

Epidemiology Of Dengue

What is Dengue?

Arbovirus

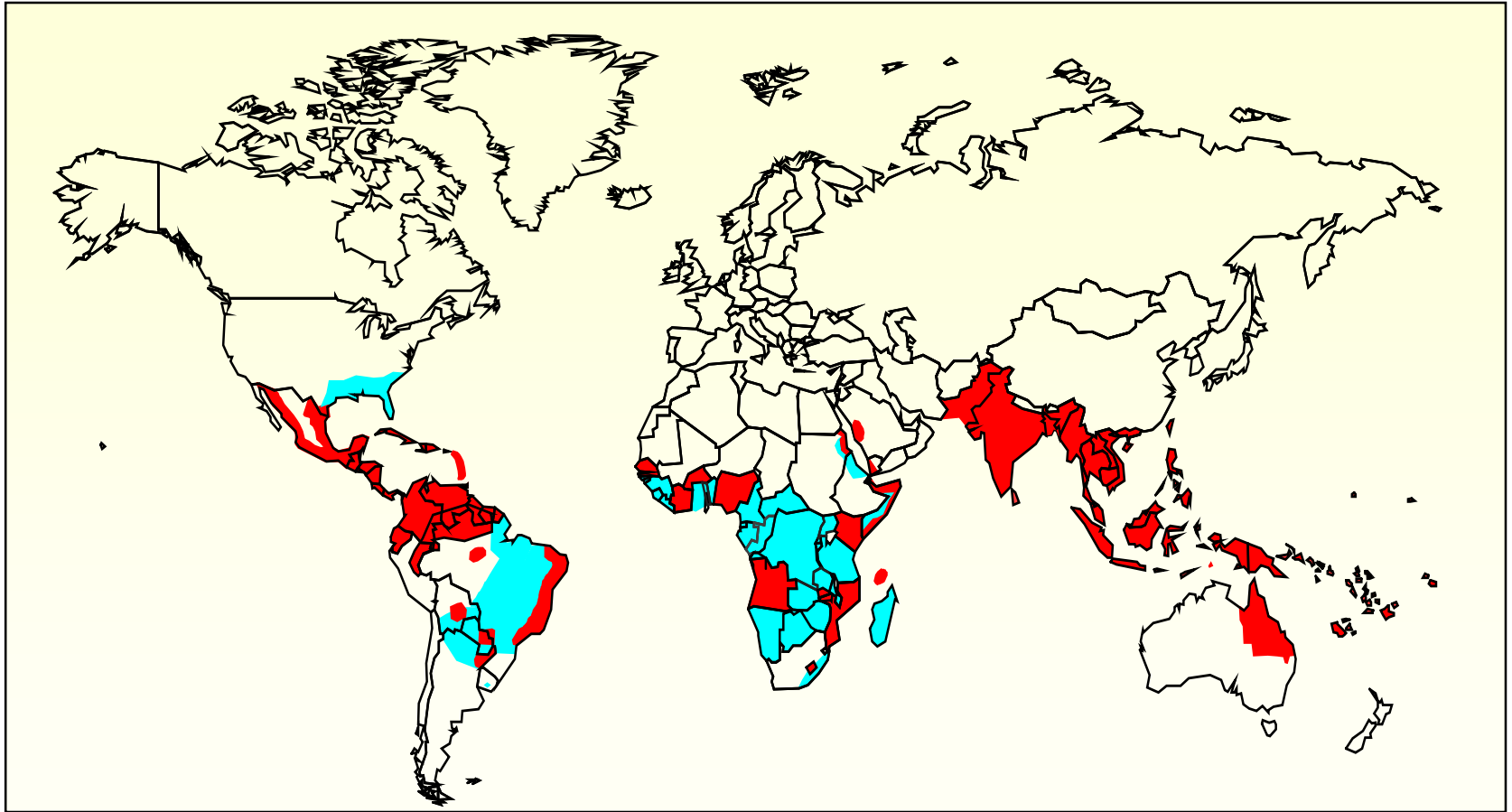
- Dengue is caused by a dengue virus which is carried by a mosquito.
- The mosquito is scientifically called *Aedes* carry the virus.



- Dengue infection have the potential of rapid spread leading to an acute public health problem.
- It is a notifiable disease

Distribution of Dengue

30°N to 40°S latitude of tropics – subtropics.



■ Areas infested with *Aedes aegypti*

■ Areas with *Aedes aegypti* and recent epidemic dengue

Trouble Ahead

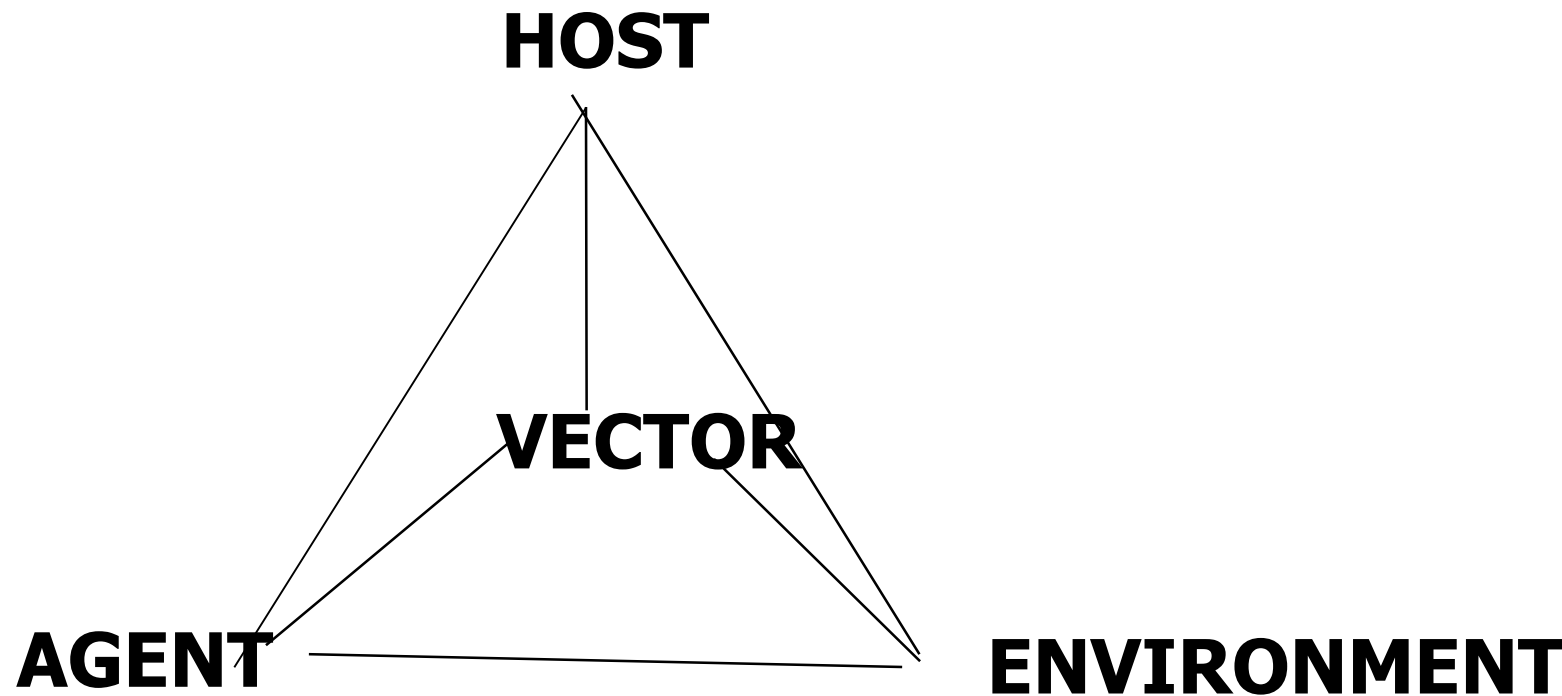
- 2.5 billion people at risk world-wide

South –East Asia

- Currently DF\DHF is endemic in-

**India, Bangladesh, Indonesia,
Madives, Myanmar, Srilanka, Thailand**

Epidemiological Triad



AGENT

- Virus
- Vector

Virus

- Flavi RNA virus
- Types- 4 types
 Den-1, Den- 2, Den- 3, Den- 4
 (All are isolated in India)
- Type 2 is the Commonest .

Infection with one serotype-long lasting immunity to that subtype BUT do not provide protection against other types.

