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Epidemiology of Malaria, Vector Control Measures& Malaria Vaccines

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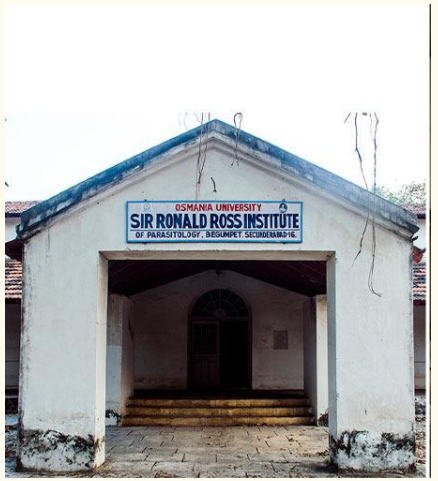
Epidemiology of Malaria

Who is this?



August 20 is World Mosquito Day. On this day, Ronald Ross, **a British physician working in a small laboratory in Secunderabad**, discovered the presence of malarial parasites in a dissected female Anopheles mosquito and concluded that the deadly disease was transmitted by the female Anopheles mosquito.

Ancient History - Early Documentation

- **Indian writings of the Vedic period (1500 to 800 BC) called malaria the "king of diseases"**

- Malaria is named after the **Italian term** "mal'aria", which means "**bad air**", to represent the association of the disease with marshy areas.

Epidemiology

- **Distribution of Health related state or event** (in terms of place, time and person)

+

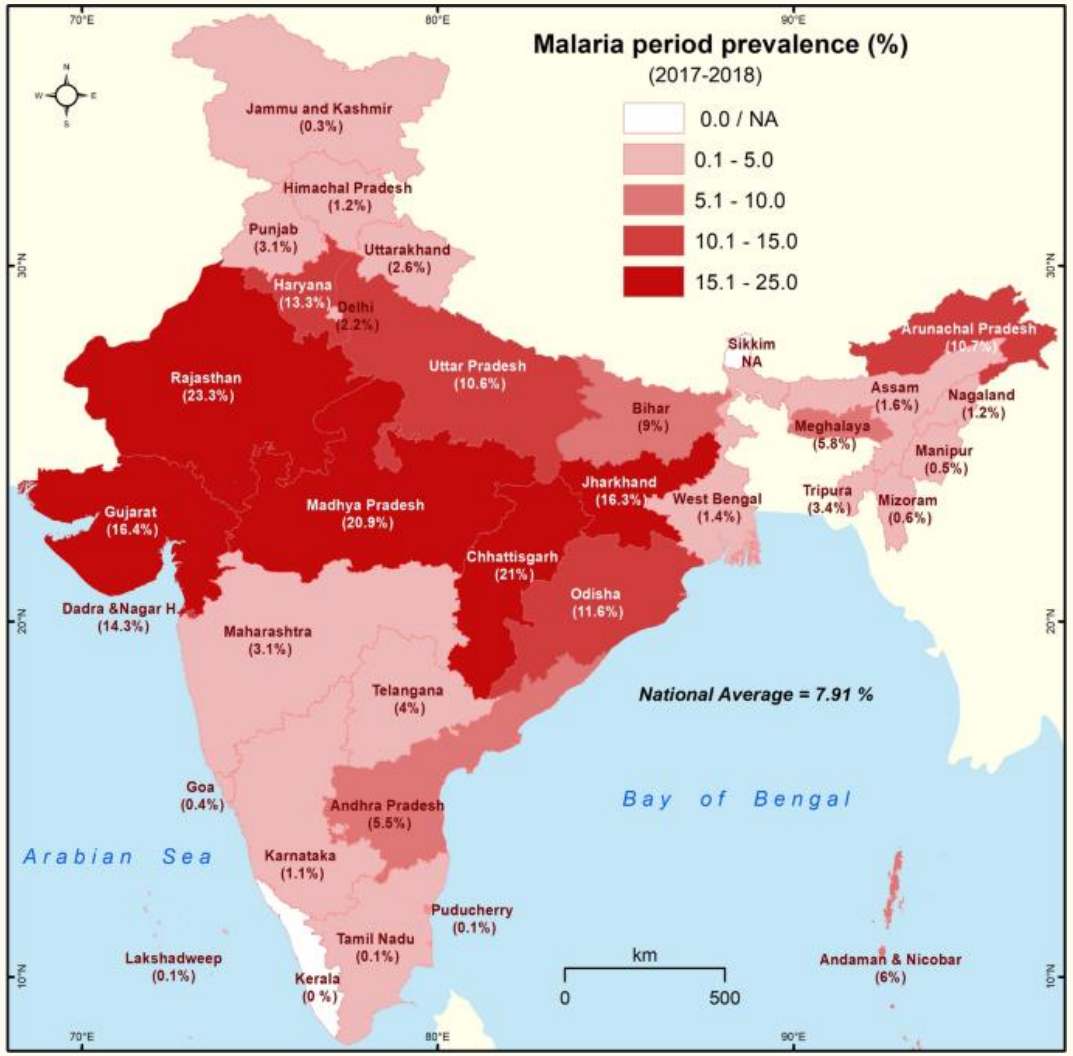
- **Determinants of Health related state or event** (in terms Agent, Host and Environmental factors)

