

## PORTABLE MOSQUITO NET SUPPORT DEVICES FOR INDOOR AND OUTDOOR USE

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**ABSTRACT.** Polyvinyl chloride plumbing and electrical cover pipes are used in the assembly of low-priced devices that will support mosquito bed nets. One such device is a frame assembled from components in a lightweight compact set with dimensions of 75 x 20 x 5 cm, weighing approximately 0.5 kg. It can be mounted on a wall or attached to a stand of adjustable height which is also made from plumbing pipes. This support frame provides minimum obstruction of view and movement as it is attached at only one point. It can be used indoors or outdoors either for sleeping on beds or on the ground. A second device is composed of short pipe sheaths attached to bed legs for easy insertion or removal of support poles.

The regular use of bed nets is an effective means of reducing mosquito bites during sleep. Bed net use was associated with reduced parasitemia (Campbell et al. 1987) and reduced splenomegaly (Bradley et al. 1986) in young children in a malaria endemic area in the Gambia. Their use was also found to be equivalent to the long-term prophylactic use of antimalarials (Nevill et al. 1988). In addition, the use of insecticide-impregnated nets (Schreck and Self 1985, Snow et al. 1987) has been shown to further increase the efficiency of these nets in protection against malaria. However, during visits to malaria endemic areas in the Asir region, southwestern Saudi Arabia, we were struck by the general lack of use of bed nets, despite the frequent expression of annoyance with mosquito bites during sleep. Upon supplying ready-made nylon or cotton nets and assessment of their subsequent use, several drawbacks were expressed. These included easy tearing, inconvenient setting up and folding, and inability to use these nets when sleeping outdoors as is often done in hot weather. The usual way of supporting mosquito nets by 4 poles that are permanently attached to the corners of the bed was not favored as local inhabitants tend to use their beds for family and guest seating during the day. Such fixed poles would obstruct the view and movement and would interfere with a socially acceptable sitting arrangement. The provision of a place for the convenient folding of the net when not in use is also desirable. Two support devices are described that minimize some of the inconveniences indicated above in the regular use of bed nets.

**Bed-net frame:** The support frame (Fig. 1) is assembled from 7 pieces. The 3 forming the back part (pieces 1, 2 and 3) are made from pressure 40 polyvinyl chloride (PVC) plumbing pipes of 1/2-inch (1.25-cm) inner diam. Pieces 2 and 3 (70 cm long) have joints glued at one end and are reversibly attachable to a middle T-joint

which is attached to piece 1. Holes are drilled in both tubes and the T-joint and screws are attached to prevent vertical rotation. The front part is made from lightweight PVC pipes used for covering electrical wires. The outer diameter of the electrical cover pipes (about 1.2 cm) is just smaller than the inner diameter of the plumbing pipes. Pieces 4 and 5 (55 cm long) have short sleeves (15 cm) of the plumbing pipe glued at one end to allow for an appropriate fit at the back joints. Tube 1 is securely mounted on the wall by 2 metal brackets. The rest of the frame is reversibly attached to it at the T-joint. The frame described in Fig. 1 is placed approximately 120 cm above the bed which is placed sideways against the wall.

A modified version can be placed at the head position. The latter version is also used with the stand described below. For this version, electrical cover pipes of either smaller or larger diameter (2.3 cm) than the plumbing pipes are used to construct the outer U-shaped part of the frame which slides in and out of the U-shaped inner part made from the plumbing pipes. The stand consists of a vertical column made from 2 joined pieces (70-cm each) of 1-inch (2.5-cm) pressure 40 PVC plumbing pipes. The column is attached to a U-shaped base (80 cm wide, 70 cm long) made from the same material or clamped by metal brackets to the back of a wooden bed. A reduction ring fitted with a connection piece allows the attachment of the frame (1/2-inch diam) to the stand (1-inch diam). The stand height can be reduced for sleeping on the floor by eliminating one of the 2 column tubes or by adjusting their length.

The mosquito net is spread on the topside of the frame but is passed to the inside at the T-joint through a 5-cm incision made at the seam line. This allows complete tucking of the net under the mattress. The incision can be fitted with Velcro tape for complete closure. The whole assembly (frame and net) can be easily detached

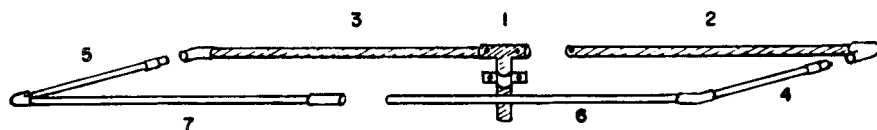


Fig. 1. Components and assembly of a mosquito net support frame (side position). Numbers refer to the individual pieces as described in the text. Shaded pipes and joints are plumbing material while the unshaded pipes and joints are used for covering electrical wires.

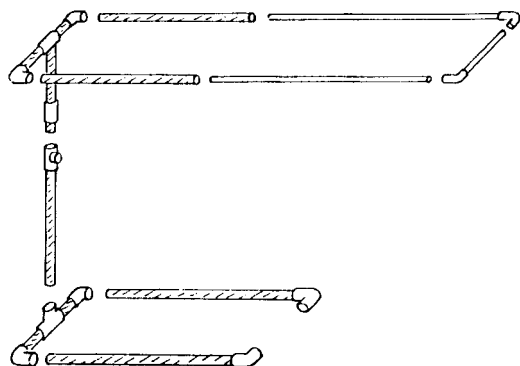


Fig. 2. Components and assembly of support frame and stand (head position).

at the T-joint leaving only the fixed piece 1 in place.

