

Mechanical Vectors



REDUCING DEATHS AND SUFFERING
FROM **TROPICAL DISEASES**



Common Mechanical Vectors

- House Flies
- Filth Flies
- Blowfly
- Cockroaches

Orangeacid. (Photographer). [Photograph]. Retrieved February 13, 2012, from:
<http://www.flickr.com/photos/orangeacid/189512184/sizes/z/in/photostream/>



Lerind. (Photographer). [Photograph] Retrieved February 13, 2012, from:
<http://www.flickr.com/photos/lerind/3520284423/sizes/z/in/photostream/>



Keiding J. The housefly—biology and control. Training and information guide (advanced level). Geneva, World Health Organization, 1986 (unpublished document WHO/VBC/86.937; available on request from Division of Control of Tropical Diseases, World Health Organization, 1211 Geneva 27, Switzerland).



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350 fly species in 29 families spread food-borne disease

Flies as Mechanical Vectors:

- > **50 species** of synanthropic flies correlated with unsanitary conditions
- **21 species of filth flies** transmit human gastrointestinal diseases
- ALL disseminate human pathogens in the environment.
- Breed in animal manure, human excrement, garbage, animal bedding and decaying organic matter

Keiding J. The housefly—biology and control. WHO 1986 WHO/VBC/ 86.937

Keiding J. The housefly. Training and information guide. WHO 1991 WHO/VBC/90.987



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Musca domestica characteristics:

- 6-7 mm long, grey color
- marked by 4 dark longitudinal stripes
- breed in animal/human excrement or domestic organic waste
- land, breed, and feed on feces and human food

RESPONSIBLE FOR:

- Infantile diarrhea
- Shigellosis and Cholera
- Dysentery
- Typhoid

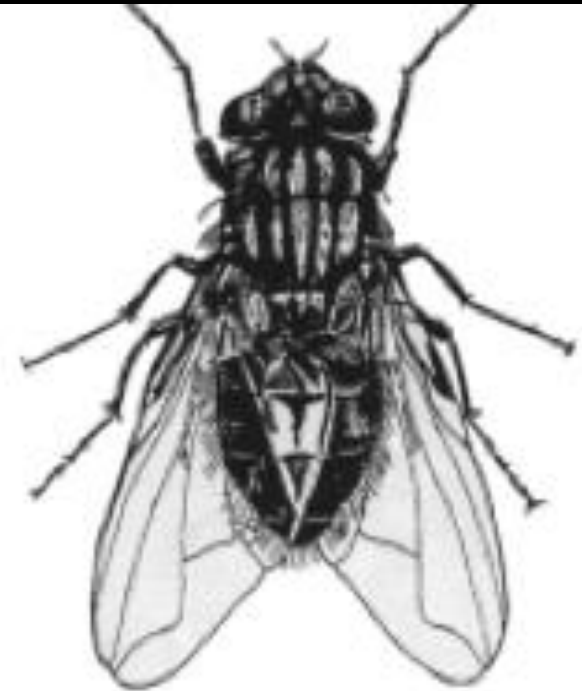


Figure 2.1.
***M. domestica*, (WHO, 1997)**



Indian Housefly Scenario

“Vector potential of houseflies (Musca domestica) in the transmission of Vibrio cholerae in India”

R. Fotedar, Acta Tropica, 2001

METHODS:

- 1) Small village 15 km away from Delhi city outbreak of diarrhea
- 2) 150 houseflies captured with sterilized nets from animal pens, yards or houses
- 3) Collect stool samples from 50 patients within 24 hrs of illness, before anti-microbial



Praline 3001. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/praline3001/6672614287/sizes/1/in/phobstream/>.



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Housefly Scenario

RESULTS:

- **-60% fly pools were positive** for *V. cholerae*
- -during outbreak: *V. cholerae* Ogawa T2 El Tor isolated from stools of patients suffering from diarrhoea
- **Houseflies act as mechanical vectors of *V. cholerae* biotype El Tor, and aid in dissemination



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African Cholera Scenarios



Medicinsansfrontieres. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/medicinsansfrontieres/3085562538/sizes/z/in/photostream/>.

Goma, DR Congo 1994. Post Rwanda Genocide. Rwandan Refugee Camps



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Hospital Housefly Scenario

The housefly (Musca domestica) as a carrier of pathogenic microorganisms in a hospital environment

R. Fotedar, U. Banerjee,, S. Singh, Shriniwas and A. K. Verma, Journal of Hospital Infection, 1992

Collect *Musca domestica* from:

- surgical ward (All India Institute of Medical Sciences Hospital)
- remote residential area 5 km away as a control
- A total of 113 flies were collected:
 - 65 from a surgical ward (test)
 - 48 from a residential area (comparison)



Gusthed. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/bokage/5521594305/sizes/l/in/photostream/>.