Distribution of Malaria in the World

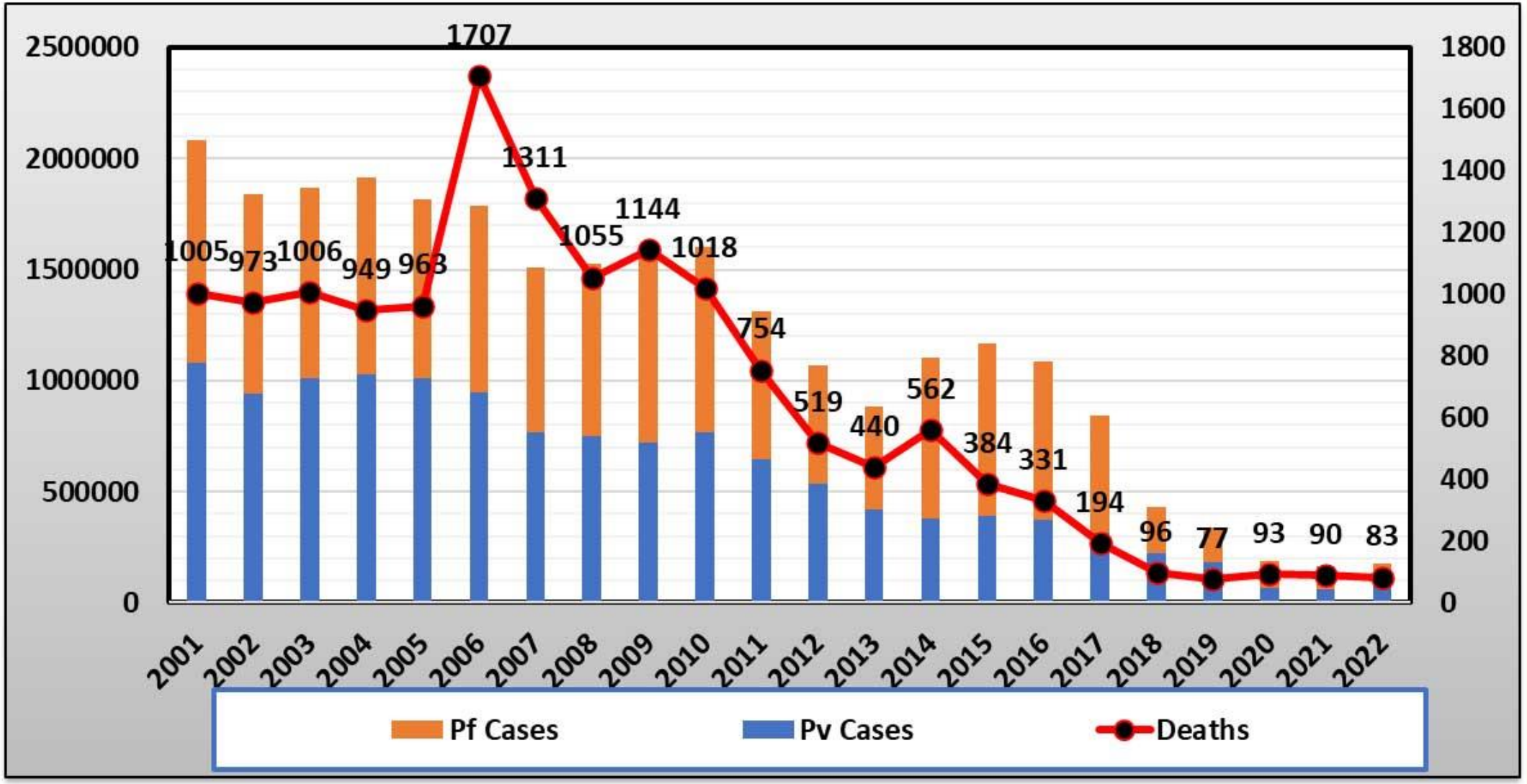
- Globally in 2023, there were an estimated 263 million malaria cases and 597 000 malaria deaths in 83 countries.
- The WHO African Region carries a high share of the global malaria burden. It was home to 94% of cases and 95% of deaths
- Over 50% of these deaths occurred in four countries: Nigeria, the Democratic Republic of the Congo, Niger and United Republic of Tanzania.

