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**Emergence of Rift Valley Fever
Arabian Peninsula, Yemen
1999 -- 2000**

**Hammam El Sakka, Ross Graham, Sam Lewis, Daa Salman,
Wafik Attalla, Amgad El Kholy, Frank Mahoney**

Introduction

Rift Valley Fever in Arabian Peninsula, 2000

- Large Rift Valley Fever outbreaks in East Africa in '98
- No prior reports of RVF outside of Africa prior to '00
- There is considerable economic trade in livestock from East Africa to the Tihama in association with the Haj.

Livestock Trade – Horn of Africa

Rift Valley Fever Outbreak, Yemen 2000



Ecological Conditions of the Tihamah

Rift Valley Fever Outbreak, Yemen 2000

- Focus of extensive agricultural development over the last 30 years.
- Ecologic conditions are highly receptive to RVF virus transmission
- Rainfall in AUG- SEP, 2000 was > 4 times higher than the previous 10 years.

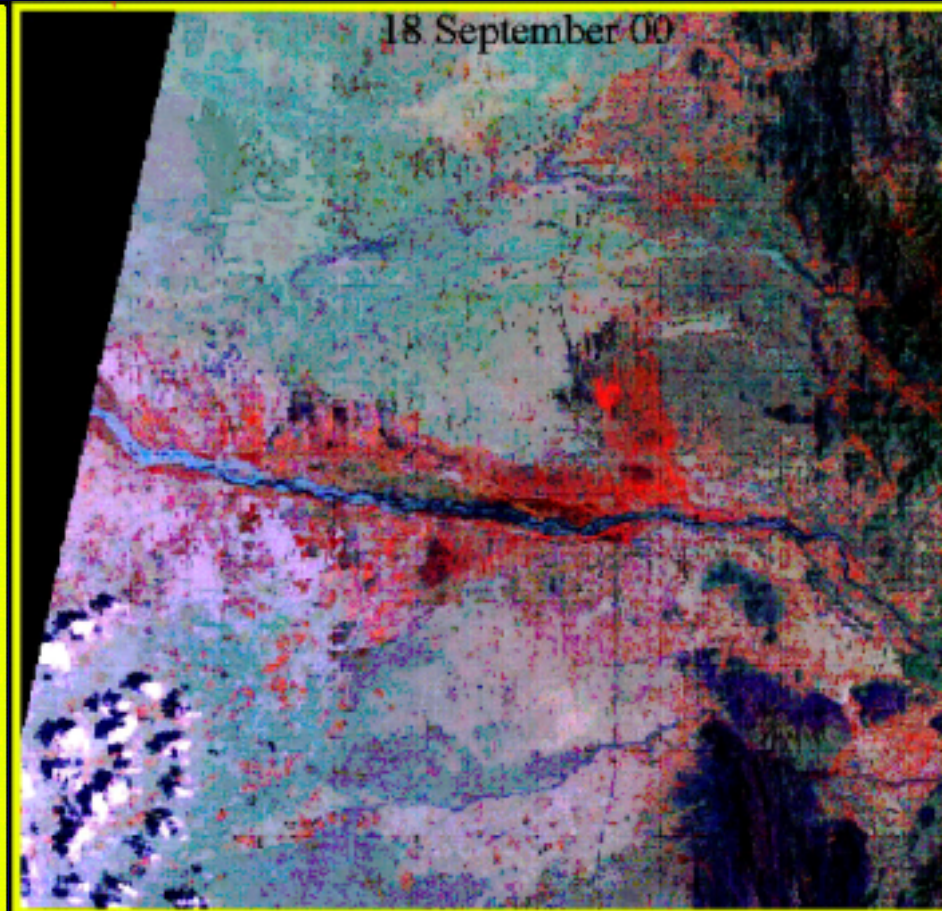
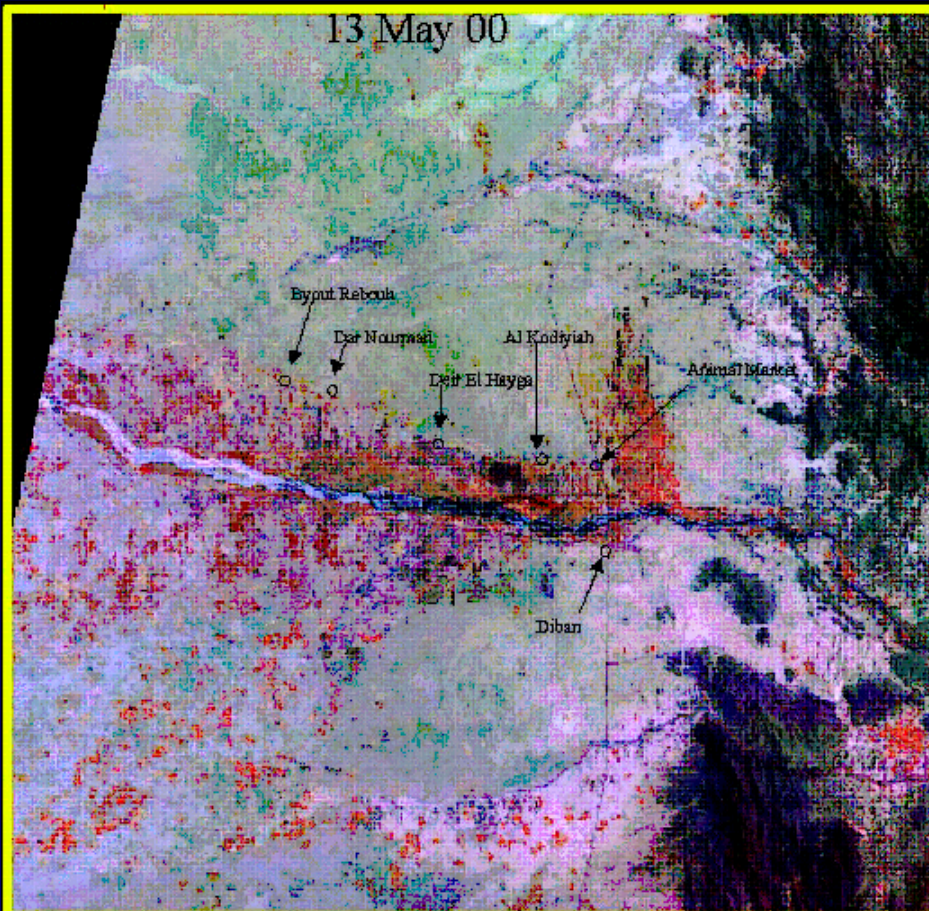


