Rotavirus - (Molecular) diagnostic findings and possible implications in the field
轮状病毒——（分子）诊断结果及其在该领域可能造成的影响

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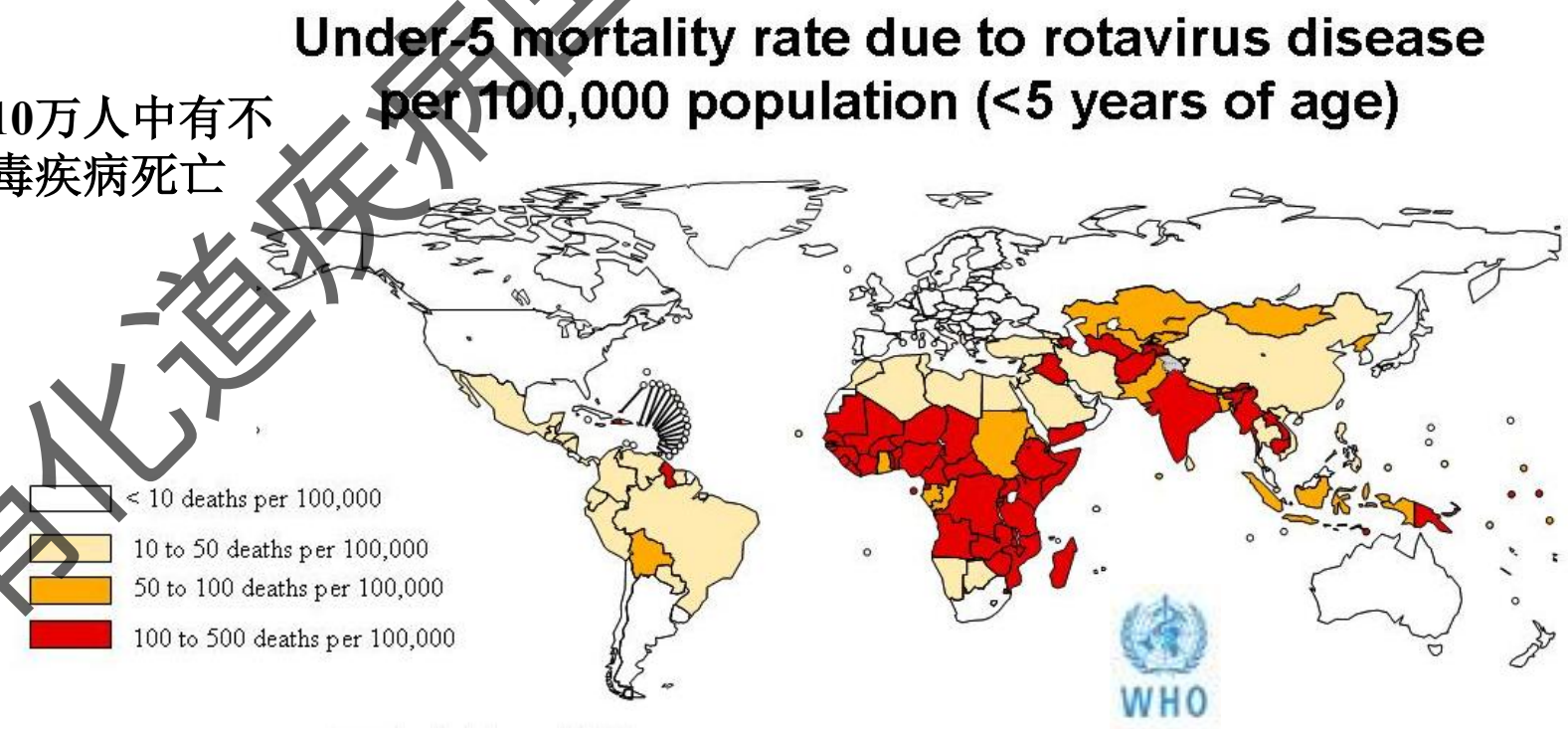
Short overview
概述

Rotaviruses
轮状病毒

Major cause of acute viral gastroenteritis in young children and animals
幼儿和动物幼崽患急性病毒性胃肠炎的主要病因

5岁以下幼儿每10万人中有不到5人因轮状病毒疾病死亡



Clin Infect Dis, Volume 62, Issue suppl_2, May 2016, Pages S96–S105, https://doi.org/10.1093/cid/civ1013
来源：Clin Infect Dis, Volume 62, Issue suppl_2, May 2016, Pages S96－S105,可在以下链接找到： https://doi.org/10.1093/cid/civ1013

Short overview
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Rotaviruses (rota->wheel like virion appearance)
轮状病毒（缩写rota->病毒粒子外观呈轮状）

Major cause of acute viral gastroenteritis in young children and animals
幼儿和动物幼崽患急性病毒性胃肠炎的主要病因

