HAV and HEV: What's New?

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The 14th Asian Pan - Pacific Society of Pediatric Gastroenterology, Hepatology and Nutrition

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Toward Good Health and Well-being of Children

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Current position: Head of Center of Excellence in Clinical Virology

Education: MD. Chulalongkorn University
Board Of Pediatrics, Chulalonkorn University
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Special Interests: Hepatology, Virology

Pubblication : more than 500 publications

Citation : > 14000 Cites

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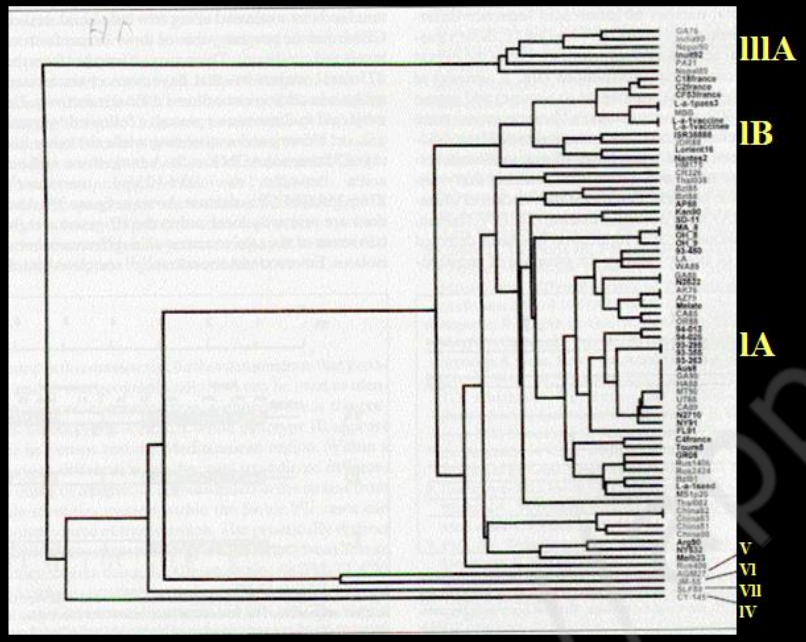
Hepatitis A virus

- Picornavirus (RNA)
- Humans are only natural host
- Stable at low pH
- Inactivated by high temperature formalin, chlorine
- Entry into mouth
- Viral replication in the liver
- Virus present in blood and feces after about 2 weeks
- Illness usually self-limited

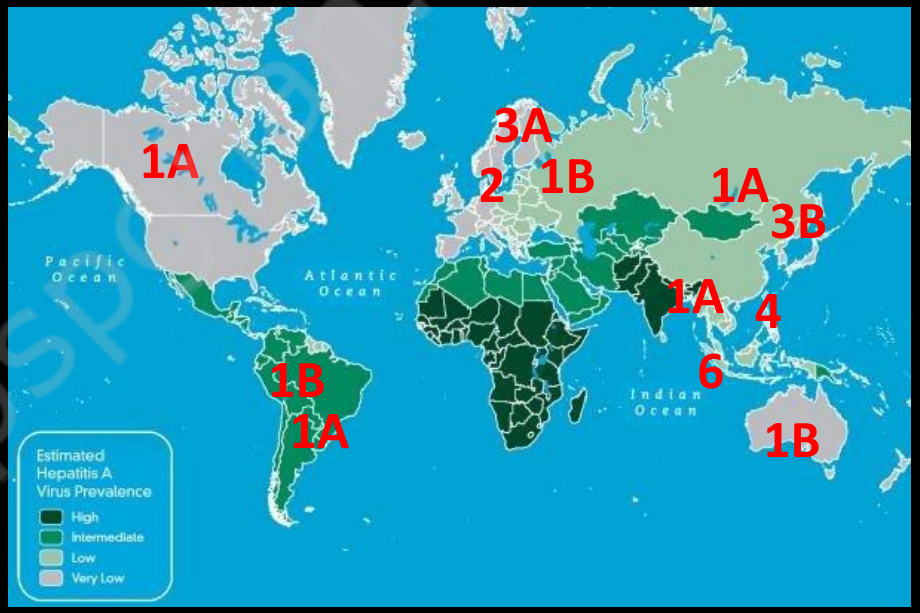
Hepatitis A Virus Genotype

HAV genotype



Dendrogram representing the relatedness of VP1 amino terminal nucleic acid sequences

Robertson BH 1997.



https://www.researchgate.net/publication/262383253_Enteric_hepatitis_viruses/figures?lo=1

HAV Extent of the problem

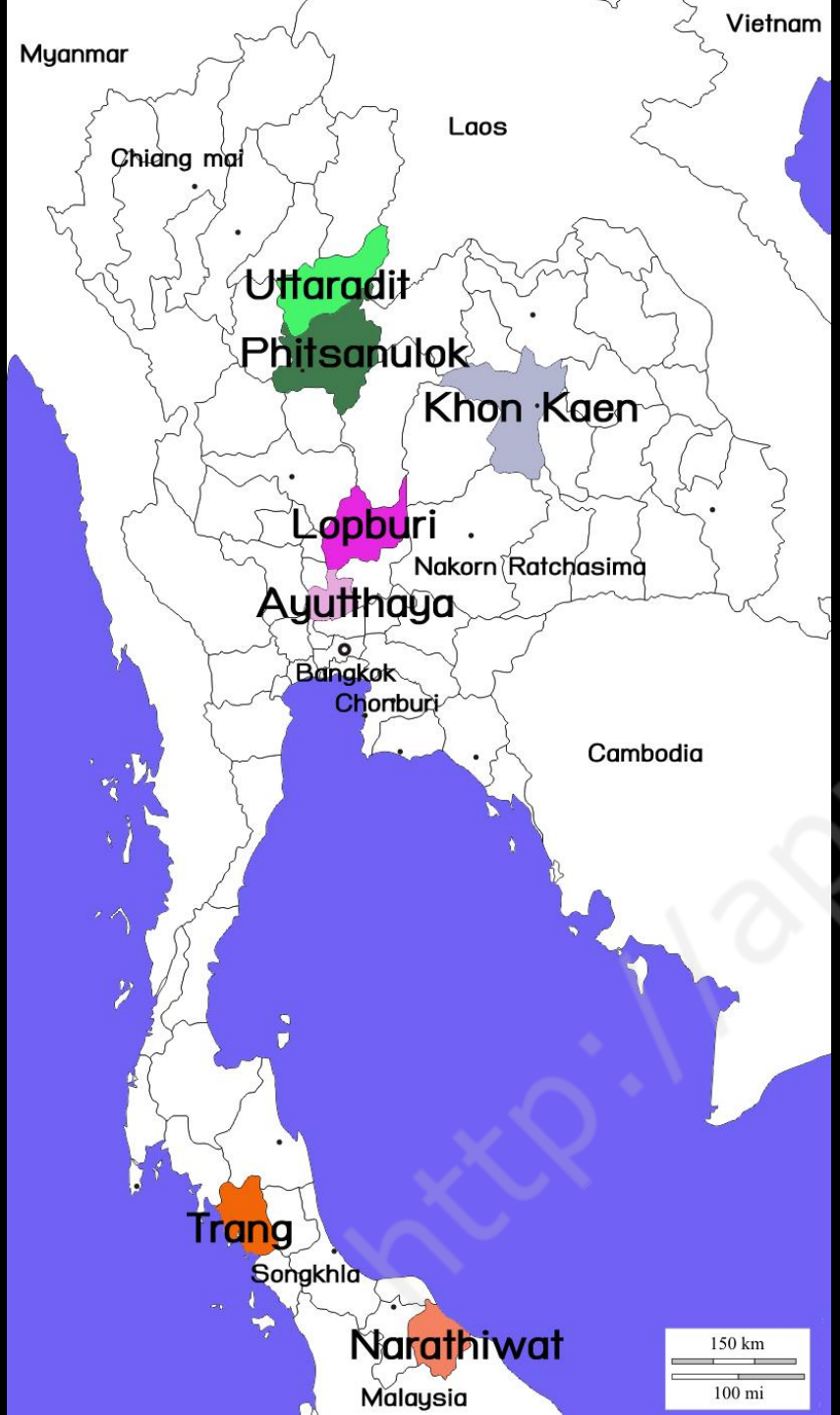
- The incidence of enteric infections have fallen
- The incidence of hepatitis A has increased

Global hepatitis A epidemiology

- Developed countries
- Developing countries Improved living standard
- Developing countries, Poor sanitation and hygiene

Geographic distribution of HAV infection

Epidemiology of hepatitis A



Northern part

Uttaradit : 904 (389 males, 515 females)

Phitsanulok : 518 (193 males, 325 females)

North-eastern part

Khon Kaen: 1,638 (854 males, 784 females)

Central part

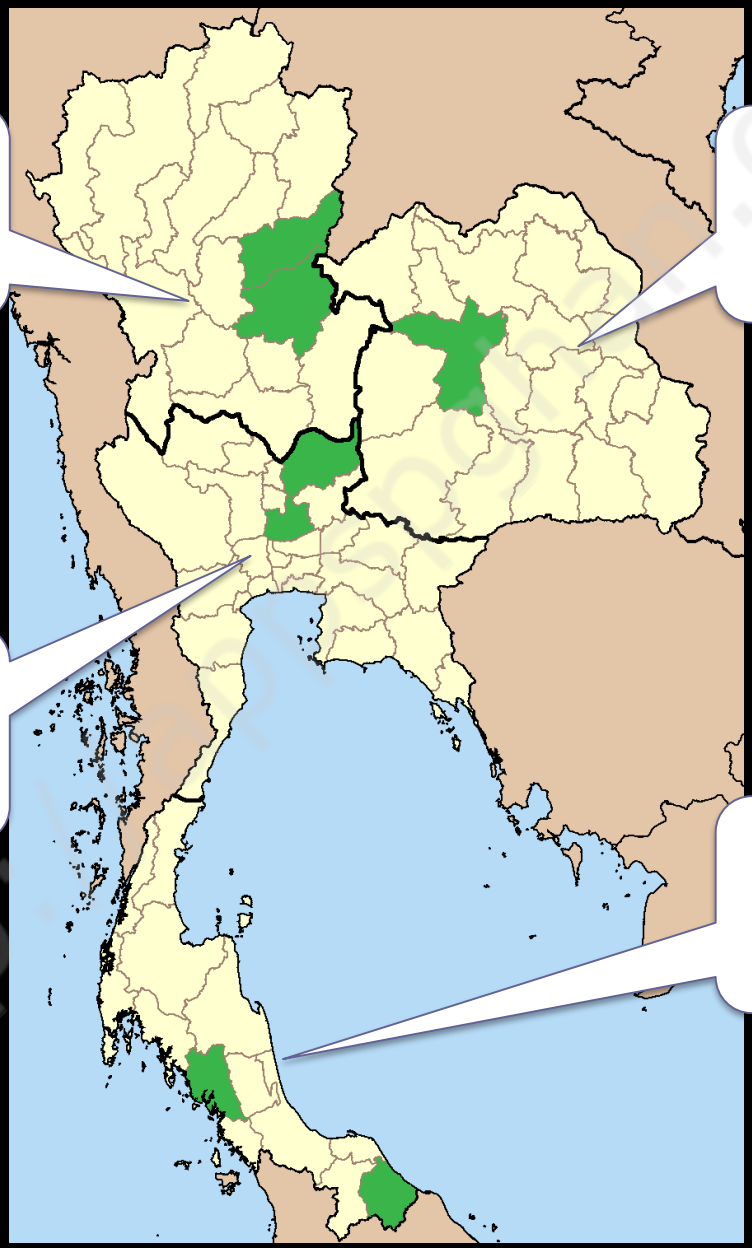
Lopburi: 781 (389 males, 392 females)
Ayutthaya: 757 (313 males, 444 females)

Southern part

Trang: 733 (297 males, 436 females)
Narathiwat: 648 (173 males, 475 females)

Total: 5,979

Sample Collection



North
1,421 samples

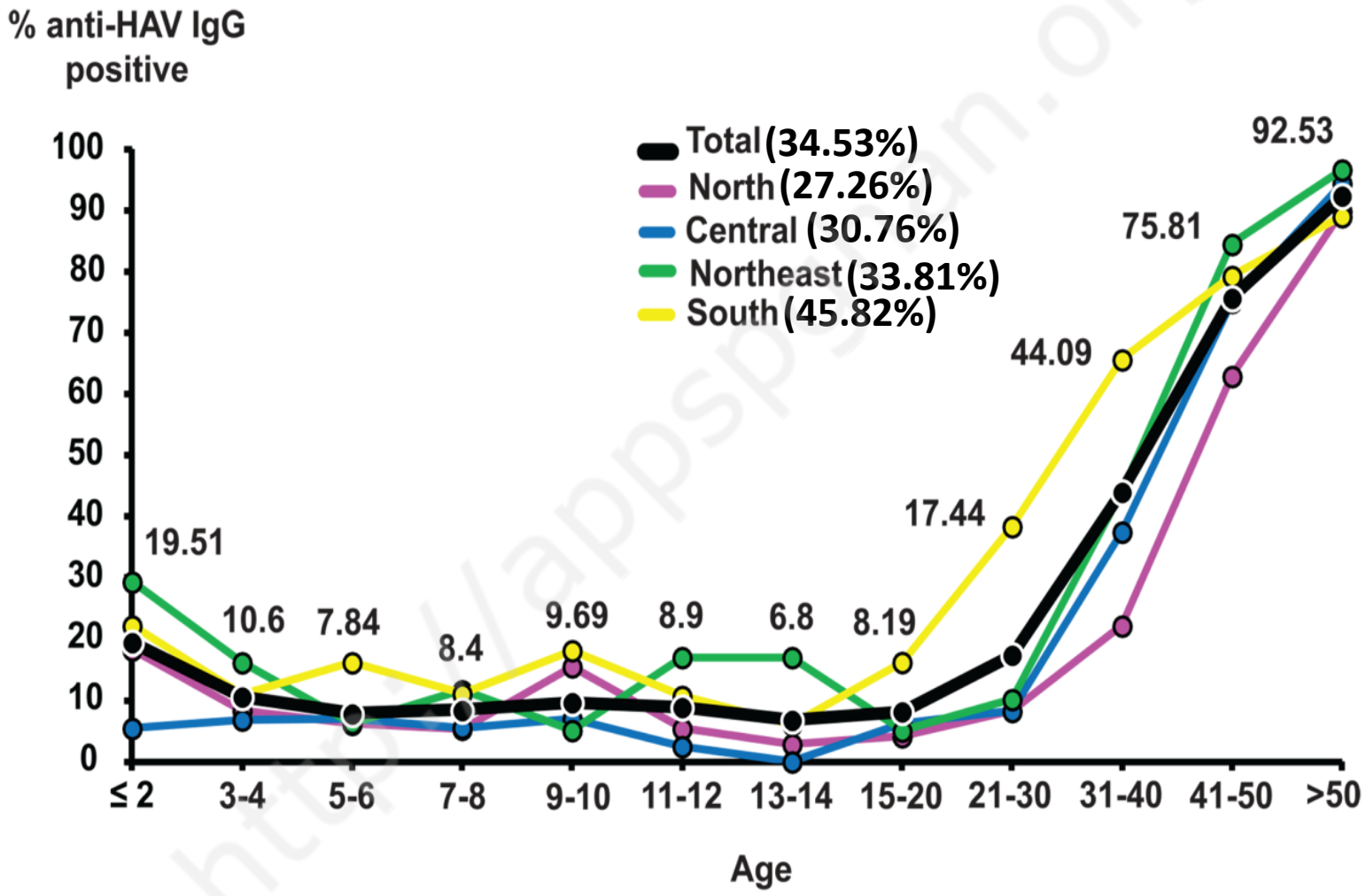
Northeast
1,633 samples

Central
1,535 samples

South
1,375 samples

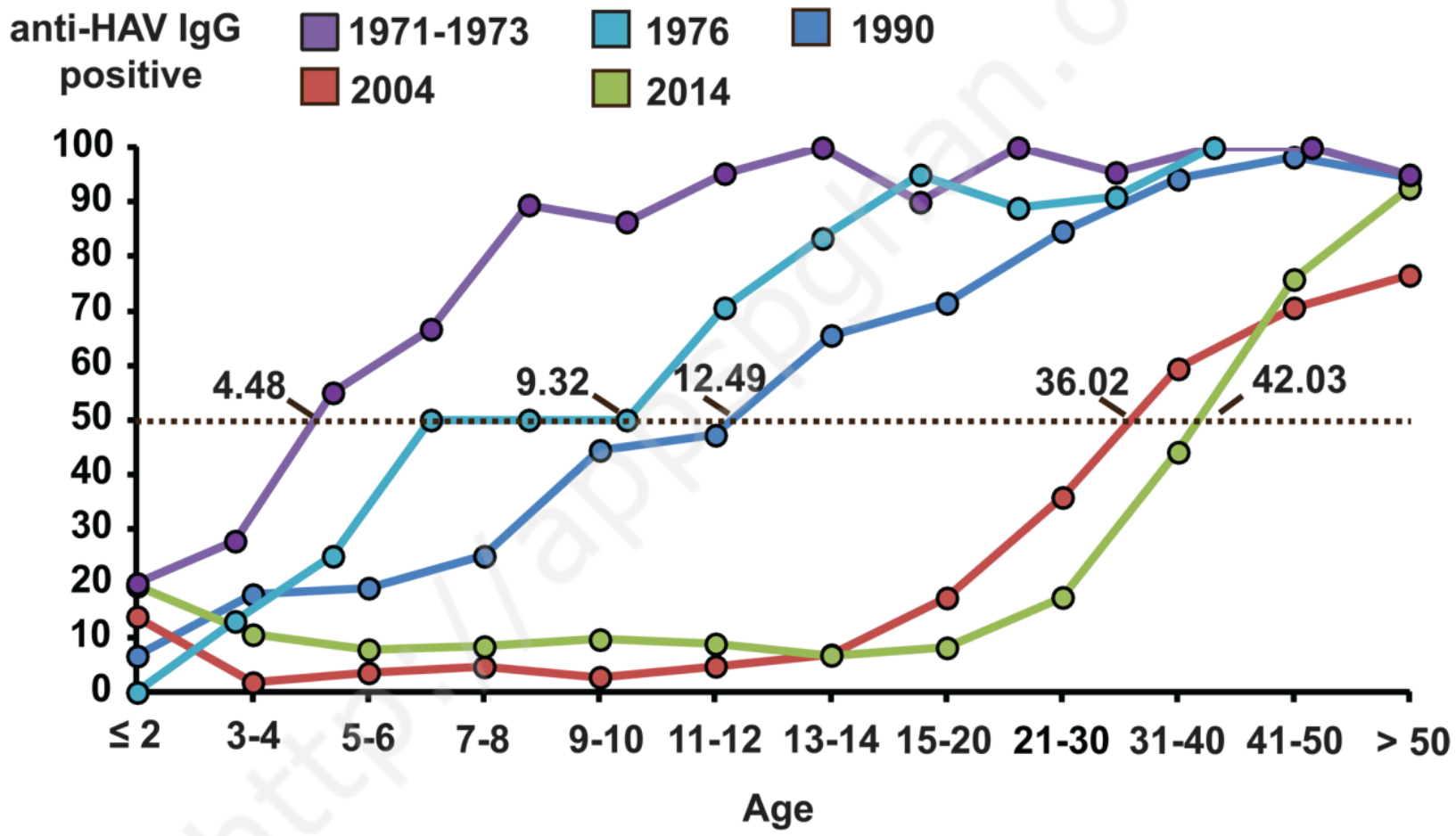
Sa-nguanmoo P, et al. PLoS One. 2016 Mar 23;11(3):e0151304.

