Integrated Approach in the Control and Management of Skin Neglected Tropical Diseases in three health districts of Côte d’Ivoire

CURRENT STATUS: UNDER REVIEW

BMC Public Health  BMC Series

Aboa Paul Koffi
Programme National de Lutte contre l'Ulcère de Buruli

Théodore Ange Kouakou Yao
Programme National de Lutte Contre l’Ulcère de Buruli

YVES Thierry BAROGUI  yvesbaro@yahoo.fr
Ministry of Health, Benin
Corresponding Author
ORCiD: 0000-0002-9266-1476

Gabriel Diez
Fondation Anesvad

Simplice Djakeaux
Programme National d’Elimination de la Lèpre

Marie Hélène Zahiri
Programme National d’Elimination de la Lèpre

Ghislain Emmanue I Sopoh
Institut Régional de Santé Publique de Ouidah, Université d’Abomey-Calavi

Silvia Santos
Fondation Anesvad

Asiedu Kingsley
World Health Organization

Roch Christian Johnson
Centre Inter Facultaire de Formation et de Recherche en Environnement pour le
Developpement Durable, Université d'Abomey-Calavi

Henri Assé
Programme National de lutte contre l’Ulcer de Buruli

DOI: 10.21203/rs.2.13484/v2

SUBJECT AREAS
Tropical Medicine  Health Economics & Outcomes Research

KEYWORDS
Neglected Tropical Diseases - Integration – Skin diseases - Côte d’Ivoire
Abstract

Background Neglected Tropical Diseases (NTDs) comprise 20 communicable diseases that are prevalent in rural poor and remote communities with less access to the health system. For an effective and efficient control, the WHO recommends to affected countries the implementation of integrated control interventions that take into account the different co-endemic NTDs in the same community. However, implementing these integrated interventions involving several diseases with different etiologies, requiring different control approaches and driven by different vertical programs remains a challenge. We report here the results and lessons learned from a pilot test of this integrated approach based on integrated screening of skin diseases in three co-endemic health districts of Côte d'Ivoire, a West African country endemic for Buruli ulcer, leprosy and yaws three skin NTDs. Method This cross-sectional study took place from April 2016 to March 2017 in 3 Districts of Côte d’Ivoire co-endemic for BU, leprosy and yaws. It was carried out in 6 stages: identification of potentially co-endemic communities; stakeholder training; social mobilization; mobile medical consultations; case detection and management; and a review meeting. Results In total, 2310 persons screened had skin lesions at the screening stage. Among them, 07 cases were diagnosed as Buruli ulcer. There were 30 leprosy cases and 15 yaws detected. Other types of ulcerations and skin conditions have been identified and represent the majority of cases detected. We learned from this pilot experience that integration can be successfully implemented in co-endemic communities in Côte d’Ivoire. Health workers are motivated and available to implement integrated interventions instead of interventions focused on a single disease. However, it is essential to provide capacity building, a minimum of
drugs and consumables for the care of the patients detected, as well as follow up of detected patients including those with other skin conditions. Conclusions The results of this study show that the integration of activities can be successfully implemented in co-endemic communities under the condition of a staff capacity building and a minimal care of the detected patients.

Background

As defined by the WHO, Neglected Tropical Diseases (NTDs) currently include 20 prevalent communicable diseases in tropical and subtropical areas. These diseases affect more than a billion people mainly in poor rural communities with limited access to health care [1,2]. The WHO classified NTDs into two groups: those that are amenable to preventive chemotherapy (PC-NTDs) and those that are addressed through case management (CM-NTDs) [3]. In addition, there are NTDs (such as BU; leprosy; yaws; cutaneous leishmaniasis and mycetoma; onchocerciasis; lymphatic filariasis; etc.) which have in common easily recognizable skin manifestations [3]. The WHO target by year 2020 for the three skin NTDs (leprosy, BU and yaws) are, respectively, elimination as a public health problem, control and eradication in all endemic countries [3]. Thus, examining the skin of people in communities or schools offers the possibility of identifying patients and of detecting several diseases in one visit.

Côte d’Ivoire is a West African country endemic for BU, leprosy and yaws [4–8]. While the situation of leprosy and BU is relatively well documented, data on yaws is limited [7,9].

