Three critical points for quick ASFV elimination:

Implications of mathematical model innovation

快速实现群体非瘟净化的三个关键问题:

数学模型创新的启示

Zhichun Jason YAN

CSSC, 2025-09

提纲 Outlines

- 应对ASF疫情的控制实践与方法演进

Evolution of ASF control practice and methodology

- “连续-离散”数学模型的推导

Derivation of a `discrete-continuum` mathematical model

- 数学模型的实用意义

Implications by a mathematical model: critical control points for ASF elimination by `whole herd testing and precise removal` strategy

非瘟预防、控制、清除的**新**情况
母猪场/自育肥场出现疫情、效果不好的
New situation of ASF prevention, control, and elimination in sow farms/self fatting farms with poor results

- **人员和团队**已经出现新变化！
  - 就某一公司，大多已经物是人非。
  - 现场新员工很多**不熟悉原已成功的有关技术和方法**
  - 此前积累的成功经验，没能很好传承！
- 前期市场低迷等原因，既定的生物安全方案`调整了`
  - 流程形式化；流程疲劳
  - 领导觉得`都一样`
- 畏难情绪蔓延
  - 弱毒感染后母猪场尽快大量清群，育肥场带D生产…
- **缺乏坚实的群体数学理论指导**

- **New changes have taken place in the personnel and team!**
  - For a company, most things have changed.
  - Many new employees on the site are not familiar with the original successful techniques and methods
  - The accumulated successful experience was not well passed on!
- Due to the downturn in the early market, the established biosecurity plan has been ` adjusted `
  - Process formalization; process fatigue
  - Leaders think ` are all the same `
- Fear spreads
  - After weak drug infection, the sow farm should be cleared as soon as possible, and the fattening farm should be brought with D production...
- **Lack of solid group mathematical theory guidance**

1

我国防控非洲猪瘟疫情策略的演进

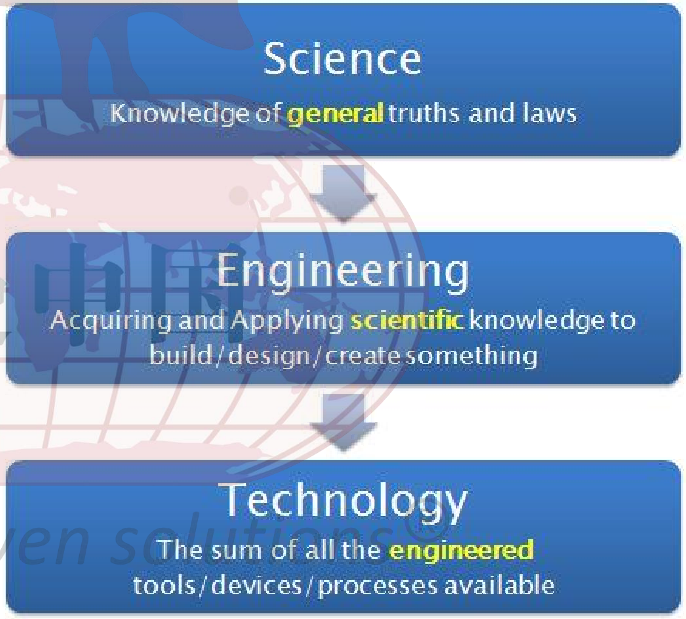
Evolution of epidemic prevention and control strategies for African swine fever in China

防控ASF疫情的差距，是科学原理还是工程技术问题？
Is the gap in the prevention and control of ASF a matter of science or engineering?

- 非洲猪瘟防控，与其他猪群健康管理问题一样：为什么有时防控成功，有时没有解决好是因为

Why a heal issue did not solve right?

- 1/ 不知道**科学**原理？Not have scientific knowledge?
- 2/ 没有开发出相应的**工程工具**？Not handle correct tools?
- 3/ 没有形成成套**技术**？
- 4/ 没有将正确的技术和方法**管理**落地？Not managed execution?
- 5/ 都知道，但受限于企业**经营**状况？Limite by company resources?



科学Science
对真理和规律的知识掌握
Knowledge of truth and law

工程 Engineering
获取并应用科学知识，
Acquire and apply scientific knowledge,
设计研发出方法和工具
Design and develop methods and tools

