

September  
2010

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE AFTER MONSOON RAINS IN PAKISTAN



Department of Zoonotic and Vector-Borne Diseases  
Epidemic Investigation Cell  
Public Health Laboratories Division  
National Institute of Health  
Ministry of Health  
Government of Pakistan



## **Foreword**

Vector-Borne Diseases (VBDs) transmission has been closely associated with heavy rains around the globe and these diseases always flourish after rainy season when water become cessation and humidity level raises. Being a sub-tropical country, VBDs are also of a significant public health problem in Pakistan and major transmission period is post monsoon (August-November) season. All major public health vectors viz., mosquitoes, sandflies, fleas, ticks, coachroaches, mites, and bedbugs have their peak densities after monsoon season which reveals that there is a concrete relationship between rains, vector densities and disease transmission. Though some vectors remain dominant throughout the year. This document mainly deals with prevention of vectors of public health importance after monsoon season, under complex emergencies and among displaced population to interrupt the disease transmission through Residual Insecticides Application, Treatment of Breeding and Resting Sites, Personal Protection (by using repellents, Long Lasting Insecticidal bednets, cloth treatments etc), Environmental Sanitation, Health Promotion Campaign, and Integrated Vector Management (IVM) etc. Fogging has also been recommended as one of the best choice for rapid knock down effect on vector densities only during emergencies and has not been recommended as routine intervention. These guidelines have been prepared in the light of best practices available in the world for vector control operations. These guidelines are also very effective for armed forces when they deployed in a new area, particularly in forests. Development of this document is an approach that aims at strengthening provincial/district level capacities for control of all public health pests as well as the promotion of functional mechanisms for inter-sectoral coordination for cost-effective and sustainable vector control interventions to ameliorate diseases of public health importance in Pakistan.



**Dr. Rashid Jooma**  
Director General (Health)  
Ministry of Health-Islamabad.

## **Introduction**

Vector-Borne infectious Diseases (VBDs) are emerging or resurging as a result of changes in public health policy, insecticide and drug resistance, shift in emphasis from prevention to emergency response, demographic and societal changes, and genetic changes in pathogens and account for approximately 17% of the estimated global burden of infectious disease. During last two decades, many important VBDs, including malaria, dengue,



African trypanosomiasis and leishmaniasis, had re-emerged or spread to new regions. These diseases returned to a world that was now characterized by accelerating population growth, rapid urbanization, and land-use trends conducive to the spread of vector-borne diseases.

This document mainly deals with *prevention of vectors* of public health importance under both routine and outbreak situation and is published by Department of Zoonotic and Vector-Borne Diseases, Public Health Laboratories Division, National Institute of Health *to provide practical help to local health authorities to interrupt the disease transmission by reducing vectors densities in local settings*. In this document we have given very comprehensive information on different preventive methods and finally how to apply these method (s) *singly or in combination* for prevention of vectors of major public health importance. This approach called Integrated Vector Management (IVM) which is now being endorsed as the recommended strategy to exploit the preventive power of vector control in cost-effective, sustained and ecologically-sensitive ways. In this document we highlighted that IVM relies on packages of evidence-based interventions, tailor-made for local settings, and provides a way to coordinate and refocus resources for vector control, while at the same time reducing reliance on insecticides.

We hope that in long term this document will enable health authorities at all levels to make better informed-decisions in selection of more effective and sustainable *vector-specific* intervention (s) in their local settings, judicious and rationale use of insecticides and bednets for future vector control operations in Pakistan.

**Dr. Birjees Mazher Kazi**  
Executive Director  
National Institute of Health  
Islamabad

### **Executive Summary**

Vector-Borne Diseases are transmitted typically by the bite of infected arthropods like mosquitoes, ticks, mites, fleas, sandflies or black fly. These arthropods that carry and transmit diseases are known as *vectors* in public health. Different vectors carry different diseases such as malaria, leishmaniasis, dengue, encephalitis, African sleeping sickness, and yellow fever.



Because public health pests are sensitive to climate, therefore seasonal pattern or temporal distribution of diseases that are carried and transmitted through vectors is also greatly influenced by climatic changes. There is evidence that the geographic range of mosquitoes, sandflies, ticks and fleas etc that carry disease has changed in response to climate change. For example, approximately 40% of world population currently lives in the *warm, moist* tropical and sub-tropical regions of the world where climate particularly after monsoon rains is ideal for the mosquitoes breeding which ultimately results in increased transmission of malaria, dengue, yellow fever, and encephalitis etc.

Being a subtropical country, in Pakistan major vectors such as mosquitoes, sandflies, houseflies, ticks, fleas, cockroaches, bed bugs attains their peak densities after monsoon rains and subsequently diseases associated with them are transmitted after these rains which shows a significant relationship between rains, vector densities and disease transmission. In Pakistan more than 80% of total VBDs caseload of the country reports after monsoon season every year. For cost-effective and sustainable control, *vector-specific* control measures must be implemented well before the disease transmission period and in case of epidemic, these interventions should be implemented at an early stage of epidemic.

Department of Zoonotic and Vector-Borne Diseases, Public Health Laboratories Division National Institute of Health developed this document for health authorities which gives time and type of intervention (s) for control of public health pests under different epidemiological situations.

**Muhammad Mukhtar**

Head of Department of Zoonotic and Vector-Borne Diseases  
Public Health Laboratories Division  
National Institute of Health-Islamabad

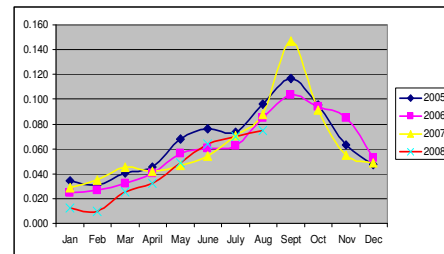
## **1.0). Vector Borne Diseases in Pakistan**

### **1.1). Background**

Vector-borne diseases (VBDs) account for approximately 17% of the estimated global burden of infectious disease. During last two decades, many important VBDs, including malaria, dengue, African trypanosomiasis and leishmaniasis, had re-emerged or spread to new regions. These diseases returned to a world that was now characterized by accelerating population growth, rapid urbanization, and land-use trends conducive to the spread of vector-borne diseases.

In Pakistan, VBDs are also a significant public health problem. Being a subtropical country, Pakistan has a rich fauna of disease vectors that includes mosquitoes, sandflies, houseflies, biting midges, ticks, lice, mites, fleas, cockroaches, bed bugs which, account for number of VBDs including arboviruses. Major vector-borne diseases in the country include malaria, leishmaniasis, dengue/dengue haemorrhagic fever (DHF) and Crimean Congo Haemorrhagic Fever (CCHF). Malaria 2nd most prevalent and devastating disease and accounts 16% disease load of the country (HMIS 2006 & 2008). Leishmaniasis also showing rising trend in country particularly in Balochistan, Sindh and FATA. Since 2005/06 Pakistan facing regular outbreaks of dengue/DHF across the country claiming more than 155 human lives during last 5 years. This shows that there is rising trend of VBDs in country.

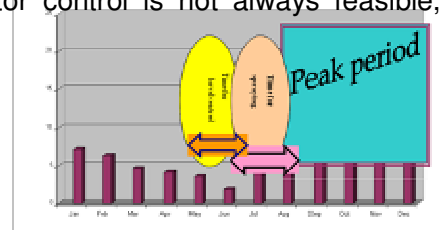
In Pakistan, densities of mosquitoes, sandflies, houseflies, bedbugs, cockroaches, fleas etc attain their peaks after monsoon season, subsequently VBDs particularly malaria and dengue always flourish after monsoon season (post monsoon: August-November) as shown in graph: Monthwise malaria disease incidence. During these months more than 80% of total VBDs caseload of the country reported every year. For example major malaria transmission period in Pakistan is post monsoon (July to November). Overall situation reveals that there is a concrete relationship between rains, vector densities and disease transmission in country.



Despite the importance of VBDs, only Malaria Control Program has an organized *vector control component* and there is no other specific institute/department for the control of vectors of leishmaniasis, dengue, and also bedbugs, ticks, human mites, fleas, houseflies etc which is one of the reasons for not proper control of VBDs in country. Currently vector control operations are being carried out on limited scale individually by different departments without any coordination, planning, effective guidelines and long term policies.

### 1.2). Effective response to control of VBDs after monsoon

Though the complete prevention of VBD only by vector control is not always feasible, therefore vector control interventions should also be supplemented by drug-based interventions. The implementation of vector control interventions require adequate preparation including coordination between line departments, planning and follow up. Ideally vector control interventions must be implemented well before the disease transmission period. In case of epidemic, these interventions should be implemented at an early stage of epidemics. Moreover a good understanding of vector (s) habits like where they breed, when they bite (Diurnal, nocturnal, dawn & dusk etc) and resting places (endophilic, exophilic) and the duration of transmission (short or prolong) is crucial in determining time and type of intervention, cost-effectiveness and sustainability of intervention (s). For effective response to emerging threats of VBDs as a result of heavy monsoon, the selection of appropriate *vector-specific* intervention (s) for different VBDs varies under different epidemiological situations have been given in table 1.



### **1.3). Need of document**

This document mainly deals with *prevention of vectors* of public health importance after monsoon season, under complex emergencies or among displaced population (both internally and internationally) living in camps. The overall goal of document is *to provide practical help to local health authorities to interrupt the disease transmission by reducing vector (s) densities*. These guidelines have been prepared in the light of best practices available in the world for vector control under different epidemiological scenario. These guidelines are also equally effective for the armed forces when they deployed in a new area, particularly in forests. This is an approach that aims at strengthening of capacities of provincial/district health authorities for the control of pests of public health importance and also for promotion of functional mechanisms for inter-sectoral coordination for cost-effective and sustainable vector control intervention (s) depending upon local settings.

### **2.0). Vector Control Methods**

For vector control operations, these guidelines mainly focus on following main vector control methods;

- 2.1). Residual insecticides application (Spraying and dust application of insecticides)
- 2.2). Breeding sites treatment (Larviciding)
- 2.3). Personal protection measures that include the use of;
  - 2.3.1). *Repellants*
  - 2.3.1). *Insecticides Treated bed nets (ITNs/LLINs)*
  - 2.3.2). *Cloth Treatment*
  - 2.3.3). *Protective cloths*
  - 2.3.4). *Screening of houses*
- 2.4). Space spraying or fogging
- 2.5). Environmental management that includes;
  - 2.5.1). *Source reduction*
  - 2.5.2). *Sources management*
  - 2.5.3). *Elimination of hiding places*
- 2.6). Health Promotion Campaign
- 2.7). Integrated Vector Management (IVM)
- 2.8). Feasibility of Aerial application

Details of strategic directions for implementation of each intervention are as under;

#### **2.1). Residual insecticides application**

##### **2.1.1). Selective Indoor Residual Spraying (SIRS)**

Generally, SIRS is a valuable option for vector (s) control, particularly when applied in right circumstances, time, with full coverage and with proper application method. Pakistan, since eradication era solely dependent on residual insecticides spraying for vector control. However since late 1980's this intervention is being carried out on limited scale. Currently the total areas in the country covered by Indoor Residual Spraying is not more than 5-10% which is extremely low as compared to required one i.e. 80% of target areas. Since IRS is not highly recommended intervention after the outbreak of disease, therefore this activity must be completed well before the start of transmission period and all resting places of vector (s) should be sprayed thoroughly using right equipments.



### **2.1.2). Strategic directions for SIRS**

Following key points should be considered for vector (s) control through SIRS;

- Only the insecticides of WHOPEs (World Health Organization Pesticides Evaluation Schemes) tested and recommended insecticides should be used for spraying.
- For routine operation, spraying should be started at least 1 month before the onset of the transmission season (mostly July-August).
- Spraying activities should be finished in shortest possible period of time by employing more number of people if manageable.
- Special mobile squads (Entomologists, Malaria Superintendent, M. Supervisors, CDC Officer etc) should be raised to carry out vector density surveys in district by involving district government staff and logistics.
- The target areas must be covered up to >80% through residual spraying.
- The insecticides with longer residual efficacy should be preferred.
- The recommended dose of Deltamethrin and Alphcypermethrin should be 10-20 and 20-40 milligrams/m<sup>2</sup> of active ingredient respectively for plastered smooth surfaces. In case of mud walls, dose should be doubled. Details has been given at table 2.
- Always use equal distribution (E type) nozzle for indoor spraying.
- Verandas, porches and all sleeping rooms, stores, bath rooms and animal sheds should be sprayed thoroughly.
- Ceilings of rooms particularly if made of straw must also be sprayed along with walls.
- Doors and windows from inner side and undersides/behinds of furniture boxes should also be sprayed.
- Treatment of curtains with insecticides particularly from backside will also be useful to control endophilic vectors.
- After spraying, room should be closed for at least one hour.
- Keep the children and animals away from room during this period.
- Never leave any food item inside room during spraying and always transfer food item insides at least after two hours of spray.
- Never clean (broom) the wall after spray.
- In case of displaced population or deployment of armed forces, spraying of tents from inside will also be very effective and spraying operation should be done before mid of the day. After spraying, close the tent for at least half hour.
- Spraying must be done after the transportation and installation of tents.
- Hang a black cloth sheet (CHADDAR) in rooms (preferably in corners) and spray it thoroughly. This will give maximum mortality of vectors resting inside the room during day time.
- There is no need of spraying in open air/sunlight, on water or on debris/garbage.
- In areas with long transmission period (>4 months), there should another round of IRS and in case of transmission around the year there should be 3<sup>rd</sup> round of application of residual application (depending upon the residual efficacy of insecticides).

### **2.1.2). Application of dust formulation of insecticides (dusting)**

Dust formulations are ready-to-use formulations usually manufactured by combining the active ingredient with a dust diluent which is usually inert. The concentration of active ingredient in the dust formulation can vary from almost 100% to quite low concentrations such as Coopex Dust which is 1%. Dust formulations have many advantages i.e. able to provide greater distribution of the active ingredient on/into difficult target sites (cracks and crevices), around electrical motors and equipment where liquid application is dangerous.

