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ORIGINAL ARTICLE

Feasibility of a combined camp approach for vector control together with active case detection of visceral leishmaniasis, post kala-azar dermal leishmaniasis, tuberculosis, leprosy and malaria in Bangladesh, India and Nepal: an exploratory study

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Background: We assessed the feasibility and results of active case detection (ACD) of visceral leishmaniasis (VL), post kala-azar dermal leishmaniasis (PKDL) and other febrile diseases as well as of bednet impregnation for vector control.

Methods: Fever camps were organized and analyzed in twelve VL endemic villages in Bangladesh, India, and Nepal. VL, PKDL, tuberculosis, malaria and leprosy were screened among the febrile patients attending the camps, and existing bednets were impregnated with a slow release insecticide.

Results: Among the camp attendees one new VL case and two PKDL cases were detected in Bangladesh and one VL case in Nepal. Among suspected tuberculosis cases two were positive in India but none in the other countries. In India, two leprosy cases were found. No malaria cases were detected. Bednet impregnation coverage during fever camps was more than 80% in the three countries. Bednet impregnation led to a reduction of sandfly densities after 2 weeks by 86% and 32%, and after 4 weeks by 95% and 12% in India and Nepal respectively. The additional costs for the control programmes seem to be reasonable.

Conclusion: It is feasible to combine ACD camps for VL and PKDL along with other febrile diseases, and vector control with bednet impregnation.

Keywords: Active case detection, Bednet impregnation, Febrile cases, Post kala-azar dermal leishmaniasis, Visceral leishmaniasis, Sandfly control

Introduction

Visceral leishmaniasis (VL) is an important public health problem in India, Bangladesh and Nepal. The regional VL elimination program with the target to reduce the annual incidence of VL below one case per 10 000 inhabitants by 2015 was launched in 2005 after the signing of a memorandum of understanding among Bangladesh, India and Nepal. The multi-national VL elimination programme aims at the interruption of disease transmission through the control of the vector *Phlebotomus argentipes*–an indoor night biting exclusively anthropophilic sandfly with high densities between March and August when temperature and humidity are high–and the early identification of disease through effective disease surveillance and access to health care for VL treatment with particular attention to the poor and marginalized communities of VL endemic foci.[1,2]

Detection of all clinical types of VL (active clinical, subclinical and asymptomatic) and their management is very pertinent in order to bring down the parasite load in the community.[3] The identification of disease foci is essential as the VL cases are found in clusters in the endemic areas.[4]

During recent years a continuous decrease of VL cases has been observed in the three countries, coming close to the elimination goal. Active case detection (ACD) in the endemic areas, using a case definition according to national guidelines in the three countries (i.e., fever for more than 2 weeks, spleen enlargement and positive rapid diagnostic test rK39 [Gilead Sciences, Alberta, Canada]), is essential for further reducing and finally interrupting parasite transmission by detecting and treating new cases at an early stage.[5] During the late stage of the attack phase of elimination, the priority must be to effectively implement existing interventions at the community level through ACD in endemic villages.[6] Lack of active disease surveillance results also in the under-reporting of VL burden[7] which is particularly detrimental to the elimination initiative. A multi-center study conducted in Bangladesh, India and Nepal found that the proportion of VL cases detected through ACD was high compared to cases reported through routine surveillance.[5] The analysis of the effectiveness of ACD for new VL cases using house to house screening in Bangladesh and India and neighborhood screening around index cases in Nepal revealed that the percent increase of new VL cases through ACD compared to passive case detection (PCD) was 6.7–17.1% in India,38.8% in Nepal and 60% in Bangladesh.[8] However, the number of new VL and post kala-azar dermal leishmaniasis (PKDL) cases was limited in areas of lower endemicity, therefore the efficiency (i.e., cost in relation to the results) of fever camps could be improved by screening for other fever diseases (tuberculosis and malaria) or skin afflictions (leprosy); additionally vector control through insecticide treated bednets would enhance the impact of the combined fever camps.[9,10]

