TOWARDS ONE HEALTH PARADIGM FOR THE CONTROL OF CRIMEAN-CONGO HEMORRHAGIC FEVER IN PAKISTAN

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DR. FARHAN AHMAD ATIF
Associate Professor (Medicine)
Officer Incharge, Deptt. of Clinical Sciences
College of Veterinary and Animal Sciences, Jhang;
University of Veterinary and Animal Sciences, Lahore;
Pakistan

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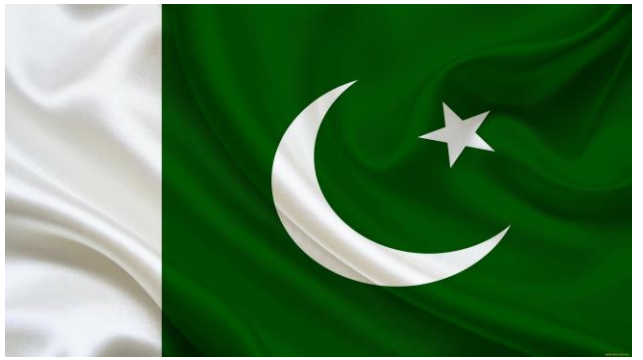
Vector-borne diseases (VBDs)

- Approximately 80% population of the world is at risk of acquiring one or more VBDs (WHO, 2024)

- One million deaths occur each year, worldwide (WHO, 2014)

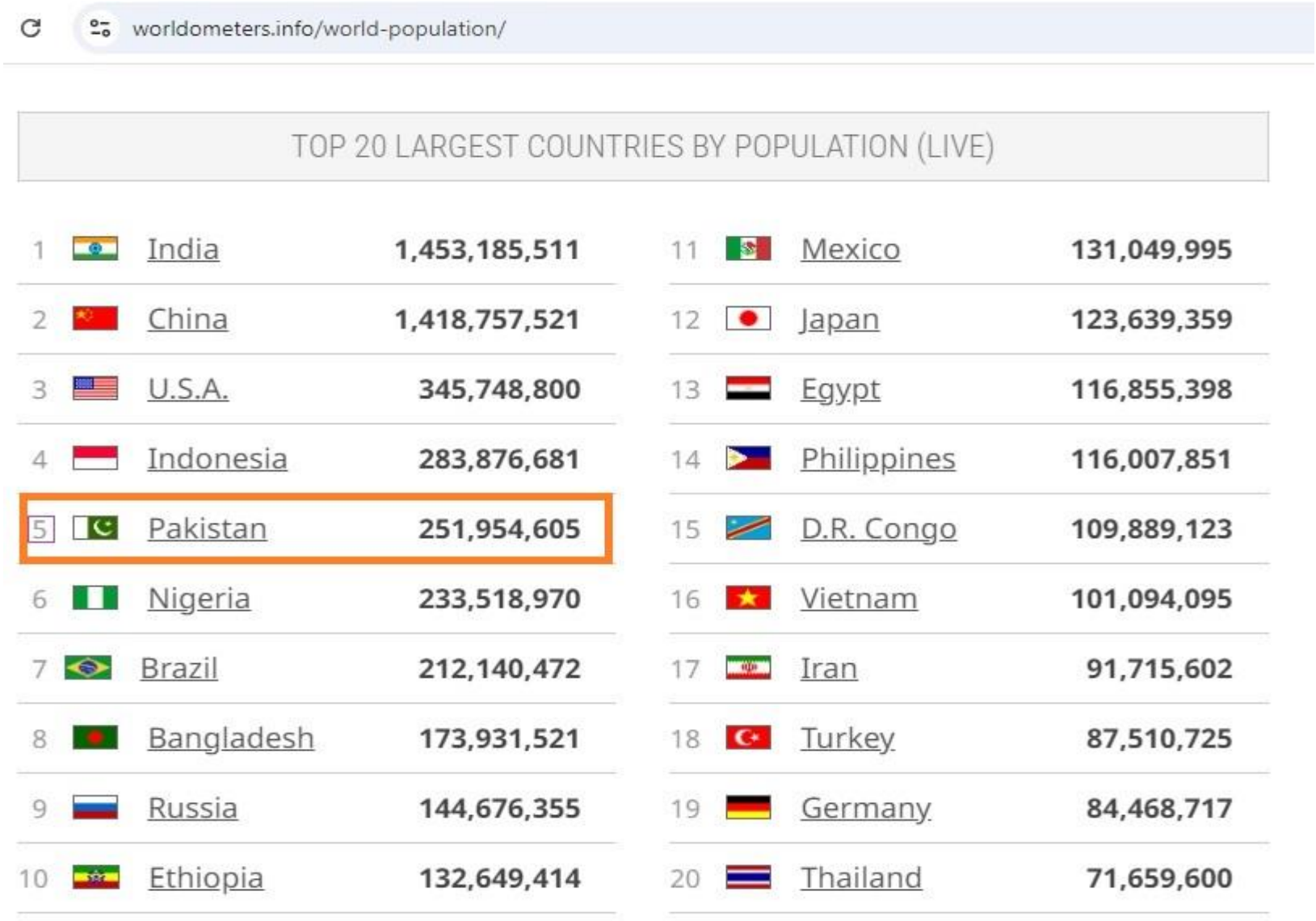
- Climate Change: (Yasmeen et al., 2022)
  - Global warming
  - Increased temperature
  - Increased humidity levels
  - The above mentioned climatic factors are contributing for the increase of VBDs

PAKISTAN



- Livestock is the principal subsector of agriculture, contribute 60.84% to agriculture.
- Livestock contribute 14.63% to the national gross domestic product (GDP) of Pakistan.
- Over eight million village families are associated with livestock production, deriving 35-40% income from Livestock.

Photo Source: www.getwallpapers. com; Economic survey of Pakistan (2023-24)

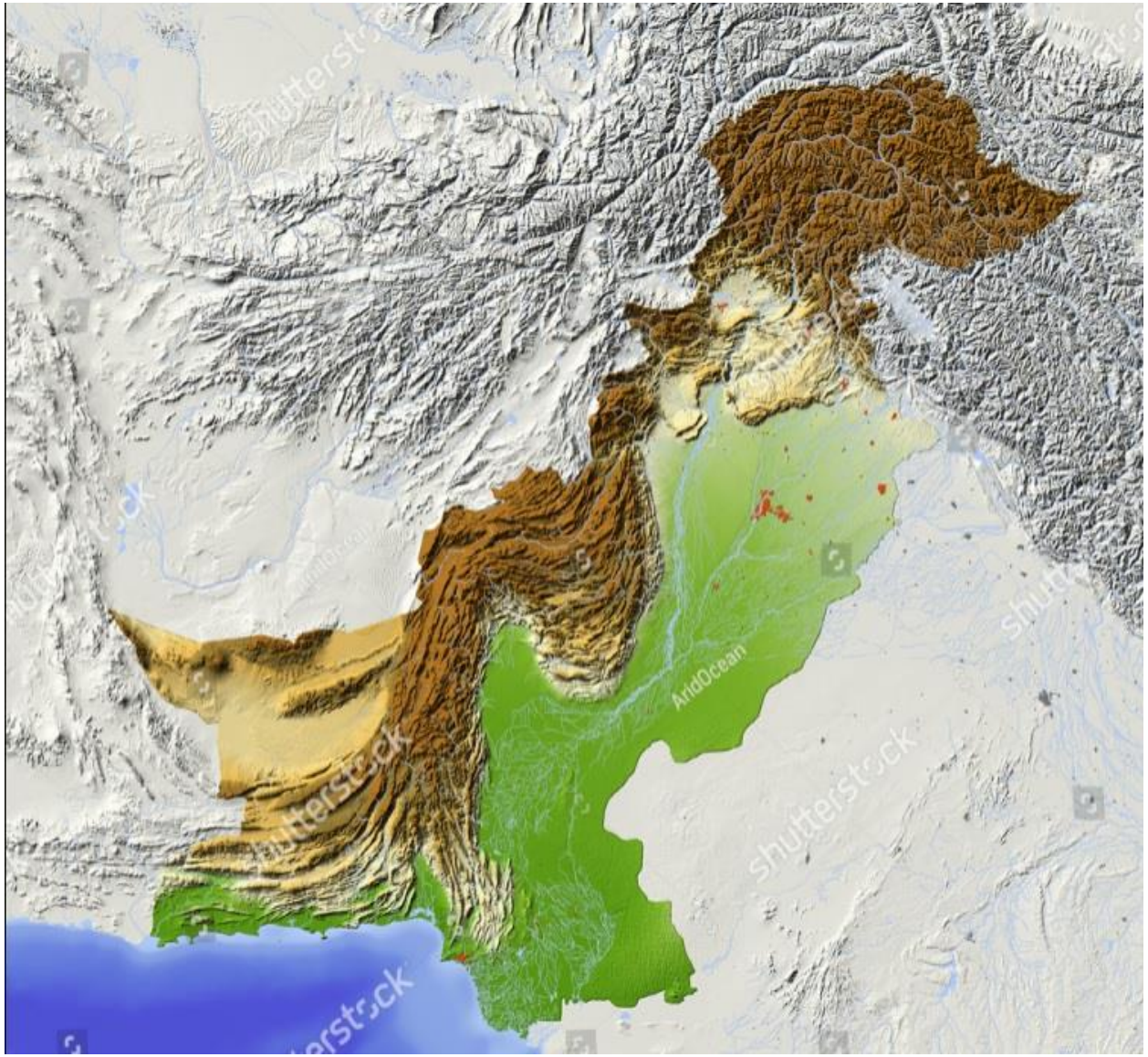


Source: https://www.worldometers.info/world-population/

Global ranking:

- **2nd** buffalo producer
- **3rd** largest goat meat producer
- **4th** largest rice (Basmati) exporter
- **4th** Irrigated land area
- **5th** largest milk producer
- **5th** Populous country

- **33rd** Largest country

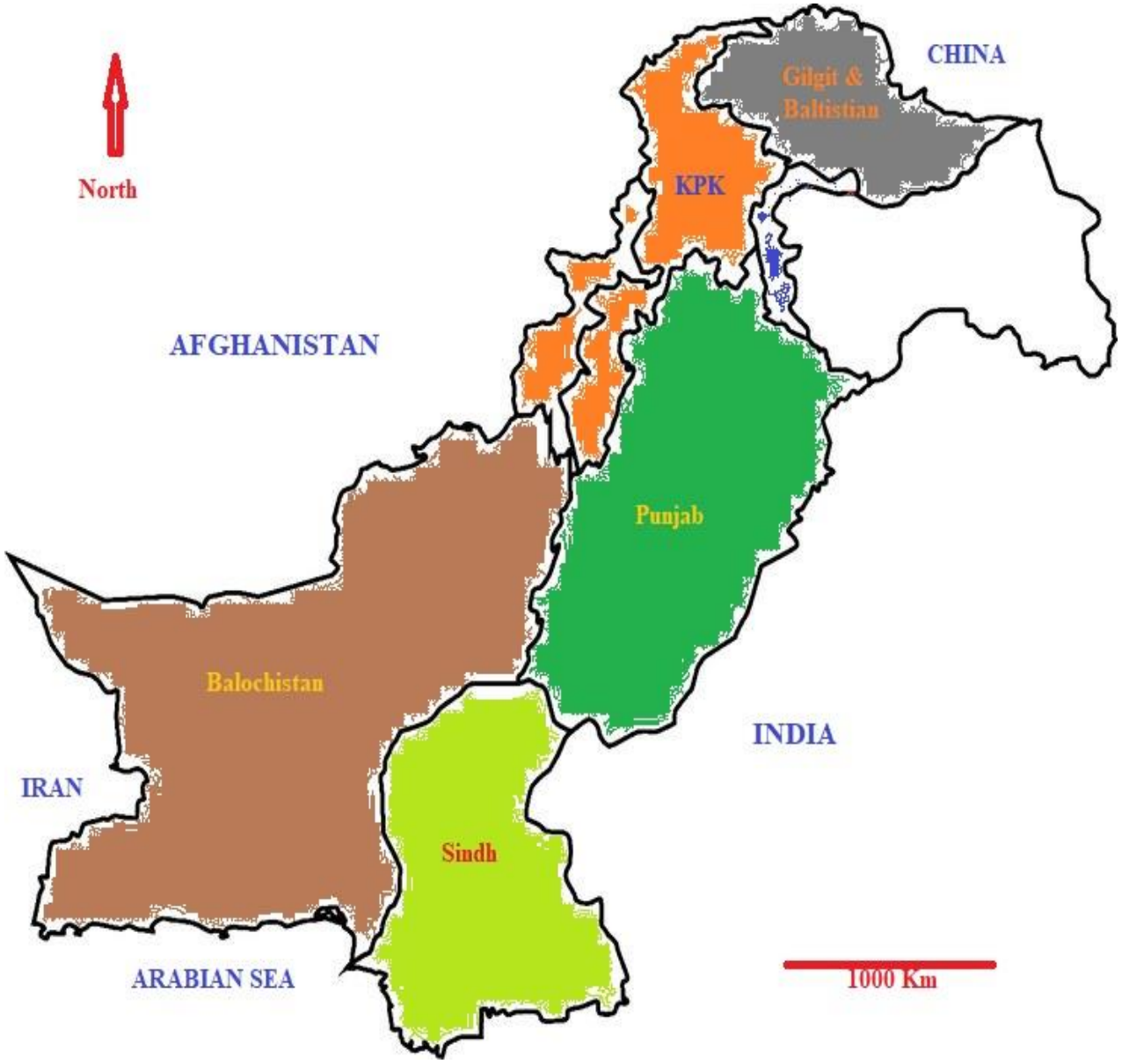


(Worldmeters, Wikipedia and FAO; Photo source: https://www.dreamstime.com/

Zoonotic diseases in Pakistan

- Salmonellosis
- Rabies
- Anthrax
- *E. coli*
- Hepatitis E
- Leptospirosis
- Brucellosis
- Bovine TB
- Plague
- Glanders