Distribution of Malaria in India

- More than 80% of malaria cases in India were reported from **Noth Eastern states, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan, West Bengal & Karnataka.**



Distribution of Malaria in India from 2001-2022



Distribution of Malaria in high-risk people

1. Young Children
2. Non immune pregnant women
3. Semi immune pregnant women
4. Semi immune HIV infected pregnant women
5. People with HIV and AIDS
6. International travelers
7. Immigrants and their children

Determinants of Malaria

01 Agent – Plasmodium species

02 Host – Human being

03 Environmental factors – Mosquito breeding

Agent

Malaria is caused by mainly four species of Plasmodium parasite

1. Plasmodium vivax – (Most prevalent throughout the world)
2. Plasmodium falciparum – (Most prevalent in India)
3. Plasmodium malariae
4. Plasmodium ovale
5. Plasmodium knowlesi – Newly detected

Life Cycle of the Parasite

01 Human stage / Asexual stage

02 Mosquito stage/ Sexual stage

Reservoir of infection

Except Chimpanzees, no other animal reservoir is known to exist.

- ✓ A human reservoir is one who have **viable, mature and both sexual forms of gametocytes.**
- ✓ **Children are more better reservoirs of parasite than adults**

Human Host Factors

- Age – All ages except Newborns
- Gender – Males will get more attacks than females
- Race – People with **Sickle cell hemoglobin** and **Duffy negative RBC** are protected.
- Pregnancy – Increases the risk
- Immunity and Resistance – Immunocompromised conditions increases the risk

Human Host Factors

- Socio Economic Development – Lower Socioeconomic classes
- Housing – Ill-ventilated and ill-lighted houses
- Population mobility – From one part of country to another part
- Occupation – Agricultural workers are at risk
- Human habits – Outdoor sleeping, Not using Mosquito nets, etc.

Environmental Factors

Season

Maximum prevalence in **July to November**

Temperature

Optimum temperature for parasite is **20 to 30 deg. C**

Humidity

60% relative humidity is necessary for mosquitos to live. If humidity is high mosquitos are more active

Environmental Factors

Rainfall

Moderate Rainfall,
Not heavy Rainfall

Altitude

Anopheles **not found above 2000 to 2500 meters** altitudes

Man made

Burrow pits
Garden pools
Construction sites
etc.