We organized mobile one-day 'fever camps' (no over-night stay; the term 'camp' adopted from national programme) in villages to screen and diagnose VL, PKDL, leprosy, malaria and tuberculosis among residents with chronic fever (for more than 2 weeks) or skin disease and to treat the existing bednets, which were very common in the area, with pyrethroid insecticides for vector control. The mobile teams conducting these 'combined fever camps' included medical officers, laboratory technicians from the district/sub-district health office and community health workers. The case detection of VL and other fever diseases and vector control activities were combined in order to make transmission prevention complete (early case detection and reduction of vector density) and to increase the efficiency of these camps (reduced cost per fever case diagnosed).The main objective of this study was to assess the feasibility, costs and results of a combination of active VL and PKDL case detection (including other fever diseases) and transmission reduction through vector control (bednet impregnation with slow release insecticide KOTAB 123, Bayer, Lyon, France) using the combined camp approach in Bangladesh, India and Nepal.

Materials and methods

Study districts and selected villages

VL incidence has now decreased to low levels in the three countries; districts with VL endemicity levels slightly above (Bangladesh, India) or below (Nepal) the elimination target of 1 case per 10 000 inhabitants; Table 1) were selected for the study in co-ordination with the national programmes: Mymensingh (Trishal sub-district) in Bangladesh, Vaishali in India and Saptari in Nepal. The study covered four villages in each of the three countries including on average in each village 2390 inhabitants in Bangladesh, 8397 in India and 1920 in Nepal.

Study design

A cross-sectional evaluation (exploratory proof of concept) study was conducted from June to August 2013 to determine the feasibility and constraints of combined fever camps with VL and PKDL ACD (including the detection of other febrile diseases) and vector management (including the analysis of the reduction of vector densities). Both qualitative and quantitative research methods were used.

Intervention activities (combined fever camps)

The research team together with the national and district level health officers first developed a plan for combined fever camps in the target areas. Then these activities were conducted in the villages together with the control staff of the national programmes. Discussion and orientation meetings were held with district health officers.

Pre-camp activities

Date, time and place of each camp, in particular health post, sub health post or Primary Health Care Centres, were defined. Community health volunteers and health workers were identified

Table 1. Background characteristics of the study area

Characteristics	Bangladesh	India	Nepal
Study district/sub-district	Trishal (Mymensingh)	Vaishali	Saptari
Number of VL cases in 2012 in the study district[a]	270	2076	47
Number of villages selected	4	4	4
Number of VL cases in the selected villages in one year	4	23	18
Incidence of VL per 10 000 population in 2012/2013 in district/sub-district	6.4 (270/424 243)	7.6 (2076/2 718 421)	0.7 (47/657 971)

[a] District and sub-district health/public health offices.
VL: Visceral leishmaniasis.

by the mobile camp teams from the district and sub-district assisted by the research team and trained to disseminate the message of the forthcoming fever camp, its purpose and who was supposed to attend the camp. Only people with fever and skin lesions were invited to attend the camp. The untreated bednets in the community were expected to be washed before the camp day and people were informed to bring those bednets for impregnation with KOTAB 123. The health workers disseminated the message 2–3 days (in Bangladesh 7 days) ahead of the camp day by house to house visits and meetings with village leaders.