Comparison of anti-HAV IgG positive in each age group among region.



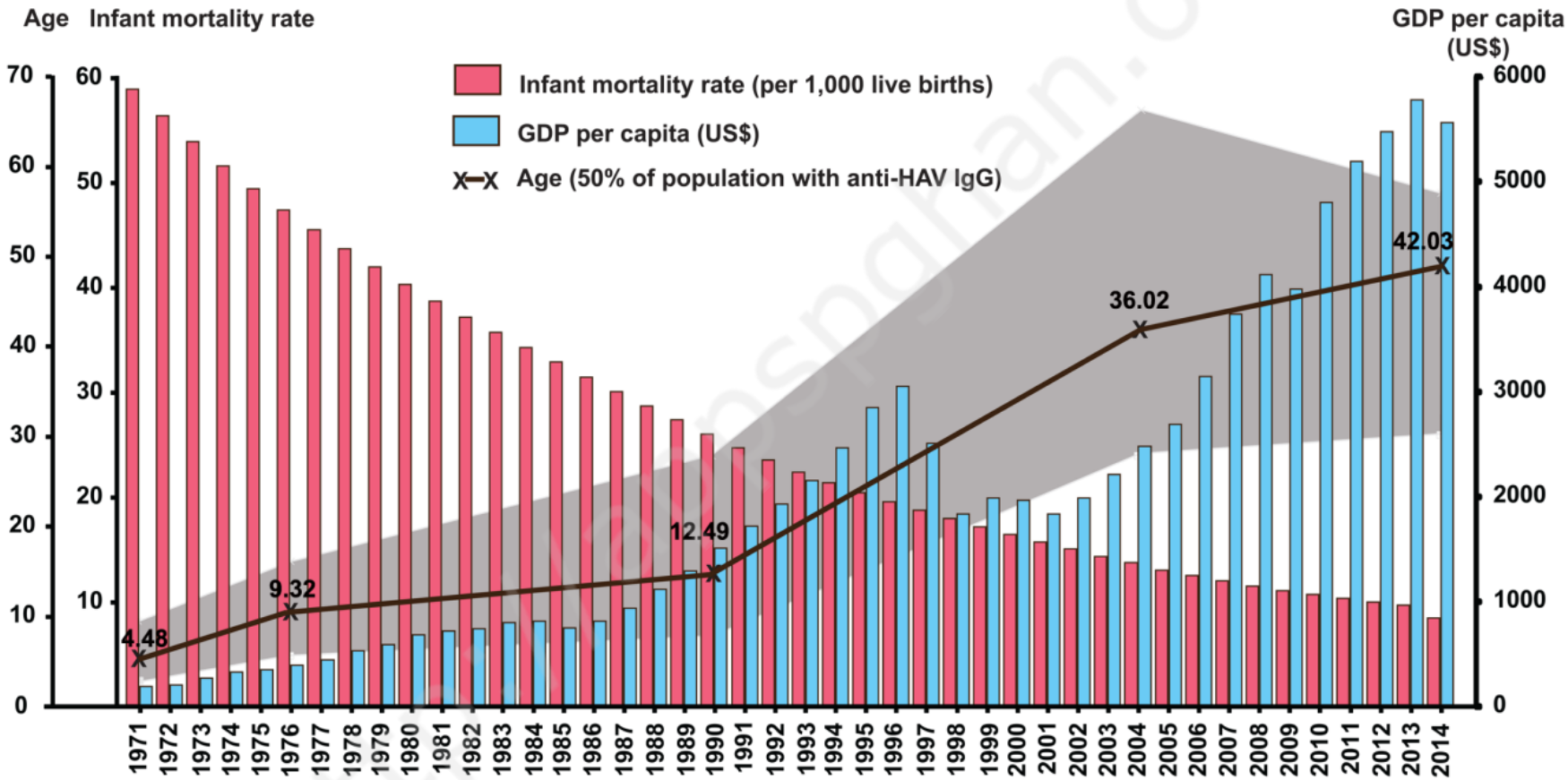
Sa-nguanmoo P, et al. PLoS One. 2016 Mar 23;11(3):e0151304.

Comparison of anti-HAV IgG positive from 1971 to 2014.



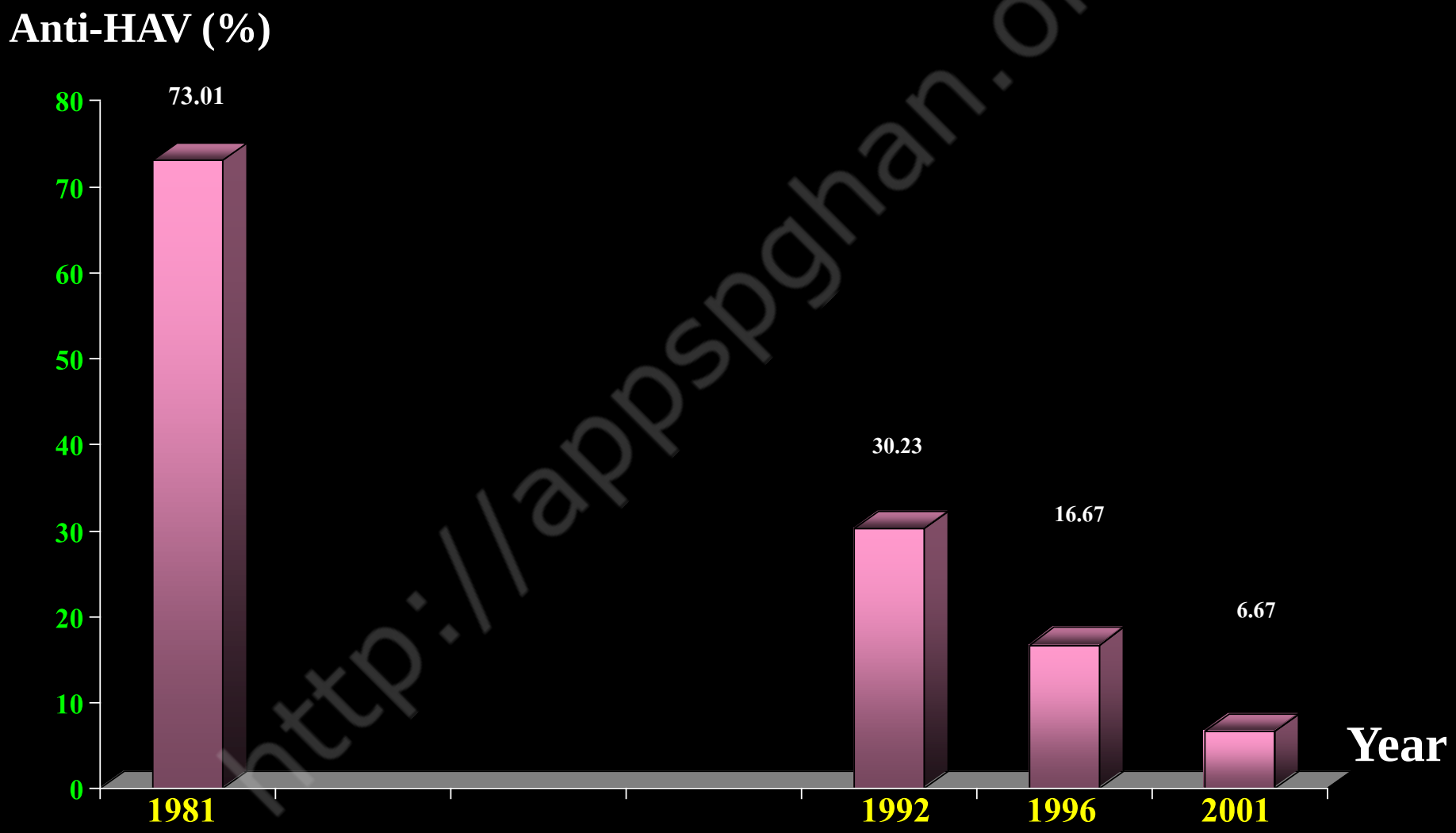
Sa-nguanmoo P, et al. PLoS One. 2016 Mar 23;11(3):e0151304.

Correlation between infant mortality rate (per 1,000 live births), Gross Domestic Product (GDP) and age of 50% anti-HAV IgG seropositive in population



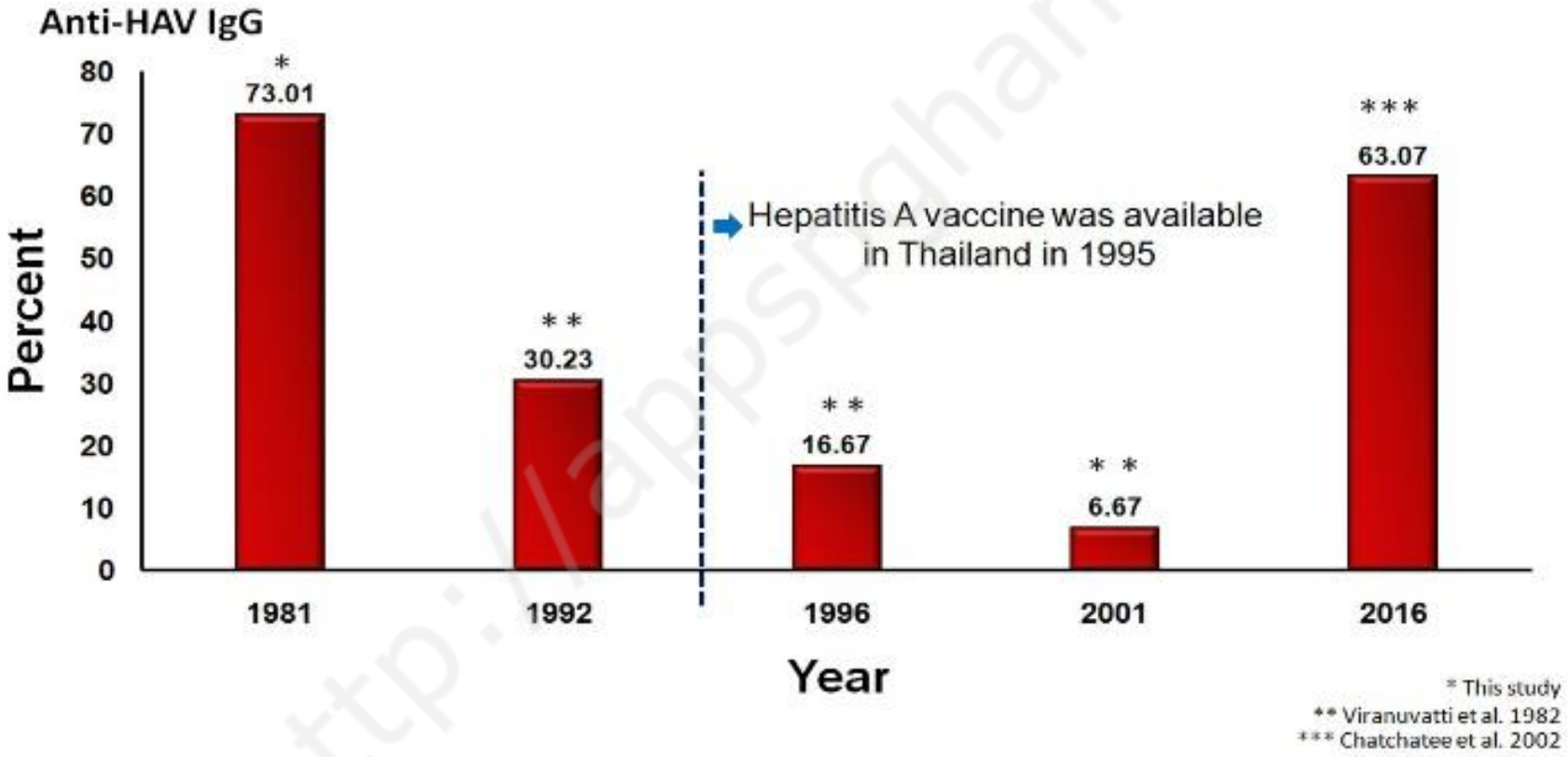
Sa-nguanmoo P, et al. PLoS One. 2016 Mar 23;11(3):e0151304.

Seroprevalence of anti HAV among medical student in Bangkok



Chatchatree et al 2002

Changes in hepatitis A virus (HAV) seroprevalence in medical students in Bangkok, Thailand, from 1981 to 2016



Sintusek P, Sa-Nguanmoo P, Posuwan N, Jaroonvanichkul V, Vorayingyong A, Poovorawan Y. BMC Res Notes. 2018 Sep 3;11(1):640.

Outbreak of hepatitis A

Hepatitis A outbreak

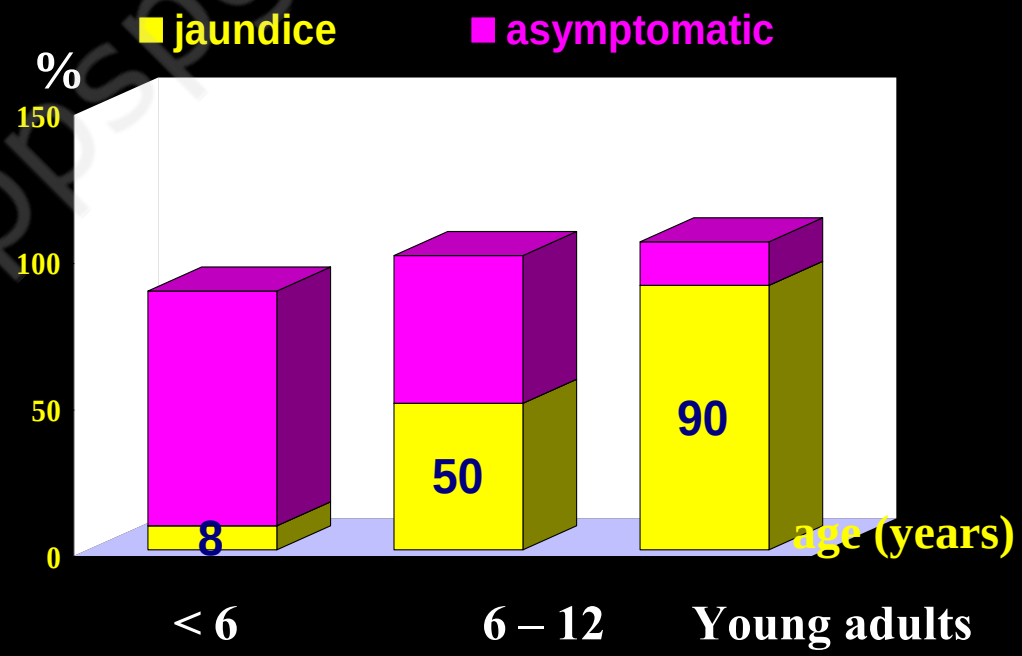
Child care institution, Thailand

- **Number of children 112 cases**
- **antiHAV IgM positive 65 cases**
- **Children with clinical hepatitis 5 cases**
- **Symptomatic : asymptomatic 1:13**
- **No virus was detected in saliva**
- **HAV-RNA can be detected in stool for at least 3 wks.**

Poovorawan et al, J Clin Virol 2005

Hepatitis A - The disease

- **Severity of the hepatitis A is highly correlated with :**
  - the age of the subject
  - previous liver disease

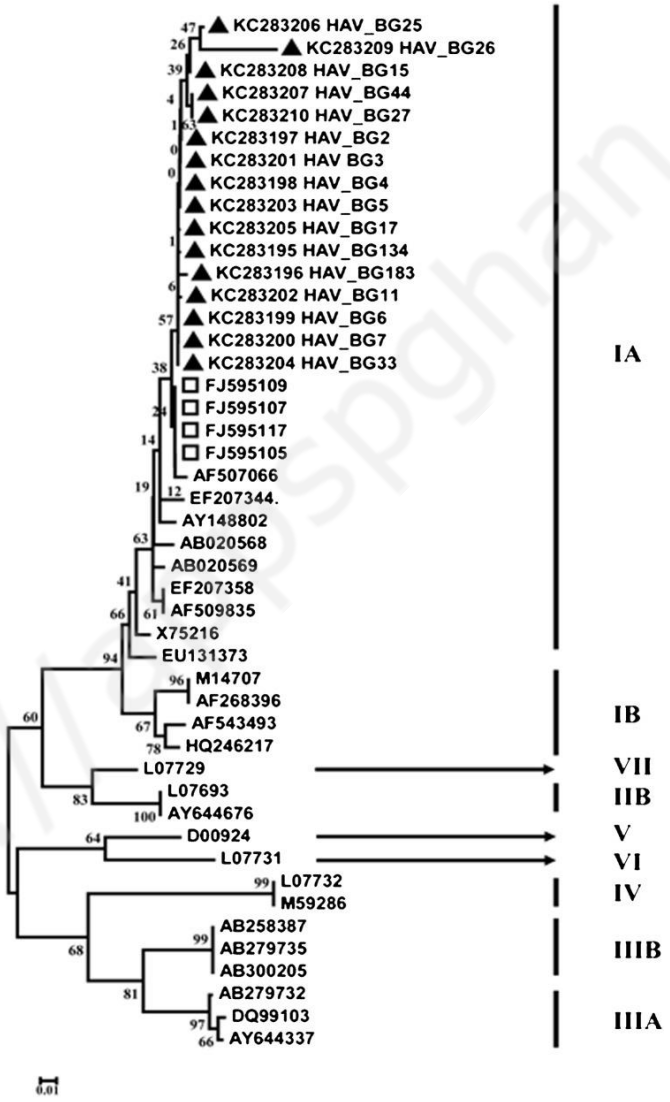


Poovorawan Y, J Clin Virol 2004 (inpress),
Sinlaparatsamee S et al, 1995,
Poovorawan Y (unpublished data)

Buengkan province where the large-scale hepatitis A virus (HAV) outbreak occurred in 2012