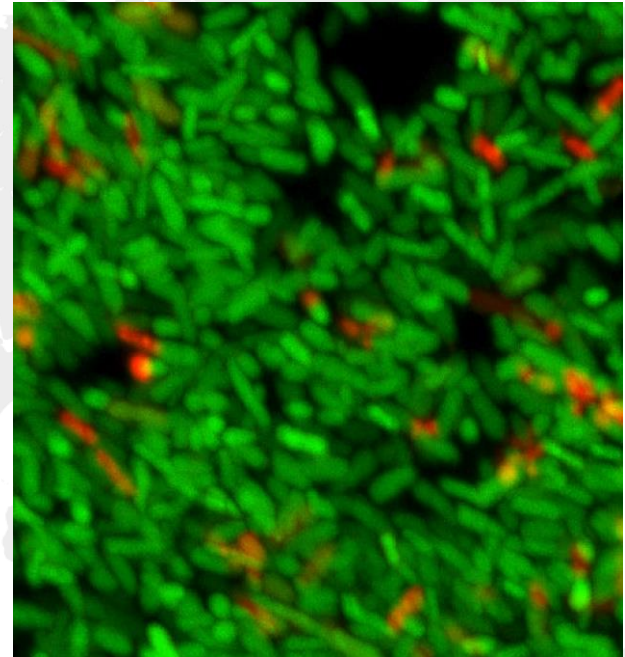
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Hospital Housefly Scenario

RESULTS:

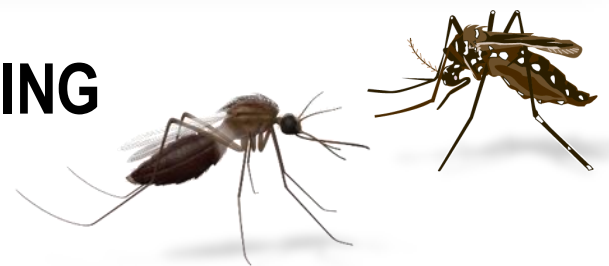
- -10 genera of bacteria isolated from the test group, 9 from control group
- -the load of bacteria carried by the test group of flies was significantly more
- House flies therefore may act as vectors of potentially pathogenic bacteria in a hospital environment.



Cardiff Biosci Imaging. (Photographer). [Photograph]. Retrieved February 13, 2012, from: <http://www.flickr.com/photos/biosci-imaging/5517090693/sizes/l/in/photostream/>.



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Musca sorbens (Filth Flies)

Characteristics:

- lives in tropical areas
- breeds in human feces
- feeds on the secretion produced by eyes of people, especially children.
- 6 mm long, grey
- 2 dark stripes on the thorax.

RESPONSIBLE FOR:

- diarrheal diseases
- transmission of the eye disease trachoma

Musca sorbens



Figure 2.3.
***M. sorbens* (WHO, 1997)**



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Chrysomya spp (Blowfly).

Characteristics:

- worldwide distribution
- breeds in open latrines, garbage, animal excrement
- compact body, measuring 10 mm
- shiny blue or green

RESPONSIBLE FOR:

- Diarrheal diseases
- Dysentery
- Intestinal worm eggs

Chrysomya spp.



Figure 2.4.
Chrysomya spp. (UNHCR,
1996)