Camp activities

A district mobile camp team consisting of one doctor, one health assistant and one laboratory technician visited the defined communities in each area to conduct the one-day camps. The camps in Nepal moved from community to community covering four communities in four days; in Bangladesh and India the teams returned in the evenings to the base (small hospital or Primary Health Care Centre). At the camp (usually a small school or community building), patients with fever were registered at the registration desk. Registered patients were examined and screened by the physician who decided on the further procedure. The laboratory technician performed rapid diagnosis for VL (in case of fever and spleen enlargement), PKDL and malaria at the camp site. The physician filled the referral forms for suspected tuberculosis and leprosy cases as well as for VL and PKDL cases (see below). The formats developed by the research team were used for registration, clinical examination by physicians and rapid diagnosis by laboratory technicians. Copies of all forms (including the filled referral forms collected from local hospitals) were kept at a central office by the research team and analysed by the data manager in each of the three country teams. The patients with VL (with chronic fever, spleen enlargement and positive in the rK39 test) diagnosed in the camp were referred to the nearest district or sub-district hospital for further diagnosis and treatment. Prior to organizing the camps, district and sub-district hospitals were informed by the camp teams about their role for the confirmatory diagnosis and treatment of referred patients from the camps. Patients with VL, after confirmatory diagnosis at district or sub-district hospitals, were reimbursed for travel and food costs and daily wages lost as per national program guidelines and norms. Patients suspected of having PKDL—a potentially communicable form of post-treatment leishmanisasis—were diagnosed by examining skin lesions and rK39 test. Patients with skin lesions and a positive rK39 test were referred and re-confirmed as PKDL positive cases in the district or sub-district hospital. Patients with skin lesions with a negative rK39 test result were clinically examined for leprosy and referred to the next hospital or primary health care centre for further examination. Rapid diagnostic tests (SD-Bioline, Standard Diagnostics Inc., Yongin-si, Gyeonggi-do, Republic of Korea) for malaria were used in the few villages of Nepal where malaria is prevalent. The patients suspected of having malaria, leprosy and tuberculosis were referred to the district hospital for confirmatory diagnosis with sputum smear (tuberculosis), blood smear microscopy (malaria) and skin examination (leprosy) and for treatment if confirmed. The referral forms and hospital reports were later analyzed by the research team.

Bednet impregnation in combined fever camps

During the camps and parallel to the clinical evaluation of fever patients vector control activities were conducted by impregnating the pre-existing bednets (note that the mesh size of non-impregnated nets allows sandflies to enter the net) with a slow release insecticide. Bednets were brought to the camp place by household members. They were impregnated by previously trained village health workers, under the supervision of the health assistant, with KOTAB 123 slow release insecticide, following the method described by Shreck and Self.[11] The active ingredient of KOTAB 123 is WHO specified deltamethrin with favourable bio-efficacy and a high safety level.[12] The impregnation of ordinary nets –which had a high household coverage in the study areas – with KOTAB123 transformed these into insecticide treated nets with long term protection. In our previous study the efficacy remained for at least 18 months, even after 25 washes.[9] After bednet impregnation, community people were told to dry the bednets in shadow and keep folded during the day. No additional KOTAB 123 were provided to the community people for future use (see Discussion).

Research activities

Qualitative and quantitative research

A formal survey was conducted with the 16 staff members involved in the camp activities of the three countries, asking questions about the need for doing such camps, their positive and negative experiences and suggestions for improvements. Additionally, observations using an observation checklist were conducted in the camps and community meetings after the camps for getting information on the peoples' perception of the intervention. Socio-demographic information and bednet use by the villagers was collected by structured interviews (392 in Bangladesh, 2048 in India and 300 in Nepal) and observation in all study households.

Determination of effectiveness of bednet impregnation

Sandflies were collected using CDC light traps hung in the bedrooms on two consecutive nights from 20 randomly selected households in the eight study villages and two matched control villages in India and Nepal (no measurement in Bangladesh due to resource constraints) at 2 weeks before, 4 weeks and 24 weeks after the impregnation of bednets and in control villages at the same time points. The procedure of sandfly collection, preservation and identification was followed as stated in the monitoring and evaluation toolkit.[13]

Determination of resource needs and feasibility of combined fever camps

'Feasibility' as a combined variable was defined as the viability of conducting one-day fever camps with the given financial, material and human resources. To this end a series of sub-studies was conducted:

1. At district hospitals, district public health offices and primary health care centres, observations were made to assure the

availability of the storage and distribution system of rK39 and VL drugs. In addition, equipment and supplies needed for the combined approach were identified and documented.
2. The costs of each item (personnel cost for case detection and bednet impregnation, cost of diagnostics and logistics, supplies and travel cost) using the ingredients method as well as staff time were recorded to enable the estimation of direct costs for the fever camps (NB: only the 'additional costs' for the national control program have been assessed because this is what the program officer considers when deciding about the adoption of a new strategy).The above mentioned costs of different resource elements were estimated (using allocation factors such as percentage of time spent by staff or vehicle used); they were then added up to get the total costs of a fever camp. Then average or unit cost per case detected (VL, PKDL, leprosy and tuberculosis) and cost per bednet impregnated and per household protected were calculated.
3. The completion of the work within 6 to 7 working hours per camp was documented.
4. At the end of the study period all field staff involved were interviewed with a standardized questionnaire soliciting opinions and experiences about ACD and vector management. It was originally intended to also interview the patients attending the camp, but it became clear that this would have interfered with the routine camp activities.