- Each type has different antigenic strain.
- There is no cross immunity

Vector Bionomics

- **Type & Species**
- **Breeding Habits**
- **Resting behavior**
- **Flying range**
- **Life span**
- **Feeding behavior**

Vector

Aedes aegypti Mosquito



Tiger Mosquito

- *Aedes Aegypti* is (Tiger).
other types- *A. albopictus*,
A. polynesiensis,
A. Scutellaris

AEDES

Adult- 3 weeks



Adult

**7- 10
days**

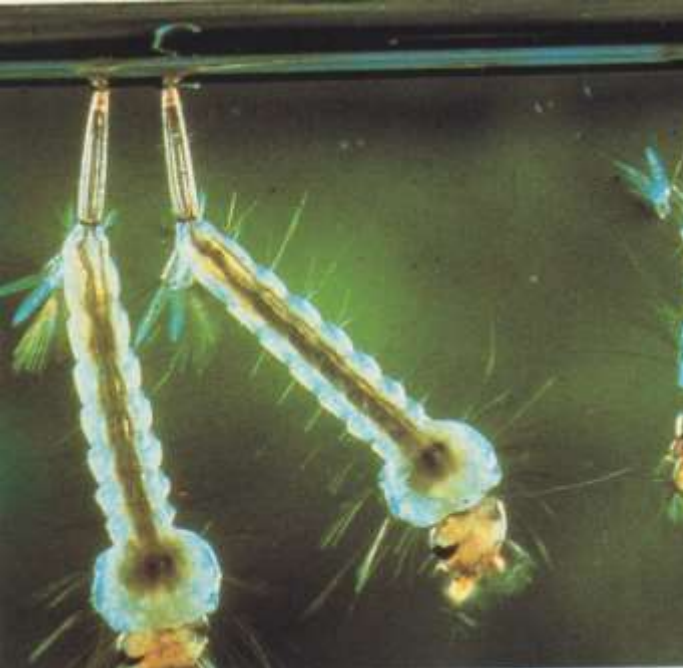
Larvae

Eggs

Pupa



Egg may survive for many months



Trans ovarian transmission

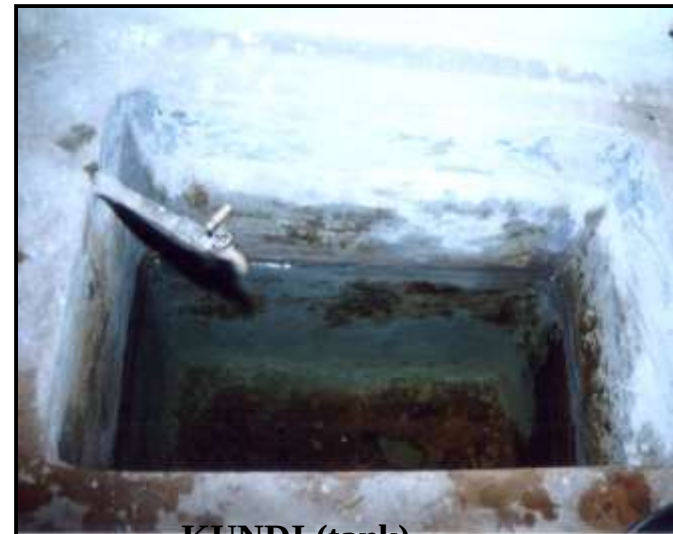
INTRADOMESTIC CONTAINERS



DESERT COOLER



KOTHIS



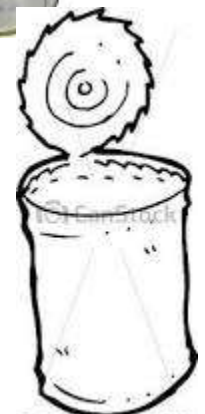
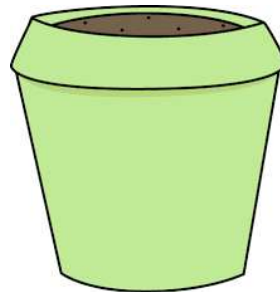
KUNDI (tank)

Outdoor Mosquito Breeding Habitats





House hold water collection



Can Stock Photo - csp155488

- **Breeding-** lays eggs at the bottom of clean open domestic, Peridomestic containers
- Larvae stick to the inside walls; but have to come up to surface to breathe.

- Habitat ie 30°N to 40°S latitude of tropics – subtropics.
- Hot – humid temp of 16° to 40° C so peri-monsoon Aug-Nov .
- < 16° C & > 40 ° C mosquito cant survive.
- Below 26°C. Temp. Mosquitoes fail to transmit type 2 virus.

- Mosquito becomes infective 8-10 days after taking infective blood meal.
- Once mosquito is infected , remains infected for lifelong.
- Eggs can withstand dry season upto one year.

- Flying range- 400 meters
- Resting habits- Endophily (indoor, dark places)

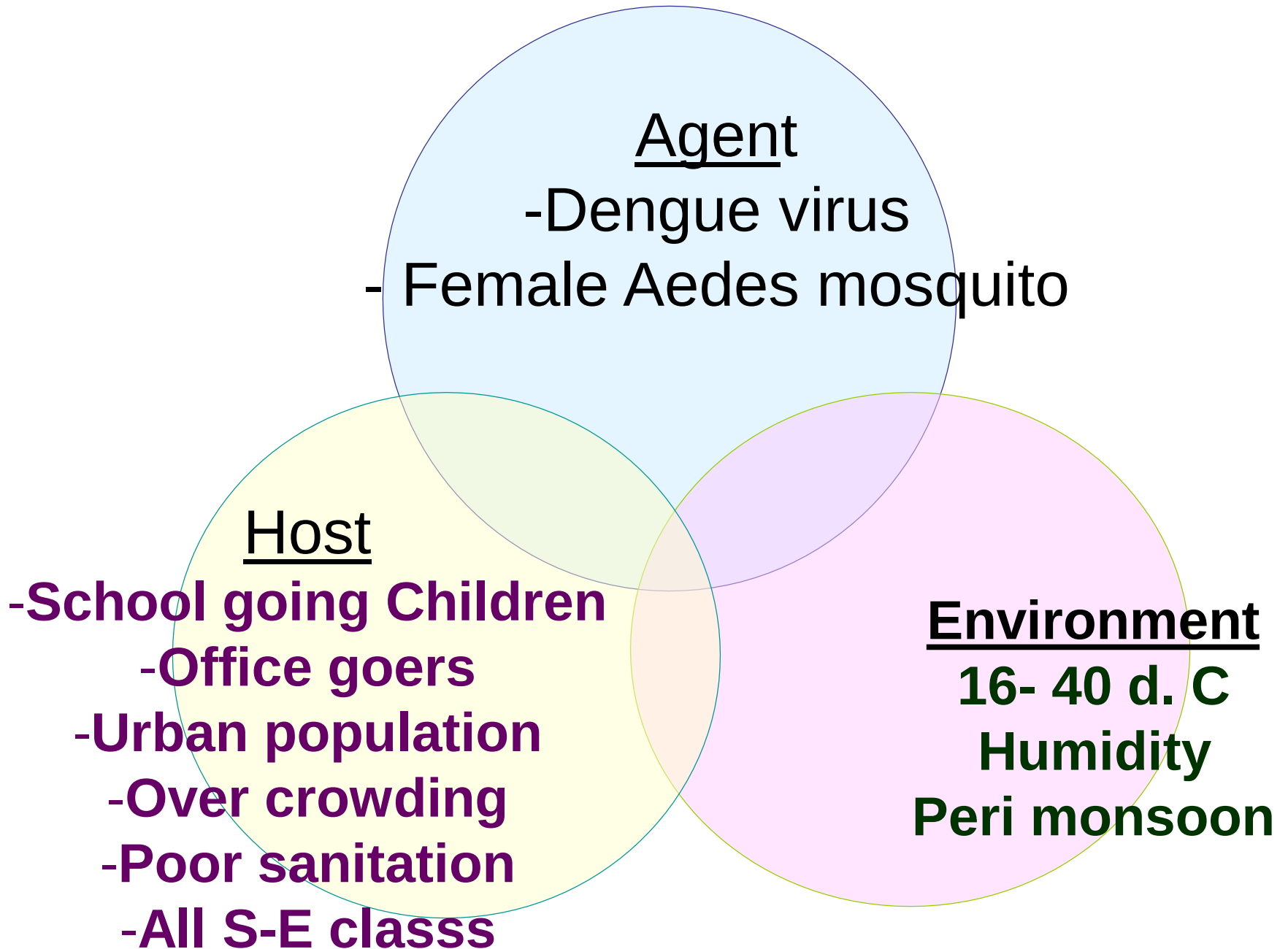
Aedes mosquito- Sucking blood



- feeds on many humans,
- Time of biting- daytime (8am -1pm) & late afternoon (3pm -5pm)

Host factors

- Not a dis. of the poorest but of those who use water tanks, flower pots, coolers, Ac.
- Affects school children & office goers.
- Children most vulnerable to get DHF as low immunity and interaction with maternal Ab in infants.



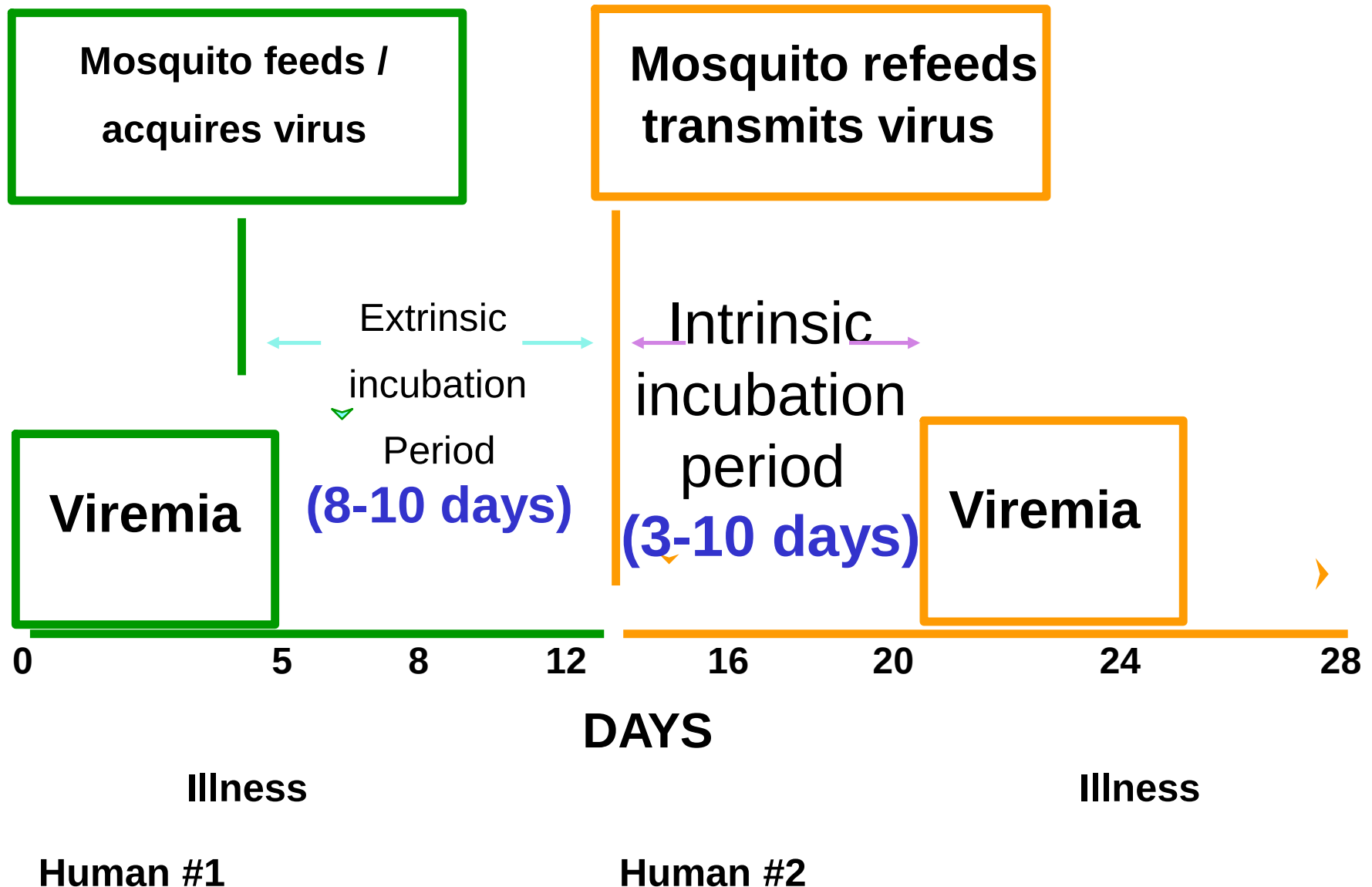
Reasons for Dengue Expansion in the Asia

