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Definition of an algorithm for the management of common skin diseases at primary health care level in sub-Saharan Africa

A. Mahé[a,*], O. Faye[b], H. Thiam N'Diaye[b], F. Ly[a], H. Konaré[b], S. Kéita[b], A.K. Traoré[b], R. Hay[c]

[a] *Institut d'Hygiène Sociale, B.P. 7045, Dakar-Fann, Senegal*
[b] *CNAM (ex-Institut Marchoux), B.P. 251, Bamako, Mali*
[c] *Faculty of Medicine and Health Sciences, Queens University Belfast, 97 Lisburn Road, Belfast, BT9 7BL, UK*

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Summary In order to help primary health care (PHC) workers in developing countries in the care of common skin diseases, an algorithm for the management of pyoderma, scabies, superficial mycoses, contact dermatitis and referral of early leprosy cases (based on the identification of diseases through the presence of objective key signs, and on treatments by generic drugs) was elaborated. One thousand patients were seen by trained dermatologists, who established diagnoses and treatments; in addition, there was systematic recording of each key sign, according to the successive algorithm steps. We compared the diagnostics and treatments obtained for several combinations of diagnostic signs, with those of the dermatologists. Sensitivity, specificity, positive predictive value and negative predictive value of defined combinations were high for pyoderma, scabies and superficial mycoses. Values were less exact for dermatitis and leprosy, but were considered sufficient for the level of health care targeted. The apportionment of treatments between the algorithm and the dermatological approaches was considered appropriate in more than 80% of cases; mismanagement was possible in 7% of cases, with few predictable harmful consequences. The algorithm was found satisfactory for the management of the dermatological priorities according to the standards required at the PHC level.

1. Introduction

Certain skin diseases have been identified as significant health problems in developing countries (Anonymous, 1991). Prevalence studies in the gen-

* Corresponding author. Present address: B.P. 16705, Dakar-Fann, Senegal.
E-mail address: mahe@refer.sn (A. Mahé).

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eral population have found high rates for pyoderma, scabies and superficial mycoses, especially in children (Bechelli et al., 1981; Belcher et al., 1977; Mahé et al., 1995). Families frequently seek treatment for the most severe disorders, i.e. pyoderma and scabies, reinforcing the view that these should be seen as serious problems (Mahé et al., 1995). Studies conducted in primary health care (PHC) centres found that about 10% of visits were related to these common skin diseases, making them one of the commonest organ-specific reasons for visiting a health centre (Badame, 1988; Mahé et al., 1997). However, the low level of knowledge amongst non-specialist health care workers (HCW) in the management of skin diseases has been underlined (Figueroa et al., 1998; Hay et al., 1994). Training these individuals on skin diseases has been targeted as a critical step in skin health improvement (Hay et al., 1991; Kopf, 1993). The desire to integrate leprosy services at PHC level would also probably benefit from an improvement in the dermatological skills of HCWs (Saunderson and Ross, 2002).

Because of the large disease burden in developing countries, and the total lack of training in the care of skin diseases for many HCWs, who are often nurses, there is a need for simple and cost-effective procedures, including training. Experience in other fields has shown that a syndromic and algorithmic approach may well meet such concerns (WHO, 1997, 2001), but this approach is not yet available for common skin diseases. In order to provide a tool that could be used as a support for training and help in the daily practice of non-specialist HCWs at PHC level in developing countries, we have developed an algorithmic approach to the management of the commonest skin diseases encountered in these settings. This paper describes an evaluation of the potential of this approach.

2. Patients and methods

2.1. Definition of dermatological priorities

This study was part of a wider 'pilot program for a fight against common skin diseases in Mali', of which one of the main scheduled activities was the training of non-specialist HCWs in the Bamako area in the basic management of common skin diseases. Previously published work (Canizares, 1986; Ratnam and Jarayaju, 1979; Verhagen et al., 1968), including studies from Mali (Mahé et al., 1995, 1997, 1998), suggested that HCWs would benefit from an improvement in their practice performance, a view supported by local health authorities, in the following dermatological situations: identification and management of pyoderma, scabies, tinea capitis, other superficial mycoses and contact dermatitis (either irritant or allergic), and referral of early suspected leprosy cases.