Data management and analysis

Data were entered using EpiInfo version 3.3.5(CDC, Atlanta, GA, USA). Data were checked and cleaned before analysis. Descriptive statistics were explored. The percent changes (PC) of sandfly counts attributed to intervention compared to the control areas was calculated as:

$$PC = (EF/\text{mean }(A)) * 100$$

Where, EF (effect of intervention) = [median(B) – median (A)] – [median (D)-median (C)]; and A=baseline median sandfly count for the intervention area; B=post-intervention sandfly count for the intervention area; C=baseline sandfly count for the control area; D=post-intervention sandfly count for the control area. Effect is negative or positive if sandfly density is decreased or increased after intervention and the effect should be zero if sandfly density is same as at baseline. Difference of sandfly count between pre and post intervention measurement for both intervention and control areas were assessed. Comparison of median difference in sandfly density between intervention and control areas was done using Mann-Whitney U test and p-value was reported. All calculations were performed by SPSS 13 (IBM, Armonk, NY, USA) and STATA 10 (Stata Corp LP, College Station, TX, USA).

Ethical considerations

The study received written consent from the participants. The diagnostic procedure followed national guidelines and no alternative drugs were tested. The study received ethical clearance by Ethical Review Committee, World Health Organization (ERC-WHO) and by institutional review boards of each country.

Results

Background information

The annual VL incidence per 10 000 population in 2012 was, according to official statistics, 6.4 in Trishal sub-district of Bangladesh, 7.6 in Vaishali district of India, and 0.7 in Saptari district of Nepal (Table 1).

Active case detection

During pre-camp activities, community people with fever or skin lesions were invited to attend the camps. A total of 100 people in Bangladesh, 220 in India and 85 in Nepal attended the four combined fever camps in each country. Among them, patients with fever for more than 2weeks numbered 23, 42 and 37 in Bangladesh, India and Nepal respectively. The spleen examination showed a slight to marked spleen enlargement in one case in Bangladesh, one in Nepal and none in India. The rK39 test was positive in three patients in Bangladesh, five in India, and one in Nepal. All patients positive by rK39 in India were past VL cases. The patients positive by rK39 in Bangladesh and Nepal were referred to district or sub-district hospitals for final diagnosis. Only one patient was positive for VL out of three referred to hospital in Bangladesh and one patient confirmed as having VL was referred to hospital in Nepal. In Bangladesh, two patients were positive for PKDL according to the final confirmatory diagnosis at district or sub-district hospitals (Table 2).

In Nepal, 33 individuals suspected of having malaria were tested with rapid diagnostic tests (SD-Bioline) but none were positive. Among two patients suspected and tested for tuberculosis in Bangladesh, five in India, and 34 in Nepal, two in India were sputum smear positive. Similarly, among four patients suspected and tested for leprosy, two were clinically diagnosed as having leprosy in India (Table 3). The patients with fever who were negative of above mentioned tests were referred to district or sub-district hospitals but they could not be followed due to resource constraints.

Bednet impregnation: coverage and effect on the vector population

In the fever camps, existing bednets of the study villages were impregnated with KOTAB 123. From the community survey conducted before organizing the combined camp, it was found that households having untreated bednets were 97.2% (381/392) in Bangladesh, 59.3% (1214/2048) in India, and 89.3% (268/300) in Nepal. The median number of bednets per household was two. Regular use of bednets by all family members of the household was 58.7% (230/392) in Bangladesh, 23.2% (281/2048) in India and 67.7% (203/300) in Nepal. The bednet impregnation rate was 82.1% (653/795) in Bangladesh, 81.5% (1680/2060) in India, and 99.8% (536/537) in Nepal (Table 4).