- (CDC 2017; Yasmeen et al., 2022)



Vector-Borne Diseases in Pakistan

- Dengue
- Chikungunya
- Malaria
- Crimean-Congo hemorrhagic fever (CCHF)
- Leishmaniasis
- West Nile Virus
- Rift Valley Fever

- (CDC 2017; NIH, 2020; Yasmeen et al., 2022)

Vector-borne diseases of animals in Pakistan

- Anaplasmosis
- Babesiosis
- Theileriosis
- Surra (*Trypanosoma evansi*)
- Lumpy Skin Disease (LSD)
- Blue Tongue

Crimean-Congo Hemorrhagic Fever (CCHF)

- Order: Bunyavirales
- Family: Nairoviridae
- Genus: *Orthonairovirus*
- CCHF virus (Bente et al., 2013).

- *Hyalomma* spp. are reservoir as well as main vector (Bente et al., 2013).

- *Hyalomma marginatum* is the most efficient vector (Maltezou et al., 2010).

- Mild CCHFV infections can be **asymptomatic (88%),** however severe infections are potentially life threatening (Formentry 2019; Frank et al., 2024).

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Photo Source: https://www.aopnews.com/wp-content/uploads/2019/08/tick.jpg

Global distribution of CCHF

- Most widespread tick-borne disease
- 10,000-15,000 cases/year
  (Formenty, 2019)
- WHO notifiable disease
- Eastern and Southern Europe
- Mediterranean
- Northwestern China
- Central Asia
- Africa
- Middle East
- South Asia

(Hawman and Feldmann, 2023).

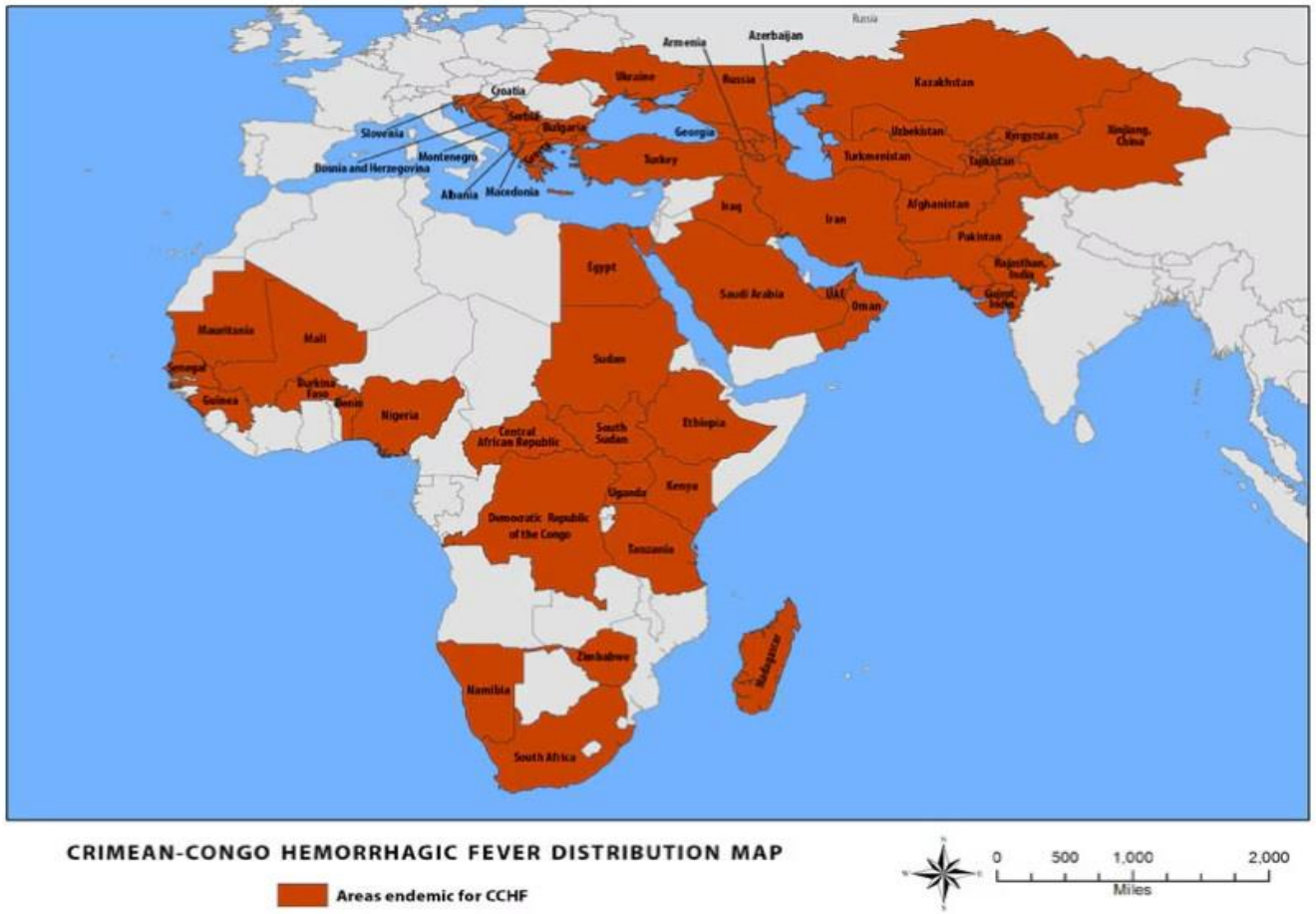

Photo source: Centers for Disease Control and Prevention

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Source: www.guideoftheworld.com

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History

- **1100-1200** -- (early 12th century), noticed in countries of Tajikistan and Uzbekistan

- **1944** – World War-II, Soviet Union soldier (about n=200) develop hemorrhagic fever in Crimean Peninsula, called as Crimean Hemorrhagic Fever

- **1956** -- Congo hemorrhagic fever virus (Democratic Republic of the Congo)

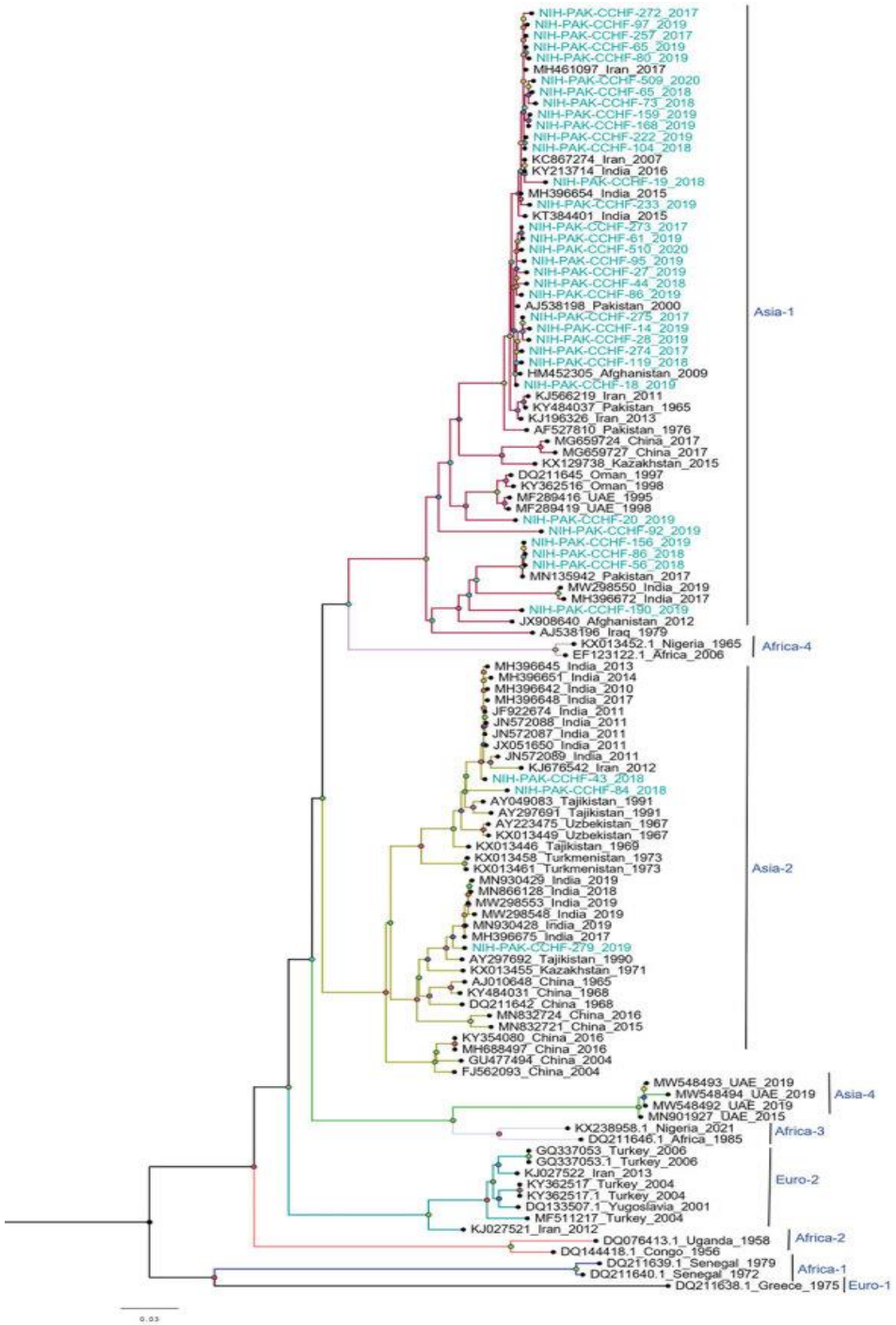
- **1967** -- Serologically indistinguishable

- **1970** -- Crimean-Congo hemorrhagic fever (CCHF)

(Whitehouse 2004; Hoogstraal et al., 1979).

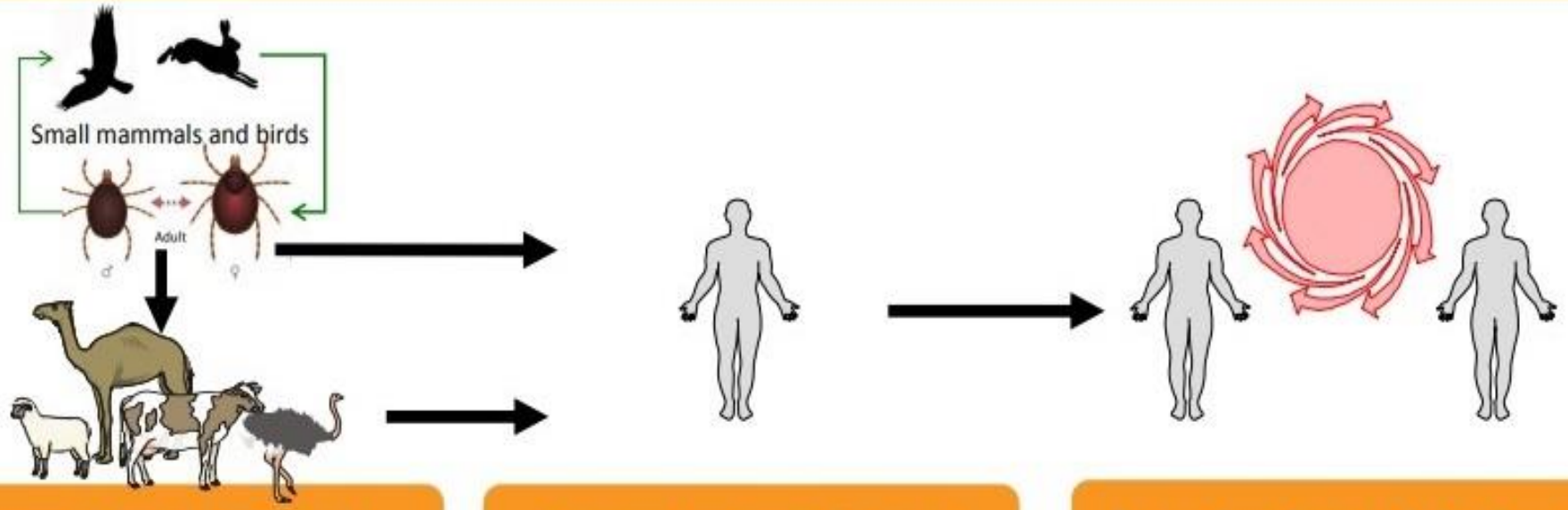
CCHF

- Negative sense RNA virus
- Segmented genome
  - Small (S) segments
  - – Responsible for regional diversity
  - Medium (M) segments
  - Large (L) segments
- Clade-I: Africa 1–3
- Clade-II: Asia 1 and 2
- Clade-III: Europe 1 and 2
- Clade-IV: Asia 1 and 2 (Pakistan)
- Clade-V (Europe 1)
- Clade-VI (Europe 2)



(Chinikar et al., 2013; Di Nardo et al., 2001 ; Phylogenetic tree (Umair et al., 2024).

