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for the Western Pacific

Manila, 19–21 February 2019

WHO Informal Consultation on a Framework for Scabies Control

Meeting report

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Abbreviations and acronyms

AIM	azithromycin–ivermectin mass drug administration
DALY	disability-adjusted life–year
IACS	International Alliance for the Control of Scabies
IDM	intensified disease management
IU	implementation unit
MDA	mass drug administration
M&E	monitoring and evaluation
NTD	neglected tropical disease
SHIFT	Skin Health Intervention Fiji Trial

Executive summary

In 2017, the Strategic and Technical Advisory Group of the WHO Department of Control of Neglected Tropical Diseases recommended that the department add scabies to its portfolio. The recommendation was made to respond to the high burden of scabies and its complications, particularly in areas with limited access to health care, and in the light of new public health control strategies for reducing the burden. The Group also recommended that, before large-scale activities for prevention and control were initiated, the prevalence of the disease should be mapped, research should be conducted to improve control, scabies should be added as an indication for use of ivermectin, guidelines should be developed for use of the medicine in public health, and affordable access to avermectins should be secured. Scabies has now been added as an indication for ivermectin to the WHO Model List of Essential Medicines, regional attempts have been initiated to map the disease burden, and, in partnership with national health ministries, studies are being conducted to provide evidence as a basis for recommendations on control. Work is under way to ensure access to medications, in the absence of adequate resources.

In order to find agreement on common strategies and to identify research priorities for a global control strategy, an informal WHO consultation was organized to discuss a framework for scabies control. The meeting took place at the WHO Regional Office for the Western Pacific in Manila, Philippines. The consultation resulted in recommendations for mapping and control strategies, research priorities and programmatic needs. Although an informal consultation does not have the authority to set WHO guidelines, the recommendations in this document represent the views of many experts, and a review of current data could therefore be considered a reasonable basis for a complete framework for scabies control. Once sufficient data are available, the framework could result in guidelines to be reviewed in the rigorous WHO process. The scabies control community should adapt its work as the framework evolves. This document should guide direction of resources to common priorities and ensure that common strategies are evaluated and updated as the evidence evolves.

The recommendations made during the informal consultation can be found in the text. The main recommendations are listed below.

1. Map the burden of scabies

Although the burden of scabies has been estimated in some countries, significant gaps remain in understanding the global distribution of the disease and its contribution to the burdens of impetigo, skin and soft-tissue infections, glomerulonephritis and possibly rheumatic heart disease. Two types of mapping were recommended: rapid mapping to generate approximate estimates of disease burden and, more importantly, identify areas that should be considered for mass treatment strategies; and detailed mapping of prevalence to refine the estimates, confirm conclusions reached by rapid mapping and identify sites for longitudinal impact assessment. Prevalence mapping would be based on the diagnostic criteria of the International Alliance for the Control of Scabies (IACS), referred to as the 2019 IACS criteria, which require clinical diagnosis of scabies in most cases and visual confirmation of the diagnosis in a subset of cases when feasible. Rapid mapping should be based on a simplified version of the 2019 IACS criteria.¹

General recommendations were made on implementing the two mapping strategies, including a recommendation to conduct community-based surveys where feasible; however, more detailed descriptions of mapping methods should be prepared urgently and validated in operational research. Rapid mapping and sampling strategies should be designed to identify communities with a prevalence of scabies of $\geq 10\%$, which is the consensus threshold for public health action. The relations between the prevalence of scabies and the prevalence of impetigo and other complications should be clarified in order to evaluate the contribution of scabies infestation to long-term sequelae.

¹Since the meeting, the 2020 IACS criteria have been published and should now be used: Engelman D, Yoshizumi J, Hay RJ, Osti M, Micali G, Norton S, et al. The 2020 International Alliance for the Control of Scabies consensus criteria for the diagnosis of scabies [published online ahead of print, 2020 Feb 8]. *Br J Dermatol*. 2020;10.1111/bjd.18943. doi:10.1111/bjd.18943.

2. Provisional control strategies

Evidence suggests that mass drug administration (MDA) of 200 µg/kg body weight ivermectin orally (and 5% topical permethrin for groups in which ivermectin is contraindicated) can markedly reduce the community prevalence of scabies. The effectiveness of MDA has been best demonstrated in settings where the community prevalence of scabies infestation was $\geq 10\%$ and on islands. The consensus was that pilot control initiatives in districts should start by targeting MDA to areas in which the community prevalence is $\geq 10\%$, as measured by rapid mapping or more precise surveys, and MDA should continue until the community prevalence is $< 2\%$. In areas with a prevalence of 2–10%, an alternative strategy, intensified disease management (IDM), was recommended for clinical case detection and treatment of close contacts. It was recognized that these recommendations are based on current data and should be refined as more data become available. A number of unanswered questions remain, including whether two treatments 7–14 days apart are necessary or whether a single treatment will suffice for control in communities; whether children < 90 cm in height can be safely treated with ivermectin; whether MDA or IDM should be used when the prevalence is 2–10%; whether IDM can maintain the gains of MDA after MDA is stopped; and whether control strategies should be adapted for use in urban and non-island settings. These questions will require additional research as the framework is refined.

3. Monitoring and evaluation

Monitoring and evaluation (M&E) will be critical components of the control strategy, as they ensure documentation of the impact of interventions on scabies and its complications and will be required for long-term surveillance when MDA is stopped. Regular monitoring of sentinel communities will be an important component of the M&E strategy, with selection of some communities at random. Coverage surveys, used in many neglected tropical disease (NTD) programmes, will help document achievement of treatment targets but are not sufficient for documenting impact. New tools may be necessary for M&E, such as a point-of-care serological test or another inexpensive diagnostic tool, as clinical diagnosis will become more challenging as the prevalence decreases. The *WHO guidance on Recognizing neglected tropical diseases through changes on the skin*¹ explains how to diagnose several NTDs, including scabies, which front-line health workers without specialist knowledge of skin diseases may encounter. Until a more detailed strategy is available, countries should use such tools and opportunities that arise during assessments of other NTDs or conditions of importance in affected communities, for example by adding a skin examination to an onchocerciasis survey, to determine whether MDA can be stopped.

4. Other major issues

It was recognized that standard guidelines should be made available for individual management of scabies infestation and of scabies outbreaks. The guidelines will be based on a review of the evidence to identify gaps and on research to fill the gaps. Communities affected by scabies and national public health authorities should be engaged early in the development of the framework to ensure that programmes effectively meet their needs. Advocacy by WHO and partners will be essential in ensuring access to the necessary resources for further development of the framework and eventual expansion of programmes.

The consultation was an important first step towards meeting an important unmet global health need. The report should help countries, researchers and other partners to recognize the key issues to be addressed in order to better define the framework. Once operational research is completed and pilot projects in countries are scaled up, strategies should be refined and shared. Further operational research will be the basis for formal WHO guidelines on the control of scabies and inclusion of control targets for scabies in national NTD strategic plans. It will also facilitate the development of national and local policies for epidemic situations in which mass treatment may be required.

¹Recognizing neglected tropical diseases through changes on the skin: a training guide for front-line health workers. Geneva: World Health Organization; 2018 (<https://www.who.int/publications-detail/9789241513531>).

1. Background to the meeting

In January 2017, a formal application and dossier of evidence were submitted to the WHO Department of Control of Neglected Tropical Diseases for recognition of scabies as an NTD. The proposal was supported by the WHO country offices in Ethiopia, Fiji and Solomon Islands. The application was reviewed by the Strategic and Technical Advisory Group at its 10th meeting (29–30 March 2017). The application noted that scabies met each of the four conditions for consideration as an NTD:

1. Scabies causes and exacerbates the burden of illness of the poorest of the poor living in overcrowded, impoverished conditions with limited or no access to effective treatment. Of the currently listed NTDs, only soil-transmitted helminthiasis and schistosomiasis affect more people globally than scabies, and only six listed NTDs cause more disability-adjusted life-years (DALYs).
2. Although scabies occurs globally, the highest prevalence is recorded in tropical and subtropical regions, affecting at least 100 million people at any one time. Scabies is frequently complicated by bacterial skin infection (impetigo), which may result in abscesses, sepsis and invasive infections with *Staphylococcus aureus* and *Streptococcus pyogenes*, the latter of which may result in kidney disease and rheumatic heart disease.
3. Scabies is treatable. Not only is there tremendous scope to bring the disease under control with existing WHO strategies against NTDs, with a medicine that is already widely used (ivermectin), but there is also the collateral benefit of eliminating the complications of scabies.
4. Scabies is largely neglected in research agendas, and laboratory research, epidemiology, mapping, diagnostics and control strategies have received little investment.

On the basis of the submitted evidence, the Strategic and Technical Advisory Group recommended that scabies be formally adopted as a WHO NTD. The Group noted that further steps should be taken before programmes could be initiated, including more detailed mapping to establish disease prevalence; addition of scabies as an indication for the use of ivermectin and moxidectin on the WHO List of Essential Medicines; ensuring affordable access to avermectins; and guidelines for their public health use. As a first step towards such guidelines, WHO consulted experts in the fields of scabies and NTD control on common strategies and research priorities for preparation of a global control strategy. A WHO informal consultation was held on 19–21 February 2019 to provide input to a framework for global scabies control activities.

This report of the meeting outlines the discussions and recommendations reached by consensus. The discussions addressed mapping and surveillance, control strategies and M&E. Research priorities were identified throughout the meeting.

2. Infection, disease and transmission

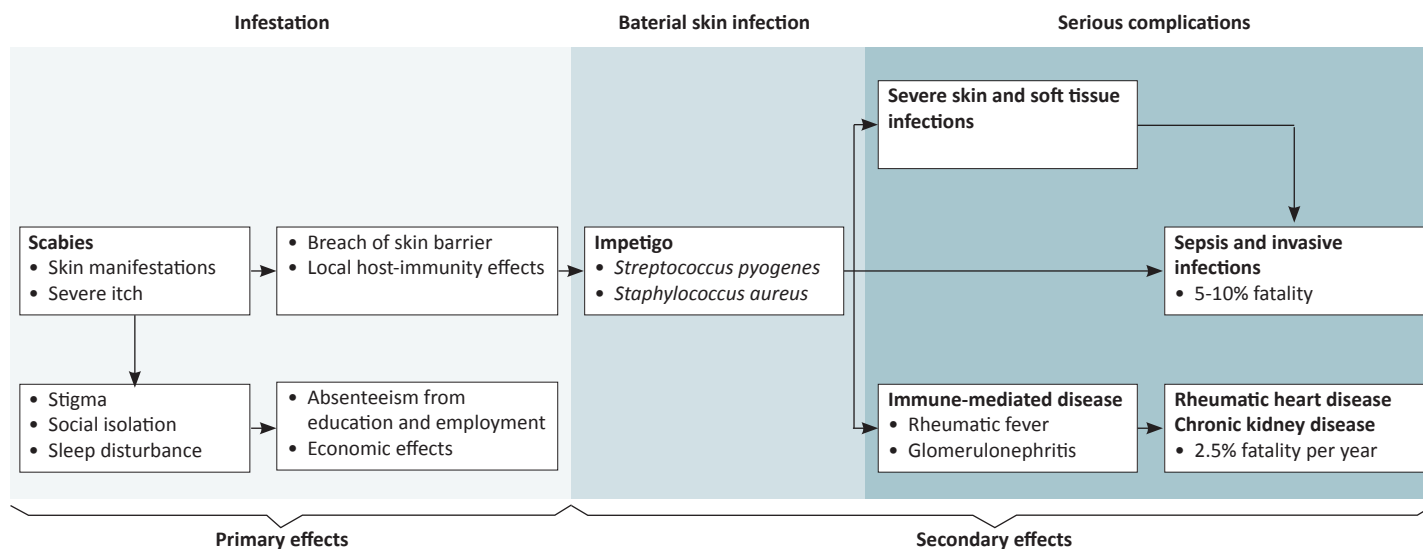
Scabies is caused by infestation of the skin with a microscopic mite (*Sarcoptes scabiei var. hominis*) (1). It is a contagious disorder characterized by itch and a skin eruption of variable severity. Female mites burrow into the stratum corneum of human skin to lay eggs. In “classic” scabies, the infestation – typically with 5–15 mites – causes a hypersensitivity reaction in the human host that triggers severe itch, which may interfere with everyday activities, including eating, sleeping, working and studying. Severe itch and skin eruptions usually appear 2–5 weeks after initial infestation with the female mite. The eruptions are considered to be an immune response to the presence of the mites and their products in the skin. Sec-