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02

Vector Control Measures

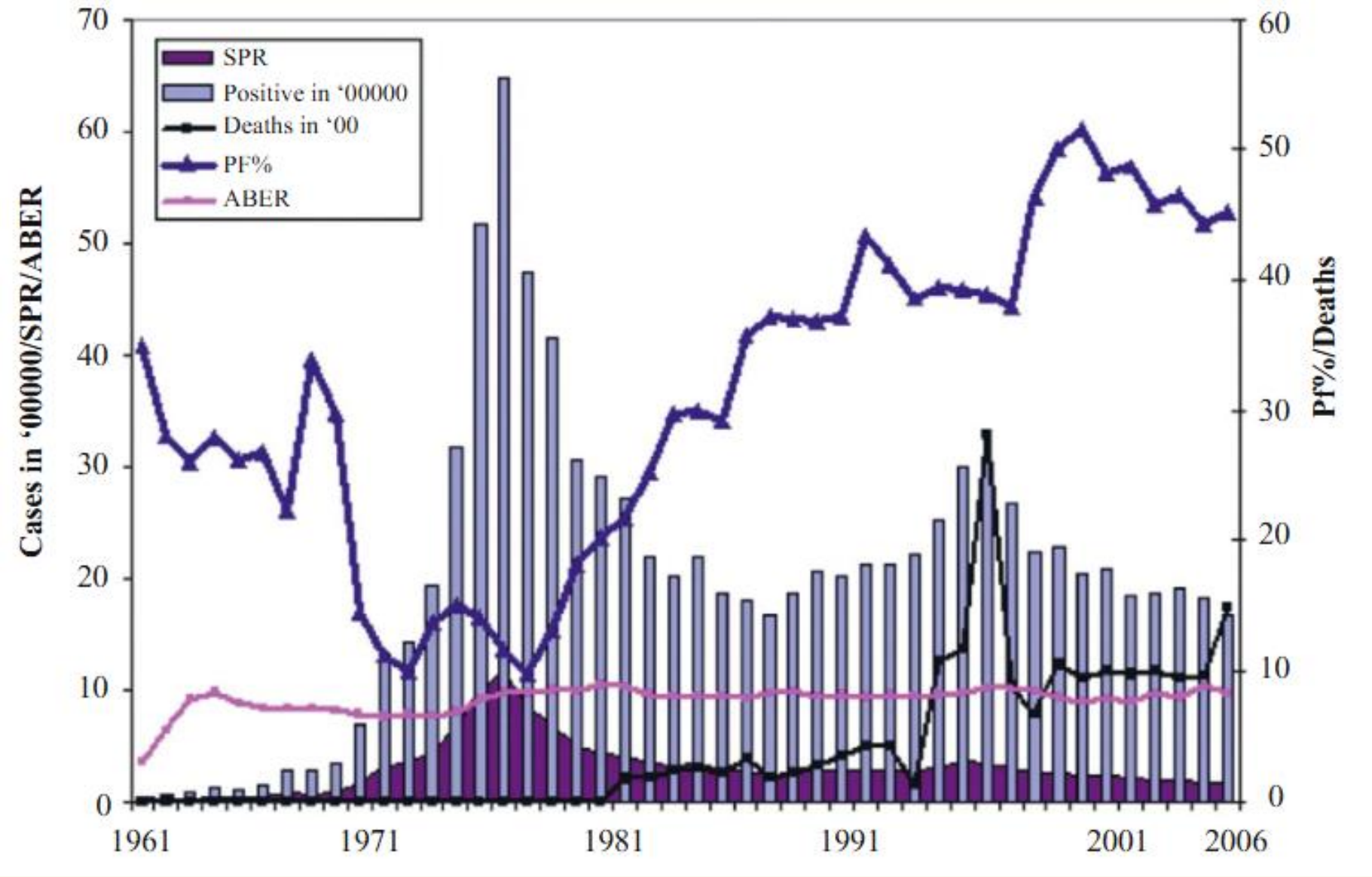
What is a vector for Malaria

- Malaria is transmitted by the **bite of certain species of infected, female, anopheline mosquitoes**.
- Out of 45species of anopheline mosquitoes in India, only few species will act as vectors.
- **An.culicifacies, An.fluviatis, An.stephensi, An.minimus, An.philippinensis, An.sundaicus, An.maculatus**
- A single infected vector, during her life time may infect several persons
- The mosquito is not infective unless the sporozoites are present in its salivary glands