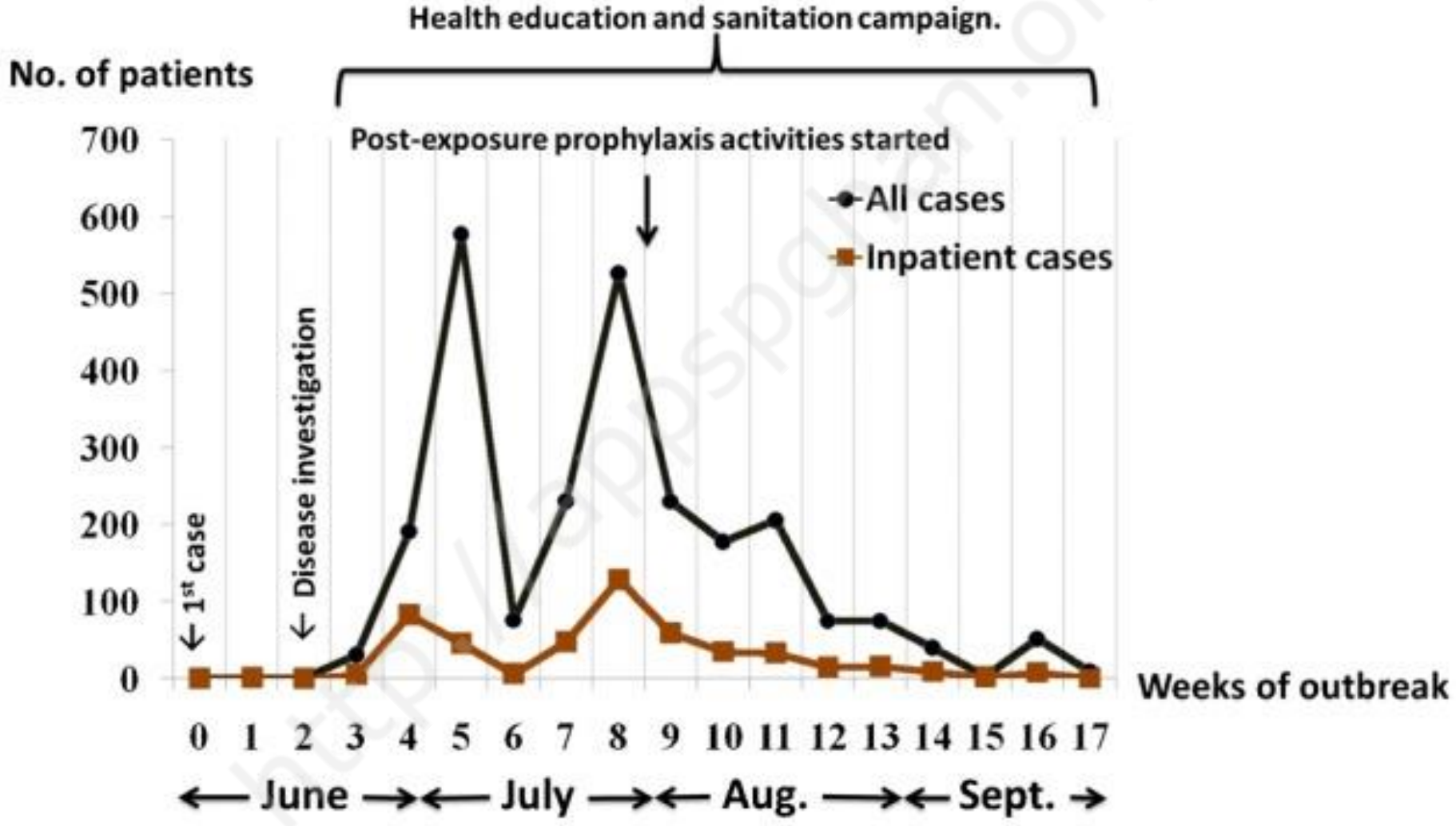
Poovorawan K et al. Pathog Glob Health. 2013 Oct;107(7):367-72

Phylogenetic tree of hepatitis A virus (HAV) strains based on the VP1-2A region



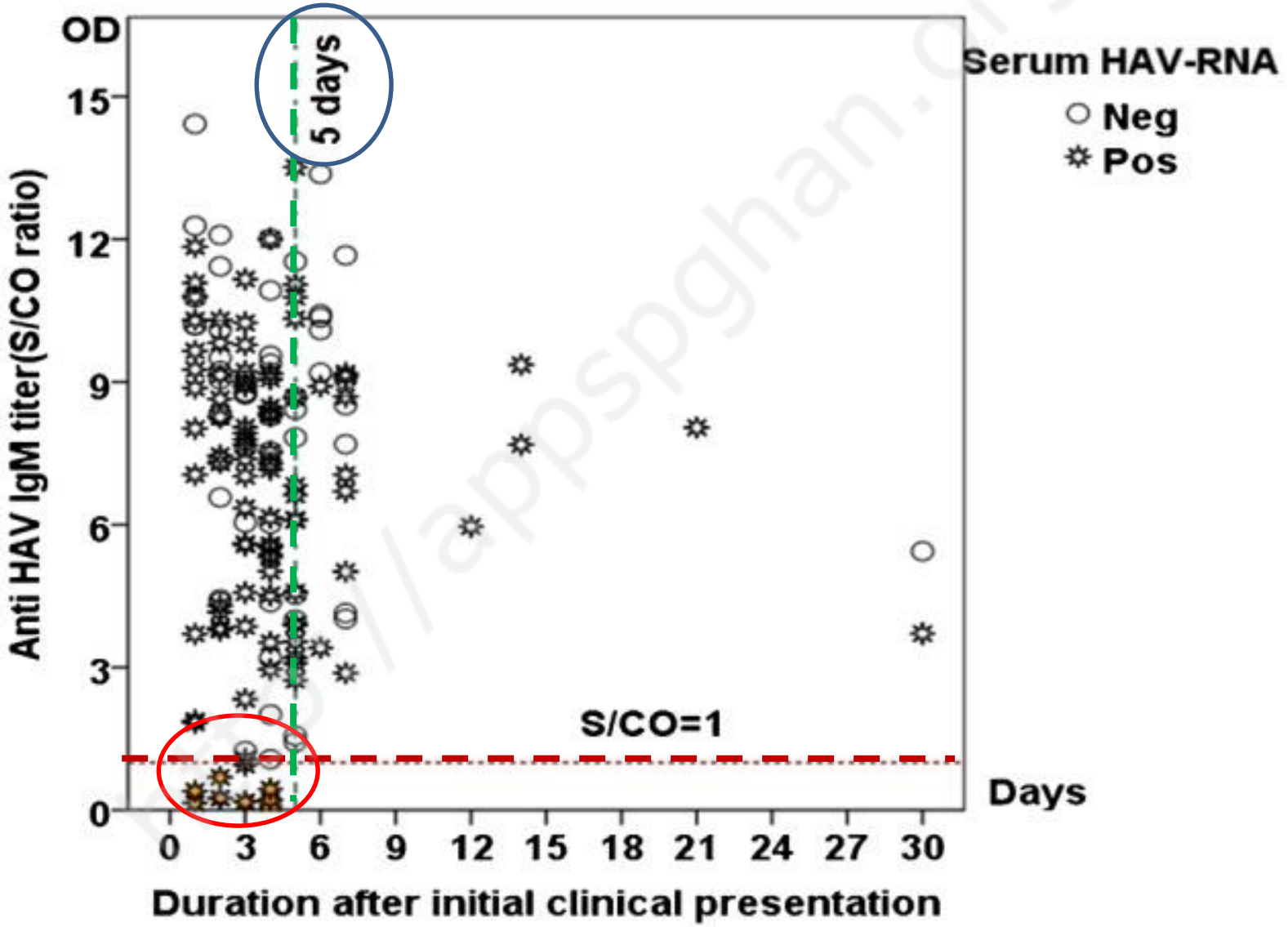
Poovorawan K et al. Pathog Glob Health. 2013 Oct;107(7):367-72

Three waves of acute hepatitis A patients during the epidemic and intervention phase.



Poovorawan K et al. Pathog Glob Health. 2013 Oct;107(7):367-72

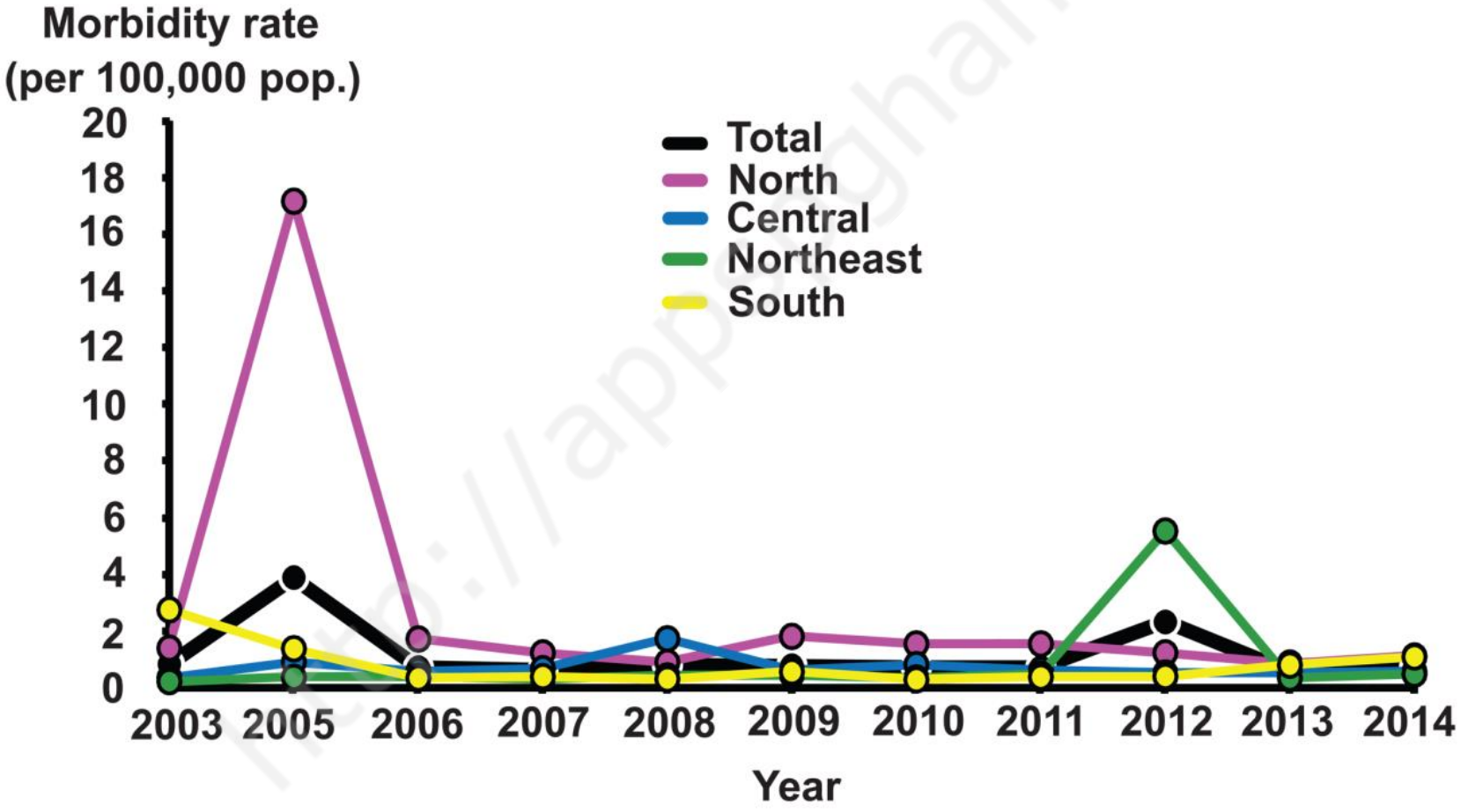
Anti-HAV IgM and HAV-RAV assays when analyzed individually



Hepatitis A virus infection

- Symptomatic and severity increased with age
- Mortality in children <0.1%
  - In patient with age >40 yr.. = 1%
- High mortality in CLD

Total hepatitis A infected cases and morbidity rate in Thailand



Hepatitis A high-risk groups

- Preschool children
- Homosexual men
- Intravenous drug users
- Travellers to areas of high endemicity
- Hospital workers
- Nursery / child day-care centre employees
- Food handlers

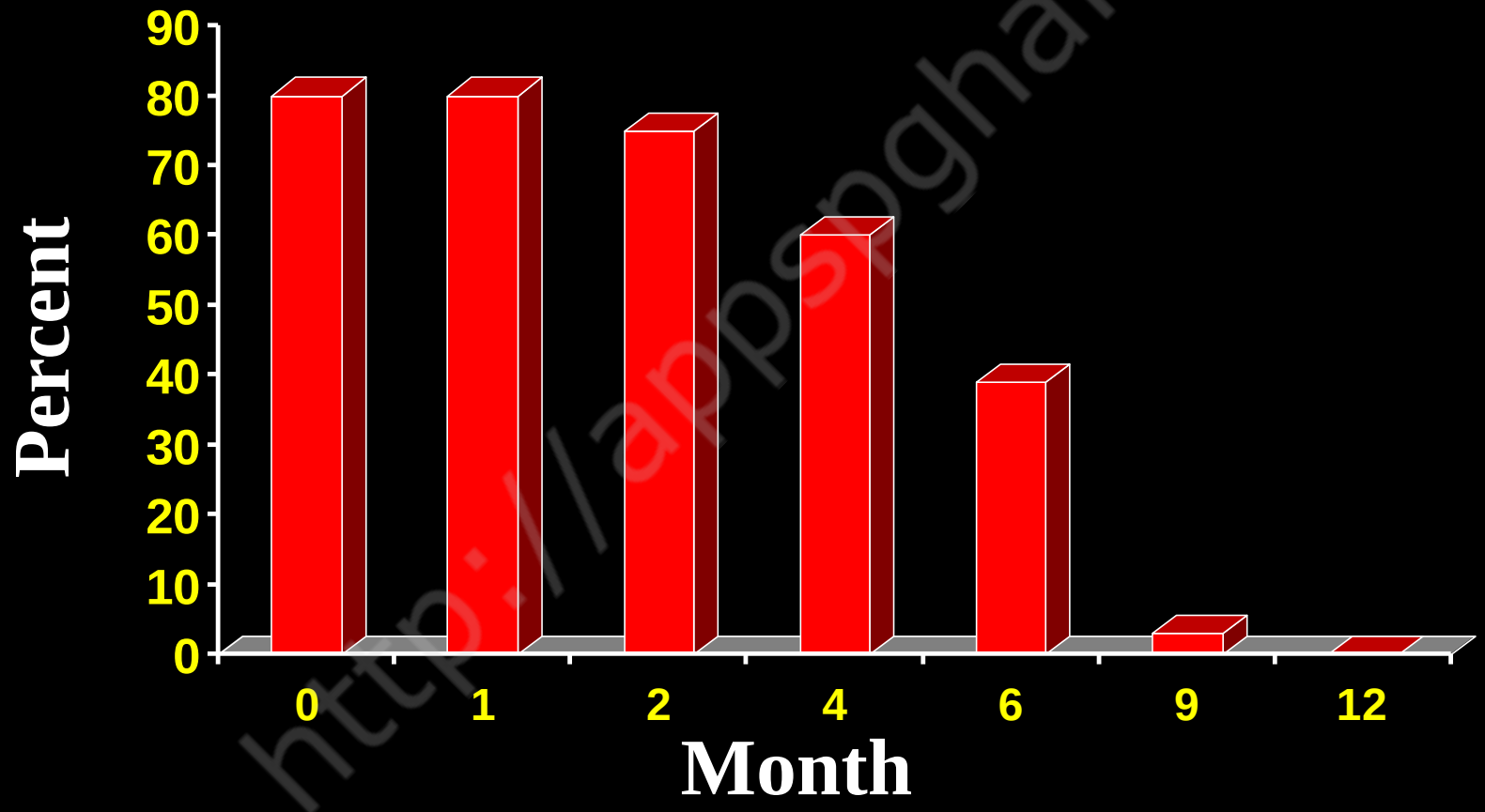
WHO

Control of hepatitis A

- implementation of standard and public health
- Pre & post exposure prophylaxis
  - Active immunization
  - Passive immunization

Passive antiHAV from mothers to infants

Passive anti HAV in infants



Control of hepatitis A

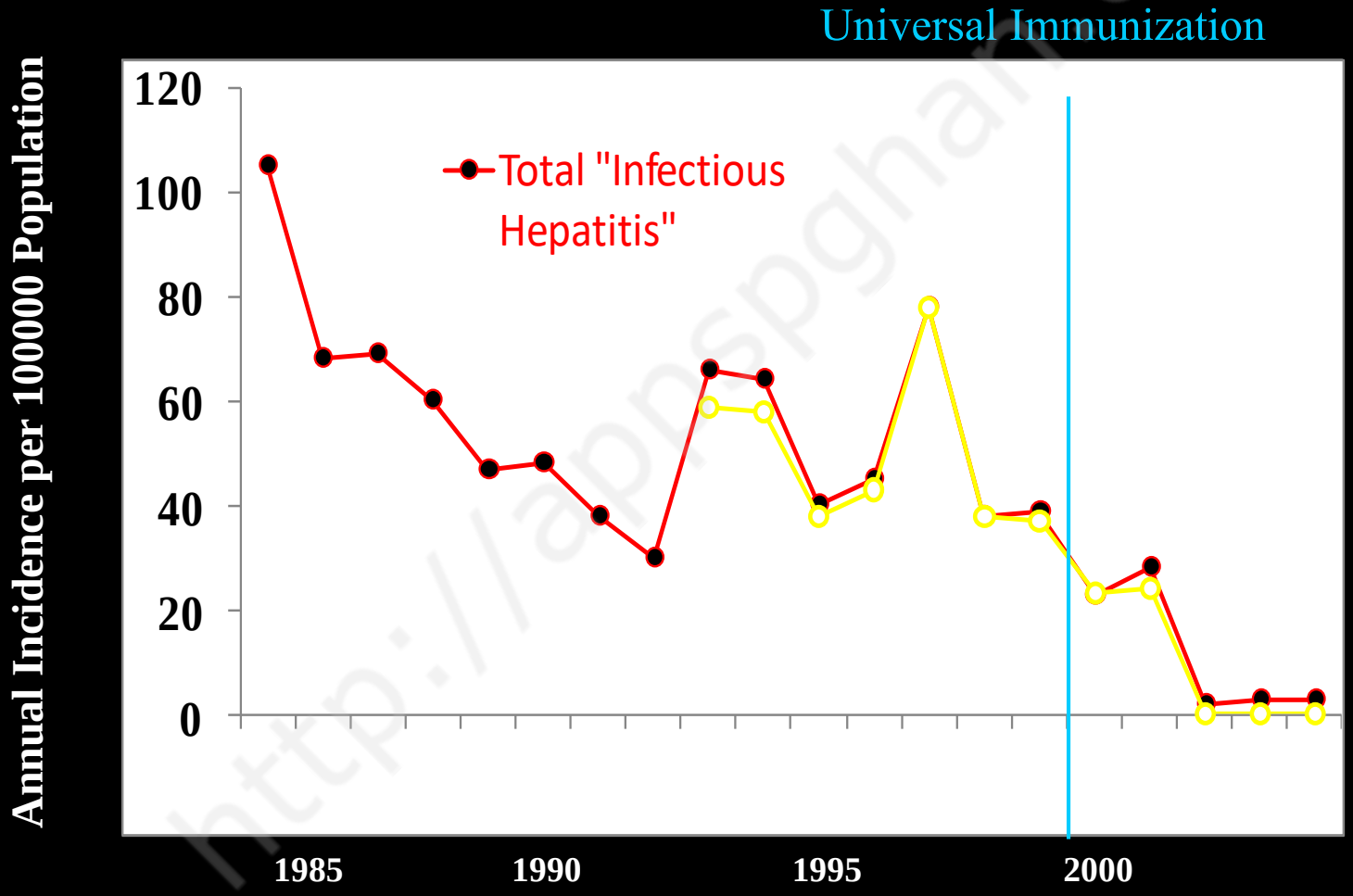
- Implementation of standard and public health
- Pre & post exposure prophylaxis
  - Active immunization
  - Passive immunization

Hepatitis Vaccine

Hepatitis A vaccine

- Live attenuated
- Inactivated

Incidence of Hepatitis A in Israel Following Universal Immunization of Toddlers



Dagan, R. et al. JAMA 2005;294:202-210

Hepatitis E

Hepatitis E virus

Background

1794: First outbreak in Lüdenscheid, Germany
1991: Named as hepatitis E virus (HEV)
1997, 1999: Reported in domestic pigs and wild boars
2010 - : Rat, rabbit, ferret, mink, fox, bat and moose

Host

Genotype 1 and 2: humans
Genotype 3 and 4: humans, pig, wild boar, deer, moongoose, monkey, rat

Poor sanitation at the Yusuf Batil refugee camp in South Sudan caused an outbreak of hepatitis E earlier 2012.