Dust formulations sit loosely on surfaces and so can be picked up on the bodies of pests passing through the area. This characteristic of dusts or powder is exploited to great effect with the use of tracking powder for control of rodents, termites, bedbugs, fleas, flies, and cockroaches etc. This characteristic is also a disadvantage sometimes; the product can also become airborne, increasing the risk of human exposure or treatment efficiency reduction. Many dust formulations suffer from visible residue problems. In all respects the application of dust formulations needs to be carefully and skillfully applied to ensure human safety and treatment effectiveness.

### **2.1.3). Strategic directions for dust application**

Key guiding points for vector (s) control through dusting of insecticides are as under;

- Insecticides should be applied in enclosed at dry places.
- It should not be applied as heavy deposit which may repel target vector (s).
- Should be applied in thin layer i.e. 6.0-12 gm/10 m<sup>2</sup>
- Should be applied in/on cracks and crevices or resting/hiding places of vectors (*Spot treatment*).
- Can be used to control vector (s) on animal fur, starting from around neck to tail avoiding eyes, nostrils and mouth.
- Organophosphates (malathion) should be avoided for dust application on kittens and puppies <4 weeks of age.
- For flies control it should be applied on garbage, heaps of animal dung etc. and application should be repeated after 2-3 weeks.

## **2.2). Breeding sites treatment (Larviciding)**

The best and most effective method of vector (s) control is to find, treat or eliminate their breeding places. Generally larval control includes use of chemical, environmental management, biological control, etc. However in Pakistan the use of chemical has always been given top most priority. For mosquito control, larvicides should be used in breeding sites that cannot be drained, filled or where other larval control methods are too expensive or impossible to use. Generally larval control operations should be used during dry months (May-June) when there are manageable breeding sites.

For effective control of flies, breeding sites i.e. garbage, heaps of animal dung etc should be repeatedly treated with chemicals at interval of 2-3 weeks particularly after monsoon rains.



### **2.2.1). Strategic directions for treatment of breeding sites**

#### *2.2.1.1). Mosquito control*

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

---

- Larviciding should be done during “Dry months i.e. May & June” when there will be limited and manageable numbers of breeding places.
- For routine operations, larviciding should be carried out very carefully after proper Breeding Sites Assessment Surveys (BSAS), mapping and marking as “Fixed” and “Non-Fixed” breeding sites.
- Larvicides should be applied in water bodies having densities of;
  - ▶ **Anopheles** (Malaria control) 1-2 anopheline larvae per dip.
  - ▶ **Aedes** (Dengue control) 0.5-1 Aedes larvae per dip.
  - ▶ **Culex** (Nuisance mosquito control) 2-3 culicines larvae per dip.
- Organically polluted water should only be focused for control of nuisance mosquitoes (*Culex*) by using granular larvicides (Fenthion 2%) while clean water for control of anophelines mosquitoes by using Temephos 50%.
- In case of drinking water the recommended larvicides are Abat/Temephos, Methoprene/Altosid (XR Briquets), Bacillus Thuringiensis (BT), Diflubenzuron (Dimlin).
- Strictly follow the dose criteria of manufactures, particularly when use for drinking water.
- Generally larviciding should be focused only to those water bodies which are close to human dwellings (within 1-2 kilometer radius).
- Granulars (Fenthion 2g) should be sprinkled (using sieve) along the 2-3 feet from margin @ 75 g/100 m<sup>2</sup> of stagnant water (a.i. 22-112 g/h)
- Liquids larvicides (Temephos 500E) should be sprayed along margin up to 2-3 feet @ 1.5 lit/5hec (a.i. 56-120 l/h). Details of doses have been given at table 2.
- No larviciding should be done beyond these limits (2-4 feet) from margin or in the center of water bodies.
- Larviciding during rains and floods (flowing water) should be strictly prohibited.
- Larviciding should be carried out at least 2-3 weeks of cessation of rains (permanent water bodies).
- Larviciding should be focused in water bodies less than 100 sq. meters of size.
- In case of very large water bodies >100 m<sup>2</sup>, larviciding (if very necessary) should be confined to areas where there are emergent vegetations along pond margin and also towards downwards of wind direction.
- Ideally larviciding should be carried out at 2<sup>nd</sup> and 3<sup>rd</sup> stage/instars of development stage of mosquitoes.
- For spraying of larvicides, hallow/solid cone nozzles are only recommended.
- Direct mixing of liquid larvicides should be strictly prohibited.
- For most efficient larviciding program, treatments must be repeated after 7-10 days depending upon larval density and availability of resources (3-4 cycles per month).
- Larviciding operation should be carried out for at least 2 months.
- In case of unserviceable water bodies (even for animal use), used mobil oil should be sprinkled. Similarly mixing of animal dung (15-20 kg/100 m<sup>2</sup>) in such water bodies will also give a significant control of nuisance mosquitoes.

### 2.2.1.2). Flies and other vectors control

- Frequently application of chemical on dung and garbage.

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

- Larvicides can be applied with a watering cane or a sprayer as emulsions, suspension or solutions @ sufficient to wet the upper 10-15 cm of the substrate i.e. 0.5-5 liters/m<sup>2</sup>.
- In case of heavy infestation (after rainy season or in refugees camps), application of dust formulation to garbage, heaps of animal dung, etc should also be a top most priority intervention for significant flies control.
- Simple dusting of Calcium carbonate (*Chunna*) on such sites can be effective if insecticides is not available.

### 2.3. Personal Protection

Personal Protection includes different methods used by an individual or small group of people to protect themselves from biting insects and diseases they may carry. Personal protection measures act as a barrier between human and vector (s). However, these methods have no significant impact of reduction of diseases incidence. *Personal Protection* measures which includes the use of repellants, LLINs, cloth treatment, protective cloths etc are top most priority interventions after heavy rains and subsequent floods resulting in an increased vector densities or threat of VBDs outbreak. These measures are also most important in emergencies, displaced population and for armed forces particularly when they deployed in forests. Similarly if IRS operation could not be done and there is a threat of an outbreak, again the priority should be given to *Personal Protection* than IRS.



Following are the main methods of Personal Protection for vector (s) bite control;

#### 2.3.1). Repellents

Repellents are among the most commonly used methods to prevent blood sucking pests from biting. They are applied directly on skin or to cloths and they evaporate much quickly than insecticides. Insecticides last longer and act by killing or knocking down vector when come in contact, where as repellent act by preventing human-vector contact only. The duration of protection by repellents applied to skin varies from 15 minutes to 8 hours whereas on clothing the effects last much longer.

##### 2.3.1.1). Strategic directions on use of repellents

- The repellents containing N, N-Diethyl-m-toluamide (DEET) and PICARIDIN/ICARIDINE (odorless and more advance form of repellants) etc are highly recommended. However Benzyl benzoate, dimethyl phthalate, dimethyl carbamate and ethyl hexanediol can also be recommended.
- Repellents should be applied particularly to exposed body parts (foot, arms, face) to prevent vector bites.
- Repellents should not be sprayed directly to the face; spray the repellent onto hands and then apply to face. Sensitive areas like the eyes, mouth and nasal membranes should be avoided.
- Children <5 and pregnant women (PW) should use repellents at time of sleeping, particularly when sleeping outsides. During emergencies particularly when

population displaced, the repellents must also be used by children and PW even when they are not sleeping.

- Clothing can also be treated with P./ICARIDINE or DEET, etc to repel vectors.
- The repellents (DEET) containing concentration above 30-35% will be quite effective. However, effect will last for up to 4 hours.
- For children repellents with lower concentrations (<10%) should be preferred.
- Repellents should not be used for children <2 years. However in case of extreme need, it should not be applied to their hands and/or faces, preferably to their clothing.
- The repellent which gives at least 8 hrs should be preferred (PICARIDIN/ICARIDINE), particularly during emergencies/outbreaks.
- In case of hot and sweating days, application of repellents should be repeated particularly when repellents have short duration (2-4 hrs)
- Repellents must be used according to label directions to avoid misuse or overuse of repellents.
- Prolong use of repellants for more than 2 months should be consulted with doctor.
- Natural repellants like Garlic, basil (niaz boo) onion, neem, Cedar, Eucalyptus spp, cloves oils, can also be used during peak breeding times during/after monsoon or complex emergencies.
- In case of tent during emergencies, burn the leaves of neem, Eucalyptus spp (smoke only) in a tin/metallic container inside and close the entrance for at least 15 minutes. This practice should be done under close supervision and at least 1-2 hours before sleeping.
- In case of open air, burn (smoke) the leaves of neem, Eucalyptus spp close to sleeping place (downward wind direction) at least 1 hr before the sleeping time and stopped just before sleeping for avoiding health hazards.



### 2.3.2). Insecticidal Treated Nets (ITNs/LLINs)

The use of ITNs/LLINs should be the one of the major intervention particularly for children<5 and pregnant woman (PW) and also for those people living outdoor during peak vector breeding season. However during outbreak, emergency or among displaced population the use of Long Lasting Insecticidal Treated nets (LLINs) become best choices for the control of vectors of public health importance.



#### 2.3.2.1). Strategic directions on use of LLINs

Following are the major instruction for better use of LLINs for control of vector (s) bites;

- ONLY WHO-Recommended LLINs (PermaNet, Olyset, Dawa plus, Yarkool, Interceptor, NetProtect, and DuraNet) should be promoted and used.
- In case of prolong rainy season (floods) and when there is risk of outbreak of disease, whole population at risk should be protected by LLINs. However, priority should be given to PW and children <5 year.
- 2 bed LLINs per household should be provided to cover entire family.
- Armed forces particularly when deployed in forest must use LLINs.

- All patients of vector-borne diseases (malaria, and dengue etc) must be kept under LLIN to decrease risk of further spread of diseases.
- After opening of packet, LLIN should be spread under shade for 1 hrs before use.
- Don't leave the net in sun or in rain after use.
- Don't fold the net but hang it in room or tent (preferably in corners) during day time when it is not in use.
- The use of LLINs as curtain will also give significant control of vector densities and in tents particularly, LLINs should also be used as curtains at entrance.
- Before sleeping tuck the hanging edges of LLIN under bed sheet/mattress.
- Normally LLINs should be washed after at least 3-4 months. However it should not be washed during peak transmission, rainy days, emergency/epidemic/N disasters.
- Washing should not be done in lakes, well and other drinking water resources.
- Make sure the 100% coverage of target population particularly children <5 and PW.
- If there is any hole in bed net it must be replaced with new one. However, if new one is not available it must be repaired immediately.

### 2.3.3). Cloth treatment

Certain vectors like mosquitoes and bugs can also bite through cloths particularly when they are skin tight. Currently to prevent this bite, treatment of cloths with quick-acting insecticides of *pyrethroid* group such as "permethrin" is the most practiced personal protection measure. Cloth treatment is most feasible and effective interventions during peak densities of vector after heavy monsoon. This is also best choice for armed forces particularly when they are deployed in forests during peak vector (s) breeding season to prevent the disease transmission and also to avoid the bite of nuisance mosquitoes and other insects.



Though these compounds don't repel the vectors but allow them to make contact with fabric and irritate or kill them before they manage to bite. The application of repellents to cloths is prefer to application on skin because of reduction of likelihood allergic reaction on skin. Some of the other pyrethroids like "*cyfluthrin*" can also be effective however degrade quickly in sunlight. The clothing can be treated with permethrin by spraying the insecticides from a pressurized can or by soaking in an aqueous emulsion. Treated cloths repel or kill vectors quickly.

#### 2.3.3.1). Strategic directions on cloth treatment

- Permethrin is the best insecticides to treat cloths because of its safe, economical, low-odor, safe for fabrics and effective against all household pests, when label instructions are followed.
- Long sleeve shirt (*Kameez*) and *Doupatta/Chaddar* of female (PW) can be treated with this insecticide at the recommended dose of 1.25mg/m<sup>2</sup>.
- They are long lasting and effective up to 10-12 washes in cold water. However, washing of treated cloths in hot water and during peak transmission period should be avoided.
- Preferably retreat the clothing with permethrin after every 5 washings
- To avoid any irritation on skin, it should be applied at right dose mentioned above.

Since these synthetic pyrethroids are non-volatile in nature, therefore there is risk of attack of vectors particularly mosquitoes, sandflies, fleas and bugs to expose body parts. Therefore during peak densities of vector and transmission period after monsoon, use of volatile repellents should be preferred intervention.

#### **2.3.4). Protective cloths**

Protective cloths can offer one of the best protections against vectors mosquitoes, sandflies, bed bugs, fleas, ticks etc., particularly when they are thick and loose. Following important measures should be considered during transmission period;

- Always wear;
  - long sleeves while sleeping
  - socks and also cover other exposed body parts
  - full trousers
  - loose fittings
  - light color clothings

#### **2.3.5). Screening of tents/houses.**

- In case of house, vector-proof screens on doors and windows should be promoted to prevent the entry of vector (s) particularly mosquitoes.
- Screen of mesh size 150-170/ inch<sup>2</sup> or 25-30/cm<sup>2</sup> should be used to prevent entry of vectors.
- In case of tent, net with same mesh size should be hanged at entrance.
- In case of any damage to screen, it should be repaired quickly.

### **2.4). Space Spraying/Fogging**

The space spraying is not recommended for routine vector control operations in Pakistan. It should be considered as “*Epidemic Contingency Measure*” particularly during outbreak or complex emergencies. Space spraying is usually designed to provide a rapid knock-down effect on exophilic vectors during peak breeding season or during outbreak after monsoon season.



#### **2.4.1). Strategic directions for Space spraying**

Following are the key points for effective implementation of this intervention;

##### **2.4.1.1). Indoor Fogging**

For endophilic vectors control during emergencies situation or outbreak as a result of heavy monsoon, indoor thermal fogging should also be an important component of VBDs control operation. Personnel conducting this activity require training on following safety measures to be applied;

- Switch off all electricity at main/master switch.
- All heating and cooking equipments including pilot light (and allow them for a cool down) must be turn off before operation.
- To reduce the risk of fire, *water-diluted products* should be used.

