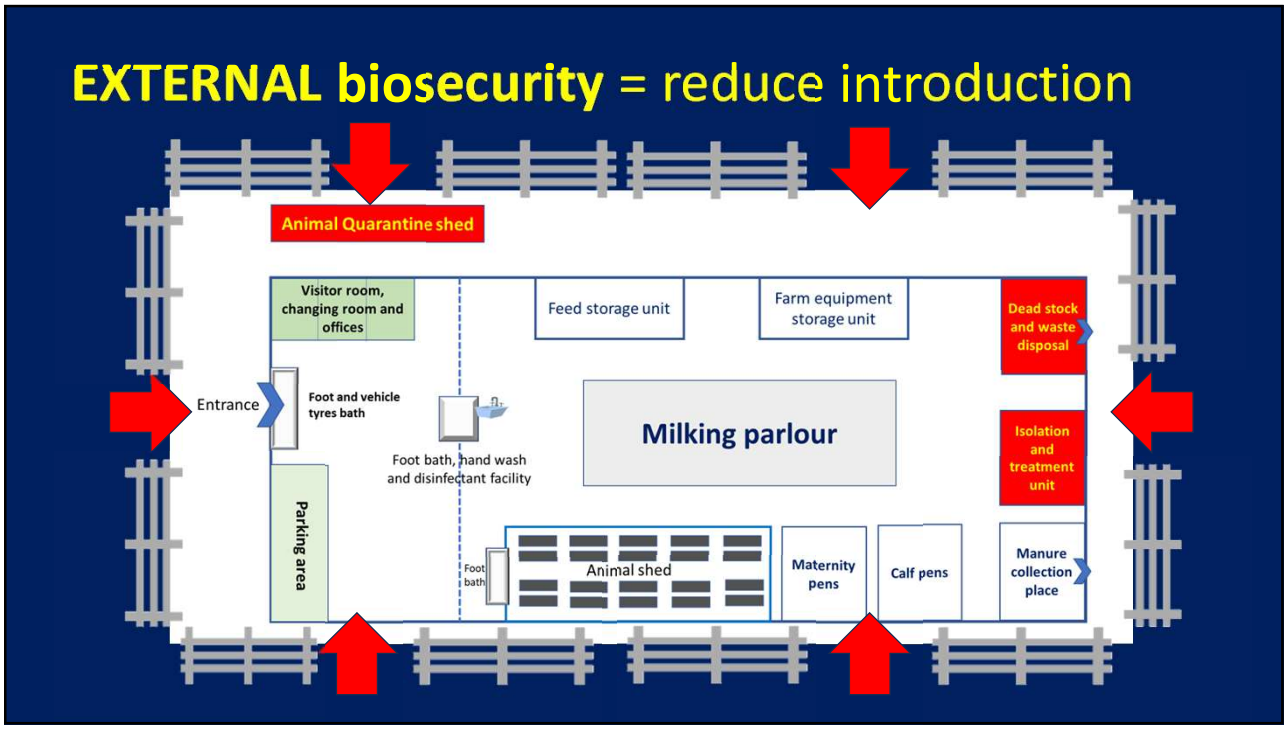
37

Overview of components of "Biosecurity Measures"

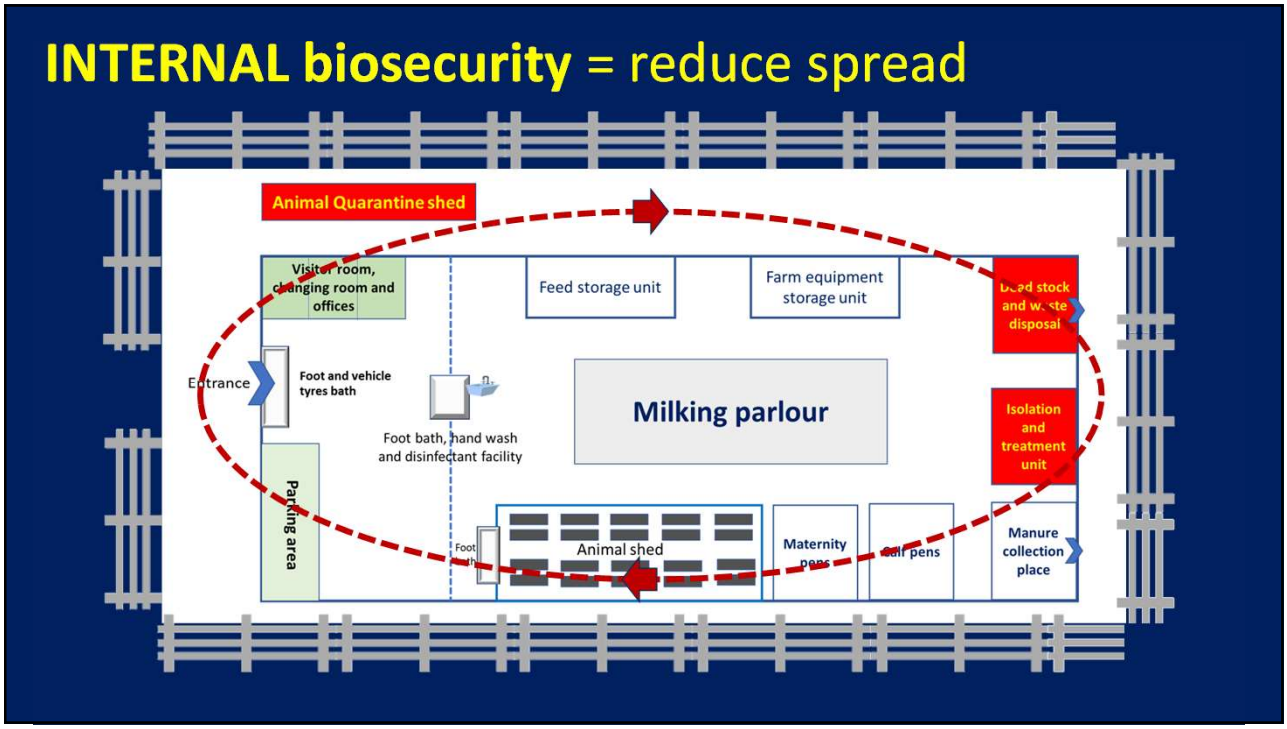


(Huber et al., 2022)

38


EXTERNAL biosecurity = reduce introduction
Animal Quarantine shed
Visitor room, changing room and offices
Feed storage unit
Farm equipment storage unit
Dead stock and waste disposal
Entrance
Foot and vehicle tyres bath
Foot bath, hand wash and disinfectant facility
Milking parlour
Isolation and treatment unit
Parking area
Foot bath
Animal shed
Maternity pens
Calf pens
Manure collection place