Fecal-oral infection ->
粪口传播感染

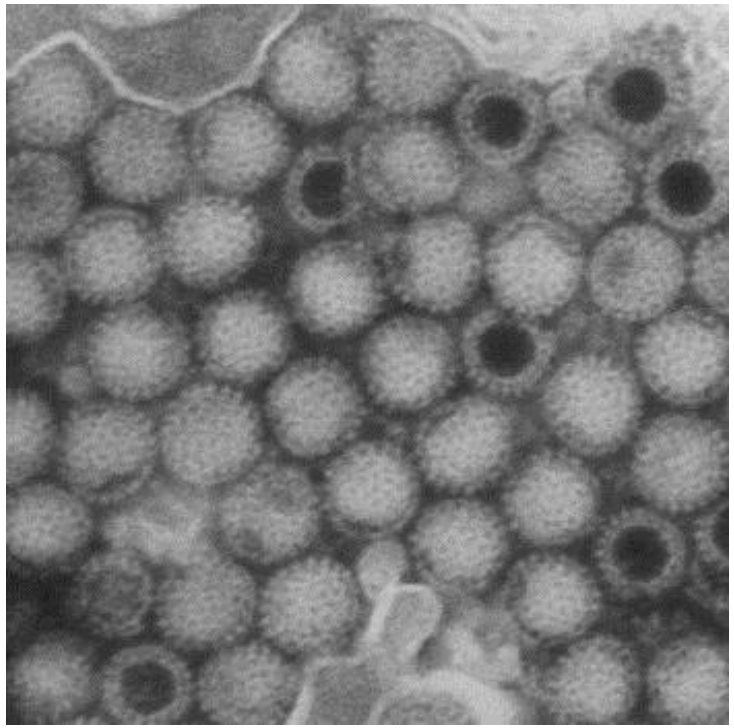
Destruction of the enterocytes
肠上皮细胞坏死

Malabsorption -> osmotic diarrhea
吸收不良->渗透性腹泻

Enterotoxin (NSP4)
肠毒素（NSP4）

Secretory diarrhea
分泌性腹泻

Increase of intestinal motility
肠道蠕动增加



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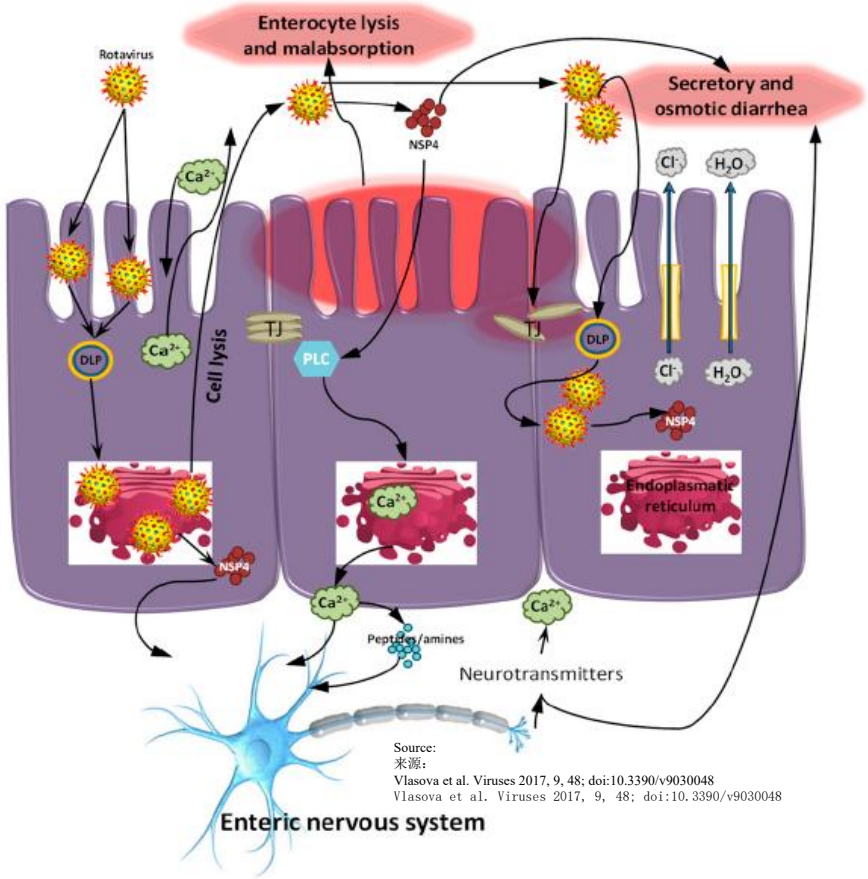
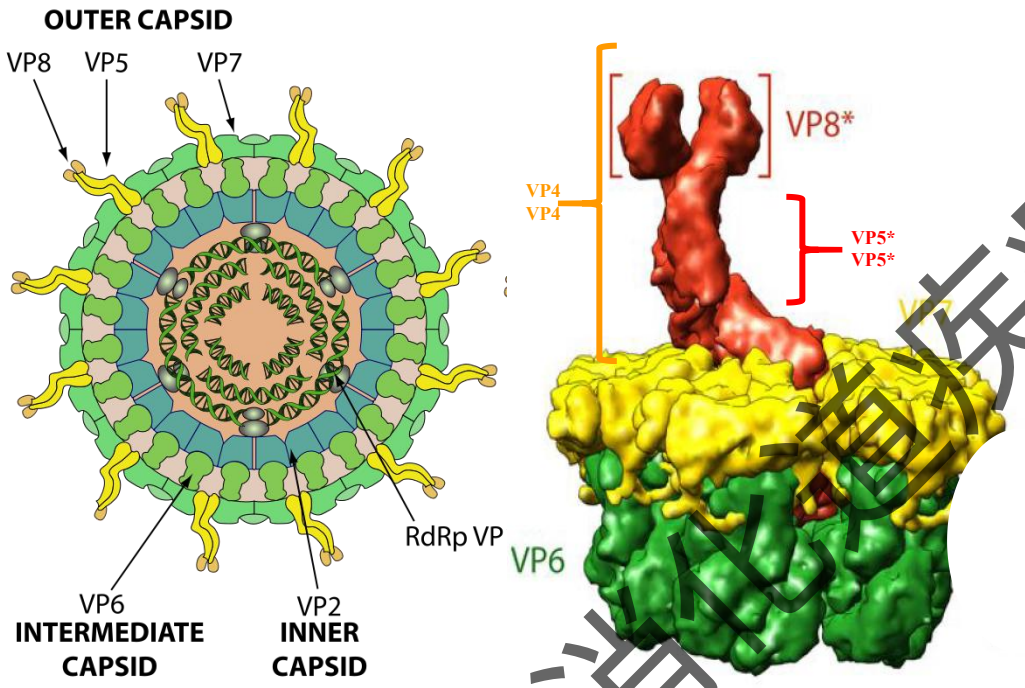