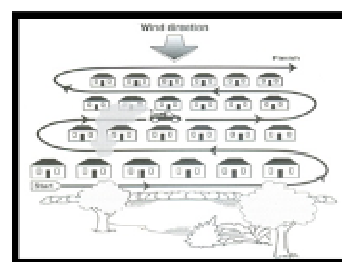
## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

- All foodstuff and water containers must be properly protected.
- For indoor fogging a team of 2 persons should target 75-100 houses per day.
- The person operating should move backwards and away from fog to minimize the exposure.
- Other persons should assist in moving furniture, exposing hidden sites and guide the spray man through tight spaces.
- For *small* single-storey house, the spray can be delivered from front door or through open window without having entry to every room, provided that adequate dispersal of insecticides have achieved.
- For *large* single-storey building, fogging should be carried out from room to room beginning at back of building and moving towards the front.
- For multi-storey buildings, operations should be started from top floor to ground and from back of the building to front.
- Before fogging, windows and doors (tents also) should be closed and keep them closed for at least 15-30 minutes to ensure the maximum efficacy.
- Residents and pets should move out.
- Before entry of home, ventilation of home/building must be ensured.
- Size of an average household/building (in m<sup>2</sup>) first should be estimated and volume of diluted spray required should be prepared according to manufacturers' label recommendations. The "Flow Rate" of machine (ml/minute) should be checked so that average time required to treat the home/building should be calculated and fog machine operator should be informed and trained.
- A fog must be "dry" before going in to house/building. To check it place the machine on ground and check the area immediately in front of nozzle is not wet. To reduce the production of large wetting droplets, obtain the correct balance between flow rate and combustion temperature, usually by reducing the flow rate.

### 2.4.1.2). Outdoor fogging

For outdoor fogging operation, advance route planning should precede which may require combination of vehicle-mounted and hand carrier or knapsack equipment particularly for area with difficult or limited vehicle access. Consideration must be given to following;

- One day before operation, there should be an announcement about operation in area and community should be advised to keep open doors and windows during outdoor fogging operation.
- Space spraying must be conducted at the time of peak activity of adult vector (s).
- It should be implemented in a compact community and should be within 1000-2000 meter radius of affected areas.
- First prepare plan with respect to layout of streets and wind directions.
- Fogging should be done perpendicular to the wind direction. While using vehicle mounted fog machine, speed of vehicle must be maintain at 5-8 km/hr.
- The downwind side of spray area should be treated first, working systematically from downwind to upwind.
- To avoid driving into spray cloud, *dead-end road* must be sprayed only on the way out.



## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

- During outbreak, fogging should be done (preferable at dawn) on alternate days during first week of outbreak and later on 3<sup>rd</sup> day for next two weeks.
- Finally there should be 4 cycles/month during the epidemic/emergency situation and operation should be continued for at least next 2 months.
- For vehicle-mounted equipment, in areas where the roads are narrow and houses are close to roadside, the spray should be directed from “Backwards” from vehicle.
- In areas with wide roads and building far from the roadside, the spray should be directed at an “Angle (downwind)” to the road rather directly behind the vehicle.
- The nozzle of vehicle-mounted “cold fogger” may be directed upwards when there is barrier that impede airflow. However, for thermal fogger the nozzle should be directed horizontally.
- Spray must be turned off when vehicle is stationary.
- In case of outdoor fogging, the operation should not be carried out when;
  - wind speed is >10 km/h.
  - Day time heat is >28°C
  - wind speed is less than 3 km/h
  - relative humidity is >85% (during/immediately after rains)
- Follow the dose criteria of manufacturer mentioned on label i.e. 1 liter insecticides in 160 liters of kerosene oil or diesel which will be sufficient for 700,000 – 800,000 sq. m area. In case of Ultra-Low Volume (ULV) there should be 1 liter insecticides for 50 liters of kerosene oil or clear water which will be sufficient for an area of 250,000-300,000 sq meters.

N.B: *Blood cholinesterase must be monitored on regular basis, if organophosphates compounds are used.*

### 2.5.) Environmental Management (EM)

EM refers to any modification in environment which deprives the vector population of its requirements for survival, thus reducing *vector densities*, *man-vector contact* and finally the *transmission risks*. Though during rainy season EM is not effective and feasible option on large scale, however very effective at home level i.e. covering of water storage containers and cleaning of surroundings of houses, destruction of hiding places etc., Following are important EM for the control of public health pests;



- Remove the stagnant water by;
  - Fill the ditches with soils
  - Drain out water in nearby water course/channel
- Use the used mobil oil to cover unusable water bodies.
- Cover the water storage tanks properly.
- Elimination of hiding places by;
  - Sealing of cracks and crevices
  - Cutting of weeds and grasses
  - Repairing of holes in mattress

- Destruction of wild bird nest in around houses
- Removal of unnecessary grasses and weeds particularly in around houses

## **2.6). Health Promotional Campaign**

Before the start of monsoon season, a comprehensive mass media campaign for community awareness should be started for better acceptance of intervention (s) particularly *Personal Protective measures*. Health promotional campaign should always be the top most priority/activity to;



- Change the behavior of people for improved hygiene practices.
- Recognize the symptoms of disease for prompt treatment seeking behavior.
- Cleanliness of the surroundings
- Draining out of stagnant water
- Destruction or treatment of hiding places of vectors.
- Treatment of undesired stagnant water with used mobil oil and chemicals (larvicides) where necessary for other nuisance mosquitoes.
- Promotion of personal protection practices (use of LLINs/ITNs, creams, oils, coils and other repellents, and treatment of cloths etc).

The overall success of implementation of interventions particularly personal protection measures solely depend upon the strong and sustainable health promotion campaign. In this regards the extensive distribution of posters and pamphlets (involving local leaders, Imams, teachers, and LHWs) in should be the best approach for the success of such campaigns.

## **2.7). Integrated Vector Management (IVM)**

Vector control has proven highly effective in preventing disease transmission around the globe. However, for complete prevention of disease, vector control intervention (s) should be supplemented by drug-based interventions. Similarly implementation of single vector control intervention will not give its desired results and ideally one or two even more interventions should be used simultaneously. This approach called *Integrated Vector Management (IVM)* which is now being endorsed as the recommended strategy to exploit the preventive power of vector control in cost-effective, sustained and ecologically-sensitive ways. IVM relies on packages of evidence-based interventions, tailor-made for local settings, and provides a way to coordinate and refocus resources for vector control, while at the same time reducing reliance on insecticides. This approach aims to control, manage and monitor VBDs at all relevant points in the life-cycle and transmission-cycle of the vector.

## **2.8). Aerial Application**

Aerial spraying can be used to treat large areas quickly and can be carried out when field conditions prevent wheeled vehicle access. It mainly used in agricultural lands, however, for the control VBDs its use is very limited and only to those areas where



vector(s) are exophilic and breeding and resting sites cover huge area over miles. In applying space spray from the air, careful consideration must be given to local meteorological factors that include high wind speed and direction, temperature inversion, relative humidity that may limit treatment application whilst trees, waterways, environmental considerations and overhead power lines further prevent some fields from being treated. Vortices created by the aircraft passage will also influence spray distribution efficiency. Environmental contamination can be significant if spraying deposition on target sites is not accurate. Ideally treatments are often late in evening to take the advantage of any inversion and to allow droplet to fall from a higher release height to where the disease vector (s) are flying.

### **2.6.1). Strategic directions for aerial application**

Ideally aerial application for the control of vectors of public health can only be done when;

- Vector (s) are exophilic, breeding and resting sites are huge in size and away from human settlements.
- Time of peak activity (exposed) is dawn and dusk.
- Surface wind speed is 1-2.5 m/s. or <10 km/h. When the wind speed is <3m/s, a boom height of 2-3 m above the surface will ensure good lateral movement of the spray.
- Crosswind, flying speed and application rate are constant for both flight direction.
- At low relative humidity  $\pm 70\%$ .
- Availability of Smooth or uniformly leveled area (at least 2 km).
- Ground temperature is <30°C. (Higher temperature prevents the spray cloud settling within the treated area.

In Pakistan, aerial application for control of vectors of public health importance is **ABSOLUTELY NOT FEASIBLE OPTION** because;

- major vectors of VBDs are endophilic
- breeding/resting sites are small, within human settlement (in/around house)
- unavailability of smooth area etc.
- Breeding of vector mosquitoes in drinking water sources.

### **2.9). Strategic directions for applications of preventive measures against vectors.**

Pakistan since eradication era in 1960's, is implementing vector control interventions successfully mainly through Indoor residual Spraying. Being a subtropical country, it has a rich fauna of disease vectors that includes mosquitoes, sandflies, houseflies, biting midges, ticks, lice, mites, fleas, cockroaches, bed bugs which attain their peak densities after monsoon rain, and subsequently increased transmission of diseases associated with these vectors. Since these vectors have wide range of breeding and resting places, therefore each vector requires different set of interventions (IVM) and time of implementation of interventions. For effective and sustainable vector control and disease transmission, the selection of *vector-specific intervention* for all above mentioned vectors has been shown in table 1. Details of application of intervention (s) against individual vector are as under;

### **3.0). Mosquitoes**

Mosquitoes are small fragile, but one of the most important public health pest, capable of transmitting diseases such as malaria, yellow fever, dengue fever,



filariasis and Japanese encephalitis and some other viral diseases to humans and animals. They cause more humans suffering than any other living organism and there are more two million deaths from mosquito-borne diseases annually in the world.

Mosquitoes vary in period their peak activity, host preference, egg laying and in the flight range. For example, the *Anopheles* (malaria carrying mosquitoes) are mostly night feeders. Female generally prefers fresh and clean water for egg laying. *Culex* mosquitoes (carrier of viral encephalitis) are active during the dusk and also at night. Domestic and wild birds are the usual victims over man, cows and horses. Generally they prefer polluted and dirty water for egg laying. *Aedes* (dengue fever, yellow fever, and encephalitis transmitting mosquitoes) search for their victim during dusk and dawn, some are even daytime feeders especially during cloudy days and in shaded areas. Female of this group lay eggs mostly during evening in man-made clean water habitats. In Pakistan Malaria and dengue fever are two major diseases transmitted through mosquitoes.

### **3.1). Preventive measures against mosquitoes**

Mosquitoes are often difficult to control because their wide range of breeding habitats, resting places and resistance issue etc. Use of insecticides alone or any single method will not control mosquitoes significantly. A strategy based on “*Integrated Vector Control Approach*” is the best solution of mosquito bite problem. To decrease risk of mosquito bite and disease transmission following IVM approach should be adopted;

#### **3.1.1). Residual Insecticides Spraying**

- Residual insecticides (usually pyrethroids) spray should be top most priority and should be carried out at least 1 month before transmission focussing only *rural areas* for routine malaria control.
- In case dengue control, priority should be given to *urban areas*.
- All sleeping rooms, stores, bath rooms, porches, verandas and animal sheds should be sprayed thoroughly.
- Ceilings particularly if made of straw must also be sprayed along with walls.
- Doors/windows from inner side and undersides/behinds of furniture boxes should also be sprayed. Consult guidelines for IRS explained in section 2.1.1.

#### **3.1.2). Larviciding**

- For malaria control, larviciding should be focused for clean, stagnant water in irrigated-related habitats in rural areas.
- For dengue control, it should be focused for “man-made habitats in side house. However, use of chemical for the control larvae of dengue mosquitoes is only recommended only if expertise (well experienced entomologist) is available.
- For drinking water habitats, recommended larvicides are Methoperene/Altosid (Briquets), *Bacillus Thuringiensis* (BT), Diflubenzuron (Dimlin).
- For other nuisance mosquito control (*Culex* mosquitoes), larviciding should be focused on organically polluted habitats.
- Consult guidelines for larval control given at section 2.2.1.

#### **3.1.3). Personal Protection**

##### **3.1.3.1). Insecticides Treated Bednets (LLINs)**

- Regular use of LLINs is the best strategy to control malaria particularly under disasters or emergency and also during normal disease transmission period.

- For dengue control, the use of LLINs should be limited only to patients and also to other family members of patients.
- Consult guidelines for better use of LLINs given in section 2.3.2.

#### 3.1.3.2). *Repellents*

- One of best strategy to control mosquitoes particularly under disasters or emergency and best recommended repellents are PICARIDIN/Icaradine and DEET.
- Since anophelines are night feeders, therefore for their effective control repellents should be used at the time of sleeping for malaria prevention.
- During emergencies, outbreak etc, repellents must be used by PW and children <5 even when they are not sleeping.
- Aedes mosquitoes are day time biters, therefore for dengue control apply repellents during day time.
- Consult guidelines for effective use of repellents against mosquitoes given at section 2.3.1.

#### 3.1.3.3). *Cloth Treatment*

- In case of heavy mosquito infestation, treatment of cloths with “Permethrin” will give a significant control of mosquitoes.
- These cloths should be retreat after every 4-5 washings (consult section 2.3.3.1).

#### 3.1.3.4). *Protective Cloths*

- Wear protective clothing that includes full sleeves shirts, long pant, loose fitting etc.

#### 3.1.4). **Space Spraying/Fogging**

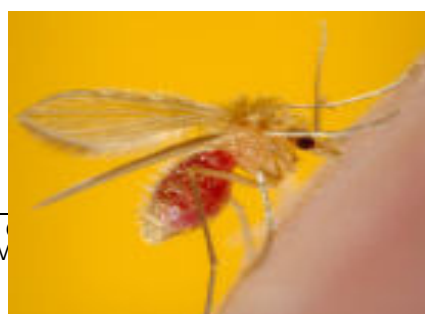
- Indoor fogging for control of dengue is best choice particularly during outbreak and epidemic.
- For malaria control, its use is very limited and not very effective and only recommended during outbreak or during emergencies focussing indoor application.
- Consult guidelines for effective fogging operations explained in section 2.4.1.

#### 3.1.5). **Other Simple Measures**

- Vector-proof screens (mesh size 120-170/inch<sup>2</sup>) on doors and windows should be promoted to prevent the entry of mosquitoes.
- All stagnant water should be removed through filling of ditches with soils.
- Apply the used mobil oil to cover unusable water bodies.
- Cover the domestic water storage tanks properly.
- Removal of all emergent grasses along pond margin, removal of blocking shaper bags and floating bottles in drains and channels.

### 4.0). Sandfly

Sandflies are minute insects which primarily transmit a serious parasitic disease called leishmaniasis caused by *Leishmania* parasite. Sand flies are primarily nighttime biters and usually most active in twilight, evening, and night-time hours (from dusk to dawn).