Disease burden

Every year there are an estimated 20 million hepatitis E infections, over 3 million acute cases of hepatitis E, and 56 600 hepatitis E-related deaths. (WHO, Fact sheet 2014)

The discovery of infectious hepatitis E virus in retail pork products may help explain the purported association between liver failure and pork consumption.

(1) Johne et al. Infect Genet Evol. 2014;27:212-29 (2) www.nature.com (3) www.nutritionfacts.org

History of HEV outbreaks

HISTORY

1955-56: 30,000 cases in New Delhi, India after flooding

1977: 20,000 cases in Mandalay, Myanmar, and found that 18% mortality in pregnant women

1978: 52,000 cases in Kashmir, India

1986-88: 100,000 cases in China

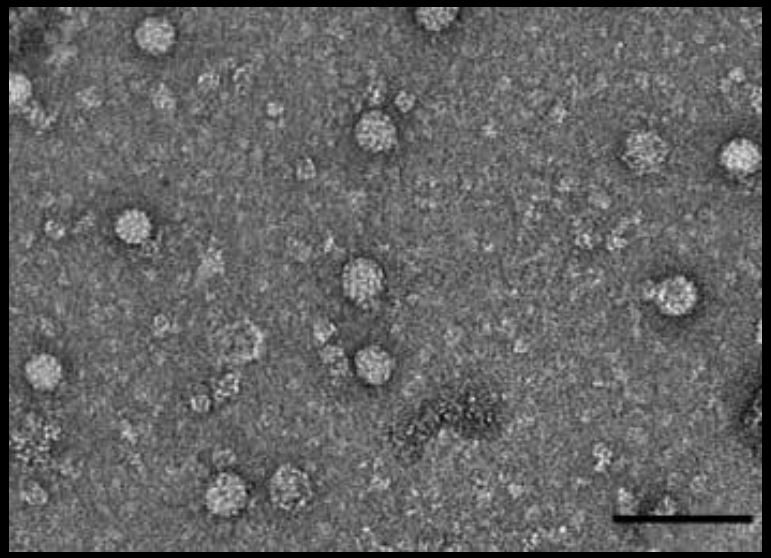
1988-89: 11,000 cases in Somalia
4,000 cases in Mexico

1995: Patients in Italy and Spain

2004: 2,600 cases in Sudan.

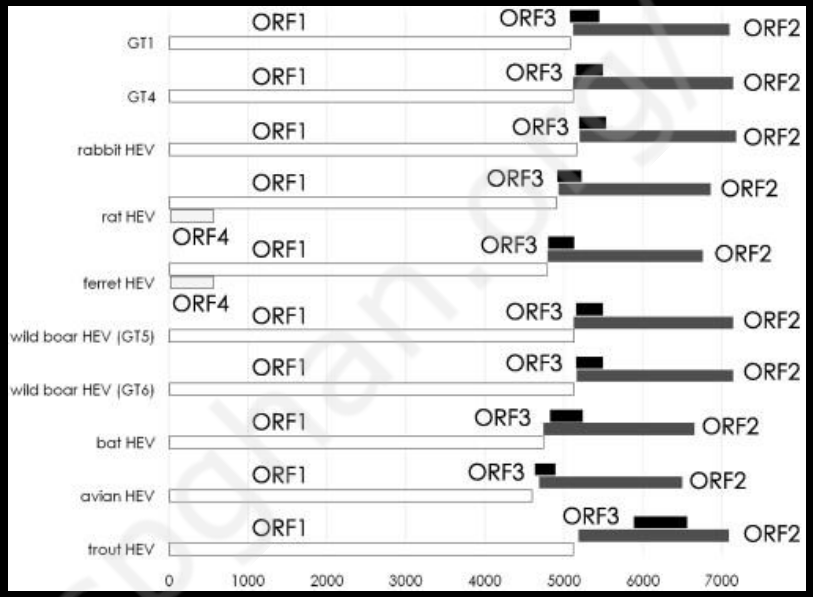
2008: 10,000 cases in Uganda

Virus structure



Hepeviridae, 25-35 nm

Genome organization

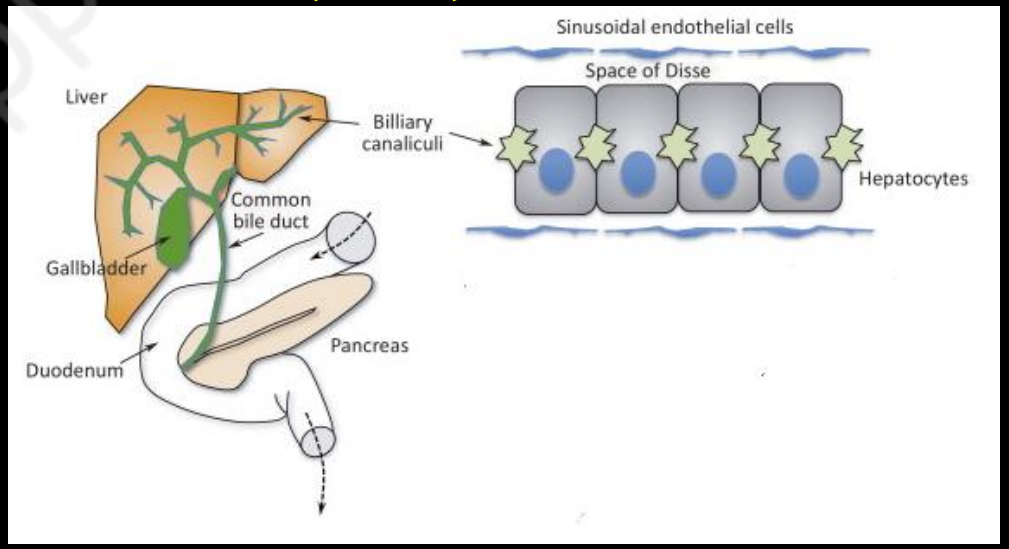


ssRNA,7kb, ORF1-4

Replication of HEV

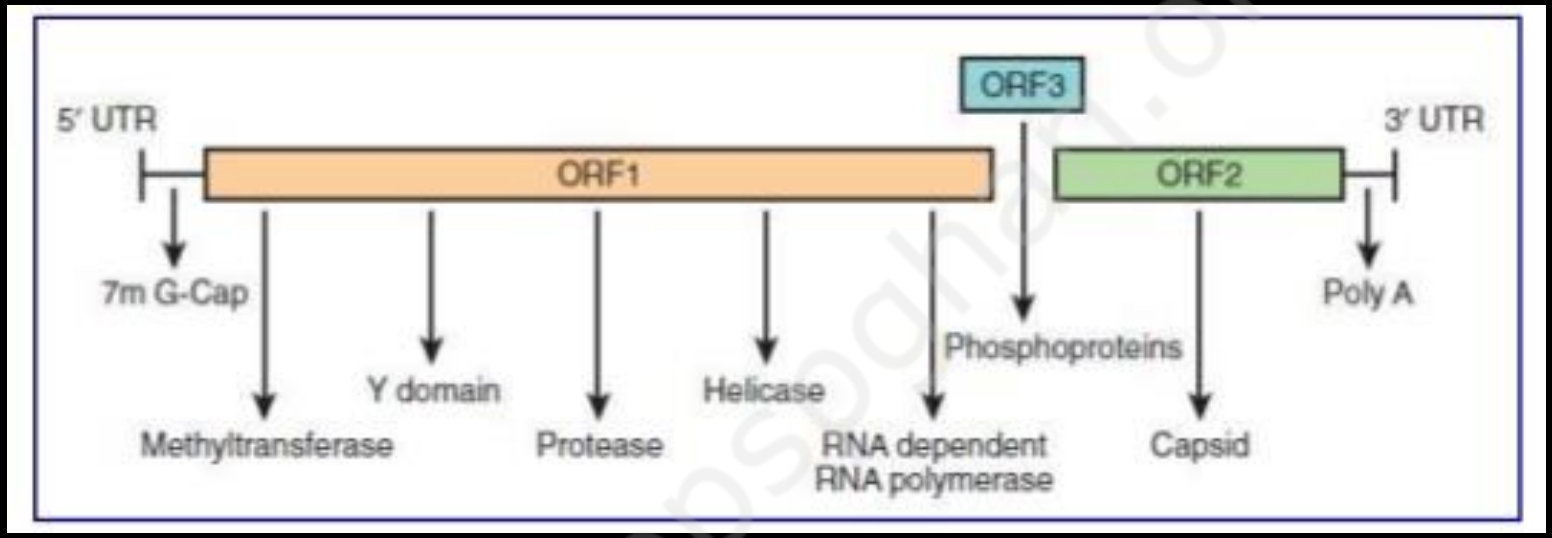
-Within cords of polarized hepatocytes

- Released across canalicular membrane into the biliary canaliculus and to a lesser extent across the basolateral membrane into the space of Disse and the hepatic sinusoids that are bathed by blood. It is likely that most virus shed in feces.



(1) Johne et al. Infect Genet Evol. 2014;27:212-29 (2) Feng et al. Trends Microbiol. 2014 ;22(2):59-64.

Genomic organization of HEV

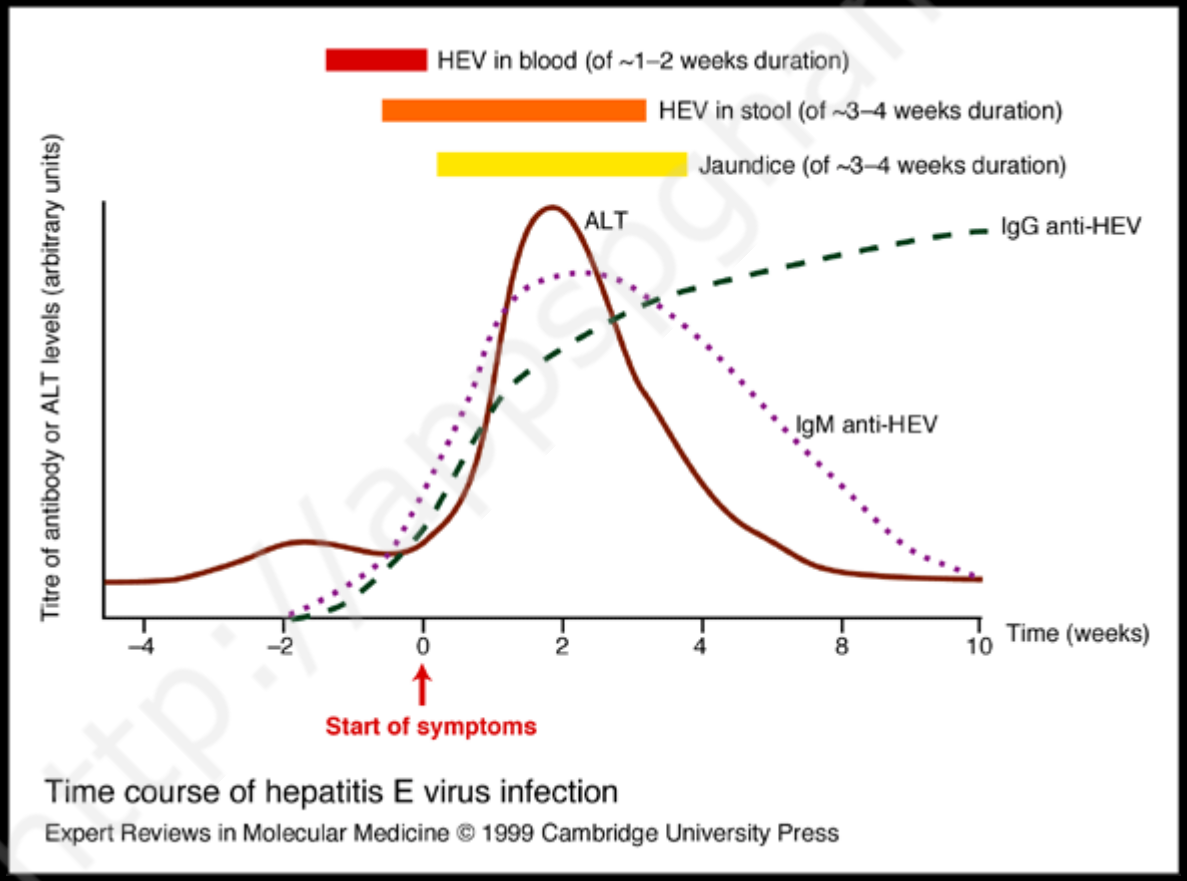


Three open reading frames (ORFs)

- **ORF 1 : encodes nonstructural protein (nsp)**
- **ORF 2 : encodes viral capsid protein**
- **ORF 3 : encodes small regulatory phosphoprotein**

Clinical characteristic

Incubation period: 3-8 wks **Symptoms:** jaundice, anorexia, vomiting, fever

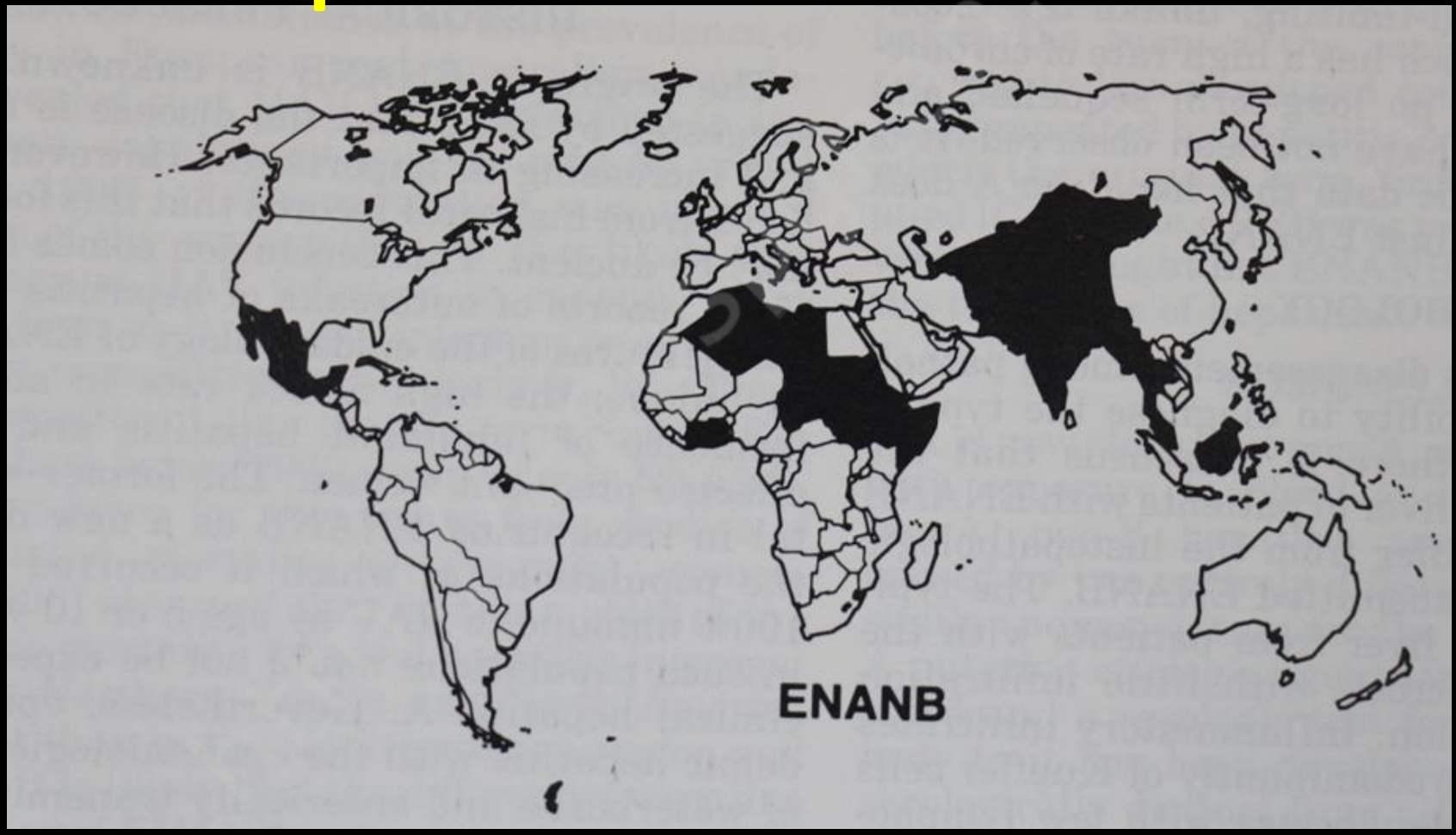


Time course of hepatitis E virus infection

Expert Reviews in Molecular Medicine © 1999 Cambridge University Press

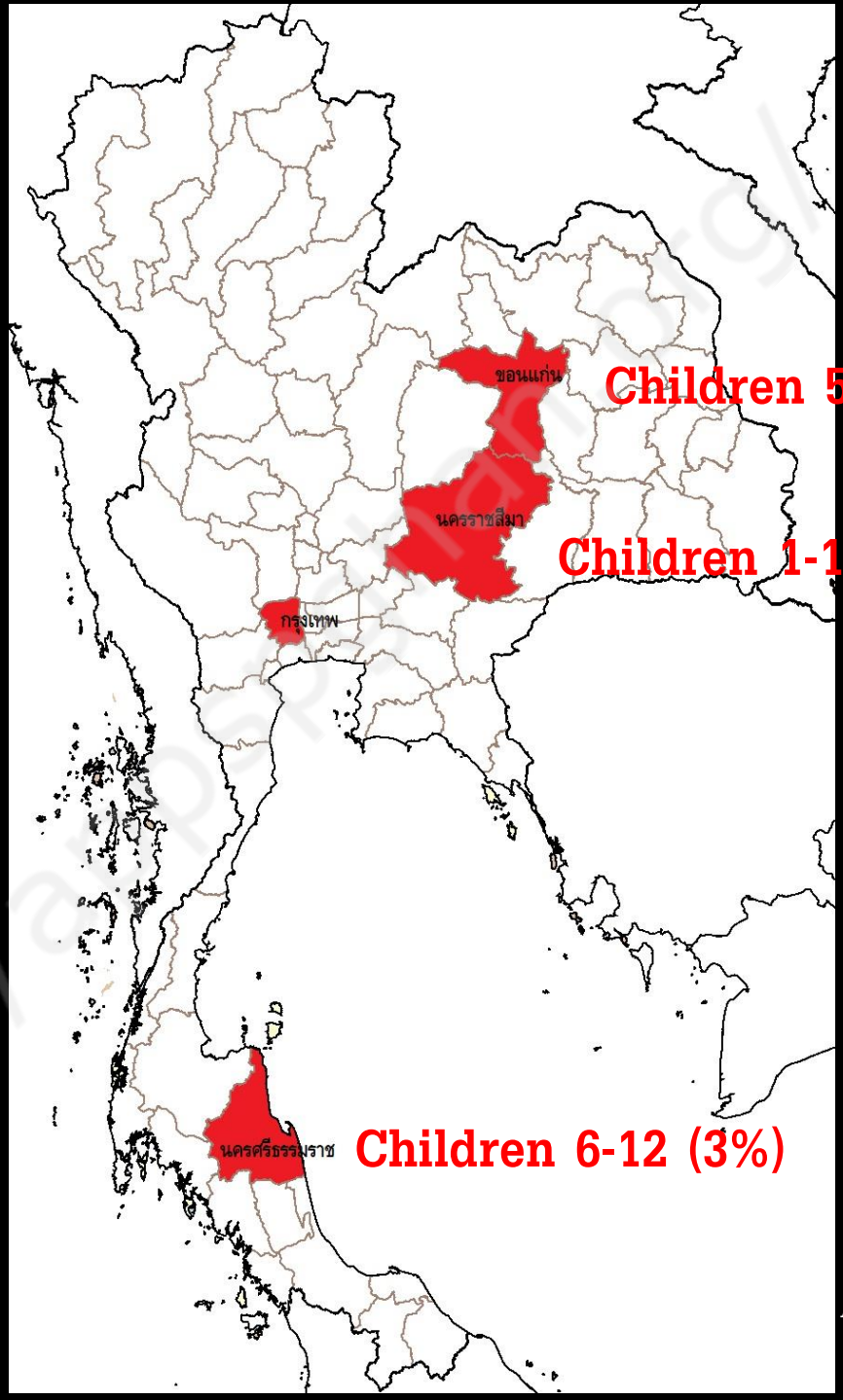
journals.cambridge.org

Proceeding of the 1987 International Conference Symposium on Viral Hepatitis and Liver Disease