2.2. Description of the algorithm

The algorithmic approach was based on the use of a flowchart in which there were successive diagnostic steps based on the identification of certain objective key signs (Figure 1). In practice, after exclusion of patients with clinical features that obviously differed from those described in this scheme, and who should be managed separately from the algorithm (acne, nail diseases, tumours, scalp disorders in adults), each patient had to be evaluated first for the presence of signs that would lead to a diagnosis of pyoderma; if such signs were present, then he/she was managed as described for this diagnostic category; if they were absent, the patient had to be evaluated for the presence of symptoms and signs that would lead to entry into the second step, the diagnosis of scabies; and so on through the subsequent steps; a patient remaining undiagnosed at the final step was considered to have 'contact dermatitis'. If, after reaching a diagnosis at any step, additional symptoms or signs were present, the patient had to be evaluated according to the following steps. This approach raised the possibility of more than one diagnosis and treatment option in the same patient.

The key diagnostic signs selected for identification of the targeted skin diseases were the following.

(i) Pyoderma: presence of yellow crusts, pus, dirty-looking sore, blister.
(ii) Scabies: presence of itching involving at least two sites of the body, visible lesions involving typical sites for scabies (i.e. interdigital spaces of hands, wrists, axillae, elbows, knees, buttocks, genitalia in men, breast areolae in women, palms and soles in children aged less than two years), presence of others in the same household with itch.
(iii) Tinea capitis: scalp disorder in a child aged less than 15 years, visible loss of hair, scaling.
(iv) Superficial mycosis (other than tinea capitis and pityriasis versicolor): involvement of a skin-fold, presence of a skin lesion with a circular shape.