Besides the camp activities, the research team measured the sandfly density at baseline, 2 and 4 weeks after bednet impregnation in intervention and control villages in India and Nepal (no measurement in Bangladesh due to staff shortage). The reduction in sandfly density after 2 weeks of bednet impregnation was 86.5% and 32.6% in India and Nepal respectively as compared to baseline: the reduction after 4 weeks was 94.6% and 12.5% in India and Nepal respectively. The reduction was significant in

Table 2. Detection of visceral leishmaniasis (VL) and post kala-azar dermal leishmaniasis (PKDL) cases in four camp villages per country

Characteristics	Bangladesh	India	Nepal
Number of camp attendees	100	220	85
Number of fever cases screened in the camp[a]	25	42	53
Cases with fever more than 2 weeks	23	42	37
Fever cases with enlarged spleen	1	0	1
Cases with past VL history	3	5	1
rK39 test done[b]	3	42	24
rK39 test positive (including past VL cases)	3	5 past VL cases	1
Final diagnosis for VL (fever + enlarged spleen + rK39 positive)	1	0	1
Skin lesion like PKDL	2	0	0
Patient referred for VL/PKDL confirmatory diagnosis and treatment[c]	3	0	1

rK39: rapid test for VL and PKDL.
[a] The remainder had either skin lesions or recent feverish conditions (e.g. common cold) or diseases without fever (e.g. chronic diarrhea).
[b] In India and Nepal rK39 test was done on most or all cases with chronic fever, disregarding the spleen examination.
[c] Includes in Bangladesh and Nepal patients with skin lesions unlike PKDL.

Table 3. Detection of malaria, tuberculosis and leprosy in four camp villages per country

Characteristics	Bangladesh	India	Nepal
Number of cases suspected and tested for malaria	0	0	33
Number of malaria positive cases	0	0	0
Number of cases suspected and tested for tuberculosis	2	5	34
Number of tuberculosis positive cases	0	2	0
Number of cases suspected and tested for leprosy	0	4	0
Number of leprosy positive cases	0	2	0

India and non-significant in Nepal for both measurements (Table 5).

Feasibility and acceptability of the combined camp approach

The rK39 test kits, drugs for the treatment of VL, and other supplies for VL case management were available in district and sub-district health facilities of the three countries. Physicians of district and sub-district hospitals of the three countries and primary health care centres of Nepal and India had previously been trained for VL diagnosis and treatment. Public health authorities at district and sub-district level of the three countries were found maintaining up to date information of VL cases including linelisting of the cases and timely reporting to the central level. All the activities in the camps including registration, record keeping and case referral were done properly and within the given working time according to observation and document analysis by the research teams.

All 16 health workers of the three countries involved in the combined fever camps expressed in the interviews their positive experiences and feelings. Typical examples were: *We like the fever camps and want to continue the ACD camps including bednet dipping* (physician involved in camp activities in Bangladesh). People in the community were also satisfied with their fever diagnoses and bednet impregnation: *I would have bought some new bednets for dipping if I had known the advantages of such activity before* (community people attending camp in Nepal).

Government health workers who actively participated in the camps particularly underlined the importance of ACD and vector control during the maintenance phase of VL elimination. It was, however, suggested to further improve the pre-camp activities so that all fever patients would attend the camps.

Cost analysis

Cost per case detected (VL, PKDL, leprosy or tuberculosis) was US$219, 232.5 and 500.6 for Bangladesh, India and Nepal respectively (Table 6). When taking only VL or PKDL cases, the cost per case detected was US$219.0 in Bangladesh, and US$500.6 in Nepal. Regarding cost per combined camp, the total cost was US$164.25 in Bangladesh, US$232.5 in India and US$125.15in Nepal (Table 6). However, when including only the 'additional costs' which health services would have to bear, these would be much lower as they include only travel costs to the endemic villages and daily allowance plus some capacity building activities, but not salaries.