According to official statistics of the Ministry of Health and Public Hygiene of Côte d’Ivoire, the epidemiological trend of new cases of leprosy and BU have been
declining. A total of 1 169 leprosy cases were reported in 2013 compared to 645 in 2018 [10] and 1 039 cases of BU were detected in 2013 compared to 261 in 2018 [11]. This decrease in the number of new cases makes the vertical control programs focused on single diseases less effective and efficient. Several districts are co-endemic for leprosy and BU. In these co-endemic districts and communities, very often the screening and management of these NTDs are carried out by the same health workers. To increase the effectiveness and efficiency of interventions and extend coverage of care in this context, a common integrated approach in the control and management of NTDs is recommended [3,12,13].

Even though theoretically, the notion of integration seems logical and simple, its practical implementation remains a challenge because of traditional partnerships that have supported vertical control programmes. For example, leprosy supported by members of the ILEP organization with their own modus operandi and highly vertical funding system. At the national and treatment facility levels, the technical staff is often different for each disease. From a technical point of view, each vertical program has its own strategic and normative plan, its management tools, notification and reporting system. Similarly, the interventions are sometimes specific to each disease depending on its mode of transmission and the technical guidelines for its management [different WHO technical guidelines]. Several publications have been made in recent years on this concept of integration [12,14-16]. Among these, Mitjà et al proposed an integration approach based on the 7 key points: initial assessment of the disease burden; training; development of an integrated control strategy for each district; social mobilization; active case detection; case management; mapping and strengthening of health facilities. Based on this approach, the two health programs, one in charge of the control of BU
and the other of the elimination of leprosy, experimented with the screening and the integrated management of cutaneous diseases in three co-endemic health districts of Côte d’Ivoire between April 2016 and March 2017.

We report here the results and lessons learned from the pilot test of this integrated approach to the detection and treatment of leprosy, BU and yaws associated with other skin diseases in three co-endemic health districts of Côte d’Ivoire, namely Divo, Zouan-Hounien and Oumé.

Methods

Study context

Buruli ulcer and leprosy programmes in Côte d’Ivoire

Control activities for Buruli Ulcer (BU) and Leprosy are implemented by two different programmes in Côte d’Ivoire:

The National Programme for the Elimination of Leprosy;
The National Programme for Buruli Ulcer Control;

There is no specific programme for yaws eradication. Yaws management, as per of other skin diseases, falls into the general health system.

The structures involved in the control of leprosy are organized nationally at three levels:

the central level: with a coordinating office headed by an Executive Director of the National Programme for the Elimination of Leprosy and a leprosy referral center, namely the Institut Raoul Follereau in Adzopé.

the intermediate level: comprise 82 health districts with 82 chief medical officers. The screening, care and follow-up of patients are under the direct responsibility of leprosy-specialist nurses or of leprosy controllers based in the health departments or districts. Some leprosy-specialist nurses are responsible for several health districts, which explains the almost universal coverage of the country.

the peripheral level: it includes 1910 first-contact health facilities. In these institutions, 500 nurses and health workers trained to look out for signs of leprosy are responsible for detecting and referring all suspicious cases to the intermediate level for confirmation of diagnosis, then for caring for and following-up with patients living in their jurisdiction.
For BU, the central level responsible for the administration, coordination and scientific support of the National Program for the Control of BU comprises the program’s Coordination Department, headed by a Coordinating Director, and six technical, administrative and financial services.

The intermediate level is composed of referral structures with adequate technical platforms such as an operating theater for standardized case management. There are 7 of these centers: 2 are public and 5 are faith-based centers.

It is apparent from this presentation that the management of leprosy, BU, yaws and other common dermatological conditions is structured differently, which makes it difficult to develop an integrated strategy for their control.

**Study site and Method**

The study was conducted in the 3 health districts of Divo, Zouan-Hounien and Oumé in Côte d’Ivoire between April 2016 and March 2017. These districts are co-endemic for BU and leprosy. Localities in these 3 districts were targeted based on co-endemicity criteria.

The 3 health districts have different geographical and demographic characteristics. The District of Zouan-Hounien, with its 210,453 inhabitants, is located in a mountainous region. The Districts of Divo and Oumé, which respectively have 404,821 and 296,670 inhabitants, are located in the middle of Côte d’Ivoire forest belt.

From a health standpoint, the District of Zouan-Hounien, Divo and Oumé have 24, 42 and 25 peripheral health centers respectively. The District of Divo has a regional hospital with surgical unit dedicated to the management of complicated BU and leprosy cases.