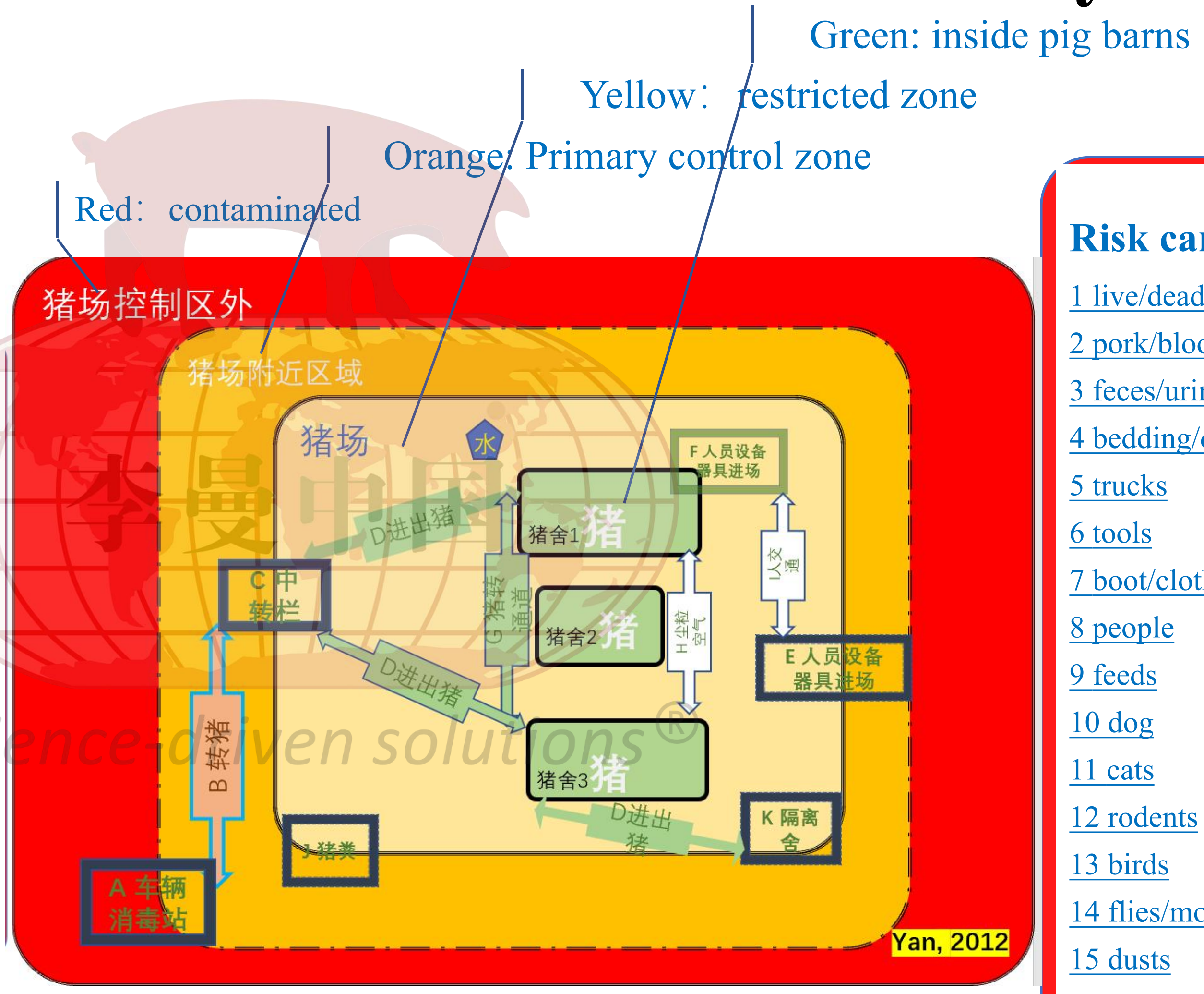
技术Technology
将工程工具/仪器/方法整合
Integration of engineering tools/instruments/methods

RISHABH DEV, 2023

生物安全体系：长城-通行证-守卫理论

Biosecurity System: Great Wall – Pass – Guard theory

- 猪总是在农场的绿地里。
- Pigs always in Green area on a farm.
- **实施Implementation**
  1. Categorize zones 对区域进行分类
  2. Define zone borders 定义区域边界
  3. Setup Passes 设置通过
  4. Deter carriers 威慑载体