- Increased distribution & densities of vector
vector infestation,
- Unreliable water supply systems
- Increasing non-biodegradable containers
and poor solid waste disposal

Reasons for Dengue Expansion in the Asia

- Increased air travel
- Increasing population density in urban areas- unplanned & uncontrolled urbanization
- Deterioration of public health infrastructure & surveillance system

Transmission of Dengue Virus by *Aedes aegypti*



Reservoir of infection

Man, Mosquito, (Monkey),

Clinical Features

Dengue Viral Infection

```
graph TD; A[Dengue Viral Infection] --> B[Asymptomatic]; A --> C[Symptomatic]; C --> D[Dengue fever]; C --> E[DHF]; D --> F[Undifferentiated]; D --> G[Classical Dengue fever]; F --> H[Without H'age]; F --> I[With H'age]; E --> J[No shock]; E --> K[DSS]; K --- L[Plasma leakage];
```

The diagram is a hierarchical flowchart classifying Dengue Viral Infection. At the top is a red rounded rectangle labeled 'Dengue Viral Infection'. It branches into two pink rounded rectangles: 'Asymptomatic' on the left and 'Symptomatic' on the right. From 'Symptomatic', it branches into two green rounded rectangles: 'Dengue fever' and 'DHF'. 'Dengue fever' branches into two blue rounded rectangles: 'Undifferentiated' and 'Classical Dengue fever'. 'Undifferentiated' branches into two red rounded rectangles: 'Without H'age' and 'With H'age'. 'DHF' branches into two blue rounded rectangles: 'No shock' and 'DSS'. A yellow rectangle labeled 'Plasma leakage' has two lines pointing to the 'DSS' box.

Asymptomatic

Symptomatic

Dengue fever

DHF

Undifferentiated

No shock

Classical
Dengue fever

DSS

Without
H'age

With
H'age

Plasma
leakage

Dengue Clinical Syndromes

- Undifferentiated fever
- Classic dengue fever (DF)
- Dengue hemorrhagic fever (DHF)
- Dengue shock syndrome (DSS)

Dengue Fever

Undifferentiated Fever

87% of patients infected were either asymptomatic or only mildly symptomatic

Pt. is viremic at the time of fever--- Infective
to mosquito



Petechiae



Positive Tourniquet Test



Tourniquet Test

- Inflate blood pressure cuff to a point midway between systolic and diastolic pressure for 5 minutes
- Positive test:
 - 20 or more petechiae per 1 inch² (6.25 cm²)
 - or
 - 20 or more petechiae per 3 cms. diameter

Suspected C/O of DF

- Acute onset
- High grade fever <7 days duration
- Severe headache, backache
- Joint , post orbital & muscle pain
- With or without rash

Probable C/O of DF

- Suspected case
- High vector velocity
- Presence of confirmed cases in area
- Bd. –ve for Mp, No response to anti- malarials

Confirmed case of DF

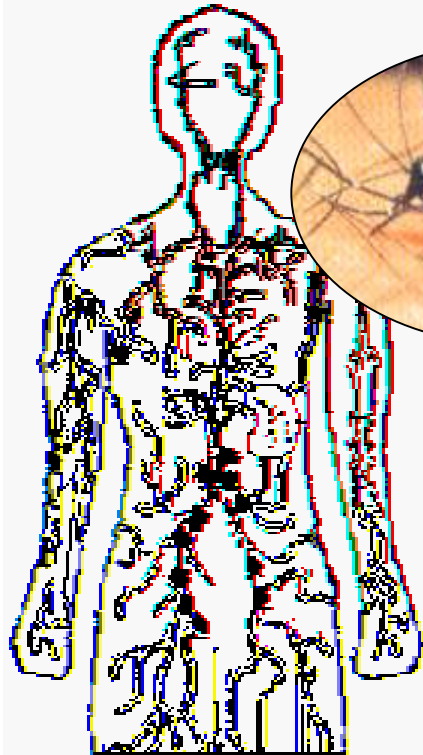
- Isolation of virus from the blood in early phase
- IgM abs. in single serum samples or
- 4 fold rise of Abs. in paired serum samples.