Although sand flies are less active during the hottest time of the day, however a person may get bite if resting sandflies are disturbed. Sand fly activity in an area can easily be underestimated because sand flies are noiseless fliers and their bites is painless which might not be noticed. People of all age group are at risk for infection if they live or travel in a area where leishmaniasis is problem. Some types (species) of *Leishmania* parasites may also be spread by blood transfusions or contaminated needles (needle sharing). Congenital transmission (spread from a PW to her baby) has also been reported. There are several forms of leishmaniasis, of which most common are;

A). *Cutaneous leishmaniasis* (CL), the most common form of Leishmaniasis and is characterized by numerous skin sores on the body that develop weeks or months after the infected bite of a sand fly. CL usually heals on their own, even without treatment. However, the sores usually leave scars that can be quite disfiguring its victims for life.

In Pakistan two types CL are prevalent viz., *Zoonotic Cutaneous Leishmaniasis* (ZCL) and *Anthroponotic Cutaneous Leishmaniasis* (ACL) which are endemic in most parts of the country, including Baluchistan, Punjab, Sindh, NWFP, and AJK. Classification of CL in Pakistan has been based mainly on clinical picture, epidemiology and Sandfly fauna in the endemic foci.

B). *Visceral leishmaniasis* (Kala Azar), the most serious form of the disease and can be fatal if left untreated. In Pakistan *Visceral Leishmaniasis* (VL) mainly prevalent in North-East Region.

#### **4.1). Preventive measures against sand flies**

At present no vaccines are available for prevention of leishmaniasis infections. The best way to prevent leishmaniasis infection is by protecting themselves from sand fly bites through adopting following preventive measures;

##### **4.1.1). Residual Insecticides Spray**

Prevention of **ACL** is very similar to malaria prevention, as sandflies bite at night and rest indoor (endophilic) in human settlements or dwellings. ACL can be control very effectively through;

- Selective Indoor Residual Spray (SIRS) with Pyrethroids insecticides mainly focussing the stores, animal sheds, porches and verandas.
- Spraying human sleeping rooms should also be equally focused for spraying.
- In case of outbreak, ultra-low-volume insecticides space-spray in and around house will also be of a significant importance.
- Thermal fogging should also be a top priority intervention particularly outdoor.

Prevention of **ZCL** is quite different and difficult. In this case vector Sand fly (*P. papatasi*) tends to bite outdoor, therefore spraying of human sleeping rooms and animal sheds etc is not an advisable option. The reservoir of infection is found among rodents living in deep borrows around human habitations, therefore for effective control of ZCL, following preventive measures should be adopted;

- Locate the borrows of rodents (reservoir of infection)
- Borrow destruction through deep ploughing or hoeing (*goddi*)
- Thorough irrigation
- Killing of rodents through rodenticides

However, this can only be achieved through effective and sustainable coordination with line departments like agriculture and irrigation (IVM).

#### **4.1.2). Personal Protection**

An individual can prevent infection by protecting him/herself through adapting personal protective measures particularly during peak vector densities and disease transmission. Personal protective measures include the use of;

##### *4.1.2.1). Repellents*

- Insect repellents like PICARIDIN/Incarnadine or DEET should be applied to all exposed body parts (hand, arms, ankle, etc) and also under the edges of clothing, such as under the ends of sleeves and pant legs.
- Repellents must be used during outdoor activities especially at dusk and/or dawn.
- Consult guidelines and other precaution for effective use repellents given in section 2.3.1.

##### *4.1.2.2). Insecticidal treated bed nets (ITNs/LLINs)*

- It can also be effective personal protective measure if ITNs/LLINs with ultra fine/small meshing (220 holes/sq inch) is used. In case fine mesh nets are not available, large mesh size ITNs/LLINs can also give good personal protection.
- Consult guidelines for the use LLINs given in section 2.3.2.

##### *4.1.2.3). Cloth Treatment*

In case of high densities, use the cloths properly treated with insecticides "Permethrin" can give best protection against sand fly bite. Such cloths should be retreated after every 5 washing (section 2.3.3.).

##### *4.1.2.4). Protective Cloths*

- Full sleeves shirts, long pant, loose fitting etc are highly recommended.

#### **4.1.3). Space Spraying/Fogging**

Both indoor (particularly) and outdoor (generally) fogging will also be very effective intervention to provide a rapid knock-down effect on sand fly densities during peak breeding season or during outbreak. Consult guidelines for the use space spraying explained in section 2.4.1.

#### **4.1.4). Other Simple Personal Measures**

- Try to limit or minimize outdoor activity at dusk and during the evening, when sand flies are most active.
- When someone gets bite of sandfly, the bite area should not be scratched as scratching prolongs the swelling, itching, and discomfort, and can open the skin and cause an infection.
- Wash the affected areas with soap and water to ensure no infections develop and help to reduce the itching.
- Making a paste of baking soda and water and spreading it over the bite areas.
- Using calamine lotion or a topical anesthetic to help relieve the itch and pain.
- Itching can also be relieved by using a one percent hydrocortisone cream.
- Aloe vera gel is an effective natural sand fly bite treatment which reduces swelling and itching and soothes the affected area.

- If the bite area becomes red and swollen and if the area around the bite feels warm to the touch, the bite may be infected. If this condition persists and does not respond to above mentioned and standard bite treatment, consult a doctor immediately.

Some people have/had cutaneous leishmaniasis more than once. Therefore, it is important to follow strictly the above mentioned preventive measures particularly whenever travelling to an area where leishmaniasis is a problem.

## **5.0). Bedbugs**

Bedbugs are small, oval, flat bodies non-flying insects which feed by sucking blood from humans or animals. Bed bugs are most active at night and can bite on face, neck, back, hands, and arms or any exposed areas of skin while an individual is sleeping. They can live in any area of the home particularly in sleeping areas and can reside and hide in tiny cracks in bed and furniture frames as well as in/on mattresses. Other sites where bedbugs often reside include curtains, corners, inside dressers and other furniture, cracks in wallpaper (particularly near the bed), behind picture frame etc. Since bed bugs can live up to one year without feeding, they can also be found in vacant homes. Hot and humid climate after monsoon are leading factors for intensive increase of densities of bedbugs. They can also become great nuisance in displaced population living in camps.



Though the bedbugs have not been found to transmit diseases to their host, however intense itching and discomforts of bedbug bites can result in a secondary skin infection. Usually no treatment is required for bedbug bites, however if itching become severe enough then steroid creams or oral antihistamines can provide some relief.

### **5.1). Preventive measures against bedbugs**

Bedbugs are often difficult to control because their hiding spots are hard to find or inaccessible. Use of insecticides alone or any single method will not eliminate bedbug infestation.

To decrease risk of bedbug bite and infection, following an *Integrated Vector Management Approach* focusing refugee camps, shelters homes, dormitories, etc should be adopted;

#### **5.1.1). Residual Insecticides (Spraying and Dusting)**

- Residual insecticides (usually pyrethroids) spray should be applied as “*Spot Treatments*” to cracks and crevices where bedbugs are hiding.
- For increased penetration of the insecticide into deep and narrow cracks and crevices, it should be applied through syringe or other insecticide injectors.
- In case of heavy infestation, residual insecticides spraying on walls of human sleeping rooms, stores will be very effective.
- Dust formulations of insecticides can also be used to treat wall with a “hand-operated puff duster” particularly at the corners of rooms.
- Insecticides dusting under mattress, in/around joints of furnitures will also give excellent results.
- For best and longer control of bedbugs, insecticide applications should be repeated 2 weeks after the initial treatment since it is difficult to find all hiding places and hidden eggs may have hatched.

### **5.1.2). Aerosol application**

- This will provide a quick but temporary relief from bedbugs as mostly they will disperse to other places of the building from which they may return later making their control more difficult.
- Only effective when directly hit bedbugs.

### **5.2). Personal Protection**

#### **5.2.1). *Repellents***

- Application of PICARIDIN/Icaradine or DEET on skin and cloths is one of best strategy to control bedbugs after monsoon when there is heavy infestation.
- Since bedbugs are night feeders, therefore for their effective control repellents should be used at the time of sleeping.
- In case of heavy infestation repellents particularly Icaradine can also be used during day time.
- Burning of mosquito coils can also give some protection against bedbugs.
- Consult guidelines for better use of repellents against bedbugs given in section 2.3.1.

#### **5.2.2). *Cloth Treatment:***

- Treatment of cloths with “Permethrin” in case of heavy infestation will give significant control of bedbugs (section 2.3.3).

#### **5.2.3). *Insecticides Treated Bednets (ITNs/LLINs)***

- Regular use of ITNs/LLINs is the best strategy to control bedbugs under disasters or emergency and also during normal disease transmission period (section 2.3.2).

### **5.3). Other simple personal measures**

- For best control of bedbugs, all clothes and bedding suspected of being infested should be soaked in hot water at 120°F for at least 30 minutes and then washed in same water.
- In case of natural disaster when such practices are not possible, the bedding cloths should be spread in sunlight for whole day before use at night.
- During routine days, drying of on HIGH temperature for at least 30 minutes will give better results than hot water washing to kill bed bugs.
- During routine days, vacuuming and brushing can be very useful for removing any live bugs and eggs from mattresses, carpet, walls, and other surfaces. Particular attention should be given to seams, tufts and edges of mattresses and box springs, and the perimeter edge of wall-to-wall carpets.
- Vacuum contents should be disposed off properly in a sealed trash bag.
- Seal all cracks in walls and glue down loosened wallpaper to eliminate bedbug hiding sites.
- If there are holes or tears in the mattress and in other fabrics, it must be repaired immediately as bugs can hide itself at the time of intervention which will more difficult to control next time as they may lay eggs inside.
- Wild animal roosts and bird nests inside home must be remove and destroy when possible.

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

- Bed should not be kept attached with wall, should be at least 18 inches away from wall.
- Picture frames should be removed from the walls and cleaned or treated (dusting insecticides).
- After visiting infected area/house, personal belongings should be examined carefully. If any infestation found these should be cleaned, and sealed in plastic bags or bins for treatment or proper dispose off.
- Do not use cardboard boxes, bed bugs can hide in folds and will deposit eggs there.

### 6.0). Fleas

Fleas are small, wingless bloodsucking insects with a characteristic jumping movement. They feed mainly on mammals but also on birds. Of the 3000 species, only a dozen commonly attack humans. Important species are cat flea, rat flea and human flea. Humans are most commonly bitten by the cat flea, which is a vector of bubonic plague and flea-borne typhus. Cat fleas also incidentally transmit tapeworms. The sand flea or jigger burrows into the skin of humans and may cause infections. Fleas jump up from the ground



and most frequently attack people on the ankles and legs, the easiest parts to reach, although sleeping people can be attacked anywhere on the body. Their bites can cause irritation, serious discomfort and loss of blood. Heavy infestations may cause allergic reactions and dermatitis.

#### 6.1). Preventive measures against fleas

To decrease risk of fleas bite and infection following instructions must be followed;

##### 6.1.1). Use of insecticides

- In case of heavy flea infestation, use of insecticides (spraying and dusting) should be given top most priority.
- Residual Insecticides should be sprayed at the corners of rooms and other places where fleas and their larvae like to be occur.
- Spraying and dusting insecticides (Pyrethroids) as “*Spot Treatments*” to cracks and crevices where fleas hide will also give a significant control.
- For better penetration of insecticides in cracks and crevices, inject water soluble insecticides by using syringe.
- In case of heavy infestation, fumigate the room, and repeat the treatment twice in a week for whole month.

#### 6.2). Personal protection

##### 6.2.1). Repellents

- The repellents such as PICARIDIN/ICARIDINE and DEET etc are highly effective to prevent flea bites and can be applied on skin and cloths.
- However, other repellents such as Benzyl benzoate, dimethyl phthalate, dimethyl carbamate and ethyl hexanediol can also be recommended. However their efficacy ranges from 30 minutes to 2-3 hours.
- Consult guidelines for use of repellents given in section 2.3.1.

6.2.2). *Cloth treatment*

- Cloth treatment with *Permethrin* is most feasible and effective interventions during peak densities of fleas which repel or kill fleas quickly.
- They are long lasting and to some extent withstand weathering, sunlight and washing with cold water (section 2.3.3).

6.2.3) *Insecticides treated bednets (ITNs/LLINs)*

Regular use of ITNs/LLINs in highly infested areas is highly recommended. (Section 2.3.2.)

**6.3). Application of insecticides to domestic animals (Cat and dog)**

- Fleas can be detected in the hair around the neck or on the belly of cats and dogs. Insecticides should be applied through sprays, dusts on fur of animals.
- Dusts are safer to use than sprays because the insecticides are less likely to be absorbed through the skin in the dry form.
- Dusts also produce fewer odors and do not affect the skin and don't cause any irritation for animals as much as sprays.
- Dusts must be rubbed thoroughly into the hair and can be applied by means of a shaker or with a "hand-operated puff duster"
- Application should be started above the eyes and all the areas backward to the tail and haunches should be covered, ensuring thorough treatment around the ears and underneath the forelegs. However, they must not be allowed to get into the eyes, nostrils and mouths of animals.
- Heavy application on abdomen should be avoided.
- Carbaryl and Malathion should not be used on kittens and puppies under four weeks of age.
- Pets can be provided with plastic flea-collars impregnated with an insecticide.
- Flea collars are effective for 3–5 months, whereas other treatments give only short-term control.
- The use of lufenuron tablets is also highly recommended to control fleas in cats and dogs. The tablets are administered once monthly at a dose of 30mg per kg of body weight for cats and 10 mg per kg of body weight for dogs and are safe for use in pregnant and nursing animals.
- Lufenuron is taken up by the female flea during feeding and acts by inhibiting egg development.

**6.4). Other simple hygienic measures**

When people enter an infested house that has been vacant for some time, large numbers of newly emerged fleas may attack. Fleas and their eggs, larvae and cocoons can be effectively controlled through;

- Keeping houses well swept.
- Treatment of floors with detergents, insecticides or a solution of naphthalene in benzene is highly recommended. However, care should be taken to avoid inhaling benzene fumes.
- Removal with a vacuum cleaner is also effective.

**7.0). Ticks**

Ticks are well known bloodsucking external parasites of humans, pets, livestock, and are second only to mosquitoes in terms of public health importance. Both hard and soft ticks are vectors of a wide variety of disease-causing organisms to animals and human. Hard ticks can feed on human body from a few hours up to many days while soft tick feed for only few minutes. Hard tick can transmit diseases as soon as their bodies become full with blood meal while soft ticks do not take over a minute to start transmitting diseases. Some of the common diseases transmitted by ticks among humans include: Crimean Congo Haemorrhagic Fever, Tick typhus, Tick paralysis, Lyme disease, Q fever, Rocky Mountain spotted fever, rash illness, and tick-borne relapsing fever. Allergic reactions are the most serious medical condition associated with ticks bite.