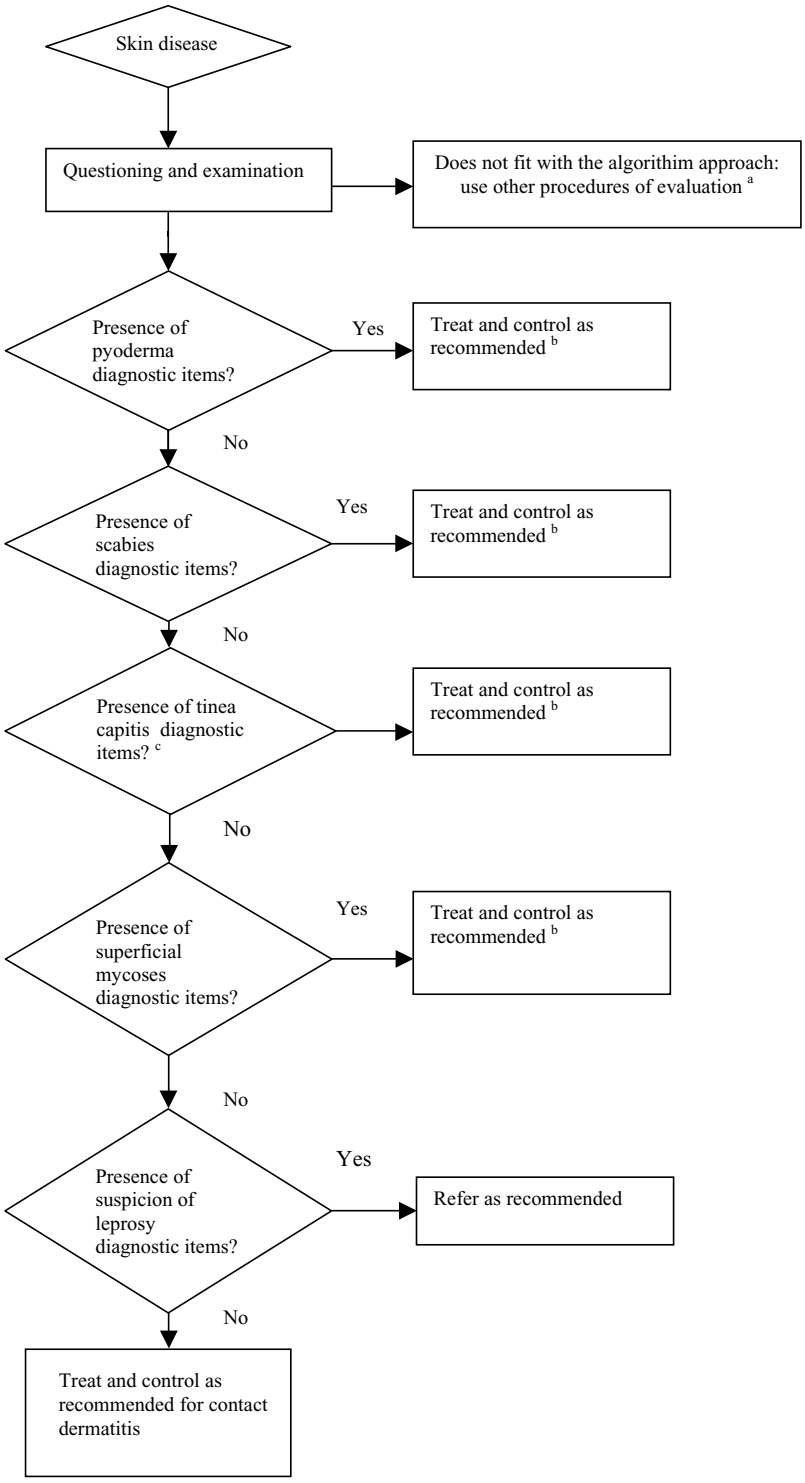

Figure 1. Algorithm for the management of common skin disorders at a primary health care level in sub-Saharan Africa. [a]Scalp disease in adults, chronic disorders, nail diseases, acne, tumours. [b]If additional signs: go further with following steps. [c]Facultative step only for children aged $<$ 15 years (dropped if aged $>$15 years).

(v) Suspected leprosy: presence of a clear (i.e. hypochromic) patch, reduced sensation within the patch, chronic duration.
(vi) Contact dermatitis: any other skin disease.

Once the diagnosis was established, the treatments and follow-up recommended were the following.

(i) Pyoderma: first, evaluate for the presence of an abscess, and refer if there is; if not, evaluate severity by a standardized assessment of diffusion of lesions: if mild pyoderma, antiseptic treatment (10% polyvidone iodide or 1/10000 potassium permanganate) for one week; if high or after failure of a course of topical treatment, oral antibiotics for one week (erythromycin or amoxicillin) in addition to antiseptics; evaluate at one week for cure and presence of additional skin diseases; refer if there was failure.
(ii) Scabies: if not superinfected, apply 10% benzyl benzoate solution once and leave on for 24 hours; if superinfected, begin with a one week course of treatment for pyoderma, followed by topical benzyl benzoate; evaluate at one week: if not cured and symptoms still compatible with scabies, treat again; refer in other situations.
(iii) Tinea capitis: oral griseofulvin for six weeks if aged more than two years, topical miconazole if aged less than two years; evaluate at one month, refer if not cured.
(iv) Superficial mycoses (other than tinea capitis): miconazole cream twice daily for four weeks; evaluate at one month, refer if not cured.
(v) Suspected leprosy: refer; presence of a clear patch with no other feature of leprosy: consider diagnosis of pityriasis versicolor or pityriasis alba and treat with miconazole twice daily, refer after one month if not cured.
(vi) Dermatitis: stop any former topical application and apply a basic neutral ointment; evaluate at two weeks, refer if not cured.

All drugs were chosen from among generic formulations easily available in Mali.