Discussion

ACD and early treatment has been recommended for long lasting communicable diseases in order to shorten the transmission period of the infective agent and to reduce human suffering. As an

Table 4. Bednet related information in four camp villages per country

Characteristics	Bangladesh	India	Nepal
Number of HHs in study villages	392	2048	300
Median number of living rooms per HH	2	2	2
Number of HHs with bednets, n (%)	381 (97.2)	1214 (59.3)	268 (89.3)
Median number of bednets in each HH	2	2	2
Bednet material	98.2% nylon	99.6% nylon	89.0% nylon
Median number of family members in the house	5	5	6
HHs with regular use of bednets by all family members, n (%)	230 (58.7)	281 (23.2)	203 (67.7)
Total number of bednets in the study villages	795	2060	537
Total number and proportions of bednets impregnated in the camps, n (%)	653 (82.1)	1680 (81.5)	536 (99.8)

HH: household.

Table 5. Median sandfly density per Centers for Disease Control (CDC) light trap per night before and after 2 and 4 weeks of bednet impregnation

Timeline	Median (IQR) sandfly density (per CDC light trap per night)			
	India		Nepal	
	Intervention	Control	Intervention	Control
Before intervention	3.5 (3.0–4.38)	3 (2.5–4)	8.25 (1.50–20.75)	1.50 (1.13–10.88)
After 2 weeks of intervention	0.0[a] (0.0–0.5)	3.0 (2.5–3.5)	10.0 (4.50–15.13)	7.50 (3.63–8.00)
After 4 weeks of intervention	0.5[a] (0.13–0.88)	3.5 (3.0–4.0)	4.75 (2.63–17.75)	9.50 (4.0–15.75)

[a] Significant reduction ($p<0.05$); Mann-Whitney U test.

example: the lag time from onset of VL symptoms to treatment was 104 days in India and 58 days in Nepal[14]; this would be considerably reduced by ACD and will be an indicator in further studies (see Conclusions). Different ACD methods have been tested against the gold standard of house-to-house screening; both the camp approach (detecting new cases in fever camps) and the incentive approach (detecting new cases through village health workers) were most promising due to relatively low costs and high yields of new cases.[15,16] One question which came up repeatedly in the context of ACD studies was what to do with the many fever patients who were not suffering from VL. Therefore, in the present study we extended ACD to other diseases where rapid diagnostic tests are available (such as malaria and to a less extent tuberculosis) or skin diseases similar to PKDL, in the case of our study region leprosy. Other diseases diagnosed by the camp doctors such as common cold or chronic diarrhea were not systematically registered. Due to resource constraints the patients with fever negative for our target diseases could not be followed; this will more systematically be done in the forthcoming extended study (see Conclusions). Regarding vector control, it had been shown in rural Bangladesh that a bednet impregnation programme with involvement of local communities can be cost-effective,[9,10] therefore combining different approaches without overburdening health workers and communities. Particularly, the national control programme in Bangladesh is considering the replacement of the expensive indoor residual spraying programme with impregnating existing bednets (national programme manager, personal communication).

Regarding the 'feasibility of combined fever camps, our study showed that it is technically feasible to conduct with the existing resources combined fever camps for detecting VL, PKDL, tuberculosis, leprosy and malaria, and to conduct at the same time vector control operations. Only the costs for the health services need further consideration. When estimating only the 'additional costs' for the Ministry of Health (mainly travel costs and per diem for health workers but not the costs for consumables–forms and diagnostic tests–which are covered by the routine budget) the costs per camp go down and they may be further reduced if combined camps are part of routine operations where every team member knows his or her role and responsibility and health staff can be partly replaced by community health workers. Indirect benefits of the camp activities were not included in the equation although they are probably considerable. To these belong the treatment of other diseases by the doctor during the camp, the reduced indirect costs for patients arising from early detection of the disease and avoiding the long pathways to diagnosis and treatment, and from averting parasite transmission through early diagnosis and vector control. Furthermore, when moving towards VL elimination, elevated cost for identifying the last few cases in order to interrupt the transmission will be accepted by health