Secondary skin lesions usually develop, including papules, vesicles and nodules. Rarely, patients develop crusted (previously known as “Norwegian”) scabies, which is characterized by plaques and extensive scales and/or crusts containing millions of mites, associated with a variable degree of erythema. This form is highly infectious, is associated with mortality (2), occurs more frequently in immunosuppressed individuals and is a frequent cause of institutional outbreaks of scabies.

Scabies is transmitted by direct skin-to-skin contact, so that individuals living in overcrowded environments in the poorest of the world’s communities are particularly susceptible. Scabies is not zoonotic and cannot be transmitted to humans from dogs or other animals with sarcoptic mange, which is caused by other, genetically distinct varieties of the *Sarcoptes* mite. It is not waterborne and does not appear to be associated with poor hygiene. Skin conditions such as scabies are so common among children in some countries that parents may not consider it a reason for seeking medical treatment for their child (3).

Scabies infestation results in breaks in the skin due to scratching and therefore increases the risk of skin infections. The risk is augmented by the inhibitory effects of infestation on host complement pathways, thereby promoting bacterial colonization (4). Scabies infestation is known to be a major risk factor for impetigo caused by *Streptococcus pyogenes* and *Staphylococcus aureus* and is therefore considered a risk factor for more serious infections, including cellulitis, necrotizing fasciitis and bloodstream infections. Several studies also showed that outbreaks of scabies are a major risk factor for acute post-streptococcal glomerulonephritis (5–8). A growing body of evidence also implicates impetigo caused by *S. pyogenes* in the pathogenesis of rheumatic fever and rheumatic heart disease (9). Fig. 1 shows the primary and secondary effects of scabies.

Fig. 1. Primary and secondary effects of scabies infestation



Source: reference 10.

3. Mapping and surveillance

3.1 Background evidence

Currently, there is a paucity of epidemiological data on scabies in many countries, and most of the available data are from a few surveys, with limited generalizability to the whole population. Therefore, practical, standardized approaches to estimating the burden of scabies are required.

The available estimates indicate a global point prevalence of 100–200 million cases of scabies, with 455 million incident cases annually (11). Scabies is estimated to cause approximately 3.8 million DALYs, making it one of the highest-burden NTDs. Furthermore, the estimate does not include the associated complications of infestation. As scabies occurs in all countries, all populations are theoretically at some risk of infestation. The risk is considerably higher among people living in crowded, impoverished conditions, because of greater skin-to-skin contact and lack of access to effective treatment. The highest reported prevalence is among infants and children in tropical, resource-poor countries. In some regions, especially the Pacific, a general population prevalence of 20–30% has been reported, with a prevalence among children > 50%. Scabies is also a major risk factor for impetigo in many tropical countries (12).

Standardized approaches are necessary for:

- rapid mapping to define areas in which scabies prevalence is likely to be above the threshold for recommending MDA;
- prevalence surveys to understand the epidemiology of the disease more accurately and advocate for appropriate resources for control; and
- M&E to assess the impact of control interventions over time.

No “field-friendly” rapid test is currently available for diagnosing scabies. Scabies can be diagnosed definitively by microscopic examination of skin scrapings, but this is impractical in the field and insensitive, because only a few mites burrow in most affected individuals. Scabies usually presents as typical skin lesions and itch, although it can take many forms, and a clinical diagnosis is sometimes difficult. The 2019 IACS criteria include detailed definitions of the clinical features of scabies (13). The diagnosis is based on diagnostic certainty to one of three levels: confirmed scabies: objective visualization of mites, mite eggs or faecal pellets; clinical scabies: specific dermatological features detected on clinical examination and history; or suspected scabies: less specific dermatological features detected on clinical examination and history.

3.2 Mapping and surveillance: discussion, recommendations and research priorities

3.2.1 Identifying locations for mapping

The consultation noted that data routinely reported by health care systems on presentations to health care facilities may grossly underestimate the true burden of scabies (up to 20 times lower). This is therefore not a dependable method for identifying areas of significant transmission. The group made a provisional recommendation on the basis of field experience in scabies and methods used in other NTD programmes.

Recommendation

In order to identify areas suspected of having a high prevalence of scabies, where rapid mapping might be warranted, a preliminary review is required.

This could involve:

- a desk review of:
 - any routinely collected health data and
 - any previous prevalence surveys in the country; and
- discussions with frontline clinical and managerial health staff to identify geographical areas of concern (e.g. unconfirmed reports of scabies or other skin diseases).

3.2.2 Strategy for rapid mapping

The aim of rapid mapping is to find areas of high prevalence as a basis for public health decisions about scabies control strategies. According to the approach taken, rapid mapping may or may not also provide an accurate estimation of prevalence; it cannot replace individual diagnosis.

The group agreed that examination of the arms and legs is sufficient for rapid mapping and that examination of abdominal or genital areas is not necessary for this purpose. The contact history required in the 2019 IACS criteria (13) was considered difficult to achieve during rapid mapping and possibly poorly reproducible; it was therefore not recommended. The group agreed that dermoscopy, other non-invasive mite visualization techniques and skin scrapings would be unnecessary for rapid mapping, although they might be necessary to confirm or refute the presence of scabies when the results were unclear.

Brief, 2–3-day training of nurses and health workers in rapid mapping should continue to be refined and validated (14) and should include consideration of other diseases with similar presentation to scabies.

The group discussed whether data on the prevalence of impetigo (infected skin sores due to *Staphylococcus aureus* or *Streptococcus pyogenes*) should be collected during mapping for scabies. Although the prevalence of impetigo will not affect a decision to implement MDA, the group agreed that, as little additional time would be required for assessing impetigo, it would be reasonable to collect the information, which could be used in assessing the likely overall impact of a scabies control programme. It was noted, however, that standardized criteria might be necessary for the diagnosis of impetigo. The group agreed, however, that it might not be feasible or useful in rapid mapping to routinely collect information on the more severe complications of scabies and impetigo, such as severe infections, glomerulonephritis or rheumatic fever. Crusted scabies, although important in assessing the success of control, also need not be accurately quantified during mapping. Any cases of suspected crusted scabies found should be reported for appropriate specialist assessment.

The main concepts in clinical diagnosis of scabies are summarized in the 2019 IACS criteria for the diagnosis of scabies.

A. Confirmed scabies: at least one of:

- A1, Mites, eggs or faeces on light microscopy of skin samples;
- A2, Mites, eggs or faeces on an individual visualized on a high-powered imaging device;
- A3, Mites visualized on an individual by dermoscopy.

B. Clinical scabies: at least one of:

- B1, Scabies burrows
- B2, Typical lesions affecting male genitalia
- B3, Typical lesions in a typical distribution and two history features

C. Suspected scabies: one of:

- C1, Typical lesions in a typical distribution and one history feature
- C2, Atypical lesions or atypical distribution and two history features

History features:

- H1, Itch
- H2, Positive contact history

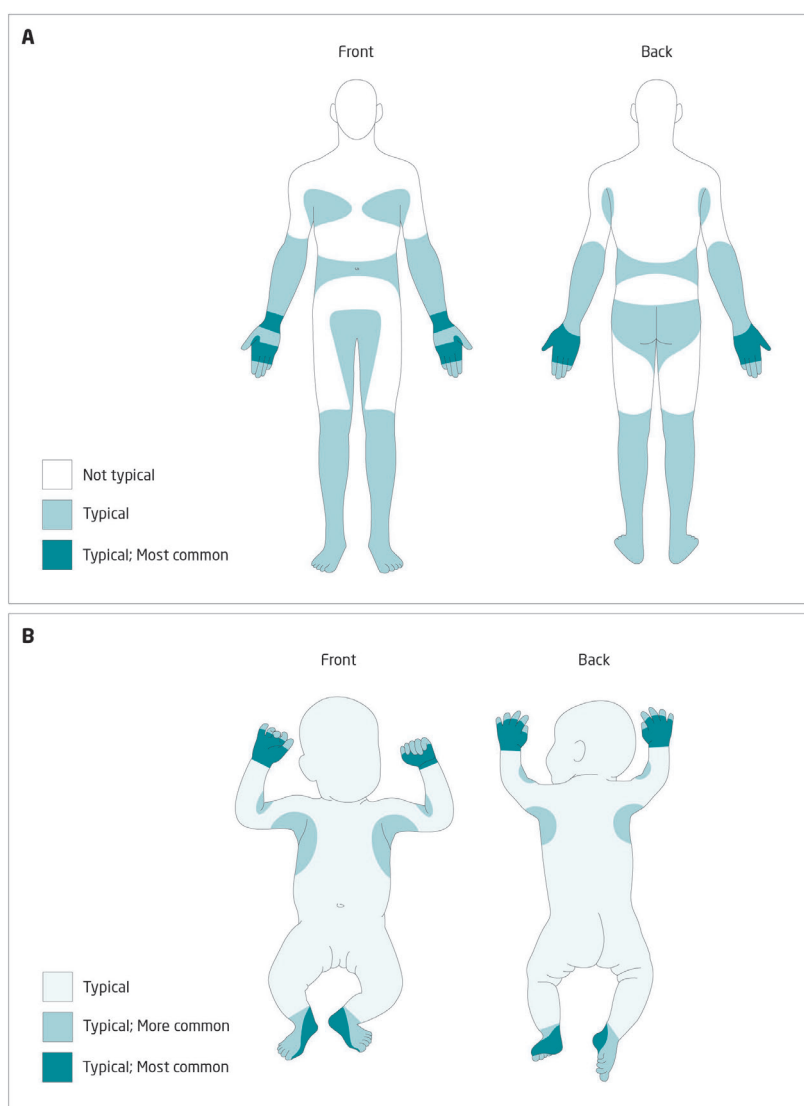
Notes:

1. Diagnosis can be made at level A, B or C.
2. A diagnosis of clinical or suspected scabies should be made only if differential diagnoses are considered less likely than scabies.