World Health Organization — Crimean-Congo Haemorrhagic Fever Transmission



Reservoir *Hyalomma* ticks

- In nature, CCHF virus maintains itself in a cycle involving ticks and vertebrate.
- Most animals don't show symptoms.

Primary human infections

80 to 90 % of humans are infected through:

- tick bite or direct contact with blood of infected ticks;
- direct contact with blood/tissues of infected wild animals and livestock.

Secondary human infections

- Secondary human-to-human transmission occurs through direct contact with the blood, secretions, organs or other body fluids of infected persons.
- High transmission risk when providing direct patient care or handling dead bodies (funerals).

Source: Formenty P. Introduction to Crimean-Congo haemorrhagic fever. 2019 . https://cdn.who.int

Transmission

- Detected in most of the patients with the history of tick bite (60 to 69%) (Bakir et al., 2005).
- The majority of cases --- people involved in livestock industry (Umair et al., 2024)

Human-to-human:

✓Close contact

✓Infected blood, secretions and organs

✓Bodily fluids of infected individual (Formenty et al., 2019)

Hospital-acquired infections (Nosocomial):

(i) Improper sterilization of equipment (ii) reuse of needles

(iii) needle prick (iv) contamination of medical supplies

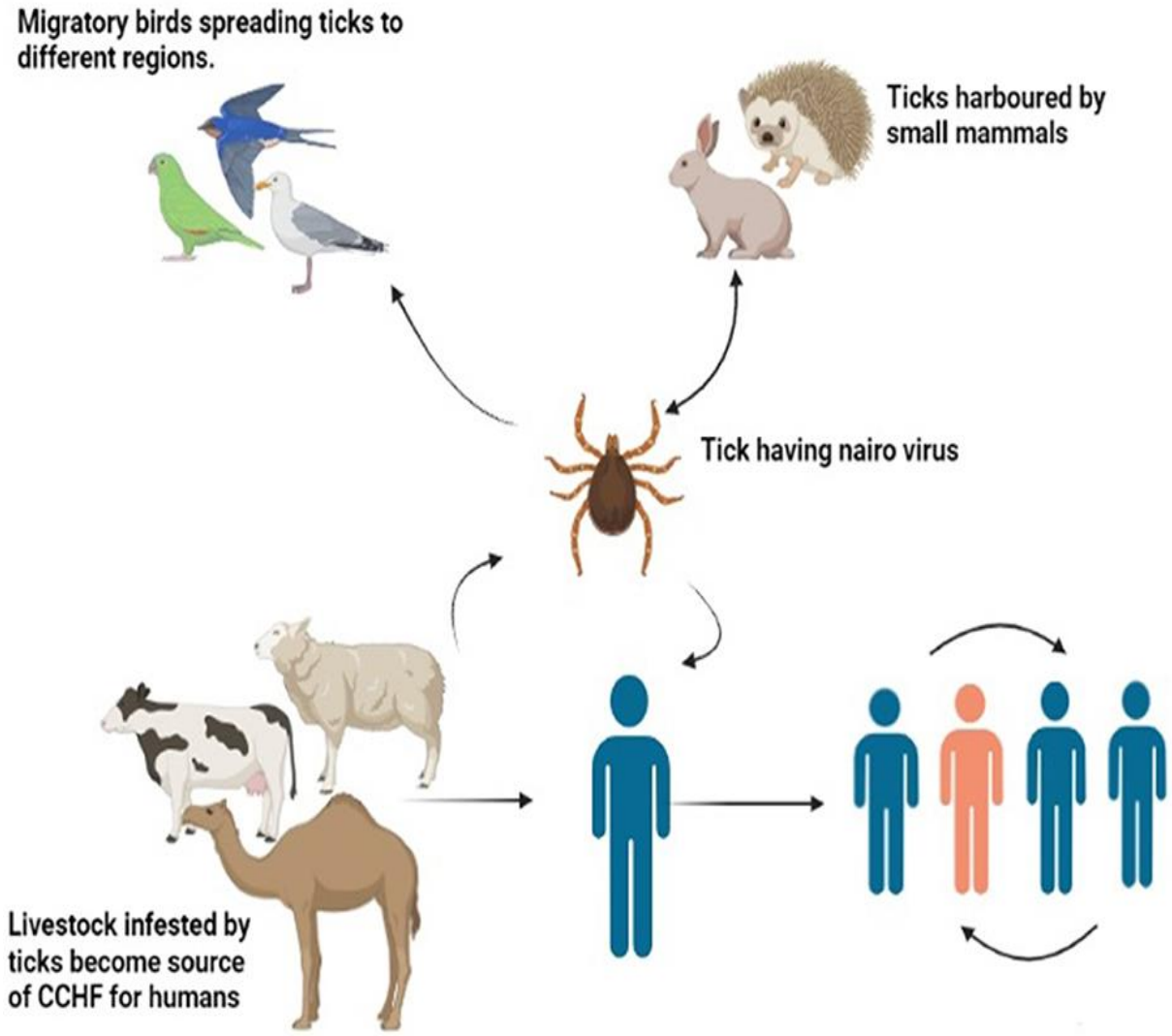
(Pshenichnaya et al., 2015; Tsergouli et al., 2020; Gaina et al., 2023)

Transmission

- Ticks become life infected (Papa et al., 2015).
- Transstadial (Turell et al, 2020)
- Transovarial (Bhowmick et al., 2022)
- Co-feeding transmission
- Male ticks change hosts to seek female ticks

- The hemorrhagic phase: a high risk for accidental infection

(Turell et al, 2020 ; Aslam et al., 2023)



[Photo source: Aslam et al., 2023]

Epidemiology

- Vertebrates are the amplifying hosts (Mohamed et al., 2008)
- The *Argasid* (soft ticks) are not the vectors (vertically or horizontally) (Papa et al., 2015).
- Mortality in humans is 3-30% (Ergönü, 2006)
- The case/ fatality in humans (up to 40%) (WHO, 2022)
- 1 out of 8 develop a severe form of the disease (NIAID, 2024).

Scenario in Pakistan

- 1976: Detected in 1976 at Rawalpindi Hospital, Pakistan (Burney et al., 1980)
- 356 cases in Pakistan (Alam et al., 2013).

Sr. No.	Province	Prevalence
1	Balochistan	38%
2	Punjab	23%
3	Khyber Pakhtunkhwa (KPK)	19%
4	Sindh	14%
5	capital city Islamabad	6%

Epidemiology of CCHF in Pakistan

Vector seasons is linked to Vector-borne diseases

Higher CCHF incidence in vector season in Pakistan

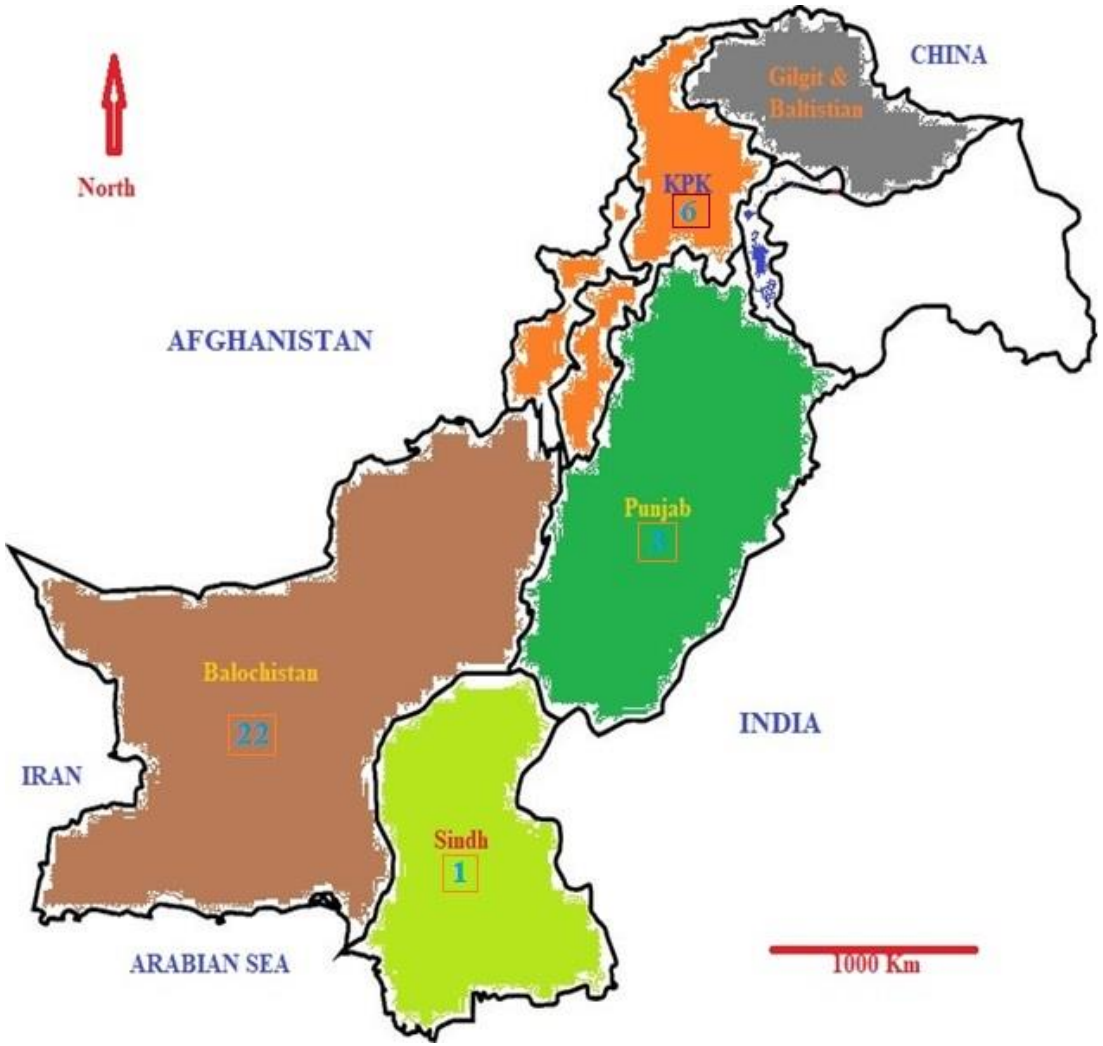
March to May

August to October (NIH, 2016).