Source:
来源：
Vlasova et al. Viruses 2017, 9, 48; doi:10.3390/v9030048
Vlasova et al. Viruses 2017, 9, 48; doi:10.3390/v9030048

Rotavirus virion
轮状病毒粒子



Source: ViralZone, SIB Swiss Institute of Bioinformatics
来源：ViralZone, SIB Swiss Institute of Bioinformatics
https://viralzone.expasy.org/1072?outline=all_by_species
https://viralzone.expasy.org/1072?outline=all_by_species

Non enveloped
无包膜

- Infectious at Rom temperature for 3-9 month.
  室温下3至9个月内具有感染性

Double stranded segmented RNA
双链分节段RNA

Multilayered capsid
多层衣壳

- Inner Capsid (VP2)
  内层衣壳（VP2）
- Intermediate Capsid (VP6)
  中间衣壳（VP6）
- Outer Capsid (VP7, VP4 (VP8, VP5))
  外层衣壳（VP7、VP4 （VP8、VP5））

Rotavirus virion
轮状病毒粒子

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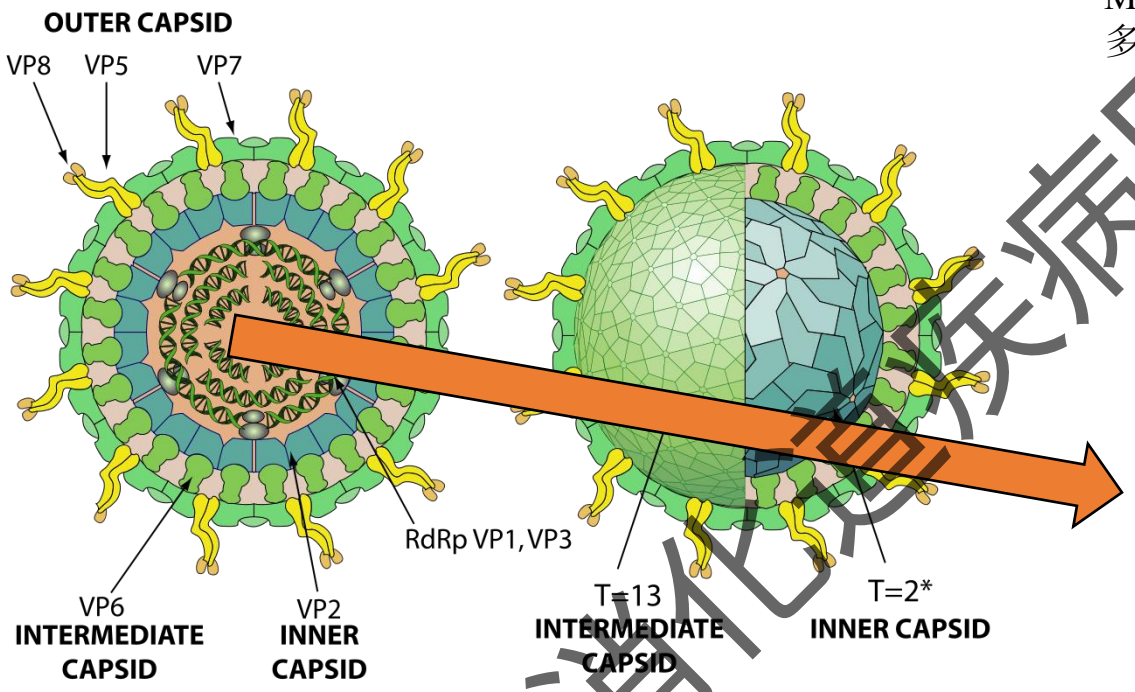
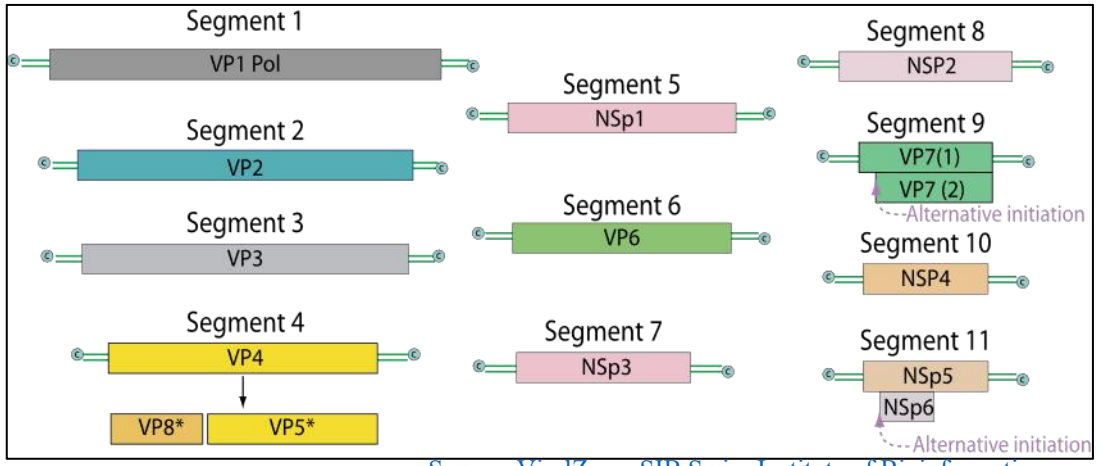


