In 2006, WHO made an historic recommendation to the global health community: stop delivering four massive global programmes as separate entities and integrate them into a single and coordinated approach. The time was ripe: sufficient new data had been collected, key safety studies had been completed and the political climate had changed.

Such a seismic shift in thinking represents one of those rare and exciting moments in public health. It also takes time for new ways of thinking to filter through to the drug distributors whose responsibility it is to deliver these programmes and to those charged with carrying out baseline or monitoring and evaluation surveys.

Drug distributors come from a variety of backgrounds. Some are fully trained health staff, others are teachers and many are community volunteers. Whoever they are, they have one of the most vital jobs during large-scale drug administrations. They must know about the diseases they are controlling, they must be clear about the drugs they are delivering and they must be prepared for any questions that the community may ask. In other words, drug distributors must feel confident in their work – and communities must have confidence in them.

This issue of Action Against Worms provides a one page overview of the dose poles that drug distributors should use to help them calculate the correct number of tablets to give. It then gives a description of the field tools used to measure the prevalence and intensity of the diseases that lend themselves to large-scale drug delivery.

As outlined in issue 9, this newsletter will now focus on five diseases: lymphatic filariasis, onchocerciasis, schistosomiasis, soil-transmitted helminthiasis (STH) and trachoma.

The four global programmes are schistosomiasis and STH (which are sometimes considered as one programme because the drugs for both infections are delivered together in many places), lymphatic filariasis and onchocerciasis.
Delivering drugs to thousands of people can be a daunting task. Tools to make that job easier are therefore welcomed. For three of the drugs – azithromycin, ivermectin and praziquantel – the use of dose poles, which use height to calculate the correct dosages for each person, greatly simplifies the process.

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Table 1: WHO-recommended drugs and calculation of dosages for large-scale drug administrations

<table>
<thead>
<tr>
<th>Priority diseases in endemic countries</th>
<th>Drugs</th>
<th>How to calculate dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymphatic filariasis in countries co-endemic for onchocerciasis in Africa</td>
<td>albendazole + ivermectin</td>
<td>albendazole: one tablet per person&lt;sup&gt;a&lt;/sup&gt;  ivermectin: use an ivermectin dose pole</td>
</tr>
<tr>
<td>Lymphatic filariasis but no onchocerciasis</td>
<td>albendazole + DEC</td>
<td>albendazole: one tablet per person&lt;sup&gt;b&lt;/sup&gt;  DEC: 6mg/kg body weight</td>
</tr>
<tr>
<td>Soil-transmitted helminthiasis</td>
<td>albendazole or mebendazole</td>
<td>Fixed dose by age&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td>ivermectin</td>
<td>Use an ivermectin dose pole</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>praziquantel</td>
<td>Use a praziquantel dose pole</td>
</tr>
<tr>
<td>Trachoma&lt;sup&gt;d&lt;/sup&gt;</td>
<td>azithromycin</td>
<td>Use an azithromycin dose pole</td>
</tr>
</tbody>
</table>

<sup>a</sup> When albendazole + ivermectin are delivered as part of the LF package, albendazole is given to everyone >90 cm in height.

<sup>b</sup> When albendazole + DEC are delivered as part of the LF package, albendazole is given to everyone aged ≥2 years.

<sup>c</sup> When albendazole or mebendazole is delivered as part of the STH package, the dose is determined by age. Half a tablet (200 mg) is given to children aged 12–24 months and 1 tablet (400 mg) is given to everyone aged over 24 months. For mebendazole, the dose is 1 tablet (500 mg) for everyone over the age of 12 months.

<sup>d</sup> The treatment of trachoma has not yet been integrated into the preventive chemotherapy package. Azithromycin should still be given in a separate treatment round.

Dose poles, which may be made of paper or wood, are attached to the wall of the clinic or school where the drug distribution is taking place. The bottom of the pole should just touch the ground. Each person should remove his or her shoes and stand straight against the pole so that the drug distributor can read off the correct number of tablets to give.

