

# Control of Mechanical Vectors



**REDUCING DEATHS AND SUFFERING FROM  
TROPICAL DISEASES**





WAITING FOR THE  
NEW MOVIE  
"CONSTIPATED"  
IT HASN'T  
COME OUT YET

## Water and sanitation interventions to prevent and control mosquito-borne diseases: focus on emergencies



- WHO & UNICEF latest guidance on WASH VC for emergency urban and camp contexts:
- World Health Organization (WHO)
- <https://www.who.int/Publications/item>
- April 2024



# Mechanical Transmission Process

*Feces enhances transmission of infectious agents much greater than that of any other substrate or medium*



- More flies in isolated human feces vs. latrines
- Dog, calf, & goat feces are also viable breeding grounds
- Dislodgement onto Food
- Fecal Deposits (on flies body)
- Eye-seeking behavior of vector

lwork2travel1. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/72457981@N00/353447863/sizes/1/in/photostream/>.



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## Example: Gaza

- Limited access to safe drinking water
- Starvation and compromised immunity
- Shortage of fuel impacts on desalination plants & sewage systems & hospitals
- Poor sanitation standards & high possibility for open defecation
- Accumulation of solid waste & waste water (>1200 tons/day)
- Limited access to health care
- Overcrowded living conditions



# Humanitarian crisis

Mass destruction of  
infrastructure

Disruption of  
waste management

Increase of breeding sites for  
vectors transmitting diseases

Poor sanitation standards



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# Priority Vectors in Gaza

## Filth flies:

- Breed in domestic waste and faeces
- Transmit diarrheal diseases (e.g. cholera, shigella, myiasis, amoebiasis)
- secondary bacterial infections in open wounds



## Sand flies:

- Breed in domestic waste and cracks of buildings
- Transmit leishmaniasis



## Fleas, mites, ticks, bed bugs and other ectoparasites

- Typically in war damaged and shelter contexts
- Cause extensive skin conditions (e.g. scabies,...)



# Ectoparasites and their disease risks in Gaza

- Ticks — (Rickettsioses, Lyme disease, Relapsing fever borrelioses, Tularaemia)
- Body lice — Typhus (*Rickettsia prowazekii*)
- Fleas — Murine Typhus (*Rickettsia typhi*)

Other ectoparasites:

- Mites - *Sarcoptes scabiei*
- Bedbugs
- Fly larvae - Myiasis



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# Sanitation

The first and best method for long-term vector control:

1. Preventing access of flies to toilets
2. Destroying other fly breeding sites (managing garbage)
3. Eliminating contact between flies and children, food, and utensils



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# Sanitation – Latrines/Toilets



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# Sanitation – Latrines/Toilets

- Situation of latrines
- At least 6m from living area
- If no latrines are available, establish defecation area 500m away from living area and 30m from water



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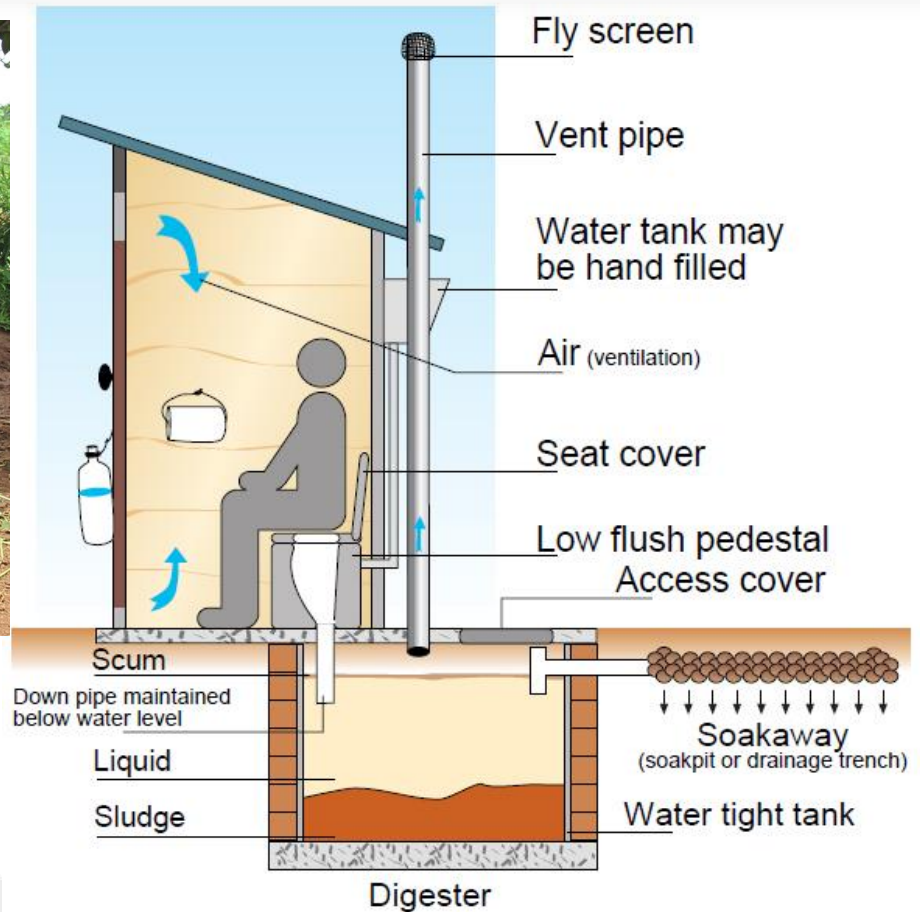