Source: ViralZone, SIB Swiss Institute of Bioinformatics
https://viralzone.expasy.org/107?outline=all_by_species



Source: ViralZone, SIB Swiss Institute of Bioinformatics
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Bildung neuer Reassortanten
新型重组毒株

猪消化道疾病国际研讨会
International Pig Digestive Diseases Symposium

仔猪腹泻与新型重组猪轮状病毒B组有关

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Outbreak of piglet diarrhea associated with a new reassortant porcine rotavirus B

Qingxian Li [a,b,1], Zunbao Wang [a,1], Jianfeng Jiang [a,b], Biao He [b], Sun He [c], Changchun Tu [b,d], Yidi Guo [a,*], Wenjie Gong [a,*]

found negative, therefore metagenomic sequencing was performed to explore other
diarrheal samples. Unexpectedly, the most abundant viral reads mapped to RVB, and
complete 11 viral gene segments. Sequence comparisons revealed that 5 gene segment
NSP3 and NSP4 of RVB strain designated as HNLY-2022 are most closely related to
herbivores with low nucleotide similarities of 65.7–75.3%, and the remaining segmen
porcine RVB strains with the VP4 gene segment showing very low nucleotide identi
strains, indicating HNLY-2022 is a new reassortant RVB strain. Based on the prev
classification criterion, the genotype constellation of RVB strain HNLY-2022 is G6-P[
E5-H4 with more than half of the genotypes (P[6], R6, C6, M6, T7 and E5) newly repo
reassortant RVB strain is the likely causative agent for the diarrheal outbreak of piglets occurred in China and

Porcine
猪的
Rotavirus
轮状病毒

澳大利亚儿童因感染一种新型马样G3P[8]跨基因组重组轮状病毒而出现胃肠炎

Journal of General Virology (2016), 97, 403–410 DOI 10.1099/jgv.0.000352

Emergence of a novel equine-like G3P[8] inter-genogroup reassortant rotavirus strain associated with gastroenteritis in Australian children

RVA

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[2]La Trobe University, Melbourne, Victoria, Australia
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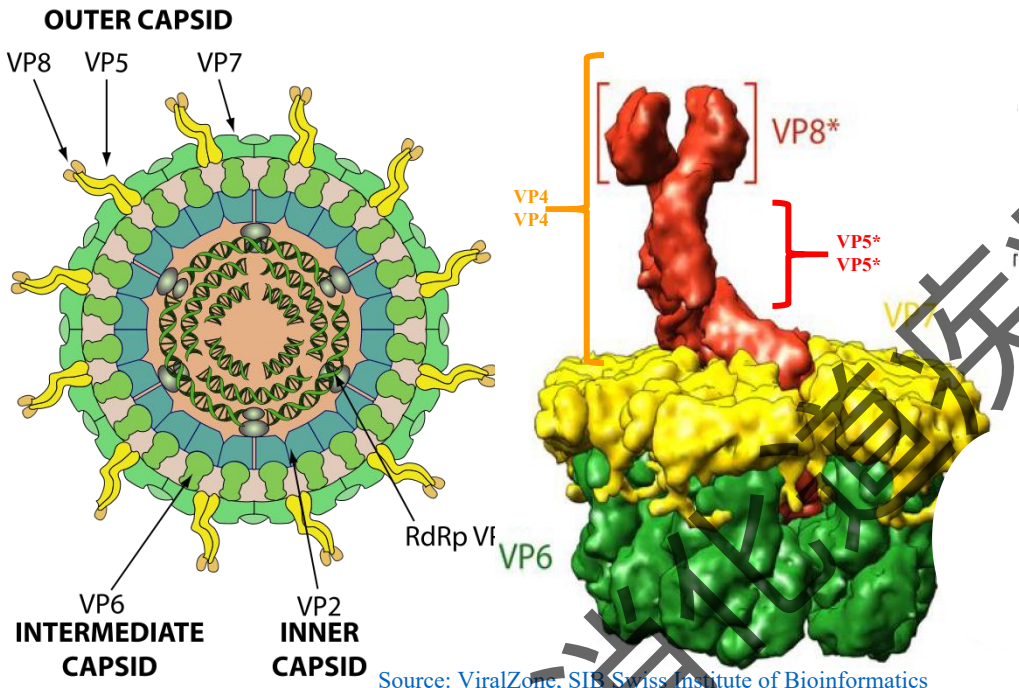
Human
人的
Rotavirus
轮状病毒

ssortante)
重组

Rotavirus Virion
轮状病毒粒子



Source: ViralZone, SIB Swiss Institute of Bioinformatics
https://viralzone.expasy.org/107?outline=all_by_species