- Male (82%) and female (18%)
- Case fatality rate (CFR) **~35%**

(Umair et al., 2024)

CCHF Scenario in Pakistan (2024)



CCHF surveillance

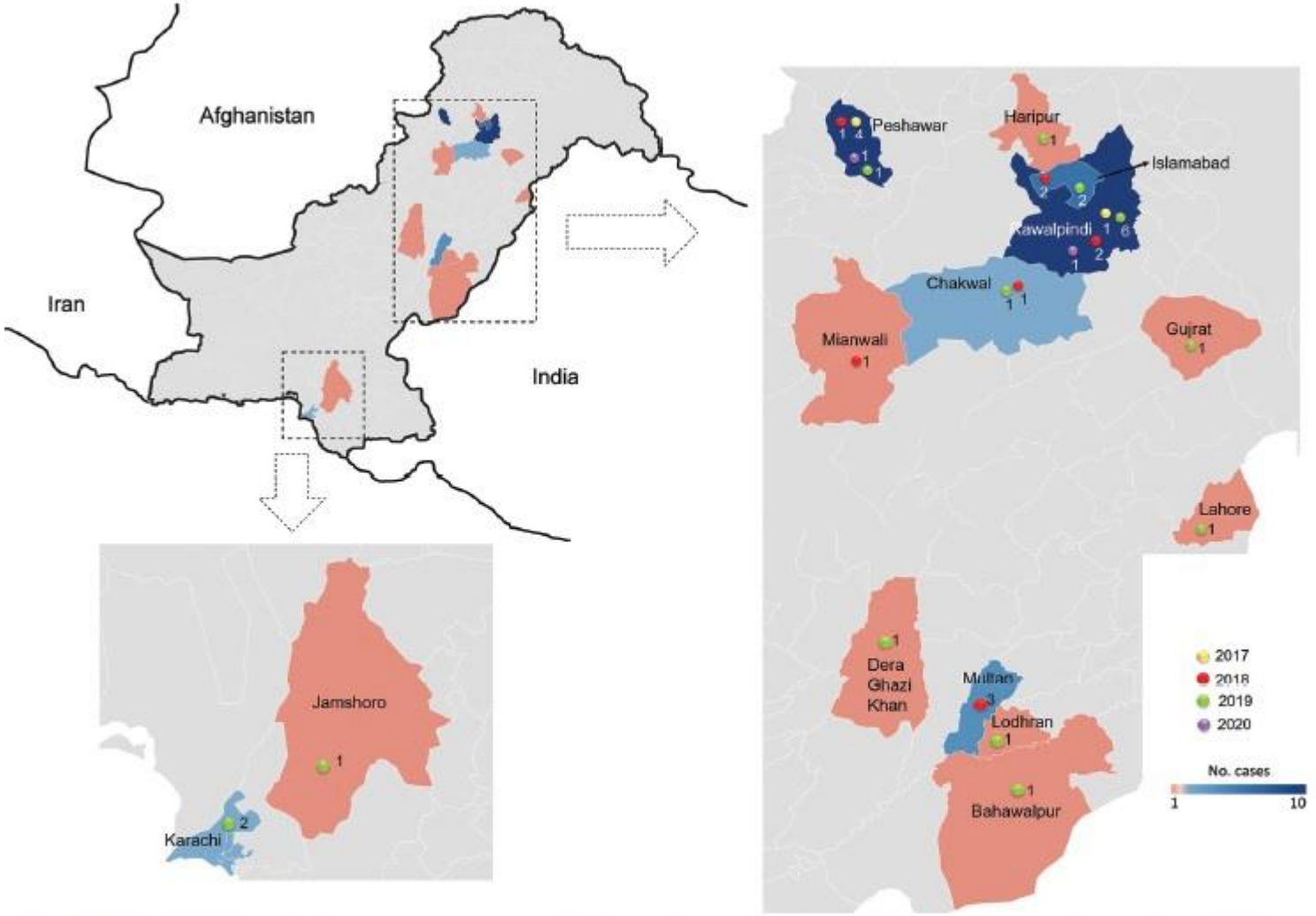


Figure 1. Locations of Crimean-Congo hemorrhagic fever cases in study of virus diversity and reassortment, Pakistan, 2017–2020. Main maps indicate the 2 regions in Pakistan with positive cases. Shading indicates provinces that had 1–10 cases. Inset map shows Pakistan and borders with Afghanistan, India, and Iran.

Umair et al., 2024

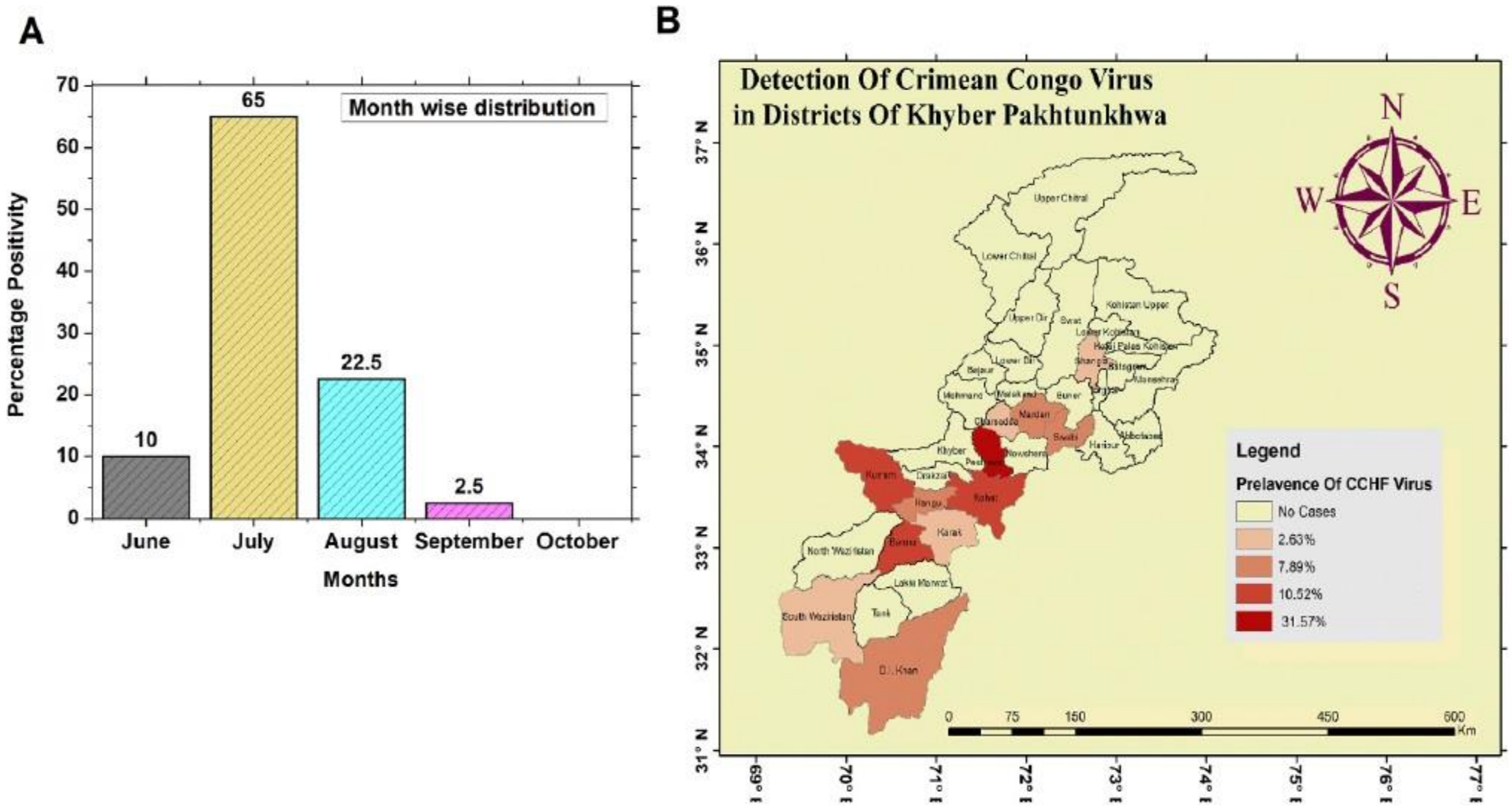
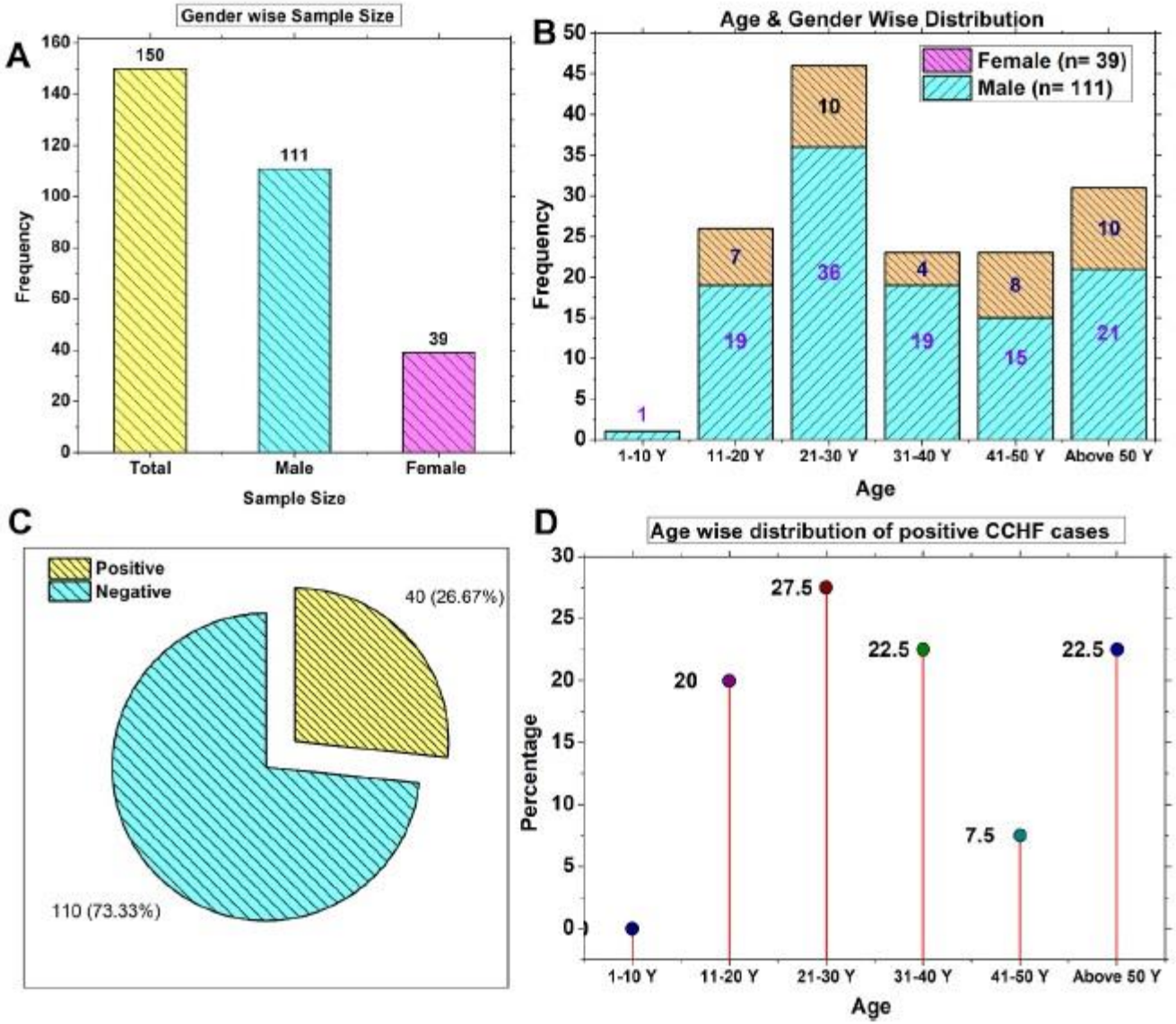


Fig. 2 (A–B). (A) Month-wise detection of CCHFV-positive cases on PCR from June 2022 to September 2022; (B): District wise heat map of the CCHFV positive cases.