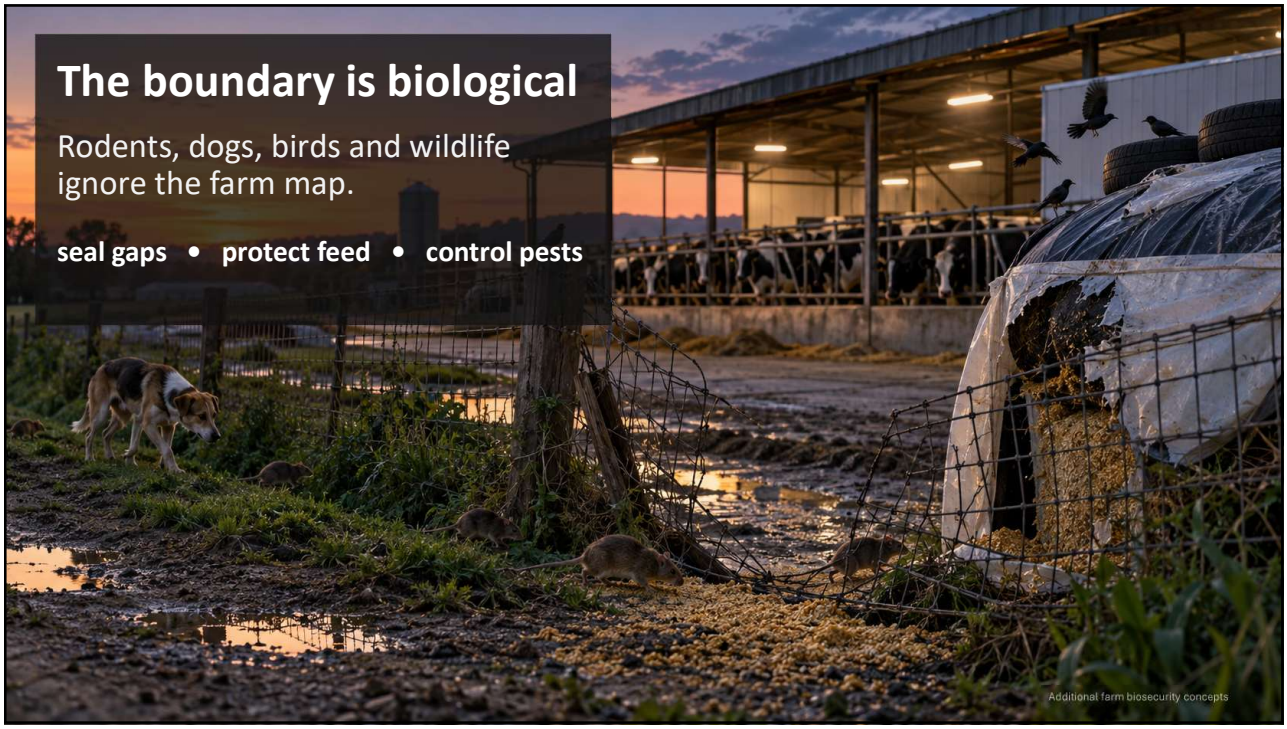
39


INTERNAL biosecurity = reduce spread
Animal Quarantine shed
Feed storage unit
Farm equipment storage unit
Entrance
Foot and vehicle tyres bath
Foot bath, hand wash and disinfectant facility
Milking parlour
Isolation and treatment unit
Parking area
Animal shed
Maternity pens
Manure collection place

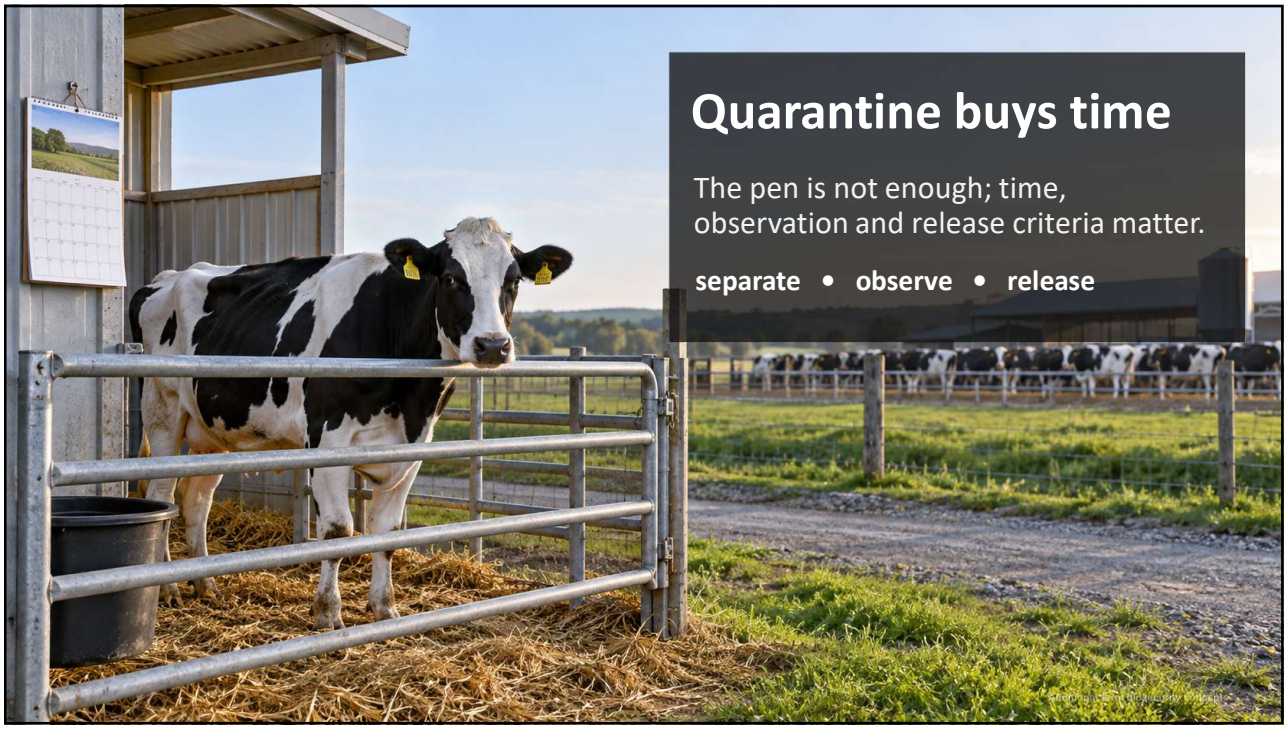
40


Farm gate = risk filter
Not every visitor, vehicle or object should enter the same way.
single gate • entry log • pre-entry check

41


The boundary is biological
Rodents, dogs, birds and wildlife ignore the farm map.
seal gaps • protect feed • control pests
Additional farm biosecurity concepts

42


Quarantine buys time
The pen is not enough; time, observation and release criteria matter.
separate • observe • release

43


Design movement before movement happens
Separate routine flows so high-frequency contacts do not become high-risk contacts.
one-way routes • parking outside • no cross-over

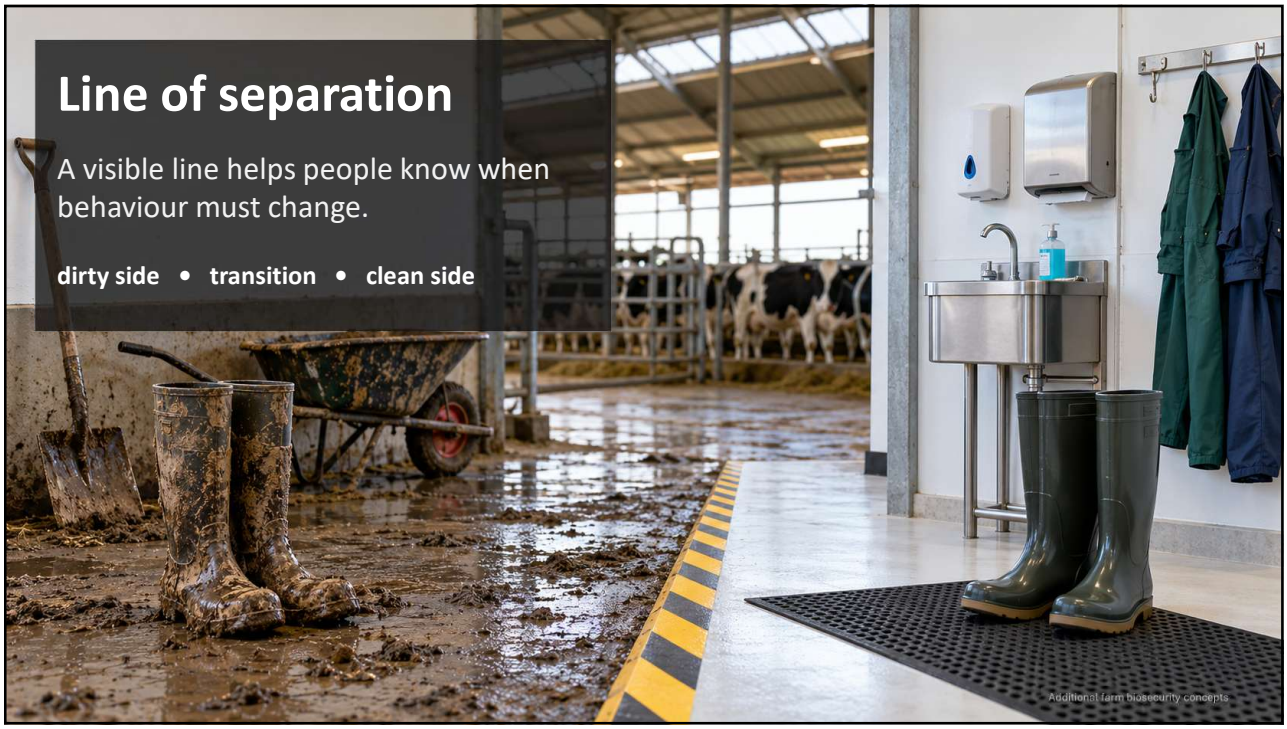
44


Different people, different rules
Farmer, veterinarian, visitor and driver do not carry the same risk.
access tiers • role-specific PPE • restricted zones