Robert H Purcell et al. 1988;131-137

Prevalence of anti HEV in 1994, Thailand



Poovorawan et al. 1996

Ann Trop Med Parasitol

1996;90:189-96

Seroprevalence anti-HEV in Thailand 1994 Bangkok

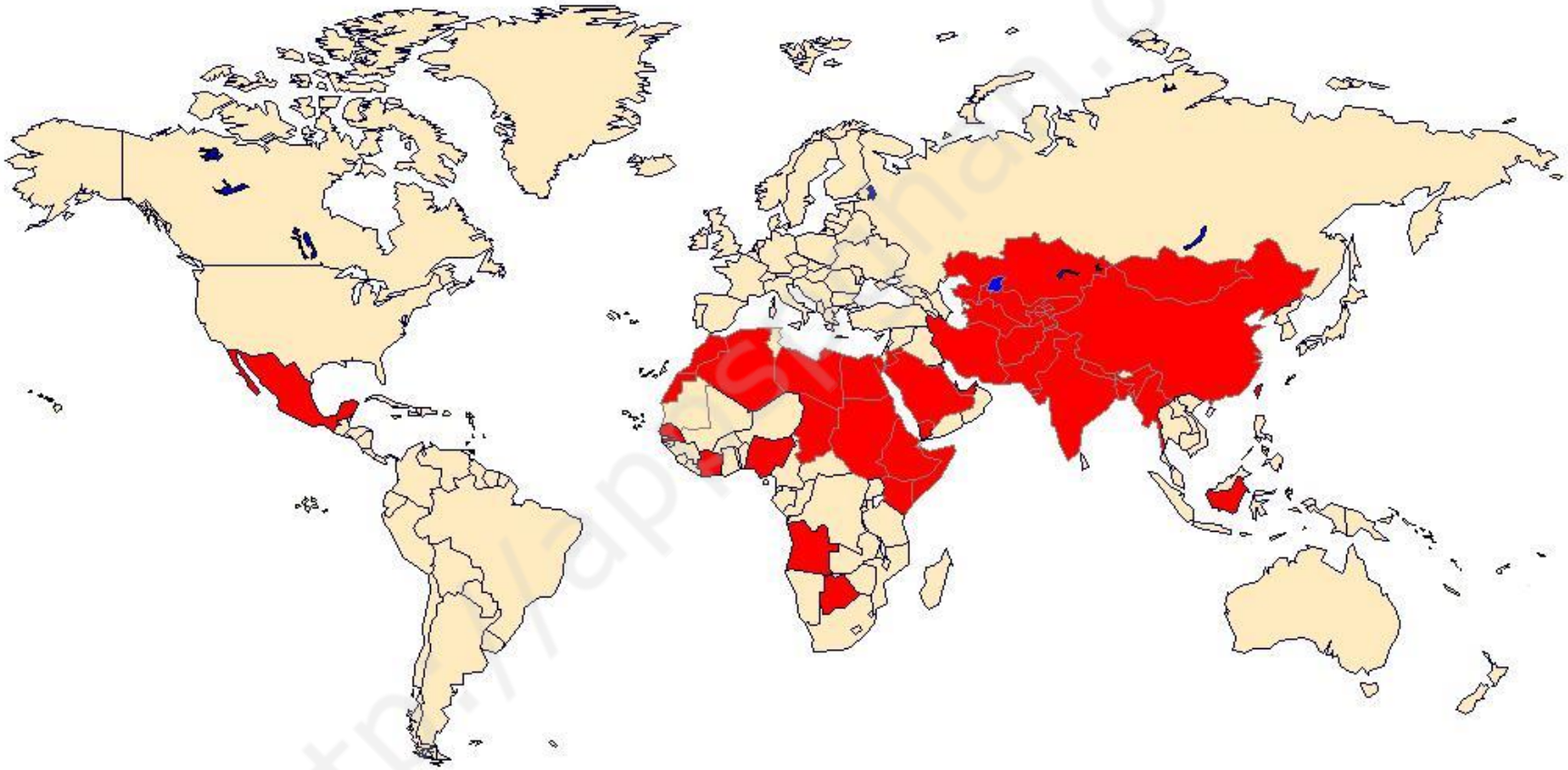
	No.	+ve	(%)
Blood donor 16-60 years	178	28	(15.7)
Pregnant women 16-45 years	178	16	(9.0)
Secondary school children 13-18 years	140	5	(3.6)

Poovorawan et al. 1996

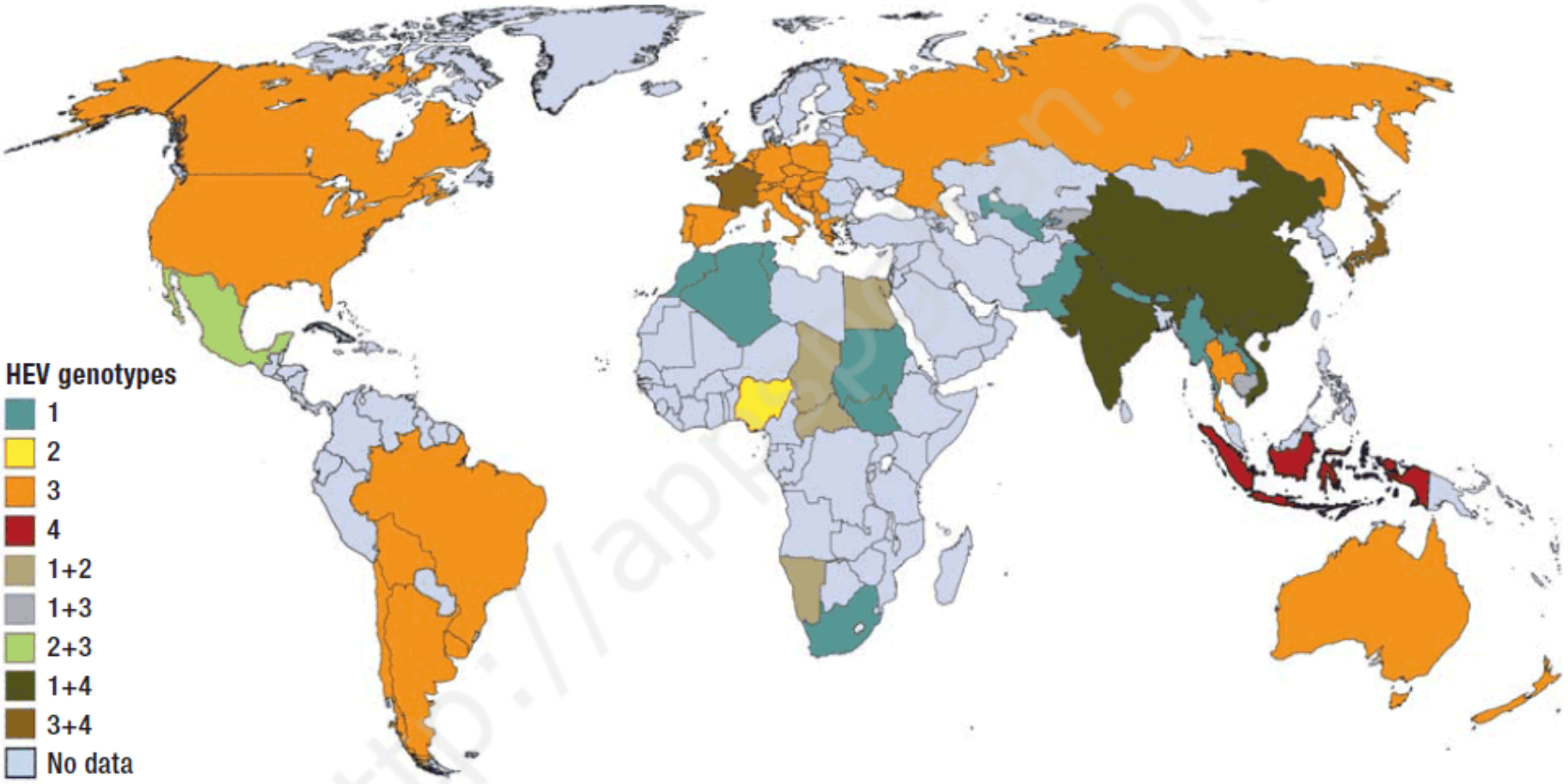
Ann Trop Med Parasitol 1996;90:189-96

Geographic Distribution of Hepatitis E

Outbreaks or Confirmed Infection in >25% of Sporadic Non-ABC Hepatitis



The global distribution of HEV genotype

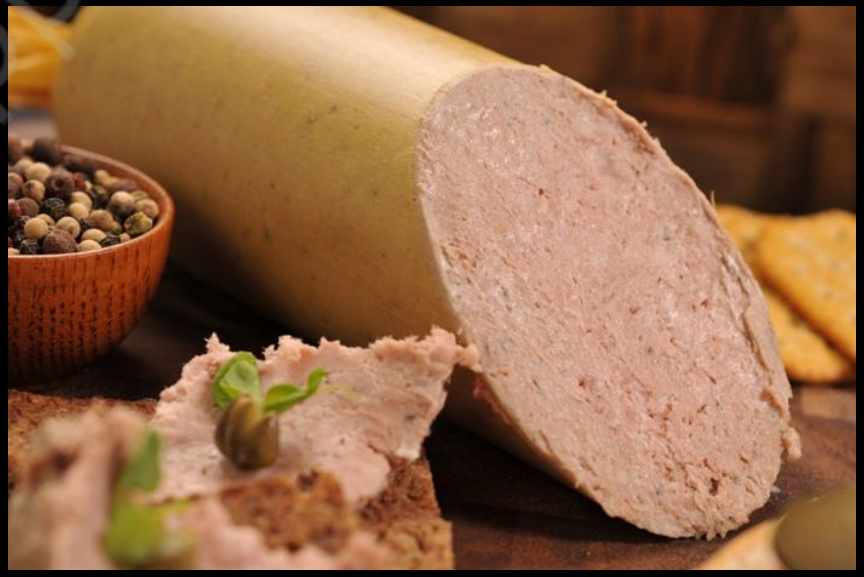


Pischke, S et al. (2014). Hepatitis E in Germany—an Under-Reported Infectious Disease. *Deutsches Ärzteblatt International*, *111*(35-36), 577.

Swine is the possible source of HEV infection in Thailand

Japan : HEV in wild boar

UK and France : HEV can be found in pork and pig products



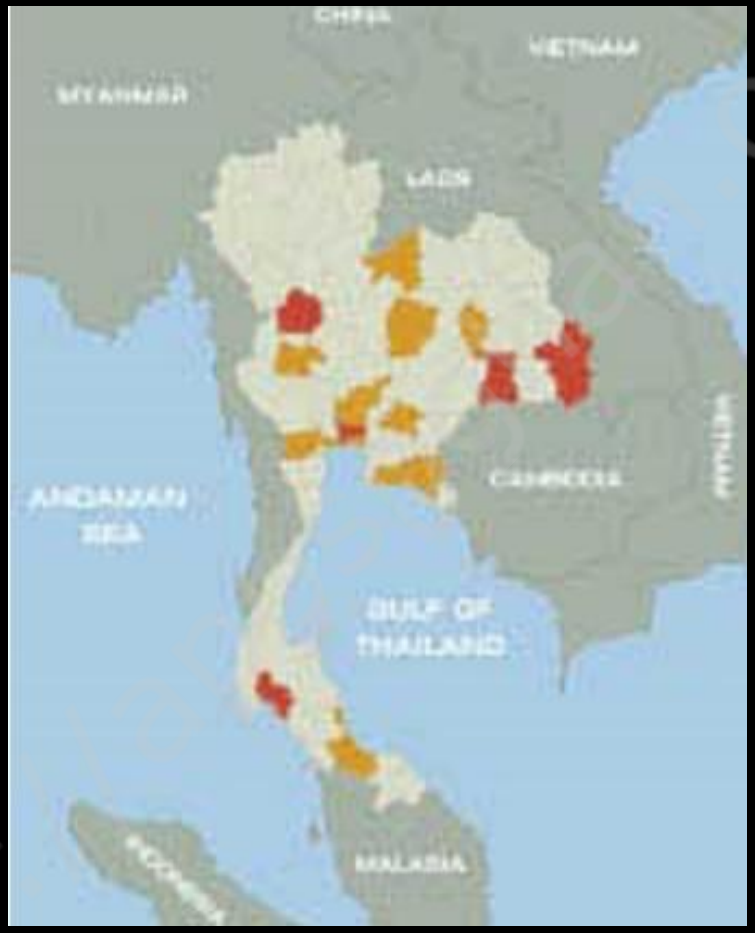
http://finestsausageandmeat.com/,www.tofugu.com,http://wlanru.blogspot.com/

HEV infection at Chulalongkorn Hospital

www.med.cmu.ac.th

Poovorawan K, Jitmitrapab S, Treeprasertsuk S, Thongmee T, Theamboonlers A, Tangkijvanich P, Komolmit P, Poovorawan Y.Asian Pac J Trop Med 2014. DOI: 10.1016/S1995-7645(14)60121-8

Risk factors and molecular characterization of acute sporadic symptomatic hepatitis E virus infection in Thailand



Regions of exposure (red) and residence (yellow) of acute HEV cases in Thailand.
Regions of confirmed relevant exposure included Nonthaburi, Ubonratchathani, Kamphaengphet, Krabi, Surin and Bangkok; regions of residence included Ayutthaya, Ratchaburi, Rayong, Prachinburi, Uthaithani, Chanthaburi, Loei, Samutprakarn, Samut Sakhon, Mahasarakham, Chaiyaphum, Saraburi and Songkhla.

Poovorawan K, Jitmitrapab S, Treeprasertsuk S, Thongmee T, Theamboonlers A, Tangkijvanich P, Komolmit P, Poovorawan Y.Asian Pac J Trop Med 2014. DOI: 10.1016/S1995-7645(14)60121-8

Laboratory data of acute hepatitis E patients classified by patient risk. Plus–minus values are mean ± SD for all comparisons. TB: total bilirubin, DB: direct bilirubin, AST: Aspartate transaminase, ALT: Alanine transaminase, ALP: alkaline phosphatase, INR: international normalized ratio. †Risk group defined as patients with one of the following clinical risks: very elderly (>80 years), liver cirrhosis or immune-compromised/post transplantation. *Statistically significant, ‡ mean (range), § Mann–Whitney U test

Laboratory data	All cases (*n*=40)	High risk group (*n*=16) †	Low risk group (*n*=24)	*P* value
TB (mg/dL)	10.4±9.9	9.4±9.5	11.1±10.3	0.62
DB (mg/dL)	8.5±8.6	7.1±7.7	9.6±9.2	0.40
AST (U/L) ‡	226 (24-5440)	197 (117-5440)	324 (24-3266)	0.51§
ALT (U/L) ‡	463 (32-3986)	237 (54-3986)	495 (42-3750)	0.18§
ALP (U/L)	192±96	221±119	156±57	0.01*
INR	1.25±0.34	1.35±0.30	1.17±0.30	0.20
Peak TB (mg/dL) ‡	10.4 (0.7-56.5)	13.1 (4.6-56.5)	10 (0.7-41)	0.46§
Peak DB (mg/dL) ‡	9.2 (0.4-37.5)	10.3 (2.6-37.5)	7.7 (0.4-34)	0.69§
Peak INR	1.4±0.4	1.5±0.6	1.2±0.2	0.07

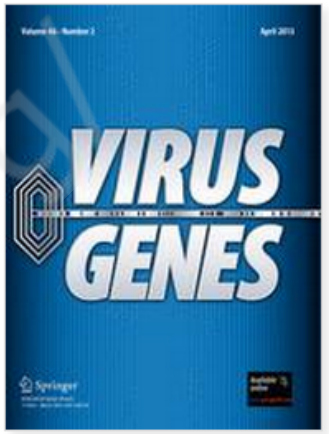
Poovorawan K, Jitmitrapab S, Treeprasertsuk S, Thongmee T, Theamboonlers A, Tangkijvanich P, Komolmit P, Poovorawan Y.Asian Pac J Trop Med 2014.