Zia et al, 2024

CCHF in Khyber Pakhtunkhwa Province (Pakistan)



Zia et al., 2024

Table 2. Univariate analyses of 1,838 livestock samples positive for Crimean-Congo hemorrhagic fever virus by ELISA, Pakistan, 2017–2018

Category	No. positive/no. tested	Prevalence, % (95% CI)	Odds ratio (95% CI)	p value
Species				<0.001
Camel	272/480	56.7 (52.1–61.2)	5.6 (4.2–7.6)	
Cattle	81/183	44.3 (36.9–51.8)	3.4 (2.3–5.0)	
Sheep	138/424	32.6 (28.1–37.2)	2.1 (1.5–2.8)	
Buffalo	92/311	29.6 (24.6–35.0)	1.8 (1.3–2.5)	
Goat	83/440	18.9 (15.3–22.8)	1.0	
Province				<0.001
Balochistan	213/359	59.3 (54.1–64.5)	7.6 (5.4–10.6)	
Khyber Pakhtunkhwa	230/439	52.4 (47.6–57.1)	5.7 (4.1–7.9)	
Punjab	159/644	24.7 (21.4–28.2)	1.7 (1.2–2.40)	
Sindh	64/396	16.2 (12.7–20.2)	1.0	
Sex				0.377
F	552/1,504	36.7 (34.3–39.2)	1.1 (0.9–1.4)	
M	114/334	34.1 (29.1–39.5)	1.0	
Age, y				<0.001
≤5	332/1,121	29.6 (27–32.4)	1.0	
>5	334/717	46.6 (42.9–50.3)	2.1 (1.7–2.5)	

Zohaib et al., 2020

Detection capacity

Pakistan

- **Humans:** Clinical signs observed
  - Fever
  - Hemorrhage
  - Myalgia

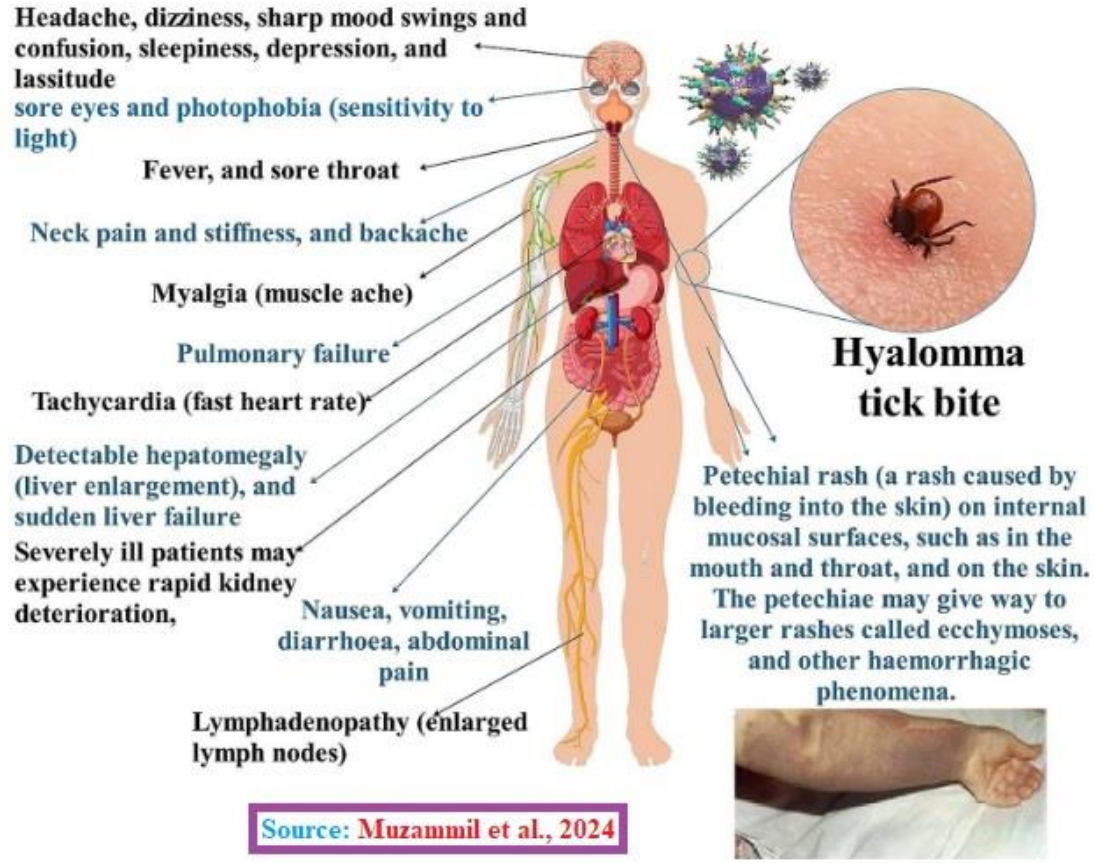
- Other signs:
  - Nausea
  - Vomiting
  - Headache

(Umair et al., 2024)

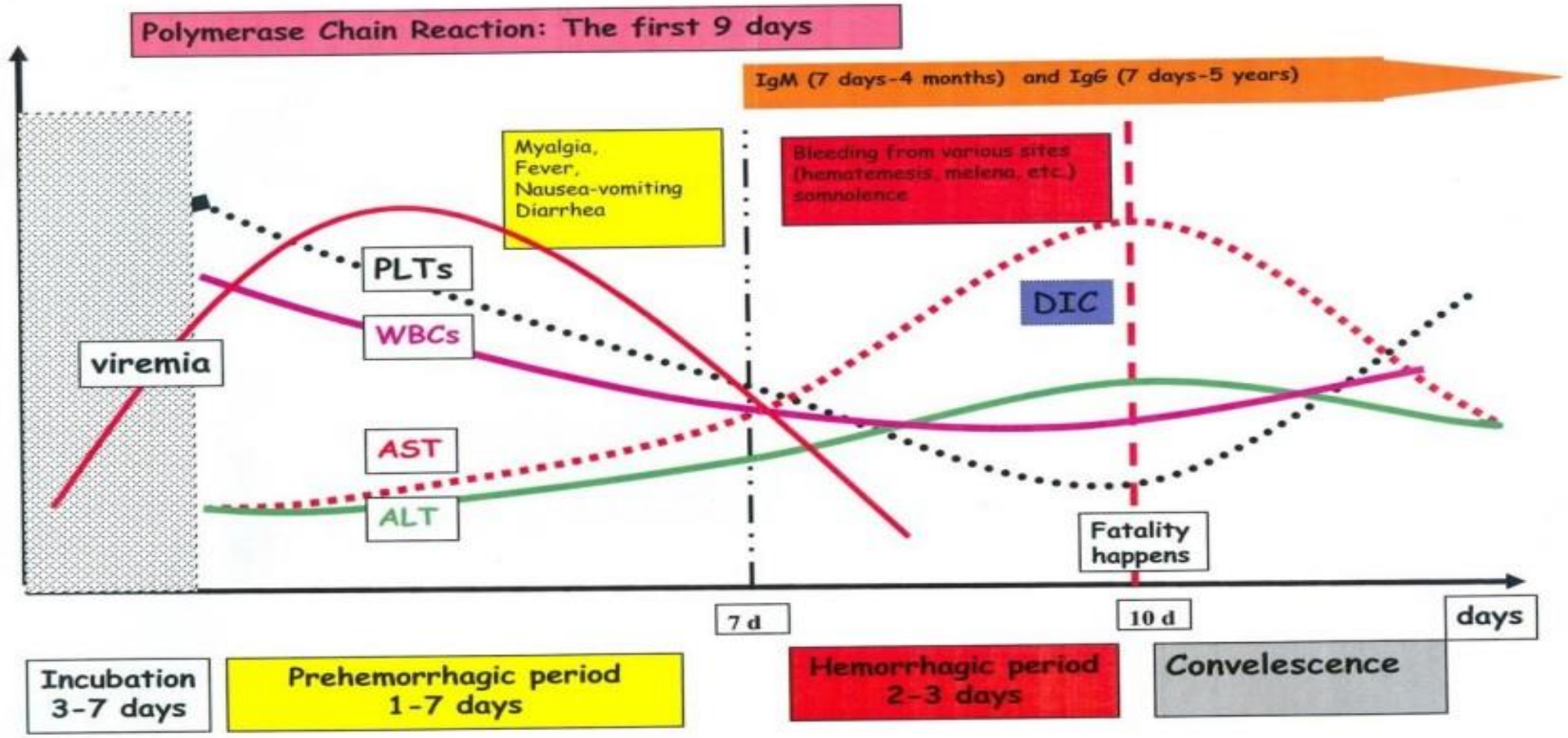
- **Animals:**

Remain a symptomatic

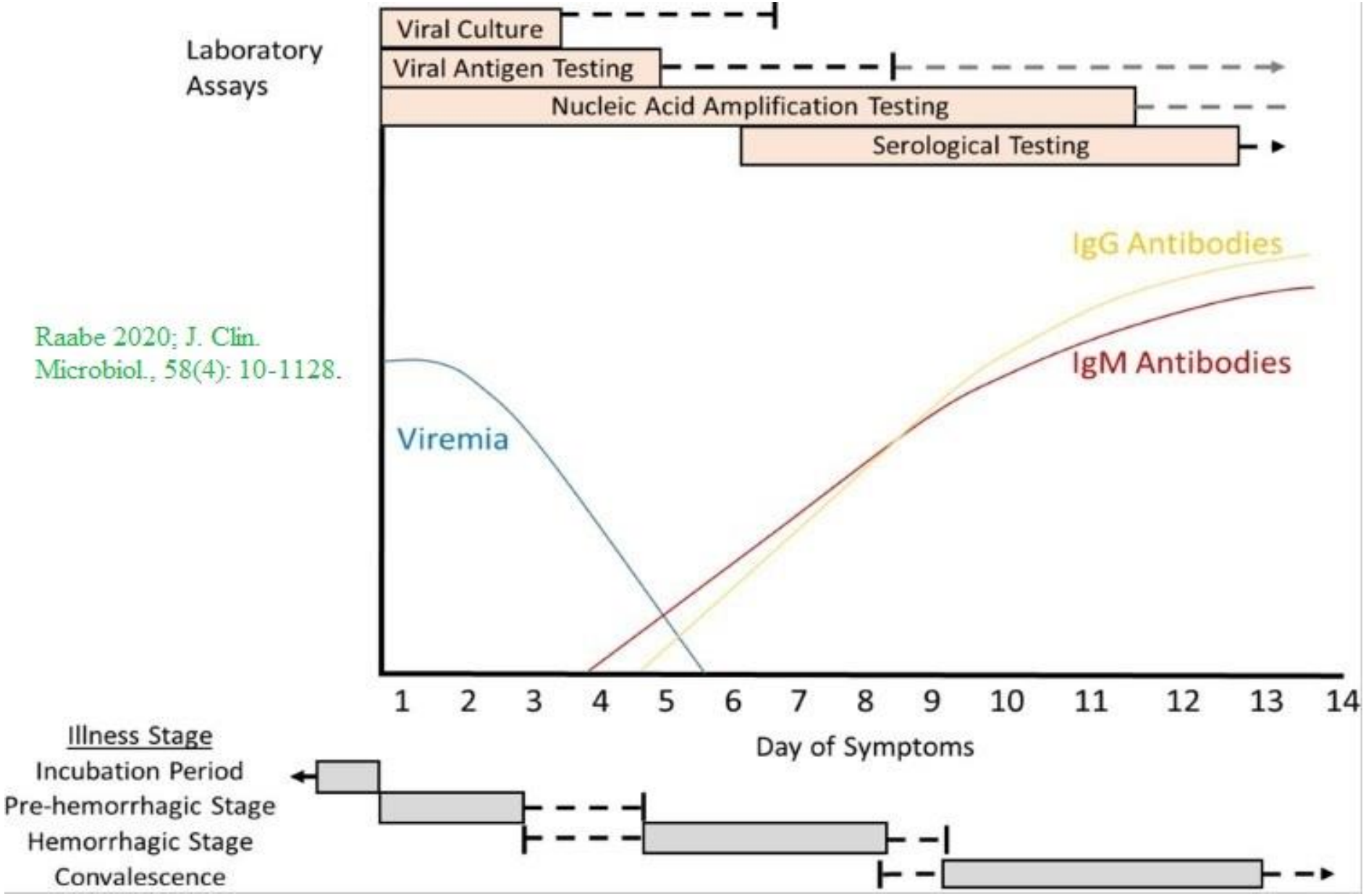
From: Recent Advances in Crimean-Congo Hemorrhagic Fever Virus Detection, Treatment, and Vaccination: Overview of Current Status and Challenges



Symptoms of CCHFV The duration of the incubation time is determined by the manner of viral acquisition. The incubation time after a tick bite usually is one to three days, with a maximum of nine days. After contact with contaminated blood or tissues, the incubation period is generally five to six days, with a known maximum of 13 days



