Practices of Mini-FLOTAC in public health

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PI Meeting – STARWORMS
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Outline

- Introduction: the needs
- Mini-FLOTAC
- Mini-FLOTAC & public health
- Discussion

Introduction

Veterinary and human parasitology: needs of better diagnostics

Accurate, simple and affordable tests to provide results in time for effective control measures

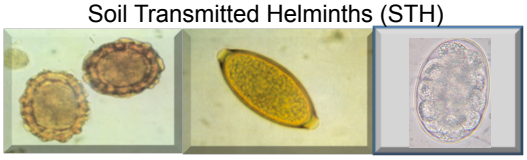
Diagnostic test

A	**a**ffordable
S	**s**ensitive
S	**s**pecific
U	**u**ser-friendly
R	**r**apid and **r**obust
E	**e**quipment-free
D	**d**eliverable

Banoo et al., Nature Reviews Microbiology, 2010

Introduction

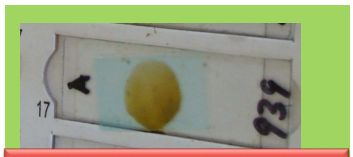
…..a step forward in the fight against Soil Transmitted Helminths (STH)



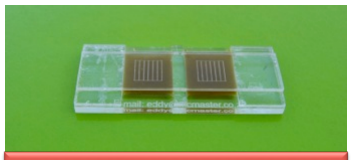
Introduction

Kato-Katz is the faecal egg count (FEC) technique recommended for the diagnosis of STH. McMaster, FLOTAC and Mini-FLOTAC techniques are used both in veterinary and human parasitology.

FEC techniques and analytic sensitivities (EPG)



Kato-Katz
24 EPG



McMaster
15-50 EPG

FLOTAC
1 EPG

Mini-FLOTAC
5-10 EPG

Introduction

Faecal Egg Count (FEC) techniques and performance

FEC Techniques	Diagnostic performance	Technical performance
Kato-Katz		
McMaster		
FLOTAC		
Mini-FLOTAC		

- A plethora of variants of each FEC technique
- Standardization of FEC techniques does not exist
- Diagnostic, research and teaching laboratories often apply their own protocols based on the “lab traditions”

Introduction

Factors often neglected:

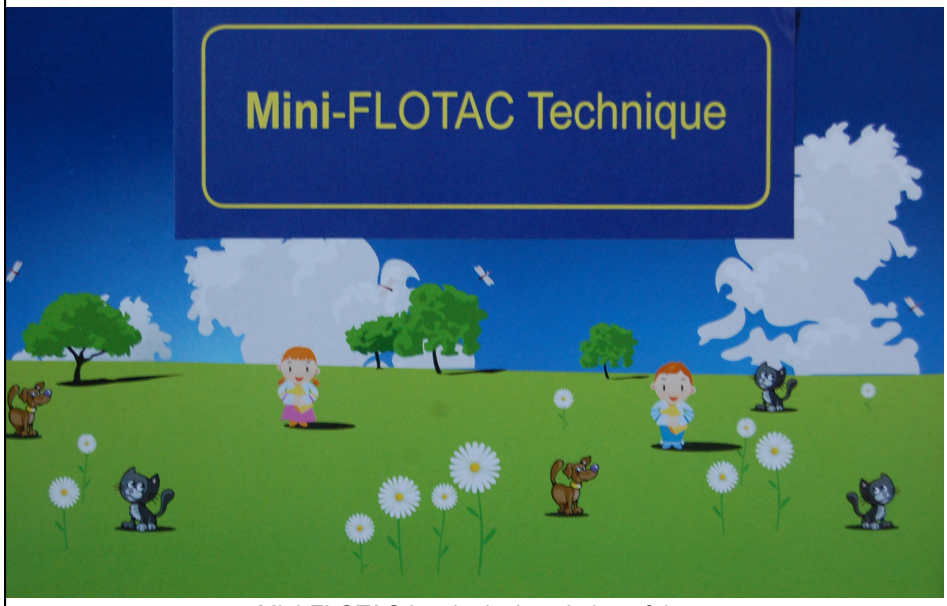
- ✓ Accuracy of lab procedures and experience of the laboratory technicians: the human factor!
- ✓ Impact of: fixative used for preservation, duration of faecal preservation before analyses, flotation solution, etc.
- ✓ Helminth eggs should not be considered "inert elements"

Introduction

The "FLOTAC strategy" aims at improving the quality of copromicroscopic diagnosis