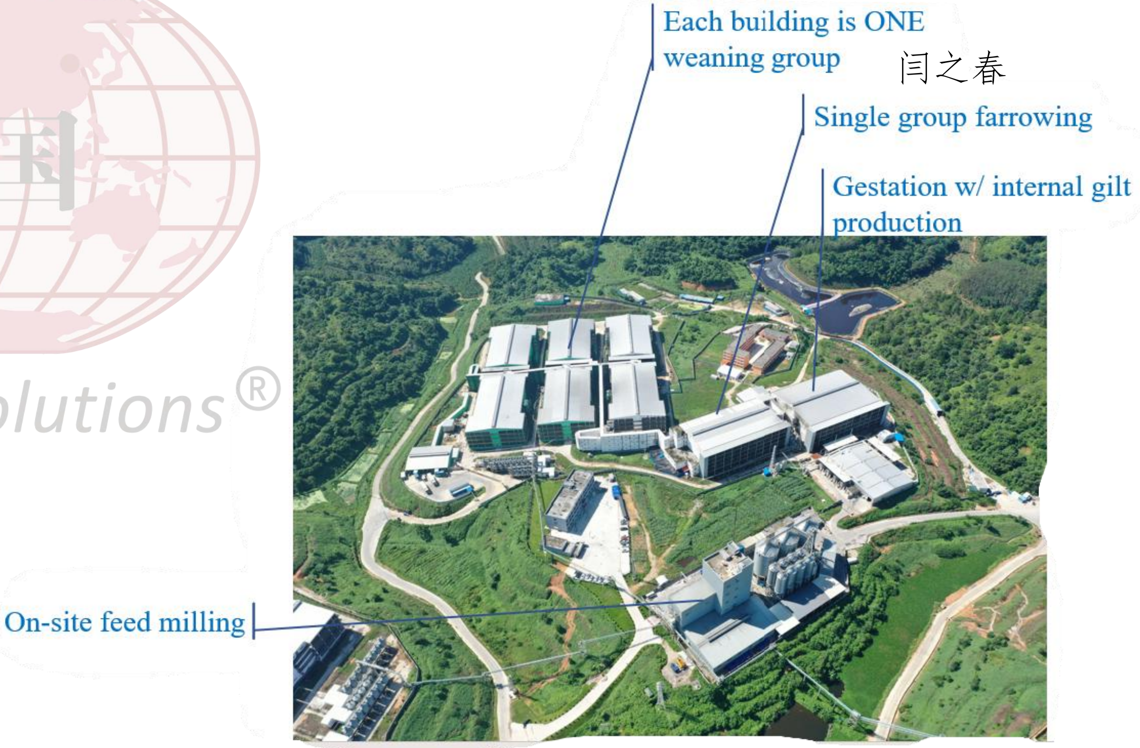
Risk carriers:

1 live/dead pigs
2 pork/blood/semen
3 feces/urine/body fluids
4 bedding/drinking water
5 trucks
6 tools
7 boot/clothes
8 people
9 feeds
10 dog
11 cats
12 rodents
13 birds
14 flies/mosquitoes/insects
15 dusts
16 aerosol

ASF疫情后，我国业者广泛采用的工程技术措施 2/5
Engineering and technical measures widely adopted by Chinese industryers after ASF epidemic 2/5

养猪生产
工艺升级正当时
Welcome to the New Era of Pig Production
202010

- 2. 养猪工艺升级：猪场建设和生产流程工艺大改进、大创新，形成了防控非洲猪瘟疫情的中国特色。
- 2.Upgrading pig raising technology: The construction of pig farms and the process of production have been greatly improved and innovated, forming the Chinese characteristics of epidemic prevention and control of African swine fever.…
  - 减少猪只和物资中转环节，
  - Reduce the transfer of pigs and materials,
  - 建立**猪场内核心群**提供后备母猪；
  - Establish a core herd in the pig farm to provide gilts;
  - **大批次生产的新式一条龙**猪场；
  - A new one-stop pig farm with large batch production;
  - **全密闭和空气过滤**技术普及；
  - Full closure and air filtration technology popularization;
  - 大场小单元猪舍减少交叉转群；
  - Large field small unit pig barns reduce cross transfer;
  - …



猪群不能与非瘟病毒共存
Pigs can not coexist with ASFV

- 生物安全措施即使防得住接触病毒和感染，但遗憾的是，如果已形成感染
- Biosecurity measures can prevent exposure to the virus and infection, but unfortunately, if an infection has developed
- 到目前为止，非洲猪瘟病毒对一个猪群，不是多和少的问题， 是有和无的问题！
- So far, the African swine fever virus to a herd, is not more or less, is yes and no!
  - 几乎**没有**非瘟病毒株可以与其长期、共存“带毒生产”
  - Few ASFV strains can coexist with them for a long time and "produce with the virus"
  - 多数情况下，与毒共存更加不经济In most cases, coexisting with poison is even less economical
- 面对检出感染的猪群，唯一正确的非瘟控制之道，仍然是快速清除病毒？
- In the face of infected swine, the only correct way to control ASF is still to quickly eliminate the virus?
  - 怎么能够在已经有感染猪只的群体，快速清除病毒？实现病毒净化？
  - How can we quickly eliminate the virus in a group that already has infected pigs and achieve viral eradication?

生物安全非常重要，但是生物安全**无法**清除已感染猪群的ASF病毒！

Biosecurity is very important, but biosecurity can not eliminate the ASF virus in infected swine herds!