Dengue Hemorrhagic Fever

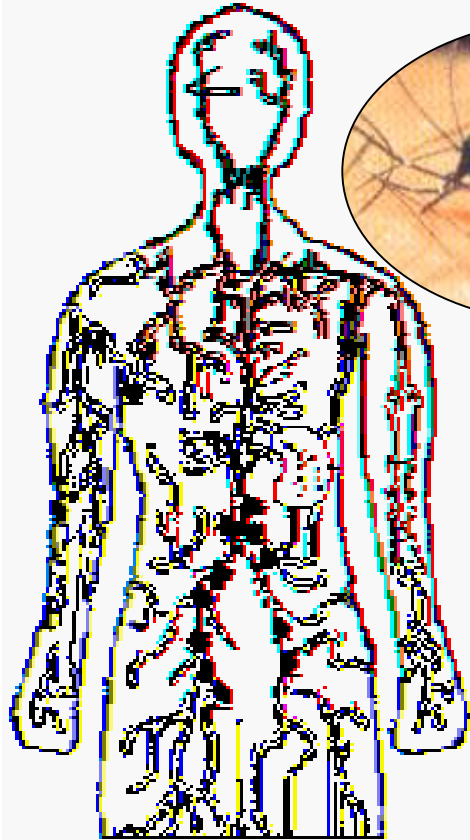
DHF

It is not a complication of dengue fever
but has separate etio-pathogenesis

Pathogenesis- DHF



Bitten dengue virus

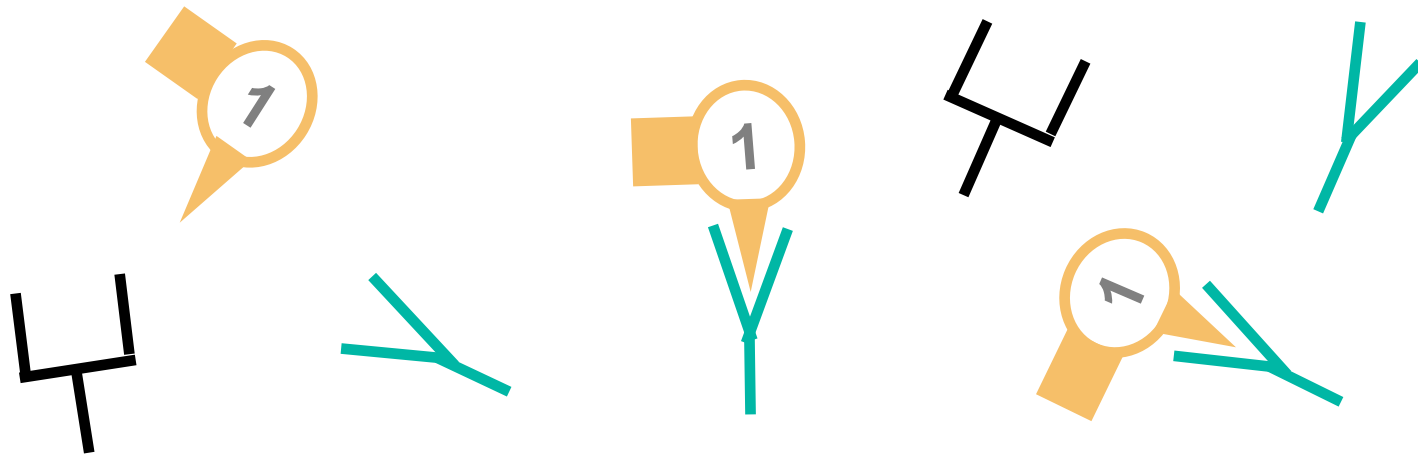


Bitten dengue virus



**Specific Antibodies to
Same type virus**

Homologous Antibodies Form Non-infectious Complexes



Dengue 1 virus



Neutralizing antibody to Dengue 1 virus



Non-neutralizing antibody



Complex formed by neutralizing antibody and virus

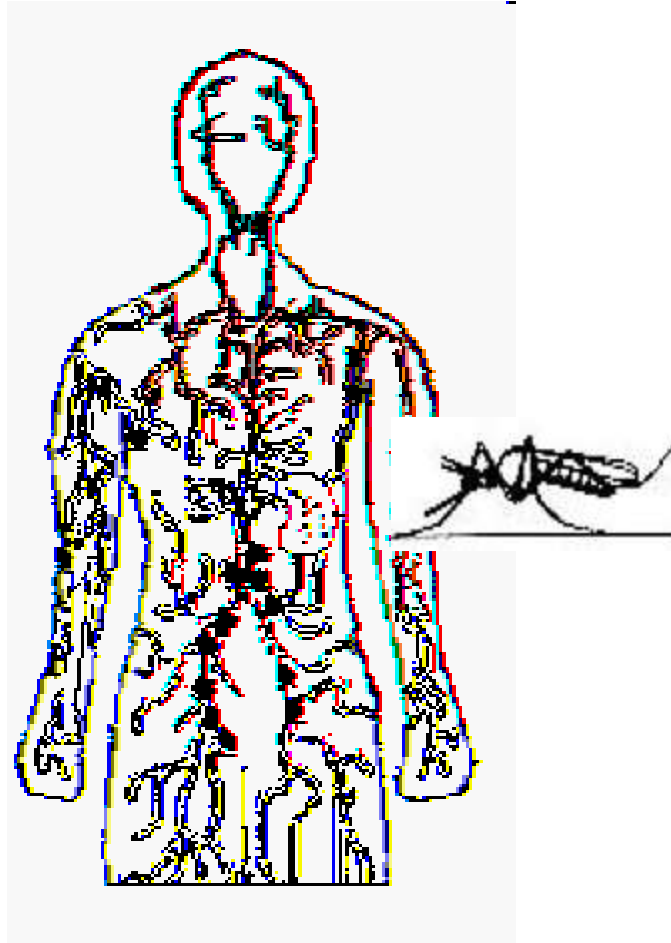
Bitten dengue virus



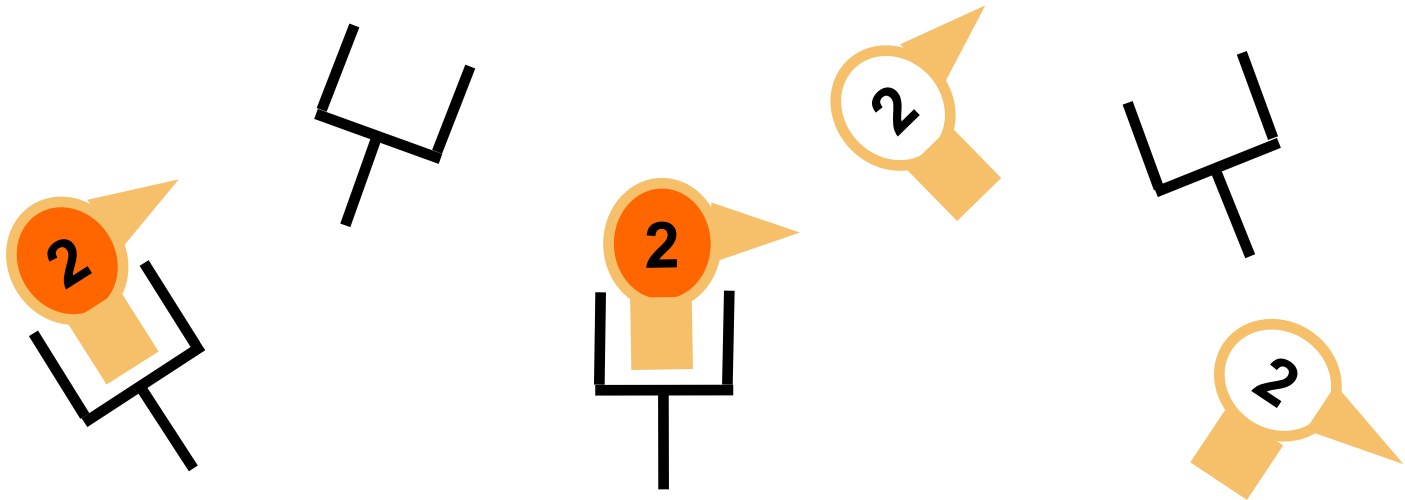
**Specific Antibodies to
dengue virus**



**Bitten dengue virus
Other sub-type**



Heterologous Antibodies Form Infectious Complexes



Dengue 2 virus



Non-neutralizing antibody to Dengue 1 virus



Complex formed by non-neutralizing antibody and virus

Bitten dengue virus



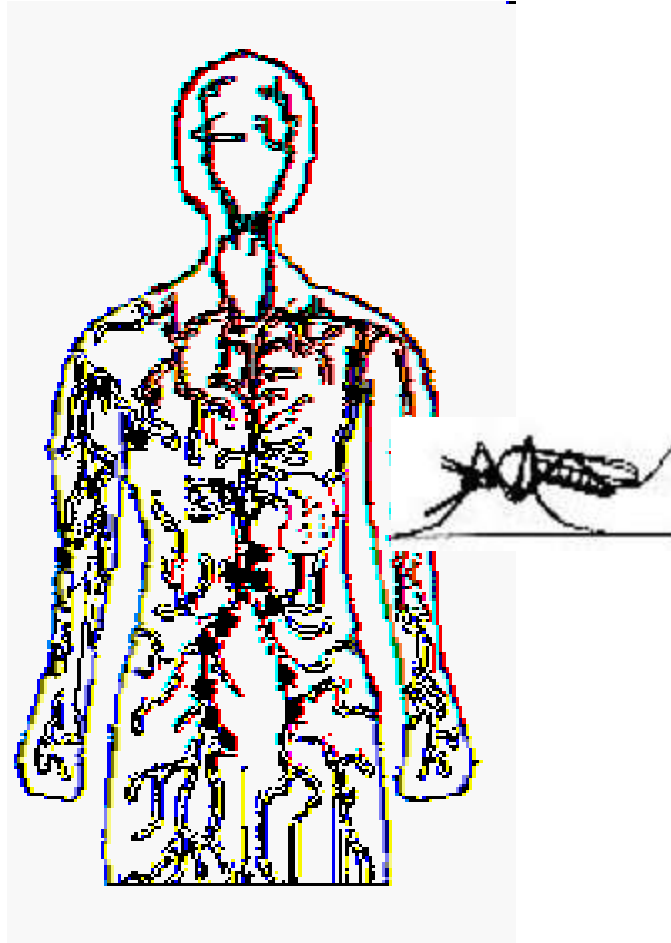
**Specific Antibodies to
dengue virus**

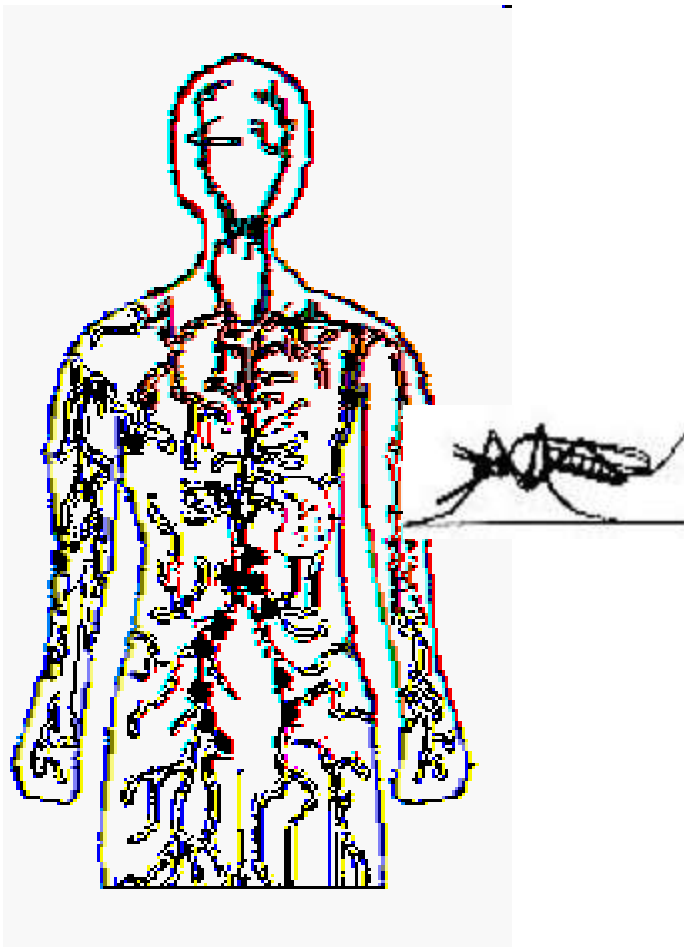


**Bitten dengue virus
Other sub-type**



**Immune reaction
Ag-Ab complex**





Bitten dengue virus

Specific. Antibodies to
dengue virus

Bitten dengue virus
Other sub-type

Immune reaction
Ag-Ab complex

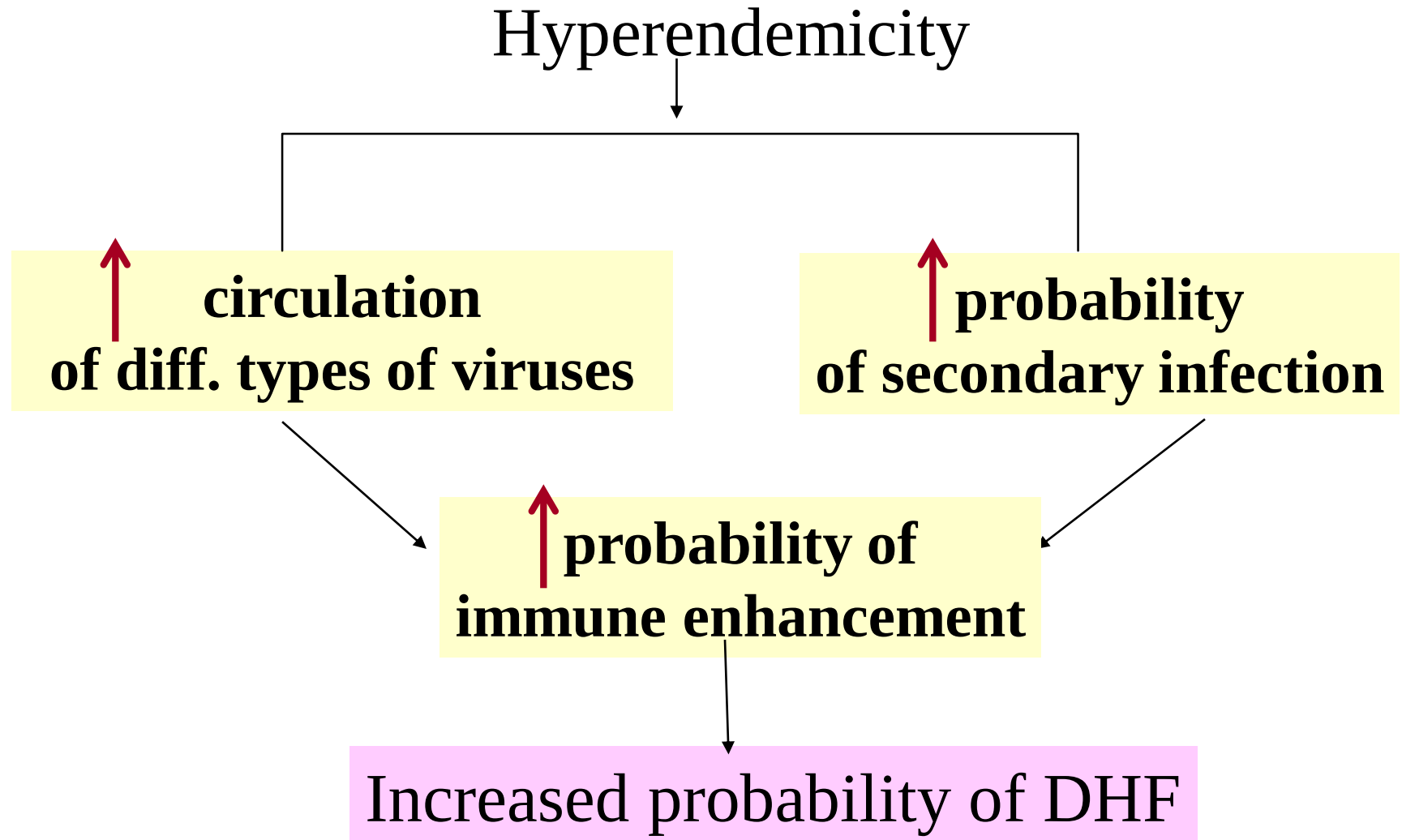
Capillary leakage

DHF

Hypothesis on Pathogenesis of DHF

- Antibody-Ag complex-can enter a greater proportion of cells of the mononuclear lineage, thus increasing virus production
- Infected monocytes release vasoactive mediators, resulting in increased vascular permeability and hemorrhagic manifestations that characterize DHF and DSS

Increased Probability of DHF

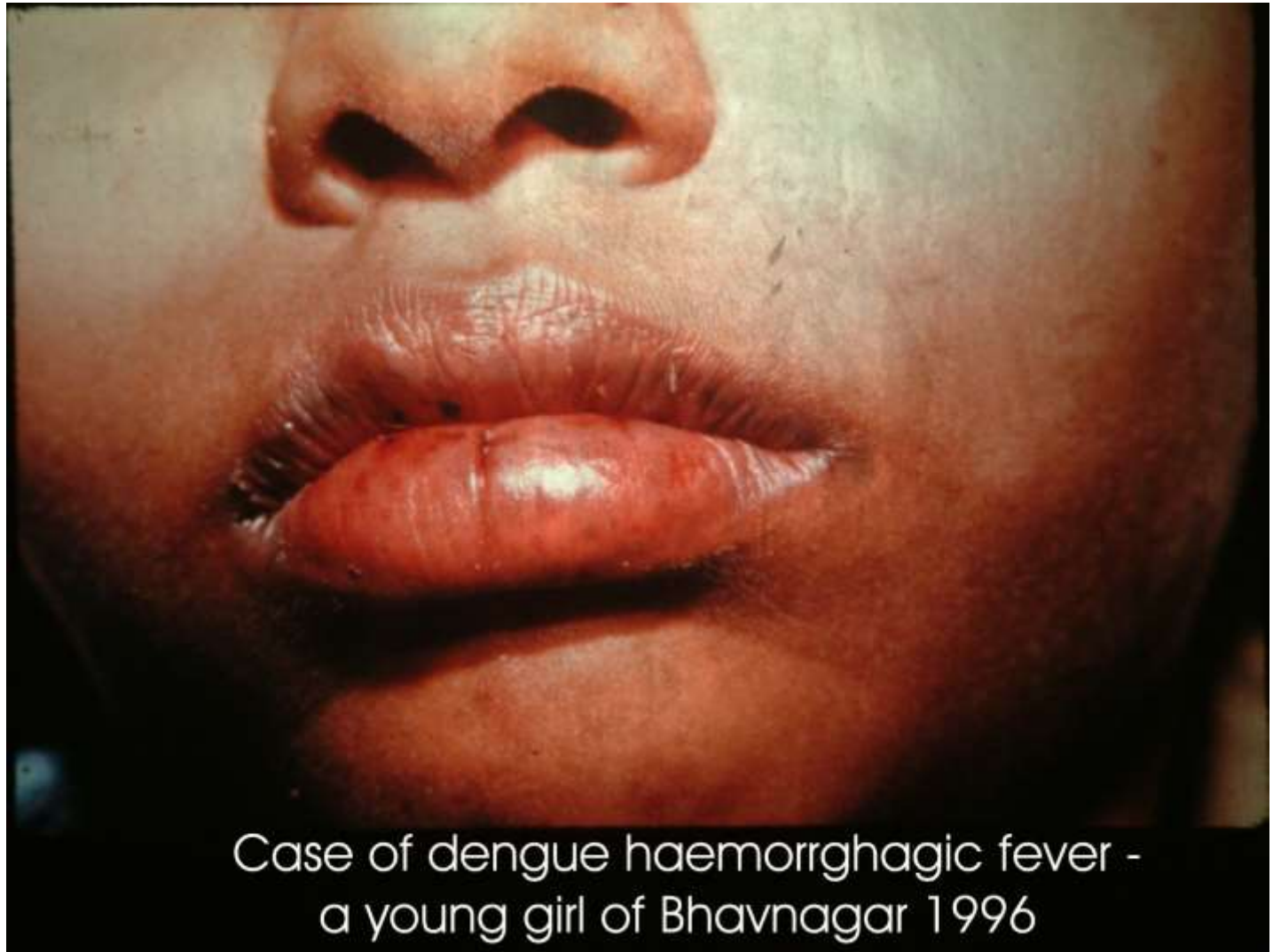


Dengue- Hemorrhagic form

- Hemorrhagic arm



DENGUE FEVER



DHF

Decrease Platelets found ONLY in DHF.

Done 48 h apart.

Clinical Case Definition for DHF

4 Necessary Criteria:

- H/o acute fever(probable/confirm case of Dengue)
- Hemorrhagic manifestations
- Low platelet count ($100,000/\text{mm}^3$ or less)
- Objective evidence of “leaky capillaries:”