Typical appearance of scabies lesions: Scabies may present with one or more of three types of skin lesion: papules, nodules and burrows. It most commonly presents with small, easily palpable lumps on the skin (papules) measuring < 5 mm. Lesions are frequently excoriated by scratching. In some cases, scabies may present as larger (5–10 mm) palpable lumps (nodules), especially in the genital region, axilla and breast area. Scabies burrows are short (generally < 5 mm) linear lesions created by tunnelling female mites, which lay their eggs in the stratum corneum. Burrows are highly specific (pathognomonic) findings of scabies but are difficult to locate and often not present in highly endemic settings where repeated infestation and secondary infection are common.

Typical distribution of scabies lesions: The typical distribution of scabies in older children and adults includes lesions on skin distal to the mid–upper arm and mid–upper thigh and in the groin, breast and peri-umbilical areas. Lesions are most common on the hands, particularly the fingers and finger web spaces, and wrists. In infants, lesions are typically more widespread, including the trunk, scalp, palms and soles (Fig. 2).

Fig. 2. Typical distribution of scabies lesions



Source: Engelman D, Yoshizumi J, Hay RJ, Osti M, Micali G, Norton S, et al. The 2020 International Alliance for the Control of Scabies Consensus Criteria for the Diagnosis of Scabies. *Br J Dermatol.* 2020;Feb 8 [ePub ahead of print]. doi:10.1111/bjd.18943.

A, children aged > 2 years and adults; B, infants aged < 2 years

Modified criteria for rapid mapping: Identification of typical lesions and distribution of scabies, with or without itch

Note: This case definition is only for estimating community burden and should not be used to decide on individual management. The skin examination can be limited to the arms (above the elbow to the fingertips) and legs (above the knee to the toes).

Recommendations

The modified criteria for the diagnosis of scabies should be used for rapid mapping of the burden of scabies.

Primary health care workers should be trained in rapid mapping; appropriate training packages should be further refined.

Information about the presence of impetigo should be collected during rapid mapping, and standardized criteria should be set for clinical diagnosis of impetigo.

3.2.3 Target population and sampling strategy

The experts discussed definition of the implementation unit (IU) to be used for mapping. They acknowledged that mapping strategies must achieve a balance between accuracy, detailed epidemiological information and logistical factors, particularly cost. A pragmatic approach was considered most appropriate, as data on interventions at programme level are limited, and there are no donations to support control programmes. This decision should be revised as the situation evolves. Agreement was reached that a population of approximately 100 000–150 000 would be an appropriate IU for both mapping and interventions. A smaller or a larger population might be used in some settings, such as islands and urban areas.

The experts had a lively discussion on the relative benefits of a community or a school sampling strategy. Community surveys are a more robust strategy but may be more logistically challenging in terms of travel, time and cost. School surveys may be easier to implement and would provide estimates of the burden among individuals at very high risk of transmission. Such surveys are likely, however, to exclude children who do not attend school, who may be at higher risk of scabies. The degree of clustering of cases (the design effect) in schools might also be significant, which would increase the required sample size. In addition, community sampling was used in all the published studies on MDA for the control of scabies. Finally, in high-prevalence settings, communities might not permit researchers to visit schools but only to examine a subset of students.

The experts agreed that house-to-house surveys in communities should be the recommended design, although examination at a central point might be more practical in some settings. The survey should be designed to allow estimates of prevalence by age group, gender and village and to detect prevalence above the threshold for starting MDA. They concluded that a school survey method might be reasonable if school attendance was high and a community strategy was not feasible.

The recommendations address mainly rural and remote populations, as there are currently insufficient data and experience to make recommendations for urban areas.

Recommendations

An all-ages, a cluster sampled, community-based, house-to-house sampling strategy is the most appropriate design for measuring the prevalence of scabies.

Sampling methods similar to those used in other NTD mapping programmes for MDA should be adapted for mapping scabies.

An IU of approximately 100 000–150 000 population is appropriate for both mapping and intervention.

3.2.4 Strategy for estimating prevalence for long-term monitoring of sentinel sites

Estimated prevalence can be used to:

- provide epidemiological data on the burden of scabies and impetigo;
- monitor the impact of interventions, by repeating prevalence surveys at sentinel sites; and
- identify new ways to predict areas with suspected high-level prevalence from other easily identified characteristics.

Long-term monitoring in areas where prevalence is measured will determine whether heterogeneity of transmission persists after treatment or whether new areas become hotspots of transmission.

Prevalence, as opposed to rapid mapping, should be estimated by the most accurate diagnostic method feasible in each setting. Estimates should meet the full 2019 IACS criteria, and the breakdown by diagnostic level (confirmed, clinical, suspected and subcategories) should be reported. Clinical assessment should be the mainstay; however, the diagnoses of a subset of cases could be confirmed with dermoscopy, microscopy and other visualization techniques by experienced operators, where feasible.

The prevalence of impetigo should be assessed on skin examination at the same time as the prevalence of scabies. The expert group agreed that it would not be feasible or practical to collect information on more severe complications of scabies and impetigo.

Recommendations

Prevalence, as opposed to rapid mapping, should be estimated in areas of concern (e.g. unanticipated results) or in areas that are programmed to be followed longitudinally as sentinel sites.

Survey methods should be based on the 2019 IACS criteria; a subset of infestations should be confirmed as described in the criteria.

Surveys should be designed to determine age- and gender-specific community prevalence, with an appropriate sampling method in large communities and census evaluations in small communities.

The sentinel sites should include some with a lower prevalence in order to understand spatial and temporal heterogeneity in transmission.

Process (e.g. coverage) and outcome (e.g. impact of treatment on prevalence) should be evaluated at some sentinel sites, as appropriate, and should be linked when possible.

3.2.5 Research priorities

- As rapid mapping may be less precise than a formal prevalence survey, studies should be conducted to determine whether “true prevalence” and “rapid mapping prevalence” are correlated.
- As it might be more cost-effective to evaluate prevalence in schools rather than communities, studies should be conducted to determine whether there is a consistent relation between prevalence in schools and in communities, including children who do not attend school.
- Although not an immediate priority, strategies for mapping and MDA implementation should be developed for urban areas; programmes and researchers should use opportunities to gain information as they arise, such as adding examinations for scabies to mapping of other NTDs in urban areas.
- Operational research should be conducted to validate and refine the proposed mapping strategy.

4. Control strategies

4.1 Background evidence

The original landmark studies of community control were conducted in Panama in the 1970s and 1980s. Taplin and colleagues (15) found, in small island communities with a very high prevalence of scabies, that treatment of all community members with topical 1% lindane resulted in 98% cure, while treating only those with clinical scabies resulted in 50% cure. The same team evaluated MDA with topical 5% permethrin on a small island, treatment of new arrivals and continued surveillance for new cases (16). The prevalence of scabies was reduced from 32% to < 2% and maintained for 3 years, with a concomitant reduction in impetigo without use of antibiotics (from 32% to 1%).

In 1997, Lawrence and colleagues (17) introduced an MDA control programme on five of the Solomon Islands. Oral ivermectin was used in place of permethrin, except in children weighing < 15 kg and pregnant women, who received 5% permethrin. All children were re-examined and treated at 6-monthly intervals if necessary, and returning residents were also treated. The prevalence of scabies was reduced from 25% to < 1% over 3 years, with a concomitant reduction in impetigo.

The only randomized controlled trial of MDA for scabies control was conducted in Fiji in 2012, where Romani and colleagues (18) conducted the Skin Health Intervention Fiji Trial (SHIFT). Three groups on small islands were randomized to one of three groups: MDA with ivermectin (as by Lawrence et al.), MDA with permethrin or standard care, in which all community members were examined for scabies and referred for treatment. After 12 months, the prevalence of scabies was reduced by 94% (from 32% to 2%) with ivermectin, by 62% (from 42% to 16%) with permethrin and by 49% (from 37% to 19%) with standard care. Concomitant reductions in impetigo were seen in all three groups, with the greatest reduction in the group given ivermectin. A survey 24 months after MDA showed that the prevalence of scabies continued to be low in the group given ivermectin (3.6%), who had an even lower prevalence of impetigo (2.6%) (19).

MDA with ivermectin for scabies was scaled-up to a population of over 26 000 in the azithromycin–ivermectin MDA (AIM) trial conducted in the Solomon Islands by Romani and colleagues in 2015 (20). A single round of ivermectin plus azithromycin for trachoma control was well tolerated, with no serious adverse events, and the prevalence of scabies was reduced by 88% (from 18.7% to 2.3%) at 12 months (21). A subsequent survey showed that the prevalence of scabies remained 74.9% lower than at baseline at 36 months (22).

Not all studies of MDA for scabies have had the same impressive results. In a single cohort study in a remote island community of Australia, MDA with ivermectin to a population of about 1000 people reduced the prevalence from 4% to 1% 6 months after MDA, but the prevalence increased to 9% after 12 months (23). After a second MDA, the prevalence of scabies fell to 2% 6 months later. In a study in the United Republic of Tanzania, annual MDA for lymphatic filariasis, which included a single dose of ivermectin, was associated with a smaller reduction in scabies prevalence (from 4.4% at baseline to 2.9% after 4 years (24).

These studies are summarized in *Table 1*.

The largest MDA with ivermectin was conducted in 2018 in an epidemic of scabies associated with drought in Ethiopia, where over 700 000 people were treated (25). Formal evaluation of the impact of MDA was not available at the meeting.

Mass treatment has also been used to manage scabies outbreaks in closed institutions, such as schools, prisons, hospitals, aged care facilities and camps for refugees and displaced people.

Table 1. Summary of trials of mass drug administration for scabies control

Study site	Design	Size	Intervention	Doses of treatment	Baseline scabies prevalence	Prevalence at 12 months	Reduction in scabies prevalence at 12 months	Reference
Panama	Single arm	756	Permethrin MDA and continuous surveillance and treatment of cases	1 dose for all participants	33%	1%	AR 32% RR 97%	16
Solomon Islands, Lau Lagoon	Single arm	915	Ivermectin MDA ^a and continuous surveillance and treatment of cases	1 dose for all participants	25%	1%	AR 24% RR 96%	17
Fiji, SHIFT study	RCT	2051 in three arms	1. Ivermectin MDA 2. Permethrin MDA 3. Routine care	1 dose for individuals without scabies 2 doses for individuals with scabies	1. 32.1% 2. 41.7% 3. 36.6%	1.8% 16% 18.8%	1. AR 30.3%, RR 94% 2. AR 25.7%, RR 62% 3. AR 17.8%, RR 49%	18
Australia, Northern Territory, Galu-winku tribe	Single arm		Ivermectin MDA	1 dose for individuals without scabies 2 doses for individuals with scabies	4%	9% (prevalence reduced to 1% at 6 months)		23
Solomon Islands, AIM trial	Single arm	26 372	Ivermectin MDA	2 doses of treatment for all participants	18.7%	2.3%	AR 16.4% RR 88%	12
Solomon Islands, AIM skin trial	RCT	1291 in two arms	1. Ivermectin MDA 2. Ivermectin and azithromycin MDA	1 dose for individuals without scabies 2 doses for individuals with scabies	1. 11.8% 2. 9.2%	1% 0.7%	1. AR 10.8%, RR 91.5% 2. AR 8.5%, RR 92.4%	22

AIM, azithromycin-ivermectin MDA; AR, absolute reduction; MDA: mass drug administration; RCT, randomized controlled trial; RR, relative reduction; SHIFT, Skin Health Intervention Fiji Trial

^a Ivermectin MDA includes topical permethrin treatment for individuals with a contraindication to ivermectin, including small children and pregnant women.