This is a cross-sectional study using routine data which targeted populations in
communities co-endemic for BU, leprosy and yaws in 3 Districts of Côte d’Ivoire implemented between April 2016 and March 2017 in 6 stages: identification of potentially co-endemic communities; stakeholder training; social mobilization; mobile medical consultations; case detection and management; and a review meeting.

**Identification of co-endemic communities:** During this phase, the co-endemic localities were identified through analysis of available data. For leprosy and BU, the statistical data for the last five years available at the two programs were used. As for yaws, the national statistical yearbook of 2015 [17] was used. It should be noted that these cases of yaws were reported essentially on a clinical based without biological confirmation. As a result, 64 communities that are co-endemic for BU and leprosy were selected in the 3 Districts: 10 localities in Divo; 34 in Zouan-Hounien and 20 in Oumé.

**Training of stakeholders:** For the successful implementation of this approach, a training was provided on the three diseases, to 44 nurses and 50 community health workers. We trained nurses and community health workers in the integrated control and management of leprosy, BU and yaws. The training of the nurses covered basic epidemiology, clinical diagnosis, differential diagnosis, complications, social consequences, performing rapid diagnostic test for yaws and treatment of these three diseases were discussed. The training for the community health workers was mainly focused on clinical diagnosis to increase their capacity to suspect cases.

**Social mobilization and sensitization:** After the identification of the 64 communities, letters were sent to community leaders and to community radio for social mobilization. “Town criers” were also involved in announcing the event. These communities were visited one by the team. Sensitization kits included a generator, a sound system, a video projector and a projection screen were acquired for the implementation of sensitization activities. Some Information, Education and Communication (IEC) materials for BU, Leprosy and yaws were distributed. Movies on the diseases were presented to the population. Some comments were provided by the nurses.

**Mobile medical consultations:** During this phase, five teams were formed according to the available experimented human resources for this activity. Each team was composed of qualified and specialized human resources in the fields of BU, leprosy and yaws (doctors, nurse specialists in dermatology, nurses, communication officers, etc.). These teams are experimented in the in the diagnosis and the management of BU leprosy and yaws: there were been involved in the control of these diseases since several years. The consultations took place in schools in well-day light lit rooms and ensuring the respect of the patient’s privacy. Only patients with skin lesion were selected. They were then seen by nurses under the supervision of their trainers. They were carefully examined in a well-lit area which respected their privacy. The socio-demographic
information and the characteristics of the lesions were collected as well as adequate samples to confirm BU and yaws cases. Only patients with skin lesions were included in this study. Patients that had general diseases without skin lesion were excluded and referred to the nearest health facility.

**Case detection and management:** The leprosy and BU screening was done according to the WHO clinical criteria. For BU cases, swabs or Fine Needle Aspiration were collected accordingly by experimented nurses. BU cases were confirmed by Polymerase Chain Reaction (PCR) for IS2404 at the Pasteur Institute of Côte d’Ivoire. BU lesions were classified according to the WHO categories: Category I (a single lesion with a diameter 5 cm); Category II (a single lesion with a diameter between 5 and 15 cm); Category III (a single lesion with a diameter >15 cm; multiple lesions; osteomyelitis; a lesion located in a critical area such as the eyes, breasts or genitals) [18].

The yaws screening was done on the basis of clinical suspicion and confirmed by two rapid tests. The first test was SD Bioline Syphilis 3.0; then patients who tested positive were confirmed by DPP ® Syphilis Screen & confirm Assay. Cases of leprosy were diagnosed clinically according to WHO clinical definition [19,20] by specialist nurses with many years’ experience in leprosy control. Cases classified into paucibacillary (≤ 5 lesions) and multibacillary (> 5 lesions or with nerve involvement (pure neuritis, or any number of skin lesions and neuritis)) according to WHO launched the Global Leprosy Strategy 2016–2020 [19,20].

All patients identified benefited from free treatment on-site within the community. After receiving the initial treatment onsite, complicated cases were referred to the peripheral health center or to the specialized referral facility. The new leprosy cases received the multidrug therapy.

BU cases were referred to the health center for treatment. Former BU and leprosy patients attended counseling sessions for the prevention of impairment or disability. Some were given vaseline (petroleum jelly) or shea butter (a local available alternative to Vaseline) for the maintenance of their scars and to prevent skin dryness.