Virus Genes
April 2013, Volume 46, Issue 2, pp 369-370

Date: 27 Nov 2012

Hepatitis E virus genotype 3f sequences from pigs in Thailand, 2011–2012

Juthatip Keawcharoen, Thanunrat Thongmee, Raphee Panyathong, Pichai Joiphaeng, Supansa Tuanthap, Kanisak Oraveerakul, Apiradee Theamboonlers, Yong Poovorawan

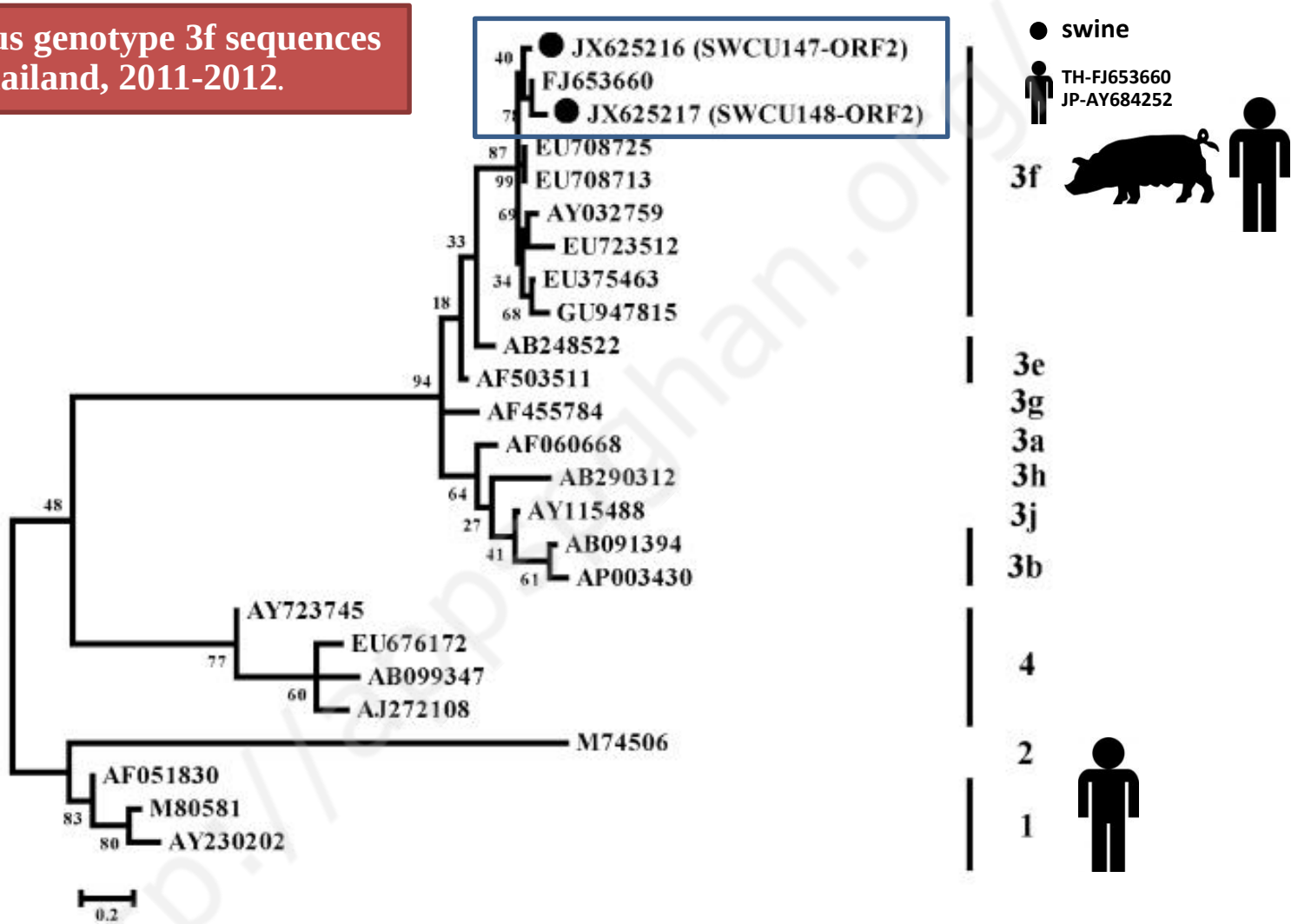


Three of 237 one to 22 week old pigs fecal specimen were positive for HEV-RNA

Phylogenetic analysis of partial ORF1 and ORF2 genes of Hepatitis E virus (HEV) strains from pigs in Thailand during 2011–2012 was performed. The result indicated that the current Thai strains belonged to the genotype 3 subgroup 3f, which were similar to the previous HEVs circulating in humans in Thailand

Hepatitis E virus genotype 3f sequences from pigs in Thailand, 2011-2012.

ORF2 of HEV



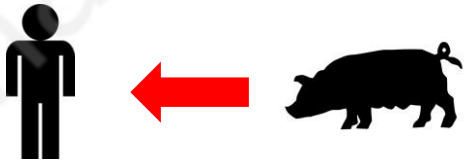
Keawcharoen J, Thongmee T, Panyathong R, Joiphaeng P, Tuanthap S, Oraveerakul K, Theamboonlers A, Poovorawan Y. Virus Genes. 2013;46:369-70.

Arch Virol (2010) 155:1697–1699
DOI 10.1007/s00705-010-0751-8

BRIEF REPORT

Swine as the possible source of hepatitis E virus transmission to humans in Thailand

Kamol Suwannakarn · Chitima Tongmee · Apiradee Theamboonlers · Piyawat Komolmit · Yong Poovorawan



We found that viruses recovered from Thai patients are closely related to genotype 3 and swine hepatitis E virus in Thailand. Based on analysis of a 302-base-pair ORF2 fragment the strains investigated belong to subgroup 3 e and are closely related to European strains. Based on the results obtained, swine are suspected to be a source of HEV transmission to human in Thailand

related to genotype 3 and swine hepatitis E virus in Thailand. Based on analysis of a 302-base-pair ORF2 fragment, the strains investigated belong to subgroup 3e and are closely related to European strains. Based on the results

Based on genetic variability, HEV has been divided into five genotypes. Genotypes 1–4 have been reported in mammals [1, 3, 7, 11], whereas genotype 5, avian HEV, has been detected in avian species and does not seem to

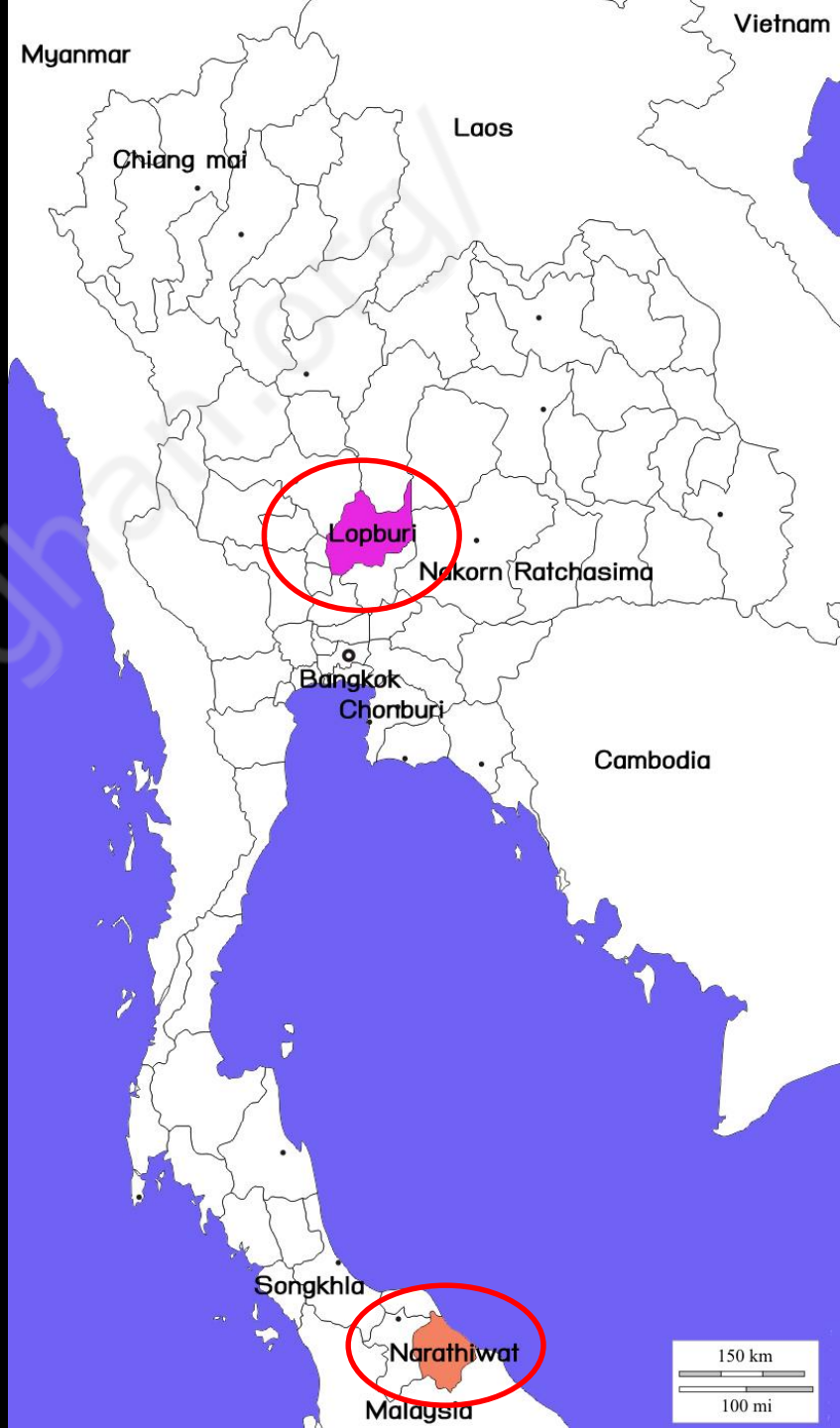
Narathiwat province

Target provinces

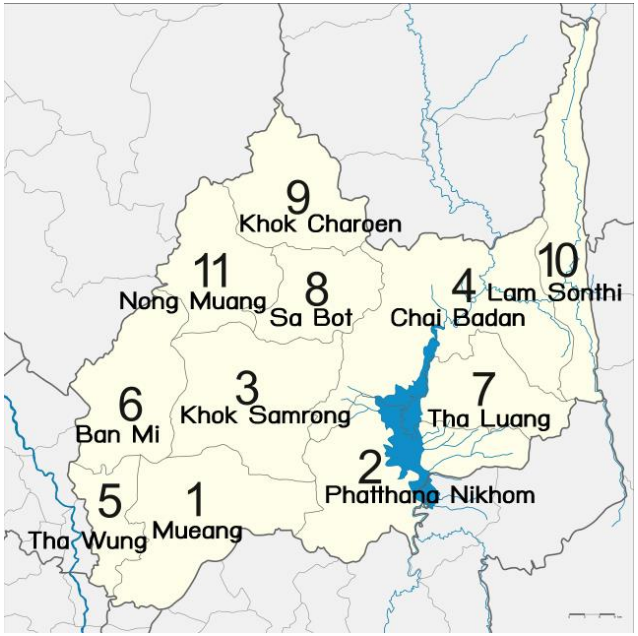
Lopburi: 778
(388 males, 390 females)

Narathiwat: 566
(134 males, 432 females)

Sa-nguanmoo P et al. PLoS One. 2015 Apr 30;10(4):e0126184



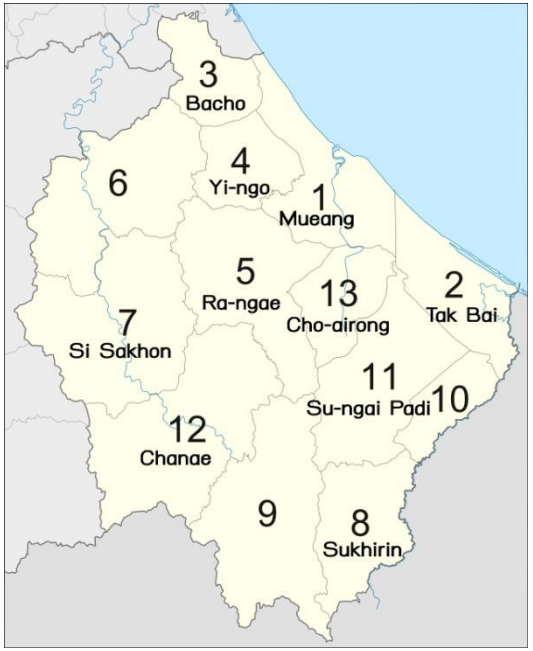
Lopburi



Total population: 758,059[a]
Pig population: 342,276[b]
Islamic: 0.13%[c]
Pig farm: 226[e]
Population study: 778 (388 males, 390 females)

Narathiwat

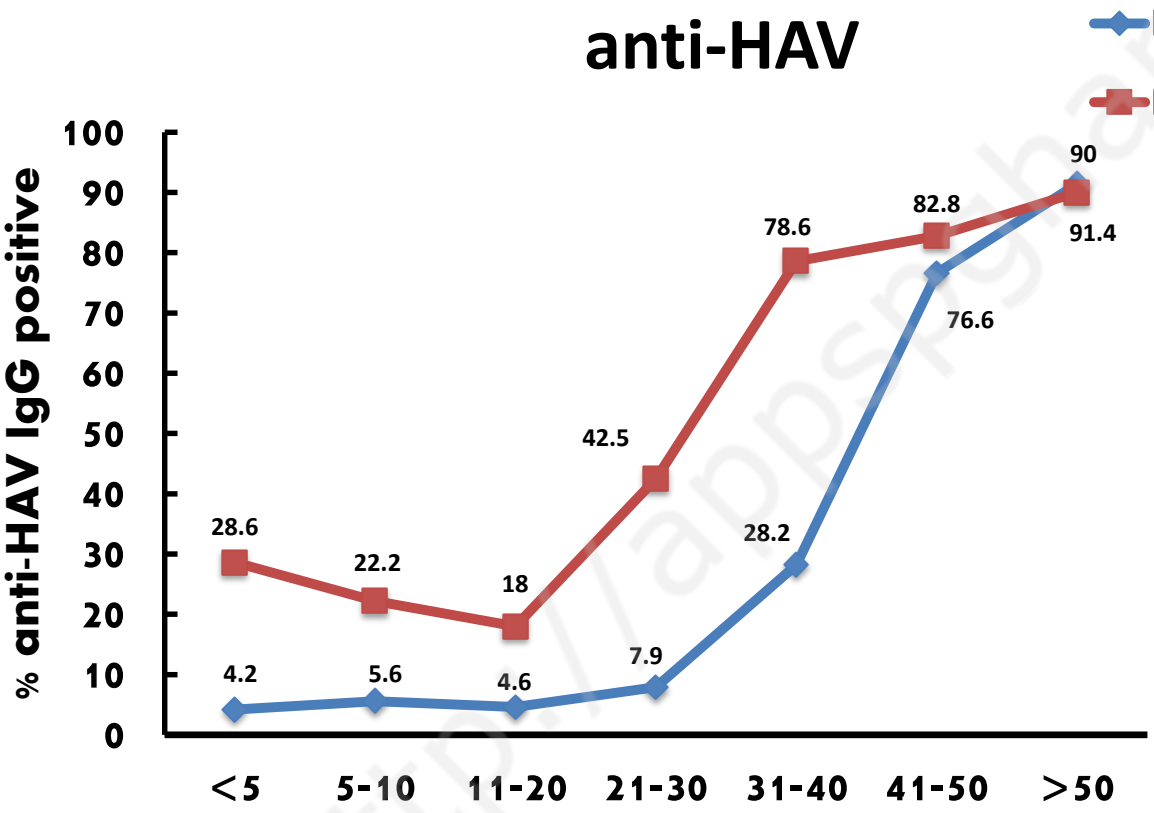
Total population: 757,397[a]
Islamic: 82%[d]
Pig farm: no data[e]
Population study: 566 (134 males, 432 females)

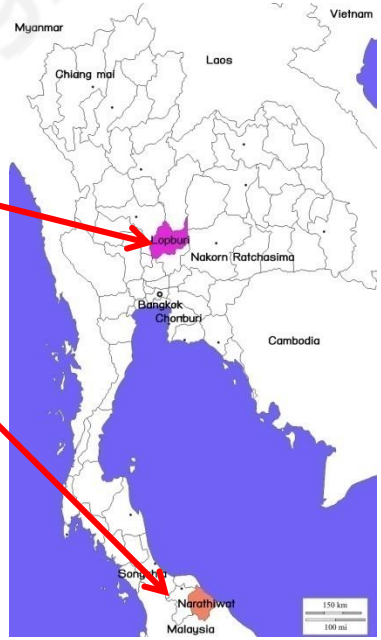


[a] Year 2012 , The Bureau of Registration Administration, Department of Provincial Administration, Ministry of Interior (available on 203.146.15.175/ESSNEW/)
[b] Year 2013, Information Technology Center, Department of Livestock Development (available on http://ict.dld.go.th/th2/images/stories/planning/2557/report_summary2013.pdf) Ministry of Agriculture and Cooperatives
[C] Year 2012, Lopburi Province, (availabe on http://www.lopburi.go.th/plan_lopburi/plan_lop57-60.pdf)
[d] Year 2012, Narathiwat Province, (available on http://103.28.101.10/briefprovince/filedoc/96000000.pdf)
[e] Department of Internal trade, Ministry of Commerce, (avialable on http://gis.dit.go.th/region/Report/rp_place_all.aspx?pid=40&poid=11&p=16)