Table 6. Cost of active case detection and bednet impregnation in combined camps

Particulars	Bangladesh	India	Nepal
No. of VL or PKDL case detected	3	0	1
Total number of bednets impregnated	653	1680	536
Travel cost	78	132	100.80
Daily allowance	545	621	365.9
Cost of rK39 test kit for VL or PKDL	8	42	24.00
Cost of KOTAB 123[a]	NA	NA	NA
Logistics for camp (record keeping, referral forms)	26	135	9.9
Total cost of four camps	657	930	500.6
Cost per case (VL, PKDL, TB, leprosy) detected	219.0	232.5	500.6
Cost per bednet impregnated	0.67	0.55	0.93
Cost per combined camp	164.25	232.5	125.15

NA: not applicable; PKDL: post kala-azar dermal leishmaniasis; rK39: rapid test for VL and PKDL; VL: visceral leishmaniasis.
All costs are given in US$.
[a] KOTAB123 (slow release insecticide for bednet impregnation) provided by the programme.

authorities as expressed by national program managers in an evaluation workshop of the here presented research. These strategies could be sustainable since the national programmes of these three countries have intensified their effort in ACD of VL and PKDL and vector control. Involvement of local health facility and organizing camps in the local health facility and out-reach clinics would cover the target population.

The bednet impregnation coverage was high (almost 100% in Nepal and approximately 82% in India and Bangladesh) and the reduction of the vector population was significant in India but not statistically significant in Nepal although a recent efficacy trial in Nepal with the same slow release insecticide as used in our study showed a significant reduction of VL vector densities (ML Das, personal communication; publication in preparation). This may be because in Nepal both intervention and control villages were covered additionally by indoor residual spraying with pyrethroid insecticides so that the impregnation of bednets did not provide an additional significant benefit. Informal conversations during the camps showed that the population was satisfied; they repeatedly mentioned that not only a small segment of the community (patients with fever) was attended but the whole population felt the benefits from the camps. From the provider point of view, the participating health staff was satisfied with the combined camps and recommended the strategy for general use in the national programmes. A workload assessment had previously shown that in most primary health care units there would be sufficient staff time available to carry out combined camps.[17]

National programme managers–who are involved in the design and analysis of this research porogramme–are willing to spend more resources on combined fever camps if the benefits of early detection of public health relevant diseases are obvious; particularly when, with the decline of VL cases, the largely unchanged burden of tuberculosis and the constant appearance of new leprosy cases justify the intervention and when in the geographical malaria-VL overlap areas new malaria cases can be detected through the camp approach. This will be further tested in a more extended study which will also include the detection of other infectious diseases.

The main limitation of this study was the small sample size; however, we could show in this exploratory study that it is feasible to conduct combined fever camps within the context of national control programs and that the potentials for detecting several fever diseases and organizing at the same time vector control are promising for the maintenance phase of the VL elimination initiative. Also the inclusion of only a reduced number of diagnostic tests can be overcome by doing extended testing of candidate pathogens during the fever camps. Regarding the bednet impregnation program, we have learned that the advanced promotion at community level is needed for achieving a high coverage of insecticide treated nets.

Conclusions

With the decrease of VL/PKDL cases in the context of the elimination initiative it is necessary to use a cost-effective case detection tool which has been explored in this study. This proof-of-principle study provides the first piece of evidence that case detection of various diseases combined with vector control interventions for VL elimination during the consolidation and maintenance phase is a promising approach for being integrated into the national control programmes. Further analysis of the strategy presented here of combined fever camps (ACD of an extended number of fever diseases and at the same time organization of vector control operations) in larger settings is planned for the near future.

Authors' contributions: All authors contributed equally in designing the study. MRB, MMH, VK, CKG, MLD, SR, PD, and DM implemented the study. MRB, AK, MMH, VK, CKG, DM analyzed data and writing the manuscript. All the authors read and approved the final manuscript. MRB, AK, PD and DM are guarantors of the paper.

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Competing interests: None declared.

Ethical approval: The study received written consent from the participants. The diagnostic procedure followed national guidelines and no alternative drugs were tested. The study had received ethical clearance by ERC-WHO and by IRBs of each country.

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