### **7.1). Prevention against Tick Bites**

Prevention of ticks includes both chemical and non-chemical measures and to decrease risk of tick bite and associated infection, following instructions must be adopted;

#### **7.1.1) Chemical Control**

It includes spraying and dust application of residual insecticides in houses and other resting places for animals. In case of heavy tick infestation, use of insecticides (spraying and dusting) should be given top most priority and operation should be done during the months of August-September

##### **7.1.1.1). Insecticides**

- Spray residual insecticides on floor (also lower areas of walls) of houses, porches, verandas, animal sheds and other places where domestic animals rest or sleep.
- House infested with soft ticks, can be sprayed with ***lindane*** (0.2g/m<sup>2</sup>), deltamethrin (10-20mg/m<sup>2</sup>) and details of other insecticides has been given at table 2.
- For better control of hiding ticks, inject insecticides in cracks and crevices by using syringe (*Spot Treatment*).
- Powder formulation of insecticides (preferably Pyrethroids) can be dusted on cracks and crevices in wall, floor, in furniture (*Spot Treatment*).
- In case of heavy infestation, animals shed must be sprayed at the interval of 4-5 weeks.
- 2 applications of acaricides and weedicides per season directly on/in their natural habitats like grasses and other vegetation close to animal shed will be adequate to control ticks in and around houses.

##### **7.1.2). Personal Protection**

The best way of protection against tick-borne illness is to avoid tick bites. This includes avoiding the known tick- infested areas. However, in case of visiting such areas, following instructions must be followed to decrease risk of tick bite and subsequent infection;

###### **7.1.2.1). Repellents**

- The repellents such as PICARIDIN/ICARIDINE, DEET are only highly recommended and should be applied particularly to lower exposed body parts (foot, ankle etc.,) and arm and face generally.
- Consult guidelines for effective use of repellents given in section 2.3.1.

7.1.2.2). *Protecting cloths*

- Wear protective clothing such as long-sleeved shirts, long trousers, boots or sturdy shoes and a head covering.
- Wear light-colored clothing as ticks can easily detect on such colors.
- Tuck trouser cuffs in socks and shirt in pant.
- Use long gloves and shows while treating CCHF patients.

7.1.2.3). *Cloth treatment*

- Cloth treatment with *Permethrin* is one of the most feasible and effective interventions in highly infested areas with ticks during peak breeding season (section 2.3.3)

7.1.2.4). *Insecticides Treated Bednets (ITNs/LLINs)*

- Uses of LLINs particularly in areas of high infestation can also a give good relief.

**7.1.3). Insecticides application (spraying, dusting) on domestic animals**

- Apply insecticides (acaricides) directly to bodies of domestic animals by spraying, dusting to protect livestock against ticks without injuring animals.
- Acaricides, including arsenical, chlorinated hydrocarbons, organophosphates, Carbamates and synthetic pyrethroids should be used for controlling ticks on livestock.
- Pyrethroids *powder formulation* should be applied directly by means of puff-duster or plunger-type duster.
- Pyrethroids *Liquid formulation* should be applied with hand-compression sprayer
- Liquid or powder formulations must not be allowed to get into the eyes, nostrils and mouths of animals.
- Heavy applications to abdominal area should be avoided.
- It is particularly important to treat the back, neck, belly, and back of the head.

**7.1.4). Non-Chemical**

It includes both physical and cultural control measures (Environmental Management).

**7.1.4.1). Vegetation management (Cultural)**

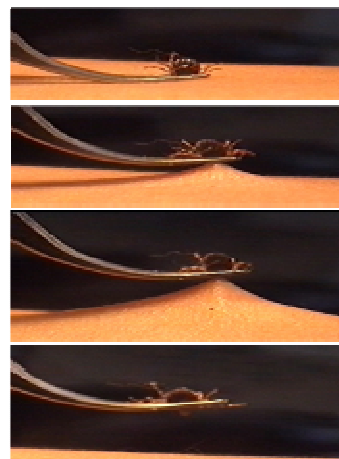
- Ticks can be control very effectively by removal/destruction of their natural habitats through cutting, mowing grasses and weeds around the houses.

**7.1.5). Removal of ticks from skin (Physical)**

Ticks can wander on the body for 1-2 hours before attaching. Most ticks (hard one) seldom attach quickly and rarely transmit disease organisms before 4-5 hours. Children and pets should be examined very carefully for ticks after visiting infested bushland areas. If a tick is found attached, following precaution should take into account for removal;

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

- Never attempt to place any chemical such as *methylated* spirits onto the tick, nor should it be touched or disturbed, as the tick may inject saliva into the skin, which could make the situation worse.
- Do not burn the tick with a match.
- Do not use *bare hands* to remove the tick because tick secretions may carry disease.
- Tick should be sprayed with an **aerosol** insect repellent preferably containing pyrethrin or a pyrethroid, if such repellent is not available, then any scabies cream (Lyclear) containing permethrin can be used.
- The best way to remove a tick is to grasp it firmly with tweezers as close to the skin as possible and gently, but firmly, pull it straight out. Do not twist or jerk the tick.
- If tweezers are not available, grasp the tick with a piece of tissue or cloth or whatever can be used as a barrier between fingers and tick.
- Spraying of “hydrocarbons and pyrethrin” in combination (preferably) or individually will act as a narcotic and a toxicant, and prevents the tick from injecting its saliva.
- Tick should be sprayed again 2-3 minute later (or dabbed with the Lyclear) and left it. After few hours it should drop off naturally or be gently removed with fine-tipped forceps.
- The bite area and hands should be wash thoroughly with soap and water and apply an antiseptic to the bite site.
- After visiting tick infested area, if there is unexplained illness with fever, contact a physician immediately and inform him/her about travel history to areas where tick-borne diseases are common.



### 7.1.6). Prevention and control of ticks around homes

Since ticks are sensitive to dry conditions and do not thrive in short vegetation therefore;

- Remove all items that attract rodents which may carry ticks, such as spilled birdseed, and hiding places like old wood piles.
- Destroy rodents borrows if any found around home.
- Remove all extra grasses and weeds around home.
- Acaricides and weedicides 2 applications per season will be adequate to control ticks in around houses.

### 7.1.7). Other simple hygienic measures

#### 7.1.7.1) At home/community level

- Remove the occasional tick found indoors by vacuuming, seal the vacuum bag and dispose off or destroy it properly.
- Cloths must be examined after visit of infested area.
- In case of visiting infested area, immediately remove all clothing on returning and placed into a hot dryer for 20 minutes, which will kill any ticks that may still be on the clothing.
- If ticks are crawling on the outside of clothes, they can be removed with forceps or by other methods.

- While walking in infested outdoor areas, walk in the center of trails so weeds do not brush against you.
- In camping or infested areas, don't sit on ground so that leaf litter on the forest floor may not disturb to encounter ticks.

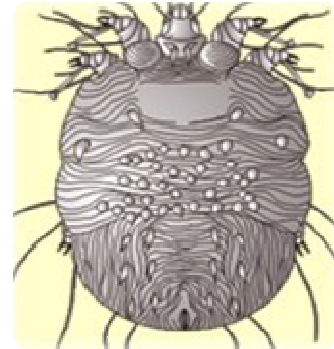
#### **7.1.7.2) Prevention of CCHF transmission at Healthcare Facility Level**

Apply standard precautions for all patients all times. Avoid unprotected exposure to blood, body fluids, mucous membranes, and non-intact skin. When patients with CCHF are admitted to hospital, to avoid the risk of nosocomial spread of infection health care providers must follow these instructions;

- Patients with suspected or confirmed CCHF should be kept in "*Isolated Ward*" and cared for using protective infection control measures as per the standard precautions.
- Only designated medical/paramedical staff and attendants should attend the patients after wearing the required PPE according to expected exposure risk as follows;
  - If you expect exposure to blood, body fluid, mucous membranes, or non-intact skin use disposable gloves, and gowns.
  - If you expect splashes of patient's blood or body fluids to the face and body, wear gloves, gowns, and use face protection (face shield, or mask and goggles)
- PPE should be removed safely and disposed immediately after the medical procedure.
- Specimens of blood or tissues taken for diagnostic purposes should be collected and handled using standard precautions.
- Maximum care should be adopted to avoid the spill, pricks, injury and accidents during patient handling. All instruments should be de-contaminated and reprocessed before re-use.
- Contaminated needles and sharps should be disposed of immediately after use in puncture proof, sharp boxes. All waste contaminated with blood or body fluids should be considered bio-hazardous wastes and should be handled, disposed, safely.
- All linen and hospital clothings used by patients must be collected, handled, and transported safely. HCWs should wear proper PPEs to prevent exposure to contaminated linen and sheets. Linen should be transported in leak-proof bags to avoid contamination of the environment. Linen can be washed in the hospital laundry as per the hospital policy.
- All surfaces should be de-contaminated with liquid bleach, Use concentration of (1 bleach: 99 water) of 5% chlorine bleach for environmental decontamination of the surfaces and floors. Use concentration of (1 bleach: 4 water) for decontamination of blood and body fluid spills. Prepare bleach solution fresh daily and keep it in tight dark container.
- In case of death of CCHF patients, family should be advised for safe burial practices. Precautions should be taken to prevent exposure to blood, body fluids, and non intact skin.
- All healthcare workers who exposed to potential CCHF infective source should report exposure to the hospital administration. Blood sample should be sent to the NIH for testing. For high risk exposures (needle stick, sharp injuries, contact of patient's blood with HCW's mucous membrane or non-intact skin, or gross splash of blood or body fluids to HCW's body) Ribavirin should be started immediately. Cases of low risk exposure (e.g. contact with patient environment) should be followed up by body temperature and CBC for 14 days. If any case starts to show low platelet and/or WBCs counts, Ribavirin and treatment measures should be started immediately.

## **8.0). Mites**

Scabies is a contagious ecto-parasitic curable skin infection caused by the mite *Sarcoptes scabiei*. Scabies is highly contagious and can be spread by scratching, picking up the mites under the fingernails and simply touching another person's skin. They can also be spread onto other objects like keyboards, toilets, clothing, towels, bedding, furniture, and anything else onto which the mite may be rubbed off, especially if a person is heavily infested. The characteristic symptoms of scabies infection include superficial burrows, intense itching, a generalized rash and secondary infection. Acropustulosis, or blisters and pustules on the palms and soles of the feet, are characteristic symptoms of scabies in infants. Symptoms usually occur within 4-6 weeks after infection. Secondary infection may occur due to continued, aggressive scratching. More severe forms of scabies include crusted scabies and Norwegian scabies.



### **8.1). Preventive measures against mites**

The only way to prevent infestation with scabies is to avoid direct contact with infected people and other objects (bed linens, clothing and furnitures etc). To avoid the spread of scabies, the personal protective measures should be applied at early stage of infestation and following good hygiene practice/techniques must be adopted;

#### **8.1.1). Practice good hygiene**

- Keep all surroundings neat and clean at all times as the parasites usually evolve in unhealthy and unhygienic situations.
- A patient must take bath daily using separate medicated soap (containing 3% acid salicylic and 10% sulphur), and towel etc.
- A patient must use a separate bed, bed linen,
- Physical contact with any infected person and its belongings should be avoided strictly.
- Fingernails and toenails should be clipped and apply scabicides under nails. It will further prevent the secondary infection.
- Health care workers should wear gloves and gowns when making contact with people suspected to have scabies.
- Sharing of personal items such as clothing, towels, and bedding etc should be avoided.
- Vacuuming upholstery and carpets is an important step in stopping the spread of scabies. Vacuum cleaner contents should be discarded properly.
- Safe sex techniques and limiting sexual relationships to one partner can prevent getting scabies. Condoms generally do not prevent the disease, so make sure that partner is not infected before having sexual intercourse with him/her.
- Household pets must be bathed at least two times in a week.

#### **8.1.2). Washing clothes and linens in hot water**

- Wash bed sheets and clothing of patients or suspected person in hot water at temperature  $>120^{\circ}\text{F}$  after soaking for at least 30 minutes in same water.
- Washing below this temperature will not sufficiently kill the parasite.

- Washing with hot water should be repeated weekly, to guard against potential parasites that could be living in around material.
- Alternatively, permethrin sprays can be used for items that cannot be laundered.
- Non-washable blankets, cushions, and other articles can also be placed in plastic bags for at least 7 days to control infestation.
- Dry cleaning the clothings or tumbling in a hot dryer at high heat (>130°F) for at least 20 minutes will give better results than washing in hot water.
- Ironing the cloths at high temperature will also be further helpful to kill mites or its eggs and larvae.

### **8.1.3). Removal of vegetation**

The control of mites by killing them in their natural habitats is very difficult because of patchy distribution of their population. However, following steps are highly recommended in the vicinity of refugee camps (displaced population etc) and houses close to vegetation;

- First identify the patch of vegetation that harbors large number of larval mites (Mite Island).
- Destroy this patch by burning, cutting and then to scrape plough the top soil.
- Mowing grass or weeds in such areas is also very effective.

## **8.2). Use of Chemicals**

### **8.2.1). Residual spraying on vegetation**

- If the removal of vegetation is not possible, mite islands should be sprayed thoroughly with residual insecticides (acaricides) and operation should be repeated after 15 days for at least 1 month.

### **8.2.2). Fogging**

- In case of heavy infestation, insecticides should be applied as fog with “Ultra-Low-Volume spray equipments.
- Most effective insecticides are diazinan, fenthion, malathion, deltamethrin, propoxure, gokilaht, and permethrin (table 2).

## **8.3). Personal protection**

### **8.3.1). *Repellents***

- It is a most effective measure to prevent mite bites and can be applied on skin and cloths.
- Picaridin/Icaradine and DEET are highly recommended.
- Benzyl benzoate, dimethyl phthalate, dimethyl carbamate and ethyl hexanediol can also be recommended, but not effective more than 2-3 hours.

### **8.3.2). *Cloth Treatment***

- Cloths treated with one or a combination of above mentioned repellents particularly DEET, Picaridin/Icaradine and dimethyl phthalate or with pyrethroids insecticides (Permethrin) will provide long lasting protection against mites even up to 3-4 washes.