2.3. Evaluation

2.3.1. Population study

The study was conducted prospectively in two centres: the dermatological clinic of the Institut Marchoux of Bamako, Mali, and the dermatology unit of the Institut d'Hygiène Sociale in Dakar, Senegal. It was estimated that a sample of 1000 patients (500 in each centre) should be tested. Only patients presenting for the first time at each centre were considered. Patients with symptoms that differed obviously from the symptoms and signs described in the algorithm as mentioned above, or referred patients, or those with rare dermatological disorders or chronic diseases, were excluded.

2.3.2. Recording of data

Each patient was seen by a dermatologist, who provided a diagnosis and prescribed a treatment. Simultaneously, there was a systematic recording of each diagnostic key sign, listed according to the successive steps of the algorithm as defined above. Therefore, for each patient, diagnosis and treatment were derived in two different ways: one given by a dermatologist, and the other, virtual management, obtained with the algorithm. The patient was seen for follow-up if necessary, but the performance of the algorithm at the first visit only was determined.

2.4. Analysis of data

We compared the diagnostic and therapeutic data obtained with the algorithm with the dermatological ones, according to the following methods.

2.4.1. Determination of the intrinsic and extrinsic properties of the algorithm

The whole flowchart was considered to be a global diagnostic test, with several capabilities corresponding to each skin disease cited; its properties were evaluated by comparison with the diagnoses made by the dermatologist (eventually confirmed by laboratory tests), considered as the 'gold-standards'. The sensitivities (Se), specificities (Sp), positive predictive values (PPV), and negative predictive values (NPV) of the algorithm for pyoderma, scabies, tinea capitis, contact dermatitis, superficial mycoses (other than tinea capitis and pityriasis versicolor), and leprosy, were calculated according to usual methods for each defined diagnostic item (Grenier, 1999), either in isolation or in various combinations with others; the calculations were made for each disease on the sample of 1000 patients. Stratification of the properties of the algorithm for each disease based on site of study was performed. All data were captured and analysed with EpiInfo, version 6.04 (CDC, Atlanta, GA, USA).

2.4.2. Agreement between treatment options

For each patient, the active principles of the compounds prescribed by the dermatologists were considered as the reference with which the

treatments that would have been obtained through using the algorithm were compared. Several levels of agreement were defined.

a) Complete agreement.
b) No use of topical steroids.
c) Lack of any optional treatment (other than steroids) (e.g. oral antihistamine for prurigo due to insect bites).
d) Neutral treatment, i.e. any use of a medication not indicated but with no predictable harmful effect (e.g. topical miconazole for vitiligo, or a basic ointment formulation for prurigo).
e) Lack of any essential medication (e.g. oral antibiotics for severe pyoderma).
f) Use of a non-indicated medication with potentially harmful effects.

For patients presenting with several skin diseases, agreement was calculated once if the diseases were related (e.g. pyoderma associated with scabies), or, in rarer instances, for each skin disease, if the two appeared to be unrelated and could be evaluated separately.

3. Results

3.1. Description of the sample

There were 546 female and 454 male patients. Their mean age was 18.4 years (SD = 17.3), with 51.2% of patients aged less than 15 years. The main skin diseases, as registered by the dermatologists in the 1000 patients included, are shown in Table 1.

Table 1 Main skin diseases registered amongst 1000 study patients (as diagnosed by dermatologists)

Dermatological diagnoses	Bamako	Dakar	Total
Pyoderma	195	176	371
Scabies	26	107	133
Tinea capitis	80	34	114
Other superficial mycoses	54	80	134
Leprosy[a]	8	4	12
Contact dermatitis[b]	78	98	176
Other variants of eczema[c]	17	10	27
Pityriasis alba	33	16	49
Pityriasis versicolor	5	11	16
Seborrhoeic dermatitis	16	16	32
Vitiligo	6	9	15
Prurigo (insect bite reactions)	69	19	88
Herpes virus infection[d]	11	10	21
Miliaria	3	9	12
Others	41	29	70
Total	642	628	1270

[a] Disabilities present in one patient.
[b] Either irritative or allergic.
[c] Atopic dermatitis, dyshydrosis, and nummular eczema.
[d] Herpes zoster, herpes labialis, and chickenpox.