# VIP Design



Animals and their Zoonoses (PAZ) project in Busia, Kenya (photo credit: ILRI/Charlie Pye-Smith).



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# Temporary Pit Latrine Structures



Maban refugee camps, Upper Nile, South Sudan

- 12 years after the camps began



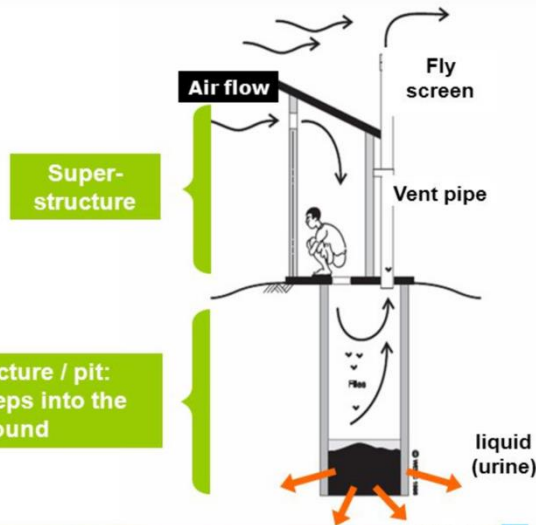
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# Engineering solutions?

- VIP latrine is the same as simple pit latrine but has a vent pipe and fly screen (reduces odour and fly breeding)
- Toilet room and pit should be dark to not attract flies
- Some VIPs are built as a double-pit structure (see next slide)



Pits are not water tight as they would otherwise fill up too quickly

Source: Harvey et al. (2007) UNESCO-IHE



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# Latrines/Toilets – VIP – Maintenance

- To keep the VIP free of flies and odours, regular cleaning and maintenance is required
- Dead flies, spider webs, dust and other debris should be removed from the ventilation screen to ensure a good flow of air
- The VIP can be used until it is filled up half a meter below the top, than it needs to be emptied (human powered and motorised emptying) or closed and relocated



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# Latrines/Toilets – VIP – Advantages

- Flies and odours are significantly reduced (compared to non-ventilated simple pit latrines)
- Can be built and repaired with locally available materials
- Does not require a constant source of water
- Can be used immediately after construction



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# Latrines/Toilets – VIP – VBD Issues

- Often not maintained
- Pit openings left open or uncleaned
- Fly infested (deters use and encourages open defecation)
- Pits may flood in rains and increase fly breeding sites
- Can be challenging to empty



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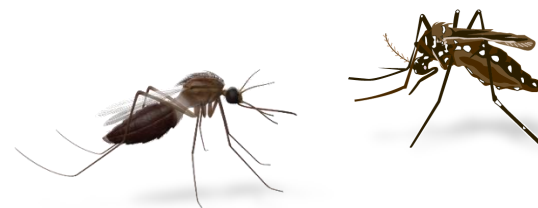


# Latrines/Toilets – VIP – Maintenance

- The emptying of pits containing fresh excretes can present problems → active pathogens in sludge



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# Destroying Breeding Sites: Managing Waste

- Garbage and organic waste are the perfect breeding grounds for flies and must be managed properly for effective control
- In humanitarian crises, where removal of waste may not be feasible, a recommended method is disposing of solid waste in a pit that is positioned away from living areas