Ecological Conditions of the Tihamah

Rift Valley Fever Outbreak, Yemen 2000

13 May 2000

18 September 2000





10th September 00'

Abo Harbah Village: 1 Calf died and 1 cattle aborted

12th September 00'

Mahal Abd Village: Several calves & lambs died

19th September 00'

Mahal Manah Village: 12 goats & 150 sheep aborted

1 Human Disease

Outbreak Response

Rift Valley Fever Outbreak, Yemen 2000

- MOH

- 3 operation centers
- Mobile surveillance teams
- Health education
- Protective cloths

- MOAI

- Stop importation of animals
- Restriction of animal movement
- Vector control

- WHO

- NAMRU-3, FETP-Egypt, WHO-Geneva
- Development of laboratory (IgM and IgG)
- Virus isolation at NAMRU-3
- Mosquito collection

Case Definition – Suspected Cases

Rift Valley Fever Outbreak, Yemen 2000

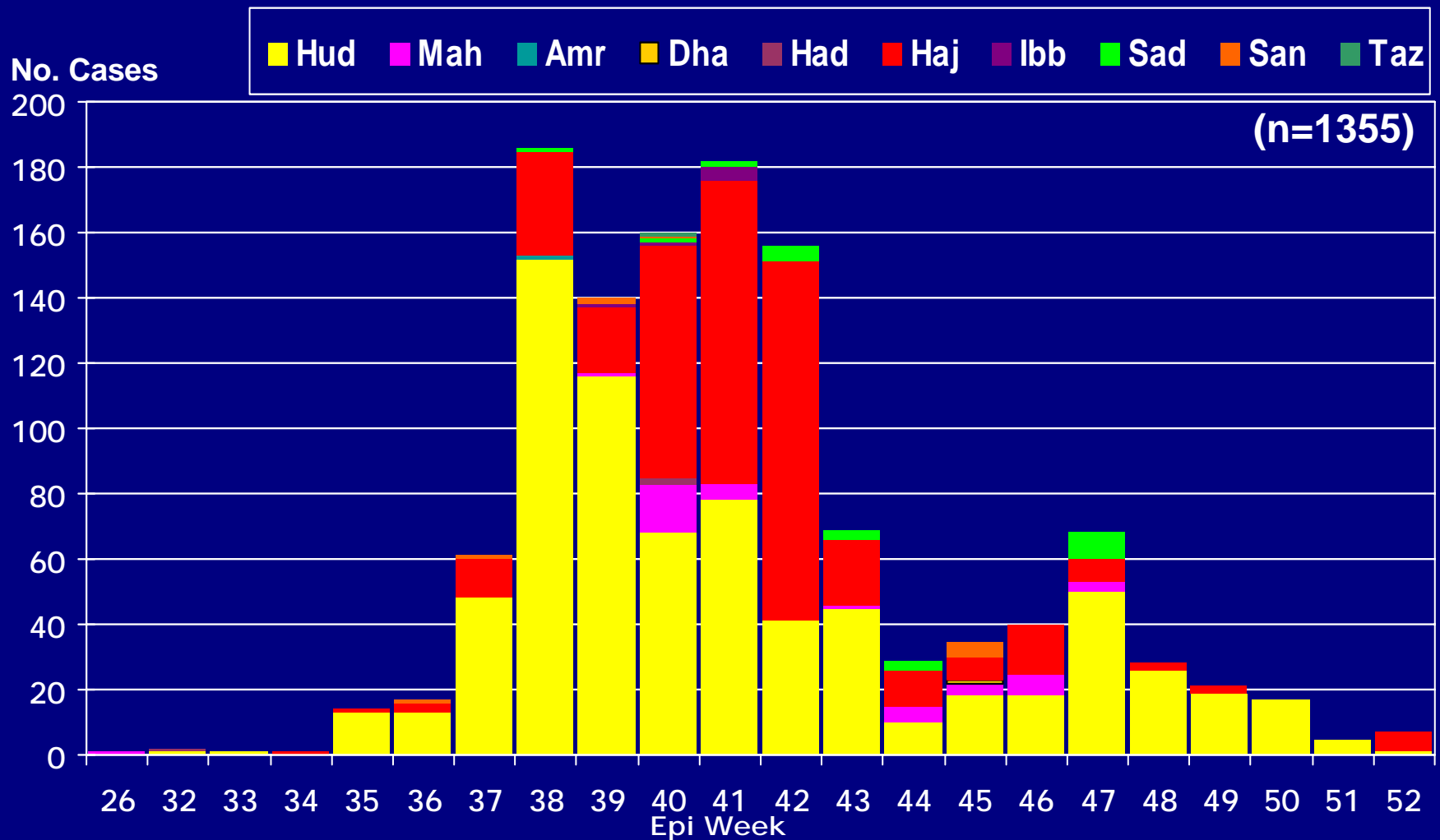
- Resident of **outbreak area** with acute onset of fever ($>38.5^{\circ}\text{C}$) and any 3 of the following symptoms: headache, rash, diarrhea, photophobia, vomiting, eye pain, muscle pain, or visual disturbance.

OR

- **Any resident in Yemen** with acute onset of fever ($>38.5^{\circ}\text{C}$) and at least one of the following:
 - Bleeding diathesis
 - Sudden loss of vision in one or both eyes
 - Decreased level of consciousness, coma, or paralysis
 - Unexplained death

Epi Curve of Suspected Cases by Governorate

Rift Valley Fever Outbreak, Yemen 2000



Objectives

Rift Valley Fever Serosurvey, Yemen 2000

- **Characterize magnitude of outbreak**
 - attack rates by age group
- **Identify risk factors for human disease**
 - Compare relative importance of vector versus animal exposures
- **Formulate recommendations for prevention**

Study Enrollment

Rift Valley Fever Serosurvey, Yemen 2000

Sample

- Household Survey
- Population census (8000 households)
- Random sample 235 households