Sa-nguanmoo P et al. PLoS One. 2015 Apr 30;10(4):e0126184

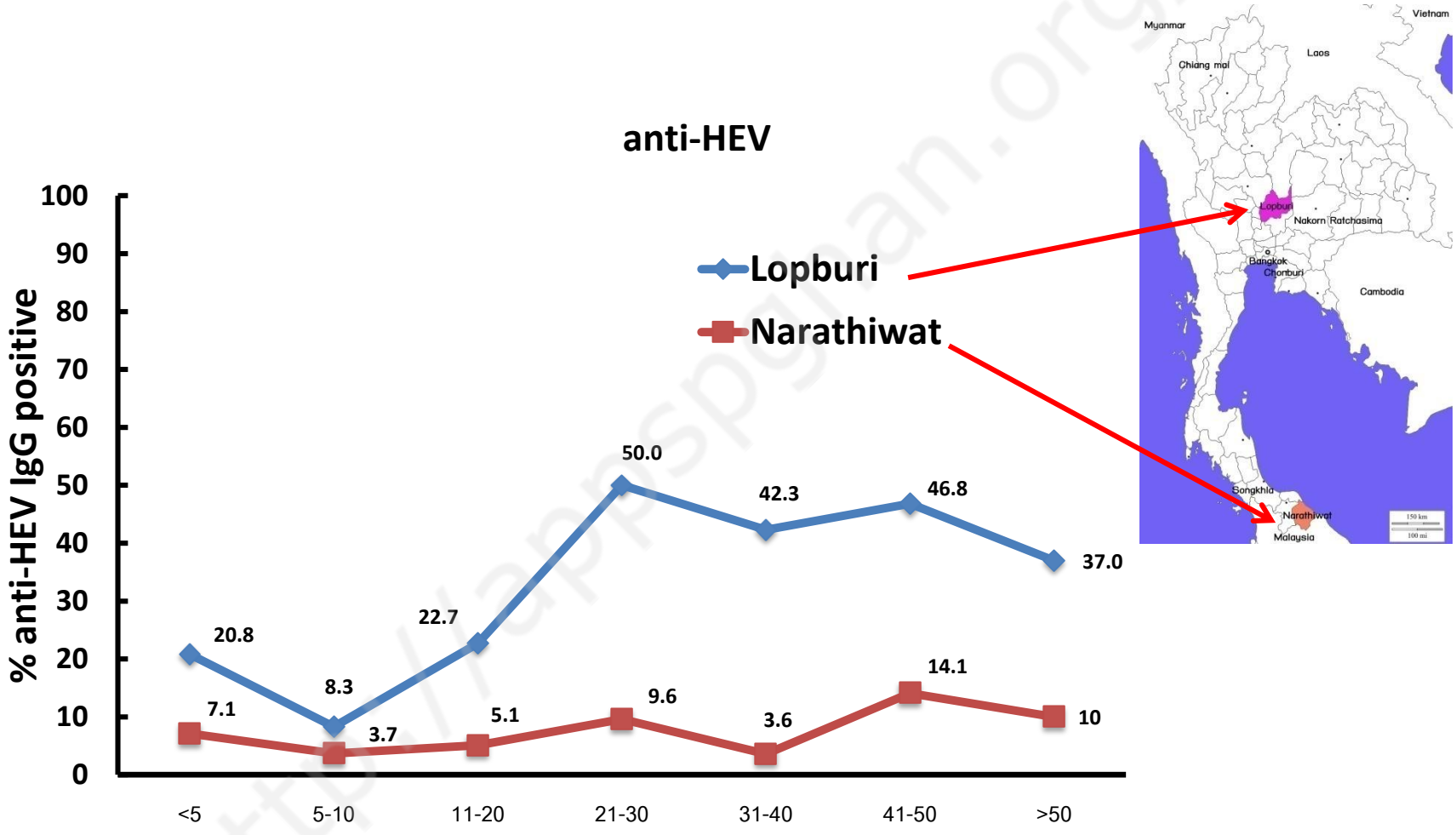
Seroprevalence of anti HAV





Sa-nguanmoo P et al. PLoS One. 2015 Apr 30;10(4):e0126184

Seroprevalence of anti HEV



Sa-nguanmoo P et al. PLoS One. 2015 Apr 30;10(4):e0126184

PLOS | ONE

RESEARCH ARTICLE

Swine Is a Possible Source of Hepatitis E Virus Infection by Comparative Study of Hepatitis A and E Seroprevalence in Thailand

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Academic Editor: Srinand Sreevatsan, University of Minnesota, UNITED STATES

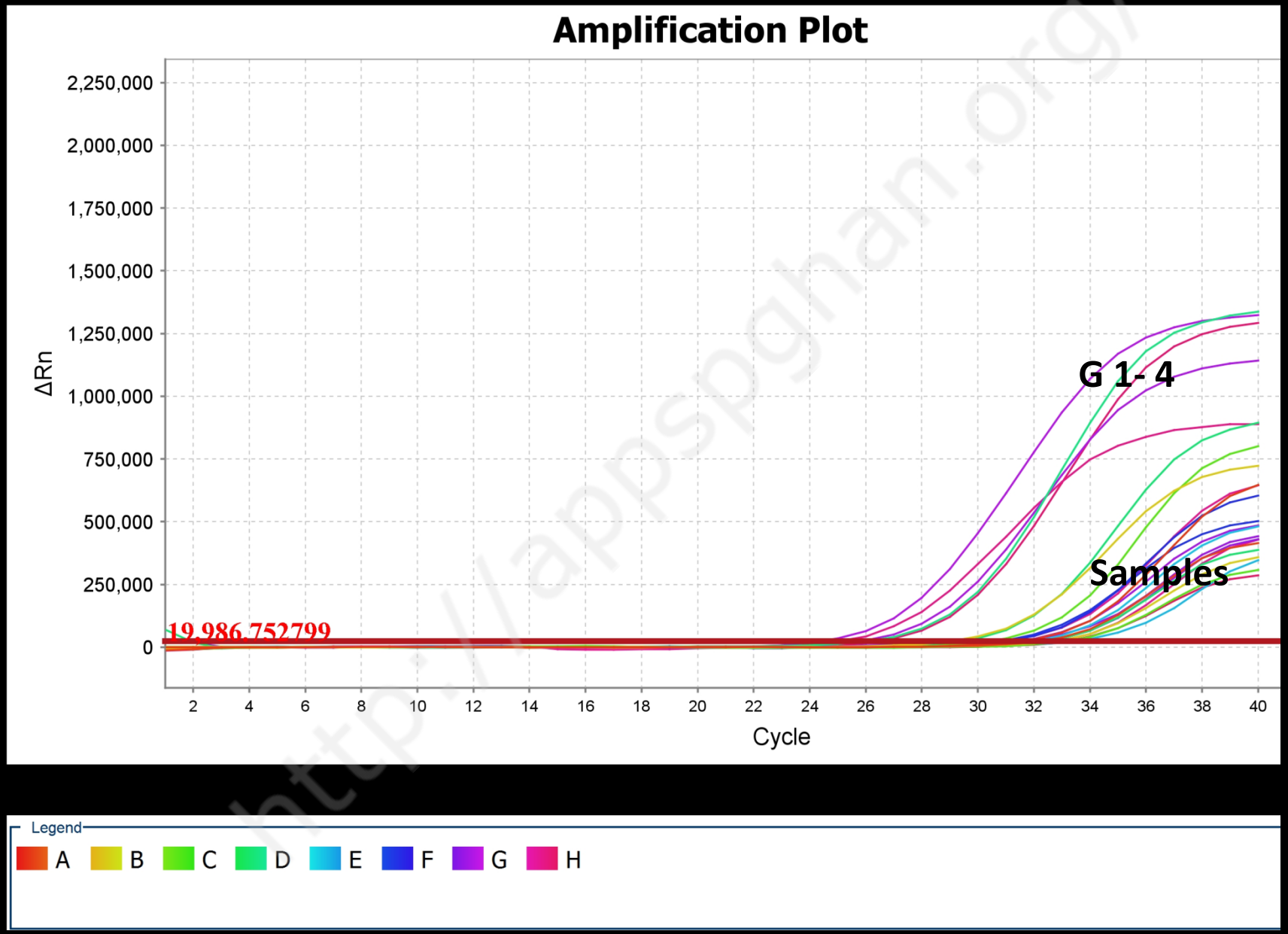
Received: February 13, 2015

Abstract

Hepatitis A virus (HAV) and hepatitis E virus (HEV) infection in developing countries are associated with contaminated food or water. Although Thailand is non-endemic for HEV, sporadic infections may occur from zoonotic transmission. Individuals between 7 months to 69 years (mean age = 32.8) from predominantly Islamic Narathiwat (n = 305) and swine farm-dense Lop Buri (n = 416) provinces were screened for anti-HEV and anti-HAV antibodies by commercial enzyme-linked immunosorbent assay and automated chemiluminescent microparticle immunoassay, respectively. Seroprevalence and relative antibody titers were analyzed according to age groups. HAV IgG antibody positive rates in Lop Buri and Narathiwat residents were 39.9% and 58%, respectively ($p < 0.001$). Greater than 90% of individuals

Diagnostic Development of Hepatitis E virus by Real-Time RT PCR

Real time PCR testing on samples



Hepatitis E in Pork and Variety Meats in Fresh Markets

Sample collected from swine

Collection time :
November 2014 – February 2015

Liver : 1,144 samples
Pork : 560 samples
Intestine : 557samples

Bile : 720 samples
Feces : 720 samples

Slaughter house

Klongtoey

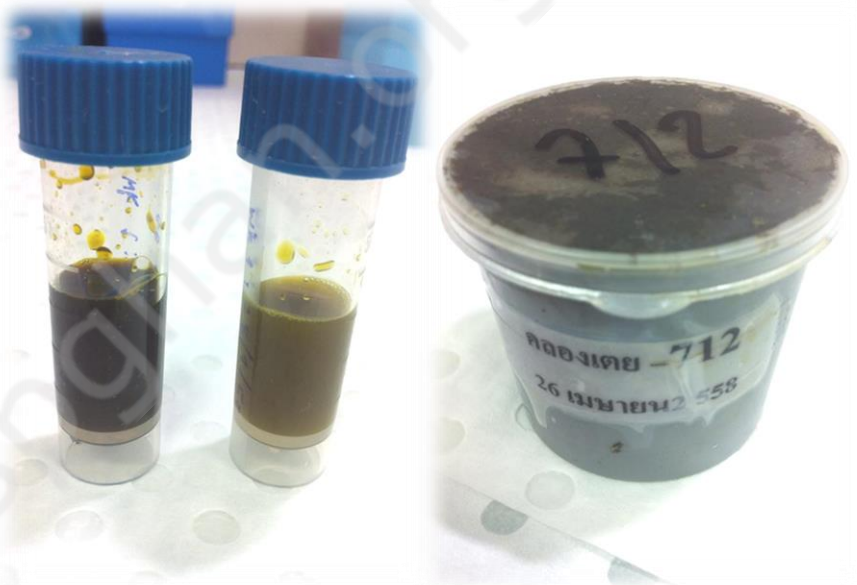
Market

- Klongtoey
- Suanplu
- Bangkruai
- BangPo
- S.K. floor 11
- Bangson

Swine samples

Market

- Khlong Toei
- Suan Plu
- Bang Kruai
- Bang Po
- Bang Son
- Tao poon



Sluaghterhouse

- Khlong Toei

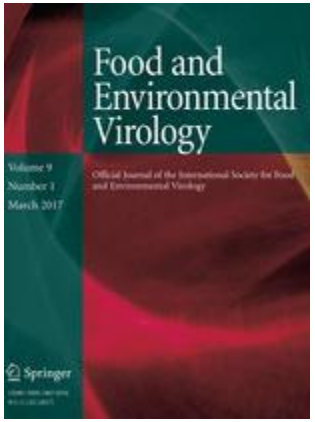
HEV in variety part of pig in fresh markets and slaughter house

Liver	3	in	1000
Bile	3.6	in	100
Feces	5	in	100
Pork	0.7	in	1000
Intestine	not found		

Food Environ Virol (2017) 9:45–53
DOI 10.1007/s12560-016-9258-0

ORIGINAL PAPER

Hepatitis E Virus in Pork and Variety Meats Sold in Fresh Markets



Duangnapa Intharasongkroh[1] · Pattaratida Sa-nguanmoo[1] · Supansa Tuanthap[1] · Thanunrat Thongmee[1] · Ausanee Duang-in[1] · Sirapa Klinfueng[1] · Jira Chansaenroj[1] · Sompong Vongpunsawad[1] · Apiradee Theamboonlers[1] · Sunchai Payungporn[2] · Chintana Chirathaworn[3] · Yong Poovorawan[1]

Received: 13 June 2016 / Accepted: 25 August 2016 / Published online: 31 August 2016

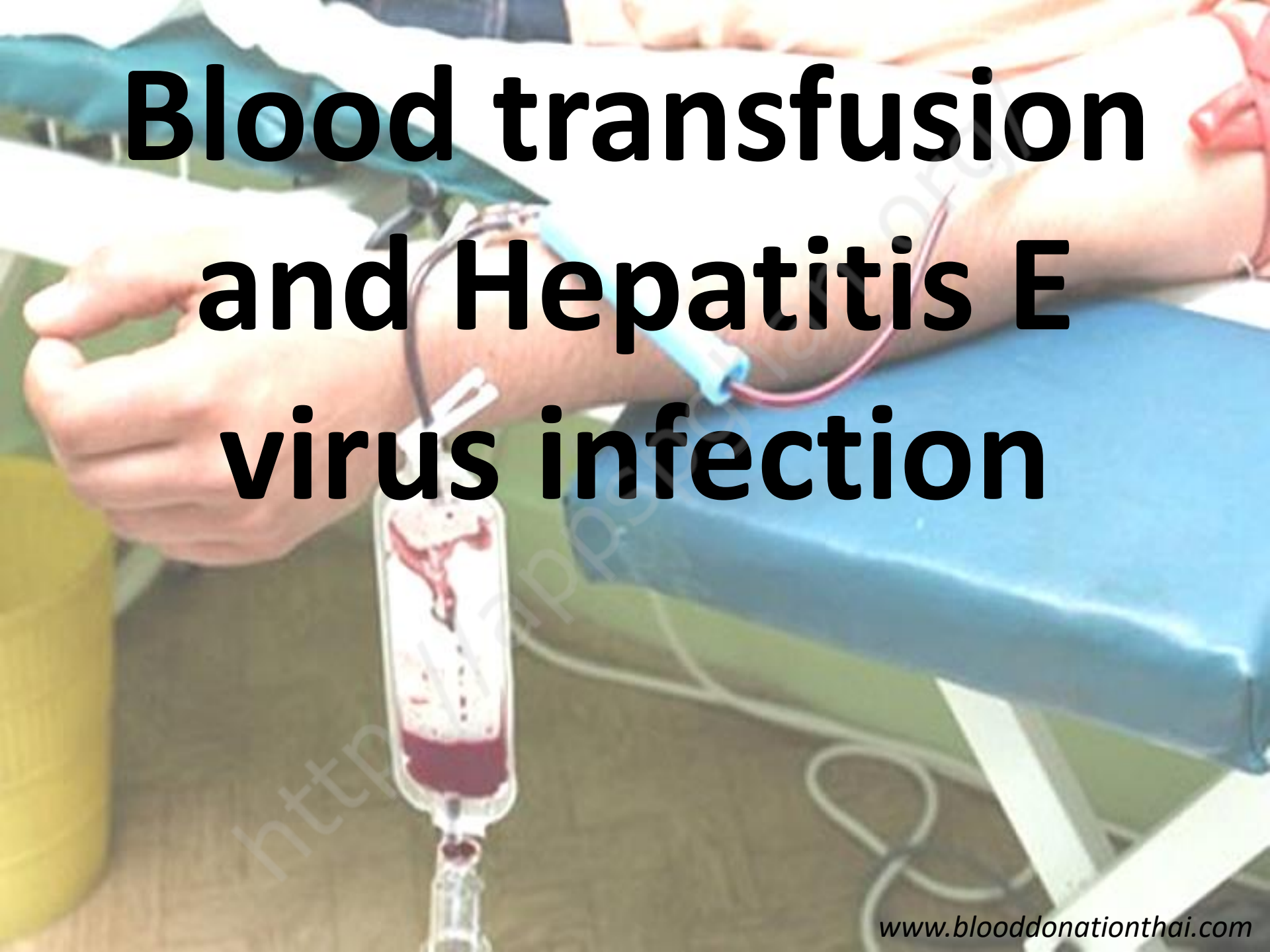
Abstract Swine is an economically important livestock, yet pork consumption and close contact with pigs are associated with the risk of hepatitis E virus (HEV) infection. Limited data on the prevalence of HEV in Southeast Asia have mainly examined farm animals. To investigate the potential zoonotic transmission of HEV from dietary consumption of pork and variety meats (i.e., offal or organ meats), we obtained 1090 liver, 559 pork meat, and 556 studies will be required to further assess potential dietary transmission of HEV elsewhere in the region.

Keywords Hepatitis E virus · Pork · Prevalence · RT-PCR · Thailand · Fresh market

Introduction

Nosocomial HEV infection

Blood transfusion and Hepatitis E virus infection



Prevalence of HEV among Thai blood donors

Source of samples in this study

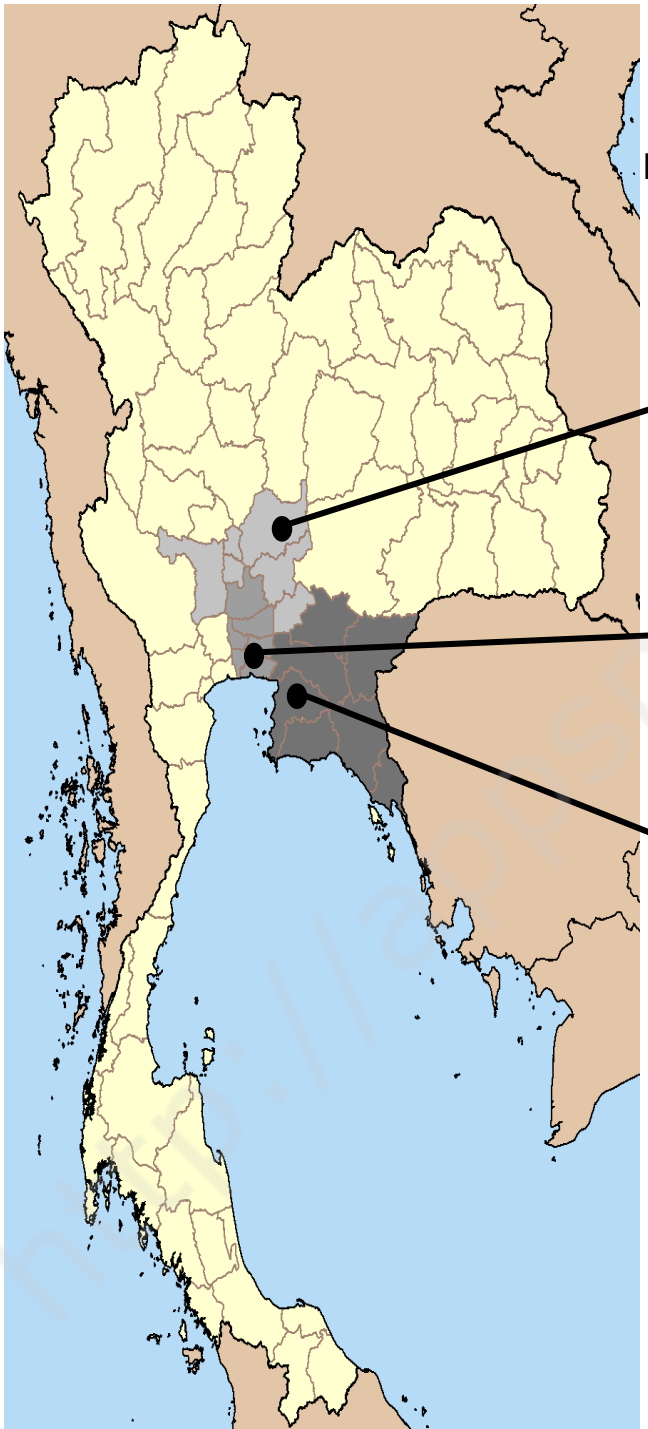
N = 30,000

Duration time : 3 months
October – December 2015

EDTA blood samples were collected from The National Blood Center (n = 30,000).