#### **8.4). Skin treatment**

Permethrin is a synthetic chemical that has a broad spectrum of insecticidal activity. Permethrin in form of cream is recommended to treat skin infections with mites (scabies) or crab lice. For better results of use of permethrin, following precautions should be adopted;

- This preparation is for external use only.
- Permethrin cream should be applied to entire body from the neck to down.
- Avoid contact with eyes, mouth or nasal opening.
- Rubber gloves must be worn by health workers during giving repeated applications or treating large numbers of individuals e.g. clinic nurses.
- Body should be washed 8-12 hours after application of permethrin.
- It should be reapplied if they are washed with soap and water before the treatment period is complete.
- It should be applied to cool, dry skin. If applying after a warm bath, wait for skin to cool first.
- If someone feels an allergic reaction after application, it should be stopped and should be consulted with doctor or pharmacist immediately.

#### **9.0). Cockroaches**

Cockroaches are very common pest in homes, restaurants, hospitals, warehouses, offices, and in food preparation or storage areas. Cockroaches are nocturnal and remain hiding in dark, warm areas, especially narrow spaces. They are rapid breeders, so just a couple of roaches can turn into huge numbers in just a few weeks particularly during and after monsoon. Cockroaches tend to congregate in corners and generally travel along the edges of walls or other surfaces. People are repulsed when they find cockroaches in their homes and kitchens.



Cockroaches contaminate food and eating utensils, destroy fabric and paper products, and impart stains and unpleasant odors to surfaces they contact. Some cockroaches (American cockroach) can transmit bacteria that cause food poisoning (*Salmonella* spp. and *Shigella* spp.). German cockroaches transmit disease-causing organisms such as *Staphylococcus* spp., *Streptococcus* spp., hepatitis virus, and coliform bacteria. They also have been implicated in the spread of typhoid and diarrhea, dysentery, leprosy, plague. Indoor infestations of roaches are an important source of allergens and risk for asthma among some populations. The organisms causing these diseases are carried on the legs and bodies of cockroaches, and are deposited on food and utensils as roaches feed and move about.

#### **9.1). Prevention of cockroaches**

Cockroaches are difficult to control with insecticides and use of chemical alone will give temporary relief. For effective and long lasting control of roaches, it should be combined with environmental sanitation and house improvement practices that includes the reduction of food and water source and hiding places that limit the cockroach's ability to establish or reinvade. Integrated Vector Management approach (IVM) for cockroaches control includes;

##### **9.1.1). Chemical control**

Chemical control of roaches includes Residual Insecticides spray, Dusting of powder insecticides and use of poisonous baits and traps

**9.1.1.1). Residual Insecticides Spray**

- Residual Insecticides spray preferably Pyrethroids is less effective than application of dust formulation of insecticides. However, preferred area to be treated with residual spray includes kitchen, galleries, behind along skirting-boards, in and around sinks, in or under cupboards, under furnitures, utility cabins, under loose floor coverings, food preparation areas, ducts, pipes, sewerage mainholes.
- Food storage areas in restaurants and warehouses and other commercial establishment should be sprayed.
- Treatment should be repeated at the interval of 2-3 weeks. However, the areas where children may come in contact with insecticides treatment should be avoided.

**9.1.1.2). Dusts formulation**

- Dry powder formulation (mixture of insecticides & talcum or other inert martial) is one of the most effective tools for roach control particularly when applied in enclosed.
- Powder formulation of insecticides should be applied with hand operated puff-type applicator.
- Preferred areas for treatments should be hallow walls, false ceilings, crack and crevices, under the sink, in the dead space between the sink and wall, and around utility pipes and other hiding places of roaches.
- Don't apply heavy dust deposit as it may repel roaches to some other inaccessible areas.
- Also treat along the back edges and in corners of shelves in cabinets, cupboards, pantries, and closets.
- Dust should not be applied on wet surfaces as it will lose its effectiveness.
- Boric acid is most common and effective powder and should be used preventively or when treating existing infestations.
- For long lasting control, Boric acid powder should be remains dry and undisturbed.
- Because of its toxicity to plants, boric acid is not recommended for outdoor use.

**9.1.1.3). Baits**

Baits (mechanical or a sticky ones) work on the principal of attracting roaches to a specific point and then trapping or killing them there. Bait is a mixture of insecticides and attractive food of cockroaches which remain effective for many months. To make bait more effective, following precautions should be adopted;

- There should be no food in close vicinity to compete with bait.
- For long-term control of roaches baits and traps should be places at sites frequently visited by roaches (Utensil shelves in kitchen, cabinets, behind/under cupboards etc).
- In case of heavy infestation after monsoon, baits should be replaced frequently (biweekly basis).
- For cracks and crevices treatments, gel baits can be very effective which should be applied through a bait gun or syringe.
- Bait should not be placed in area where insecticides spray or dust application has already been done.

Following are commercially available very effective baits for cockroach control;

## **GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN**

<b>Active ingredient (a.i.)</b>	<b>Brand name</b>	<b>Form</b>
abamectin	Avert	gel, powder
boric acid	Niban	granules
	Stapleton's magnetic Roach Food	paste
fipronil	Maxforce	bait station, gel
hydramethylnon	Combat	bait station, gel
	Siege	gel
indoxacarb	HotShot Maxattrax Ultra Brand Nest Destroyer Roach Bait	pellets

### **9.1.1.4). Traps**

- Use of traps (glass jar putting in petroleum jelly and some food like bread, raisin etc) is also very effective for roach control.
- Traps should also be placed at most frequently visited sites of roaches.
- Traps should not be placed at sites where insecticides have been applied.

### **9.1.1.5). Aerosols spray**

- This will provide a quick but temporary knockdown of cockroaches as mostly they will disperse to other areas of the building from which they may return later.
- Only effective when directly hit cockroach.

For better results, aerosol spray should be done;

- At night when cockroaches are most active
- Apply very quickly so that cockroach cannot be escaped
- Repeat the treatment on every 3<sup>rd</sup> or 4<sup>th</sup> day after initial treatment during September to November (post monsoon season).

### **9.1.2). Environmental sanitation/management that includes;**

- Source reduction (food and water).
- Eliminate hiding places.
- House improvement practices. (Good hygiene practices)

### **9.1.3). Sanitation**

This is one of the best and effective strategies against roaches. Important sanitation measures include;

- Food should be stored in insect-proof containers such as glass jars or re-sealable plastic containers, screened cabinets, or refrigerators.
- Keep all areas cleaned so that no fragment of food or organic matter remains as food of roaches.
- Rubbish should be securely covered and emptied frequently, preferably daily.
- Basement and areas underneath should be kept dry and free of accessible food and water.
- Garbage and trash should be kept in containers with tight-fitting lids.

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

- Remove trash, newspapers, magazines, piles of paper bags, rags, boxes, and other items that provide hiding places and harborage.
- Eliminate plumbing leaks and correct other sources of free moisture.
- Vacuum cracks and crevices to remove food and debris. Be sure surfaces where food or beverages have been spilled are cleaned up immediately.
- Vacuuming also removes cockroaches which reduces their numbers significantly and vacuumed cockroaches and debris should be destroyed carefully.

### 9.1.4). Destruction of hiding places

- Destroy all possible hiding places in and around houses which includes around water heaters, in cupboard cracks, stoves, crawl spaces, outdoor vegetation, and many other dark locations.
- Thick vegetation is perfect outdoor resting place of roaches. Remove overgrown or growing large mounds of grass very near home wall will help control roaches.

### 9.1.5). Limit access

- Groceries, egg crates, boxes, furnitures should be checked before bring into the house.
- Locate and seal cracks inside the treatment area where cockroaches can hide.
- Inspect food deliveries before putting them in kitchens.
- Use of yellow light bulbs called bug-lights in kitchen can also reduce the number of insects, including cockroaches.
- Apply a band of petroleum gel at least 10 cm wide around the dry drain hole to prevent entry from sewerage system.
- Install wire mesh of 2mm at drain hole to prevent the entry of American cockroaches to home and kitchen.
- Apply the dust form of insecticides along the wall near door of kitchen, bathrooms.

## 10.0). Houseflies

Houseflies are one of the most important public health pests which live in close association with people all over the world and feed on all kinds of human food, garbage and excreta, including animal dung. Water is an essential component of a fly's diet and flies cannot normally live more than 48 hours without access to it. Other common sources of food are milk, sugar, blood, meat broth and many other materials found in human settlements. Flies evidently need to feed at least 2 to 3 times in a day. Female flies deposit their eggs on decayed, fermenting or rotting organic material of either animal or vegetable origin. Heaps of accumulated animal faeces, cargage, sewage sludge and solid organic waste in open drains, cesspool and cesspits are most important breeding sites for houseflies. During daytime when not actively feeding, flies may be found resting on floor, walls, ceiling, and other interior surfaces as well as outdoor on the ground, fences, walls, steps, simple pit laterine, and garbage cans etc. These resting places are generally near favoured daytime feeding and breeding areas and sheltered from the wind. Flies can pick up and transport various disease-causing agents including diarrhoeal diseases and skin and eye infections. Those that stick to outer surfaces of fly may survive for few hours, but those that are ingested with the food may survive in fly's crop or gut for several days. Transmission take place when the fly makes contact with people or food. The diseases that flies can transmitt includes enteric infections (such as dysentery, diarrhoea, typhoid, cholera and certain helminths infeaction), eye



infections (such as trachoma, and epidemic conjunctivitis), poliomyelitis and certain skin infection (such as yaws, cutaneous diphtheria, some mycoses and leprosy).

### **10.1). Prevention against houseflies**

Flies can be killed directly by chemical or insecticides or physical means such as traps, sticky tapes, fly swats and electrocutting grids. However, they should ideally be controlled by improving environmental sanitation and hygiene. This approach provides long-lasting results, and is more cost-effective and usually has other benefits.

#### **10.1.1). Chemical methods**

The application of effective insecticides can temporarily lead to very quick control, which is essential during outbreaks of cholera, dysentery or trachoma particularly after monsoon. However, control with insecticides should be undertaken only for a *short period* when absolutely necessary because flies develop resistance very rapidly.

##### **10.1.1.1). Spraying of resting sites with residual insecticides**

This method gives immediate control of flies ranging from several days to few weeks.

- Only the surfaces that have been observed as *resting sites* should be thoroughly sprayed.
- On farms or in house having livestock inside, the residual spraying should mainly be focused in animals units/sheds.
- Porches, verandas should always given top most priority to residual insecticides spraying.
- Application are made with hand-operated sprayers or power generated sprayers (mainly in camps). However operation should be carried out at low power to avoid the insecticides particles drifting away.
- Consult guidelines for residual spraying given in section 2.1.1.

##### **10.1.1.2). Space Spraying**

- Flies can quickly be knowed down and killed by mists or aerosols of insecticides solutuions or emulsions.
- This treatmnt should be carried out by spraying with pressurized aerosol spray cans, hand operated sprayers, or small portable powered-operated sprayers.
- For best results, it should carried out at small scale or house level where the space can be filled with particles of insecticides that can be picked up by insects whey they fly.

##### **10.1.1.2a). Indoor space treatment**

- In animal sheds, space spraying should mainly be used to supplement to residuual treatment or toxic baits, but on farms where latter treatment fail, frequent space-spraying should be top most priority intervention.
- Treament should be done when as many as possible flies are indoor e.g. in the evening.

##### **10.1.1.2b). Outdoor space treatment**

- Such treatments should be carried out on *refuse dumps* where adequate cover by soil is not possible like recreational areas, markets, food industries, or for areas control in cities and towns, espicially in emergencies.

- In case of heavy infestation particularly in camps or shelter homes, space spraying with hand-carrying thermal fogger will give rapid control of flies (consult section 2.5).
- Operation should be carried out when flies densities are at peak e.g. in the morning/evening.
- Operation should be repeated on alternate days for at least 2 weeks to reduce the densities significantly. After it, treatment should be repeated at longer intervals i.e. 1-2 weeks depending upon densities.

#### **10.1.1.3). Treatment of breeding sites**

- Chemical application on breeding sites like dung garbage will give a significant control of flies.
- Since the dung is continuously accumulating and changing, therefore larvicides should be applied frequently.
- Larvicides can be applied with a watering can or a sprayer as emulsions, suspension or solutions. The dosage should be sufficient to wet the upper 10-15 cm of the substrate i.e. 0.5-5 liters/m<sup>2</sup>.
- In case of heavy infestation (after rainy season or in refugees camps), application of dust formulation to garbage, heaps of animal dung, etc should also be a top most priority intervention for significant flies control.
- Simple dusting of Calcium carbonate (*Chunna*) on such sites can be effective if insecticides is not available.

#### **10.1.1.4). Insecticides vaporizer**

- At household level, Insecticides vaporizers such as strip of absorbent material impregnated with dichlorvos, dimethoate, and trichlorfon should be used.
- However, these vaporizers should only be used for small places with little ventilation.
- These vaporizers should not be used in rooms where infants or old people are sleeping.

#### **10.1.1.5). Introduction of toxic materials to resting sites.**

- Introduction of materials that has been impregnated with insecticides at resting sites of flies such as edges, strips, wires, strings, and ceilings etc., can give a significant control of flies for several weeks.
- Commonly used toxic materials should be curtains, bednets, cotton cords, cloth or gauze bands, and strong paper strips which are cheaper, long lasting and less likely to provoke insecticides resistance than residual spraying.
- Insecticides for treatment of material should preferable be diazinon, fenchlorphos, malathion, fenthion, trichlorfon; carbamate such as propoxure and pyrethroids such as cypermethrin, deltamethrin, permethrin, and cyfluthrin (table 2).
- Recommended concentration of solution is 1-10% for organophosphates and carbamate insecticides.
- Higher concentration (>15%) should be avoided as they will repel or irritate flies to rest on treated sites.

- Treated materials should be suspended under ceilings or other fly infested place.
- Vertical parts or loops are more attractive than horizontal ones.
- Materials with red or black colors should be preferred for treatment and yellow color material should be avoided.
- Strips may be used in animal sheds, poultry farms, markets, restaurants, shops, or any other fly infested areas.