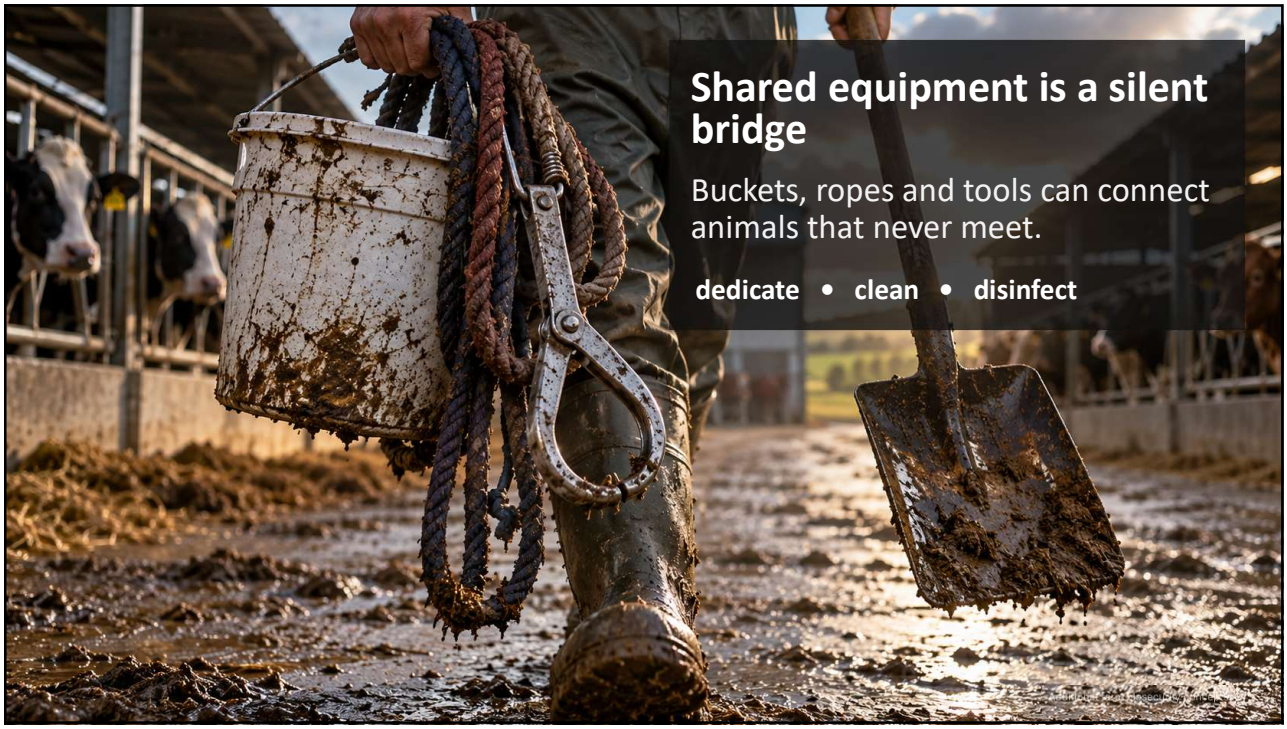
45


High-risk moments need special rules
Calving, abortion and sick-animal care are not ordinary routines.
gloves • separate pen • safe disposal
Additional farm biosecurity concepts

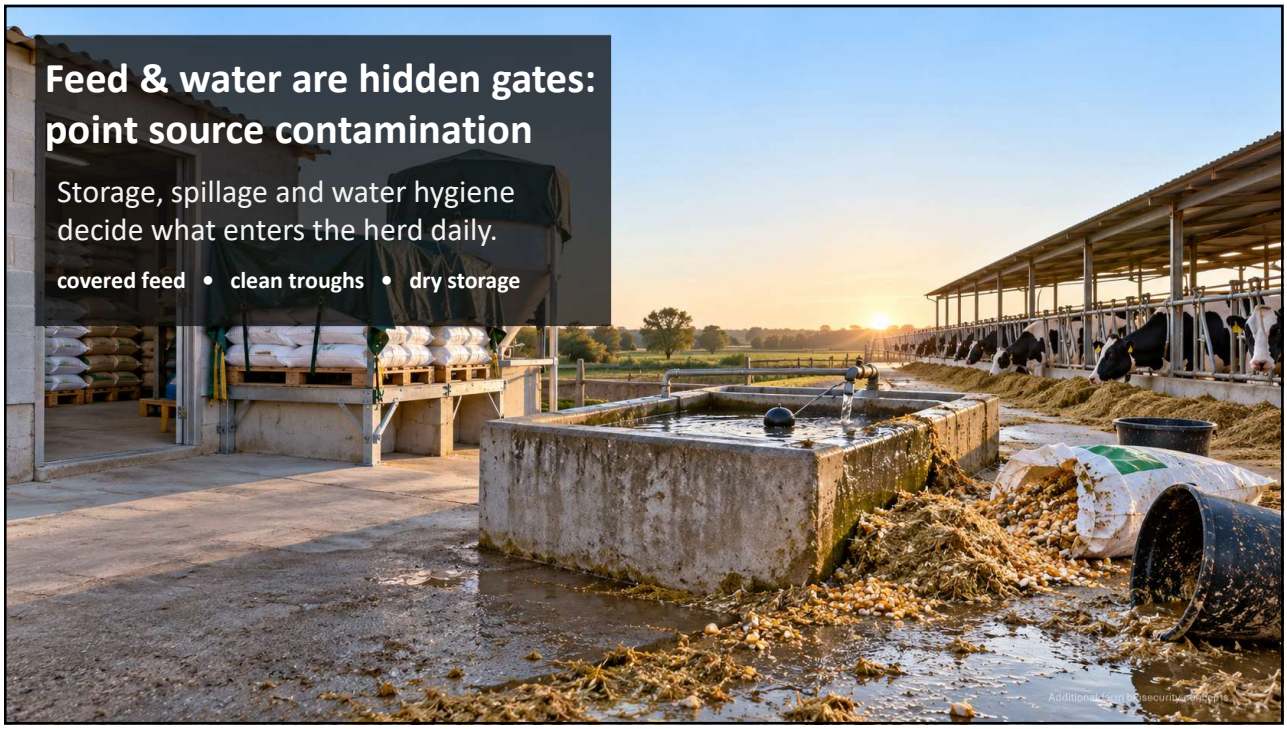
46


Line of separation
A visible line helps people know when behaviour must change.
dirty side • transition • clean side
Additional farm biosecurity concepts