 - elevated hematocrit ($>20\%$ over baseline)
 - low albumin
 - pleural or other effusions, Ascitis, Hypoproteinemia

Hemorrhagic manifestations/tendencies

Evidenced by one or more following -- +ve
tourniquet test, petechie, ecchymosis or
purpura, bleeding from the mucosa,
genitourinary tract, injection sites or other
sites, maleana

DSS

- Severe DHF leaks persist for 72 hrs.



fluid leaks into serous cavities

eg Peritoneum, Pleura, Pericardium. Abdominal distension, colic, low Pulse Pr.

- Congestive phase after the leaks stop.
- Untreated DHF ► DSS ► DIC. So recognize early.

Clinical Case Definition for DSS

- 4 criteria for DHF
- Evidence of circulatory failure :
 - Rapid and weak pulse
 - Narrow pulse pressure (≤ 20 mm Hg) **OR** hypotension for age
 - Cold, clammy skin and altered mental status
- Frank shock is direct evidence of circulatory failure

Pt dies of Shock, not bleeding

Viral Risk Factors for DHF

- Virus strain (genotype)
 - **Epidemic potential: viremia level, infectivity**
- Virus serotype
 - DHF risk is greatest for DEN-2, followed by DEN-3, DEN-4 and DEN-1

Risk Factors Reported for DHF

- Virus strain– with two or more serotypes circulating simultaneously at high levels (hyperendemic transmission)
- Pre-existing anti-dengue antibody
 - previous infection
 - maternal antibodies in infants
- Host genetics
- Age- Children
- Higher risk in secondary infections

Prevention

- Primary
- Secondary- Early diagnosis & treatment
- Tertiary- Mx of shock
- National Programme - Surveillance

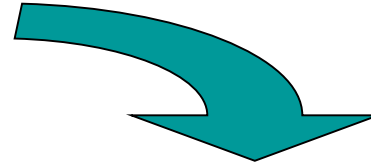
Primary prevention

VACCINES

Vaccine for Dengue

most cost effective Under trial

Pre existing heterotypic dengue antibody
is a risk factor for DHF



Tetravalent dengue vaccine –

Phase 2 trial completed successfully in Thailand

Other approaches-

Infectious cDNA cloned derived
vaccine, inactivated whole virion vaccine

- There is no vaccine or specific medicines available against Dengue infection.
- Vector control is currently the only option available for reducing dengue & DHF.