The 7-piece frame, weighing about 0.5 kg, together with the required brackets and screws are transported in a cloth bag approximately 75 x 20 x 5 cm. A mosquito net can also be enclosed to complete the set. The optional stand is carried in a separate cloth bag approximately 85 x 30 x 10 cm, and weighing about 2 kg. Color coding at the joints together with an instruction sheet may be added for guidance on the assembly of both frame and stand.

Figure 2 shows the modified frame and stand placed at the head position of the bed. When used outdoors, wind straps tying the outer corners of the frame to the legs of the bed or any adjacent structure may be necessary to prevent horizontal rotation although such rotation is also prevented when the net is properly secured under the mattress.

The cost of the frame set has been estimated at U.S. \$4.00 while that of the stand at U.S. \$8.00. Both the frame and net can be hidden during the day by a cloth cover which is decoratively more appealing.

A functional aspect of the frame support is that it reduces the tear of the net. This is because the frame will bend when the net is pulled thereby absorbing the force of the pull.

The support frame is lightweight and does not have any sharp edges. It resists breakage and rusting. It is low priced and made from locally available components for easy replacement or

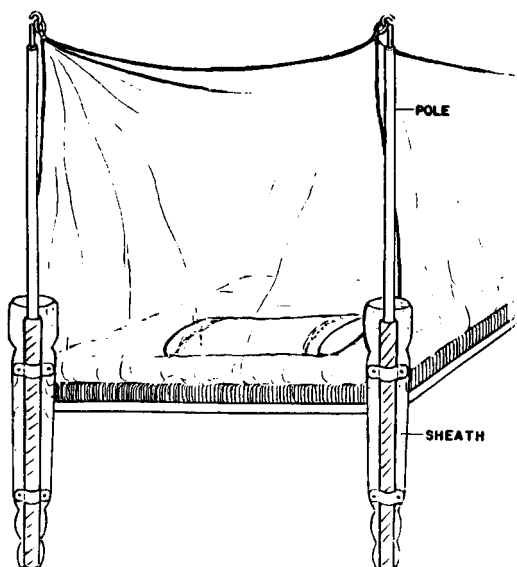


Fig. 3. Affixed sheath and insertable pole attached to bed leg.

repair. It is easily transported as a compact set and does not require any special tools for assembly other than a hammer and a screwdriver for mounting on the wall.

*Pipe sheaths for support:* Figures 3 and 4 show sketches of the second device which consists of plastic sheaths made from electrical cover pipes (2.3-cm inner diam, about 50 cm long) which can be permanently attached to the legs of the bed by metal clamps or tied with rope or adhesive tape. Support poles are made of PVC plumbing pipes (1.3-cm inner diam, pressure 40, 120 cm long) which have a diameter just smaller than the inner diameter of the sheath pipes so that they can be snugly inserted in them. The upper ends of these poles are fitted with plastic pegs and metal hooks. The mosquito net, usually fitted with 4 plastic or metal rings at the corners, can be hooked up and tucked in under the mattress (Fig. 3). However, if the size of the net is larger than that of the bed or if no proper mattress is used as is often the case, horizontal pipes are attached by joints to the poles at both the head and leg positions (Fig. 4). The net is then spread on top of these horizontal bars. In this case, the net needs to be long enough to

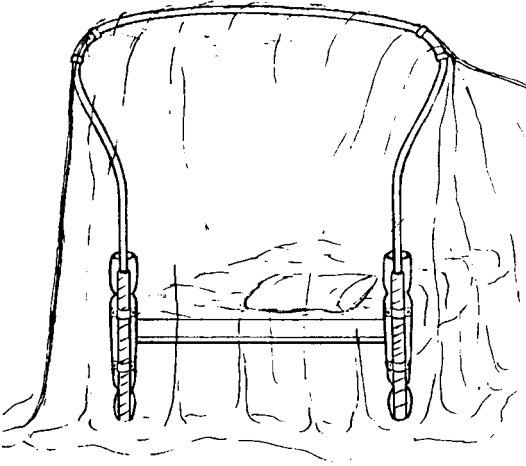


Fig. 4. Assembly used with narrow beds or in the absence of an appropriate mattress.

reach the ground and is kept in place by stone weights. The horizontal bars extend the net farther than the width of the bed and prevent it from touching parts of the body, which is useful in avoiding biting through the net in the case of narrow beds. This device allows quick and convenient setting up of the net at night and its detachment during the day. All components of the device make up a sturdy set that is easily assembled and transported.

The availability of all components of the support devices in a kit form is necessary for reducing the cost and effort required to find these

components and in encouraging a do-it-yourself approach. Enclosure of a net made from strong fabric in the set will constitute an additional important measure. Nets that are commercially available in our area are made from easily torn fabrics, thus we have recently resorted to the use of locally sewn nets made of strong nylon fabric (mesh size about 17 to the linear inch) which is used for making inside drapes (marquisette). This mesh size can also protect against sandfly bites.

Preliminary pilot trials have shown good acceptance of the support devices described above, particularly in conjunction with the heavy-duty nets. However, evaluation of their regular long-term use requires further follow-up.

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