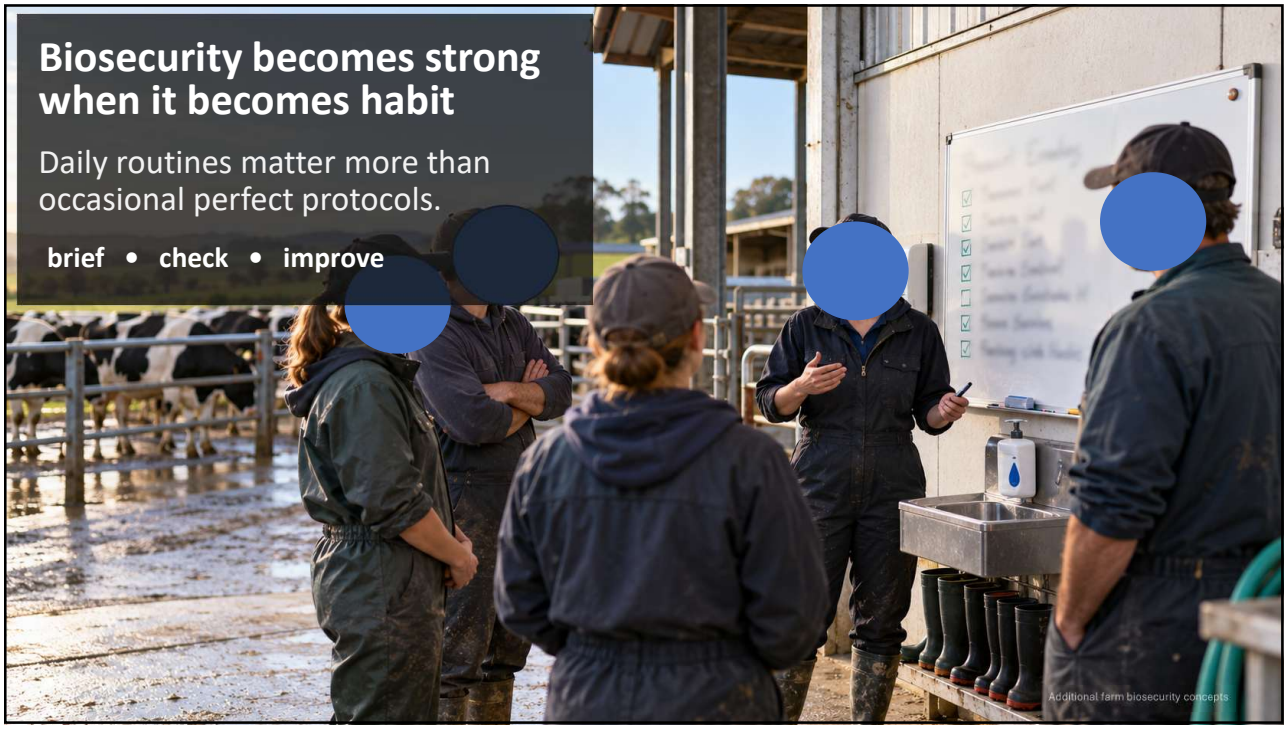
47


Shared equipment is a silent bridge
Buckets, ropes and tools can connect animals that never meet.
dedicate • clean • disinfect

48


Feed & water are hidden gates: point source contamination
Storage, spillage and water hygiene decide what enters the herd daily.
covered feed • clean troughs • dry storage

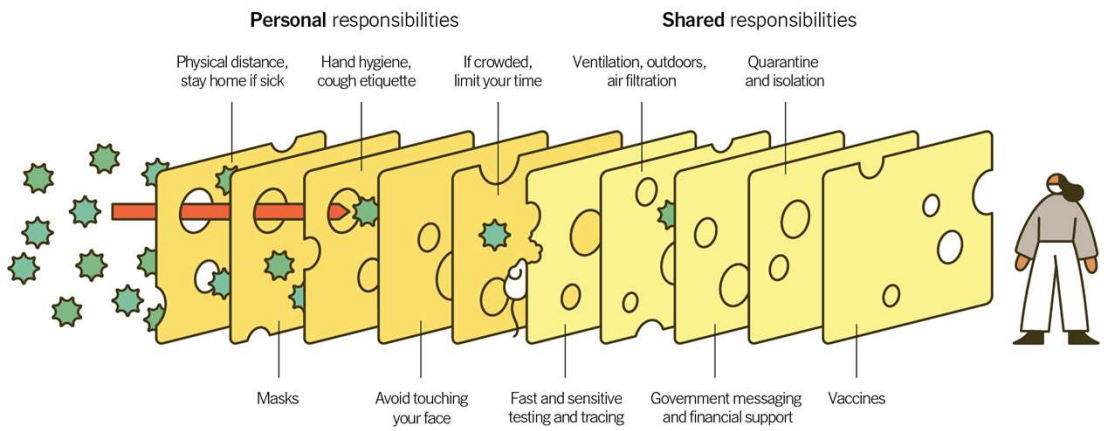
49


Biosecurity becomes strong when it becomes habit
Daily routines matter more than occasional perfect protocols.
brief • check • improve
Additional farm biosecurity concepts

50

Thumb Rule: Multiple Layers Improve Success

Swiss Cheese Respiratory Pandemic Defence Model



Source: Adapted from Ian M. Mackay (virologydownunder.com) and James T. Reason. Illustration by Rose Wong

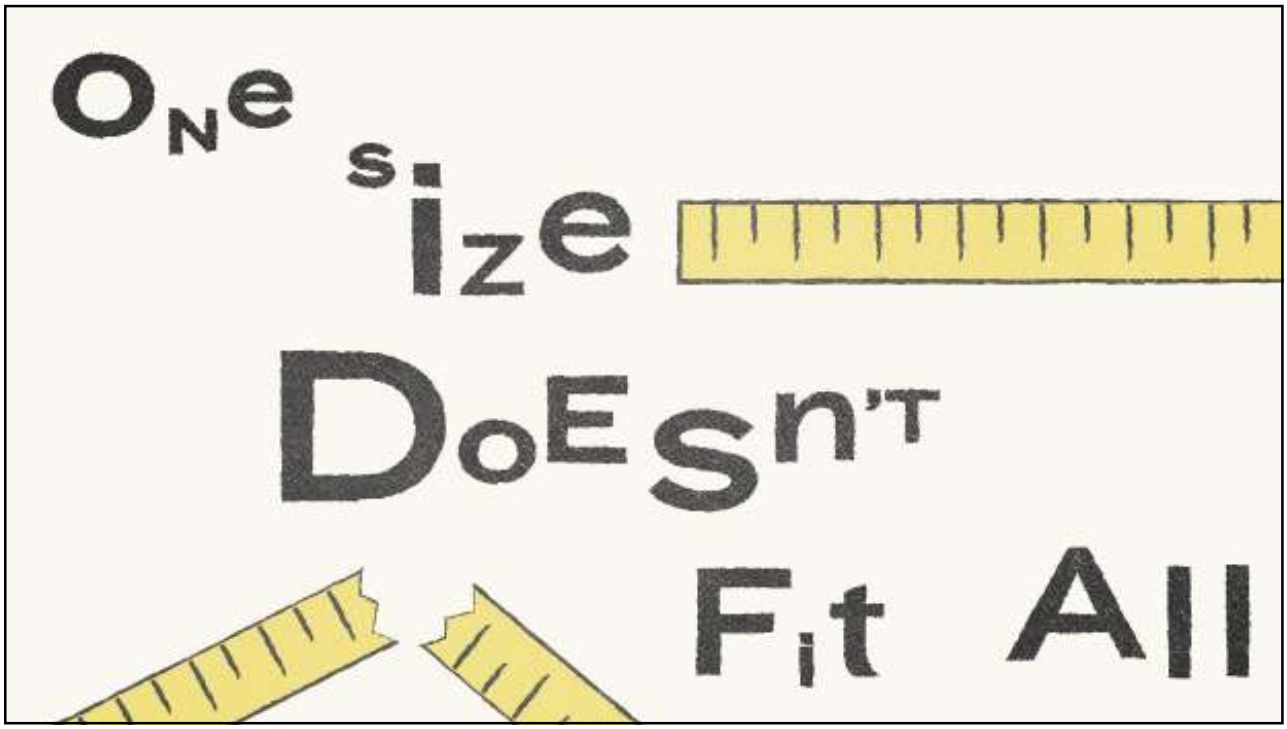
51

Most valuable control is often **not** the **most expensive one;**

it is the control placed at the highest-risk pathway and performed reliably.



52



53

Drafting a farm biosecurity protocol….

It involves BIOLOGY, SCOIOLOGY, ECONOMICS & POLICIES..!!

- **Analyze**
- **Explain**
- **Propose**
- **Set** (needs a positive final decision of the farmer (Investment/Change).



54


Biosecurity….
Preventive measures
Combinations of actions
On different level
This Photo by Unknown Author is licensed under CC BY-SA-NC

55


Different levels…..
Very different farm facilities
Small/medium/large, old, new, expanding, multispecies, high-density area…
Very different business priorities
Level of production, bank loans, plans for the future?
Very different personalities of the farmers
Shy, aggressive, proactive, traditional..