# Minimizing contact between humans and flies

- Installing screens in eating areas and healthcare facilities is optimal
- Fly exclusion is crucial from food, food preparation, and eating areas
- Methods include:
  - Screening
  - Hanging beads in the entryway
  - Proper containers for food
  - Fly traps



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# Fly Traps

- Traps will not stop a large-scale infestation, but should be use in targeted areas, such as medical and food facilities
- Multiple types of traps are available, including:
  - Light traps (not to be used near food, as they may cause flies to explode, releasing pathogens)
  - Sticky tape
  - Traps constructed of local materials



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# Light Trap

- Light traps fitted with sticky cards available, effective indoors and around food preparation areas to remove flies → Attract flies to ultraviolet light



# Light trap with electrocutor

- Flies attracted to the light are killed on contact with an electrocuting grid that covers it
- Blue and ultraviolet light attracts blowflies but is not very effective against houseflies
- The method should be tested under local conditions before an investment is made



# Fly Traps – local made

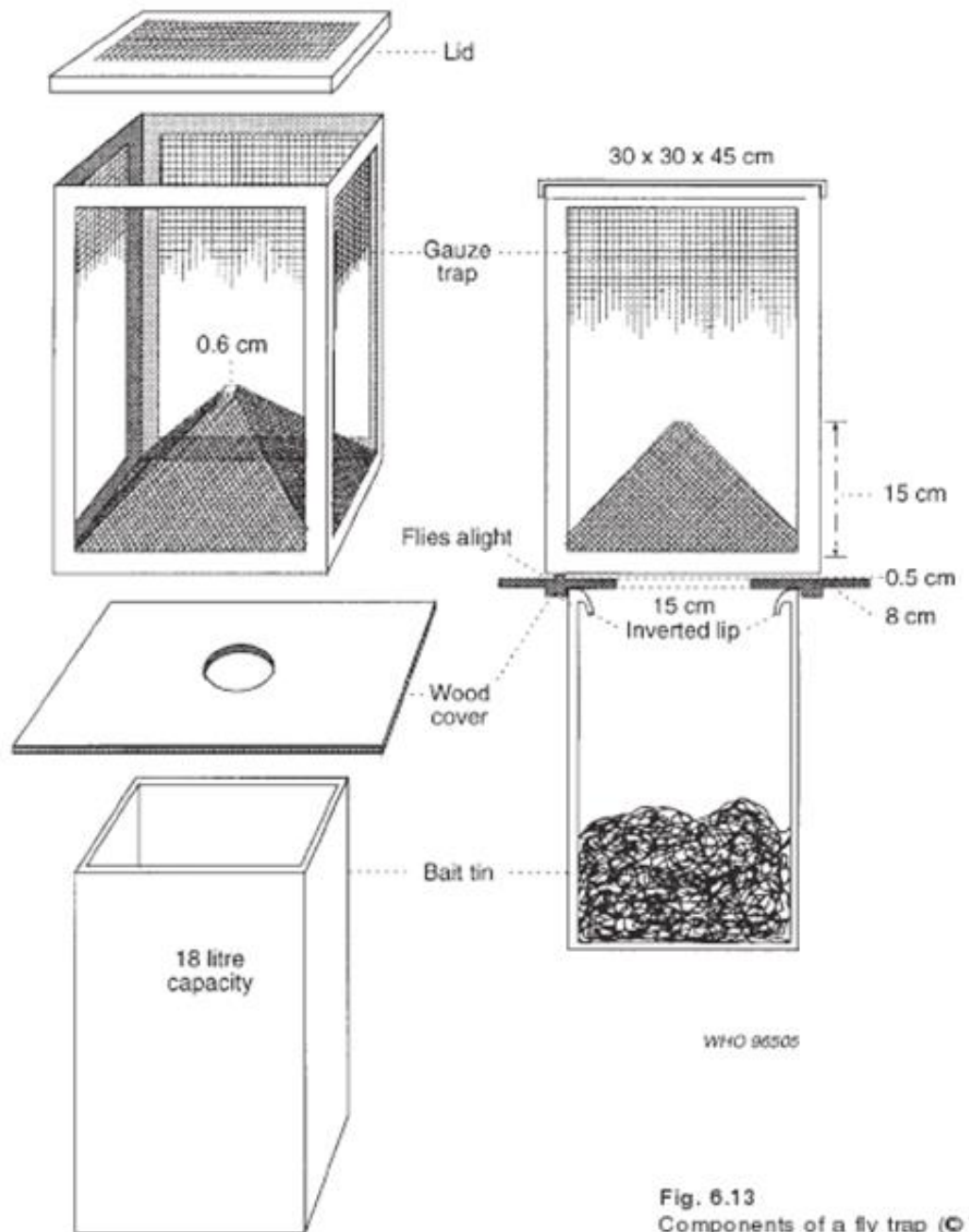


Fig. 6.13  
Components of a fly trap (© WHO).