3.2. Intrinsic and extrinsic properties

After testing with isolated diagnostic items, it was found that the most interesting values were obtained with the following combinations (Table 2).

(i) For a diagnosis of pyoderma: presence of any of the corresponding items, either isolated or associated with others (P1); presence of any of the items, except blisters (P2).
(ii) For scabies: presence of a diffuse itching with visible lesions, with either: at least two typical locations of scabies, or presence of a household member with itch (S1); at least two typical locations of scabies (S2); at least three typical locations (S3).
(iii) For tinea capitis: presence of a scalp disorder in a child, with visible loss of hair and scales.

Table 2 Sensitivity (Se), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV) of the tested algorithm for various combinations of diagnostic items for pyoderma, scabies, leprosy, tinea capitis, superficial mycoses (other than tinea capitis and pityriasis versicolor), and contact dermatitis

Disease[a]	Se (%)	Sp (%)	PPV (%)	NPV (%)
Pyoderma (P1)	97.8	96.5	94.3	98.7
Pyoderma (P2)	95.7	97.9	96.5	97.5
Scabies (S1)	100	96.9	83.1	100
Scabies (S2)	96.2	98	87.7	99.4
Scabies (S3)	79.7	99.5	96.4	97
Leprosy (L1)	75	100	100	99.7
Leprosy (L2)	83	97.1	25.6	99.8
Leprosy (L3)	100	97.1	29.3	100
Tinea capitis	98.2	99.5	96.6	99.8
Other superficial mycoses	98.5	94.2	72.5	99.8
Contact dermatitis	81.8	81.7	48.8	95.5

[a] For explanation of diagnostic combinations (P1, S1, L1, etc.), see 'Intrinsic and extrinsic properties' under Results.

Table 3 Levels of agreement between the treatment prescribed by a dermatologist and the one that would have been obtained by using the algorithm, when P1, S1, and L1 were chosen (for explanation of diagnostic combinations P1, S1, L1, see 'Intrinsic and extrinsic properties' under Results)

Level of therapeutic agreement	No. of patients (%)
Complete	
In diagnosis and treatment	549 (54.3)
At least for first visit	68 (6.7)
Coincidental	52 (5.2)
Lack of topical steroids	125 (12.5)
Lack of optional component (other than steroid)	81 (8)
Neutral	60 (5.9)
Lack of an important component	11 (1.1)
Risk of harm	64 (6.3)
Total of evaluated diseases	1010

(iv) For other superficial mycoses: involvement of a skin-fold, or presence of a lesion with a circular shape.
(v) For suspected leprosy: presence of a clear patch, with either: diminished or equivocal sensation (L1); duration of at least six months (L2); any of these two items (L3).

When considering each centre separately, the performances of the algorithm differed significantly for the following intrinsic properties ($P < 0.05$): specificity for scabies if the diagnosis relied on two locations (96.7% in Dakar vs. 98.9% in Bamako), specificity for superficial mycoses (91.9% vs. 96.4%), sensitivity (69.4% vs. 97.4%) and specificity (89.8% vs. 73.9%) for contact dermatitis.

3.3. Therapeutic agreement

The proportions of the different levels of agreement when P1, S1, and L1, were chosen, are shown in Table 3.

For patients for whom there was complete agreement, there were three possible outcomes.

a) Complete agreement in diagnosis and treatment.
b) Complete agreement for the first visit, but eventually insufficient at follow-up (e.g. superinfected dermatitis cases in which topical steroids were contraindicated at the first visit).
c) Coincidental agreement (e.g. topical miconazole for seborrheic dermatitis wrongly labelled as tinea capitis or flexural mycosis).

'Neutral' treatments consisted mainly of diseases wrongly labelled according to the two last steps of the algorithm, such as cases of vitiligo (labelled as 'pityriasis versicolor/pityriasis alba'), or of prurigo (labelled as 'contact dermatitis'). The main therapeutic situations classified as potentially 'harmful' comprised the prescriptions of oral antibiotics in a non-bacterial skin disease, of scabicides in cases of an erroneous diagnosis of scabies, and of topical antimycotics in cases of contact dermatitis.