Problems and needs:

- ✓ Absence of a true gold standard (⟹ modeling)
- ✓ Field and remote diagnosis (⟹ e-health, m-health)



Mini-FLOTAC is a logical evolution of the FLOTAC technique

Mini-FLOTAC and Fill-FLOTAC

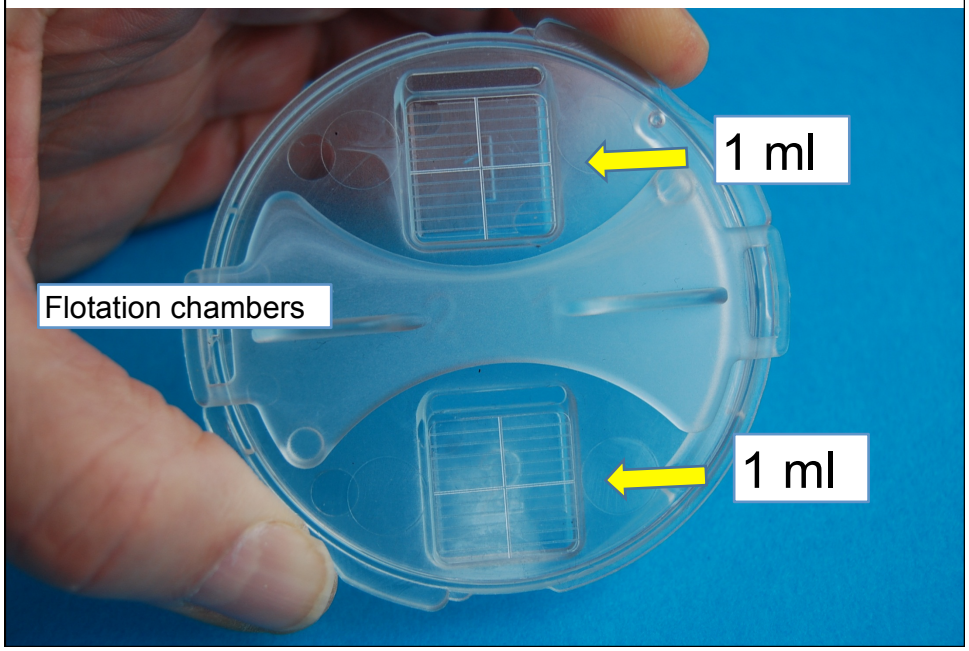
Mini - FLOTAC

Fill - FLOTAC

- ✓ Closed devices: safe with no risk of contamination for the operator
- ✓ No centrifugation
- ✓ Fresh samples
- ✓ Formalin or any preservative can be added and the samples stored for further testing