Ergonul O. *Lancet ID* 2006; 6: 203-214



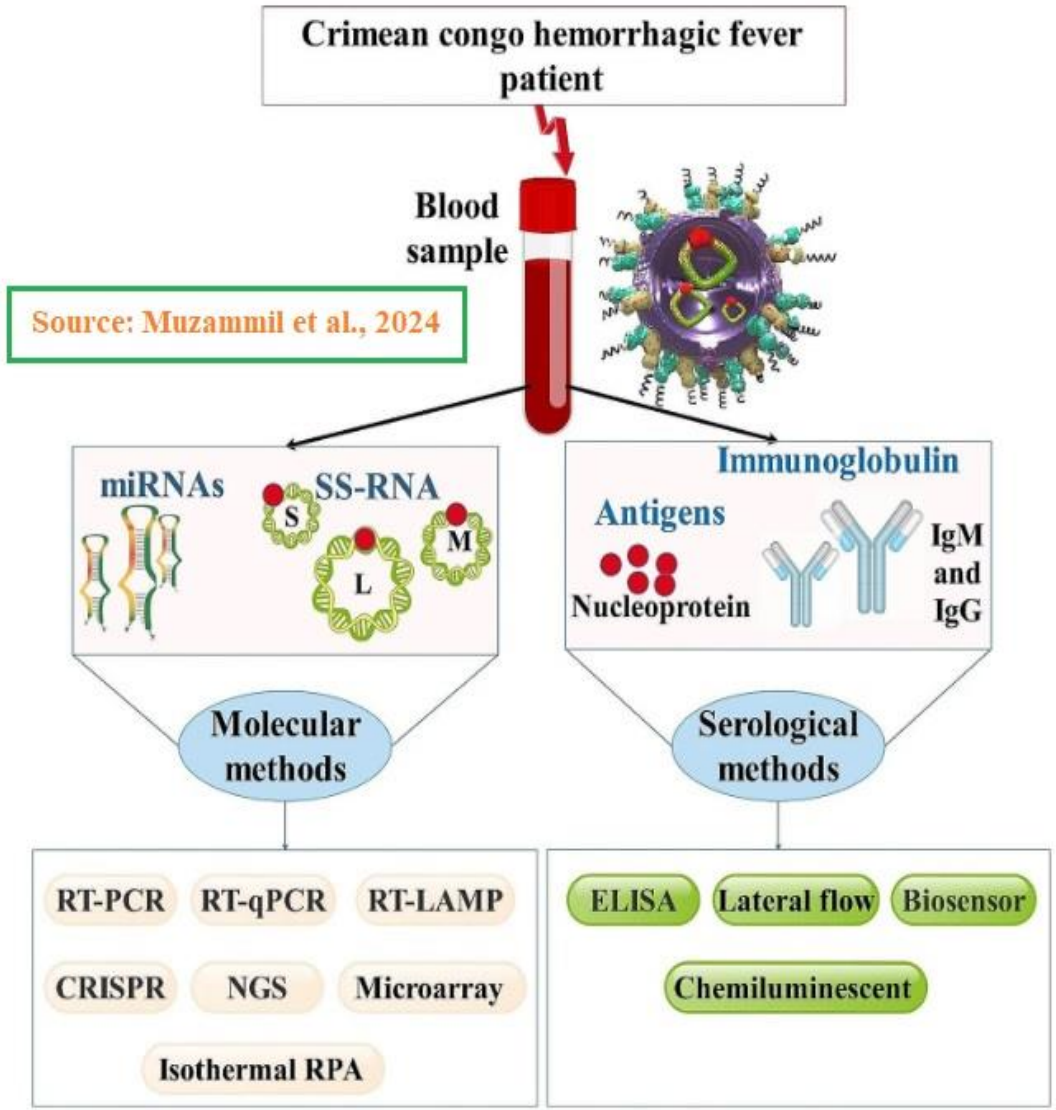
Raabe 2020; J. Clin. Microbiol., 58(4): 10-1128.

Case definition

Suspected	Probable case	Confirmed case
✓ **Sudden onset** of fever [> 38.5°C; 3-9 days) in endemic region ✓ In contact with sheep or other livestock ✓ Fever do not respond to antibiotic or antimalarial treatment	✓ Acute history of febrile illness 10 days or less, AND ✓ Thrombocytopenia <50,000/mm AND ✓ Petechial or purpuric rash, epistaxis, haematemesis, haemoptysis, blood in stools, ecchymosis, gum bleeding, other haemorrhagic symptom AND ✓ No known predisposing host factors for haemorrhagic manifestations and ≥1 haemorrhagic sign or thrombocytopenia.	✓ Confirmation of presence of IgG or IgM antibodies in serum by ELISA (enzyme-linked immunoassay) or any similar method. ✓ Detection of viral nucleic acid by PCR in specimen or isolation of virus. [NIH, 2013, Pakistan]

Detection of CCHF in humans

- **ELISA:** A two-step sandwich enzyme-linked immunosorbent assay
- VectoCrimean-CHF-IgG kit; Vector BEST Company, Novosibirsk, Russia, https://vector-best.ru
- **PCR:** Extraction from blood samples (QIAamp Viral RNA Mini Kit (QIAGEN, https://www.qiagen.com).
- Real-time PCR using a RealStar CCHFV RT-PCR Kit (Altona Diagnostics, https://www.altona-diagnostics.com).
- Crimean-congo Haemorrhagic Fever RT-qPCR Kit — Zet Biotech (www.zetbiotech.com)


Crimean congo hemorrhagic fever patient
Blood sample
Source: Muzammil et al., 2024
miRNAs
SS-RNA
S
M
L
Immunoglobulin
Antigens
Nucleoprotein
IgM and IgG
Molecular methods
Serological methods
RT-PCR
RT-qPCR
RT-LAMP
CRISPR
NGS
Microarray
Isothermal RPA
ELISA
Lateral flow
Biosensor
Chemiluminescent

Detection of CCHF in animals

- The double antigen (DA) ELISA , ID Screen® CCHF Double Antigen Multi-species ELISA kit (IDvet, Grabels, France).

- **Detection:** Cattle, sheep, goats & other animal species as well as humans* (*Research use)

https://www.innovative-diagnostics.com

- Specificity (99.8%–100%)
- Sensitivity (96.8%–99.8%)

Ranking of zoonotic diseases in Pakistan

APPENDIX D: Numerical Weights for the Criteria Selected for Ranking Zoonotic Diseases in Pakistan (short-term goal)

1. Impact of Disease (criterion weight = 0.406486361)

Question: Does the disease have a significant impact on human or animal populations? CFR ≥10% or evidence of associated long term disability (human indicator) Loss of production (animal indicator)?

Answer: (score)

- ☐ Yes for both humans and animals (2)
- ☐ Yes to either humans or animals (1)
- ☐ No to both humans and animals (0)

2. Burden and Epidemic Potential (criterion weight = 0.232295915)

Question: Is the disease prevalence ≥5% and/or has it caused any epidemic/outbreak among humans or animals in the last 10 years in Pakistan?

Answer: (score)

- ☐ Yes to both (prevalence and epidemic) (2)
- ☐ Yes to one (prevalence or epidemic) (1)
- ☐ No to both (0)

3. Country Capacity (criterion weight = 0.175892772)

Question: Does the country have capacity in terms of (i) prevention (vaccine), (ii) detection (lab testing and reporting (case based, indicator/routine, event) and (iii) control (treatment, culling, stamping out, quarantine)?

Answer:	Human	Animal
☐ Yes to all	3	3
☐ Yes to two	2	2
☐ Yes to one	1	1
☐ No to all	0	0

4. Bioterrorism Potential (criterion weight = 0.070575586)

Question: Is the disease listed as a bioterrorism agent according to the WHO guidance document?[69]

Answer: (score)

- ☐ Yes (1)
- ☐ No (0)

ONE HEALTH ZOONOTIC DISEASE PRIORITIZATION & ONE HEALTH SYSTEMS MAPPING AND ANALYSIS RESOURCE TOOLKIT™ FOR MULTISECTORAL ENGAGEMENT

5. Coordination (criterion weight = 0.114749366)

Question: Does any mechanism exist for sharing of epidemiology or laboratory data among relevant stakeholders (Ministry of Health and Ministry of Agriculture)?

Answer: (score)

- ☐ Yes, both formal mechanism in place and data is shared (3)
- ☐ Yes, formal mechanism in place, but data is not shared (2)
- ☐ No formal mechanism in place, but data is informally shared (1)
- ☐ No mechanism in place and no data is shared (0)

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- CDC, 2017

APPENDIX C: Final Results of the One Health Zoonotic Disease Prioritization Workshop in Pakistan

Zoonotic diseases considered for prioritization in Pakistan: Final results of prioritization and normalized weights for 33 zoonotic diseases. The top prioritized zoonotic diseases selected by the voting members representing all ministries active in zoonotic disease work are shown in **bold**.

Rank	Disease	Raw Score	Normalized Final Score
1	**Zoonotic influenza viruses (including avian and swine)**	**0.912053614**	**1**
2	***Brucella spp.***	**0.855935172**	**0.938470237**
3	***Bacillus anthracis* (Anthrax)**	**0.854536581**	**0.936936785**
4	**Rabies virus**	**0.735662988**	**0.806600596**
5	**Crimean-Congo Hemorrhagic Fever virus**	**0.679494972**	**0.745016478**
6	***Salmonella spp.***	**0.652691991**	**0.715628973**
7	*Yersinia pestis (plague)*	0.594323795	0.65163252
8	*Cryptosporidium spp.*	0.579603923	0.635493259
9	Leishmaniasis	0.579603923	0.635493259
10	*Burkolderia mallei* (Glanders)	0.535692871	0.587348006
11	West Nile virus	0.522634318	0.573030259
12	*Chlamydia psittaci*	0.506377409	0.555205748

- CDC, 2017

Response to CCHF

- Prioritization and diseases ranking
- Dissemination of awareness

- **Alert threshold**
- One probable case

- **Outbreak threshold**

One confirmed case of CCHF is an outbreak [NIH, 2013, Pakistan]

Response to CCHF

Human treatment of CCHF in Pakistan

- General supportive therapy
- Rehydration and electrolyte balance
- Red blood cells (RBCs), platelets, and fresh frozen plasma transfusions
- Intensive monitoring to guide volume and blood component
- Analgesics and antipyretics
-

- [NIH, Pakistan, 2013]

Treatment of probable case

- Oral Ribavirin, immediately
- Oral Ribavirin: 2 gm loading dose
- 4 gm/day in 4 divided doses (8 hourly) for 6 days
- 2 gm/day in 4 divided doses for 6 days.

[NIH, 2013, Pakistan]

Response to CCHF in Pakistan

- **Antiviral**
- Favipiravir and interferon-alpha have shown results in drug trials.

- Ribavirin: Pregnancy should be absolutely prevented (whether female or male partner is victim) within six months of completing a course of Ribavirin.

- **Response**
- Animal surveillance
- Screening of contact person or care givers

NIH, 2013, Pakistan

Monitoring contacts

- All suspected contacts should be monitored for 14 days by **taking temperature twice daily.**

- They should have baseline blood tests

- Start Ribavirin **only** if sick (i.e.)

(i) Temperature equal to or more than 38.5ºC

(ii) Severe headache

(iii) Myalgia (muscle pains)

[NIH, 2013, Pakistan]

Disinfection

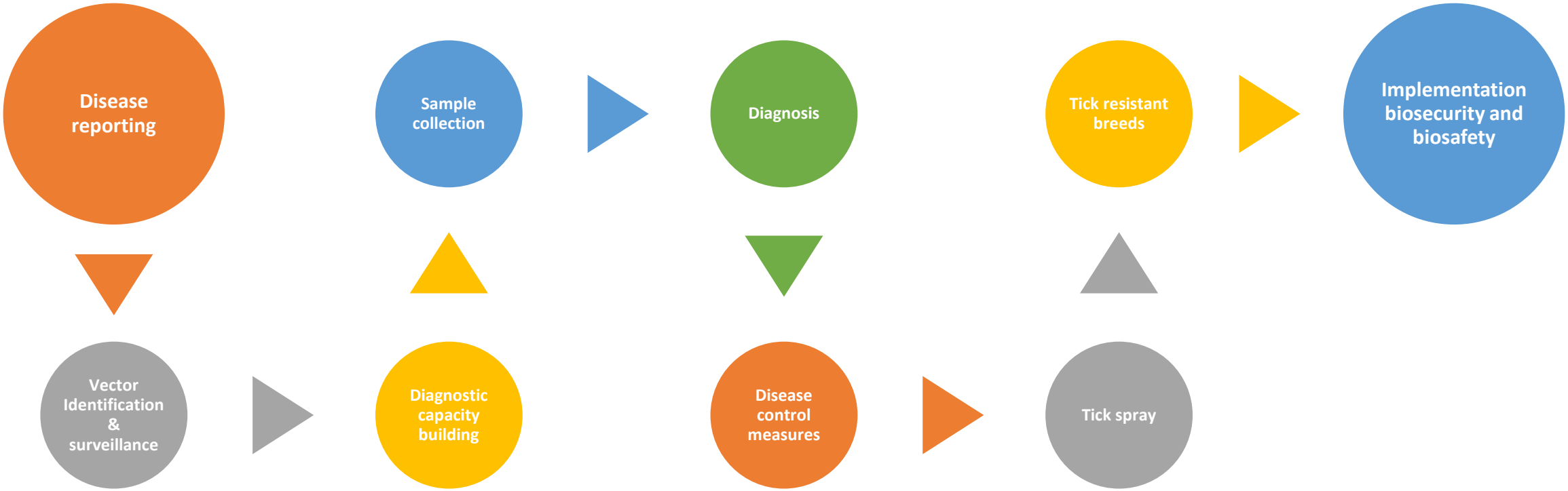
❑Thermo Scientific™ RNase AWAY™ -- disinfection of laboratory working area

❑Heating to 56°C (30 minutes), gamma irradiation, UV light, acidifying (<6)