56

Development of dairy farm biosecurity scoring system

57

Development of dairy farm biosecurity scoring system

Cross-sectional survey for biosecurity scoring of farms

- Literature review on Animal Biosecurity Practices
- Discussions with animal health experts (n=06)
- Formation of initial draft: **63 parameters**
- 2nd FGD with animal health experts (n=8): **58 parameters**
- Key person interviews/discussion from Vet. University experts of GADVASU
- Validation from field experts
  - SMS, KVK (05)
  - Punjab Veterinary Officers (10)
- **Final draft: 53 parameters**

58

Development of Biosecurity Scoring System for Dairy Farms of Punjab, India

Pankaj Dhaka[1*], Manmeet Singh[1], J.S. Bedi[1], B.B. Singh[1], R.S. Aulakh[1], Jaswinder Singh[2] and J.P.S. Gill[1]

[1] Centre for One Health, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India-141004

[2] Department of Veterinary and Animal Husbandry Extension Education, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India-141004

ISBD

Abstract

The current study was planned to develop a biosecurity scoring system to quantitatively assess the biosecurity levels in dairy farms of Punjab. A literature review was carried out to assess the farm biosecurity parameters. The selected parameters were discussed with animal health experts (n=6) through focus group discussion (FGD). The initial draft of the scoring system was formulated with 63 parameters on external and internal biosecurity. Each of the parameter(s) was evaluated for *expected efficacy, feasibility,* and *economics* on a *5-level Likert scale (very low, low, neutral, high, very high)* in context with *small (<10 animals), medium (10-50 animals),* and *large farms (>50 animals).* The proportionate scoring was carried out against the cumulative score for each parameter to make the scoring system out of 100 for each farm category. A second FGD was carried out with the animal health experts (n=8) of Punjab, which resulted in agreement on 58 parameters. Later, the discussion on each parameter and its relative scoring was carried out with the academic experts of GADVASU (n=10), leading to the formulation of the final draft with 53 key parameters (19 external and 34 internal biosecurity parameters). The final draft was validated by field experts (n=05) and field veterinarians (n=10) to assess its duration, clarity, and technical strength. The external biosecurity parameters were broadly classified under prevention of incursion of pathogens with animals and fomites (n=12), limiting access to the farms (n=3), and prevention of incursion of infection sources (n=4). The internal biosecurity parameters were classified under prevention of within farm spread of pathogens (n=24) and maintenance of preparedness (n=10). This scoring system can be used for mapping out the dairy farm biosecurity status, and will help in the improvement of existing loopholes in farm biosecurity.

Introduction

"Healthy animals secure better livelihoods, ensure food safety, and maintain equal access to food for all"



Why Farm Biosecurity is Important?

- To improve the farm productivity
- To obtain farm stability
- To improve quality and safety of farm products
- To reduce the risk of zoonotic infections
- To improve animal welfare
- To reduce antimicrobial usage and resistance

"Remember that the biosecurity chain remains as strong as the weakest link"

Materials and Methods



Literature review on Animal Biosecurity Practices

↓

Focus Group Discussion (FGD) with animal health experts (n=06)



↓

Initial draft: 63 parameters

↓

2nd FGD with animal health experts (n=08): 58 parameters

↓



Key person interviews/discussion with the academicians of GADVASU

(04 VPH, 02 LPM, 02 Vet Extn., 01 Nutrition, 01 Dairy economics)

↓

Validation from field experts [SMS, KVK (n=05), Veterinary Officers (10)]

↓

Final draft: 53 parameters (19 external & 34 internal biosecurity)

Results

Scoring method: For each measure, we considered the expected efficacy in disease prevention, expected feasibility and expected economics [return on investment] on 5-level Likert scale (very low, low, neutral, high, very high). To each level of the Likert scale, we attributed a score of 1, 2 3 4 and 5 for the levels very low, low, neutral, high and very high, respectively

Biosecurity Parameters	Small farms (<10 animals)				Medium farms (10-50 animals)				Large farms (> 50 animals)			
	Eff.	Fe.	Eco.	R. Pt.	Eff.	Fe.	Eco.	R. Pt.	Eff.	Fe.	Eco.	R. Pt.
EXTERNAL BIOSECURITY (Bio-exclusion)												
Prevention of incursion of pathogens with animals and fomites												
1. Provision of quarantine facilities of animals when introducing into farm (at least 4 weeks)	5	3	2	1.91	5	4	4	2.11	5	5	5	2.26
2. Proper farm fencing with regular inspection to prevent the livestock from mingling or straying	5	3	2	1.91	5	4	4	2.11	5	5	5	2.26
3. Separate provision for the parking of farm or visitor's vehicles away from the main operational farm area	5	2	3	1.91	5	4	4	2.11	5	5	5	2.26
4. Disinfection of all vehicles before entering the farm premises	3	1	2	1.15	3	4	4	1.79	5	5	4	2.11
5. Provision of cleaning and disinfection facilities for hands/shoes of farm workers/visitors at entry points	5	4	4	2.49	5	5	5	2.44	5	5	5	2.26
6. Disinfection of materials and equipment directly used for animals when carried into hygiene control area	5	4	3	2.29	5	5	5	2.44	5	5	5	2.26
7. No contact with animals of other farms (including any contact during animal fair or contact during grazing)	5	4	4	2.49	5	4	4	2.11	5	4	4	1.96
8. Testing of animals for endemic diseases (e.g., brucellosis, tuberculosis, hemoprotozoans) during purchase	5	1	1	1.34	5	2	1	1.30	5	2	2	1.36
9. Testing of milk sample of newly introduced cows for mastitis	5	2	2	1.72	5	4	4	2.11	5	4	4	1.96
10. Screening of bull's semen for sexually transmitted diseases where natural insemination is practiced	5	2	1	1.53	5	2	1	1.30	5	2	2	1.36
11. Restrict the access of animals to natural water bodies (e.g. ponds) of unknown hygienic status	5	3	4	2.29	5	4	4	2.11	5	5	5	2.26
12. Avoid manure from other farms being spread within a 500-meters radius of your farm/ pastures	5	2	2	1.72	5	2	2	1.46	5	2	2	1.36
Limiting access to the farm												
13. Placing of sign boards to inform visitors about the biosecurity requirements and protocols	4	3	3	1.91	4	5	5	2.27	4	5	5	2.11
14. Hygiene lock (designated changing room for workers/visitors) available before entering the animal shed	4	1	1	1.15	4	3	2	1.46	4	4	3	1.66
15. Segregation of hygiene control area (e.g., milking & feed storage) from other areas with proper signboard	5	3	3	2.10	5	5	5	2.44	5	5	5	2.26
Prevention of incursion of infection sources												
16. Prevention of birds or animal feces entering to feeding and water facilities of the farm	5	3	2	1.91	5	4	2	1.79	5	4	4	1.96
17. Installment of systematic plan for rodent control	5	2	2	1.72	5	3	3	1.79	5	3	3	1.66
18. Installment of systematic plan for control of ectoparasites (e.g., ticks)	5	4	4	2.49	5	4	4	2.11	5	4	4	1.96
19. Installment of systematic plan for control of insect (e.g., mosquitoes and flies)	5	2	2	1.72	5	3	3	1.79	5	3	3	1.66
INTERNAL BIOSECURITY (Bio-management)												
Prevention of within-farm spread of pathogens												
1. Strict working lines (starting with healthy animals & handling sick animals at last) during farm operations	5	4	4	2.49	5	4	4	2.11	5	5	5	2.26
2. Provision of isolation pen for sick animals with facilities of separate equipment (e.g. buckets, utensils etc.)	5	4	4	2.49	5	5	4	2.27	5	5	5	2.26
3. Separate milking of diseased animals (including mastitis) after the healthy animals in the farm	5	4	4	2.49	5	4	4	2.11	5	5	5	2.26
4. Animals of different age groups are strictly separated in different compartments in the farm	5	2	2	1.72	5	3	3	1.79	5	4	4	1.96
5. Proper disposal or disinfection of materials to which body fluid of animals (esp. sick animals) got attached	5	4	3	2.29	5	5	5	2.44	5	5	5	2.26
6. Cleaning and disinfection of manger and waterer on regular basis	5	4	4	2.49	5	5	4	2.27	5	5	5	2.26
7. Availability of separate and dedicated parturition box (or exclusive calving area) at farm	5	2	2	1.72	5	3	3	1.79	5	5	5	2.26
8. Rearing animals with suitable density (optimal floor space allocation (open and close space))	4	2	2	1.53	4	2	2	1.30	4	2	2	1.21
9. In case of mixed species farming, adequate facilities of separate housing of different animal species	5	2	2	1.72	5	3	3	1.79	5	4	3	1.81
10. No pets (e.g., dogs and cats) should be allowed in the animal shed	5	2	3	1.91	5	3	4	1.95	5	3	4	1.81
11. All used equipment should be shed specific	5	2	2	1.72	5	3	4	1.79	5	4	4	1.96
12. If borrowed or lend, equipment to be cleaned and disinfect before and after use	5	4	4	2.49	5	4	4	2.11	5	5	5	2.26
13. Stockbreed inspection to ensure its quality (e.g., free from pest damage, mycotoxins & visual contaminants)	5	2	3	1.91	5	3	3	1.79	5	5	3	1.96
14. Proper storage of feed to prevent contamination by mycotoxins, vermin, livestock, wildlife & feral animals	5	2	2	1.72	5	3	3	1.79	5	4	4	1.96
15. Use sperate utensils for feed & farm waste (i.e., no double use of same utensil for feed & waste handling)	5	4	2	2.10	5	4	3	1.95	5	4	3	1.81
16. Provision of clean drinking water for animals	5	2	2	1.72	5	4	3	1.79	5	3	3	1.66
17. Cleaning and disinfection of cow's hindquarters (including the udder) before each calving	5	3	3	2.10	5	4	3	1.95	5	4	3	1.81
18. Testing of cattle after abortion for possible infectious causes	5	2	2	1.72	5	2	2	1.46	5	2	2	1.36
19. Chemical & microbiological analysis of drinking water (at source & end of drinking line) at least once a year	5	2	2	1.72	5	3	3	1.79	5	3	3	1.66
20. Provision of separate space to place the dead animal in the farm and proper disposal of dead animal	5	4	4	2.49	5	4	4	2.11	5	4	4	1.96
21. Proper handling of carcass with gloves, and disinfect all the materials used for manipulation of carcasses	5	4	4	2.49	5	5	5	2.44	5	5	5	2.26
22. Facilities for proper effluent dispersal to minimize pathogen spread in environment	5	1	1	1.34	5	2	2	1.46	5	2	2	1.36
23. Containment of household-garbage areas to prevent access by vermin, livestock, feral animals & wildlife	5	2	2	1.72	5	3	3	1.79	5	4	4	1.96
24. The farm employees should not be allowed to work on other farms	3	1	1	0.96	3	1	1	0.81	3	1	1	0.75
Maintenance of preparedness												
25. Collecting up-to-date information on prevention of animal infectious diseases	5	2	2	1.72	5	4	4	2.11	5	4	4	1.96
26. Daily health check of animals (basic physiological parameters)	5	2	2	1.72	5	3	3	1.79	5	4	4	1.96
27. Immediate report of specific symptoms to the veterinary officer and restriction of animal movement	5	1	1	1.34	5	2	2	1.46	5	2	2	1.36
28. Proper transport facilities to minimize potential welfare issues, disease and/or contamination spread	5	2	2	1.72	5	3	3	1.79	5	3	3	1.66
29. Periodic training on farm hygiene, including use of protective clothing and personal cleanliness	5	1	1	1.34	5	3	3	1.79	5	4	4	1.96
30. Written protocols/SOPs for farm hygiene procedures	4	2	2	1.53	4	3	3	1.62	4	4	4	1.81
31. Record keeping (including, movement of visitors and vehicles) for early identification of source of infection	4	2	2	1.53	4	4	3	1.79	4	4	3	1.66
32. Written protocols for vaccination, deworming and disease treatment records	4	3	3	1.91	4	4	4	1.95	4	5	4	1.96
33. Maintenance of health record of workers including vaccination	4	3	3	1.91	4	4	3	1.79	4	4	3	1.66
34. Contact details of local vet(s) and govt. animal health officer(s) should be available in farm	4	5	4	2.49	4	5	4	2.11	4	5	4	1.96