# Baited fly traps – non toxic, commercially made



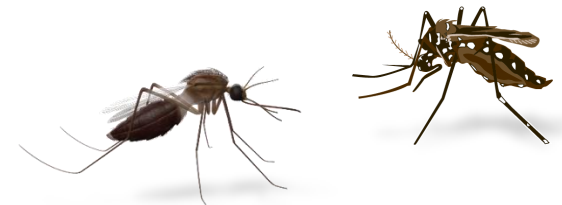
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# Sticky Tape



- Contain a cardboard strip coated with a sugar-based matrix containing a pesticide. House fly sex pheromone and other attractants attached to the top and bottom of the strip
- Toxicity to flies occurs rapidly upon ingestion
- Use at the rate of 1 strip per 9 to 30 m
- Should be protected from moisture and direct sunlight



# Sticky Tape

This pile of dead flies seems to be extremely attractive to other flies. Placing strips in a can will increase effectiveness.



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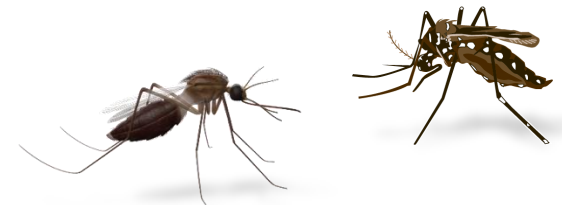


# Chemical Methods

- Best to be used for short periods, because flies develop resistance rapidly
- Methods include:
  - Space spraying
  - Treating faeces and waste with insect growth regulators
  - Toxic baits (note: UNHCR does not advise using this method in refugee camps)
  - Insecticide-treated plastic tarpaulins



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# Chemical Methods – Space Spraying

- Spraying ultra low volume insecticide solution (diesel) into the air, adult flies are killed
- Spraying inside VIP latrine structures to kill adult flies
- Useful for spraying in domestic waste management sites
- Reduction in fly population is achieved rapidly
- Can be appropriate for immediate, short-term control in camps or urban contexts (away from humans).



# Chemical Methods – Treating Surfaces

- Identify areas where flies rest (look for excrement and waste)
- Landing flies absorb residual chemicals through their feet
- Garbage sites should be insect growth regulator (IGR) treated every few weeks if within 400 meters of homes
- Latrine structures should be IRS sprayed/painted every 3-4 months
- The latrine contents and open defecation sites should be treated with IGR to target larval stages



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# Dimilin®

**The chitin deposition inhibitor diflubenzuron for control of public and animal health pests**

Insects are important transmitters of (vector-) diseases to humans and animals. In many tropical and subtropical countries, these diseases are among the major causes of illness and death. Vector-diseases can be prevented with vaccines or controlled by treatment of the hosts with drugs. Alternatively, the spread of diseases can be reduced by removing breeding habitats of the vector, the use of self-protection methods and also by biological or chemical control of the insects. As a chemical control agent is often used in the immediate vicinity of humans or animals, it should have minimal impact on mammals. A compound that combines a high activity on target insects and low activity on mammals is the larvicide diflubenzuron (most widely used trade name Dimilin®). Diflubenzuron is a Chitin Deposition Inhibitor. In contrast to compounds that are active on the nervous system of organisms, diflubenzuron shows a qualitative selectivity, as it interferes with a biochemical process that occurs in insects but not in mammals.

In this publication, most attention is given to the biology and control of mosquitoes and houseflies with diflubenzuron. Additionally, control of several other insect species connected with domestic animals are discussed, including the horn fly, sheep blowfly, face fly, stable fly, the lesser mealworm, biting lice and fleas.

Human diseases transmitted by adult mosquitoes include malaria, dengue, yellow fever, West Nile virus and Chikungunya. In temperate zones, where vector-transmitted diseases are not much of a problem, mosquitoes can cause inconvenience as nuisance insects. Also in these situations, populations can build up to levels where control measures become inevitable.