4.2 MDA thresholds and targets: discussion, recommendations and research priorities

4.2.1 Threshold above which MDA is recommended

The group discussed this issue at length. Their considerations included measurability, feasibility, sustainability, durability and potential links to health benefits other than against scabies. There were insufficient data to set a threshold risk of severe infective and immune-mediated complications (e.g. glomerulonephritis or rheumatic heart disease) for starting MDA.

The consensus was that there was convincing evidence that MDA can be highly effective in places where the community prevalence is $\geq 10\%$, but the evidence for its effectiveness in places with lower prevalence settings was less clear. The group also noted that many of the studies were conducted in island populations, and the results may or may not be generalizable to mainland or urban areas. The experts concluded that, if a school mapping strategy were used, the threshold prevalence for MDA should be a higher (for example, 15%) to be equivalent to a community prevalence of $\leq 10\%$. The correlation between prevalence determined by community mapping and that determined by school mapping should be verified in operational research.

The group also discussed alternative approaches, such as screen-and-treat. The strategy would be more resource intensive and, given the standard recommendation to treat all household contacts of people with scabies, might approximate MDA in areas where the population prevalence approaches 10% but without the benefit of treating asymptomatic carriers outside families or the cost savings of MDA.

Recommendations

MDA is recommended where the population-based prevalence is estimated to be $\geq 10\%$.

Estimates of prevalence for determining where to start MDA could be derived by rapid mapping, although a formal prevalence assessment could also be used.

If school mapping is used, a higher prevalence threshold would be required than for community MDA, which should be verified in additional operational research.

4.2.2 Target threshold for stopping MDA

Few data and little experience are available to guide decisions on the target threshold for stopping MDA. Trials of MDA with ivermectin in high-prevalence settings have shown that the prevalence can be reduced to about 2% with a single round. The effectiveness of each MDA round may, however, be lower in settings other than islands. Additional interventions, including improving the availability of drugs, better strategies for IDM and universal health coverage (see *section 4.4*), may maintain the gains achieved with MDA.

The group discussed possible thresholds for stopping MDA. A target close to the 10% starting threshold was considered inappropriate, as the prevalence would rise quickly to pre-MDA levels. There was general agreement on a threshold in the range of 2% for stopping MDA, as, above that level, slow rises in prevalence were seen in trials on islands (19,22). Some participants proposed that the target be even lower, as transmission dynamics may be more intense in areas with a higher starting prevalence of infestation, as observed for other NTDs. A lower threshold for stopping MDA was not, however, widely supported.

Uncertainties with regard to setting this target were expressed, including whether it could be achieved in settings other than the trial islands, the links with impetigo and severe complications and how and when the target should be measured.

Recommendations

IDM (see section 4.4) rather than MDA should be used when the estimated prevalence is < 2%.

The target threshold for stopping MDA should be pilot-tested in embedded operational research (see section 4.3.2).

A standard method should be used to demonstrate that the 2% target threshold for stopping MDA has been achieved.

4.2.3 Research priorities

- demonstration of the impact of MDA on scabies prevalence in non-island populations;
- the impact of MDA where the community prevalence is < 10%, including estimates of cost-effectiveness as compared with IDM;
- areas of persistent high prevalence after MDA and interventions to target such areas;
- longitudinal studies to assess spatial variation in transmission at baseline and after several rounds of MDA and after switching to IDM and to identify potential post-MDA emergence or identification of hot spots;
- better definition of the relation between scabies and impetigo and severe complications in various populations and settings (i.e. populations with different genetic backgrounds and different intensities of scabies transmission) and the impact of MDA on impetigo in these population and settings;
- modelling to estimate the impact of reducing the prevalence of scabies to 2% on impetigo and severe complications, with estimates of sustainability and rebound; and
- pilot studies to identify the optimal strategy for monitoring the impact of MDA, including where, how often and the indicator(s) to be measured.

4.3 Control strategies above the MDA threshold: discussion, recommendations and research priorities

The MDA strategies used in trials varied in: medication choice and dosing; the number and frequency of rounds; target coverage and IUs; and adjunctive approaches to control. The experts agreed that recommendations be made on all the elements of an MDA strategy. Critical considerations in a given setting include currently available data, experience in MDA for other NTDs, setting (e.g. island, rural, urban), safety, practicality, cost and ease of integration.

4.3.1 Medication choice and dosing

The SHIFT study showed that MDA with ivermectin was more effective than MDA with permethrin and more effective than standard care, which comprised treating clinical cases and their close contacts. Other single-arm studies in which MDA with ivermectin was used demonstrated reductions in the prevalence of scabies and impetigo of a similar magnitude. The experts agreed that MDA with ivermectin is the approach of choice.

In most studies, $\geq 15\%$ of the target population were ineligible for ivermectin (pregnant and breastfeeding women, small children, those with severe illness) and were treated with 5% permethrin, adding cost and logistic complexity to implementation. The experts agreed that topical treatment should be limited to people with a contraindication for ivermectin. Studies of use of ivermectin in children weighing < 15 kg or < 5 years of age that are currently in progress may lead to updating of the recommendations.

It was noted that moxidectin is being evaluated for scabies treatment and might replace ivermectin. As it has a much longer half-life, a single dose may be required for successful treatment (26,27).

In determining the dose of ivermectin, the experts prioritized considerations of safety, clinical efficacy and cost. In most trials of MDA for scabies, the dose used was 200 $\mu\text{g}/\text{kg}$ body weight. It was agreed that a

dose window around 200 µg/kg was ideal to minimize the proportion of community members receiving a potentially ineffective dose (< 150–200 µg/kg) and to minimize overdosing. Some experts noted that ivermectin has been used safely for other indications at ≤ 600 µg/kg (28), although not in MDA.

In programmes for the control of other NTDs, such as onchocerciasis and lymphatic filariasis, weight and/or height are used to determine the dose of ivermectin. The experts agreed that a standard approach to dosage of ivermectin for scabies is essential but that, ideally, as for other NTDs, it would not require weighing people. Work on basing dosage on height may elucidate the question (29).

Age-based dosing, as used in studies of triple therapy for lymphatic filariasis in Papua New Guinea, has the advantage of simplicity but has several limitations, including inaccurate reporting of age, variable correlation of age with weight, potential under-dosing in many settings and no studies of effectiveness.

Weight-based dosing (on scales), as used in previous studies of scabies interventions, is appropriate for clinical use but is logistically challenging for larger-scale MDA. The advantages include less under-dosing (especially for very heavy individuals), while the disadvantages include the cost of scales and the time required.

Height-based dosing is a common strategy in MDA for NTDs. The advantages include ease of use and straightforward conversion from measurement to dose. An “ivermectin dosing height pole” is used in onchocerciasis control programmes but is designed for a target dose of 150 µg/kg. Height poles have also been made for dosing ivermectin for lymphatic filariasis (when used with diethylcarbamazine) and for scabies intervention trials in 2019 that will target 200 µg/kg (29). The disadvantages of height-based dosing include potential under-dosing for heavy adults.

Ivermectin is active against adult and immature mite forms but not against eggs. Permethrin is active against adult mites and has some activity against eggs. In the SHIFT trial, people with a diagnosis of scabies at baseline received two doses of ivermectin or two applications of permethrin 1 week apart, and those with no clinical evidence of scabies received a single treatment. In the AIM study, all participants received two doses of ivermectin or two applications of permethrin, with estimated coverage > 95% in the first round and > 80% in the second round. Both strategies resulted in > 85% reductions in the prevalence of scabies after 1 year. The experts considered that there were insufficient data to reach a consensus about whether one or two doses should be recommended but that at least two studies are under way that might alter that decision.

Recommendations

Contraindications to ivermectin are the same as those specified in guidelines for lymphatic filariasis:

- children weighing < 15 kg or < 90 cm in height,
- pregnant and lactating women within 1 week of giving birth,
- sick and infirm people and
- people with previous hypersensitivity to ivermectin.

The experts noted that exclusion due to pregnancy is a precaution in the absence of definitive information, as there is no direct or anecdotal evidence of complications resulting from treatment with a single dose of ivermectin in pregnant women, and observational data suggest that inadvertent exposure of pregnant women is not associated with adverse outcomes (22–24).

MDA rounds should be based on two doses of ivermectin.

Ivermectin dosing (two doses 7–14 days apart):

- 200 µg/kg, rounded up to 3-mg tablets, with direct observation of ingestion;
- weight- or height-based dosing is appropriate, for a target dose of 200 µg/kg; age-based dosing is not recommended.

Topical agents should be used when ivermectin is contraindicated or not available.

- For individuals > 2 months of age, 5% permethrin topical cream is the treatment of choice. Benzyl benzoate topical cream or lotion is an alternative.
- For infants aged < 2 months, the options are: 5% permethrin cream but with a shorter application time (4 h), crotamiton or no treatment.

Permethrin dosing (two doses, 7–14 days apart):

- Adults and children > 12 years of age: apply up to one 30-g tube, and wash off 8 h after application.
- Children aged 5–12 years: apply up to half a 30-g tube, and wash off 8 h after application.
- Children aged 2–5 years: apply up to one fourth of a 30-g tube, and wash off 8 h after application.
- Children aged 6 months to 2 years: apply up to one eighth of a 30-g tube, and wash off 8 h after application.
- There are limited data on use of permethrin in infants < 6 months; expert opinion suggests that up to one eighth of a 30-g tube could be applied and washed off 4 h after application.

Benzyl benzoate 25% (two doses, 7–14 days apart):

- Apply, and wash off 24 h after application.
- For adults and children aged > 12 years, undiluted 25% should be used.
- For children aged 2–12 years, dilute to 12.5%.
- For infants aged 6 months to 2 years, dilute to 6.25%.
- Do not use in infants < 6 months of age.

Application of topical treatment:

- Adults and children 2 years of age and older: apply to the body surface from the neck to the toes, excluding the head.
- Infants < 2 years of age: apply to the entire body surface, including neck, face, ears and scalp, but avoid areas around the eyes and mouth.

4.3.2 Number and frequency of MDA rounds

A single round of MDA was used in the SHIFT and AIM studies, and in neither study was the prevalence reduced to < 1%, while, in the studies in Panama in the 1970s, with annual MDA with permethrin for 3 years and active case management, the prevalence fell to < 1%. Multiple rounds of MDA are used against other NTDs. The experts agreed that the optimal design of MDA should be based on evidence and modelling, with annual evaluation of the effectiveness of large-scale MDA programmes in carefully planned surveys. They also agreed that the number of rounds of MDA might be defined by the geographical context of the IUs, such as whether rural or urban, and baseline transmission characteristics; fewer rounds might be required in rural island settings than in larger urban settings.