Mini-FLOTAC

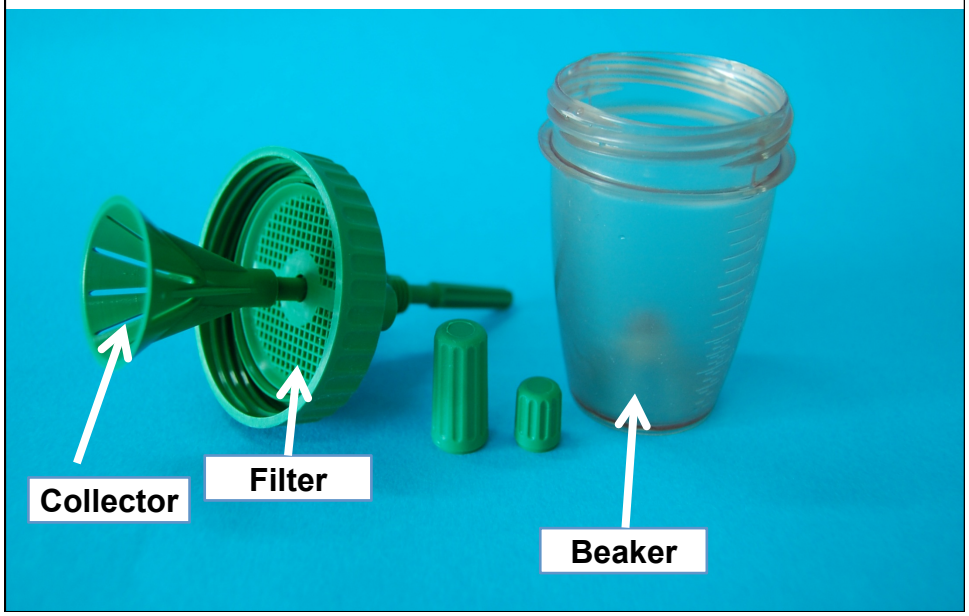
Mini-FLOTAC



Fill-FLOTAC

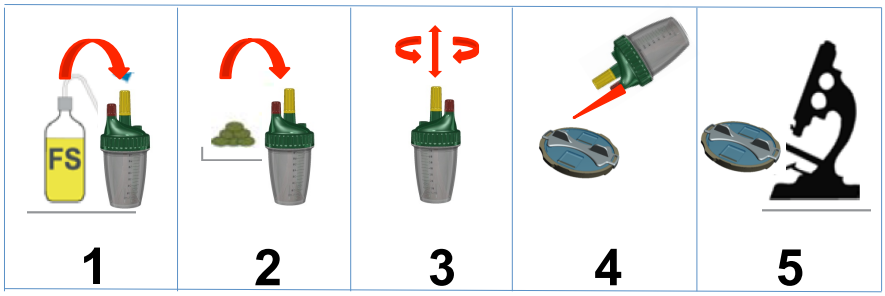
Fill-FLOTAC

Fill-FLOTAC

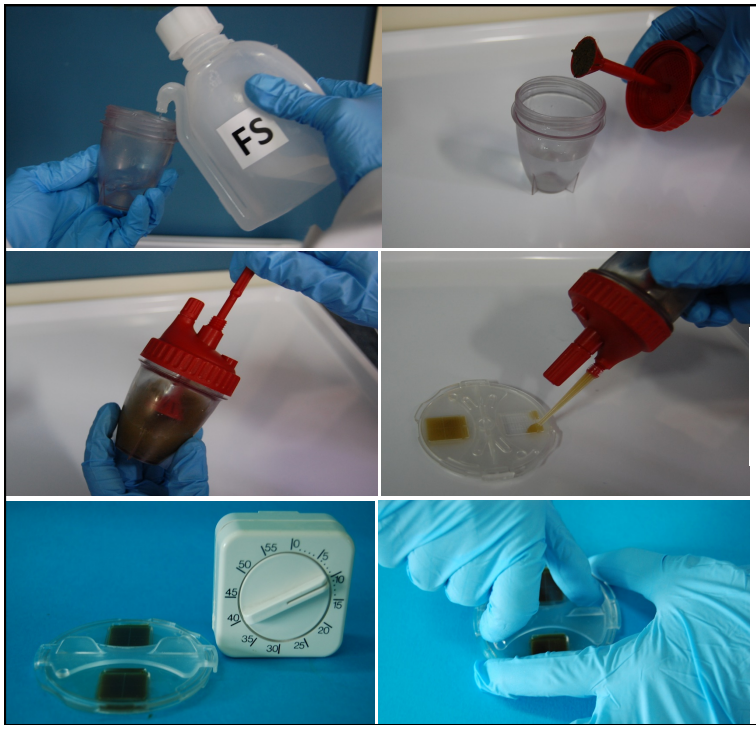


Mini-FLOTAC technique

Mini-FLOTAC technique on fresh faecal samples

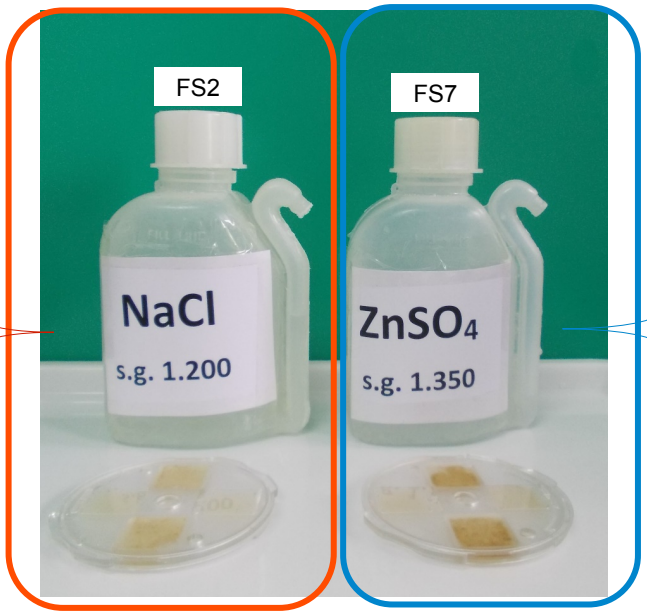


Easy to use also in settings with limited facilities



Mini-FLOTAC technique on fresh samples

Mini-FLOTAC Flotation Solutions

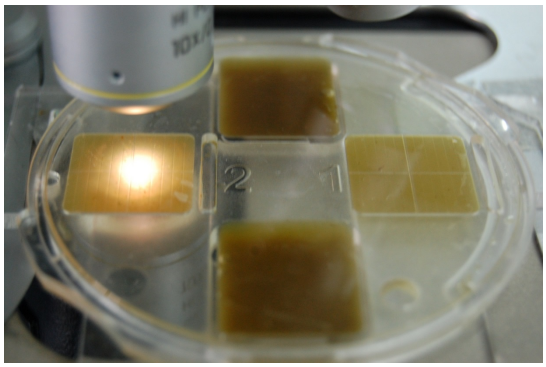


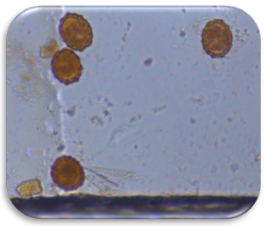
STH, other nematoda and cestoda

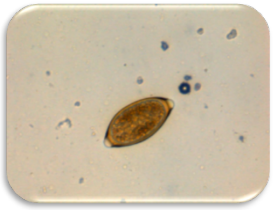
Trematoda protozoa

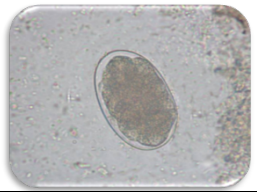
Mini-FLOTAC

Mini-FLOTAC under the microscope: STH

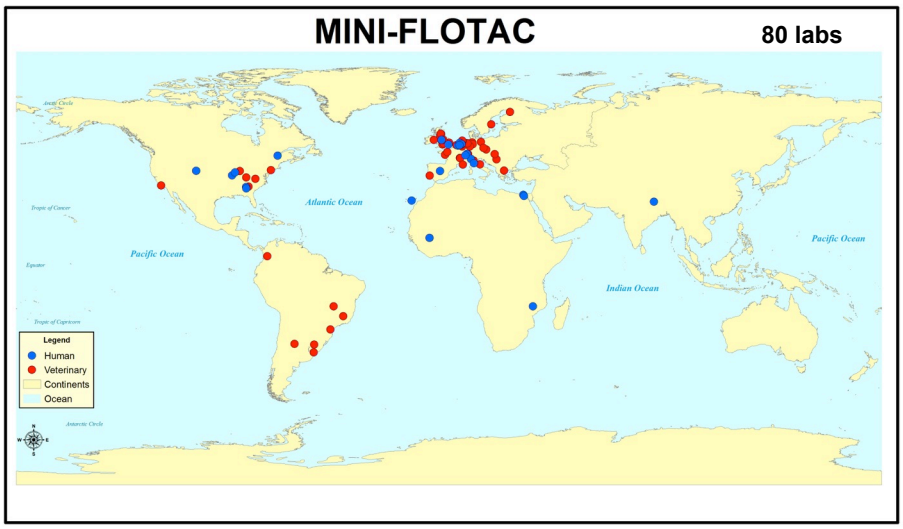








Mini-FLOTAC in public health



Mini-FLOTAC in public health

World Health Organization

UNIVERSITEIT GENT

Swiss TPH
Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut

FONDAZIONE IVO DE CARNERI ONLUS
For the promotion of control strategies against parasitic diseases in developing countries and to encourage research in parasitology

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Partnership for Treating and Preventing Intestinal Worms
ChildrenWithoutWorms

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

THE TASK FORCE FOR GLOBAL HEALTH

BILL & MELINDA GATES foundation

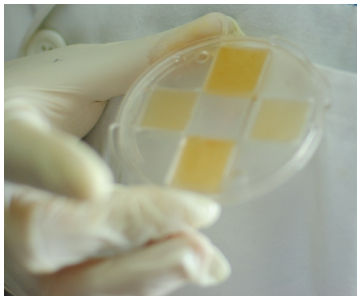
Mini-FLOTAC in public health

Tanzania (Pemba), 2012, 2013, 2015

Mini-FLOTAC in public health

Tanzania (Bukumbi, 2012)