**10.1.1.6). Introduction of toxic baits.**

- Use of traditional toxic baits having sugar and water or other fly-attracting liquids containing strong poisons such as *Sodium arsenite* should be used which effectively reduce the densities of flies.
- However, toxic baits using organophosphate or carbamate insecticides should be preferred due to their high toxicity to flies but relatively safer to human and other mammals.
- Baits should be used at place where there is high densities of flies.
- Baits should not be used in areas/places where insecticide (spraying or dusting) has already been applied.

10.1.1.8). Types of baits

10.1.1.8a). Dry scatter baits

- These contain 1-2% insecticides in a carrier, which may be plain granular sugar or sugar plus sand, ground corncomb, etc.
- Dry baits should be scattered in thin layer of 8-12 gms per 10 m<sup>2</sup> of resting places.

10.1.1.8b). Liquid sprinkle baits

- These contain 0.1-0.2% insecticides and sugar and other sweetening agents (i.e. 10%) in water.
- Liquid can be applied by sprinkling cane on floor in places where there is no children or animals, as well as to other horizontal or vertical surface but out of reach of children.

10.1.1.8c). Viscous paint-on bait

- These composed of insecticides (2-6%), a binder and sugar to form a paint that can be applied to walls, posts, window areas or ceilings, or to strips, plates etc, which can be suspended or otherwise fastened at places of concentration of flies.
- Baits will stick to the surface and remain effective for months.
- It will kill flies by both contacting with on surface or by feeding on the bait.
- Trichlorfon is highly recommended insecticides for such type of bait.

## **11.0). Human lice**

Lice are small blood sucking insects that live on skin of mammals and bird. There are 3 species which found on human body viz., head louse, body louse, and pubic louse. They are found in colder areas where people don't wash or change cloths frequently and most commonly found on people living in over-crowded, unhygienic conditions like refugee camps, and shelter homes etc. Lice feed several times in a day and heavy infestation cause intense irritation and severe itching. Out of three species of human lice, only body lice can transmit diseases like typhus fever, relapsing fever, and trench fever. An outbreak of louse-borne typhus fever sometimes claim the lives of 20-40% untreated cases in colder areas where people live in poor, crowded conditions and generally wear heavy cloths. No disease is carried by head lice but they are extremely irritating to the person suffering from it. The lice run around on the scalp and cause continual itching which is problematic and distracting. Body louse are commonly found in clothings, especially where it is in direct contact with body, as in underwear, fork of trousers, armpits, waistline, collar and shoulders. They attached themselves to body when they feeding. Head louse are the most common louse species in human, lives only on head hair and are most often found on children. Pubic louse are commonly found on base of hairs in pubic region and heavy infestation may spread to other hairy areas of body.



Lice do not jump or fly from host to host. Both head and body lice are transferred by person to person via direct contact and by certain objects like caps, combs, cloth/bed sheets, etc). Pubic louse are mainly spread through sexual or other close personal contact.

### **11.1). Prevention against lice**

#### **11.1.1). Chemical treatments**

There are a range of headlice treatments containing active insecticides and they should be applied as recommended by the manufacturer. Generally, treatment instructions recommend a second application of pediculicide after 7 days which ensures that any headlice hatching from surviving eggs are killed. Most treatments that are available in world contain one of the insecticides from the groups listed below;

#### **Synthetic pyrethroids-base products** (bioallethrin and permethrins)

- A shampoo, lotion or spray containing 1% permethrin should be applied to the hair, left for 10 minutes then rinsed out *or* a spray containing bioallethrin and piperonyl butoxide should be applied to the hair, left for 30 minutes and then rinsed out with warm water.
- Pyrethroids (permethrin, bio-allethrin) are most recommended insecticides as they don't cause burning sensation of the scalp or any other side-effects associated with other insecticides like lindane.
- A soap formulation containing 1% permethrin can be used as shampoo.

#### **Organophosphate-based products** (Malathion)

- A lotion containing 0.5% malathion should be applied to the hair and washed out after 10-12 hours with any regular hair washing product *or* a shampoo or foam containing 1% Malathion should be applied to the hair and rinsed out after 10-12 minutes and the hair dried without heat.

#### **Pyrethrin-based products**

- A lotion, shampoo or foam containing pyrethrin and piperonyl butoxide should be applied to the hair, left for 10 minutes then rinsed out and the hair dried without heat. It is important to apply the headlice treatment (pediculicide) directly onto the roots of the hair to achieve effective treatment.

**NOTE:** Treatment of children under 2 years old or pregnant or lactating women should only be undertaken after medical advice from doctor.

#### **After treatment procedure**

After each treatment, the effectiveness of the treatment can be checked using the following steps;

- Use a headlice comb on the hair, wiping the comb with a tissue after each sweep
- Repeat until the whole head is combed.
- Examine the lice carefully whether they are dead or alive and active. If the lice are dead, the treatment is effective. Lice may be alive but moving only slightly immediately after treatment, in which case they are badly injured and unlikely to survive.
- *If there are some fully active lice, treatment should be repeated after a week.*

#### **NOTE**

- Only use headlice treatments if live eggs or headlice are present.
- Never use headlice treatments to routinely prevent infestation.
- To prevent unnecessary or repeated exposure to headlice treatment chemicals, the person applying the treatment should wear protective gloves, avoid contact of the treatment with eyes, nose or throat.
- Some headlice treatments contain flammable liquids which should be avoided to ignition sources such as gas heaters, naked flames and lit cigarettes etc.
- Powder formulation is not recommended as they are less effective and acceptable for use than lotions or emulsions.

### **11.1.2). Self-Care at home**

#### **11.1.2a). Head lice**

To prevent and control the spread of head, body and pubic lice, following are steps should be adopted

- Search for head lice when hair is wet by using a fine-toothed comb or a louse comb (comb having space between the teeth 0.3 mm).
- Wet combing should be done every 2-3 days over a two-week period, with small sections of hair. The entire scalp should be inspected, not just the neck region.
- If lice are found, apply the anti-lice agent as mentioned above and rinse hair and comb with a fine-toothed comb.
- Other household members should also be checked and treat only if lice or nits are found.
- Since the use of pyrethrin (pyrethrum) kills only lice not kill nits, therefore it should be reapplied after 7-10 days to kill the newly matured lice. Permethrin kills both nits and newly hatched lice for several days after treatment. However, a repeated treatment is also recommended after 7-10 days for optimum results.



## **GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN**

---

- For children <2 years, anti-lice agents should not be used, only comb to remove lice and nits.
- Hair conditioners may coat or cover the lice, so they should not be used before applying anti-lice agents.
- During routine days, wash all bed linens and clothing in hot water (130-140°F) for at least 10 minutes that have been in contact with the infested person in the past 2 days to kill the lice and nits effectively.
- In case of emergencies or natural disaster when washing is not possible such cloths should be spread in open sunlight for whole day before use at night.
- Clothing and items that are not washable can be dry-cleaned OR sealed in a plastic bag and stored for 2 weeks then opened outdoors. Dry cleaning may be an alternative.
- Do not share combs, brushes, towels clothing such as hats, scarves, sports uniforms, hair ribbons etc., particularly during heavy infestation.
- Disinfect combs and brushes by soaking in a very hot water (greater than 131 °F or 55°C) for 5-10 minutes.
- Avoid head-to-head contact during play and other activities at home, school, and elsewhere
- Shaving the infected person's head is not recommended.
- Do not use fumigant sprays or fogs; they are not necessary to control head lice and can be toxic if inhaled or absorbed through the skin.

### **11.1.2b). *Body lice***

- Wash the body thoroughly daily.
- Wash all bed linens and clothes in hot water as described above.
- Anti-lice agents are usually not needed if clothing is thrown away and bed linens are thoroughly washed.
- Check all household members or close contacts. Treat them only if lice or nits are seen.
- Insecticide sprays in the home are not effective and not recommended.
- Use of antihistamines (such as diphenhydramine, Benadryl) for itching is highly recommended.

### **11.1.2c). *Pubic lice***

- Treat with anti-lice agents and repeat in 7-10 days.
- Remove the pubic hair immediately if lice and nits seen.
- Remove nits with a fine-toothed comb.
- Wash and dry all clothes and bed linens in hot cycles.
- If lice or nits are seen, apply petroleum jelly (Vaseline) twice daily for 8-10 days.
- Use of antihistamines (such as diphenhydramine, Benadryl) for itching is highly recommended.

### **11.1.3) General recommendations**

- Since eggs hatch 5-10 days after *oviposition*, therefore treatment should be repeated after 7-10 days, when all lice have hatched from the eggs.
- Between the two treatments, i.e., days 2–9, the person will still be infested with lice, which hatch from eggs not killed by the anti-lice product. Therefore a third treatment with same products on day 5 should be applied.
- Between treatments, it is advised to wet the hair and comb daily with a louse-comb to remove the hatching lice.
- Anti-lice products must be used according to manufacturers' instruction. During the treatment, it is particularly important to note the starting time and to treat the hair for the exact period specified in the instructions.
- Contact of the product with the eyes of the infested person should be avoided by holding a towel over the face, and eyes should be rinsed well with cold water if the product does get in contact.
- After the treatment and while the hair is still wet after rinsing with water, hair should be combed for 3–4 minutes (depending the length and type of the hair) with a louse comb to remove lice and eggs.
- 1-3 days after last treatment, i.e., days 11, 12 and 13, hair should be checked with a louse comb. If no living lice are found, the treatment was successful, even if nits/eggs are visible on the hair. If living lice are still present, the treatment should be repeated using different product.
- For a treatment with louse comb *alone*, it is recommended to comb hair for 5–10 minutes daily or every 2<sup>nd</sup> day for 14 days. Wetting the hair especially with water and shampoo will facilitate the combing and the removal of lice, eggs and nits.
- Prophylactic treatment with pediculicides is not recommended.

#### **11.1.4) Traditional/Natural prevention of head lice**

- *Mayonnaise and Vinegar*: apply mayonnaise to the hair and scalp and cover the hair with a shower cap or with cloth (preferably with linen) for at least 4-5 hours and finally wash hair with vinegar. Repeat this process after 7-10 days to make sure the lice have disappeared completely.
- *Lime Juice and Garlic Paste*: mix 1 teaspoon of both lime juice and garlic paste, apply it to the scalp and wash hair after 30 minutes. Repeat this process after 7-10 days to make sure the lice have disappeared completely.
- *Basil (niaz boo) and neem leaves*: this serve as excellent remedy. The leaves can be crushed to form a paste and then apply on the scalp for 30 minutes. Basil and neem leaves can either be used separately or collectively.
- *Vinegar and water*: apply vinegar and water in a ratio of 1:2 to the scalp and wait for 10 minutes and then comb the hair thoroughly with a nit comb to remove head lice. Continue this therapy twice a week for a month.
- *Neem & coconut oil*: In a glass bottle keep 3-4 leaves of the neem in about 100 ml of coconut oil. Keep the bottle covered so that the essences of the neem leaves get properly exuded in the coconut oil. Apply this oil on the scalp regularly and then comb the hair with a strong comb.

- *Baby oil and vinegar*: rub a solution of baby oil and vinegar in equal proportions on the scalp and apply on hair thoroughly. Cover the head for 1 hour and then wash with normal shampoo (for children).
- *Apple*: chop an apple into small pieces and apply them into the scalp with a strong massaging action for about 20 minutes. Continue this practice once in a day for 3 days.
- *Other traditional remedies*:
  - Grind the seed of a *shareefa* and apply it on the scalp for 1-2 hours. Then wash the scalp with ordinary shampoo.
  - Mix 20 drops of Eucalyptus essential oil, 20 drops of tea tree oil, 10 drops aniseed essential oil, 10 drops lemon oil in about 75 ml olive oil. Apply it to hair and leave it for an hour.
  - Mix 10-15 drops of tea tree oil into a bottle of normal shampoo and shampoo the hair.
  - Mix neem leaves, basil leaves (*niaz boo*) and 8-10 cloves and grind to make a thick paste and apply for 20 minutes.
  - Massage the scalp with onion juice for about 1 hour and finally wash the hair. Follow this treatment for at least 3 days.
  - Rub Listerine Antiseptic Mouthwash which contains essential oils such as eucalyptol, thymol, menthol, methyl salicylate and alcohol, which may kill lice.
  - Apply paste of bitter almonds on the scalp for 15 minutes.
  - Apply the fumes of peel of citrus fruit (bitter lemon, orange) on the base of hair and wash hair after 1 hour, repeat the treatment for 3 days. This is one of the best remedies for head louse problem.

## **11.0). References**

1. Kaker, F. 2004. Presentation at WHO Inter-Country Meeting on Emerging Infectious Diseases, Beirut, 6-8 April 2004.
2. Rozendaal. J. A. 1999. Vector Control methods for use by individuals and communities. WHO. ISBN-92-4-154494
3. Athar MN, Baqai HZ, Ahmed M, Khalid MA, Bashir N, Ahmed AM, Balouch AH, Bashir K, 2003. Short Report: Crimean Congo Haemorrhagic Fever outbreak in Rawalpindi, Pakistan. Am. J. Trop. Med. Hyg. 69(3): 284-287.
4. Dengue outbreak in Karachi 2006. Directorate of Malaria Control. Ministry of Health.
5. Dengue outbreak in Haripur-NWFP 2009. Directorate of Malaria Control. Ministry of Health.