All cases of yaws were treated with azithromycin free of charge. Adequate
treatment was given for the other skin conditions. It was most often antifungal medicines, soap, scabicides, vaseline (petroleum jelly) or shea butter as indicated. The necessary inputs for bandages and dressings were also made available to patients.

**The review meeting:** This meeting brought together all the stakeholders at the health district level thus allowing them to: review the process; give feedback to the health authorities; organize the follow-up of the identified cases; analyze the strengths and weaknesses as well as lessons learned.

**Statistical analysis of the data**

All study data were recorded and processed with the software Microsoft Excel 2007. The frequencies of the different pathologies detected were calculated. The SWOT (Strength, Weakness, Opportunity and Threat) was conducted by 4 doctors of the Buruli ulcer programme and two nurses specialists in leprosy. This staff that has experience with community-based disease control interventions. The SWOT matrix was used to analyze the strengths and weaknesses of the activity.

**Results**

This activity took place in 64 targeted locations across all 3 health districts co-endemic for BU and leprosy. The outreach activities were attended by 16140 people. Within the sensitized population, 2310 (15%) had skin lesions (467 with ulceration and 1843 without ulceration) : 1302 cases in the district of Divo, 566 cases in the district of Oumé and 442 cases in the district of Zouan-Hounien. The median age (IQR) of the participants with skin lesions was 13 years (9.5; 31); a majority of them (61.65%) were female.

Seven cases were diagnosed as Buruli Ulcer; 5 out 7 cases were category II. There were 30 leprosy cases, 17 cases (56,7%) were female. The median age (IQR) was 53 years (39.5; 69), 21 were paucibacillary and 09 were multibacillary. There were 15
cases of yaws. In total, 467 (20.22) patients had ulcerative lesions. Most of the ulcerative lesions were post-traumatic (11.90%) when nearly half of the patients with non-ulcerative lesions (42.77%) and had fungal infection.

The summary of the main results is presented in Table 1.

**Table 1: Detailed results of the integrated screening campaigns**
| Form of the dermatosis            | Etiology                     | Divo (n) | Oumé (n) | Zouan-Hounien (n) | n* |
|-----------------------------------|------------------------------|----------|----------|-------------------|----|
| With ulceration                   | Buruli ulcer                 | 2        | 2        | 3                 | 7a |
|                                   | Yaws                         | 15       | 0        | 0                 | 15b (0.65) |
|                                   | Post-traumatic ulcerations   | 137      | 74       | 64                | 275 (11.90) |
|                                   | Ulcerations of vascular origin | 11      | 5        | 4                 | 20 (0.87) |
|                                   | Fasciitis                    | 35       | 27       | 24                | 86 (3.72) |
|                                   | Post erysipelas ulceration   | 5        | 3        | 4                 | 12 (0.52) |
|                                   | Eczema secondary infection   | 10       | 8        | 5                 | 23 (1.00) |
|                                   | Staphylococcal infection     | 12       | 9        | 8                 | 29 (1.26) |
|                                   | Total                        | 227      | 128      | 112               | 467 (20.22) |
| Without ulceration                | Leprosy                      | 12       | 8        | 10                | 30c |
|                                   | Fungal infection             | 601      | 220      | 167               | 988 (42.77) |
|                                   | Eczema and prurigo           | 310      | 137      | 105               | 552 (23.90) |
|                                   | Scabies                      | 105      | 49       | 33                | 187 (8.10) |
|                                   | Scratch injury               | 12       | 4        | 4                 | 20 (0.87) |
|                                   | Acne vulgaris                | 26       | 17       | 10                | 53 (2.29) |
|                                   | Vitiligo                     | 2        | 0        | 1                 | 3 (0.13) |
|                                   | Ichthyosis                   | 3        | 1        | 0                 | 4 (0.17) |
|                                   | Lichen planus                | 3        | 1        | 0                 | 4 (0.17) |
|                                   | Neurofibromatosis            | 1        | 1        | 0                 | 2 (0.09) |
|                                   | Total                        | 1075     | 438      | 330               | 1843 (79.78) |
|                                   | Total                        | 1302     | 566      | 442               | 2310 (1) |

\( n = \text{number of patients} \)
It resulted from the SWOT analysis that the integration of activities is possible and benefit from the current national interest in the management of NTDs and the commitment of the partners. The human resources are available and will be able to take care of some of the common skin diseases in their health zone, provided that they benefit from capacity building and availability of necessary consumables for the care and follow-up of the detected patients. However, the increased workload resulting from the implementation of this approach, requiring front line health workers to examine and test all skin lesions could be a major threat (Table 2).