VP6 -> Rotavirus Species (A,B,C,D,E,F,G,H,I,J)
VP6 -> 轮状病毒分为10种 (A、B、C、D、E、F、G、H、I和J)

VP7 -> G Serotype/ Genotype
VP7 -> G血清型/ 基因型

VP4 -> P Serotype / Genotype
VP4 -> P血清型/ 基因型

- splits to VP8 (hemagglutination)

分为VP8（血凝）

VP5 (penetration)
VP5（渗透）

例如E.g.: G6-P[6]-I4-R6-C6-M6-A7-N5-T7-E5-H4

Rotavirus Genome
轮状病毒基因组

猪消化道疾病国际研讨会
International Pig Digestive Diseases Symposium

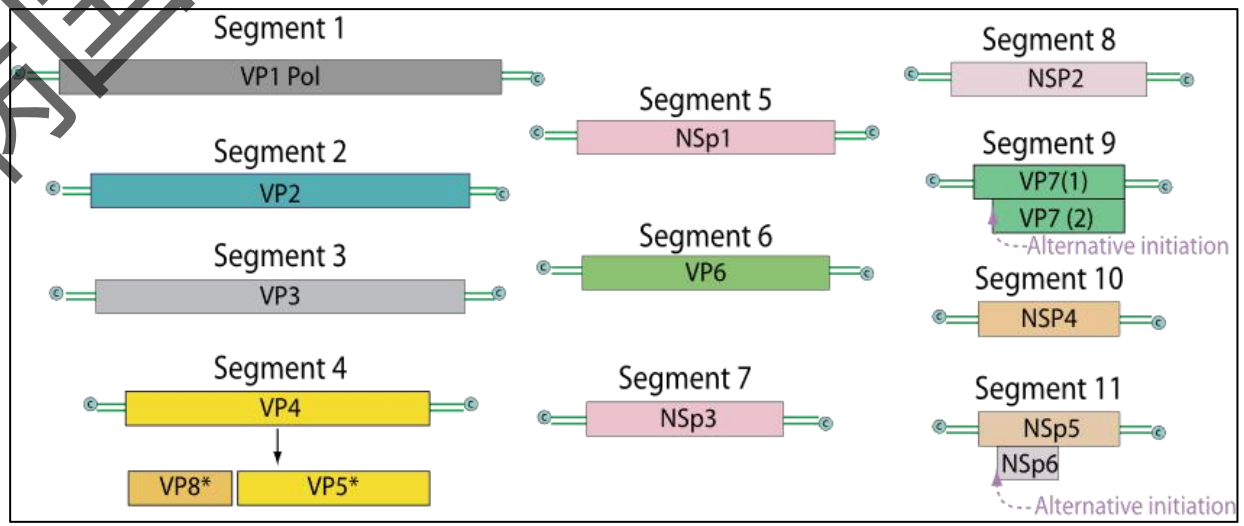
A群轮状病毒（RVA）基因片段、基因型数量和核苷酸同源性截断值

例如E.g.: G6-P[6]-I4-R6-C6-M6-A7-N5-T7-E5-H4

Table 43.1 Rotavirus A (RVA) gene segments, number of genotypes, and nucleotide identity cutoff values.

Gene segment number	Gene segment	Name of genotypes (abbreviation)	Nucleotide identity cutoff values (%) for RVA	RVA genotypes found in pigs
9	VP7	Glycosylated (G)	80	G1–G6, G8–G12, and G26
4	VP4	Protease sensitive (P)	80	P[1], P[5]–P[8], P[11], P[13], P[14], P[19], P[23], P[26], P[27], P[32], and P[34]
6	VP6	Inner capsid (I)	85	I1, I2, and I5
1	VP1	RNA-dependent RNA polymerase (R)	83	R1
2	VP2	Core protein (C)	84	C1 and C2
3	VP3	Methyltransferase (M)	81	M1
5	nsp1	Interferon antagonist (A)	79	A1 and A8
8	nsp2	NTPase (N)	85	N1
7	nsp3	Translation enhancer (T)	85	T1
10	nsp4	Enterotoxin (E)	85	E1 and E9
11	nsp5	Phosphoprotein (H)	91	H1

Frances K. et al. Reoviruses (Rotaviruses and Reoviruses); Diseases of Swine, Eleventh Edition. Edited by Jeffrey J. Zimmerman, Locke A. Karriker, Alejandro Ramirez, Kent J. Schwartz, Gregory W. Stevenson, and Jianqiang Zhang.

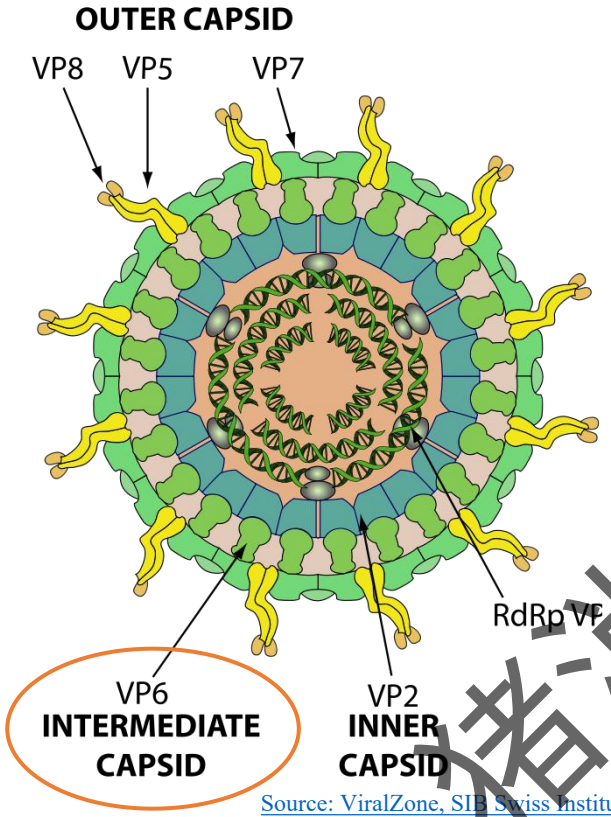


Source: ViralZone, SIB Swiss Institute of Bioinformatics
https://viralzone.expasy.org/107?outline=all_by_species

