National Healthy Skin Guideline: for the Prevention, Treatment and Public Health Control of Impetigo, Scabies, Crusted Scabies and Tinea for Indigenous Populations and Communities in Australia – 1st edition

The Australian Healthy Skin Consortium 2018

menzies school of health research
HOT NORTH Improving Health Outcomes in the Tropical North
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WESFARMERS CENTRE OF VACCINES & INFECTIOUS DISEASES

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The Australian Healthy Skin Consortium is a partnership between Telethon Kids Institute, Menzies School of Health Research, Murdoch Children's Research Institute, James Cook University, The Peter Doherty Institute for Infection and Immunity, and One Disease to synthesise the evidence on treatment and community control of skin infections throughout Australia.

Scientific Advisory Group

This group of skin health researchers oversaw the systematic review that informed the development of this guideline. Membership included Professor Jonathan Carapetis [chair], Dr Asha Bowen and Dr Pippa May (Telethon Kids Institute, WA), Professor Bart Currie and Professor Ross Andrews (Menzies School of Health Research, NT), A/Professor Steven Tong (Doherty Institute, VIC), A/Professor Andrew Steer (Murdoch Children's Research Institute, VIC), Professor Louis Schofield and A/Professor Sophie Couzos (James Cook University, Qld) and Dr Sam Prince (One Disease, NT).

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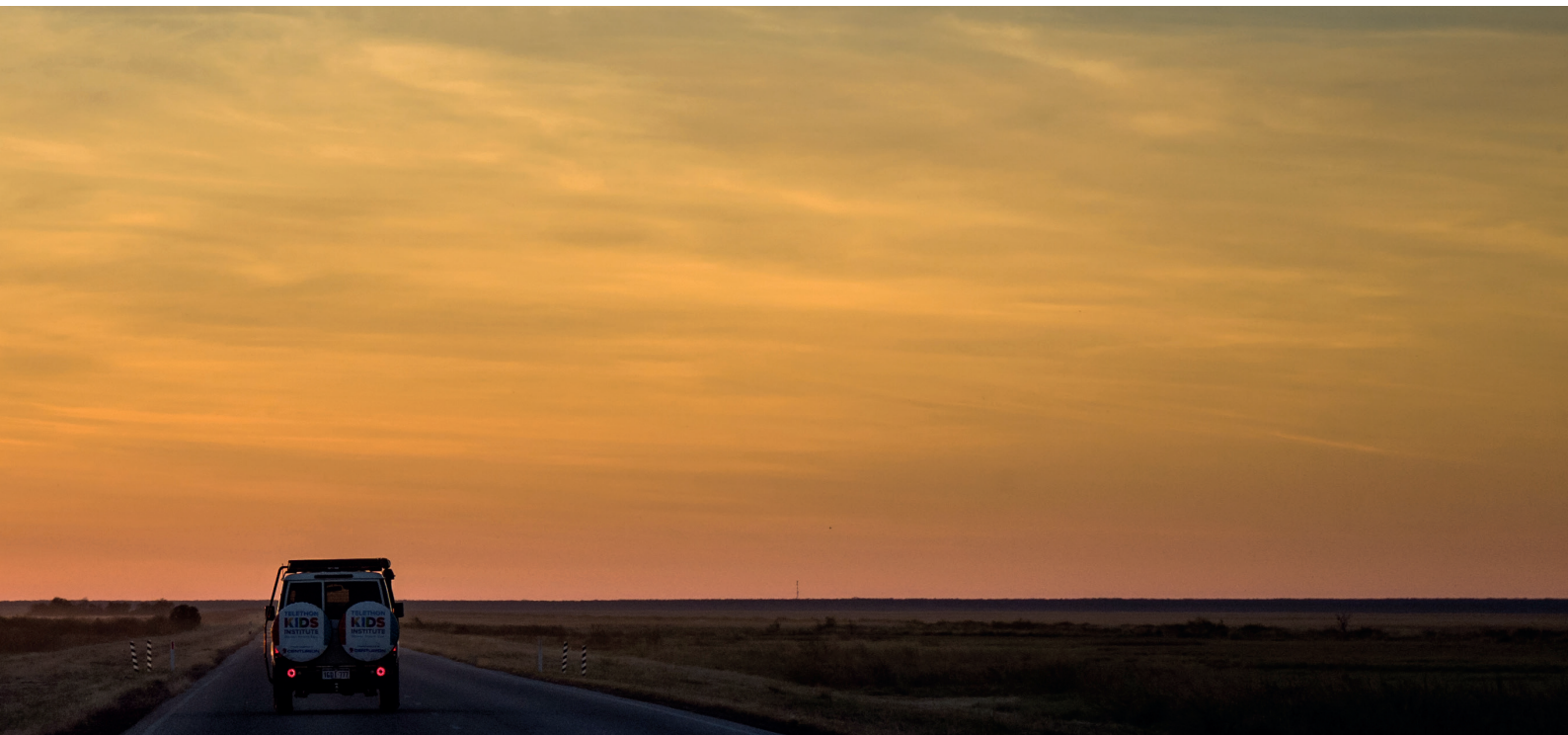