Table 2: SWOT analysis

| STRENGTHS | WEAKNESSES |
|-----------|------------|
| The motivation and enthusiasm of the actors favor their involvement in the implementation of the activities | The lack of dermatologists makes it difficult management of certain dermatoses |
| The skills and experience gained by community actors in the control of BU and leprosy can be used to implement an integrated approach | Health personnel and community volunteers equipped to diagnose and suspect dermatoses BU and yaws |
| The existence of a community volunteer network promotes social mobilization and case detection | The lack of integrated case-reporting tools do not allow for standardized reporting |
| The existence of databases on BU and leprosy can be used to determine co-endemic communities | · The increased workload for health personnel could jeopardize the sustainability of the integration |
| The existence of health centers near the targeted localities helps to ensure the care and follow-up of the cases detected | |
| The existence of referral health facilities with an adequate technical platform makes it possible to ensure the medical- | |

\[a\] Catégorie II: 05 cases and Catégorie III: 02 cases  
\[b\] 8 Cases diagnosed by rapid test (RDT) and confirmed by DPP; 07 cases diagnosed clinically  
\[c\] Paucibacillary: 21 cases and Multibacillary: 09 cases
surgical management of the referred complicated cases

Existence of a network of community health volunteers for the control leprosy and BU in every district in Côte d'Ivoire

- The partners’ commitment to an integrated approach in the management of skin NTDs

| OPPORTUNITIES                                                                 | THREATS                                    |
|-------------------------------------------------------------------------------|--------------------------------------------|
| The existence of the Regional Strategy on Neglected Tropical Diseases in the WHO African Region 2014-2020 [3]. | Very broad theme: the range of skin diseases indeterminate |
| The national interest in the control of NTDs through the creation of health programs in charge of the management of Buruli and leprosy | The non-availability of dermatological cream at contact health facilities, which could jeopardize of routine dermatological consultations in health centers |
| The possibility of intersectoral collaboration with the education sector for screening in schools | |

Discussion

In this study, we share our experience in the implementation of the integrated management of skin NTDs in Côte d’Ivoire. Through this experiment, we think that the integrated screening and care of patients with skin NTDs is feasible in Côte d'Ivoire. Indeed, in recent years the number of cases of leprosy and BU has considerably decreased in Côte d'Ivoire as in most African countries and the WHO has provided a training guide for front-line health workers [21]. These diseases are often co-endemic, show similar clinical signs and the financial and human resources to control them are limited. The implementation of this integrated approach in Côte d'Ivoire was organized using the tools, the human and material resources acquired as part of the control of BU and leprosy. This implementation allowed us to detect
and provide care for 7 cases of BU (0.3%); 30 cases of leprosy (1.3%), of which 21 were paucibacillary and 9 were multibacillary. Fifteen cases of yaws were detected, of which 8 were confirmed by serological test; the other 7 were diagnosed on a clinical basis because we did not have rapid screening tests during the first campaigns. The proportion of leprosy cases detected in our study is similar to the finding in earlier studies conducted as well in Côte d’Ivoire, in Benin [22,23] as in Malawi [24]. For this integrated activities, the most endemic districts were visited. So we can not expand our result to the population of the country.

Apart from the skin NTD, many others of skin diseases (97.75%) were detected and treated. This confirms one of the results of Msyamboza et al, who also noticed that the actors involved in the management of leprosy had acquired the ability to detect many other skin diseases [24]. In addition, to kick off the series of campaigns, the nurses in the targeted health areas, who were already experienced in the management BU and leprosy and were available, benefited from capacity building. This theoretically made them better equipped to diagnose and take care of other skin conditions. The effect of this activity could be measured through their active and operational involvement during the mobile consultation sessions. These health professionals were able to accurately identify and adequately manage various skin diseases as indicated in the results of our study. For example, only 7 cases were referred to a higher level for better care. Those were mainly chronic wounds of various etiologies as well as some cases of yaws or dermatomycosis. Eight cases of yaws detected by the nurses and confirmed positive by the rapid test during the last campaign give evidence to the quality of the diagnosis.