Limited data are available on the frequency and timing of MDA rounds for scabies. Annual single-dose rounds were used in all the studies available so far. The experts noted that, although MDA every other year might be similarly effective, experience from other NTD programmes suggests that such a strategy would be difficult to implement. The consensus was that 6-monthly MDA would be considered only if further evidence suggests that annual MDA is not sufficient for control.

Recommendations

MDA should be implemented annually.

MDA should consist of three to five annual rounds, with impact assessments to determine whether it should be continued longer (i.e. if the prevalence of infection is < 2%).

Impact assessments should be conducted either yearly or at the end of years 3 and/or 5, although initial operational research will require annual assessment.

4.3.3 Coverage targets and implementation units

High coverage is an essential requirement for an effective MDA programme. High coverage depends on: the availability of adequate quantities of both topical and oral medications at the right time; the efficiency of the drug delivery system; the motivation and productivity of drug distributors; education and motivation of the beneficiary communities; and surveys to identify population groups that are being missed. As the whole population is eligible for treatment with either ivermectin or topical medicine, the minimum coverage should be 80% of the total population. The experts agreed that coverage targets should be set for the total population for both doses.

The experts acknowledged that IUs for MDA depend on national policy and that national governments are in the best position to identify the smallest (lowest-level) administrative unit responsible for implementing MDA (district, town, city block). The experts recognized that the larger the IU, proportionately fewer resources would be required for initial epidemiological assessment but that more resources would be needed for MDA implementation.

Recommendations

The minimal target coverage for MDA is 80% of the total population (for both doses of both oral and topical treatments).

The population of an IU should not be > 150 000; smaller IUs could be used, as determined, in national programmes.

4.3.4 Adjunctive approaches to control

Little information is available on the effectiveness of environmental measures for the control of scabies in endemic communities, and the group considered that such measures would not add benefit to MDA control programmes at this stage. They acknowledged that crusted scabies might be an exception, as it involves a very high parasite burden and is highly infectious, and its management therefore necessitates environmental measures such as washing clothes, bed linen and towels in hot water and cleaning floors and furniture.

4.3.5 Research priorities

- the safety and dosage of ivermectin in children weighing < 15 kg, measuring < 90 cm or aged < 5 years;
- the safety of permethrin in children aged < 2 months;
- comparison of the efficacy and effectiveness of 150 µg/kg and of 200 µg/kg of ivermectin for MDA against scabies;
- effectiveness of a single dose of ivermectin and a single application of permethrin in MDA rather than two doses 7–14 days apart, which would facilitate integration of MDA for scabies into other MDA programmes;
- efficacy of moxidectin for the treatment and community control (MDA) of scabies;
- annual evaluation of selected sentinel sites as part of operational research to determine the number of rounds required for sustainable scabies control; and
- continued epidemiological modelling to determine the number of rounds of MDA necessary for successful control in a variety of epidemiological settings and modelling of the impact of different levels of therapeutic coverage.

4.4 Control strategies below the MDA threshold: discussion, recommendations and research priorities

4.4.1 Discussion and recommendations

Further research should be conducted to define the strategies to be used when the prevalence is low, either at baseline or when achieved by MDA. The efficacy of IDM strategies should be compared with that of MDA in the same settings. Evidence in favour of MDA is based predominantly on studies in high-prevalence settings; therefore, its cost-effectiveness should be compared with that of IDM in settings where the prevalence is < 10%.

The experts recognized that there are no data on the efficacy of non-MDA interventions for areas in which the prevalence is < 10%. The possible strategies, such as IDM, screen-and-treat and targeted MDA, and the optimal approach depend on the local context and should be decided nationally. Countries in which MDA is used could include areas with lower prevalence in the national plan. The experts noted that integration into existing health programmes and health services is crucial for the success of control strategies in areas in which the prevalence is below the threshold.

The experts highlighted the following key elements of an IDM strategy:

- Enhance clinical care in primary health care clinics by providing evidence-based guidelines on optimal treatment (ivermectin and/or permethrin) of clinical cases and all household contacts.
- Raise awareness of scabies as a clinical and public health problem among both health care workers and the public.
- Train health care workers in recognition and diagnosis of scabies and in treatment of individuals and, importantly, households and other close contacts.
- Recognize and refer cases of suspected crusted scabies, with treatment guidelines that include recommendations for follow-up and environmental measures.
- Strengthen and support routine collection, analysis and reporting of data on scabies presentations at health care facilities.
- In appropriate settings, consider active case-finding with referral or treatment, such as screening for “skin NTDs”, with an opportunity to include scabies.

Recommendations

Develop the evidence base for optimal IDM strategies for scabies.

Incorporate treatment of all close contacts into national plans and in training of health care workers.

WHO should advocate for improved availability of scabies treatments in endemic settings.

Update international guidelines for the treatment of individuals with scabies as sufficient evidence becomes available.

WHO should prepare guidelines for implementation of IDM for scabies as sufficient evidence becomes available.

4.4.2 Research priorities

- operational research to determine the impact of IDM on the transmission of scabies when the prevalence is < 10%; and
- operational research to test and compare the impacts of MDA and of IDM when the community prevalence is < 10%, perhaps including comparisons of cost and feasibility.

4.5 Epidemics and outbreaks: discussion, recommendations and research priorities

4.5.1 Discussion and recommendations

Epidemics and outbreaks of scabies have been well described, although the definitions of cases and close contacts and the control measures taken are heterogeneous. Outbreaks can occur in regions with high transmission of scabies and also in settings of overcrowded living conditions, such as refugee camps. Institutions in high-income countries, such as aged-care facilities and asylum seeker centres, are common settings for outbreaks. Further research and consensus are required to define the appropriate methods and thresholds for detecting and declaring outbreaks of scabies more accurately. MDA has been used to control some outbreaks, such as in Ethiopia, described in *Annex 1*.

Recommendations

- **An evidence base should be created for international guidelines on the optimal treatment of outbreaks of scabies, which should:**
 - set criteria for an outbreak of scabies,
 - specify the strategy to be used to control an outbreak of scabies and
 - set criteria for successful control of a scabies outbreak and when the intervention(s) can be stopped.

4.5.2 Research priorities

- a systematic review of the evidence on outbreak management to identify gaps in knowledge and
- operational research on the effectiveness of MDA for outbreak response in various settings.

4.6 Additional considerations for control: discussion, recommendations and research priorities

4.6.1 Integration

The potential for integration of scabies control activities was discussed, particularly into other MDA programmes for preventive chemotherapy. The group discussed a number of technical factors to be considered, including the timing, dosing and/or frequency of rounds of MDA, the age groups targeted and training of staff. NTD programmes in which ivermectin is used (onchocerciasis and lymphatic filariasis) represent obvious opportunities for integration. The technical barriers are topical treatment for patients who are not eligible for ivermectin and the second dose of ivermectin. The group recognized that most programmes for NTDs amenable to preventive chemotherapy include baseline mapping, and impact assessments might provide a platform for integrating scabies mapping. The group noted that, in addition to technical challenges, political factors, such as support from ministries of health and funders, must be addressed for integration. Scabies should also be integrated into approaches to skin NTDs to ensure that health care providers receive training in the diagnosis and management of scabies, and an indicator of scabies should be included in any surveillance system established for skin diseases.

Recommendations

- **Seek opportunities for integration with existing programmes, including at the stages of mapping, implementation and surveillance.**

4.6.2 Community engagement

Several speakers highlighted the importance of community engagement in disease control, to promote inclusivity, ownership and sustainability of programmes. The importance of learning from success stories of community engagement was noted, including appropriate use of community events, social media platforms and radio messaging. The tools must be appropriate for each community.

Recommendations

- Scabies control programmes should learn from and use strategies for community engagement developed for other NTD programmes and tailor them to the context.

4.6.3 Cost

Cost was recognized as a significant concern in establishing national and global scabies control programmes. As for other NTDs amenable to preventive chemotherapy, the costs of delivering treatment should be considered, including for community engagement, training, paying health care workers, transport, monitoring and surveillance. While no estimates of the cost of scabies MDA are available, the group noted that benchmark costs are available for similar programmes, although the requirement for topical treatment and second doses of both oral and topical treatments would result in higher costs than for other programmes.

Other NTD MDA programmes are supported by large drug donation programmes, but there is no equivalent programme for scabies. Prequalification of the suppliers of generics or other mechanisms to ensure access to low-cost, high-quality ivermectin and permethrin should be considered. An application for ivermectin to be added to the *WHO Model List of Essential Medicines* for the treatment of scabies had just been submitted at the time of the meeting. The listing would facilitate prequalification of new manufacturers of the medications.

For accurate assessment of the cost–effectiveness of interventions, more, detailed information is required on the costs averted. The discussants recognized that health-related cost savings could be realized at individual, household and community levels by a direct impact on scabies, including reduced stigmatization, increased attendance at school and work and less clinical care. Quantification of the potential impact of treating scabies in reducing bacterial skin infections was considered to be particularly important, as this would significantly benefit health and save costs. Health economists could be engaged in evaluating the impact of scabies control programmes.

Recommendations

- Identify mechanisms for improving access to low-cost ivermectin and permethrin, including listing of both drugs as Essential Medicines and prequalification of suppliers of generic drugs.
- Estimate the cost and cost–effectiveness of MDA and IDM strategies as a basis for implementation and decision-making.

4.6.4 Safety

The excellent safety profile of ivermectin and its widespread use in other programmes of preventive chemotherapy for NTDs were noted. The drug has a wide therapeutic window, which minimizes the risk of adverse events due to accidental overdosing. There is also extensive experience with use of topical treatments. The experts noted that drug safety monitoring in scabies programmes could be based on that in other NTD programmes, including use of the WHO pharmacovigilance database and programme

for appropriate reporting of severe adverse events. Reporting to WHO country offices, regional offices and headquarters through the Vivibase, Vigiaccess and WHO NTD operations team was discussed. The group emphasized that health systems must respond to all adverse events in order to maintain confidence in programmes.

Recommendations

- **Learn from other NTD programmes and use existing frameworks for monitoring and reporting adverse events, such as Vigibase (<https://www.who-umc.org/vigibase/vigibase/>).**
- **Support the use of pregnancy registries for recording inadvertent treatment and evaluating its impact on pregnancy outcomes.**

4.6.5 Human resources and training

The group recognized that a simplified approach to clinical diagnosis is necessary for rapid mapping and surveillance (see *section 3.2*). In the absence of trained specialists, the target audience for training should be front-line or mid-level health care workers. (For example, the ratio of dermatologists to population size is 1 to 80 000 in the United Kingdom and 1 to 1 000 000 in Ethiopia.) The experts agreed that the 2019 IACS criteria should form the basis of any training package and that staff should also be trained to recognize impetigo.

Development of such training packages should include evaluation of the reproducibility and reliability of the IACS Delphi criteria in various settings, standardization of staff evaluations, determination of whether formal assessment of inter- and intra-operator agreement is required and determination of how to establish post-training re-evaluation.

Recommendations

- **Standard training material should be developed that can be adapted locally to include different skin types and exposure, as appropriate.**
- **Training material and evaluations should be designed for front-line and mid-level health care workers.**

4.6.6 Research priorities

- integration and optimization of MDA regimens for distribution of ivermectin for other NTDs to maximize the impact on scabies;
- accurate data on the cost of MDA for scabies and on the costs averted, including the full costs associated with scabies and its sequelae for individuals, households, society and the health system to inform policy;
- evaluation and validation of the simplified IACS diagnostic criteria for use by front-line and mid-level health care providers in clinics, and inter- and intra-operator reliability of the simplified criteria; and
- development and validation of short training in use of the diagnostic criteria in programmes.