ORDERING DOSE POLES FROM WHO

Dose poles for ivermectin and praziquantel are available from WHO.

If you are the manager of a country-level control programme and you require a prototype (made from laminated paper) of a praziquantel and/or ivermectin dose pole, please contact wormcontrol@who.int, indicating your full name and postal address.

wormcontrol@who.int
FIELD TOOLS – MEASURING THE SEVERITY OF DISEASE

Selecting the correct package of drugs to deliver requires knowledge of the diseases that are present in the area and their severity. This section summarizes the tools recommended by WHO for use in the field for each of the diseases targeted for preventive chemotherapy. More detailed instructions can be found in laboratory manuals and in the WHO manual on Preventive chemotherapy in human helminthiasis.2

1 Intestinal schistosomiasis and soil-transmitted helminthiasis: The Kato-Katz technique

How the Kato-Katz technique works

In areas with moderate to high transmission rates of STH (i.e. where the proportion of infected individuals is ≥20–≥50%) or intestinal schistosomiasis (≥10–50%), WHO recommends community diagnosis using the Kato-Katz technique. Where the prevalence of STH is <20%, the specificity of this technique makes it less appropriate, and more sensitive tools should be used.3

The principle behind the Kato-Katz technique is straightforward: people infected with STH or intestinal schistosomes pass the eggs of the worms through their faeces. By examining a stool sample under a microscope it is possible to count the number and the type of eggs that are present.

SHORTAGES OF KATO-KATZ KITS

Kato-Katz kits contain a roll of cellophane that is cut into small pieces and soaked in methylene blue glycerol solution (not included in the kit) the night before the fieldwork. The cellophane is then placed directly on the faeces sample, making the eggs more easily visible and allowing long-term storage of the slides.

Unfortunately, the company that supplied the bulk of the cellophane rolls recently discontinued production, resulting in a shortage of kits. WHO is therefore field-testing cellophane produced by alternative manufacturers to identify a high-quality product. Until the situation is resolved, the Sandwich or Teesdale technique, which is very similar to the Kato-Katz technique, is the most appropriate alternative. There is one important difference: the slides prepared with the Sandwich technique must be read within one hour of preparation.

STANDARD SAFETY RULES and SPECIMEN HANDLING

- Do not use equipment that has passed its expiry date.
- Do not use contaminated equipment, or false results may occur.
- Always observe safety standards when handling samples, particularly blood samples.

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The Sandwich or Teesdale technique being used in Malawi.


3 For example, the modified Ritchie technique.
**Step 1:** Label a glass slide with the sample number and then place a plastic template on top of it.

**Step 2:** Place a small amount of the faecal sample on a newspaper and press a piece of nylon screen on top. Using a spatula, scrape the sieved faecal material through the screen so that only the debris remains.

**Step 3:** Scrape up some of the sieved faeces to fill the hole in the template, avoiding air bubbles and levelling the faeces off to remove any excess.

**Step 4:** Carefully lift off the template and place it in a bucket of water mixed with concentrated detergent so that it can be reused.

**Steps 5 and 6 of the Kato-Katz technique**

**Step 5:** Place one piece of the cellophane, which has been soaked overnight in methylene blue glycerol solution, over the faecal sample.

**Step 6:** Place a clean slide over the top and press it evenly downwards to spread the faeces in a circle. If done well, it should be possible to read newspaper print through the stool smear.

**Steps 5 and 6 of the Sandwich technique**

**Step 5:** Turn the slide containing the small amount of stool upside down and place it on a clean slide to make a "sandwich".

**Step 6:** Using a circular motion, press the top slide firmly onto the bottom slide to spread the stool in an even circular layer. If done well, it should be possible to read newspaper print through the stool smear.

**IMPORTANT:** A slide prepared using the Sandwich technique must be read within 1 hour.

**Step 7:** If hookworm is present in the area the slide should be read within 30–60 minutes, irrespective of the technique used. After that time, the hookworm eggs disappear.