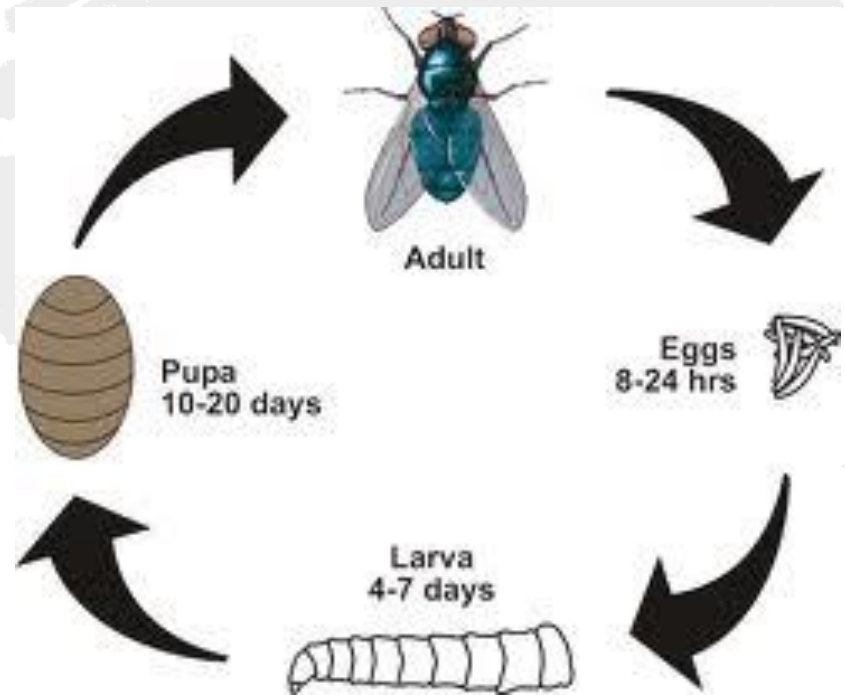
Vector Biology

Life cycle:

- egg matures and hatches (1 day)
- larval feeding stages (4-10 days)
- pupa stage (3-6 days)
- adult fly emerges (lifespan of 15-30 days)

Three vector species:

- musca sorbens (bazaar fly)
- musca domestica (housefly)
- musca vetustissima (bushfly)



BTER Foundation



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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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“Super” Transmitters

Carry Pathogens on:

- spongy mouthparts
- body and leg hairs (*setae*)
 - sticky substance
 - adherence during fly resting periods
- sticky pads of the feet (*tarsi*)



PKMousie. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/pkmousie/261846877/sizes/l/inphotostream/>.



Jatin.muddu. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/jatinmuddu/2374306028/sizes/l/inphotostream/>.



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Results of Transmission



RachSilvester. (Photographer). [Photograph]. Retrieved February 13, 2012, from: <http://www.flickr.com/photos/rachsilvester/6155801573/sizes/m/in/photostream/>.



Rubber Slippers in Italy. (Photographer). [Photograph]. Retrieved February 13, 2012, from: http://www.flickr.com/photos/rubber_slippers_in_italy/5997107603/sizes/z/in/photostream/.

Major spread of *bacterial enteric disease* agents:

- 1) Inflammation of the gut
- 2) Diarrhea

And *parasitic disease* agents:

- Sarcocystis spp
- Toxoplasma gondii
- Isospora spp.
- Giardia spp.
- Entamoeba coli
- Entamoeba histolytica/Entamoeba dispar
- Endolimax nana
- Pentatrichomonas hominis
- Hammondia spp.
- Cryptosporidium parvum



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Mechanically Transmitted *GI* Diseases

- Salmonella
- Typhoid
- Bacillary Dysentery (Shigellosis)



Gusthead. (Photographer). [Photograph]. Retrieved February 13, 2012, from <http://www.flickr.com/photos/bkage/5570316311/sizes/11n/photostream/>.



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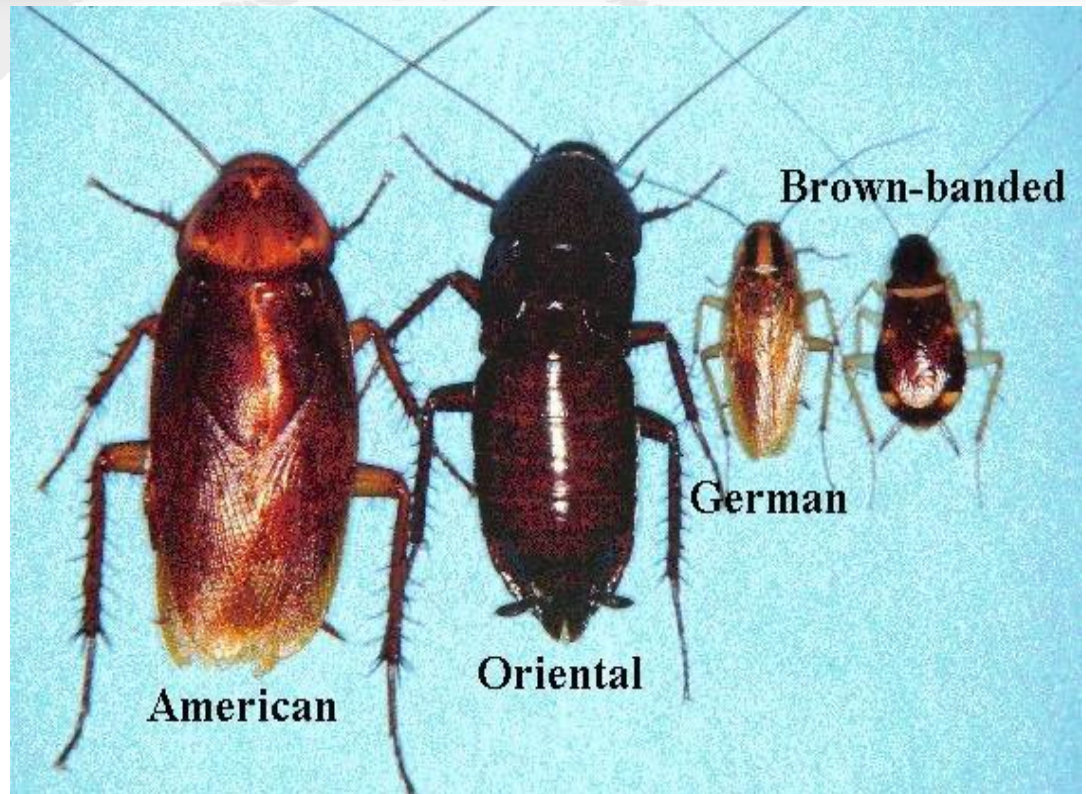
Common Cockroach