5. Monitoring and evaluation of programmes

5.1 Discussion

The experts discussed options for optimal monitoring of programmes, especially M&E of MDA. They generally agreed that M&E frameworks for other NTDs amenable to preventive chemotherapy, such as lymphatic filariasis and trachoma, could be adapted for scabies programmes.

The group discussed the benefits and challenges of collecting further epidemiological data on scabies over time (through longitudinal cross-sectional monitoring at sentinel sites) and of obtaining broadly representative samples (e.g. by random selection of different sites at each phase of monitoring). A hybrid approach was considered feasible, including sentinel surveillance of high-transmission sites, representative sites and randomly selected other sites. Any areas of high transmission identified during initial mapping and surveillance could be candidates for sentinel site surveillance after the intervention.

Programmes should not only measure impact on scabies prevalence but also incorporate coverage surveys and supply chain management and reporting into routine surveillance activities. The results of monitoring should be communicated to frontline workers and communities to ensure the sustainability of the programme.

Monitoring of impact should include the burden of scabies, the burden of complications and health and socioeconomic effects. The frequency of monitoring and integration into monitoring of other NTD interventions should be determined during development of the strategy. Monitoring for recrudescence of transmission after cessation of MDA is important, as low-level rebound was observed several years after MDA in a study in the Solomon Islands, and there are anecdotal reports of a rebound in scabies cases in regions where MDA for onchocerciasis was conducted previously (22). Development of point-of-contact diagnostic tests (e.g. a rapid serological test) could facilitate long-term monitoring and integration of monitoring into other health screening activities.

5.2 Research priorities

- operational research to determine how to capitalize on monitoring for other NTDs (e.g. transmission assessment surveys for lymphatic filariasis);
- operational research to determine how to integrate a systematic approach to M&E for scabies into M&E of programmes for other NTDs or diseases of public health concern;
- in high-prevalence or outbreak settings, research to document the impact of scabies on school attendance, educational attainment and work productivity;
- the effect of stopping ivermectin MDA for other NTDs on scabies transmission; and
- development of diagnostic tools, such as for serological testing, to standardize M&E for scabies and facilitate integration into other surveillance systems.

6. Highest priorities for research

Research priorities were discussed throughout the meeting. A session on the final day highlighted common themes that had emerged, and a priority-setting exercise was undertaken that included a poll to identify the highest priorities.

6.1 Choice of strategy and implementation of MDA

More information is required to determine the threshold above which MDA should be the strategy of choice and the threshold below which MDA should be stopped. Both empirical and modelling data are likely to be valuable in answering this question. Data are also required to assess the impact, effectiveness and cost-effectiveness of IDM strategies for use in areas with a prevalence below the threshold selected for starting or stopping MDA.

Information is also required on the number or frequency of rounds of MDA to be conducted. Experience in other programmes and the results of modelling indicate three to five annual rounds of MDA, and operational research should be designed to evaluate this approach in various settings. Both empirical and additional modelling would provide opportunities to evaluate surveillance strategies and understand spatial heterogeneity after MDA (hot spots), which could impact the strategy. Operational research should be conducted to determine the best way to implement MDA in a range of environments, including peri-urban settings and regions outside of the Pacific.

In two trials currently in progress, the effectiveness of one and two doses of ivermectin in MDA for scabies is being compared. Research should also be conducted to evaluate the safety of ivermectin in children < 5 years old, the contribution of topical therapy in addition to ivermectin in MDA programmes and the implications of not treating people who are at risk for transmission but not eligible for ivermectin.

Further data are required on the impact of scabies and associated impetigo on quality of life, absenteeism from school and work and broader social costs.

6.2 Mapping, monitoring and evaluation

The simplified diagnostic criteria recommended at the meeting should be validated in a range of epidemiological situations. Factors to be considered in determining the optimal sampling strategy include spatial heterogeneity of transmission, the likely effect of cluster sampling strategies and the relation between the prevalence of infection in schools and in communities. The group stressed the importance of understanding potential rebound of scabies transmission after cessation of MDA and the factors associated with sustained control. They noted that areas in which interventions for onchocerciasis had been stopped provide an opportunity to explore these issues.

6.3 Mapping, monitoring and evaluation

The polling exercise identified four priorities for research.

1. Much of the information on the impact of MDA on scabies transmission was obtained on non-urbanized islands, and studies should be conducted to determine the impact of MDA and other scabies control strategies in non-island and in urban settings.
2. The relation between scabies and impetigo should be studied in various settings, including the extent to which MDA for scabies predictably reduces the incidence of impetigo in a population and the factors that affect the relation between the two conditions.
3. Operational research should be conducted to define the sampling method, diagnostic tools and frequency of assessment for determining the impact of scabies control.
4. The safety of ivermectin in children aged < 5 years should be investigated.

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Annexes

Annex 1. Case study: Ethiopia

In 2015, a large outbreak of scabies in Ethiopia resulted in 379 000 cases. This large outbreak was temporally associated with a drought and may have resulted from overcrowding around water sources. In an investigation in 2015, 1 125 770 people were screened in a house-to-house survey conducted by health extension workers in the Amhara region of Ethiopia. Of the 379 000 cases of scabies identified (prevalence, 33.6%), 51.6% were in women and 60% in children. In a subset of patients re-examined by dermatologists, the diagnosis of scabies was confirmed in > 98% of cases. Overall, > 1 000 000 cases of scabies are believed to have occurred in this outbreak.

The Ethiopian Federal Ministry of Health developed guidelines for the management of scabies outbreaks. The guidelines recommended MDA where the prevalence of scabies was $\geq 15\%$ and a screen-and-treat approach where the prevalence was $< 15\%$.

Prevalence	Treatment strategy
$\geq 15\%$ in villages, <i>kebeles</i> or <i>woreda</i>	Treat all people, including contacts and other community members except children aged < 2 years, pregnant women and lactating mothers.
$< 15\%$ in villages, <i>kebeles</i> or <i>woreda</i>	Treat individual cases, family members and other contacts.

The results of intervention were not yet available at the time of the meeting.

Annex 2. Summaries of presentations

A2.1. Scabies parasite and disease

The parasite (*Sarcoptes scabiei* var *hominis*) is of the arachnid family. It burrows under the skin of human hosts to lay up to four eggs in the stratum corneum. While other varieties of scabies affect other mammals, the *S. scabiei* parasite relies entirely on human hosts. The life cycle of the mite is between 9 days and 2 weeks, with four main stages: egg, larva, nymph and adult. Females lay eggs 3–4 days after copulating with males. Females are considered to be predominately responsible for the symptoms of infestation by laying eggs and excreting faeces under the skin. In common scabies, an infested person may have only 5–50 mites, and transmission is generally by skin contact. In crusted scabies, there may be thousands or millions of mites under the skin, and fomites play a role in transmission. Scabies are attracted to their host by odour and thermal stimuli. Crusted scabies is rare and occurs mainly in immunocompromised people, such as those with HIV infections or a malignancy and aged or malnourished people.

Studies of 11 potential acaricides in the porcine model in France and Australia found that all killed adult mites, but all eggs were able to hatch. There are currently insufficient data to conclude that single applications of acaricides are effective to control scabies.

A2.2. Scabies disease: health, social and economic impacts

Scabies symptoms start 2–5 weeks after infestation. The main symptoms may include burrows that are visible to the naked eye, but they are generally difficult to see. Burrows occur in the webbing of fingers, around the wrists, on the buttocks and groin and around the female breast. Itching is considered to be a result of allergic reactions to the faeces, exuviate and other waste products of female mites. Differential diagnoses of scabies may include eczema, atopic dermatitis, drug eruption, psoriasis, any pruritic diseases, pyoderma and fungal infection. Associated infections include complicated localized skin infections, invasive *S. pyogenes*, invasive *S. aureus*, glomerular nephritis and rheumatic fever. All these conditions have serious outcomes, including a 2–10% risk of death. These conditions also have a negative impact on the social and economic situations of individuals and families. Scabies is more prevalent in lower- and middle-income countries and in lower socio-economic strata in high-income countries. Scabies accounts for the loss of 0.21 disability-adjusted life-years (DALYs). The costs associated with scabies include the individual cost of treatment and the cumulative effect of missed economic opportunities. No study has been reported on the economic costs of scabies. Treatment in an institution can cost US\$ 2000–200 000.

A2.3. Data collection on scabies

Data are collected for advocacy, planning and evaluation. Those for advocacy can be obtained from various sources, including case histories from the health system, although most countries do not yet use such sources. Data on prevalence are required for planning actions or responses to scabies, and repeated measurements show the effectiveness of an intervention for evaluation. Understanding of endemic scabies in low- and middle-income countries is important for control programmes, which should also consider the effects of factors such as seasonality and environmental factors on prevalence. The data to be collected may include not only the presence of scabies but also associated diseases. The point prevalence of scabies remains the primary focus, as incidence is difficult to measure. The various methods for identifying scabies require knowledge, skill and experience. Significant gaps remain in data on scabies, as reports of DALYs should be read with caution, and few data are available on trends over time. Most studies of the quality of data on scabies have been conducted in the WHO Western Pacific Region, where it was found that only one country had data on national prevalence, while the others had data for pockets or areas known to have a high burden of the disease. Data for Australia are predominantly for Indigenous populations with a known high prevalence of scabies.

A2.4. Diagnosis of scabies

Scabies can be diagnosed by microscopy, by direct visualization and clinically. Microscopy remains the gold standard but is limited to specialized consultants with diagnostic equipment; it is invasive and time-consuming, as a skin scraping is required for a positive diagnosis, and there are many false-negatives. In non-invasive visualization, a magnifying device to 10x–1000x is used to find burrows and mite in burrows; the techniques include dermoscopy and video-dermoscopy, low-cost, simple hand-held tools and video-microscopy. Clinical diagnosis requires training and experience and is based on patient history and examination. Clinical diagnosis is relevant for use in low- and middle-income countries and remote areas, although the accuracy of the diagnoses is challenged by the wide variation in manifestation of scabies infestations. The 2019 IACS criteria for the diagnosis of scabies, developed in a Delphi study by international experts in scabies, allow diagnosis at three levels of diagnostic certainty: confirmed scabies (level A), with visualization of mites, eggs or faeces on microscopy of skin samples; clinical scabies (level B), with specific clinical signs such as burrows, male genital lesions or a combination of clinical signs; and suspected scabies (level C), with less specific clinical signs. Diagnosis for programme mapping differs from individual diagnosis and requires an agreed definition in which an “accurate enough” approach is used to inform public health actions and monitoring. Such diagnoses can usually be performed by non-experts who have received brief training in diagnosing scabies through skin examination.