清除已感染猪群病毒的工程技术措施创新
Innovative engineering technical measures to eliminate the virus in infected swine

- **“全面检测+精准剔除”**在众多企业的成功实践，消除了“非瘟病毒不能群内净化”、“检测会造成很多污染”、“物料人员普遍污染，清除后很快发病”等等认识。
- **The successful practice of "comprehensive detection + precision elimination" in many enterprises has eliminated the understanding that "ASFV can not be eradicated in the group", "testing will cause a lot of pollution", and "material personnel are generally contaminated and soon get sick after removal".**
- 使我国的养猪业，在非瘟流行期获得升级，猪肉供应得以保障。
- Chinas pig industry has been upgraded during the epidemic period, and the supply of pork has been guaranteed.

"全群检测结合精准清除"的策略和方法很有成效，但是是否有符合群体疾病控制净化流行病学的**科学原理？**
是否有反映群体内疫情的动态变化的**数学模型？**

The strategy and method of combining whole group testing with precise clearance is very effective, but is there a scientific principle that conforms to the purification epidemiology of group disease control? Is there a mathematical model that reflects the dynamic changes of the epidemic within a group?

2

“全群检测+精准清除”法 在已感染猪群中净化ASFV的数学模型：推导与应用启示"

Whole herd detection + precise clearance" method for eradication of ASFV in infected swine herd: derivation and application implications

“全群检测+精准清除”法 应用与已感染猪群ASFV净化：**时间**
Application of "Whole herd detection + precise removal" method and ASFV eradication in infected swine herd: time

- **隐形感染期** D：`群体内`的易感猪只从接触病毒，直至形成传染能力/可被采样检测出来的期间天数
- **Hidden infection period D: `The number of days from exposure to the virus to the formation of infectious capacity/ detectable by sampling in a `group of susceptible pigs**
  - 刚接触ASFV的处于隐性感染期内的猪，不能被采样检出，**可能是非洲猪瘟弱毒等毒株未能被及时剔除的重要原因！**不同非瘟毒株的隐形感染期可能差异巨大。
  - Pigs in the incubation period of ASFV infection can not be detected by sampling, which may be an important reason why weak strains of ASFV are not removed in time! The incubation period of different ASFV strains may vary greatly.
- **传染期 F**: 传染期的已感染猪只， 可(可被检测出阳性)传染其它猪只的能力一直到被清除(死亡/移除/淘汰)离群期间的天数。
- Infection period F: The ability of an infected pig in the infection period to infect other pigs (can be detected as positive) until the date of isolation (death/removal/discontinuation).

ASFV传播的动力学: 群体猪只状态/头数
Dynamics of ASFV transmission: herd status/number of pigs

状态	英文全称	含义	Meaning	猪只表现	Pig performance
S	Susceptible (易感者)	未感染、无免疫力，有被感染风险的个体	Uninfected, non-immune individuals at risk of infection	未感染非洲猪瘟的健康猪，对病毒易感	Healthy pigs not infected with ASF are susceptible to the virus
E	Exposed (隐性感染者/接触者)	已感染病原体但尚未表现出临床症状、**通常也不排毒**（或排毒量极低）难检出的个体	Individuals who have been infected with a pathogen but have not yet shown clinical symptoms, usually do not excrete (or excrete very little) and are difficult to detect	已感染ASFV，处于潜伏期内（通常3-19天），外表健康，但体内病毒在复制	Infected with ASFV, in the incubation period (usually 3-19 days), apparently healthy, but the virus is replicating in the body
I	Infectious (传染者)	已感染病原体，**能够向外界传播病毒且能够被采样检测出阳性**的个体	An individual who has been infected with a pathogen, can transmit the virus to the outside world and can be sampled and tested positive	有些会表现出ASF临床症状（如高烧、呕吐、皮肤发绀）并大量排毒的病猪	Some will show ASF clinical symptoms (such as high fever, vomiting, skin cyanosis) and exude large amounts of toxins
R	Recovered/Removed (康复者/移除者)	**从感染中恢复并获得免疫力，或因病死亡、被扑杀移除**的个体	**Individuals who recover from the infection and develop immunity, or who die of the disease and are culled**	因ASF死亡或被执行无害化处理的猪只；极少数存活猪只可能长期带毒	Pigs that have died of ASF or have been disposed of; a small number of surviving pigs may carry the virus for a long time

群体 $N = S + E + I + R$

病毒传播造成的状态转换: $S \rightarrow E \rightarrow I, R$

“全群检测+精准清除”法 应用与已感染猪群ASFV净化：ASFV的传播

Application of "Whole herd detection + precise clearance" method and ASFV eradication in infected swine herds: ASFV transmission