Primary Prevention

- Anti larval measures
- Anti adult measures
- Personal protective measures
- Legislative measures
- Health Education
- Vector surveillance

Some examples of interventions



HEALTH AWARENESS



ADULT FOGGING



**ENGINEERING
ASPECTS**



**ENGINEERING
ASPECTS**

Community Participation

- First must educate the public in the basics of dengue, such as:
 - Where the mosquito lays her eggs
 - The link between larvae and adult mosquitoes
 - General information about dengue transmission, symptoms and treatment

रुद्राक्ष



AUDIO-MEDIA



FOLK MEDIA

Where in a house can a mosquito breed?

- Open Tanks
- Flower Pots
- Water Coolers/Refrigerators
- Rooftops
- Solid Waste
- Tyre
- Hollow fence posts
- Glass bottles/cans



Surveillance

AIM:-

Early detection of an outbreak

To initiate timely preventive & control measures

Should be carried out regularly

Vector control surveillance

- 1) **House Index**- Percentage of houses positive for larvae of aedes.
- 2) **Breteau Index**- No of containers positive for aedes egypti per 100 houses
- 3) **Container Index**- Percentage of containers positive for ades breeding

Epidemiological Interpretation of Indices

Index	High risk of transmission	Low risk of transmission
BRETEAU	>50	<5
HOUSE	>10%	< 1%

Intermediate risk of transmission- Bet. These value

Prevent *Aedes* from Breeding!

Remove ALL sources of stagnant water.

Deny the *Aedes* mosquito of any chance to breed.



- Change water in vases/ bowls every 7 day.
- After emptying scrub the container walls
- Add sand granular insecticide to water.



- Turn over all storage containers

DO'S AND DON'TS for aedes

- Remove water from coolers and other small containers at least once in a week
- Use aerosol during day time to prevent the bites of mosquitoes
- Do not wear clothes that expose arms and legs

Integrated vector control measures



Extensive use of fish Scraps/tyre removal



Health education

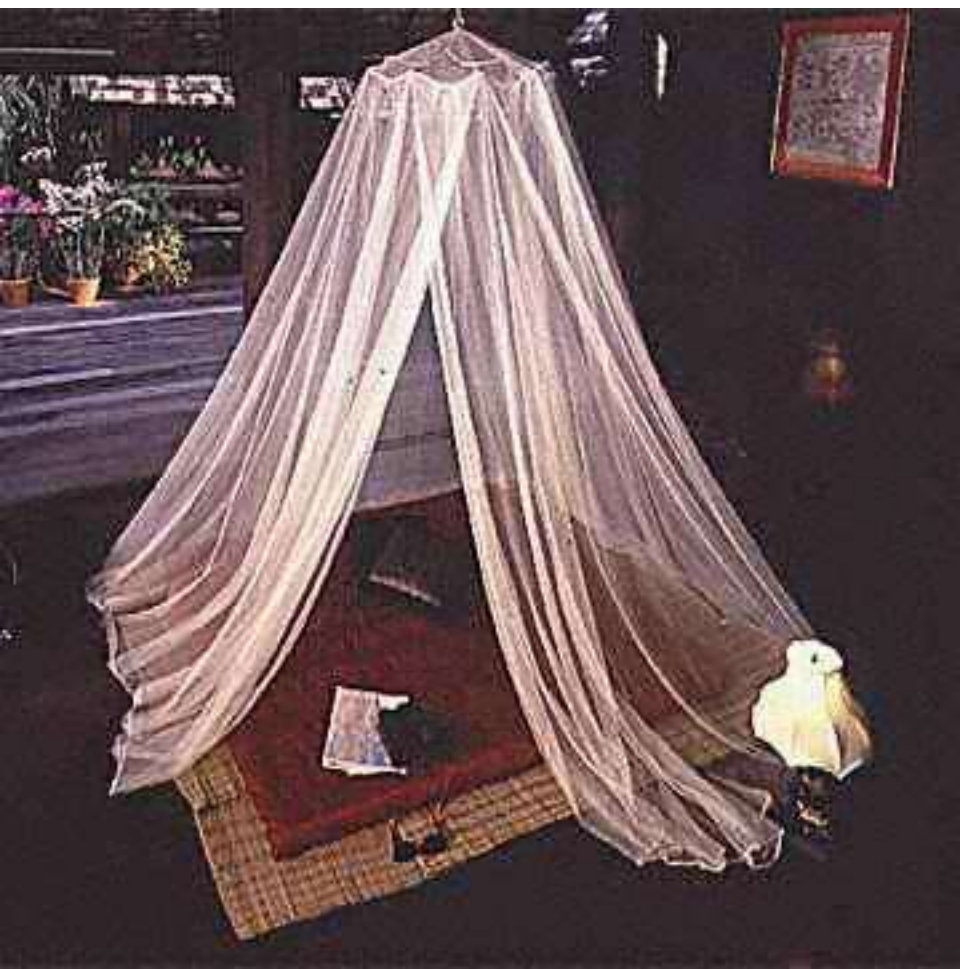


Deweeding of ponds/rivers

Personal Protection

- Protective Clothing
- Repellents
- Mats, coils and aerosols
- Insecticide-treated mosquito nets and curtains.







Legislative measures

- Fine for keeping the water container open/
breeding is found.

Prevention at individual level

- Remove water from coolers(wk.ly), small containers, scrub the wall of container
- Insecticide spray in the house
- Wear mosquito bite protecting clothes
- Use mosq. Net\repellents\mats
- Use coils \ mats even during day

Epidemiological surveillance

- Fever surveillance
- Diagnosis based on standard case definitions.
- Reporting of DF/DHF to state health authority
- 5% samples of clinically diagnosed cases during an epidemic should be tested for confirmatory lab. Diagnosis.
- Instruct peripheral health staff to report increasing no. of cases\ clustering of acute febrile illness compatible with case definition.

Surveillance

AIM:-

Early detection of an outbreak

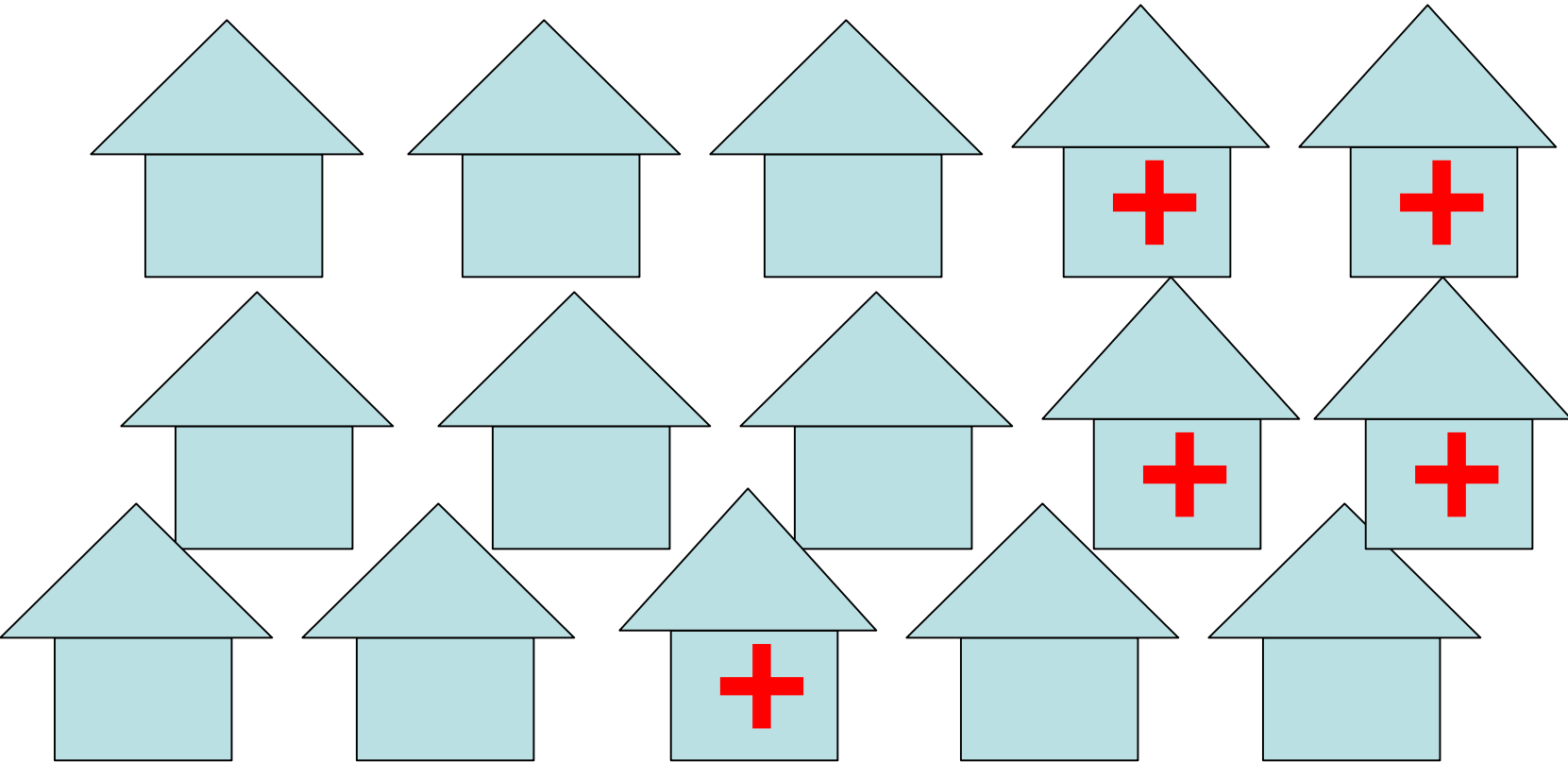
To initiate timely preventive & control measures

It is carried out regularly by entomologist.