Place the slide under a microscope and examine the whole area in a systematic zigzag pattern. If the sample created by the Sandwich technique is too thick, it may be necessary to use a x400 magnification objective. Record the number and the type of each egg on a recording form alongside the sample number. Finally, multiply the number of eggs by 24 to give the number of eggs per gram (epg) – the standard measurement to assess the intensity of infection.

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4 The Kato-Katz technique uses a 25 x 75 mm slide. The Sandwich technique uses a 58 x 75 mm slide.

5 This assumes that the standard 41.7 mg template is used. If a template of another size is used, multiply the number of eggs by the correct multiplier to give the epg.
Urinary schistosomiasis: Questionnaires, dipsticks and urine filtration kits

One of the clearest signs of urinary schistosomiasis (S. haematobium) is bloody urine. The disease can be assessed using one of three methods: the questionnaire method, the dipstick technique or a urine filtration kit. Each has its advantages and disadvantages.

How the questionnaire method works

The questionnaire method is inexpensive to use and simple to administer. It asks children whether they have seen blood in their urine over the past month. The child will answer “yes” or “no”. This response will tell whether urinary schistosomiasis is present in the area; it will not tell how many eggs are present, i.e. the intensity of infection. It is also less sensitive for girls than for boys, who are more likely to self-report bloody urine. However, by definition, a child with bloody urine is already heavily infected. Using the questionnaire method, schools can be ranked from “worst affected” to “least affected” and the areas where treatment is needed most urgently can be prioritized. Given its lack of sensitivity, the questionnaire technique should only be used to make a community-wide decision, not an individual diagnosis. WHO estimates that if 30% of children are found to be positive using the questionnaire technique, approximately 50% of the community are infected.

How the dipstick technique works

Step 1: Obtain a fresh urine sample in a clean, dry container. Examine it within 2 hours of collection. If there is a delay, refrigerate the sample. If the urine sample is grossly contaminated with faeces, discard it.

Step 2: Remove one dipstick from its bottle and replace the cap immediately. Completely immerse the reagent areas of the strip into the urine sample for 2 seconds. When removing the strip, run its edge against the rim of the container to remove any excess urine.

Step 3: Hold the strip horizontally so that the chemicals do not mix together from the adjacent reagent areas. Now match the colour of the strip with the colour chart on the bottle label and record the results on the monitoring form. Do not lay the strip on the colour chart as this will soil the chart.

Urine that is discoloured red with blood is easy to assess by sight. More normally coloured urine must be assessed using more sophisticated techniques – such as the dipstick technique. The dipstick technique indicates whether microscopic traces of blood that are invisible to the naked eye are present in a urine sample. In terms of sensitivity, the dipstick technique is comparable to that of the urine filtration kit. And although it may seem expensive (one dipstick costs US $1), its simplicity means that someone with minimal training can use it while the filtration kit requires experienced laboratory technicians and equipment including microscopes.

The technique described here is for the Hemastix urine testing product reagent strips. Other brands may follow a slightly different methodology.
How the urine filtration kit works

People infected with S. haematobium expel the eggs of the worm in their urine. Just as the Kato-Katz kit examines for eggs in faeces, the urine filtration kit examines for eggs in urine. Although considered to be the “gold standard” for diagnosis of urinary schistosomiasis, the urine filtration kit requires trained laboratory technicians and proper equipment.

For survey work, urine samples should be collected near midday – the time when most of the eggs appear. Samples should be examined as soon as possible after collection as the eggs may hatch and then become invisible, or crystals may form, making a correct diagnosis more difficult.

Step 1: Unscrew the filter holder and carefully place one filter inside the holder, making sure it is correctly held in place before screwing the unit together again.

Step 2: Shake and mix the urine sample before drawing a 10 ml sample into the syringe. Then attach the filter unit.