Concluding remark: The developed scoring system can be used for mapping out the dairy farm biosecurity status, and will help in the improvement of the existing loopholes in farm biosecurity of Punjab.

Acknowledgement: This study has been carried out under RKVY project entitled "Development of Strategies for Biosecurity Measures to Curtail Important Zoonotic diseases in Punjab, India"

59

Biosecurity scoring system……. Overall scores

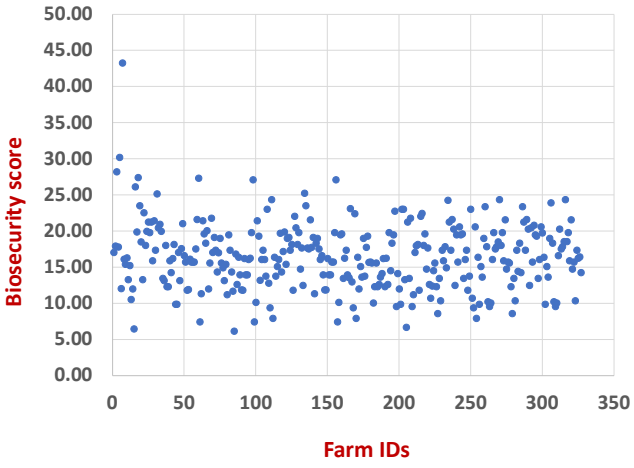
Page 1 of 4

Checklist for the development of basic farm biosecurity management protocols

Scoring method: For each measure, you need to consider the **expected efficacy** in disease prevention, the **expected feasibility** and the **expected economics** [return on investment] on a **5-level Likert scale (very low, low, neutral, high, very high).** To each level of the Likert scale, you need to attribute a score of **1, 2 3 4** and **5 for the levels very low, low, neutral, high and very high,** respectively.

	Small household farms (<10 animals)			Medium farms (10-50 animals)			Large commercial farms (> 50 animals)		
	Efficacy	Feasibility	Economics	Efficacy	Feasibility	Economics	Efficacy	Feasibility	Economics
EXTERNAL BIOSECURITY (Bio-exclusion)									
Preventing incursion with animals and fomites									
1. Provision of quarantine facilities of animals when introducing into farm (at least 4 weeks)	5	3	2	5	4	4	5	5	5
2. Proper farm fencing with regular inspection and adequate maintenance to prevent the livestock from mingling or straying	5	3	2	5	4	4	5	5	5
3. Separate provision for the parking of farm or visitor's vehicles away from the main operational farm area	5	2	3	5	4	4	5	5	5
4. Disinfection of all vehicles before entering the farm premises	3	1	2	3	4	4	5	5	4
5. Provision of cleaning and disinfection facilities for hands and shoes of farm workers and visitors at entering points of farm compartments	5	4	4	5	5	5	5	5	5
6. Cleaning or disinfection of materials and equipment directly used for animals when carried into hygiene control area	5	4	3	5	5	5	5	5	5
7. No contact with animals of other farms (including any contact during animal fair or pasture contact during grazing)	5	4	4	5	4	4	5	4	4
8. Provision of testing of animals for endemic diseases (e.g., brucellosis, tuberculosis, hemoprotozoan infections) during purchase	5	1	1	5	2	1	5	2	2
9. Testing of milk sample of newly introduced cows for mastitis	5	2	2	5	4	4	5	4	4
10. Screening of bull's semen for sexually transmitted diseases where natural insemination is practiced	5	2	1	5	2	1	5	2	2

Project: Development of Strategies for Biosecurity Measures to Curtail Important Zoonotic diseases in Punjab, India
Funding Agency: Rashtriya Krishi Vikas Yojana (RKVY), India

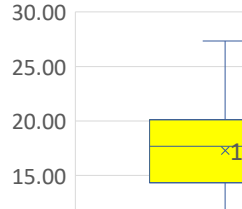


Survey of 327 diary farms across Punjab

60

Biosecurity scoring of **small farms** (<10 animals)

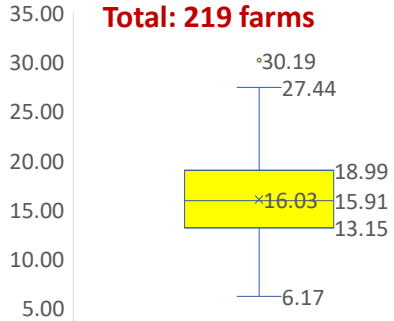
Total farms: 74





Biosecurity scoring of **medium farms** (10-50 animals)

Total: 219 farms

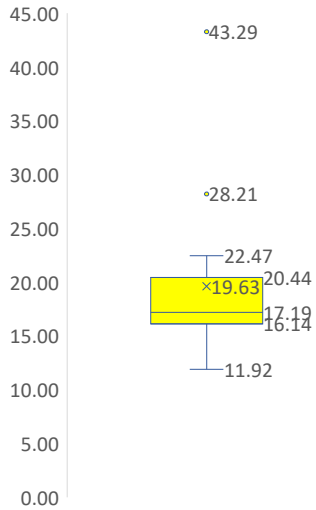






Biosecurity scoring of **large farms** (>50 animals)

Total: 34 farms



61

animals

MDPI

Article

Situation Analysis and Recommendations for the Biosecurity Status of Dairy Farms in Punjab, India: A Cross-Sectional Survey

Pankaj Dhaka [1,2,*], Ilias Chantziaras [1], Deepthi Vijay [2,3], Manmeet Singh [2], Jasbir Singh Bedi [2], Nele Caekebeke [1] and Jeroen Dewulf [1]

[1] Veterinary Epidemiology Unit, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium; ilias.chantziaras@ugent.be (I.C.); nele.caekebeke@biocheckgent.com (N.C.); jeroen.dewulf@ugent.be (J.D.)