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

---

6. Dengue outbreak in Islamabad: An entomological field investigation. 2009. Directorate of Malaria Control. Ministry of Health.
7. An Epidemic of dengue fever in Karachi. Associated Clinical Manifestation: Jahibeh A. Qureshi, Nasreen J. Notta, Naseem Salahudin, Viqar Zaman. *J. Pak. Med Ass*: 47(7): 14-17.
8. Disease surveillance and outbreak prevention and control of dengue [www.who.int/eme/disease/ebola/Denguepublication/060-66.pdf](http://www.who.int/eme/disease/ebola/Denguepublication/060-66.pdf)
9. Tayeh A, Jalouk L, Al-Khiami AM, A cutaneous leishmaniasis control trail using pyrethroid-impregnated bednets in village near Aleppo, Syria. *WHO/Leish/97.41*. 1997.
10. Reyburn H, 2002. A guide to the treatment of cutaneous leishmaniasis in Afghanistan and Pakistan. *Health Net Int*. Peshawer.
11. Dogra J. 1992. Cutaneous leishmaniasis in India: evaluation of oral drugs. *Europ. J. Dermatol.* 2:568-569.
12. Guidelines for treatment and prevention of cutaneous leishmaniasis in Pakistan. WHO & MoH-Pakistan. 2002.
13. Health Management and Information System 2006 and 2008. National Health Information Resource Unit. Ministry of Health. Government of Pakistan.
14. Malaria in Pakistan. 2008. Director General (Health) Report. Ministry of Health-Pakistan. 2008.
15. Re-emergence of malaria in India. *Indian J. Med. Res.* 1996. 103:26-45.
16. Woods ME, Monteneri JA, Eisen RJ, Zeidner NS, Borchert JN, Laudisoit A, Babi N, Atiku LA, Ensore RE, Gage KL. 2009. Identification of flea blood meals using multiplexed real-time PCR targeting mitochondrial gene fragments. *Am. J. Trop. Med. Hyg.* 80(6):998-1003. PMID 19478256
17. Rozendaal JA. 1999. Vector control methods for use by individuals and community. WHO 1999.
18. Community management of endemic scabies in remote Aboriginal communities of Northern Australia: Low treatment up-take and high on going acquisition. Sophie LV, Kearne T, Cornnos K, Cameron S, Capatis J. 3(5):444. 2009.
19. Lawrence G, Leafasia J, Sheridan J, Hills S, Wate J, Wate C, Montgomery J, Pandeya N, Purdei D. *Bull World Health Orgn.* 2005. Control of scabies, skin sores and haematuria in children in Solomon Island: another role for ivermectin. 83(1): 34-42.
20. Johnston G, Sladden M, 2005. Scabies diagnosis and treatment. 17; 331(7517): 619-622.
21. . Karthikeyan. 2005. Treatment of scabies: newer perspectives. *J. Med.* 81(951):7-11.
22. National guidelines for control of dengue vector in Pakistan 2008; Directorate of Malaria Control
23. National guidelines for malaria vector control during monsoon in Pakistan 2009; Directorate of Malaria Control.
24. Guidelines for planning and implementation of malaria vector control at district level. 2007. Directorate of Malaria Control.
25. Chemical methods for the control of vectors and pests of public health importance. WHO/CTD/WHOPES/97.2.
26. List of WHOPES-Recommended LLINs <http://www.who.int/whopes/recommendations/wgm/en/>
27. Space spray application of insecticides for vector and public health pest control. WHO/CDS/WHOPES/GCDPP/2003.5

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

**Table 1: Selection of appropriate preventive measures for control of vectors of public health importance**

Diseases/Vectors	Epidemiology	Indoor/outdoor or biting (I/O)	Day/night biting (D/N)	Personal protection						SIRS/ Dusting	Removal of hiding places	Larva/nymph control		Space spraying	
				Repellents/baits	Cloth treatment	Protective cloths	LLINs	House Screening	Other hygiene			Chem.	EM	Indoor	Outdoor
Mosquitoes (Malaria)	Routine	I	N	+/-	+	+	++++	++	+	++++/-	-	+++	+	+	-
	Epidemic (OB)			+++/-	++	+++	++++	+	+	+/-	-	+	-	++++	++
Mosquitoes (Dengue)	Routine	I	D	+/-	+	+	+	+++	+	+++/-	-	+	+++	+	-
	Epidemic (OB)			+++/-	+++	+++	+++	+	+	+/-	-	+	+++	++++	++
Sandfly	Routine	I/O	N	++/-	+	+	++	-	+	++++/-	+++	-	+++	+	-
	Epidemic (OB)			++++/-	++++	++++	+++	-	++	+/-	-	+	+	+++	++
Bedbugs	Routine	I/O	N	++/-	+	-	+	++	++	+/+++	+++	-	++	-	-
	Epidemic (OB)			++++/-	++++	-	++	+	+++	+/++	+++	-	+	++	-
Ticks	Routine	I/O	D/N	++/-	++	-	+	++	++	+/+++	++	-	++	-	-
	Epidemic (OB)			++++/-	++++	-	+++	+	+++	+/++	+++	-	+++	-	-
Fleas	Routine	I/O	D/N	+++/-	++	++	+	-	++	+/+++	+++	-	++	-	-
	Epidemic (OB)			++++/-	++++	+++	++	-	+++	+/++	++	-	++	++	-
Cockroaches	Routine	I/O	N	-/+	-	-	-	+++	-	-/+	+++	-	++++	-	-
	Epidemic (OB)			-/+	-	-	-	++	-	+/++++	++++	-	++++	-	-
Mites	Routine	I/O	D/N	+/-	+	-	-	-	++++	++	+++	-	+++	-	+
	Epidemic (OB)			+++/-	+++	-	-	-	++++	+	++++	-	+	-	++
Houseflies	Routine	I/O	D	/- -	-	-	-	++++	++++	++	++	++	++++	++	+
	Epidemic (OB)			/- -	-	-	+	+	++++	+++	+++	++++	++	++++	+++
Human lice	Routine		D/N	-	-	-	+	-	++++	+++	-	++	-	-	-

**Table 2: Selection of appropriate insecticides, methods, and doses for vector (s) control**

Insecticides	Method	Dose of a.i									
		Mosqto.	Sandfly	Bedbug	Fleas	Tick	Mites	roaches	Flies	Lice	
Alphacypermethrin	IRS	20-40 (mg/m <sup>2</sup> )	20-40 (mg/m <sup>2</sup> )	30-60 (g/l or /kg)	1 (g/l or /kg)	3-5 (g/l or /kg)	0.3-0.6(g/l or /kg)	0.3-0.5 (g/l or kg)	10-30 (mg/ m <sup>2</sup> )	-	
	Dust	-	-	-	-	-	-	5-10 (g kg)	-	-	
Deltamethrin	IRS	10-20 (mg/m <sup>2</sup> )	10-20 (mg/m <sup>2</sup> )	20-40 (g/l or /kg)	0.5-1.0 (g/l or /kg)	10-20 (mg/ m <sup>2</sup> )	0.25 (g/l or /kg)	0.5-3.0 (g/l or /kg)	7.5-15 (mg/ m <sup>2</sup> )	-	
	Dust	-	-	0.3-0.5 (g/kg)	0.5 (g/kg)	0.5-1.0 (g/kg)	0.5-0.75 (g/kg)	0.5 (g/ kg)	0.5-7.5 (g/kg)	-	
	Lotion	-	-	-	-	-	-	-	-	0.3 (g/l or /kg)	
	S. Spraying/Fog	0.5-1.0 (g/h)	0.5-1.0 (g/h)	-	-	-	0.5-1.0 (G/H)	-	0.5-1.0 (g/h)	-	
Permethrin	IRS	500 (mg/m <sup>2</sup> )	500 (mg/m <sup>2</sup> )	1-2 (g/l or /kg)	4-5 (g/l or /kg)	4-5 (g/l or /kg)	2.5 (g/l or /kg)	2.5 (g/l or /kg)	60-70(mg/ m <sup>2</sup> )	-	
	Dust	-	-	0.5-1.0 (g/kg)	5.0 (g/kg)	5.0 (g/kg)	4-5 (g/kg)	5 (g/kg)	2-3 (g/kg)	5 (g/l or /kg)	
	Lotion	-	-	-	-	-	-	-	-	10 (g/l or /kg)	
	Shampoo	-	-	-	-	-	-	-	-	10 (g/l or /kg)	
	S. Spraying/fog	5-10 (g/h)	5-10 (g/h)	-	-	-	5-10 (g/h)	-	5-10 (g/h)	-	
Cyfluthrin	Cloth treatment	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	-	-	
	IRS	20-50 (mg/m <sup>2</sup> )	20-50 (mg/m <sup>2</sup> )	-	-	-	-	0.4 (g/l or /kg)	30 (mg/ m <sup>2</sup> )	-	
	Dust	-	-	-	-	-	-	0.5 (g/kg)	1-2 (g/kg)	-	
	Cloth treatment	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	1.25 (mg/ m <sup>2</sup> )	-	-	
	IRS	25-100 (mg/m <sup>2</sup> )	25-100 (mg/m <sup>2</sup> )	0.5-2 (g/l or /kg)	0.5-2 (g/l or /kg)	0.5-2 (g/l or /kg)	0.5-2 (g/l or /kg)	0.5-2 (g/l or /kg)	25-100 (mg/m <sup>2</sup> )	-	

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

Cypermethrin	Dust S. Spraying/fog	- 2-5 (g/h)	- 2-5 (g/h)	5-7 (g/kg) -	5-7 (g/kg) -	5-7 (g/kg) -	5-7 (g/kg) 2-5 (g/h)	5-7 (g/kg) -	3-10 (g/kg) 2-5 (g/h)	- -
Bioresmethrin	Space spray	5-10 (g/h)	5-10 (g/h)	-	-	-	4-8 (g/h)	-	5-12 (g/h)	-
Resmethrin	S. Praying	2.0-4.0 (g/h)	-	-	-	-	-	-	2.0-4.0 (g/h)	-
Bifenthrin	IRS	-	-	-	-	-	-	-	25-50 (mg/m <sup>2</sup> )	-
Gokilaht-S	IRS Space spraying	100 (ml/h) 100 (ml/h)	100 (ml/h) 100 (ml/h)	- 0.5 (ml/h)	- 0.5 (ml/h)	- -	- -	- 0.5 (ml/h)	- 0.5 (ml/h)	- -
<b>Carbamate</b>										
Bendiocarb	IRS S. Spraying/fog	100-400 (mg/m <sup>2</sup> ) 10 (g/h)	100-400 (mg/m <sup>2</sup> ) -	2.4-9.6 (g/l or/ kg) 5-8 (g/kg)	2.4-9.6 (g/l or/ kg) -	2.5-10 (g/l or/ kg) -	4-9.6 (g/l or/ kg) -	2.4-4.8 (g/l or/ kg) -	100-400 (mg/m <sup>2</sup> ) -	- -
Carbosulfan	IRS	1-2 (mg/m <sup>2</sup> )	1-2 (mg/m <sup>2</sup> )	-	-	-	-	-	-	-
Propoxur	IRS Dust	1-2 (mg/m <sup>2</sup> ) -	1-2 (mg/m <sup>2</sup> ) -	- 10 (g/kg)	- 10 (g/kg)	- 10 (g/kg)	- 10 (g/kg)	10 (g/l) 10 (g/kg)	- 10 (g/kg)	- 10 (g/kg)
Carbaryl	IRS Dust	1-2 (mg/m <sup>2</sup> ) -	1-2 (mg/m <sup>2</sup> ) -	- 10 (g/kg)	- 10 (g/kg)	- 10 (g/kg)	- 10 (g/kg)	- -	- -	- 50 (g/kg)
<b>Organophosphate</b>										
Fenitrothion	IRS Larvicides Aerosol S. Spray	0,33-1 (g/ m <sup>2</sup> ) 100-1000 (g/h) -	0,33-1 (g/ m <sup>2</sup> ) - -	- -	1.1.3 (g/m <sup>2</sup> ) -	1.1.3 (g/m <sup>2</sup> ) -	1.1.3 (g/m <sup>2</sup> ) -	10-20 (g/l) -	1.0-2.0 (g/m <sup>2</sup> ) -	- -
Chlorpyrifos	IRS Dust Larvicides S. Spraying	- -	- -	2-5 (g/kg or /l) -	- 20 (g/kg)	- 20 (g/kg)	5 (g/kg or /l) 15 (g/kg)	5 (g/l) 5-10 g/kg)	- -	- -
Chlorpyrifos methyl	IRS Dust Larvicides	0.4-0.6 (g/ m <sup>2</sup> ) -	0.4-0.6 (g/ m <sup>2</sup> ) -	- -	0.4-0.6 (g/ m <sup>2</sup> ) 10 (g/kg)	0.4-0.6 (g/ m <sup>2</sup> ) 10 (g/kg)	5 (g/kg or /l) 10 (g/kg)	7-1- (g/l) 0.5 ( g/kg)	0.4-0.6 (g/ m <sup>2</sup> ) -	- -
Pirimiphos-methyl	IRS Dust Larvicides	1.0-2.0 (g/ m <sup>2</sup> ) -	1.0-2.0 (g/ m <sup>2</sup> ) -	- 10 (g/kg)	1.0-2.0 (g/ m <sup>2</sup> ) 10 (g/kg)	1.0-2.0 (g/ m <sup>2</sup> ) 10 (g/kg)	- 10 (g/kg)	25 (g/l) 20 ( g/kg)	1.0-2.0 (g/ m <sup>2</sup> ) -	- -
Malathion	IRS Dust Larvicides	2.0 (g/ m <sup>2</sup> ) -	2.0 (g/ m <sup>2</sup> ) -	- 20 (g/kg)	2.0 (g/ m <sup>2</sup> ) 20 (g/kg)	2.0 (g/ m <sup>2</sup> ) 20 (g/kg)	- 20 (g/kg)	30 (g/l) 50 (g/kg)	1.0-2.0 (g/ m <sup>2</sup> ) -	- -
Temephos	Larvicides	56-112 (g/h)	-	-	-	-	-	-	-	-
Fenthion	Larvicides	22-112 (g/h)	-	-	-	-	-	-	-	-
<b>Organochlorines</b>										
DDT	IRD	1.0-2.0 ( g/ m <sup>2</sup> )	1.0-2.0 (g/ m <sup>2</sup> )	-	-	-	-	-	-	-
Lindane	IRS dust Lotion	-	-	-	-	0.2 (g/ m <sup>2</sup> ) -	-	-	-	0.2 (g/ m <sup>2</sup> ) 10 (g/kg) 10 (g/kg)
<b>Bait</b>										
Diazinon, Dichlorvos, Dimethoate, Trichlorfon, Propoxur	Bait	-	-	-	-	-	-	Y	Y	-
<b>IGR/MI</b>										
Diflubenzuron	Larvicides	25-100 (g/h)	-	-	-	-	-	-	-	-
Methoprene	Larvicides	100-1000 (g/h)	-	-	-	-	-	-	-	-
Pyriproxyfen	Larvicides	5-10 (g/h)	-	-	-	-	-	-	-	-

## GUIDELINES FOR CONTROL OF VECTORS OF PUBLIC HEALTH IMPORTANCE IN PAKISTAN

Triflumuron	Larvicides	40-120 (g/h)								
<i>B. Thuringiensis (MI)</i>	Larvicides	Label	-	-	-	-	-	-	-	-