Acronyms and abbreviations

ARF	Acute rheumatic fever
ASPGN	Acute post-streptococcal glomerulonephritis
BPG	Benzathine Penicillin G
CARPA	Central Australian Rural Practitioners' Association
EASCP	East Arnhem Scabies Control Program
GAS	Group A Streptococcus
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IM	Intramuscular
MDA	Mass Drug Administration
MRSA	Methicillin-resistant *Staphylococcus aureus*
NHMRC	National Health and Medical Research Council
NT	Northern Territory
NTD	Neglected Tropical Disease
PCR	Polymerase Chain Reaction
PDT	Photodynamic Therapy
RCT	Randomisation in clinical trials
RHD	Rheumatic heart disease
SToP	See, Treat, Prevent skins sores and scabies clinical trial
WA	Western Australia
WHO	World Health Organization
YLD	Years lived with disability

List of tables and figures

Foreword

Impetigo, scabies, crusted scabies and fungal skin infections are too often considered by health practitioners, and sometimes by affected people and families themselves, as minor irritants or even as "normal". Yet research over the past two decades has proven that these skin diseases are important causes of morbidity and antecede substantial mortality from invasive bacterial infection and autoimmune sequelae in Australian Indigenous communities and in many overseas populations.

This Guideline is a synthesis of the available evidence for prevention and treatment of these infections. While recognising that addressing the primordial factors underlying these conditions is required for sustainable control, there are "best-evidence" public health and therapeutic approaches that can right now make substantial improvements to individuals and their families and communities. This Guideline is clearly designed to help practitioners and policy makers diagnose, treat and prevent skin infections. The recommendations have been aligned with key source references that are used in different regions of Australia and links are provided to regional guidelines. The online version links to further resources, such as photographic descriptors. Very importantly, a final section discusses primordial factors and social determinants, with emphasis on environmental health and housing. This Guideline will have a reach not only throughout Australia but also to overseas colleagues.

Finally, while providing the most informed, evidence-based recommendations available, many gaps in knowledge and best practice are also highlighted, spanning social sciences to clinical studies and basic biology, and thus should serve as a stimulant and guide for further research on skin health.

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1. Introduction

Background

Skin infections are widespread and are among the most prevalent and disabling diseases. The Global Burden of Disease study (2010) found that skin infections were the fourth leading cause of non-fatal health burden, expressed as years lost to disability,[1] and noted an 'urgent need for the inclusion of skin disease prevention and treatment in national and global health policies'.[1] The study also noted that strategies to manage and control skin disease are an effective and necessary use of health resources.[1]

Over the past thirty years, the epidemiology of skin infections in various Australian communities has been described, and has contributed significantly to global knowledge. Aboriginal and Torres Strait Islander children living in remote communities of Australia have the unenviable position as world leaders in burden of both impetigo (Chapter 5) and scabies (Chapter 6), owing to poorer living conditions, lack of equal access to high quality primary health care and health infrastructure (healthy housing, food security, safe drinking water, effective sanitation) and ongoing transmission of parasitic, bacterial and fungal skin infections.[2,3] These primordial factors and social determinants of health including avoidable and systematic health inequities influence the ongoing high burden of skin infections and downstream consequences (Figure 1).