What is the degree of ownership of this integrated approach by the different actors in the health system and in the community in Côte d’Ivoire? According to the WHO,
institutional ownership is an important component of the integrated management NTDs. It is one of the four priority strategies that the WHO impresses upon all countries as part of the development of NTDs master plans [25]. Furthermore, a resolution of the WHO Regional Office for Africa also recommends that African countries promote leadership to establish and strengthen national integrated NTDs programs and to promote multi-sectoral collaboration [26]. The mobilization of the health system stakeholders and of the community actors resulted in the good planning and successful implementation of the integration. As a result, each active phase of consultations was preceded by social mobilization. The approval and accession of the health authorities to our study were reflected in the active participation of the programs responsible for coordinating the control of BU and leprosy. These two structures attached to the Directorate General for Health in Côte d’Ivoire demonstrated their approval by disseminating technical notes and signing the terms of reference for each activity but also by actively participating in the implementation of the campaigns, in collaboration with the local health authorities. The involvement and participation of the community were important assets in the management of BU [27,28]. The implementation relied on this model. During the activities, mobilized community leaders helped to reach an important target. Just as in the management of BU and leprosy, they are a human resource which can be mobilized to sustain the integrated management of NTDs.

What are the major difficulties and constraints of this strategy? The SWOT analysis performed prior to the implementation of the integrated approach enabled us to measure the possible threats and weaknesses in the implementation of such activities. Although the planning of activities took into account the WHO guidelines, difficulties and constraints were identified. They are linked to the mobilization of
logistical assets and to the geographical accessibility of targeted co-endemic localities. Indeed, the mobile consultations require heavy logistical loads to be transported to localities on access roads that are difficult to pass. Yet the population most affected by NTDs lives in remote areas where it does not always have easy access to the health system [16]. Because of the remoteness of locations and the logistical challenges to get there, preventive chemotherapy for leprosy and yaws could be administered when the campaign is conducted. The same opportunity could be used for education and/or other interventions aimed at reducing stigma towards persons with leprosy, BU and yaws.

In addition to health professionals, community health workers were trained in the recognition of suspicious cases and in social mobilization. It is certainly difficult to assess the impact of these sessions on the behavioral changes of the population; we however know that the presence of children (50%) and women (45%) is linked to sensitization sessions (these two categories are the most vulnerable to and the most affected by NTDs). According to the WHO, “many neglected tropical diseases affect women and children disproportionately. Those living in remote areas are the most vulnerable to infections and to their biological and socio-cultural consequences.”

It should be noted however that implementation requires the mobilization of human resources but also the analysis and definition of the package of activities to be carried out, as recommended by Mitjà et al [15]. As a matter of fact, the campaigns we conducted in Côte d’Ivoire took into account that recommendation by including sensitization, screening and patient care in our package. The logistical assets and the necessary drugs and inputs were mobilized. Moreover the majority of screened cases were taken care of within the community. Subsequently, the follow-up of
these cases was carried out by the nurses in the peripheral health centers.

The model of integrated approach in the management of NTDs that we tested had ethical limits. Several people with different health problems gathered in the same place to attend the mobile clinics. This had the theoretical advantage of breaking down barriers of stigma; however, in practice, it can also create a recruitment bias since cases with very advanced lesions or elder people may not present themselves in public. But during our study, there have been instances where teams did home-based consultations on the indication of community health workers. Another limitation of this study is the selection on the patients with skin lesion. Patients with primary neural leprosy (PNL) or very tiny or scanty lesions may be missed. Future studies might focus what kind of strategy will be planned to avoid missing those cases.

The other constraint that must be resolved to ensure the sustainability of this integrated approach is the free accessibility or at least the affordability of drugs for other diseases similar to BU and leprosy. Most dermatological drugs are on the list of essential drugs in Côte d’Ivoire but are not available in first-contact facilities. Patients will only come when they have easy access to medications. Financial accessibility makes it easy to access health care and allows better management of the disease, through the use of health facilities from the earliest symptoms of illness and the availability of medications [29]. Some cases of diagnostic difficulties by nurses were noted; such cases were few. For example, the two cases of neurofibromatosis were diagnosed by supervising physicians and were referred for treatment. To deal with such cases, it is necessary to provide the support of a dermatologist or of a nurse specialized in dermatology and leprosy during these interventions. Teledermatology consultations with dermatologist is also an
alternative. Whatsapp is a possible solution.