The housefly lives in close association with man and is the most common species found throughout the world. It is a vector of many bacterial and viral diseases in man and animals. Continuous irritation by flies can result in lower weight increase of immature animals, decreased production of milk in mammals and reduced egg yield in poultry. Furthermore, faecal and vomit spots will lower the quality of the eggs and cause serious

# 1,25 to 5 kg/ha



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PM314 (2009)

# Dimilin®

**The chitin deposition inhibitor diflubenzuron for control of public and animal health pests**

Device® and Dimilin® Diflubenzuron in public and animal health

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# Insecticide treated paint: TBD in camps



INESFLY

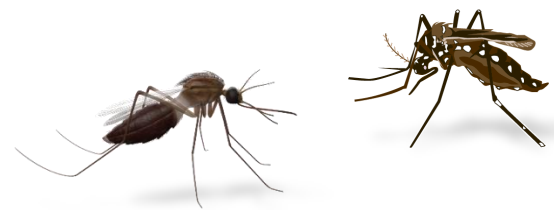
## PINTURA SP COATING

INESFLY SP COATING is a water-based polymer coating leading polymer microencapsulated suspension insecticidal, acaricidal and insect growth regulators with very high persistence.

Inesfly with its innovative technology based on polymeric microcapsules allows a slow release of the insecticide and IGR, giving the product a high persistence and very low toxicity, perfect for hard-to-reach places. It allows the control of all kinds of arthropods.



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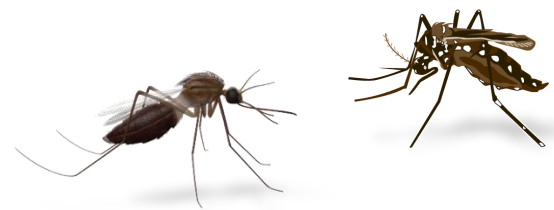
# Chemical Methods – Toxic Baits

- Toxic fly baits have been used for decades and are one of the most widely used methods for fly control
- Heavy reliance on these baits has led to house fly resistance in many areas
- Cyantraniliprole-containing baits are a new class of chemicals used in baits and have shown good results\*
- A 2015 study\* revealed that a significant degradation in bait efficacy can be observed after one to two weeks of aging in almost every bait

\* Parker, C. et al. (2015). Evaluation of Cyantraniliprole and Other Commercial Fly Baits under Laboratory and Field Conditions. *Insects* 2015, 6: 977-987.



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# Chemical Methods – Toxic Baits

**Table 6.1**  
Insecticides used in toxic baits for fly control

Insecticide	Dry scatter	Liquid sprinkle	Liquid dispenser	Viscous paint-on
<b>Organophosphorus compounds</b>				
dichlorvos <sup>a</sup>	+ <sup>b</sup>	+ + <sup>b</sup>	++	
dimethoate <sup>a</sup>		+	++	
trichlorfon <sup>a</sup>	++	++	++	++
azamethiphos	+			++
diazinon	++	+		+
fenchlorvos	+	+		+
malathion	+	+		+
naled	+	+		+
propetamphos				++
<b>Carbamates</b>				
bendiocarb	++	+		
dimetilan <sup>a</sup>		+	++	+
methomyl <sup>c</sup>				++
propoxur	++	+		
formaldehyde <sup>a</sup>			+	

<sup>a</sup> Aqueous suspension.

<sup>b</sup> + or ++ indicates insecticides that are most suitable or have been most widely used for the particular type of application.

<sup>c</sup> Can also be used in the form of granules stuck on strips or boards.

# Insecticide-treated plastic tarpaulins for latrine structure



- Insecticide is incorporated in central high density polypropylene layer, releasing to each outer LDP layer
- LDP lamination protects from UV light
- Release of insecticide is chemically controlled
- Deltamethrin
- Paralyzes nervous system of insects

# Insecticide-treated plastic tarpaulins

- Long-lasting (tested to last up to 22 months)
- Critically, provides both shelter and vector control
- Thus vector control is incorporated as immediate needs are met in the early stages of a humanitarian crisis
- Addresses multiple needs of refugees
- Targets most resting insects, including flies



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# Community Education

- Essential to educate community regarding sanitation, hygiene (hand washing) and open defecation
- Education about fly-borne infections, risk factors and avoidance
- In many situations it is necessary to clear all vegetation near campsite and water sources to discourage people from defecating openly (privacy)



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