Impetigo, scabies and fungal infections are predominantly seen in the primary health care sector,[4] or not at all because they are considered 'normal' in Australian Indigenous communities – by children, their families and even health care providers.[5] This ongoing epidemic of skin infection, which has remained essentially unchanged over the course of three decades, has significant consequences (Figure 1).

As the largest organ of the body, the skin is visible to everyone. Skin infections are unsightly, painful and the ongoing inflammation associated with skin infections contributes to general poor health. Recurrent skin infections have other consequences for individual wellbeing, growth and educational development. Bacterial skin infections are usually caused by *Staphylococcus aureus* and *Streptococcus pyogenes* (Group A Streptococcus, GAS).

The risk of death from *S. aureus* sepsis (blood poisoning) (Figure 1), which has an estimated global incidence of between 20 to 50 cases/100,000 population per year, is between 5% and 25%. This equates to a greater number of deaths than AIDS, tuberculosis and viral hepatitis combined in industrialised countries.[6] In Australia and New Zealand, *S. aureus* sepsis has a mortality rate between 3% and 5% in children aged under 18 years, with particularly poor outcomes in Indigenous children.[7] Recent data confirms scabies as an important predisposing condition for fatal Staphylococcus sepsis.[8]

Worldwide, at least 163,000 people die from GAS sepsis each year.[9] In addition, GAS infection can result in acute rheumatic fever (ARF) and acute post-streptococcal glomerulonephritis (APSGN) in children, which in turn has the long term consequences of chronic heart and kidney disease respectively (Figure 1). In industrialized countries, ARF and APSGN have been all but eliminated due to improvements in housing, hygiene and the evolution of accessible and effective clinical treatments.[10] However, even within resource-rich countries such as Australia, these conditions persist in communities where impetigo is endemic and where environmental and primordial factors have not been addressed.

Systematic reviews of the best clinical treatment for skin infections have used randomisation in clinical trials (RCT) as the criteria for inclusion.[11-16] This excludes a large body of available evidence, although lower quality, from resource-limited settings.[17-20] Non-randomised trials and observational studies may be the best and only available evidence in many poorer populations due to lower cost, feasibility[21] and for ethical considerations.[22] Furthermore, RCTs are often conducted in hospital outpatient clinics in resource-rich populations, and these findings may not be directly applicable to resource-limited settings where cultural practices, acceptability of treatments and access to these treatments may differ considerably. There is a lack of agreement on the best treatments and population health approaches for the prevention and control of skin infections, both for individuals and communities, in resource-limited settings. To date, there has not been a review of the evidence that is externally valid to these populations. To address this gap, we conducted a systematic review of studies in resource-limited settings regarding the prevention, treatment and public health management of impetigo, scabies, crusted scabies and fungal skin infections. The systematic review informed the development of this national evidence-based guideline for skin infections in endemic populations.