Conclusions

Our study based on the implementation of the integrated approach in the management of NTDs took place in 3 districts in Côte d’Ivoire. The results of this study show that the integration of activities is possible given the national interest in the control of NTDs and the commitment of the partners. The human resources are available and will be able to take care of some of the common skin diseases in their health area. It is essential that these human resources benefit from capacity building and that they have the necessary equipment for the care and follow-up of the patients detected, including those with other dermatoses.

Declarations

**Ethics approval and consent to participate**

This study was approved by the institutional review board of the Ministry of Health and Public Hygiene through the Coordination Department of the National Program for the Control of Buruli Ulcer. It was also approved by the National Leprosy Eradication Program. Technical notes about the activities were sent to the higher-ranking ministerial authorities in charge of health and public hygiene in Côte d’Ivoire. The regional and departmental health authorities were involved in the campaigns. The rural populations concerned were sensitized and freely agreed to participate in the study and present their health problem. During the consultations, the privacy of the patients was respected.

Informed consent was obtained orally from all adult participants and from parents, caretakers, or legal representatives of participants aged ≤18 years after obtaining
their assessment. Verbal informed consent was necessitated given for the need to provide more details about the study in local languages. The use of verbal informed consent was approved by the institutional review board of the Ministry of Health and Public Hygiene. Verbal informed consent was documented in a register as “verbal informed consent given: yes or no”.

Data were processed with strict respect for confidentiality and anonymity.

**Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Conflicts of interest:**

The authors declare no conflict interest.

**Funding**

This study was partially supported by the project “Rationale Approach to Effective Wound Care in West Africa” funded by UBS Foundation (https://www.ubs.com) and Anesvad Foundation (http://www.anesvad.org)

Care for the patients suffering from skin Neglected Tropical Diseases was provided with the support of the Government of Côte d’Ivoire and of the Foundation Raoul Follereau (http://www.raoul-follereau.org).

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

**Authors’ contributions**

Conceptualization, APK, TAKY, RCJ, AK, SD, HA

Methodology, RCJ, YTB, GD, MHZ, GES, SS

Formal Analysis, APK, TAKY, YTB, GES,

Investigation, APK, TAKY, MHZ
Acknowledgments

We would like to thank the health workers of Divo, Oumé and Zouan Hounien; all the community health volunteers as well as the village chiefs Divo, Oumé and Zouan Hounien for their commitment to the management of skin neglected tropical diseases.

References

1. World Health Organization (WHO). Working to overcome the global impact of neglected tropical diseases; First WHO report on neglected tropical diseases. 2010.
2. World Health Organization (WHO). Report of the Tenth Meeting of the WHO Strategic and Technical Advisory Group for Neglected Tropical Diseases. Geneva; 2017.
3. WHO. Regional Strategy on Neglected Tropical Diseases in the WHO African Region 2014-2020. 2014; 1-16.
4. lesphore Brou T, lè ne Broutin H, Elguero E, Asse H, Guegan J-F. Landscape Diversity Related to Buruli Ulcer Disease in Côte d’Ivoire. PLoS Neglected Trop Dis. 2008;2: e271. doi:10.1371/journal.pntd.0000271
5. Marston BJ, Diallo MO, Horsburgh CR, Diomande I, Saki MZ, Kanga JM, et al. Emergence of Buruli ulcer disease in the Daloa region of Cote d’Ivoire. Am J Trop Med Hyg. 1995;52: 219–224. doi:10.4269/ajtmh.1995.52.219
6. Kanga JM, Kacou ED. [Epidemiologicl aspects of Buruli ulcer in Cote d’Ivoire:
results of a national survey]. Bull Soc Pathol Exot. 2001;94: 46-51.

7. Konan DJP, Aka J, Yao KJ, Kouassi-Gohou V, Yao KE, Faye-Kette H. Update on a neglected tropical disease from the routine health information system in Côte d’Ivoire: Yaws, 2001 to 2011. Med Sante Trop. 2013;23: 433.

8. who. Weekly epidemiological record Relevé épidémiologique hebdomadaire. 2017; 205-228.

9. Touré B, Koffi NM, Assi KP, Ake O, Konan DJP. [Yaws in Côte d’Ivoire: health problem forgotten and neglected]. Bull Soc Pathol Exot. 2007;100: 130-132.