Why to control Vectors

- To control the spread of Malaria to other persons or other areas
- As there is no effective vaccine for Malaria
- Vector control measures are easy to implement in local level

Success and failure story of DDT



***Thus Integrated vector control measures needed**

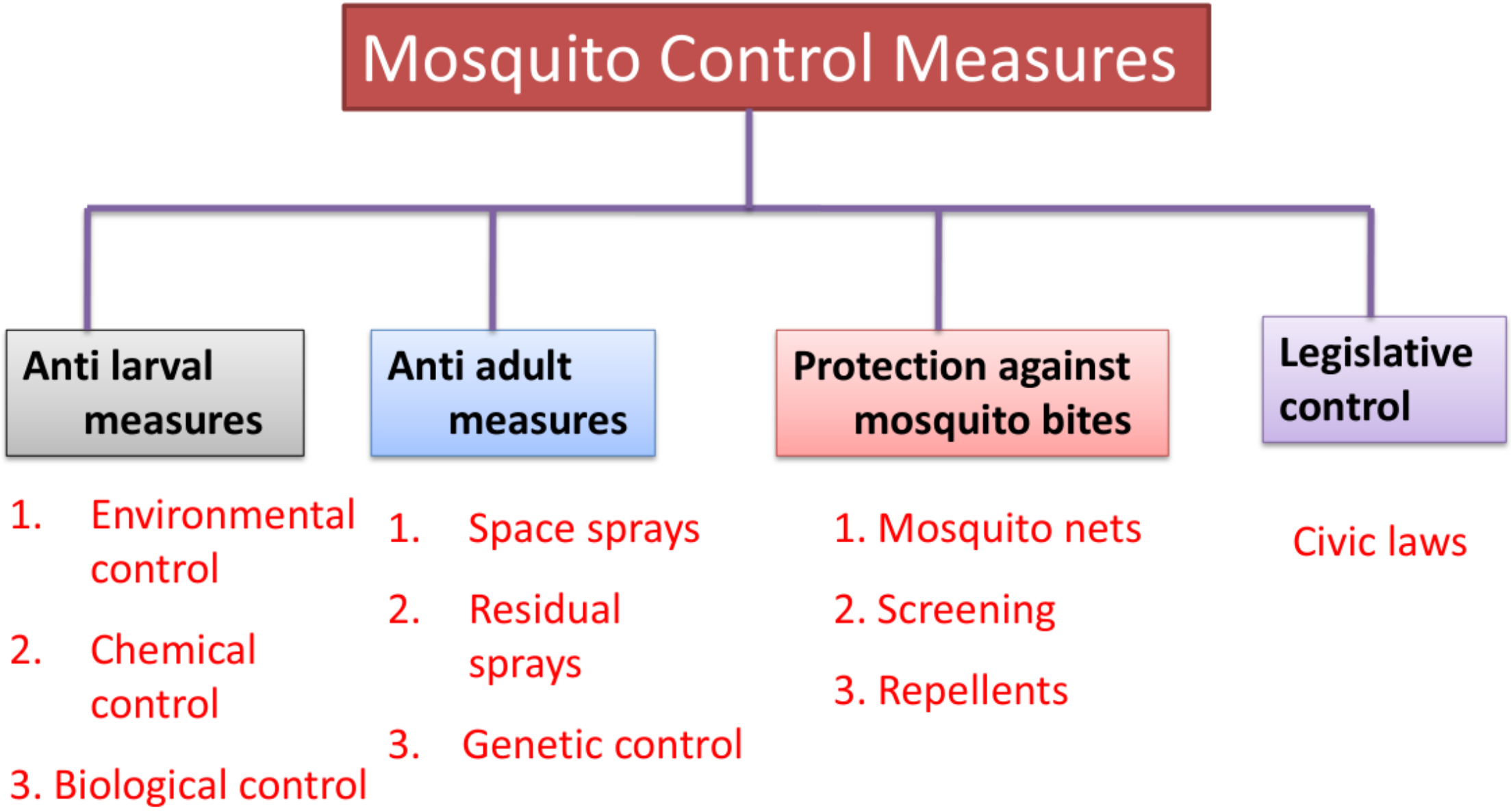
What is Integrated vector control measure