毒株/类型	R_0 值范围/描述	关键信息	Key information
格鲁吉亚2007/1株（基因II型）	**栏内传播 R_0 ：2.8** (95% CI：1.3-4.8)	英国皇家兽医学院研究，采用SEIR模型估计。表明病毒在密切接触的猪栏内传播能力较强，但栏间传播能力显著降低。	A study by the Royal College of Veterinary Medicine in the United Kingdom, using the SEIR model to estimate, showed that the virus was more transmissible in closely contacted pig pens, but significantly less transmissible between pens.
	栏间传播 R_0 ：1.4 (95% CI：0.6-2.4)		
Malta'78株	**R_0 ：18.0** (95% CI：6.90-46.9)	在**实验室条件**下估算，传播速率高。此数值在高度可控的实验环境中得出，可能与田间实际情况有较大差异。	The propagation rate is estimated to be high under laboratory conditions. This value is obtained in a highly controlled experimental environment and may differ greatly from the actual situation in the field.
疫情初期参考值	**猪场内 R_0 ：8-11**	提到了疫情初期ASFV的感染指数参考值，指**疫情初期**在无免疫背景猪群中的传播强度。	The ASFV infection index reference value at the beginning of the outbreak was mentioned, which refers to the transmission intensity in the unimmunized herd at the beginning of the outbreak.
	猪场间 R_0 ：2-3		

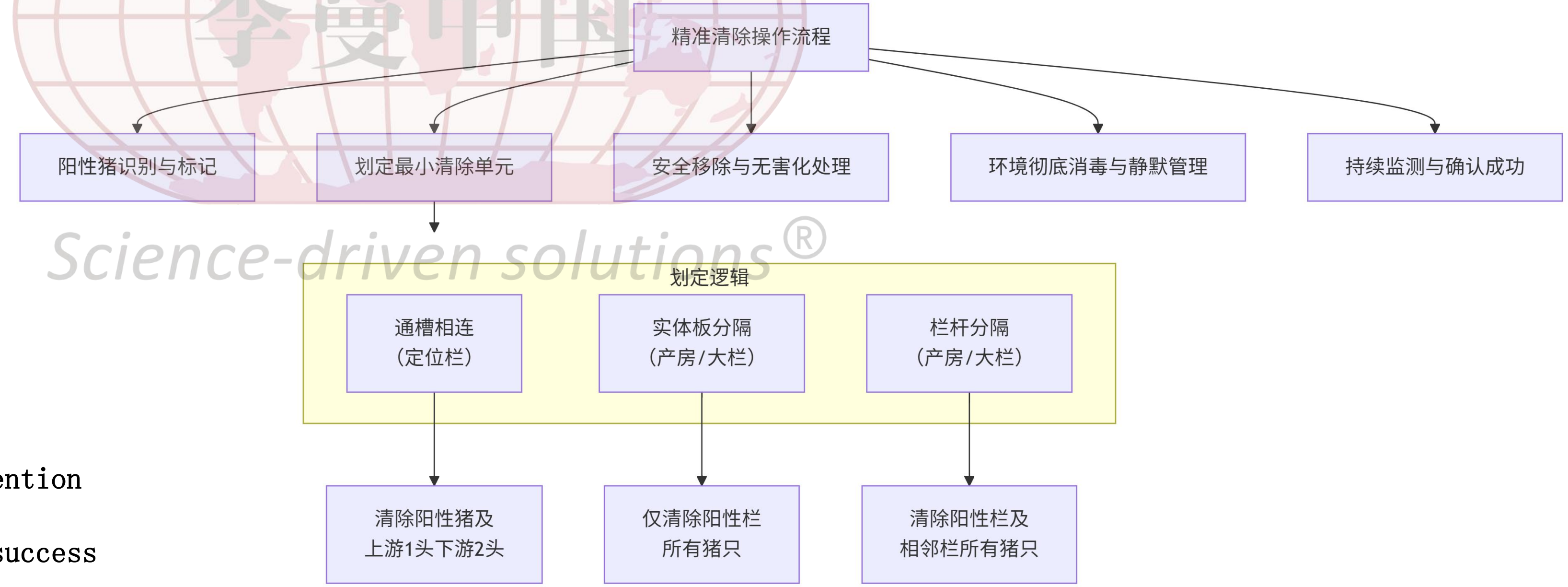
“全群检测+精准清除”法 应用与已感染猪群ASFV净化： “全群检测+精准清除”
Application of "Whole herd testing + precise removal" method for ASFV eradication in infected swine herds: "Whole herd testing + precise removal"

- **全群检测：识别“E”和“I” ＋精准清除：移除“I”并保护“S”**
- **Full group detection: Identify "E" and "I" + Precise removal: Remove "I" and protect "S"**
- 检测对象；检测技术(qPCR核酸/结合抗体；检测频率T;立即剔除：
- Detection object; detection technology (qPCR nucleic acid/bonding antibody; detection frequency T; Immediate exclusion:
- 定期普检：多轮全员普检
- Regular general examination: multiple rounds of general examination for all staff

操作要点 Key points

1. 安全移除
2. 环境网格化彻底消毒
3. 防交叉静默生产
4. 饮水酸化
5. 持续监测确认成功

1. Secure removal
2. Environmental grid disinfection
3. Cross-silencing production prevention
4. Drinking water acidification
5. Continuous monitoring confirms success