10. Programme National d’Élimination de la Lèpre. Rapport d’activités. Abidjan, Côte d’Ivoire; 2018.

11. Programme National de lutte Contre l’Ulcère de Buruli. Rapport d’activités. Abidjan, Côte d’Ivoire; 2018.

12. OMS. Soixante-sixième assemblée mondiale de la santé : résolution WHA66.12. 2013.

13. Diez Cuevas Gabriel. El papel de la Organización Mundial de la Salud en el siglo XXI y la importancia del fortalecimiento de los sistemas públicos de salud para hacer frente a las emergencias sanitarias. El caso de la “crisis” del brote de Ébola. [Internet]. Universidad del País Vasco UPV/EHU. 2017. Available: http://hdl.handle.net/10810/23127

14. Frenk J, Gómez-Dantés O. False dichotomies in global health: the need for integrative thinking. The Lancet. 2017. pp. 667–670. doi:10.1016/S0140-6736(16)30181-7

15. Mitjà O, Marks M, Bertran L, Kollie K, Argaw D, Fahal AH, et al. Integrated Control and Management of Neglected Tropical Skin Diseases. PLoS Negl Trop Dis. 2017;11. doi:10.1371/journal.pntd.0005136
16. Hotez PJ, Molyneux DH, Fenwick A, Kumaresan J, Sachs SE, Sachs JD, et al. Control of Neglected Tropical Diseases. N Engl J Med. 2007;10: 1018–1027. doi:10.1056/NEJMra064142

17. Ministère de la santé et de l’hygiène publique. Annuaire statistique national. Abidjan, Côte d’Ivoire; 2015.

18. World Health Organization. Buruli ulcer: progress report, 2004-2008. Wkly Epidemiol Rec. 2008;83: 145–154.

19. World Health Organization. Global Leprosy Strategy 2016-2020. Accelerating towards a leprosy-free world. Monitoring and Evaluation Guide [Internet]. World Health Organization. 2016. doi:978-92-9022-509-6

20. World Health Organization (WHO). Guidelines for the diagnosis, treatment and prevention of leprosy. Geneva; 2017.

21. WHO/Department of control of neglected tropical diseases. Recognizing neglected tropical diseases through changes on the skin. A training guide for front-line health workers. Geneva; 2018.

22. Yotsu RR, Kouadio K, Vagamon B, N’guessan K, Akpa AJ, Yao A, et al. Skin disease prevalence study in schoolchildren in rural Côte d’Ivoire: Implications for integration of neglected skin diseases (skin NTDs). PLoS Negl Trop Dis. 2018; doi:10.1371/journal.pntd.0006489

23. Barogui YT, Diez G, Anagonou E, Johnson RC, Gomido IC, Amoukpo H, et al. Integrated approach in the control and management of skin neglected tropical diseases in Lalo, Benin. PLoS Negl Trop Dis. 2018; doi:10.1371/journal.pntd.0006584

24. Msyamboza KP, Mawaya LR, Kubwalo HW, Ng’oma D, Liabunya M, Manjolo S, et al. Burden of leprosy in Malawi: community camp-based cross-sectional study.
BMC Int Health Hum Rights. BMC International Health and Human Rights; 2012;12: 12. doi:10.1186/1472-698X-12-12

25. World Health Organization. Buruli ulcer control Guide for national programmes. 2007; 30. Available: http://www.who.int/buruli/Guide programme managers.pdf

26. WORLD HEALTH ORGANIZATION. REGIONAL COMMITTEE FOR AFRICA, Regional strategy on neglected tropical diseases in the WHO African Region, AFR/RC63/R6, 4. Brazzaville, Republic of Congo; 2013.

27. Barogui YT, Sopoh GE, Johnson RC, de Zeeuw J, Dossou AD, Houezo JG, et al. Contribution of the Community Health Volunteers in the Control of Buruli Ulcer in Bénin. PLoS Negl Trop Dis. 2014;8. doi:10.1371/journal.pntd.0003200

28. Abass KM, Van Der Werf TS, Phillips RO, Sarfo FS, Abotsi J, Mireku SO, et al. Short Report: Buruli ulcer control in a highly endemic district in Ghana: Role of community-based surveillance volunteers. Am J Trop Med Hyg. 2015;92: 115–117. doi:10.4269/ajtmh.14-0405

29. Stierle F, Kaddar M, Tchicaya A, Schmidt-Ehry B. Indigence and access to health care in sub-Saharan Africa. Int J Health Plann Manage. 1999;14: 81–105. doi:10.1002/(sici)1099-1751(199904/06)14:2<81::aid-hpm543>3.0.co;2-p