G	P	I	R	C	M	A	N	T	E	H
VP7	VP4	VP6	VP1	VP2	VP3	NSP1	NSP2	NSP3	NSP4	NSP5
27	37									

Rotavirus Virion
轮状病毒粒子

VP6 -> Rotavirus Species
VP6 -> 轮状病毒种类



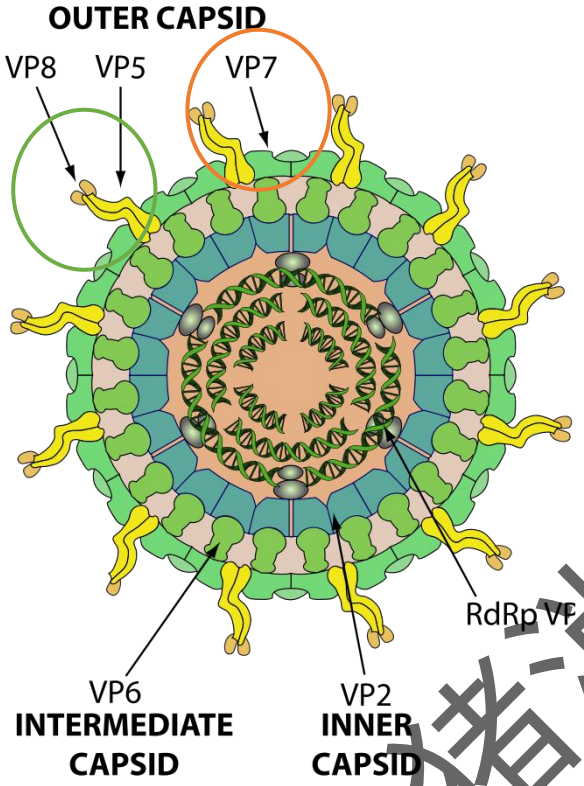
Source: ViralZone, SIB Swiss Institute of Bioinformatics
https://viralzone.expasy.org/107?outline=all_by_species

Currently, five of the ten RV species (**RVA, RVB, RVC**, RVE, and RVH) have been detected in pigs
目前，十种轮状病毒中，有五种在猪体内检出，分别是 **RVA**、**RVB**、**RVC**、RVE和RVH

- RVC with RVA having the highest prevalence and causing the most significant harm
  RVC和RVA的流行率最高，造成的危害最严重
- RVE has only been identified from a single porcine sample, calling into question its prevalence or importance
  仅从一份猪样本中检测出RVE，RVE的流行率和重要性有待确认
- The first detection of swine RVH was in1999 in Japan followed by 3 additional RVH strains isolated in 2012 from Brazil. Recently, the widespread distribution of swine RVH strains in the US was reported in multiple age groups although its role in pathogenesis is still unknown.
  1999年，日本首次在猪体内检测出RVH毒株，2012年，巴西发现了另外3株RVH菌株。最近有报道称，在美国，尽管RVH毒株在发病机制中的作用尚不明确，但广泛分布于各日龄猪群中

Rotavirus Virion
轮状病毒粒子

VP7 / VP4 -> G/P-genotypes
VP7 / VP4 -> G/P基因型



Source: ViralZone, SIB Swiss Institute of Bioinformatics
https://viralzone.expasy.org/107?outline=all_by_species

RVA: -> 12 G genotypes (G1-G6, G8-G12, and G26) and 16 P genotypes (P[1], P[5]-P[8], P [11], P[13]-P[14], P[19], P[23], P[26]-P [27], P[32] and P[34])
RVA: -> 12种G基因型 **(G1-G6,** G8-G12, and G26) 和16种P基因型(P[1], P[5]-P[8], P [11], P[13]-P[14], P[19], P[23], P[26]-P [27], P[32] 和 P[34])

RVB: -> 21 G genotypes (G4 and G6-G26); 2 P genotypes (P[4]-P[5])
RVB: -> 21种G基因型 (G4 and G6-G26); 2种P基因型 (P[4]-P[5])

RVC: -> 15 G genotypes (G12, G13, G8, G6, G5, G14, G9, G1, G17, G15, G7, G10, G3, G18, G16); 16 P genotypes (P[1], P[5]-P[9], and P[12]-P[21])
RVC: -> 15种G基因型 **(G12, G13, G8, G6, G5,** G14, G9, G1, G17, G15, G7, G10, G3, G18, G16); 16种P基因型 (P[1], P[5]-P[9], and P[12]-P[21])