Mini-FLOTAC in public health



India, 2012

Mini-FLOTAC in public health

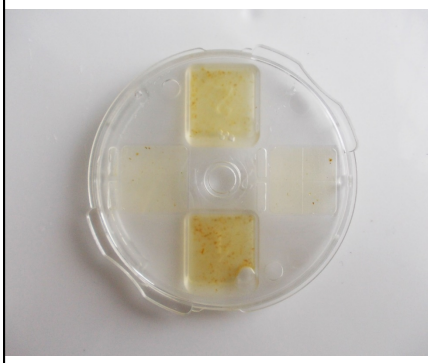
Bangladesh, 2013

Mini-FLOTAC in public health

Perù, 2013

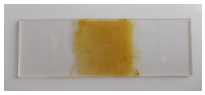
Mini-FLOTAC in public health

Mini-FLOTAC



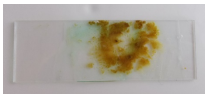
versus

Direct smear

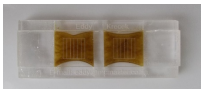


Formol-ether conc.

Kato Katz



McMaster



Mini-FLOTAC in public health

Settings	n°	FEC Techniques	Helminths investigated
Tanzania (Lake Victoria)	201	Direct smear, Kato-Katz, Mini-FLOTAC	Hookworms, *Schistosoma mansoni*
India (Dharamsala),	80	Formol-Ether Concentration, Direct smear, Mini-FLOTAC	*Ascaris, Trichuris,* others
Tanzania (Bukumbi)	100		Hookworms, *Schistosoma mansoni*, others
India (Dharamsala)	72	Formol-Ether Concentration, Direct smear, Mini-FLOTAC	*Ascaris,Trichuris,* others
India (Dharamsala)	80		
Argentina	193	McMaster, Kato-Katz, Mini-FLOTAC	STH
Tanzania (Bukumbi, Kigongo, Isamilo and Chole)	251	McMaster, Kato-Katz, Mini-FLOTAC	Hookworms, *Trichuris, S. mansoni,* others
Tanzania (Pemba)	41	Kato-Katz and Mini-FLOTAC (faeces fixed from 1 to 31 days with 5% formalin)	STH
Kenya (Bungoma)	652	Kato-Katz and Mini-FLOTAC (single and consecutive days)	STH
Bangladesh (100 villages in rural areas)	1630	Only Mini-FLOTAC	STH

OPEN ACCESS Freely available online August 2013 | Volume 7 | Issue 8 | e2344 PLOS | NEGLECTED TROPICAL DISEASES

Mini-FLOTAC, an Innovative Direct Diagnostic Technique for Intestinal Parasitic Infections: Experience from the Field

Beatrice Divina Barda[1*], Laura Rinaldi[2], Davide Ianniello[2], Henry Zepherine[3], Fulvio Salvo[4], Tsetan Sadutshang[5], Giuseppe Cringoli[2], Massimo Clementi[1], Marco Albonico[6]

180 children from two schools:

Dharamsala (India) (n = 80)
Bukumbi (Tanzania) (n = 100)

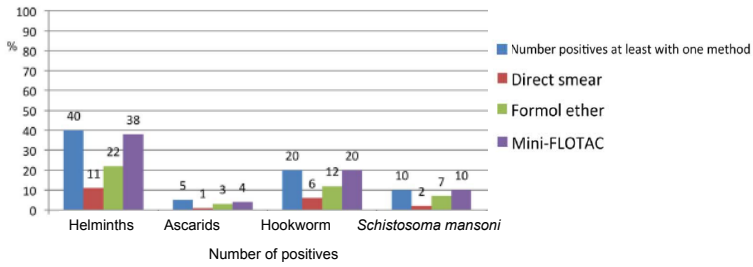
Diagnosis of intestinal parasitic infections with three methods:

- Direct fecal smear
- Formol-ether concentration (FECM)
- Mini-FLOTAC

PLOS Neglected Tropical Diseases | www.plosntds.org Barda et al. August 2013 | Volume 7 | Issue 8 | e2344

Principal findings

Overall, 72% of the children were positive for any intestinal parasitic infection (helminths and protozoa)



Mini-FLOTAC was the most sensitive method for helminth infections (90% mini-FLOTAC, 60% FECM, and 30% direct fecal smear)

Barda *et al. Parasites & Vectors* 2013, **6**:220
http://www.parasitesandvectors.com/content/6/1/220

Parasites & Vectors

RESEARCH Open Access

Mini-FLOTAC and Kato-Katz: helminth eggs watching on the shore of lake Victoria

Beatrice Barda[1*], Henry Zepherine[3], Laura Rinaldi[2], Giuseppe Cringoli[2], Roberto Burioni[1], Massimo Clementi[1] and Marco Albonico[4]