Vector control surveillance

- 1) House Index-
- 2) Breteau Index-
- 3) Container Index-

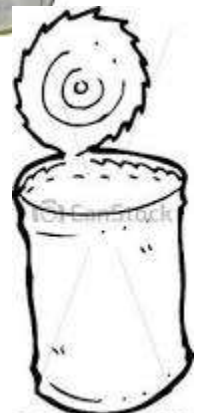
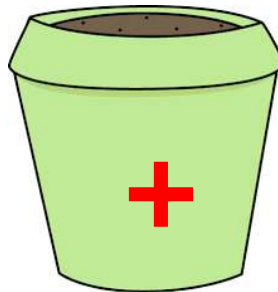
House Index



Percentage of houses positive for
aedes breeding

Container Index

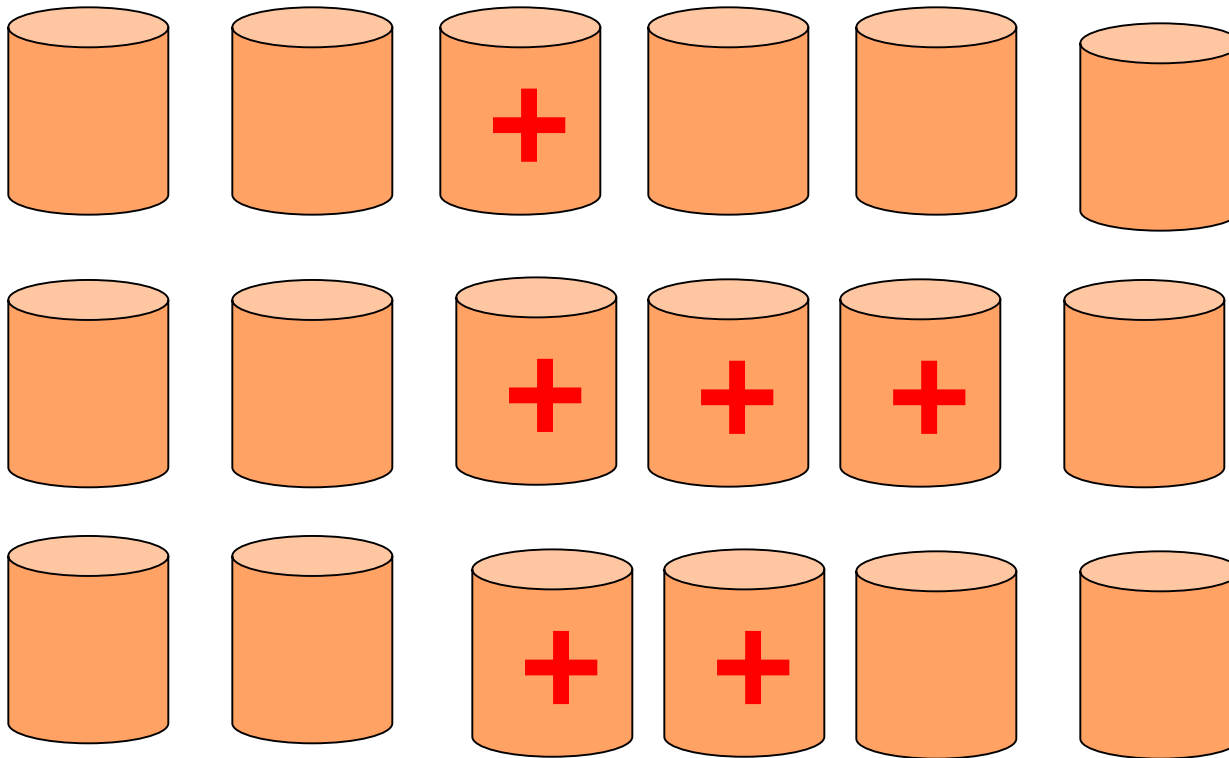
Percentage of containers positive for
aedes breeding



Can Stock Photo - csp155488

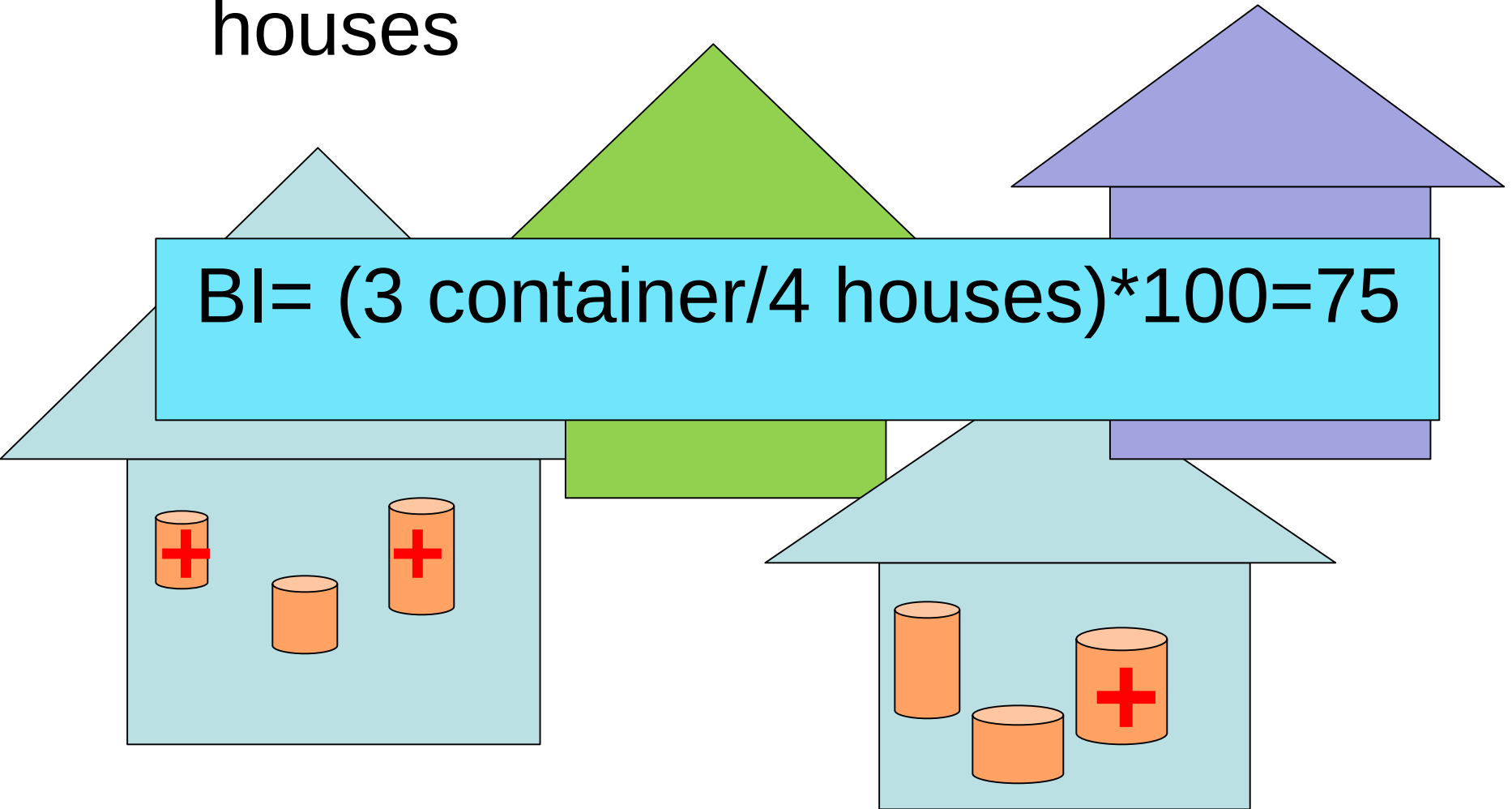
Container Index

Percentage of containers positive for
aedes breeding



Breteau Index- No of containers
positive for aedes breeding per 100
houses

$$BI = (3 \text{ container} / 4 \text{ houses}) * 100 = 75$$



Vector control surveillance

- 1) **House Index-** Percentage of houses positive for aedes breeding
- 2) **Container Index-** Percentage of containers positive for aedes breeding
- 3) **Breteau Index-** No of containers positive for aedes breeding per 100 houses

Find out Indices

- In a area A following findings were reported.
- Out of 500 surveyed housed 60 houses were found positive for aedes breeding.
- Total 1500 containers were there in these houses, out of which 450 containers were found positive for aedes breeding.

Find out Indices

- In a area B following findings were reported.
- Out of 500 surveyed housed 10 houses were found positive for aedes breeding.
- Total 1500 containers were there in these houses, out of which 300 containers were found positive for aedes breeding.