[2] Centre for One Health, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana 141004, India; deepthivijay@kvasu.ac.in (D.V.); meet.mehn@gmail.com (M.S.); bedijasbir78@gmail.com (J.S.B.)

[3] Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur 680651, India

* Correspondence: pankaj.dhaka2@gmail.com; Tel.: +91-7983-816-228

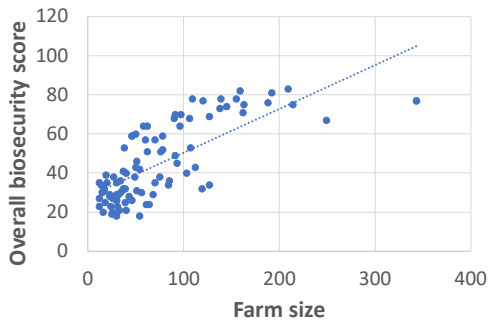
62

Biosecurity scores of the study farms and comparison with the global mean scores

Biosecurity Parameter	Mean (%) (n=94)	Global Mean (%) (n = 1848)
Total external biosecurity score	**45.4**	**67**
(a) Purchase and reproduction	30.6	78
(b) Transport and carcass removal	52.9	47
(c) Feed and water	61	59
(d) Visitors and farmworkers	47.6	70
(e) Vermin control and other animals	63	62
Total internal biosecurity score	**43.7**	**37**
(a) Health management	33.6	31
(b) Calving management	42.4	31
(c) Calf management	41.6	43
(d) Dairy management	55.1	47
(e) Adult cattle management	76.6	40
(f) Working organization and equipment	41.9	38
Overall biosecurity score	**44.8**	**52**

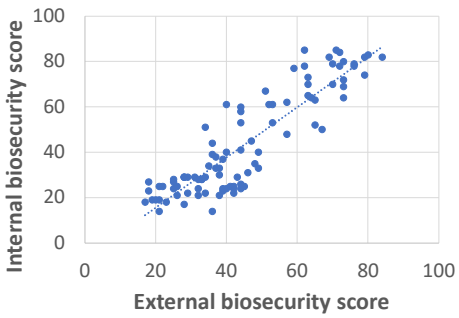
63

Scatter plot between farm size and overall biosecurity scores



Positive correlation

Scatter plot between external and internal biosecurity scores



Positive correlation

64

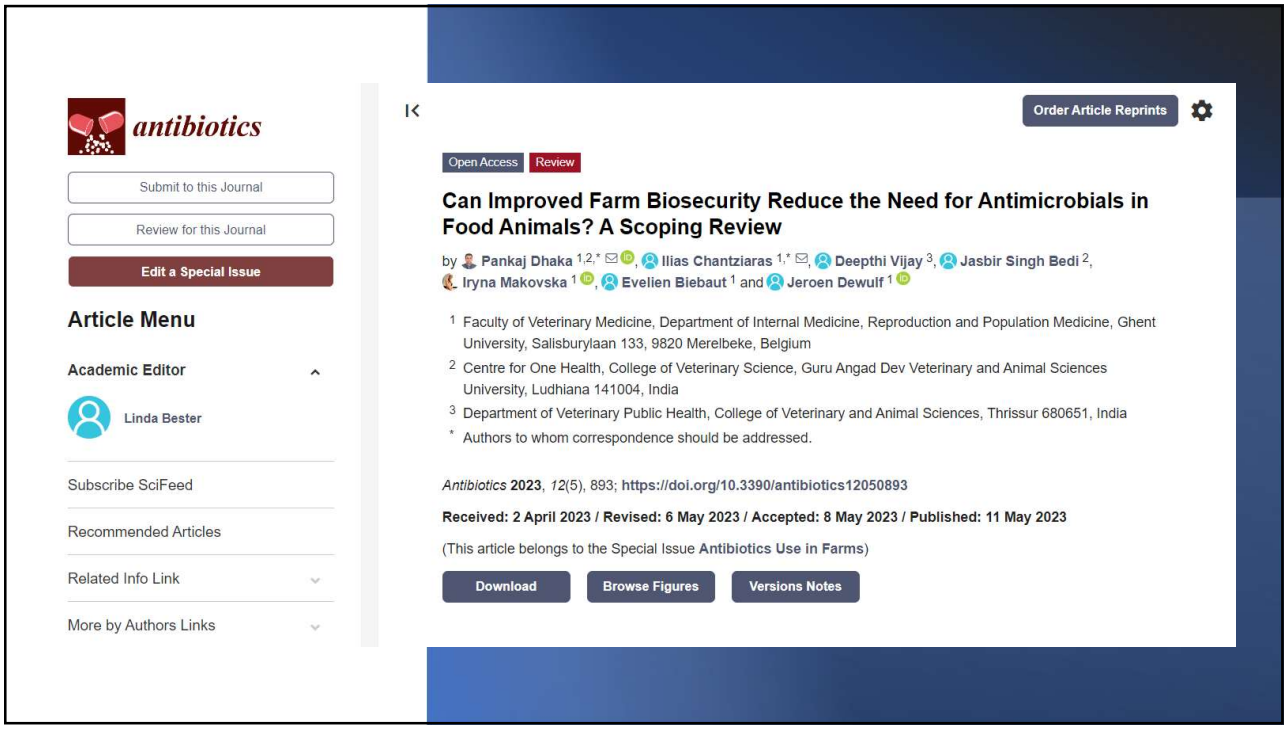
Take away points

- **Educate farmers about the long-term benefits of biosecurity, such as improved farm productivity and enhanced animal health.**
- **Study identifies areas for improvement,** including quarantine protocols; proper disposal of carcasses & placenta; use of compartment-specific equipment, clothing & boots; insect, bird, and rodent control measures, and emphasis on calf management.
- **Consider the socio-cultural values of the local community when designing policies and interventions.**
- **Policymakers and institutions should promote awareness and compliance through education and incentives.**