201 children from two schools in the Mwanza district (Tanzania):

Kigongo (n = 90)
Isamilo (n = 111)

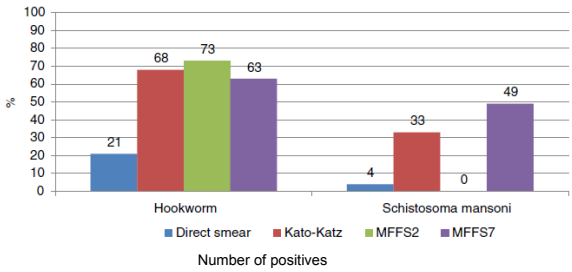
Diagnosis of intestinal parasitic infections with three methods:

- Direct fecal smear
- Kato-Katz
- Mini-FLOTAC

Barda *et al. Parasites & Vectors* 2013, **6**:220

Principal findings

Overall, 91% of the children were positive for any helminth infections



Mini-FLOTAC was
more sensitive for hookworm (98%) with FS2, and for *S. mansoni* (90%) with FS7 followed by Kato-Katz (91% and 60% respectively) and direct smear (30% and 10% respectively).

Acta Tropica 130 (2014) 11–16

"Freezing" parasites in pre-Himalayan region, Himachal Pradesh: Experience with mini-FLOTAC

Beatrice Barda[a,*], Davide Ianniello[b], Fulvio Salvo[c], Tsetan Sadutshang[d], Laura Rinaldi[b], Giuseppe Cringoli[b], Roberto Burioni[a], Marco Albonico[e]

Principal findings

152 subjects (adults and children) examined

Table 1
Prevalence of intestinal parasitic infections with three diagnostic methods: mini-FLOTAC, formol-ether concentration method and direct smear.

	Diagnostic methods									
	Mini-FLOTAC				Formol-ether concentration		Direct smear		Total	
	N. pos F2 (%)	95% CI	N. pos F7 (%)	95% CI	N. pos (%)	95% CI	N. pos (%)	95% CI	N. pos (%)	95% CI
Helminths	11 (7.2)	3.8–12.9	22 (14.5)	9.5–21.3	14 (9.2)	5.3–15.3	9 (5.9)	2.9–11.3	25 (16.4)	11.1–23.5
Ascaris lumbricoides	3 (2.0)	0.5–6.1	16 (10.5)	6.3–18.8	10 (6.6)	3.4–21.1	6 (3.9)	1.6–8.8	17 (11.2)	6.8–17.6
Others	8 (5.3)	2.5–10.5	8 (5.3)	2.5–10.5	5 (3.3)	1.2–7.9	4 (2.6)	0.8–7.0	10 (6.6)	3.4–12.1

Mini-FLOTAC resulted in the detection of higher number of helminths (14.5%) than Formol-ether (9.2%) and direct smear (5.9%)

Barda *et al. Parasites & Vectors* 2014, 7:271
http://www.parasitesandvectors.com/content/7/1/271

Parasites & Vectors

RESEARCH Open Access

Mini-FLOTAC, Kato-Katz and McMaster: three methods, one goal; highlights from north Argentina

Beatrice Barda[1*], Pamela Cajal[2], Eliana Villagran[2], Ruben Cimino[2], Marisa Juarez[2], Alejandro Krolewiecki[2], Laura Rinaldi[3], Giuseppe Cringoli[3], Roberto Burioni[1] and Marco Albonico[4]

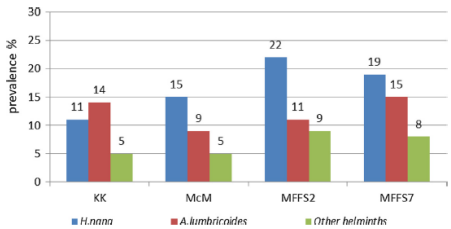
193 schoolchildren from one primary school in Oran (Northen Argentina)

Diagnosis of intestinal parasitic infections with three methods:

- Kato-Katz
- McMaster
- Mini-FLOTAC

Barda *et al. Parasites & Vectors* 2014, 7:271

Principal findings



Other helminths: *Trichuris trichiura, Enterobius vermicularis* and hookworm

Figure 1 Prevalence of helminth infections with Kato-Katz (KK), McMaster (McM), Mini-FLOTAC FS2 (MFS2) and Mini-FLOTAC FS7 (MFFS7) methods.