RVE: -> only one case sample not available
RVE: -> 只有一个病例样本，不可用

RVH: -> **G5P1**

Rotavirus - relevance of molecular findings
轮状病毒-分子研究结果的相关性

Epidemiological relevance
流行病学相关性

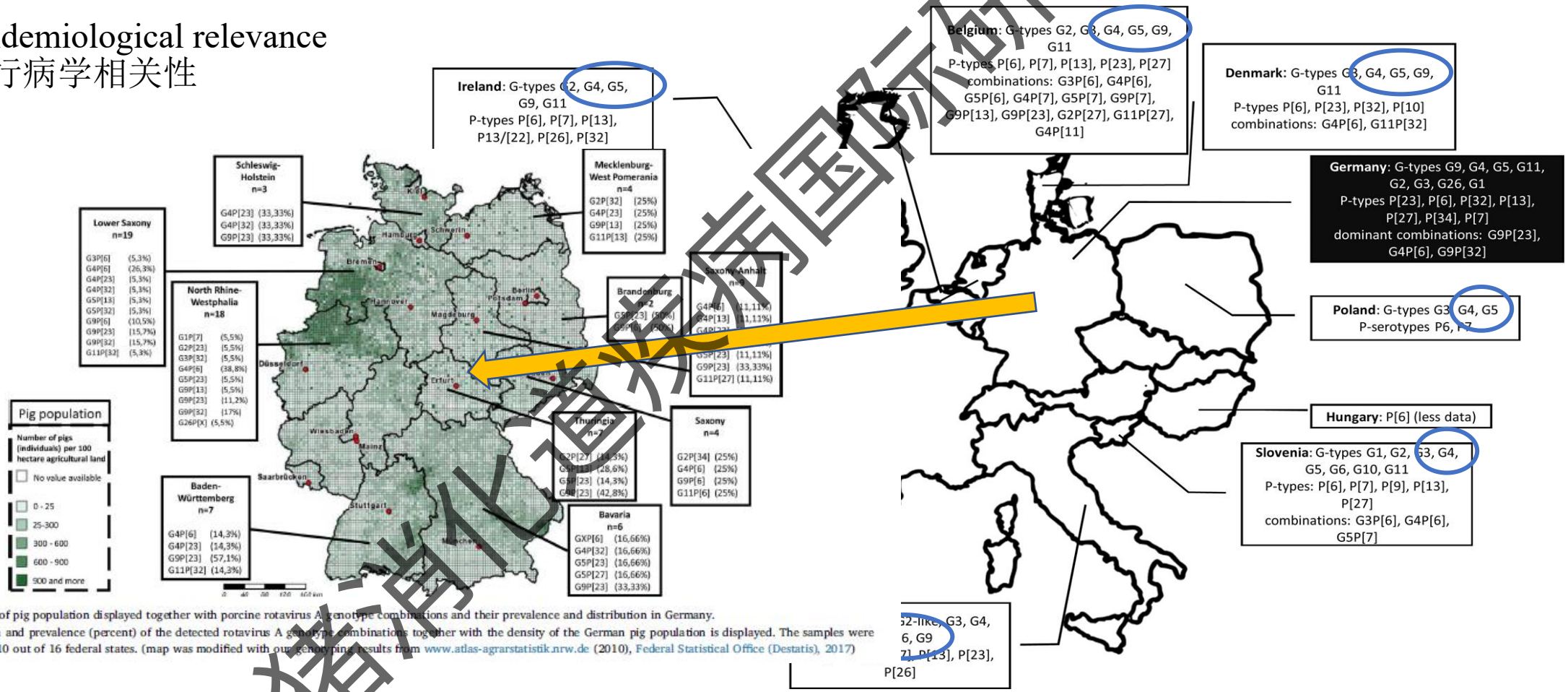


Fig. 3. Density of pig population displayed together with porcine rotavirus A genotype combinations and their prevalence and distribution in Germany.
The distribution and prevalence (percent) of the detected rotavirus A genotype combinations together with the density of the German pig population is displayed. The samples were available from 10 out of 16 federal states. (map was modified with our genotyping results from www.atlas-agrarstatistik.nrw.de (2010), Federal Statistical Office (Destatis), 2017)

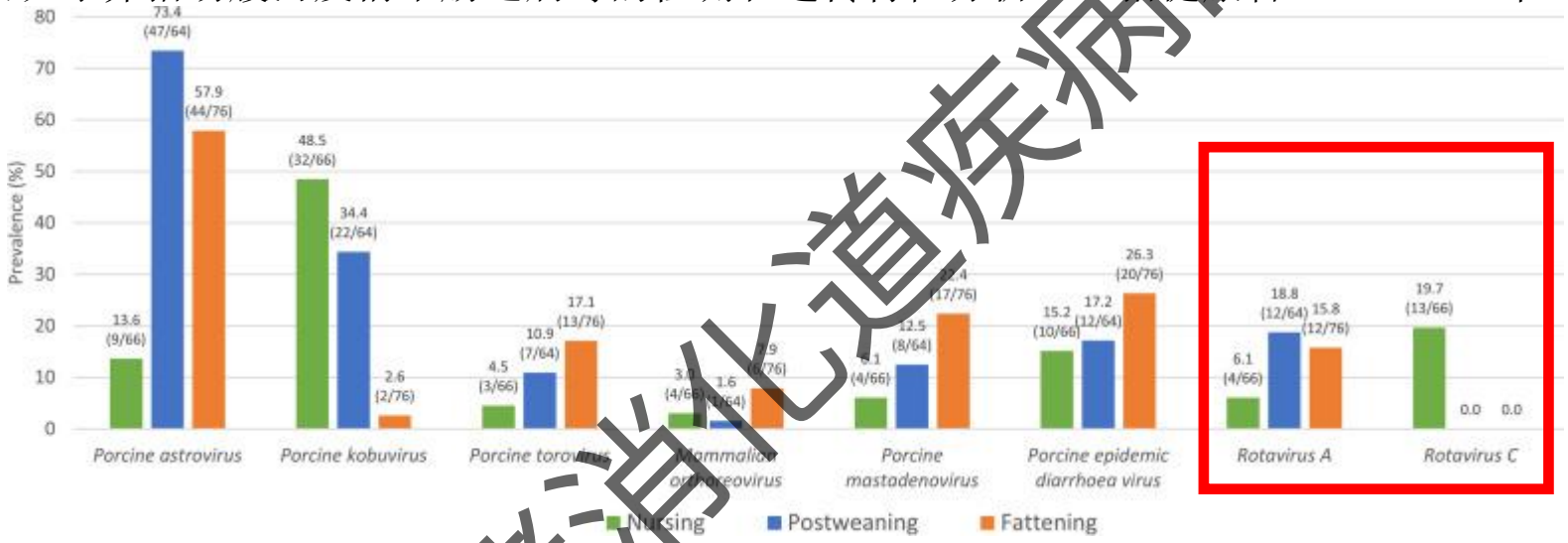
Wenske et al. Veterinary Microbiology, Volume 214, February 2018, Pages 93-98