“全群检测+精准清除”法 应用与已感染猪群ASFV净化：ASFV的传播的**“连续”** 与 **“离散”**

Application of the "Whole herd detection + precise clearance" method and ASFV eradication in infected swine herds: The "continuous" and "discrete" transmission of ASFV

- **连续过程**：`群体`中，从ASFV传入→接触病毒→形成传染→死亡/移除离群，如果没有人为因素等等的干预， 是一个ASF病毒传播并流行**的连续过程；**
- **离散间隔**：但是，我国开展的“全群检测+精准清除”，按照一定的时间**间隔**开展检测，例如每间隔5天，并将检测到的阳性猪只迅速无污染离群；然后再经过一定的时间间隔，再次开展检测+清除操作，直至连续2次全检不能检测到阳性猪只，即宣告病毒清除成功。
    - 连续2次“全群检测+精准清除”**间隔的时间天数，记作 T**
- 在间隔2次全检之间的期间内，病毒的传播又是连续的过程。
- 在检测出阳性个体的群体中，开展这种`间歇性`的全检清除操作，使病毒的传播成为一种独特的**“离散-连续”模型**

- **Continuous process：** `From ASFV in the `group`→Exposure to the virus→Forming an infection→die/Remove the outliers, and if theres no human intervention or anything like that, its aASFVirus transmission and epidemic**a continuous process;**
- **Discrete intervals**However, China has carried out "whole group testing+"Precision cleaning", according to a certain time**margin**Conduct tests, such as every interval5The pigs detected as positive are quickly isolated without contamination; and then after a certain interval of time, the test is carried out again+Clear operation, until continuous2If no positive pigs are detected in the next total inspection, the virus is declared to be cleared.
    - continuation2NextThe number of days between "whole group detection + precise removal" is denoted as T
- At intervals2During the interval between the next total inspection, the transmission of the virus is a continuous process.
- This is done in a group of people who have tested positive`intermittent`The complete elimination of the virus makes the transmission of the virus a unique **“ dispersed-Continuous" model**

微积分模型推导……
Derivation of integral calculus model......

中国兽医杂志 2025,61(9):127-133
Chinese Journal of Veterinary Medicine

DOI:10. 20157/j. cnki. zgsyzz. 2025. 09. 015

"全群检测＋精准清除"法在已感染非洲猪瘟病毒猪群中清除病毒的离散-连续混合数学模型推导和应用

闫之春[1]，李 鹏[2]，李孝文[3]

3

连续-离散混合模型

Continuous-discrete mixed model

已感染ASFV猪群“全群检测+精准清除”清除病毒的“连续-离散混合模型”

The "continuous-discrete mixed model" for virus elimination in swine populations infected with ASFV was "fully tested and precisely cleared"

- 第 k+1 轮`全群检测+精准清除`时，群体内

When the k+1th round ` full group detection + precise clearance ` is performed, the group is

传染期感染猪只的头数 I_{k+1}， 即 <u>检测出的阳性猪只头数</u>为：

The number of infected pigs in the period of infection Ik+1, that is, the number of positive pigs detected is:

$$I_{k+1} = I_k\left[1 - \frac{T}{F}\left(1 - \frac{R_0 \cdot T}{D}\right)\right](1 - p)$$

相邻2次`全检清除`间隔的天数

传染期猪的基本再生数

采样和检测方法的诊断敏感性

第k轮检测检出的传染期感染猪的头数

感染猪只有传染能力的持续天数

已接触病毒至进入传染期并可被检出的持续天数

即，下一轮检测时的阳性个体数I_{k+1}，是上一轮检测阳性个体数I_k x 系数

That is, the number of positive individuals I k+1 in the next round of testing is the coefficient of the number of positive individuals I k x in the previous round of testing

如果这个系数是衰减的(称`衰减系数`)，病毒就可以逐步得到清除

If this coefficient is attenuated (called the `attenuation coefficient`), the virus can be gradually cleared

已感染ASFV猪群“全群检测+精准清除”清除病毒的“连续-离散混合模型”
The "continuous-discrete mixed model" for virus elimination in swine populations infected with ASFV was "fully tested and precisely cleared"

- 第 k+1 轮`全群检测+精准清除`时，群体内**传染期感染猪只的头数 I_{k+1}，**
- The number of infected pigs in the group at the k+1th round ` full herd detection + precise clearance ` Ik+1,

$$I_{k+1} = I_k\left[1 - \frac{T}{F}\left(1 - \frac{R_0 \cdot T}{D}\right)\right](1 - p)$$