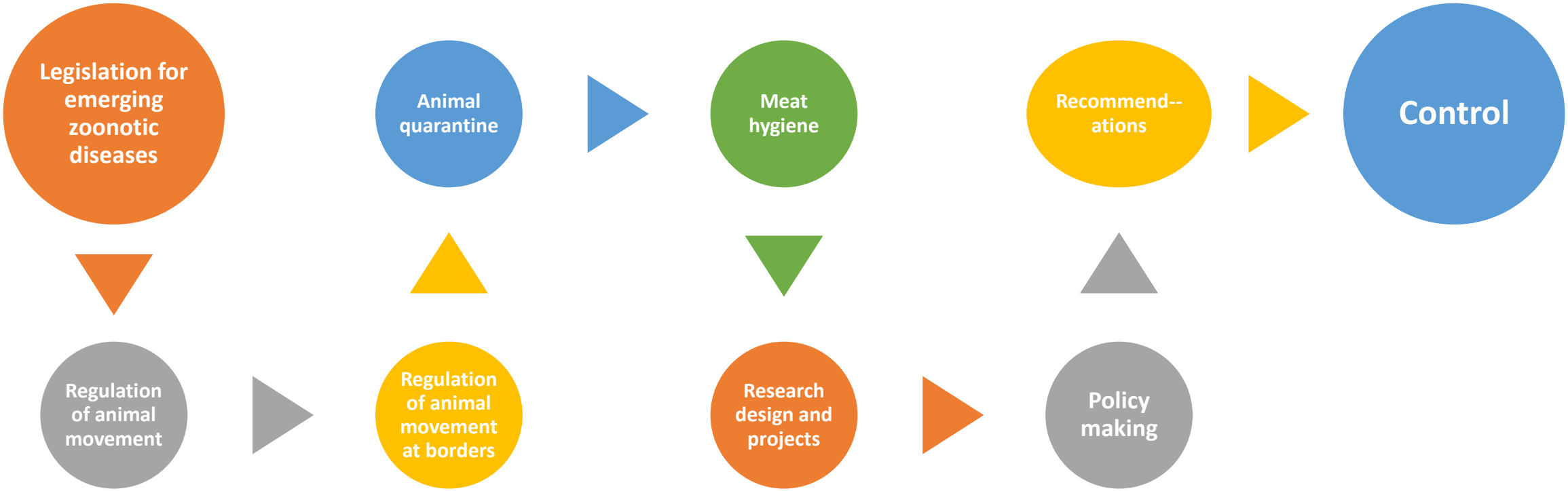
- **Other disinfectants:**
- 1% hypochlorite,
- 2% glutaraldehyde,
- Formalin
- Paraformaldehyde
- 1% sodium hypochlorite
- Hydrogen peroxide
- Peracetic acid

(Appannanavar and Mishra et al., 2011; Escadafal et al., 2012; Bartolini et al, 2019).

Roles of Animal Health Professionals in One Health



Roles of Animal Health Professionals in One Health

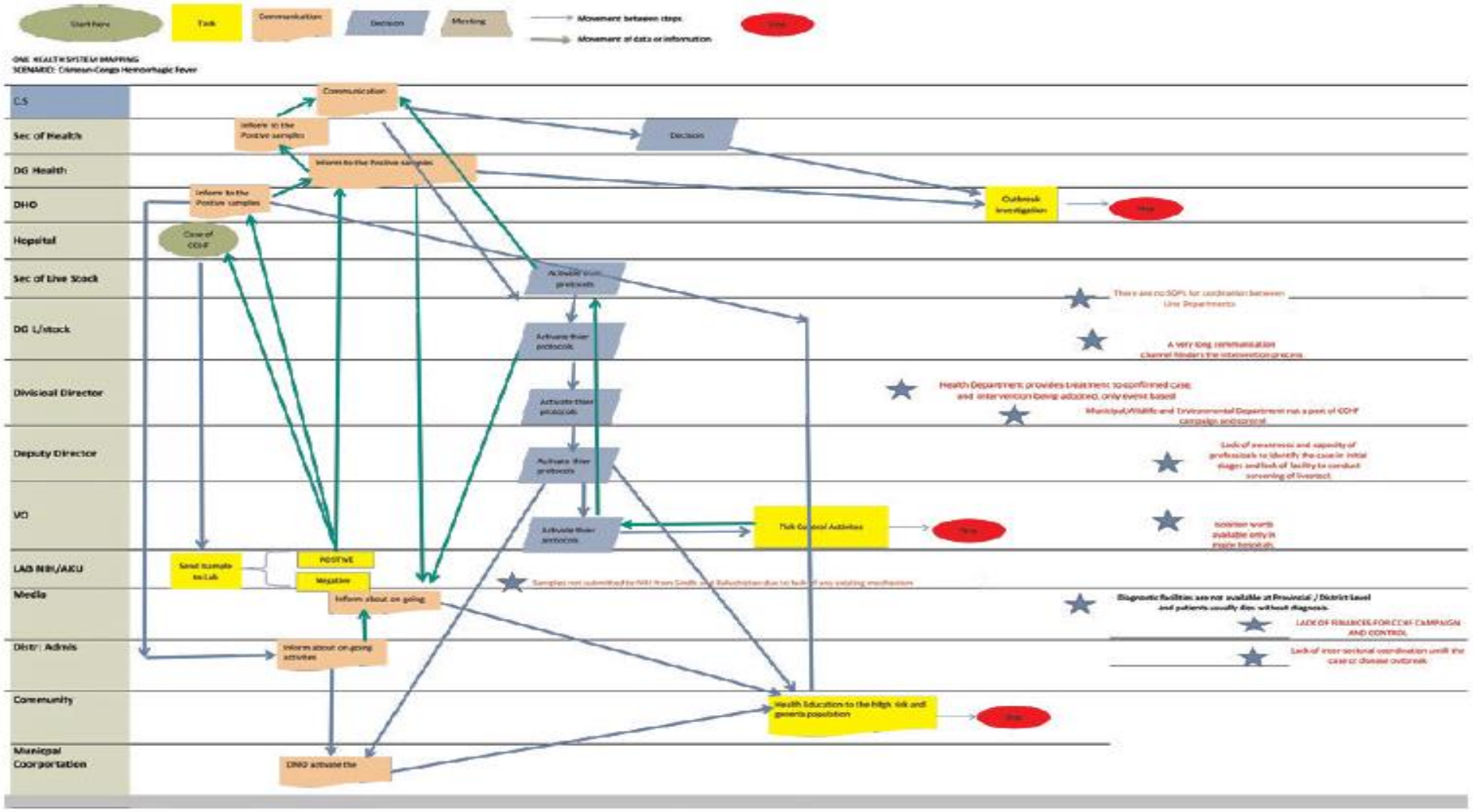


Health Sector and CCHF

Trainings:

- Field Epidemiology and Laboratory Training Program (FELTP)
- NIH & NARC/PARC, Pakistan conducted specialized training on CCHF (e.g.) and biosafety
- Training by provincial departments on vertical programs on sample collection and transportation

Map 5. Crimean-Congo Hemorrhagic Fever Outbreak Scenario



Description of Integrated Map: Crimean-Congo Hemorrhagic Fever (CCHF), as a result of OH SMART Step 4

Source: CDC: https://stacks.cdc.gov/view/cdc/84617

Impact of the actions

- Increase in awareness
- Availability of out break response plan
- Focal persons designated
- Reference laboratories designated
- One Health Hub setup established
- Availability of information/literature
- Zoonotic priority list generated
- Capacity building on biosafety & biosecurity
- Capacity building in sample collection
- Diagnostic capacity building
- Improvement in patient management
- Animal surveillance
- Vector surveillance
- Contact tracing
- Reduced mortality
- Reduced number of cases
- Improved outcome
- Research activities (National and international).
- Whole genome sequencing was conducted for local isolates.

Challenge and possible solutions for CCHF control

Already burden of diseases on health care system

1. Dengue
2. Plague
3. Hepatitis
4. Influenza virus
5. Malaria
6. Salmonella
7. Vibrio Cholera
8. Lyme disease
9. Respiratory syncytial virus
10. Skin cancer
11. TB
12. Others

Challenges

Disease in neighboring countries

- Turkey, Iran, Afghanistan, India, China, Iran, Kazakhstan, Iraq, U.A.E and Saudi Arabia etc.
-
- **In Pakistan:** Every year **~08 million animals** are Slaughtered (**sheep, goats, cattle, buffaloes** and **camels)** during Eid-ul-Azha (Islamic festival).

Mallhi et al., 2016

- Photo source: https://www.youtube.com/watch?v=oq3PFB5mWjo

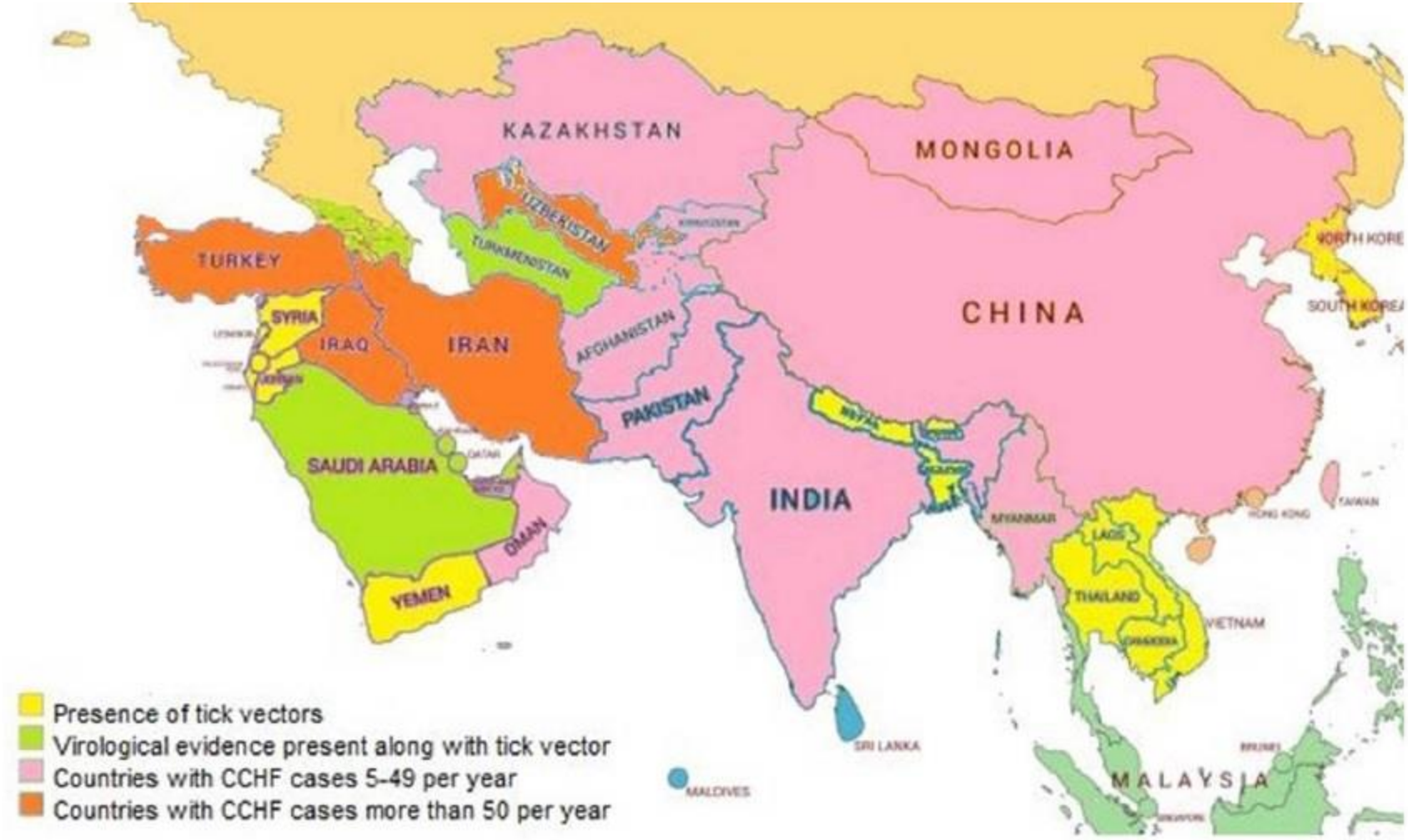


FIGURE 2
Distribution pattern of CCHF in Asian and Middle East countries.