Mini-FLOTAC was more sensitive than Kato-Katz and McMaster for *H. nana* and as sensitive as Kato-Katz and more sensitive than McMaster for *A. lumbricoides.*

Egg counts differences although relevant, did not reach statistical significance

OPEN ACCESS Freely available online May 2014 | Volume 8 | Issue 5 | e2843 PLOS | NEGLECTED TROPICAL DISEASES

Diagnostic Accuracy and Cost-Effectiveness of Alternative Methods for Detection of Soil-Transmitted Helminths in a Post-Treatment Setting in Western Kenya

Liya M. Assefa[1]*, Thomas Crellen[1], Stella Kepha[2], Jimmy H. Kihara[3], Sammy M. Njenga[3], Rachel L. Pullan[1], Simon J. Brooker[1]

652 schoolchildren from 18 schools in Bungoma (Kenya)

Diagnosis of STH infections with two methods:

- Kato-Katz
- Mini-FLOTAC

PLOS Neglected Tropical Diseases | www.plosntds.org Assefa et al. May 2014 | Volume 8 | Issue 5 | e2843

Principal findings

Table 2. Sensitivity and specificity of Kato-Katz and Mini-FLOTAC diagnostic methods for soil-transmitted helminths over singl and consecutive day sampling as estimated by latent class analysis.

Test	*N* samples/groups	Diagnostic error of Kato Katz (95% BCI)		Diagnostic error of Mini-FLOTAC (95% BCI)	
		Sensitivity	Specificity	Sensitivity	Specificity
Single day					
Hookworm	525/18	52.6 (37.8–67.1)	96.5 (92.9–99.3)	47.3 (34.4–60.9)	97.4 (94.5–99.4)
A. lumbricoides	525/18	53.3 (33.9–74.2)	99.0 (97.8–99.8)	50.5 (32.2–72.8)	99.4 (98.3–99.9)
T. trichiura	525/18	52.9 (37.7–72.5)	99.5 (98.6–99.9)	52.5 (37.3–69.7)	99.6 (98.8–99.9)
Any STH	525/18	52.0 (38.5–65.9)	95.5 (90.8–98.9)	49.1 (36.6–63.4)	96.7 (92.2–99.3)
Consecutive day					
Hookworm	132/6	77.6 (61.3–89.2)	93.2 (86.4–98.5)	72.2 (57.0–84.7)	94.9 (89.2–98.8)
A. lumbricoides	132/6	78.2 (56.4–93.3)	97.8 (95.6–99.5)	75.5 (54.1–92.6)	98.7 (96.6–99.7)
T. trichiura	132/6	77.8 (61.2–92.4)	99.0 (97.3–99.8)	77.4 (60.7–90.9)	99.1 (97.6–99.8)
Any STH	132/6	76.9 (62.2–88.3)	91.2 (82.5–97.8)	74.1 (59.8–86.6)	93.5 (85.2–98.5)

Sensitivity was comparable between Kato-Katz and Mini-FLOTAC for STH over a single day (Kato Katz: 52.0%, Mini-FLOTAC: 49.1%) and consecutive days (Kato-Katz: 76.9%, Mini- FLOTAC: 74.1%). Costs were lowest in scenarios using Kato-Katz

PLOS Neglected Tropical Diseases | DOI:10.1371/journal.pntd.0003698 April 7, 2015

How Long Can Stool Samples Be Fixed for an Accurate Diagnosis of Soil-Transmitted Helminth Infection Using Mini-FLOTAC?

Beatrice Barda[1,2]*, Marco Albonico[3], Davide Ianniello[4], Shaali M. Ame[5], Jennifer Keiser[1,2], Benjamin Speich[1,2], Laura Rinaldi[4], Giuseppe Cringoli[4], Roberto Burioni[6], Antonio Montresor[7], Jürg Utzinger[2,8]

Mini-FLOTAC task force in Pemba

- ✓ 41 children enrolled
- ✓ Stool samples analyzed at Day 0 with a single Kato-Katz and Mini-FLOTAC
- ✓ 12 aliquots of stool fixed in 5% formalin (1:1) and examined by Mini-FLOTAC up to 31 days after collection.