- Since no single method of control is likely to provide a solution in all situations, the present trend is to adopt an integrated approach for vector control

  i.e. combining two or more methods with a view to obtain maximum results with minimum effort

  & to avoid excessive use of any one method

Mosquito Control Measures



Environmental Control

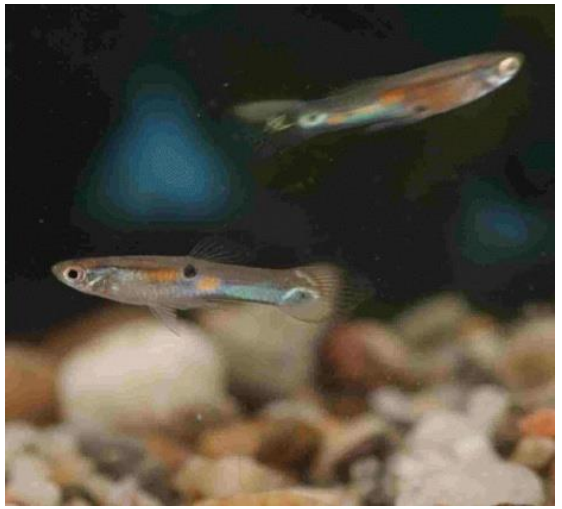
- **Elimination of breeding places – source reduction**
- Filling and drainage operation
- Proper waste water management
- Cleanliness in and around house

Chemical Control

- Using organochlorine, organophosphorus & carbamate group products
- This method is no longer effective as many species developed resistance
- **Petroleum oil, Paris green, Temephos, Abate, Biotex solutions are** commonly used as antilarval chemical control method

Biological Control

- Larvivorus fish like Gambusia and Guppy



Space Sprays

- Space sprays are those where the insecticidal formulations is sprayed into the atmosphere in the form of mist or fog or aerosols
- **Will be done where immediate results are needed like during outbreak of disease to bring down mosquito population drastically.**

Space Sprays

Sl. no	Name of Insecticide	Formulation	Preparation of formulation	Equipment used	Remarks
1	Pyrethrum extract	2.0% extract	1:19 i.e., 1 part of 20% pyrethrum extract in 19 parts of kerosene	Flit pump or hand operated fogging machine	Used for indoor spray
2.	Technical Malathion	5 parts of tech. Malathion in 95 parts of Diesel oil	Vehicle mounted thermal fogging machine Speed of vehicle 6 km/hour	Outdoor thermal fogging	Used for outdoor spray
3	Deltamethrin 1.25ULV	1 litre in 199 litre Diesel	Thermal fogging machine	Outdoor thermal fogging	Used for outdoor spray