- Aslam et al., 2023

Challenges to control CCHF in Pakistan

- Lack of coordination
- Lack of legislation
- *Political upheavals*
- Lack of funding
- Lower-middle income country
- Lack of awareness

- *Afghan war* and refugees issue in past
- Lagging --- healthcare and robust surveillance
- Low no. of physicians per patient
- *Nomadic trends* (esp. Balochistan province, Pakistan)

Challenges

- Lack of diagnostic capacity
- Lack of lab. infrastructure
- Biosecurity
- Biosafety
- Sanitation
- Population density
- Urbanization
- Deforestation
- Loss of ecosystem diversity
- Floods
- Infectious waste management
- Un-hygienic slaughter house practices
- Lack of developed *One Health* system
- Contaminated drinking water
- Equipments
- Technical assistance (RNA virus-storage issue)
- Lack of vaccination
- Consumables
- Diagnostic kits, PCR reagents

Challenges and possible solutions

SOLUTIONS

- National level One Health Hub
- Need to develop a National One Health Strategic Framework
- ***"One Health" Approach***
- Medical professionals
- Veterinarians
- Epidemiologists
- Microbiologists
- Entomologists
- Parasitologists

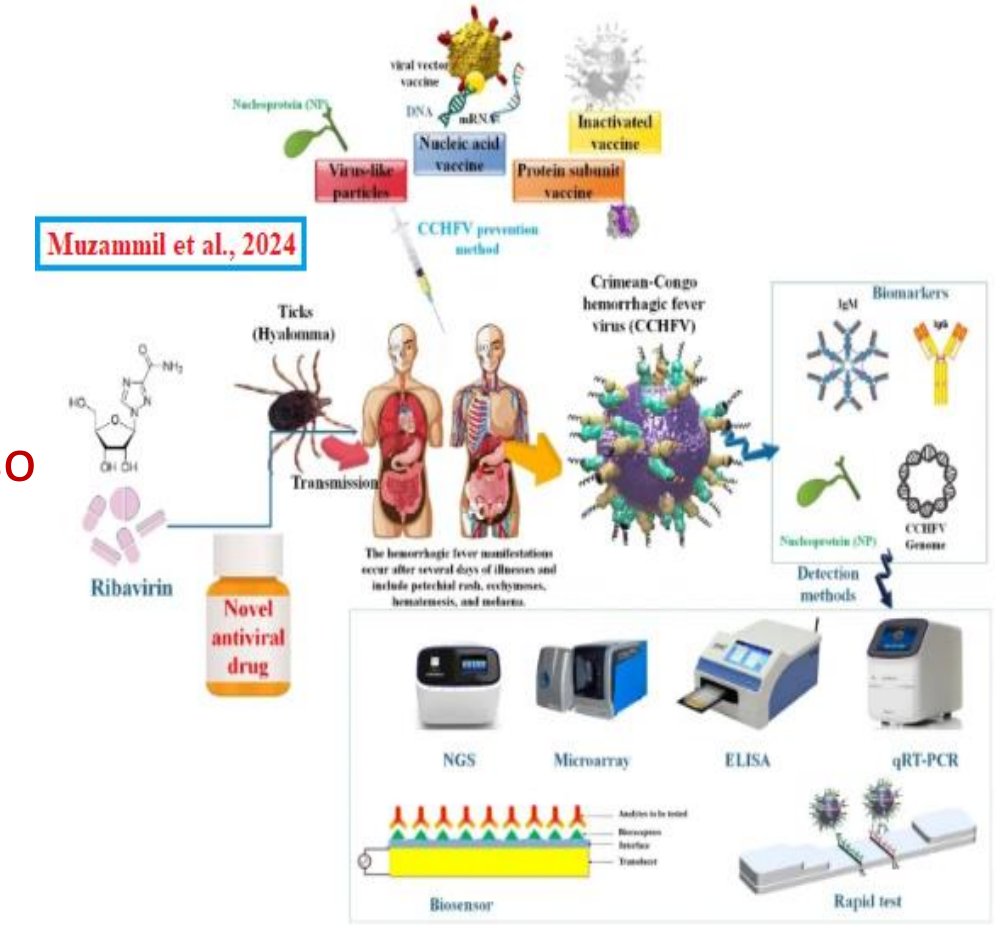
Solutions

- Awareness

  Schools, public, workers, doctors, Veterinarians, hospitals, laboratory personnel and high risk groups
- Need to update the diseases prioritization and ranking list
- Avoid tick bite
- Use light colour clothes at susceptible place
- Use of PPEs at high risk places
- Animal movement
- Border management
- Quarantine
- GIS mapping and identification of hotspots
  Capacity building/training
- Establishment of Labs. at district level
- Common slaughtering compound/station
- Need to improve the slaughtering practices
- Rearing of tick resistant animal breeds
- Monitor and strengthen; Integrated Disease Surveillance and Response System (IDSRS), Pakistan
- Disease surveillance program for human, animals, rodents and ticks
- Early diagnosis
- Early treatment
- Biosafety and biosecurity (PPE) improvement
- Acaricidal application on animals
- Implementation/enforcement of plan

Future strategies to control CCHF

- Drug development
- Development of multi-epitope vaccine
- Inexpensive and accurate diagnostics using biosenso
- Treatment trial as well as to prevent
  Disseminated Intravascular Coagulation (DIC)
- Studies on disease pathogenesis
- Biological control of vectors
- International collaboration
- Funding for research grants
- Funding for trainings, mobility, post-doc opportunities and capacity building



Collaboration with other sectors under One Health approach

- **National**
- Ministry of National Health Services, Regulations and Coordination (MoNHSRC)
- National Institute of Health (NIH)
- Ministry of National Food Security and Research (MoNFSR)
- National Agriculture Research Centre (NARC)
- National Veterinary Laboratories (NVL)
- Field Epidemiology and Laboratory Training Program (FELTP)
- Provincial Department of Health (DoH)
- Livestock and Dairy Development Departments (L&DD)

Collaboration with other sectors under One Health approach

- **International**
- Food and Agriculture Organization of the United Nations (FAO)

FAO supporting "One Health Assessment Tool Development for Pakistan" (22-23rd August, 2024).

- Public Health England (PHE)
- U.S. Centers for Disease Control and Prevention (CDC)
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Challenge and possible solutions to strengthen the collaboration

Solutions

- Prioritization
- Commitment
- Volunteer approach
- Establish common interest
- Planning
- Networking
- Collaboration
- Frequent meetings
- Monitoring and evaluation
- Feedback
- Corrective actions
- Research
- Publication
- Training
- Research funding
- Faculty and student exchange

Sr. No.	Province	Area	Prevalence/Result	Sample source	Sampling strategy	Method	Year/duration	Reference
1.	All Pakistan (All provinces) Pakistan	The 14 districts of Pakistan (Karachi, Jamshoro, Peshawar, Haripu, Islamabad, Rawalpindi, Chakwal, Mianwali, Gujrat, Lahore, DG Khan, Multan, Lodhran and Bahawalpur)	▪ Positive: 75/795 ▪ Male (82%) ▪ Female (18%) ▪ Age: 35 years (average) ▪ **Clinical signs:** Fever (100%), Hemorrhage (65%) Myalgia (41%) ▪ Case fatality (5%) ▪ Asia-1 genotype	**Human**	Event-based surveillance data	RT PCR	2017-2020	Umair et al., 2024
2.	Balochistan Province Pakistan	Balochistan	▪ **Cases:** Illness with high-grade fever (38.5°C) for >3 to <10 days with signs of hemorrhagic or purpuric rash, nosebleeding, blood in vomit/sputum/stool or other hemorrhagic symptoms. ▪ Positive: 1418/2542 ▪ Male (89%) ▪ Case fatality (5% to 13%)	**Humans**	A descriptive approach **event-based surveillance data**	RT PCR	2000-2021	Naseer et al., 2024

Sr. No.	Province/ Region	Area/ districts	Prevalence/Result	Sample Source	Sampling strategy	Method	Year/Duration	Reference
3.	Khyber Pakhtunkhwa (KPK) Province (Pakistan)	**Peshawar**, Bannu, Kohat, Karak, D. I Khan, Mardan, Charssada, Swabi, Shangla, Kurram, Hangu, South Waziristan and Hayat Abad Medical complex	▪ **Prevalence:** 26.67% ▪ **Peshawar** 31.57 % ▪ **Age:** 21-30 Years (30.6%)	**Human** (n=150) 21–40 yrs.	Convenient/ random	RT PCR	June 2022 to September 2022	Zia et al., 2024
4.	Sindh Province (Pakistan)	Sindh Province	▪ **Prevalence:** 4.2 per Million ▪ (Karachi, n=68 cases). ▪ The 0.4 per million from all Sindh ▪ CCHF were most common (44%) among the general population that had **visited livestock markets**	**Human**	Descriptive epidemiology	RT PCR	2016-2020	Syed et al., 2024

Sr. No.	Province/ Region	Area/ districts	Prevalence/findings/result	Sample type	Sampling strategy	Method	Year/Duration	Reference
5	Punjab Province (Pakistan)	Dhok Shah Gul Hassan (Union Council kot Qazi), Tehsil Lawa, village of Kharra Tehsil, district Chakwal	▪ **Cases (n=03)** ▪ Female, 45 yrs. age and his husband 55 yrs. ▪ (13.5 Yrs. boy) ▪ Ticks cattle, *Hy. anatolicum* **(positive)**	**Human Serum (Antigen)** and **Ticks from animals**	Case report	ELISA (IgG) Antigen, Kit	March 2016 to July 2016	Yaqub et al., 2018
6.	Punjab Province (Pakistan)	Sargodha	**Prevalence:** 2/94 (2.1%) **Male** (79.8%) **Female** (20.2%)	**Human (Milkmen)**	Cross sectional	IFA/ELISA (IgG and IgM) **antibodies**	August 2016 to March 2017	Ayube et al., 2018.

Sr. No.	Province	Area/ districts	Prevalence/result	Sample type	Sampling strategy	Method (Gene target)	Duration	Reference
7.	Punjab Province (Pakistan)	**Districts (n=10)** Chakwal Mianwali Rawalpindi Attock Jehlum Lahore Rajanpur Dera Ghazi Khan, Bahawalpur and Rahim Yar Khan	Ticks (12.13%) **Area:** **Chakwal (24.13%)** Mianwali (23.68%) Rawalpindi (23.07%) Attock (20.0%) Rajanpur (10.52%) Lahore (8.33%) **Ticks:** ***H. antolicum* (39.6%)** *H. marginatum* (30.18%), *H. rufipes* (13.2%), *H. impressum* (3.77%), *H. dromedarii* (1.88%), *R. microplus* (5.66%) *R. sanguineus* (5.66%).	**Hard ticks (n=2183)** from sheep, goats, cattle and buffaloes	Cross sectional	ELISA, RT PCR (partial S-segment) and sequencing	January 2017 to December 2019	Shahid et al., 2021
8.	All provinces (Pakistan)	All Pakistan	**Human:** 51 (2.7%) by ELISA and IFA **Animals:** 36.2% (666/1838) by ELISA (ID vet)	**Humans & livestock**	Cross sectional	by ELISA and IFA	2015–2017	Zohaib et al., 2020
9.	Punjab Province (Pakistan)	**Faisalabad** Basic health Care units, diagnostic laboratories, and hospitals	Sero-prevalence (7.58%)	**Human** Blood donors, pregnant females, minor health issues (hypertension and diabetes monitoring.	Cross sectional	Microneutralization assays	2019	Chen et al., 2024

Factors of CCHF in Pakistan

- Majority of the population of Pakistan is associated with livestock
- In 90 % cases, patient in contact with animals
- **Risk group:** Livestock associated persons, butchers, Lab. & health care staff and slaughter house worker at higher risk.
- **Neighboring countries:**

  Turkey, Iran, Afghanistan, Russia — CCHF is endemic
- Unregulated animal and border movement
- Nomadic lifestyle (esp. in Balochistan)
- Pakistan is located in Sub-Tropical region (linked to higher TTBDs.)

My Laboratory

Summary of Control of CCHF in Pakistan

- Pakistan is committed to control but it is the matter of whole region.
- International collaboration, training, support and technical assistance is required.
- Political situation in Central and South Asia is the key determinant.
- Human and animal movements across international borders is a major factor.
- Need to establish reference diagnostic laboratories at district level.
- Need for legislation, awareness, meat hygiene and biosecurity measures.
- Priority and disease ranking need to be optimized.
- Need for fully developed One Health frame work.
- Need for Vector and animal surveillance.
- Vector season play a key role in disease with various routes of transmission.
- Research is required on pathogenesis, inexpensive diagnosis (biosensor), drug, biological and vaccine development.

Lesson from history

- عن أسامة بن زيد رضي الله عنهما مرفوعاً: «إذا سمعتم الطاعونَ بأرض فلا تدخلوها وإذا وقع بأرض وأنتم فيها فلا تخرجوا منها».

Translation: Usāmah ibn Zayd (may Allah be pleased with him) reported that the Prophet (may Allah's peace and blessings be upon him) said: "If you get news of the outbreak of a plague in a land, do not enter it, and if it breaks out in a land in which you are, do not leave it." [Authentic hadith] - [Narrated by Bukhari & Muslim].

Restriction of movements is the key to control outbreak

https://hadeethenc.com/en/browse/hadith/5737

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Thank you

DR. FARHAN AHAMD ATIF
Associate Professor (Medicine)
Officer Incharge, Department of Clinical Sciences,
College of Veterinary and Animal Sciences, Jhang;
University of Veterinary and Animal Sciences, Lahore;
Pakistan
farhan.atif@uvas.edu.pk

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