Step 3: Keeping the syringe and the unit in a vertical position, press the plunger down to push all the urine through the filter and out into a bucket.

Step 4: Carefully detach the syringe from the filter unit. Draw air into the syringe, reattach the syringe to the filter unit holder and expel the air again. This is important as it removes any excess urine and ensures that the eggs are firmly attached to the filter.

Step 5: Unscrew the unit and remove the filter, placing it (top side up) onto a microscope slide.

Step 6: Add one drop of Lugol’s iodine and wait 15 seconds for the stain to penetrate the eggs. This makes the eggs more easily visible.

Step 7: Immediately examine the whole filter under a microscope at a low power (x40). Schistosome eggs can be seen clearly because they stain orange. Infection loads are recorded as the number of eggs per 10ml of urine.
Lymphatic filariasis (LF) is caused by three microscopic worms (*Wuchereria bancrofti*, *Brugia malayi* and *B. timori*), all transmitted by mosquitoes.

In areas with *Brugia* infection, two tests are available: an antibody test or the night-blood smear.

Where *W. bancrofti* infection is present, the antigen detection test and the immunochromatographic card test (ICT card) or an ELISA-based test can be used to indicate if LF infection is present in the area. To assess the intensity of infection, the night-blood smear should be used.

How the ICT test works in the field

The principal behind the ICT test is to detect whether the *W. bancrofti* antigen that is released by the adult worm is present in whole blood.

**Step 1:** Remove the test card from the pouch just before use. Open the card and lay it flat on the work surface.

**Step 2:** Fill a calibrated capillary tube or pipette to the 100 µl mark (the equivalent of a drop) with blood from a finger or heel puncture. Take care to avoid air bubbles; if they do occur, fill the tube past the 100 µl mark to compensate.

**Step 3:** Slowly release the 100 µl sample of blood onto the pink and white pad as shown. An arrow indicates the correct position of the sample on top of the pad. If blood remains in the tube or pipette that does not flow out freely, gently touch the edge of the tube or the tip of the pipette against the pad.

**Step 4:** Wait for the sample to flow into the pink area until it is completely wet. This should take about 30–60 seconds.

**Step 5:** Remove and discard the adhesive liner of the test card, ensuring that the adhesive on the right-hand side of the card is exposed.

**Step 6:** Close the card. To ensure a proper flow of blood through the strip, press the card firmly along the entire area to the right of the window. Start timing.

**IMPORTANT:** It is extremely important that the results of the test should be read in the viewing window precisely between 10 and 15 minutes after closing the card, otherwise the results will be invalid.

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7 To collect blood on filter-paper followed by a laboratory-based ELISA test, refer to the manufacturer’s guidelines (www.tropbio.com.au). Here we describe only field-based tests.

Some of the drawings and instructions extracted from “Binax Inc. manufacturers insert for New Filariasis Test”
How the night-blood smear test works

In most parts of the world, the microfilariae that are essential for the spread of LF appear in a person’s blood at night, making night-time the most suitable time to take a blood sample.

**Step 1:** Place the person’s left-hand palm, facing upwards, and select the 3rd or 4th finger. For infants, the big toe can be used. The thumb should never be used for adults or children.

Use cotton wool lightly soaked in ethanol to clean the finger, applying firm strokes to remove dirt and grease from the ball of the finger. Dry the finger with a clean piece of cotton wool or lint.

**Step 2:** With a sterile lancet, puncture the ball of the finger using a quick, rolling action. Apply gentle pressure to the finger, express the first drop of blood and wipe it away with dry cotton wool. Make sure that no strands of cotton remain on the finger.

**Step 3:** Working quickly and handling clean slides by the edges only, collect the blood by applying gentle pressure to the finger and collecting three drops of about this size onto the slide.

**Step 4:** Always handle the slides by the edges or a corner. Make a thick film by using the corner of the spreader slide to quickly join the drops of blood and spread them into an even thick film, or draw three parallel lines from each droplet of blood.