All samples were performed in minipool of 6 (5,000 pooled) by using automated specimen pooling

HAMILTON
Microlab
STAR/STARlet
IVD Pipettor



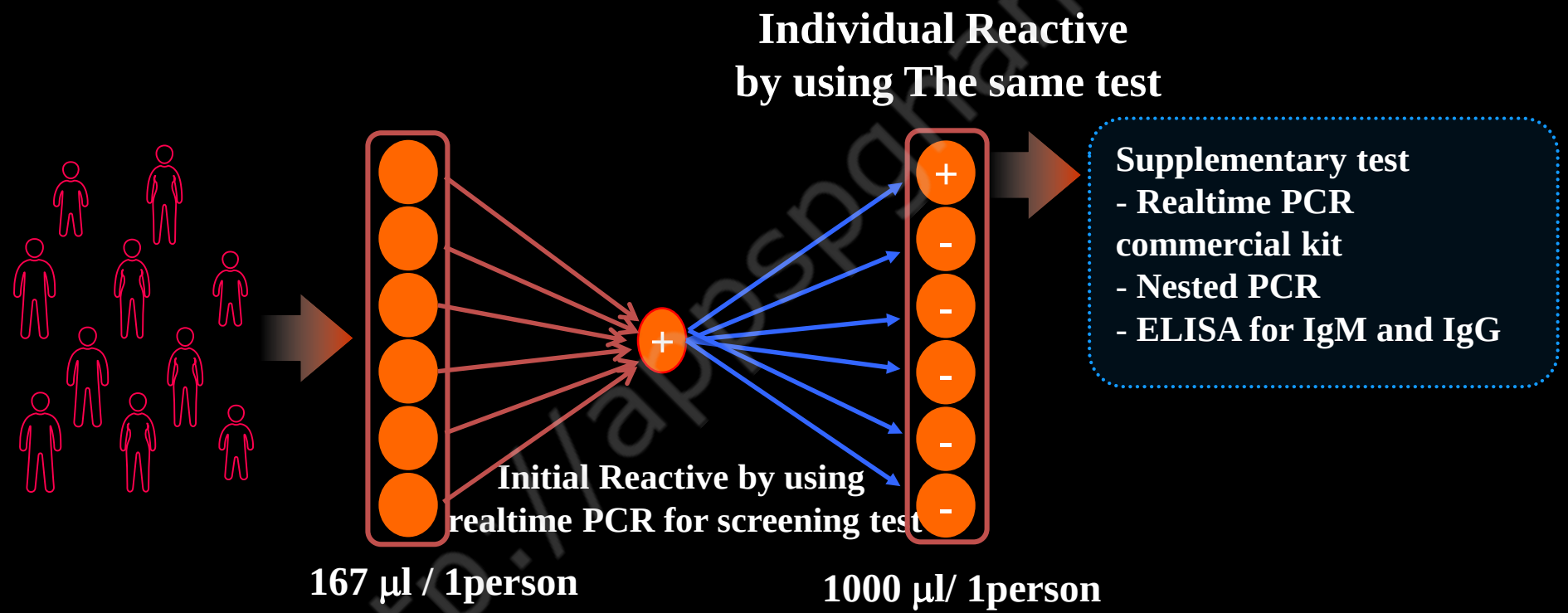
HEV RNA-positive rate of donor plasma samples derived from three areas

Regional blood centre II, Lop Buri (1/562)

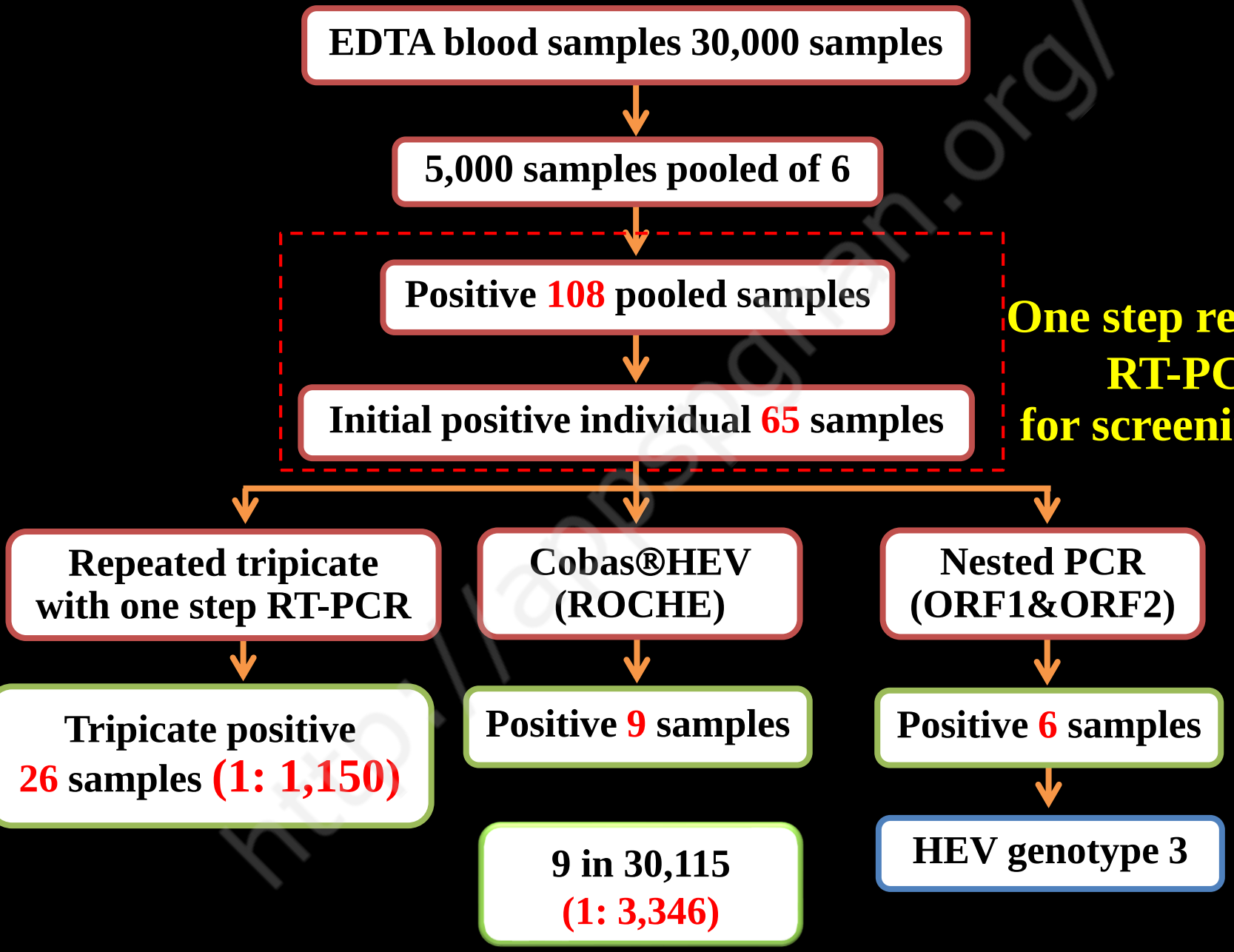
National blood centre, Bangkok (22/22,711)

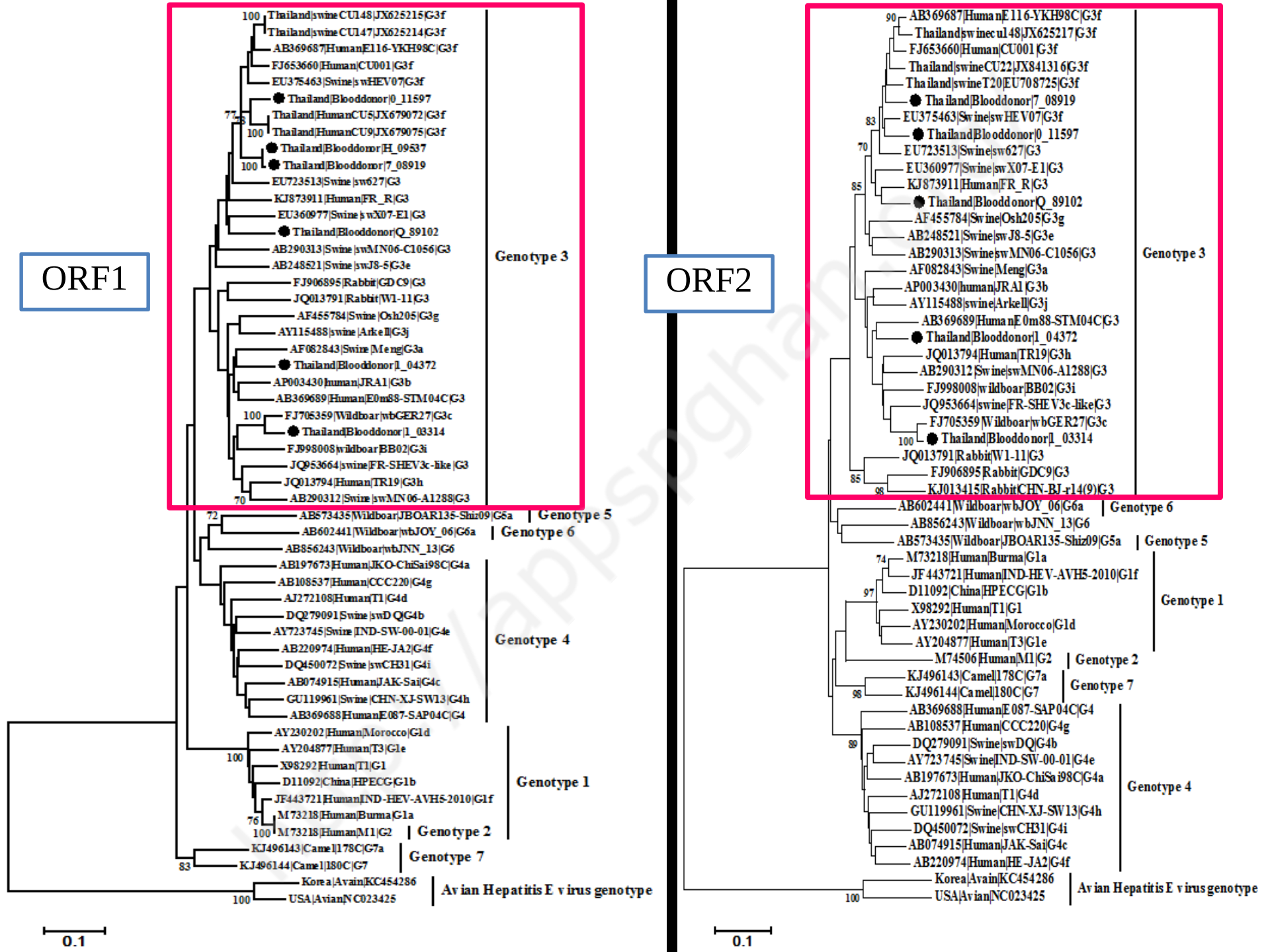
Regional blood centre III, Chon Buri (3/1,931)

Pooled 6 samples collected from blood donor



Hepatitis E in Thai Blood Donors




ORF1
Thailand|swineCU148|JX625215|G3f
Thailand|swineCU147|JX625214|G3f
AB369687|HumanE116-YKH98C|G3f
FJ653660|Human|CU001|G3f
EU375463|Swine|swHEV07|G3f
Thailand|Blooddonor|0_11597
Thailand|HumanCU5|JX679072|G3f
Thailand|HumanCU9|JX679075|G3f
Thailand|Blooddonor|H_09537
Thailand|Blooddonor|7_08919
EU723513|Swine|sw627|G3
KJ873911|Human|FR_R|G3
EU360977|Swine|swX07-E1|G3
Thailand|Blooddonor|Q_89102
AB290313|Swine|swMN06-C1056|G3
AB248521|Swine|swJ8-5|G3e
FJ906895|Rabbit|GDC9|G3
JQ013791|Rabbit|W1-11|G3
AF455784|Swine|Osh205|G3g
AY115488|swine|Arkell|G3j
AF082843|Swine|Meng|G3a
Thailand|Blooddonor|1_04372
AP003430|human|JRA1|G3b
AB369689|Human|E0m88-STM04C|G3
FJ705359|Wildboar|wbGER27|G3c
Thailand|Blooddonor|1_03314
FJ998008|wildboar|BB02|G3i
JQ953664|swine|FR-SHEV3c-like|G3
JQ013794|Human|TR19|G3h
AB290312|Swine|swMN06-A1288|G3
Genotype 3
AB573435|Wildboar|JBOAR135-Shiz09|G5a
Genotype 5
AB602441|Wildboar|wbJOY_06|G6a
Genotype 6
AB856243|Wildboar|wbJNN_13|G6
AB197673|Human|JKO-ChiSai98C|G4a
AB108537|Human|CCC220|G4g
AJ272108|Human|T1|G4d
DQ279091|Swine|swDQ|G4b
AY723745|Swine|IND-SW-00-01|G4e
AB220974|Human|HE-JA2|G4f
DQ450072|Swine|swCH31|G4i
AB074915|Human|JAK-Sai|G4c
GU119961|Swine|CHN-XJ-SW13|G4h
AB369688|HumanE087-SAP04C|G4
Genotype 4
AY230202|Human|Morocco|G1d
AY204877|Human|T3|G1e
X98292|Human|T1|G1
D11092|China|HPECG|G1b
JF443721|Human|IND-HEV-AVH5-2010|G1f
M73218|Human|Burma|G1a
M73218|Human|M1|G2
Genotype 2
KJ496143|Camel|178C|G7a
KJ496144|Camel|180C|G7
Genotype 7
Korea|Avain|KC454286
USA|Avian|NC023425
Avian Hepatitis E virus genotype
0.1
ORF2
AB369687|HumanE116-YKH98C|G3f
Thailand|swineCU148|JX625217|G3f
FJ653660|Human|CU001|G3f
Thailand|swineCU22|JX841316|G3f
Thailand|swineT20|EU708725|G3f
Thailand|Blooddonor|7_08919
EU375463|Swine|swHEV07|G3f
Thailand|Blooddonor|0_11597
EU723513|Swine|sw627|G3
EU360977|Swine|swX07-E1|G3
KJ873911|Human|FR_R|G3
Thailand|Blooddonor|Q_89102
AF455784|Swine|Osh205|G3g
AB248521|Swine|swJ8-5|G3e
AB290313|Swine|swMN06-C1056|G3
AF082843|Swine|Meng|G3a
AP003430|human|JRA1|G3b
AY115488|swine|Arkell|G3j
AB369689|HumanE0m88-STM04C|G3
Thailand|Blooddonor|1_04372
JQ013794|Human|TR19|G3h
AB290312|Swine|swMN06-A1288|G3
FJ998008|wildboar|BB02|G3i
JQ953664|swine|FR-SHEV3c-like|G3
FJ705359|Wildboar|wbGER27|G3c
Thailand|Blooddonor|1_03314
JQ013791|Rabbit|W1-11|G3
FJ906895|Rabbit|GDC9|G3
KJ013415|Rabbit|CHN-BJ-r14(9)|G3
Genotype 3
AB602441|Wildboar|wbJOY_06|G6a
Genotype 6
AB856243|Wildboar|wbJNN_13|G6
AB573435|Wildboar|JBOAR135-Shiz09|G5a
Genotype 5
M73218|Human|Burma|G1a
JF443721|Human|IND-HEV-AVH5-2010|G1f
D11092|China|HPECG|G1b
X98292|Human|T1|G1
AY230202|Human|Morocco|G1d
AY204877|Human|T3|G1e
Genotype 1
M74506|Human|M1|G2
Genotype 2
KJ496143|Camel|178C|G7a
KJ496144|Camel|180C|G7
Genotype 7
AB369688|HumanE087-SAP04C|G4
AB108537|Human|CCC220|G4g
DQ279091|Swine|swDQ|G4b
AY723745|Swine|IND-SW-00-01|G4e
AB197673|Human|JKO-ChiSai98C|G4a
AJ272108|Human|T1|G4d
GU119961|Swine|CHN-XJ-SW13|G4h
DQ450072|Swine|swCH31|G4i
AB074915|Human|JAK-Sai|G4c
AB220974|Human|HE-JA2|G4f
Genotype 4
Korea|Avain|KC454286
USA|Avian|NC023425
Avian Hepatitis E virus genotype
0.1

HEV transmission

HEV genotype 1 and 2

Developing countries

Epidemic

Person to Person
(less important)

1

15-30 years old
Acute Self-limiting hepatitis

Mortality rate: 26.9%
Third trimester

2

Environmental sample contaminated with human excretions
(Faecally contaminated water)

Drinking water

<u>Susceptible host</u>
Cynomologous macaques
Tamarins
Rhesus
Chimpanzees
Owl monkeys

Trials to infect **pigs** and **rats** was not successful.

Johne R, Dremsek P, Reetz J, Heckel G, Hess M, Ulrich RG. Hepeviridae: An expanding family of vertebrate viruses. Infect Genet Evol.2014;27C:212-229.

HEV genotype 3 and 4

Developed countries

Sporadic

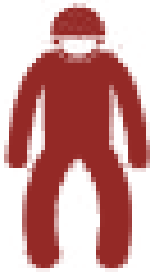
Asymptomatic

Middle-age

Men were found 4-fold than women

Symptomatic

Elderly age



Immunocompromised host organ transplantation

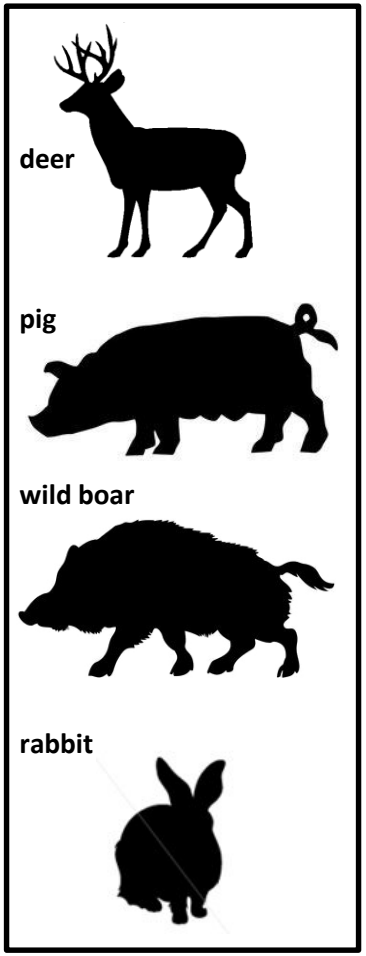
Porcine derived products

(porcine heparin products)

???

Blood Transfusion

Ingestion of HEV containing meat, liver, blood or sausage



Johne R, Dremsek P, Reetz J, Heckel G, Hess M, Ulrich RG. Hepeviridae: An expanding family of vertebrate viruses. Infect Genet Evol.2014;27C:212-229.

Hepatitis E virus

2 disease entities

Genotype 1,2

- Epidemic, water borne disease
- Yong adult
- High mortality pregnant women

Genotype 3,4

- Sporadic infection
- Developed countries
- Immunocompromised host
- Transmission :- zoonotic infection (swine)
  :- blood transfusion
- Chronic hepatitis

Acknowledgements

- Center of Excellence in Clinical Virology
- Chulalongkorn University and Hospital
- NSTDA Research Chair Grant