A2.5. Scabies treatment: individual management options and availability

Various effective treatments are available in higher-income countries, but only traditional treatments such as 10–25% benzyl benzoate are available in many low- and middle-income countries. In European guidelines, ivermectin and benzyl benzoate are first-line treatments for individuals. In individual treatment, oral medications do not result in better rates of cure than topical treatments such as permethrin, although this conclusion should be reviewed because of the weakness of the available studies. Treatment is limited for specific populations such as pregnant women and infants. Newer treatments such as permethrin creams and oral medication (ivermectin) remain difficult to access because of limited availability and cost. In West Africa, for example, benzyl benzoate is the most widely available treatment for scabies, although it is contraindicated for pregnant women and infants. In many countries, ivermectin is allowed for use only in lymphatic filariasis or in private clinics, where four tablets cost about US\$ 40 equivalent. Context-specific challenges to treatment include religious and cultural considerations.

A2.6. Scabies treatment: population management

Highly effective treatments for individuals with scabies include 5% topical permethrin and oral ivermectin, and moxidectin is a promising emerging treatment. Permethrin and ivermectin appear to be equally effective for clinical treatment of individuals in intensified disease management (IDM); however, treatment of individuals and their contacts does not achieve population-level control, where use of topical treatment has limitations. Three methods for the control of scabies transmission have been proposed: screen and refer, targeted mass drug administration (MDA) and community MDA. While individual treatment covers primary cases, contacts (often family members) who have asymptomatic infestation are not treated, increasing the risk of re-infestation. MDA to whole groups reduces the risk of re-infestation, as everyone is treated, regardless of whether they have scabies. MDA of topical creams is effective but is hugely time-intensive because directly observed application is necessary. Oral treatment (ivermectin) is simpler to deliver, although approximately 15% of a population still require treatment with topical permethrin, particularly young children. Research on this approach has shown a significant, sustained reduction in the prevalence of scabies in communities. The largest known MDA against scabies was conducted in Ethiopia, where 700 000 people were treated (see *Annex 1*); however, the results have not yet been published. Moxidectin may be given as a single dose because of its longer half-life, and pre-clinical studies of scabies in a pig model indicate promising results for this drug; however, trials of individual treatment and MDA are yet to be conducted.

A2.7. Modelling scabies transmission and interventions

A method was presented for modelling scabies to support programmes and evaluate the impact of strategies for scabies control. Modelling of scabies is still relatively theoretical, as a number of parameters are not well defined. Assumptions about the interaction between parasite and host affect modelled predictions of the impact of different MDA strategies. For example, with two-dose ivermectin MDA for scabies, the model predicts an initial decrease in prevalence followed by re-emergence of infections in the absence of continued MDA; more frequent MDA will reduce the intensity of re-emergence. Although the models are informative and can be used to predict the impacts of different strategies, they cannot replace empirical data from studies of MDA. Other aspects of modelling of scabies that require study include: the role of age and development of immunity in reducing transmission, the impact of ivermectin on egg viability and the resulting effect on the rebound of infestation after MDA and whether MDA has a different impact in areas of low and high prevalence.

A2.8. Scabies mapping

Few estimates have been made of the global burden of scabies. A mapping strategy should be based on the planned intervention, monitoring and the impact of the intervention, so that the goal of MDA should be defined before mapping. The sampling frame to be used in mapping depends on the geographical size of the area to be mapped and the resources available. Scabies mapping can benefit from tools used for mapping other neglected tropical diseases (NTDs), such as lymphatic filariasis and trachoma, which have been mapped extensively. Once a mapping survey has been designed, agreement must be reached on the diagnostic criteria that are “accurate enough” to justify an intervention. Cluster sampling is the most commonly used method for population prevalence surveys, but operational research should be conducted to determine whether this method is acceptable for scabies mapping or whether communities, schools or some other subpopulation should be mapped. Routine health data are of limited use in making decisions about MDA, as the absence of documented cases does not exclude transmission; however, routine data should trigger mapping to define the extent of the public health problem. The design of a survey affects the precision of estimates, particularly when non-homogeneous populations (e.g. urban and rural) are mapped in one survey, and sample sizes might have to be increased to adjust for a design effect.

A2.9. Thresholds and targets for MDA

Thresholds must be established for scabies control programmes, as for other NTDs. Some thresholds are arbitrary, rather than based on targeted research. The mapping strategy should accurately measure the anticipated threshold, and the diagnostic tool must be sufficiently sensitive and specific to measure the threshold. The threshold will also determine the size of the population to be treated, which in turn determines the resources required to implement a control programme. Onchocerciasis researchers were able to correlate the presence of palpable skin nodules with the community load of microfilariae in the skin and the risk of onchocercal blindness, and areas in which the nodule rate suggested that the risk of blindness was $\geq 1\%$ were identified as priorities for MDA. Other NTD programmes have linked the prevalence of infection with morbidity to advocate for better access to treatment, and setting a relatively low threshold for stopping MDA (0.1%) may provide an impetus for the development of new diagnostic tools to improve precision. The optimal threshold for starting MDA would be linked to disease morbidity. Even if that is not yet possible, the prevalence of morbidity that is a concern for communities should be a priority. Domains that should be addressed in developing a framework for scabies control include: the threshold for starting MDA, the threshold for stopping MDA and the rationale in terms of morbidity and the impact of MDA on morbidity for the selected thresholds. Discussion arose about the specificity of the MDA strategy for scabies and the importance of input from stakeholders (e.g. national health

programme) in designing the strategy. It was suggested that the relation between scabies infestation and impetigo, and subsequent morbidity, should be better defined for advocacy for scabies control.

A2.10. Mapping and surveillance

A presentation on mapping was made as an exercise for identifying methods for determining the prevalence of scabies. Mapping requires acceptance by countries and by affected communities, and better understanding of the burden of infestation can be used to advocate for investment in programmes to control scabies, new tools to measure prevalence and new treatments or treatment strategies. Recommendations and details arising from the discussion are included in the main body of the report.

A2.11. Considerations for MDA implementation

The aim of MDA is to reduce the transmission of scabies to a level at which it is no longer a public health concern and to reduce its impact in the community by reducing the rates of associated complications such as impetigo, severe bacterial infection, renal disease and rheumatic heart disease. Currently, there are limited data on the number of rounds of MDA required before it is safe to stop MDA without risk of recrudescence. The recommendation made during discussion of the presentation was at least two or three rounds in isolated or island communities where there is limited movement of people among community groups, while, in mainland areas, at least five rounds might be required for adequate disease control. The frequency of MDA determines its impact on transmission. Annual treatment is likely to be sufficient and is the most practical. Biennial treatment might also be effective but would probably be more difficult to implement. The treatment of choice is suggested to be ivermectin at two doses given 7–14 days apart. The guidelines for exclusion from ivermectin should be the same as those used in MDA for lymphatic filariasis. Dosing of ivermectin could be done according to height, as in other NTD programmes. As the recommended dose of ivermectin (200 µg/kg) is higher than that used in MDA for onchocerciasis (150 µg/kg), new height-based dosing guides would be required. The target for coverage of MDA could be similar to that used in other MDA programmes, such as 80% coverage of the whole population receiving two doses.

A2.12. Implementation and control strategies

The discussion of recommendations on strategies for the control of scabies arising from the presentations and the recommendations are included in the main body of the report.

A2.13. Estimated costs of MDA

The costs of MDA include training, transport, community mobilization and programme staff. They also include the cost of ivermectin, which is currently not available through a donation programme. Medication costs are directly influenced by the number of doses given in each round of MDA, and research is under way to determine whether one or two rounds are sufficient to control scabies. The costs averted by implementation of MDA are an important consideration, as scabies control may save costs for individuals, families and national health programmes. If MDA reduces the incidence of diseases associated with scabies infestation, such as rheumatic heart disease, impetigo, serious skin disease and renal disease, the savings to the health system could be substantial. Scabies control also reduces the effect of morbidity on people's ability to work, which affects the economy. MDA for other NTDs has saved significant costs in affected countries; for example, control of onchocerciasis and lymphatic filariasis has a potential benefit of US\$ 100 billion. Quality of life may also be improved, as scabies infestation may result in insomnia, stigmatization and social isolation. Research is under way to better understand how scabies affects the quality of life of affected people.

A2.14. Supply of medications

No suitable products are currently donated for the treatment of scabies. Ideally, medications would be donated for a single annual treatment of people of all ages in communities that exceed the threshold for MDA. Optimally, the medication would be used for several NTDs. For lymphatic filariasis, discussions on a donated product with Merck & Co. took 4 years. To approach a potential donor, clear information must be available about the requirement for the medication and the estimated length of donation. Moxidectin is a new product that could improve the treatment of scabies but is not yet licensed for use against scabies. Its use would simplify any MDA strategy and would improve compliance, as its half-life is long enough that only a single dose would be required, as opposed to the standard two doses of most anti-scabicides. Licensing of moxidectin for children aged > 1 year is in progress, which will extend the population eligible for treatment. Advocacy for greater access to suitable medications will require demonstration of their efficacy in clearing infection and their potential to reduce associated skin infections and disease and to result in economic gains for communities (e.g. by increasing productivity). Demonstration of the impact of treatment will require data on efficacy from large programmes and not just research trials in controlled settings.

A2.15. Training for scabies programmes

Dermatological expertise is lacking in many countries. The ratio of dermatologists to population size is 1 to 80 000 in the United Kingdom and 1 to 1 000 000 in Ethiopia; there are no dermatologists in Liberia or the Solomon Islands. A successful scabies MDA strategy requires reproducible, accurate diagnosis of scabies; reasonably accurate, rapid diagnosis in the field is necessary for programme implementation. Perfect diagnosis is not necessary at the beginning of a control programme, and misclassification of individual cases is acceptable as long as the overall population estimate is accurate. IDM requires individual diagnosis by examination from the head to the toes, usually in a facility where a clinical diagnosis can be made from signs, symptoms and history rather than diagnostic equipment. Clinical officers, nurses and community health volunteers should be trained in accurate clinical diagnosis of scabies and bacterial skin infections. The curriculum should include a review of skin diseases that resemble scabies infestation and should ensure that participants understand the importance and differential management of crusted scabies. Pre- and post-testing should be undertaken to demonstrate the effectiveness of training, with practical diagnosis by both trainees and the expert.

A2.16. Individual and intensified disease management

IDM is treatment not only of infested individuals but also of their close contacts, regardless of whether they are symptomatic. IDM can be used where cost-effective methods such as MDA are not available. As it applies to individuals rather than the broader population, it can be implemented in primary health care centres. IDM can reduce the impact of scabies as a public health problem and reduce the risk of re-infestation by close contacts. IDM could be introduced in areas where the community prevalence is below the trigger for MDA and after MDA has been stopped. Both scenarios require continuous surveillance. More evidence is required on the efficacy of treatments for children who weigh < 15 kg. IDM involves active contact tracing, addressing overcrowding, disinfestation of possible fomites and improving household hygiene. Patients and their contacts should be educated to ensure adherence to treatment regimens, and scabies IDM should be included in integrated NTD training.