Wenske et al. Veterinary Microbiology, Volume 214, February 2018, Pages 93-98

Rotavirus - relevance of molecular findings
轮状病毒-分子研究结果的相关性

Epidemiological relevance
流行病学相关性

Detection and genetic characterization of enteric viruses in diarrhoea outbreaks from swine farms in Spain. Porcine Health Manag. 2023; 9: 29.
西班牙养猪场腹泻疫情中肠道病毒的检测和遗传特征分析，《猪健康管理》，2023年，第9卷，第29页。



Prevalence of positive diarrhea outbreaks to each of the different investigated enteric viruses according to the age of the affected animals. Out of the 206 investigated diarrhea outbreaks, 66 affected nursing piglets (< 21 days), 64 postweaning-growing piglets (21–70 days) and 76 fattening pigs (> 70 days)
在不同日龄感染动物中每种受调查肠道病毒导致的阳性腹泻疫情暴发率。在调查的206例腹泻疫情中，有66例影响了哺乳仔猪（<21日龄），64例影响了断奶后到生长期的仔猪（21-70日龄），76例影响了育肥猪（>70日龄）

Rotavirus - relevance of molecular findings
轮状病毒-分子研究结果的相关性

猪消化道疾病国际研讨会
International Pig Digestive Diseases Symposium

No cross protection between RV species (RVA-J)
不同轮状病毒种类之间（RVA-J）没有交叉保护

“Monovalent human RV vaccine containing G1P[8] induces significant protection against severe RV disease caused by multiple G and P types not included in the vaccine, which confirms at least some level of heterotypic protection from other G and P types”.
“含有G1P[8]的单价人类轮状病毒疫苗对其中未包含的多种G和P型病毒引起的严重轮状病毒疾病具有显著的保护作用，这至少证实了该疫苗对其他G和P型的异型保护作用。”

Kumar et al. Pathogens. 2022 Oct; 11(10): 1078

Monitoring of introduction of news RV strains is crucial to identify and assign newly emerging „rotavirus like“ clinical signs).
监测新型轮状病毒毒株的传入对于识别和归类新发轮状病毒类临床症状至关重要。

“Natural infection or vaccination results in mainly homotypic RV immunity mediated by antibodies against VP7 and VP4, whereas previously exposed or adult animals produce homotypic as well as antibodies to a wide range of heterotypic RVs “
“自然感染或接种疫苗主要产生由抗VP7和VP4抗体介导的同型轮状病毒免疫力，而先前已经感染的动物或成年动物产生同型病毒免疫力以及针对多种异型轮状病毒的抗体”

Kumar et al. Pathogens. 2022 Oct; 11(10): 1078

Rotavirus - relevance of molecular findings
轮状病毒-分子研究结果的相关性

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Monitoring of introduction of news RV strains is crucial to identify and assign newly emerging "rotavirus like" clinical signs
监测新型轮状病毒毒株的传入对于识别和归类新发"轮状病毒样"临床症状至关重要

New species detected:
检出新型毒株

Include new species in gilt acclimatization process
后备母猪驯化过程中的新型毒株

Control of colostrum management
控制初乳管理

Update differential list
更新鉴别清单

Rotavirus - relevance of molecular findings
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未检出新型毒株：

Control of gilt acclimatization process
控制母猪驯化过程

Control of colostrum management
控制初乳管理

Update differential list
更新鉴别清单

Summary
总结

Molecular diagnostic and the interpretation of the results can be challenging
分子诊断和结果解释可能较为困难

Cross protection between RV-species does not exist
不同轮状病毒种类之间不存在交叉保护

Partly cross protection within the species may be present (this might not be true for "first contact pigs")
轮状病毒各血清组内可能存在部分交叉保护（这可能不适用于"首次接触猪"）

Molecular diagnostic findings gives you an idea where to look in case of a RV non-stable farm (gilt acclimatization, colostrum management, differential list).
在轮状病毒不稳定的猪场，分子诊断结果可以为您提供指引（后备母猪驯化、初乳管理、鉴别清单）。

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猪消化道疾病国际研讨会
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Zentrum für Klinische Tiermedizin