PLOS Neglected Tropical Diseases | Barda et al. April 7, 2015

Principal findings

- ✓ Kato-Katz and Mini-FLOTAC: similar prevalence estimates for *A. lumbricoides* (85% *vs* 76%), *T. trichiura* (98% *vs* 100%), and hookworm (42% *vs* 51%)
- ✓ Mean EPG according to Kato-Katz and Mini-FLOTAC was 2,075 and 11,679 for *A. lumbricoides*, 1,074 and 1,592 for *T. trichiura*, and 255 and 220 for hookworm.
- ✓ The mean EPG from day 1 to 31 of fixation was stable for *A. lumbricoides and T. trichiura*, but gradually declined for hookworm, starting at day 15.

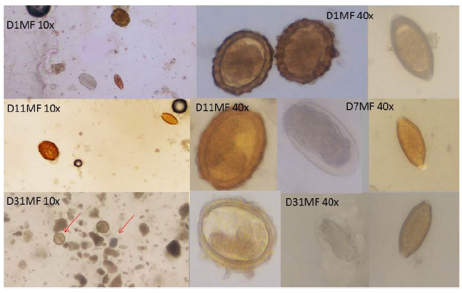


Fig 4. Pictures of soil-transmitted helminths at different time points after fixation in formalin. D_1 10x: *A. lumbricoides*, *T. trichiura*, and hookworm; D_1 40x: *A. lumbricoides* and *T. trichiura*; D_7 40x hookworm and *T. trichiura*; D_{11} 10x *A. lumbricoides* and *T. trichiura*; D_{11} 40x *A. lumbricoides*, D_{31} 10x *A. lumbricoides* and hookworm, D_{31} 40x *A. lumbricoides*, hookworm, and *T. trichiura*.

PLOS Neglected Tropical Diseases | DOI:10.1371/journal.pntd.0004256 December 1, 2015

The Interaction of Deworming, Improved Sanitation, and Household Flooring with Soil-Transmitted Helminth Infection in Rural Bangladesh

Jade Benjamin-Chung[1]*, Arifa Nazneen[2], Amal K. Halder[2], Rashidul Haque[2], Abdullah Siddique[2], Muhammed Salah Uddin[2], Kim Koporc[3], Benjamin F. Arnold[1], Alan E. Hubbard[1], Leanne Unicomb[2], Stephen P. Luby[4], David G. Addiss[3], John M. Colford, Jr.[1]

Principal findings

1,360 schoolchildren from 100 villages in rural Bangladesh

Diagnosis of STH with Mini-FLOTAC on fixed samples

Prevalence (~40%) associated with deworming, sanitation, and hygiene

Discussion

*Take home message

- ✓ Mini-FLOTAC techniques are useful for the diagnosis of STH (monitoring and efficacy studies)
- ✓ No competition…but **collaboration, integration and standardization of** diagnostic tools for monitoring the global patterns of effectiveness of drugs and AR in STH control programs

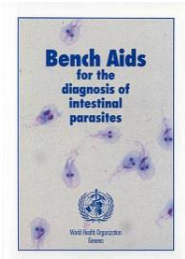
Discussion

- ✓ Parasitologists and diagnosticians are re-evaluating their attitude of …… "it's only a faecal sample"!

- ✓ Something is changing……

World Health Organization

- ✓ New guidelines ongoing, including SOP for different techniques

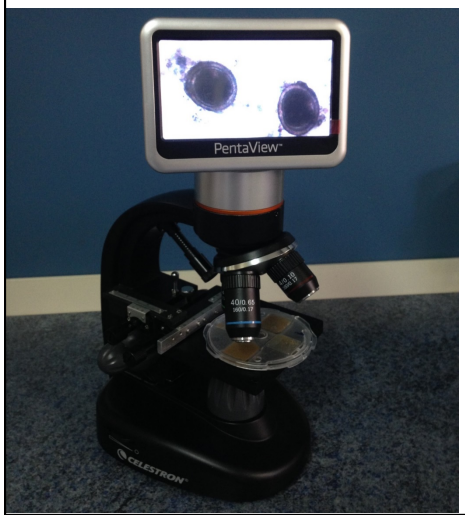


Discussion

- ✓ Ongoing research
- ✓ News: devices in biodegradable plastic

Discussion

- ✓ Mini-FLOTAC on pooled samples
- ✓ Mini-FLOTAC linked to electronic and mobile health



Mini-FLOTAC in the field

Mini-FLOTAC in the field

Mini-FLOTAC in the field

Mini-FLOTAC in the field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For the promotion of control strategies against parasitic diseases in developing countries
LONDON SCHOOL of HYGIENE
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