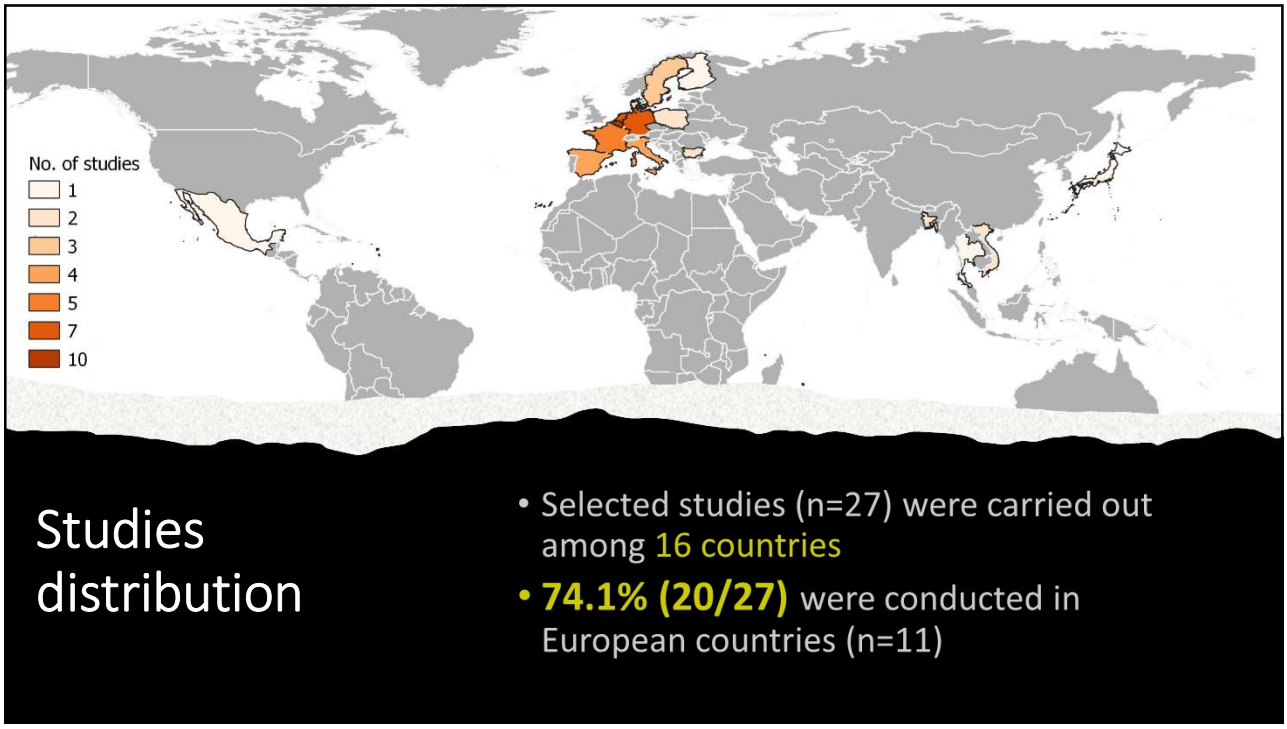
65



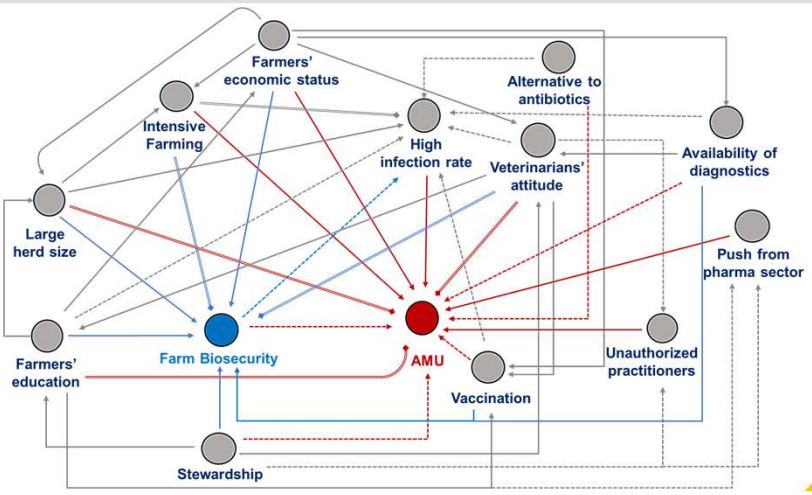
66


antibiotics
Submit to this Journal
Review for this Journal
Edit a Special Issue
Article Menu
Academic Editor
Linda Bester
Subscribe SciFeed
Recommended Articles
Related Info Link
More by Authors Links
Order Article Reprints
Open Access
Review
Can Improved Farm Biosecurity Reduce the Need for Antimicrobials in Food Animals? A Scoping Review
by Pankaj Dhaka 1,2,* , Ilias Chantziaras 1,* , Deepthi Vijay 3, Jasbir Singh Bedi 2, Iryna Makovska 1, Evelien Biebaut 1 and Jeroen Dewulf 1
1 Faculty of Veterinary Medicine, Department of Internal Medicine, Reproduction and Population Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium
2 Centre for One Health, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana 141004, India
3 Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Thrissur 680651, India
* Authors to whom correspondence should be addressed.
Antibiotics 2023, 12(5), 893; https://doi.org/10.3390/antibiotics12050893
Received: 2 April 2023 / Revised: 6 May 2023 / Accepted: 8 May 2023 / Published: 11 May 2023
(This article belongs to the Special Issue Antibiotics Use in Farms)
Download
Browse Figures
Versions Notes

67


No. of studies
1
2
3
4
5
7
10
Studies distribution
• Selected studies (n=27) were carried out among 16 countries
• 74.1% (20/27) were conducted in European countries (n=11)

68



Hypothesized causal diagram illustrating the associations between farm biosecurity (or management) factors and AMU
Red lines (→ or ⇢ or ⇒) indicate direct association with AMU, blue lines (→ or ⇢ or ⇒) indicate direct association with farm biosecurity, and grey lines (→ or ⇢ or ⇒) denotes possible indirect interactions between factors. Solid arrow (→ or → or →) represent increase effects of the factor, dotted arrow (⇢ or ⇢ or ⇢) represent decrease effect, and double-lined rhombus end arrow (⇒ or ⇒ or ⇒) indicate factors with both (increase or decrease) potential effects depending on context.

69

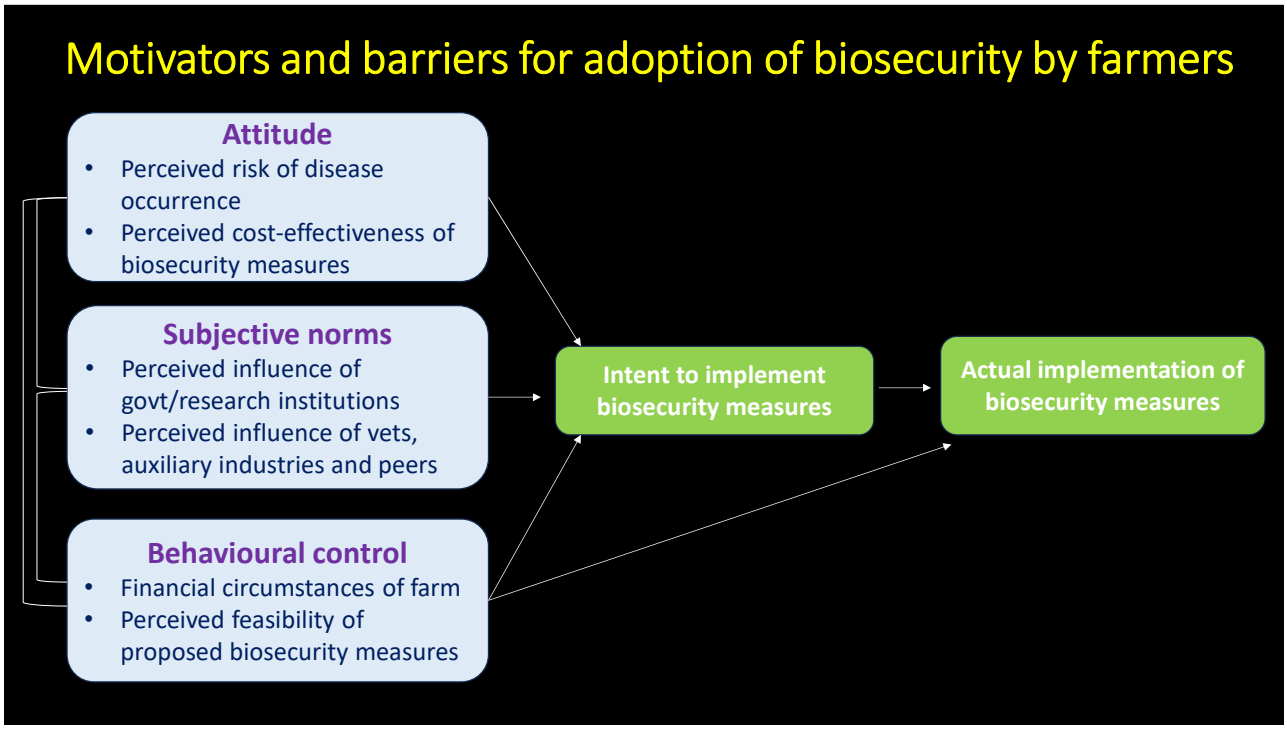
Association between farm biosecurity and AMU

- **51.8% (14/27) studies**
  ↑ farm biosecurity : ↓ AMU
- **18.5% (5/27) studies**
  ↑ farm management : ↓ AMU
- **2 studies**
  ↑ coaching & awareness: ↓ AMU
- **1 study**
  ↑ biosecurity : ↓ AMU : ↑ farm economics

5 studies: farm biosecurity & AMU → Uncertain or spurious association

70

Motivators and barriers for adoption of biosecurity by farmers



71



72