某`群体`上次全群检测时，检到传染期阳性猪 I_k = 15,
根据这次疫情的病毒特点/猪密度/通风/交叉的情况，预期本次的基本再生数 R_0 = 6,
病毒传染期 F = 30天; 病毒隐形感染期 D = 7天,
确定2次`全检清除`的时间间隔原则是少于隐形感染期天数 T = 4天,
由于采样方法和样品来源不理想，样品和检测方法的诊断敏感性 p = 65%;
代入上述公式，计得下次全检时，应可检出在传染期的阳性感染猪只 I_{k+1} = 6.95头
仍存在有传染期的阳性感染猪只，因此，2次`全检清除`不能净化病毒。
如果明显改善样品和检测方法的诊断敏感性 至 p = 95%;
则可阳性感染猪只 I_{k+1} = 0.99头

When the `last whole group test was conducted for `group ω̈, a positive pig in the infectious period was detected I k = 15,
Based on the characteristics of the virus, pig density, ventilation, and cross-over in this outbreak, the basic reproduction number R 0 is expected to be 6,
Viral infection period F = 30 days; viral invisible infection period D = 7 days,
The time interval principle for determining the time between two `full clearance ` is less than the number of days of invisible infection T = 4 days,
Due to the unsatisfactory sampling method and sample source, the diagnostic sensitivity of the sample and detection method is p = 65%;
Substituting the above formula, it can be calculated that the number of positive infected pigs that should be detected during the infectious period at the next full inspection is I k+1 = 6.95
There are still positive infected pigs in the infectious period, so two `full inspections can not purify the virus `.
If the diagnostic sensitivity of the sample and test method is significantly improved to p = 95%;
Then the positive infection of pigs is I k+1 = 0.99 head

“全群检测+精准清除”的“连续-离散混合模型”的启示：**2. 哪些参数对实现快速净化更加重要？** The inspiration of the "continuous-discrete hybrid model" of "whole group detection + precise removal": 2. **Which parameters are more important for rapid eradication?**

- 公式3 $k = \text{ceil}\left\{\frac{-\ln(I_0)}{\ln\left\{\left[1-\frac{T}{F}\left(1-\frac{R_0 \cdot T}{D}\right)\right](1-p)\right\}}\right\}$ 中的参数哪个更敏感？**Which parameter in formula 3 k = ceil is more sensitive?**
- 由此需将*k*值公式 作敏感性分析：将公式中各参数在其已知的/预设的值范围内同时迭代1000次，共100亿亿种可能性，得出
- **Therefore, sensitivity analysis of the k-value formula is required: each parameter in the formula is iterated 1000 times in its known/predefined value range, a total of 100 quadrillion possibilities, and the results are obtained**

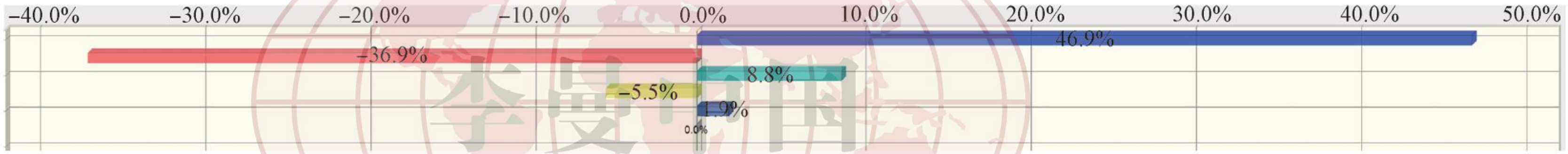


图 1　对参数 *k* 的敏感性分析

Fig. 1　Sensitivity analysis of parameter *k*

蓝色：I_0；红色：*p*；绿色：R_0；黄色：D；墨蓝色：T；灰色：F

- 即，a/ 这个`群体`开始时检测出的阳性猪只的头数I_0最为重要！启示我们非洲猪瘟病毒的净化，`早发现`比什么都重要！46.9%
- **That is, the number of positive pigs detected at the beginning of this `group`, I0, is most important! This reminds us that in African swine fever virus eradication, `early detection` is more important than anything else! 46.9%**

b/ 采集到可以把阳性猪只判断为阳性的样品、对这种样品检测可以判断为阳性的`采样+样品处理+检测`方法的诊断敏感性非常重要！36.9%

b/ The collection of samples that can be identified as positive for positive pigs, and the detection of such samples can be determined as positive ` sampling + sample processing + testing ` method diagnostic sensitivity is very important! 36.9%

“全群检测+精准清除”的“连续-离散混合模型”
讨论：3. 隐性感染期D 与 相邻2次全检清除的间隔时间T
Discussion of the "continuous-discrete hybrid model" of "whole-group detection + precise removal": 3.The interval between the adjacent two complete clearance of hidden infection period D and T

- “全群检测 + 精准清除”法净化非洲猪瘟的流行病学的“连续-离散混合模型”
  模型中，预测未来本`群体`中有传染力的阳性猪只头数、净化病毒所需要的检测轮次数等，核心指标与全群采样检测、病毒、传播能力等等主要特征参数的关系，体现在公式中

- In the "Continuous-Discrete Hybrid Model" for African Swine Fever epidemiology, the method of "Whole-Group Testing + Precise Elimination" is used to predict the number of infectious positive pigs in the `population` and the required number of testing rounds for virus clearance. The core indicators are closely related to key characteristic parameters such as whole-group sampling testing, virus characteristics, and transmission capacity, which are reflected in the formula.