Area A

- $HI=12$
- $CI= 30$
- $BI= 90$

Area B

- $HI=2$
- $CI= 20$
- $BI= 60$

Epidemiological Interpretation of Indices

Index	High risk of transmission	Low risk of transmission
BRETEAU	>50	<5
HOUSE	>10%	< 1%

Area A

- $HI=12$
- $CI= 30$
- $BI= 90$

Area B

- $HI=2$
- $CI= 20$
- $BI= 60$

Epidemic Investigation(VBD)

- Identify early S\S, confirm diagnosis, prompt measures for control
- Line listing of cases (age, sex, address, date of onset of each s\s, details of housing & mosquito breeding, lab lx.)
- Vector surveillance- collection of mosquito species, identification, density , assessment of susceptibility to insecticide
- Arrange HE activities
- On conformation precautionary actions in neighbouring high risk areas
- Reporting after the outbreak is over

Prevention

```
graph TD; Prevention[Prevention] --> Primary[Primary]; Primary --> Breeding[Breeding]; Primary --> Vaccine[Vaccine]; Primary --> Mosquito_bite[Mosquito bite]; Breeding --> Community_awareness[Community awareness]; Breeding --> Laws[Laws, Monitoring & Surveillance]; Mosquito_bite --> Personal_protection[Personal protection]; Mosquito_bite --> Mosquito_control[Mosquito control measures];
```

Primary

Breeding

Community awareness

Laws, Monitoring & Surveillance

Vaccine

Mosquito bite

Personal protection

Mosquito control measures

Integrated Vector Control Measures

Secondary & Tertiary prevention

Principles of management

- Diagnosis is purely clinical.
- Serology is no guide to management.
- Only Paracetamol as anti-pyretic
- Mx is the fluid- FLUID & FLUID.
- Blood transfusion will increase the viscosity in Hemoconcentration; may
▶ thrombosis.

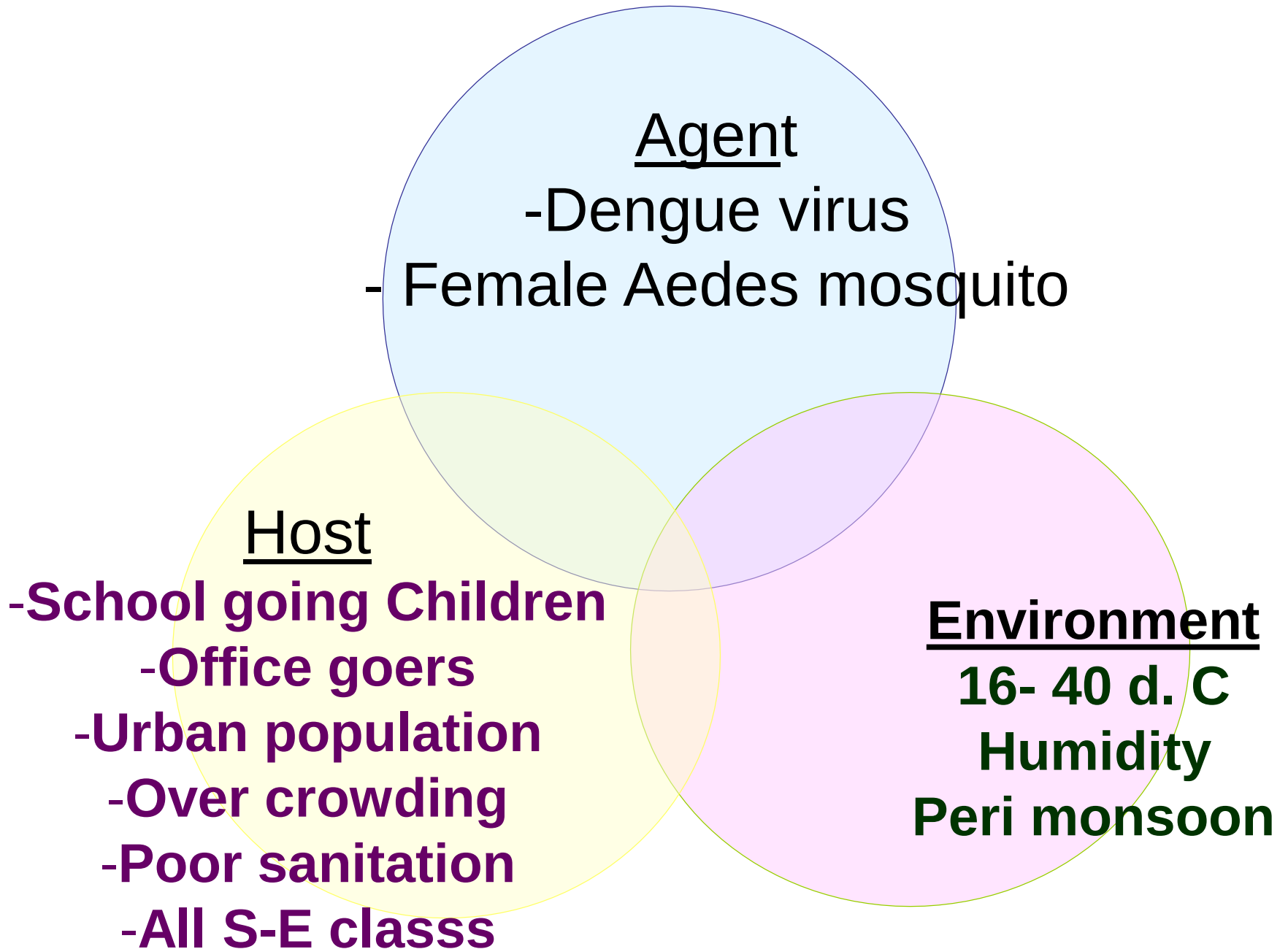
Treatment of Dengue Fever

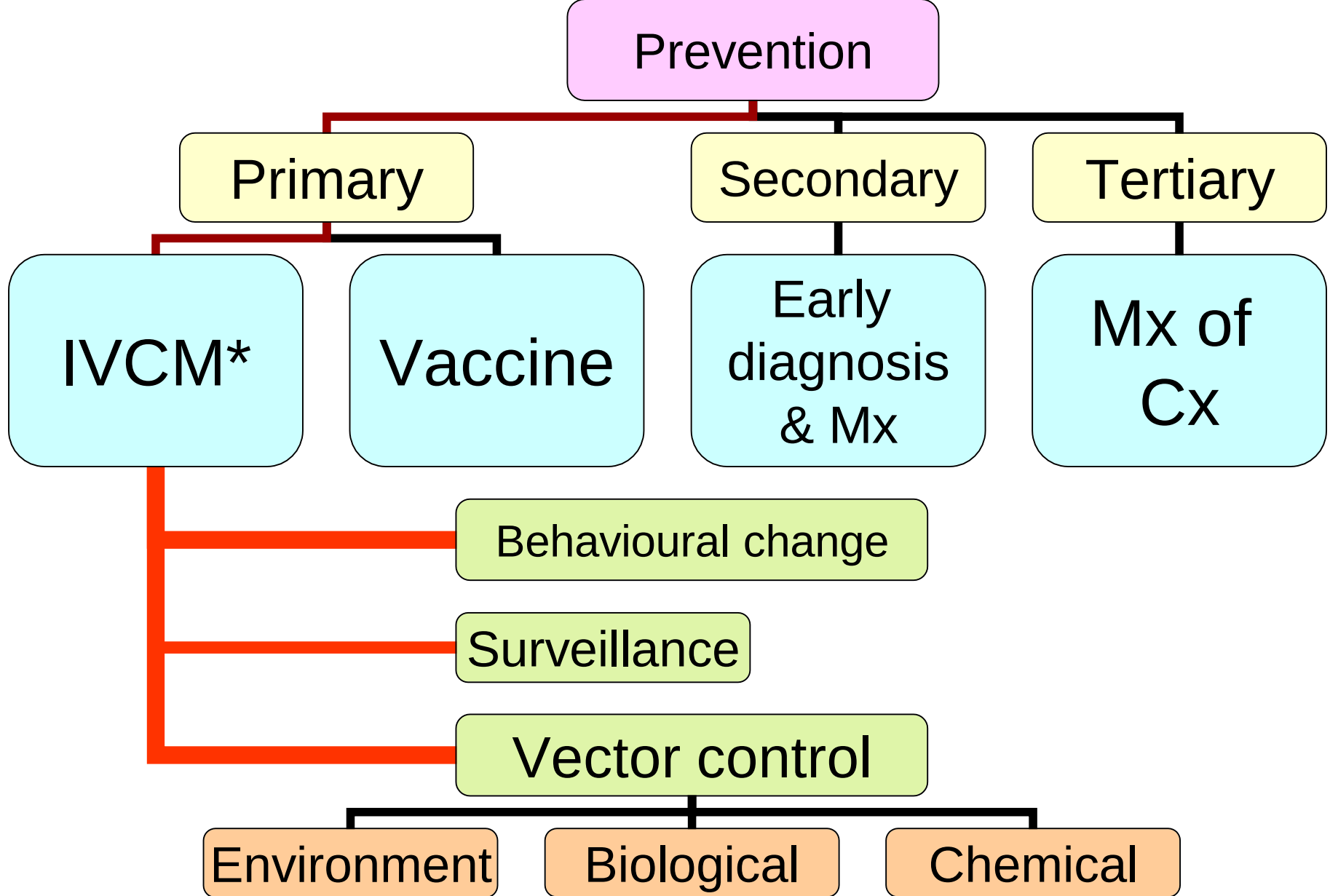
(Symptomatic)

- Fluids
- Rest
- Antipyretics (**avoid** aspirin and non-steroidal anti-inflammatory drugs)
- Monitor blood pressure, hematocrit, platelet count, level of consciousness
- Blood transfusion is contra-indicated

Mosquito Barriers

- Only needed until fever subsides, to prevent *Aedes aegypti* mosquitoes from biting patients and acquiring virus
- Keep patient in screened sickroom or under a mosquito net





*IVCM- Integrated vector control measures