3.4. Consequences of changes in combinations of diagnostic items on therapeutic agreement

3.4.1. Pyoderma

With P1, the reasons for the 22 patients wrongly labelled as 'pyoderma' were the following: presence of blisters ($n = 10$, including 5 cases of herpes zoster), or of a dirty-appearing sore ($n = 10$, including 5 cases of leishmaniasis), or of yellow crusts ($n = 6$, including 4 leishmaniasis). With P2, there was a 9/22 reduction in the number of unjustified prescriptions of oral antibiotics, but with a similar number of patients in whom an antibiotic treatment indicated was not prescribed (all were bullous impetigo cases).

The eight cases of cutaneous sepsis that were not recognized by P1 (and P2) consisted of cases of cellulitis without epidermal changes.

3.4.2. Scabies

With S1, the causes for the 27 patients wrongly labelled as 'scabies' were the following: presence of two characteristic locations ($n = 18$, including 8 widespread dermatitis, 3 prurigo, 3 lichen planus, and 1 varicella), or of 'any other family member with itch' ($n = 14$, including 5 prurigo, 4 dermatitis, and 1 varicella) (both items in 5 patients). S2 led to a 9/27 reduction in the number of erroneous prescriptions of scabicides, with five patients for whom an indicated scabicide was not prescribed (all were early cases of scabies). With S3, the number of unjustified treatments dropped to three, with 27 cases not receiving a required scabicide.

3.4.3. Superficial mycoses

For 'superficial mycoses other than tinea capitis and pityriasis versicolor', the main cause of wrong positive diagnoses was the presence of 39 non-mycotic intertrigo cases that were due to seborrhoeic dermatitis (14), contact dermatitis (13), erythrasma (1) and diaper rash (1). According to the algorithm,

only the dermatitis cases were wrongly treated, the others receiving an antimycotic preparation with probable efficacy.

4. Discussion

This trial, the first of its kind to our knowledge, was designed to delineate the value of several key symptoms, combined in different associations in an algorithmic scheme of organized steps, for the diagnosis and subsequent management of skin diseases that non-specialist HCWs in sub-Saharan Africa might commonly encounter. For design purposes, it was carried out under defined standardized conditions, although we are aware that these might differ in certain respects from those encountered in the non-specialized centres for which the algorithm is intended. This is especially true in the case of two issues. Firstly, although the study was organized in order to be objective, and the scheme was considered so by the investigators, it is possible that certain diagnostic items might depend more on subjective criteria when investigated by non-specialist HCWs. This raises the questions of their reproducibility, an issue which could be solved by testing inter- and intra-observer variations, and subsequently the training modalities to be developed for their correct assimilation. Secondly, while the patient recruitment studied here was designed to be similar to that encountered in non-specialist health centres (Badame, 1988; Mahé et al., 1997, 1998; Ratnam and Jarayaju, 1979), the respective proportions and presentations of the disorders in PHC centres may differ from those recorded here, with possible consequences for the properties of the algorithm. This might be why different intrinsic properties for certain skin diseases were found in Bamako and in Dakar, data that might be explained by differences in the presentations of diseases by country. In fact, this study should be considered as a first step, given the basic properties of the proposed algorithm, but complementary investigations addressing the topics cited above would be useful.

Concerning our method of comparison, the 'gold standards' for diagnoses can be criticized because these depended mainly on the clinical skill of trained dermatologists, rather than on a definite biological proof of diagnosis such as a laboratory test. The clinical accuracy of such specialists in the diagnosis of common skin diseases is however generally assumed to be satisfactory (Canizares and Harman, 1992). A risk of observer bias during clinical evaluation should, in our opinion, not be feared, as the procedure consisted of recording, in a systematic way for each investigated case, a list of well-defined signs, as a means of formalizing the specific diagnostic values of these symptoms. We also restricted our evaluation to the first visit, although the algorithm foresees one or more follow-up visits, depending on the skin disease considered. Finally, it was not our aim to determine the efficacies of the recommended treatments. Treatments used were those recommended in the literature and were considered to be the most appropriate for the specific situations; it would be possible to change them without noticeably influencing the results of this evaluation.