Characteristics

- -5-73 mm in length
- -2 pair of wings
- -flattened appearance
- -yellow/brown color
- -agile
- -exhibits **endophagic** behavior
- -active at night, in latrines

RESPONSIBLE FOR:

- Diarrheal diseases
- Typhoid fever
- Dysentery



Hinshaw, J. (Photographer). (2000). [Photograph]. Retrieved February 13, 2012, from: http://www.worldwidewounds.com/2000/oct/Janet_Hinshaw/Larval-Therapy-Human-and-Veterinary.html.



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Egypt Scenario

“The role of cockroaches and flies in mechanical transmission of medically important parasites”

Journal of Entomology and Nematology, Gehad T. El-Sherbini and Eman T. El-Sherbini, 2011

Surveyed residential areas in:

- Khaldyia Village, Egypt 2009 – 2010:
- 178 cockroaches collected (45 control)
- Flies from human feces also observed
- Parasites identified in defecation areas in and around houses



(Photograph). [Photograph]. Retrieved February 13, 2012, from: <http://www.cockroachesextermination.info/>.



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Egypt Scenario

RESULTS:

Cockroaches trapped in the toilets of:

- houses with **pit latrines**: **98 parasites/ml**
- houses with **water system**: **31 parasites/ml**
- Pathogens isolated from external and internal surface of **98% of test cockroaches**



Ric_k. (Photographer). [Photograph]. Retrieved February 13, 2012, from http://www.flickr.com/photos/ric_k/3196975264/sizes/z/in/photostream/.



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Trachoma

- Infectious disease causing a characteristic roughening to the inner surface of the eyelids
- The leading cause of infectious blindness in the world.
- Globally, 41 million people suffer from active infection
- 8 million people are visually impaired as a result of this disease.



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Mechanical Transmission



Flies landing on faces and feeding off secretions, serve as mechanical vectors



Gilbert; International Trachoma Initiative



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Direct Transmission



Contact with secretions
in school/playground



Contact with
secretions at home



Mukhida, SightsaverMatthews

Orbis International



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Indirect Transmission

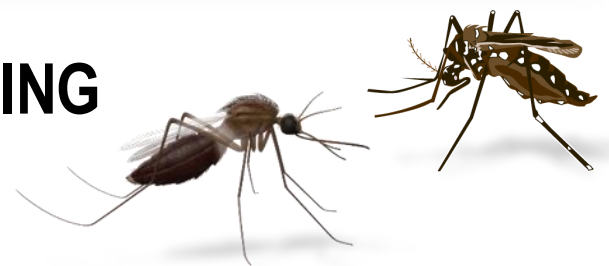


Contaminated hands, face cloths, towels, and bed sheets (fomites) also transmit infection

Mukhida, Sightsavers; Orbis



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Environmental Risk Factors: 6 D's

- **Dirt, Dust, Dung, Dry, Discharge, Density**



Poor sanitation and hygiene; "dirty faces"

Limited access to water; compromised hygiene



Transmission through ocular/nasal secretions.

Overcrowding ideal for transmission



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Risk Populations



Children under 10

Children are main reservoir due to poorer hygiene/contact with infected children

Women are main caretakers of children,
3x more likely to be infected than men



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Prevention In Crises

- Sanitation and Hygiene
- Contain fecal matter in latrines to limit fly population
- Include azithromycin in proposed “medical cocktail” of Ivermectin and Albendazole to prevent the seven neglected tropical diseases
- Fly control (where needed)



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Current challenges

Context of Humanitarian Crisis:

- endemic areas made inaccessible through conflict
- lack of political will or instability



International Trachoma Initiative



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