- 公式1 $I_{k+1} = I_k\left[1 - \frac{T}{F}\left(1 - \frac{R_0 \cdot T}{D}\right)\right](1-p)$ 公式3 $k = \text{ceil}\left\{\frac{-\ln(I_0)}{\ln\left\{\left[1 - \frac{T}{F}\left(1 - \frac{R_0 \cdot T}{D}\right)\right](1-p)\right\}}\right\}$

- 这些参数中，相邻2次全检清除的**间隔时间T不是疫情/病毒的特征值**，而是**可以人为设置的时间间隔天数**。这个间隔设置的基本原理，是**T必须少于**易感猪只从接触病毒至其具有传染性且可以通过采样检出的**隐性感染期的天数D，才能明显降低病毒的传播速率。**

- Among these parameters, the interval time T between two consecutive full clearance checks is not a characteristic value of the epidemic/virus, but rather a manually adjustable time interval in days. The fundamental principle behind this interval setting is that T must be shorter than the incubation period D from when susceptible pigs are exposed to the virus until they become contagious and can be detected through sampling. Only by doing so can the transmission rate of the virus be significantly reduced.

- 在不同毒株、猪群密度、`群体`所在舍内的通风、风险载体的交叉程度等等不同条件下，隐性感染期天数D并非一个固定的值，通常认为范围很大，3~28天。在田间实际操作时，为了迅速清除病毒，通常**将隐性感染期天数D取偏小的值**，例如预期为7天。 **T < D时，通常为7天内检测2次，特别是在处置最早期时更加重要。**

- The incubation period (D) varies significantly across different virus strains, pig herd densities, ventilation conditions in `housing units`, and cross-contamination levels of risk vectors. Typically, the incubation period ranges from 3 to 28 days. In field operations, to ensure rapid viral clearance, practitioners usually set a shorter incubation period (D) value, such as 7 days. When T <D, it is generally recommended to conduct two consecutive tests within 7 days, particularly during the initial intervention phase.

总结 Summary

- 本研究首次将日常监测结合“全群检测 + 精准清除”操作，针对ASFV感染疫情净化病毒的策略，推导出了相应的精确数学模型。该模型关联了ASFV临床清除和流行病学的主要参数，准确反映出这些参数对ASFV净化操作的影响，为田间疫情控制的不同阶段识别重点工作方向。
- 本数学模型重要的实用意义，可以通过模型中各参数对公式结果的影响加以说明。模型从数学原理上证明，**首先需要严格界定这次发现阳性猪的`群体`**，
    - 1/ 为了减少检测轮次数、缩短猪群净化ASFV所需时间，最重要的是要加强日常监测性地采样和检测，**尽早发现阳性猪只**；一旦发现阳性猪只，应尽快开展全群检测并清除离群阳性猪只。
    - 2/ `采样、样品处理、**检测`等方法的诊断敏感性**、快速检出的时效性非常重要。
    - 3/ 相邻2次“全群检测 + 精准清除”的**间隔时间**，应设置为小于预期的隐性感染期。
- 通过田间实践和观察，不断探索ASF疫情和病毒的特征参数，使用本模型可以更加有依据地开展疫情处置，预计处置效果。

- This study pioneers the integration of routine monitoring with a "full herd testing + precision clearance" protocol to develop a precise mathematical model for ASFV (African swine fever virus) eradication strategies. The model correlates key clinical clearance parameters and epidemiological factors of ASFV, accurately illustrating their impacts on eradication operations. This framework enables identification of critical priorities for different phases of field epidemic control.
- The significant practical value of this mathematical model can be demonstrated through the influence of its parameters on formula results. The model mathematically proves that it is essential to strictly define the `population` of pigs with positive findings,
    - 1/ In order to reduce the number of detection rounds and shorten the time required for herd eradication ASFV, it is most important to strengthen the daily monitoring of sampling and testing to detect positive pigs as early as possible; once positive pigs are found, herd testing should be carried out as soon as possible and isolated positive pigs should be removed.
    - The diagnostic sensitivity and timeliness of rapid detection are very important for 2/ `sampling, sample processing, detection `and other methods.
    - 3/ The interval between two adjacent "full group detection + precise clearance" should be set to be less than the expected incubation period of latent infection.
- Through field practice and observation, the characteristics of ASF epidemic and virus are constantly explored. The use of this model can carry out epidemic control more reliably and predict the effect of disposal.