A2.17. Epidemic scabies: definitions and control

A hypothetical construct was used to demonstrate the movement of scabies through a community, from the primary source to the rest of the community. The response to an epidemic outbreak of scabies should follow a decision pathway that comprises identification of the source of information, validation of the information, a formal survey of the extent of the epidemic, an appropriate, timely response and evalua-

tion of the outcome of the response. Before a campaign, political commitment and community engagement should be sought to ensure appropriate multi-sectoral coordination and engagement with the local health system to introduce the programme appropriately. Before the campaign in the large population outbreak in Ethiopia, political commitment was obtained, awareness was raised, and data were obtained from surveys to define the extent of the epidemic. These data were used in a micro-planning exercise for more formal estimation of the population that required MDA, which allowed monitoring of coverage, and also district-level budgeting, social mobilization and planning for remote populations. During the campaign, it became clear that crowd control was necessary in the drought-stricken area before, during and after drug distribution. Continuous reassurance was necessary for smooth acceptance of MDA. Because of the size of the MDA campaign, data continue to be collated for the final report. Many lessons were learnt, and recommendations are expected to be made.

A2.18. Outbreak of scabies in Liberia

In 2018, there was an outbreak of skin rash with intense itching in Monteserrado County in Liberia. After the initial reports, other counties also reported such cases, including Bong, Rivercess, Margibi and Grand Bassa. Epidemiologists, environment specialists and a reference laboratory were sent to the field, where scabies was identified. A community awareness campaign was implemented on radio and radio talk shows. After a period of passive case-finding, which had poor results, active case-finding was implemented. Subsequently, there was a country-wide stock-out of benzyl benzoate, and the price in private pharmacies increased. The Government therefore decided to conduct MDA with single-dose ivermectin, because of its proven effectiveness as compared with triple application of sulfur ointment, the ease of directly observed therapy with ivermectin and access through the Ministry of Health. Additionally, MDA with ivermectin was in line with the national NTD strategy. People who did not meet the inclusion criteria for ivermectin were treated with topical benzyl benzoate. The lessons learnt were that active case-finding without treatment options created distrust in the community, that integration with other programmes facilitates data collection, that alternative treatment should be identified in advance in case of stock-outs of the primary agent, and that health promotion messages are essential for success.

A2.19. Scabies outbreaks in high- and low-income countries

A scabies outbreak in a hospital in Japan was described, and differences in scabies outbreaks in high- and low-income countries were compared. In the outbreak, the index case was an 83-year-old man with crusted scabies who was hospitalized at two different institutions. He had a rash, which was initially misdiagnosed as a drug-related eruption and was treated with steroidal cream, which worsened the condition and led to further transmission of the disease. This case is typical of scabies outbreaks in hospitals and aged-care facilities in high-income countries. Institutional outbreaks are characterized by delayed detection, high costs (e.g. staff absences, dermatology consultations, treatment) and psychosocial effects on patients, families, staff and others. Institutional scabies outbreaks may also occur in centres for asylum seekers, camps for refugees and internally displaced people, prisons, orphanages and boarding schools. The optimal measures for managing scabies outbreaks include identifying and treating the index case, preventive treatment for either close contacts or the community and environmental measures. In low-income countries, the availability and cost of treatment are by far the most important determinants of success in ending an outbreak. Guidelines on the control of scabies outbreaks in high-income countries were presented, which varied in case definitions, the recommended treatment (with varying availability by country) and recommendation for simultaneous mass treatment or treatment of cases and their close contacts. A case definition should to be agreed upon for use in scabies outbreaks.

A2.20. Opportunity for integration

Integrated MDA for treatment of several NTDs at the same time could optimize use of limited resources, as programmes need not organize or pay for implementation of separate campaigns. MDA for scabies can be integrated into other programmes with similar strategies or that target similar populations. Components of a control programme that could be integrated include: strategic planning, mapping, training, logistics, drug distribution, health education and awareness, M&E and surveillance, morbidity management, vector control and water, sanitation, and hygiene initiatives. While integration of the technical components of MDA may be straightforward, with teams working in collaboration, political constraints and funding arrangements can create challenges. Various strategies were presented that have components that overlap with potential scabies strategies, including for measles, child health, polio and other NTDs (e.g. onchocerciasis, trachoma and schistosomiasis). Integration of scabies into programmes for lymphatic filariasis and onchocerciasis would appear to be feasible, although other opportunities should be explored.

A2.21. Community engagement

Community engagement is an essential part of disease control. The principle includes inclusivity, ownership and sustainability and places the community, government bodies and frontline implementers at the centre of the action. Community engagement ensures people-centred action rather than a top-down approach, which may not meet the needs of the community. Scabies programmes could learn from community engagement in other NTD programmes.

A2.22. Advice from the field

In a discussion among three countries, Fiji, Liberia and Solomon Islands, the representative of Solomon Islands presented the view of community members on scabies. Many people do not view scabies as a health problem, as it has been present for a long time and is widespread. When people address scabies, they often try traditional treatments before seeking advice on western medicine. Communities do, however, support health initiatives, as there is little health care on the islands and they consider that they will benefit from treatment. The representative of Fiji recounted lessons learnt from MDA for NTDs. The community must be fully aware and engaged in order to avoid resistance to MDA, as villages have the right to refuse an initiative. Specific problems in island nations include weather and transport. Coordination with other health programmes is essential, as there may be competition for time and resources to implement programmes in villages. Liberia learnt hard lessons during its response to the Ebola virus outbreak. Health messages must be true and trusted by the community to avoid negative repercussions for people implementing the programme. Health workers must listen to the community and respond to its needs and not promise outcomes that cannot be provided. The overall message from the presentations and the group discussion was that communities should consider that they own a health programme and should be part of creating it rather than recipients of a top-down programme.

A2.23. Monitoring and evaluation

M&E are important for ensuring the functioning of a programme and to demonstrate its impact on communities. Monitoring should target not just coverage of the intervention but include the supply chain and ensuring that necessary medications and tools reach people as efficiently as possible. The three principal means of demonstrating programme impact are parasitological evaluation of the prevalence of scabies infestation, the burden of impetigo and debilitating itch and socio-economic impact. Questions to be answered in each M&E plan are how, when and where to conduct monitoring; the indicator(s) for transitioning from MDA to IDM; and the aims of advocacy, such as with external donors. The main components of the discussion are included in the body of the report.

A2.24. Safety surveillance and reporting

All MDA programmes must have a surveillance system for adverse events. While ivermectin is considered safe, adverse events can occur during MDA, and staff must remain vigilant. Any adverse event should be recorded and reported. An adverse event is an untoward medical occurrence that did not exist before the drug was taken, a pre-existing occurrence that recurs with increased intensity after the drug was taken or an occurrence when the drug is taken. Serious adverse events include death, life-threatening reactions, hospitalization, persistent or significant incapacity or substantial disruption of the ability to conduct normal life functions, congenital anomaly or birth defect and other medical events considered to potentially jeopardize the life of a patient and require a medical or surgical intervention. Serious adverse events must be reported. A severe adverse event associated with ivermectin was the death of people with high-density *Loa loa* microfilaraemia who were treated for scabies. In areas where *L. loa* is endemic, ivermectin is contraindicated in the absence of appropriate testing to determine whether the individual is at risk for a severe adverse event. Certain exceptions have been made, such as in areas where the risk of blindness from onchocerciasis was considered to outweigh the risk of a severe adverse event and in which systems were in place to detect and manage adverse events. Staff must always be observant and able to respond, record and report any serious adverse event.

A2.25. Reporting adverse events

The number of reports of adverse reactions to ivermectin increased from 1 in 1992 to 708 in 2018. Once an adverse event is recorded, the mechanisms for reporting it include the WHO Coordination Centre at Uppsala, Sweden, which manages Vigibase (<https://www.who-umc.org/>) for the WHO International Programme for Drug Monitoring. Components of the database can be accessed directly through Vigiaccess (<http://www.vigiaccess.org/>). Once a severe adverse event is reported, the WHO Coordination team will investigate it to determine whether it is related to use of the medication.

Annex 3. Meeting agenda

Day 1	Item	Participants
09:00–09:15	Opening session	WHO
09:15–09:40	Welcome	All
09:40–09:50	Introductions	Paul Cantey
09:50–10:10	Meeting objectives	Olivier Chosidow
10:10–10:30	Parasite – life cycle and transmission	Rie Yotsu
10:30–11:00	Disease – health, social and economic impacts	
10:30–11:00	Coffee break	
11:00–11:20	Background	John Kaldor
11:20–11:40	Global epidemiology and public health importance	Daniel Engelman
11:40–12:00	Diagnosis – focus on mapping and surveillance	Fatimata Ly
12:00–12:30	Treatment – individual management options and availability	
12:30–13:30	General discussion and clarifications	
12:30–13:30	Lunch break	
13:30–13:50	Background	Andrew Steer
13:50–14:10	Population-level control	Jodie McVernon
14:10–14:30	Modelling scabies transmission and interventions	Michael Marks
14:30–15:00	Mapping and surveillance	
15:00–15:30	General discussion and clarifications	
10:30–11:00	Coffee break	
15:30–17:00	Mapping and surveillance	Chair: Luc Coffeng
	Discussion and recommendations	
17:00	End of day 1	

Day 2	Item	Name
09:00–09:10	Decision points for control strategies	Aya Yajima
09:10–09:30	Welcome and recap of day I	Paul Cantey
09:30–10:30	Thresholds and targets for MDA: concepts and considerations	
10:30–11:00	Discussions and recommendations	
10:30–11:00	Coffee break	
11:00–11:20	Implementation of control strategies: key considerations	Belen Lardizabal Dofitas
11:20–11:40	Individual / intensified case management	
11:40–11:55	Implementation of MDA	Daniel Engelman
11:55–12:10	Estimated costs of MDA	Andrew Steer
12:10–12:25	Medication supply	Adrian Hopkins
12:25–12:30	Training	Michael Marks
12:30–13:30	Lunch break	

Day 2	Item	Name
13:30–13:45	Implementation of control strategies	Julie Jacobson Chair: Belen Lardizabal Dofitas Panel: representatives from Colombia, Fiji, Solomon Islands, Timor-Leste Chair: Julie Jacobson
13:45–14:00	Opportunities for integration	
14:00–14:45	Discussion and clarifications	
14:45–15:30	Panel: Community engagement and acceptability Discussion and recommendations on implementation of MDA	
15:30–16:00	Coffee break	
16:00–17:30	Implementation of MDA Discussion and recommendations on implementation of MDA (contd)	Chair: Julie Jacobson
17:00	End of day 2	

Day 3	Item	Name
09:00–09:15	Epidemics and outbreaks	Aya Yajima Wendemagegn Enbiale Rie Yotsu Chair: Paul Cantey
09:15–09:30	Welcome and recap of day 2	
09:30–09:50	Epidemic scabies – definitions and control	
09:50–10:30	Institutional outbreaks in high- and low-income settings Discussion and recommendations	
10:30–11:00	Coffee break	
11:00–11:20	Monitoring and evaluation	Charles Mackenzie Adrian Hopkins
11:20–11:40	MDA safety surveillance and reporting	
11:40–12:00	Discussion and recommendations	
12:00–12:30	Overall M&E plan for scabies Discussion and recommendations	
12:30–13:30	Lunch break	
13:30–13:45	Research	John Kaldor Paul Cantey
13:45–14:15	Operational research priorities	
14:15–15:00	Discussion and recommendations Recommendations and close of meeting	
15:00–15:30	Coffee break	
15:30–17:30	Closed session	
17:00	End of day 3	

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