Survey

- Household form
- Individual form
- Blood sample



Exposures Examined -- Household

Rift Valley Fever Serosurvey, Yemen 2000

- **No. persons per household**
- **Contact with farm animals:**
 - **Daily contact**
 - **History of sickness, death, or abortion among domestic animals**
 - **Method of disposal of dead animals**
- **Standing water near households**
- **Similar illness in the last 3 years**

Exposures Examined -- Individual

Rift Valley Fever Serosurvey, Yemen 2000

- **Age, sex, education and occupation**
- **Clinical picture**
- **Animal exposures:**
 - Regular contact, type of animal
 - Slaughter, handling abortus
 - Disposal of dead animals
- **Mosquito exposures:**
 - Sleeping habits at night
 - Use of nets and insect repellent
 - Working habits

Results -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

Marker	Households (n= 203)		Individuals (n=721)	
	No.	%	No.	%
RVF IgM	13	6%	26	4%
RVF IgG	47	23%	101	14%
RVF IgM & IgG	5	2%	8	1%

Basic Characteristics

Rift Valley Fever Serosurvey, Yemen 2000

	RVF +ve (n= 135)	RVF -ve (n=590)	Odds Ratio	P-Value
Mean Age	26.2	28.7	NA	NS
Range	5-70	4-87	NA	NA
% Male	52	49	0.8	NS
Mean Persons/ Household	8.9	7.6	NA	NS

Attack Rate by Age Group -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

Age Group	No. Tested (n= 721)	Attack Rate %
< 1 year	18	22
1– 5 years	26	23
5-10 years	112	23
11-20 years	182	18
21-30 years	142	16
31-40 years	80	19
41--50 years	62	19
> 50 years	99	15

Frequency of Reported Symptoms -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

	RVF pos (n= 135)	RVF neg (n=590)
Fever	100%	40%
Headache	100%	80%
Bleeding	25%	22%
Photophobia	59%	39%
Visual Disturbance	46%	19%
Disorientation	16%	3%

Animal Related Exposures -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

Exposure	RVF pos		RVF neg		Odds Ratio	P-Value
	No.	%	No.	%		
Handling abortus	75	56%	161	27%	3.3	< 0.05
Contact with sick animals	55	41%	109	19%	3.1	< 0.05
Contact animal blood	75	58%	211	37%	2.3	< 0.05
Direct contact with dead animals	55	41%	144	24%	2.1	< 0.05
Care of farm animals	63	49%	178	31%	2.1	< 0.05
Open air disposal of dead animals	50	37%	147	25%	1.8	< 0.05

Mosquito Related Exposures -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

Exposure	RVF pos		RVF neg		Odds Ratio	P-Value
	No.	%	No.	%		
Sleeping outside	121	95%	514	91%	2.0	> 0.5
Work outside at night	56	44%	223	39%	1.2	> 0.5
Standing water close to household	71	55%	272	53%	1.1	> 0.5
Wear protective clothes at night	23	18%	120	21%	0.8	> 0.5
Use of mosquito net	4	3%	20	4%	0.8	> 0.5

“Outbreak in the Past”

Rift Valley Fever Serosurvey, Yemen 2000

No. households interviewed;	119
No. reporting similar outbreak in '98:	76 (64%)

Summary -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

- **First documented outbreak of RVF outside Africa**
- **Overall attack rate in Wadi Mawr was 18.6%**
 - estimate about 25,000 total cases in el-Zuhrah district during course of outbreak
- **Affects all age groups with no difference by gender**
 - higher attack rate in younger age groups
- **Study suggests direct animal exposures are predominant mode of transmission to humans**

Findings Suggesting RVF was Introduced During '98 Outbreak in East Africa

- **RNA sequence was identical to strains in East Africa**
- **Outbreak began simultaneously in different geographic regions**
- **Residents in the community reported similar outbreak in '98**
- **Animal importers also reported a similar outbreak in '98**

Recommendations -- RVF

Rift Valley Fever Serosurvey, Yemen 2000

- **Surveillance in humans and animals should be continued to detect future outbreaks**
- **Education efforts should be done to reduce risk factors (particularly in outbreak settings) to reduce exposure to infected animals**
- **Use of satellite imaging to forecast disease occurrence warrants further investigation**
- **Vector surveillance to monitor RVF in the environment**