When compared with the diagnostic reference provided by a specialist, intrinsic and extrinsic properties of several key diagnostic signs' combinations tested appeared good, especially for the targeted priority diseases. Among the commonest skin diseases, only dermatitis cases appeared wrongly labelled with significant frequency. It should be noted that, according to the tested algorithm, a diagnosis of 'dermatitis' would correspond to all skin diseases other than pyoderma, scabies, superficial mycoses, leprosy, pityriasis alba and pityriasis versicolor, an approach that might be considered hazardous. Yet, these low diagnostic performances for the recognition of dermatitis would not have a major impact on patients' care, if considering the level of health care for which the algorithm was scheduled. Indeed, according to the proposed scheme of organisation of skin health care in Mali, the use of topical steroids should be restricted to HCWs at a higher level in the health system pyramid than primary care. By adopting this approach, it was hoped to limit the well-known risks of steroids, especially in cases of infection or of unjustified prescription. According to the tested algorithm, it is noteworthy that superinfected cases of dermatitis, a common occurrence in developing countries, would receive adequate care, at least for the first visit.

In practice, the algorithm failed mainly in the identification of three entities: prurigo due to insect bites, chickenpox, and herpes zoster. The negative impact of a wrong diagnosis on medical management varied with the type of skin disease; generally this can be considered mild in the case of prurigo (lack of topical steroids or of oral antihistamine drugs); it might be judged more serious in herpes virus type infections receiving an unjustified prescription of antibiotics, but mostly in erosive skin disease cases treated with a scabicide. From that point of view, the diagnostic item combinations requiring the presence of three typical locations, rather than two, for a diagnosis of scabies appeared as more adequate. Another option would be to enrich the algorithm with other entities, but

this carries the risk of complicating it. In summary, the apportionment of treatments between the algorithm and the dermatologist was considered appropriate for this level of care (i.e. complete agreement or lack of a non-essential medication) in more than 80% of cases; moreover, the prescription of a neutral treatment without adverse effects for certain diseases for which there is no or uncertain treatment, such as vitiligo, as for all other more unusual skin diseases that might present and that generally would receive a mild 'dermatitis' treatment, would be considered also adequate.

The best combination of signs for an integrated identification of cases of leprosy remains to be established (Saunderson and Groenen, 2002). The low number of cases in our study affects the interpretation of the results. Our data suggest however that adding an evaluation by questioning about the length of the lesions to a testing of superficial sensitivity over a clear patch would improve the power of detection at a first visit, with a corresponding fall in specificity.

In conclusion, the algorithm tested was found to have good properties for the identification and management, as would be wished at PHC level, of pyoderma, scabies, superficial mycoses and tinea capitis, and relatively good for contact dermatitis and early leprosy. Concerning its technical limits, one should be aware that the adoption of such an algorithm in care delivered by non-specialists implies that, although the majority of patients targeted will receive appropriate management, it will not cover all eventualities. It is unavoidable that certain patients with rare diseases, or unusual presentations, will escape this approach, especially for an organ like the skin where there are a large number of distinct entities. However, in order to limit the risk of poor management of these patients, several points should be present: these algorithm structural insufficiencies would be limited; references procedures, such as exclusion criteria, should be designed; and patients wrongly labelled should not suffer through inappropriate treatment. In this respect, the tested algorithm seems satisfactory; choosing the P1, S3, and L3 combinations might appear a reasonable option for those places where there is a similar spectrum of disease. Above all, it would be essential to develop this algorithm through training sessions during which its limits would be stressed, and practical modalities of use explained. In our opinion, the simplicity of the approach described here makes it a potentially useful tool for helping non-specialist HCWs in their practice when facing common skin disorders, a so far neglected field despite growing concern about its burden.

Conflicts of interest statement

The authors have no conflicts of interest concerning the work reported in this paper.

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