Indoor Residual Sprays

Application of insecticides to surfaces,

so that the insecticide particles remain on the surface in the form,

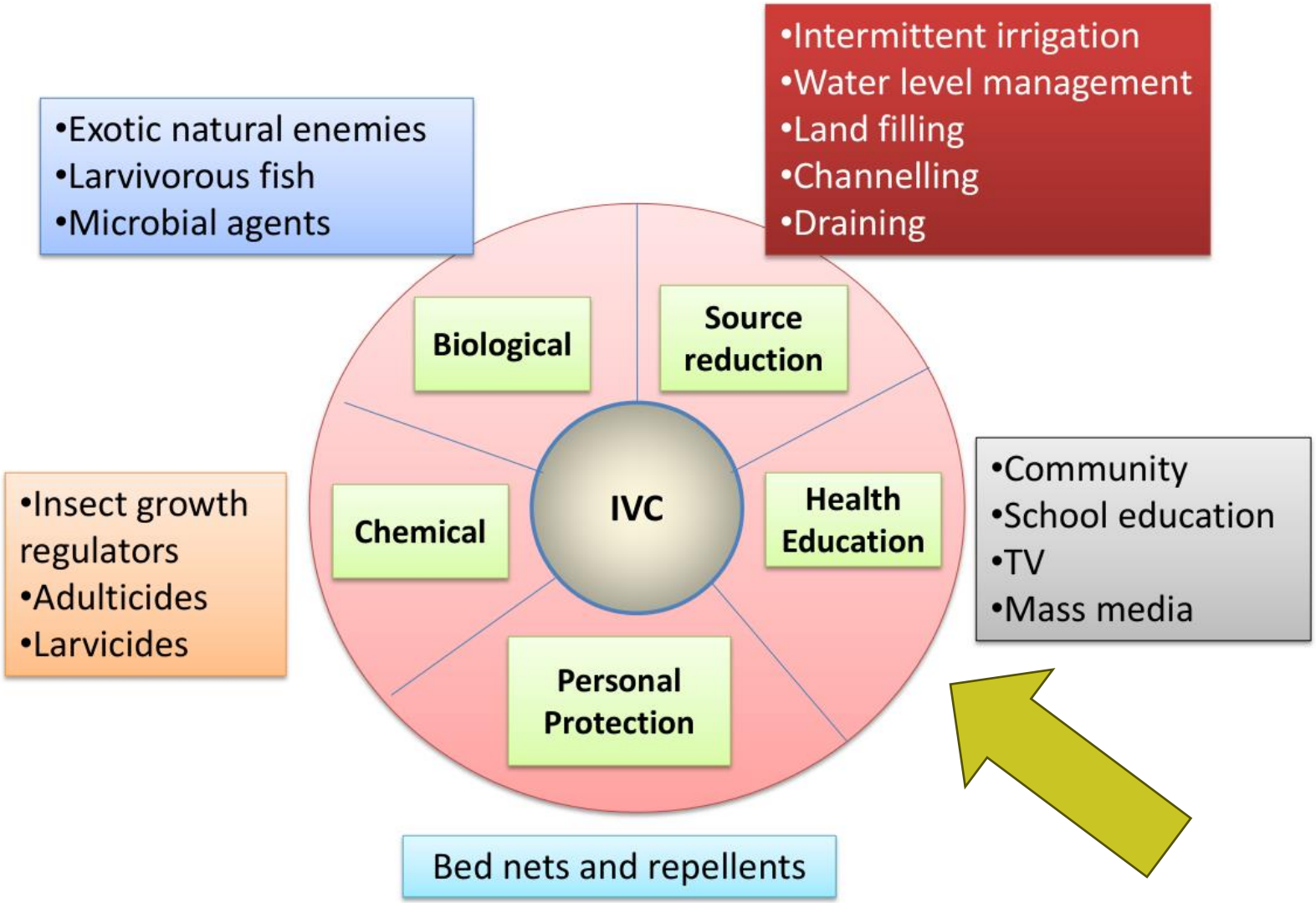
When mosquitos contact with these particles, they will show lethal effect on mosquitos

Genetic control

- Genetically Modified mosquitoes are released into an area.
- When the eggs hatch, the mosquitoes mate with wild females.
- The genes are passed on to the offspring.
- The expected result is that the number of mosquitoes in the area decreases.

Protection against mosquito bites

- Clothing
- Insect repellent
- Place screens on windows and doors
- Bed Nets Long lasting Insecticide treated Nets


•Exotic natural enemies
•Larvivorous fish
•Microbial agents
•Intermittent irrigation
•Water level management
•Land filling
•Channelling
•Draining
Biological
Source reduction
Chemical
IVC
Health Education
Personal Protection
•Insect growth regulators
•Adulticides
•Larvicides
•Community
•School education
•TV
•Mass media
Bed nets and repellents

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03

Malaria vaccines

Malaria Vaccines

- **Two malaria vaccines** are currently recommended for use.
- **On October 6, 2021**, the WHO recommended the widespread use of the **RTS,S/AS01 malaria vaccine** among children in **sub-Saharan Africa**, and approved a second vaccine **(R21/Matrix-M)** two years later for **endemic countries.**
- Current malaria vaccines **reduce uncomplicated malaria by ~40%, severe malaria by ~30%.**

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Thank you