**Step 5:** Allow the thick film to dry in a flat, level position protected from flies, dust and extreme heat. Label the dry film with the person’s name or number and date.

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**Positive test result**
The test is positive if two lines (T and C) are seen in the window. Any pink line in the T area indicates a positive test result, even if the line is lighter or darker than the C line.

**Negative test result**
The test is negative if only the C line shows. To ensure that low-positive samples have had sufficient time to develop, a negative result should not be recorded until 10 minutes have elapsed from the time when the card was closed.

**Invalid test result**
The test is invalid if the C line does not appear. If this happens, the test should be repeated.
Step 6: Once the smear has air-dried, stain it with Giemsa stain (diluted 1 in 20 with buffered water, pH 6.8) for 30 minutes.

Step 7: Using the x10 objective, scan the whole smear under a microscope to identify the number of microfilariae. If it is difficult to distinguish the nuclei of the microfilariae, return the slide to the Giemsa stain solution for another 5–10 seconds.

Onchocerciasis: Nodule palpation, the DEC patch and skin snips

Onchocerciasis, a filarial disease caused by Onchocerca volvulus, is transmitted through the bite of infected blackflies. Microfilariae (tiny worms) are found in the human body in skin nodules, causing intolerable itching, visual impairment and eventual blindness.

Three tests are available to assess if someone is infected.

Nodule palpation

A presumptive diagnosis of onchocerciasis can be made using this simple technique in which the health worker feels the areas of the patient’s body that are most likely to contain subcutaneous nodules. While this technique does not definitively demonstrate onchocerciasis, it is an indication that further tests should be run to confirm this diagnosis. This test is not suitable as a monitoring tool.

Diethylcarbamazine citrate (DEC) patch test

The DEC patch test is regularly used in West Africa but has yet to be universally recommended. The principal behind the test is the strong inflammatory reaction caused by DEC when it comes into contact with the microfilariae. DEC is mixed with cream and applied to a rectangular piece of filter-paper, which is applied to the skin. The DEC is absorbed locally. If microfilariae are present in the surrounding skin, an inflammatory reaction occurs that will be visible to the naked eye after 24 hours. DEC patches are less painful and easier to use than skin snips. However, the patches can become unstuck and are sometimes itchy, which can be troublesome for young children. The test area must be read after 24 hours, whereas the skin snip can be examined immediately.

* Where two species of microfilariae may be present, field workers should use the x40 and x100 or more objectives to identify the filarial species.
Skin snips

The skin snip test is still the best available technique for measuring both the prevalence and the intensity of infection. While this method is specific, it is unpopular with people living in endemic areas because of its invasiveness. It is therefore no longer used in clinics since large-scale treatment programmes now operate in endemic areas without prior diagnosis.

Skin snips should only be taken from certain sites of the body. In Africa, the preferred site is the iliac crest; in Central and South America, the scapular area can also be used; in Yemen, the lower calf is used. For monitoring surveys, two snips should be taken from all three of these sites – on each side of the body – six snips in total. A corneoscleral punch should be used.

Step 1: Disinfect the skin area with a gauze pad dipped in alcohol. Use a sterile corneoscleral punch to snip the skin.

Step 2: Put a drop of distilled water or saline solution on a microscopic slide.

Step 3: Transfer the skin snip(s) onto the slide and place a coverslip over them. Do not press on the snips or the coverslip. If there is insufficient saline to cover the snips, add some at the edge of the coverslip so that it runs underneath.

Step 4: After 30 minutes to 3 hours, examine the snips under a microscope at x10 power. If the microfilariae are present, their movement will be clearly visible. If the microfilariae are not visible, place the snips in an incubator at 37 °C or at room temperature overnight and re-examine them the next day.

IMPORTANT: Slowing evaporation. To slow evaporation, the slides can be placed in a covered Petri dish or tissue culture trays and covered with plastic wrap.

Uganda, Masindi district: A young boy swallows his ivermectin tablets during a central point distribution in his village.