Public health importance of impetigo

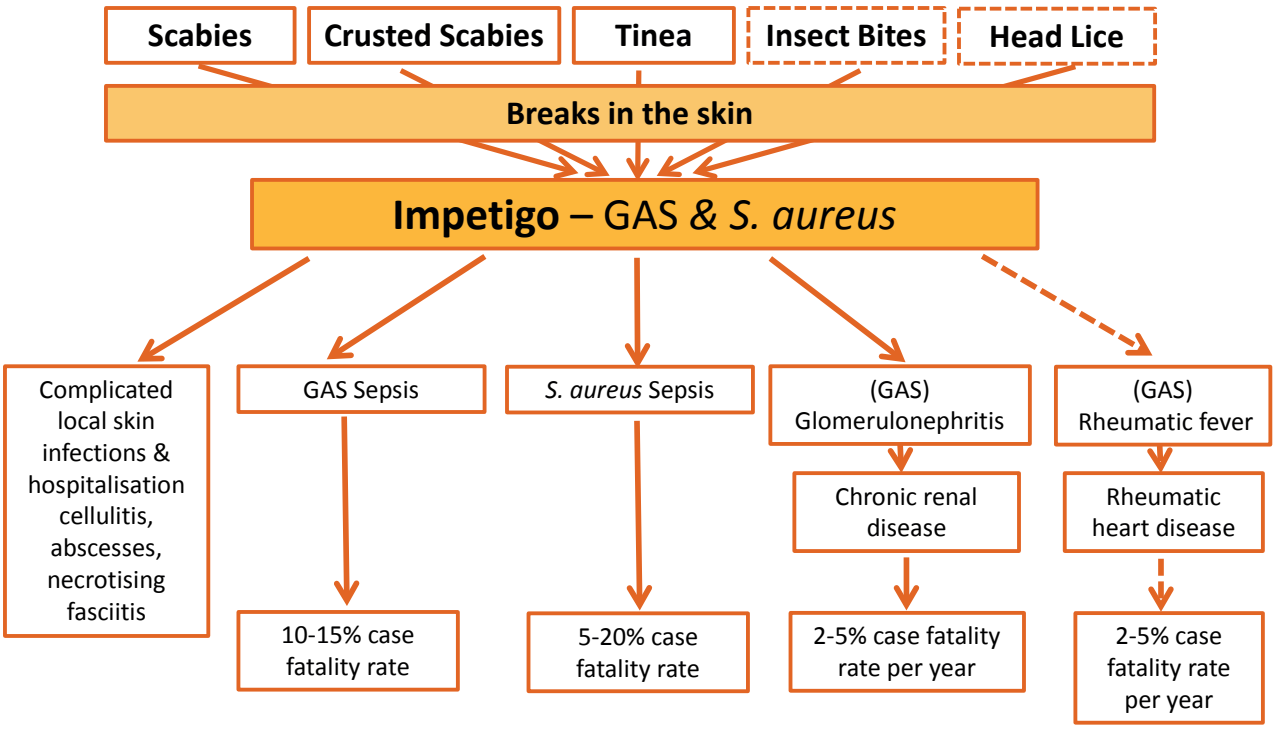


Figure 1. ***Complications of skin infections in Australian Indigenous people (adapted from Engelman et al. 2013)*** [23]

Key Aims

The key aims of this National Health Skin Guideline are:

- to establish the current state of knowledge on the burden of skin infections;
- to identify evidence-informed strategies for treatment;
- to evaluate evidence-informed strategies for public health control; and
- to identify the gaps in our knowledge to direct avenues for future investigation.

Our current evidence suggests that although the burden of bacterial skin infections and parasitic skin infestations is highest in remote Indigenous communities, there is also a significant burden for Indigenous populations living within urban communities. As such, the recommendations in this guideline will attempt to provide evidence for all endemic situations where individual treatment and community-wide interventions are likely to be of benefit.

In this first edition, impetigo, scabies, crusted scabies and tinea have been identified as priority conditions needing guidelines for prevention, treatment and public health control. The burden of head lice interacting with these conditions is well recognised, but was beyond the scope of this original systematic review.

Target audience

This document provides a detailed discussion of the evidence in regard to treatment of skin infections in resource-limited settings. We anticipate that this document will be helpful to health care providers who work in these settings to improve diagnosis and treatment of the predominant skin infections they treat.

Health professionals include medical, nursing, allied health and Aboriginal healthcare providers. For the purposes of this document, the terms 'Aboriginal,' 'Indigenous' and 'Aboriginal and Torres Strait Islander people' have been used interchangeably, in accordance with the references used.

Outline of the Guideline

This guideline has been developed to describe the available evidence for the treatment, prevention and public health control of four skin infections that are challenging in Indigenous populations and communities of Australia. These include impetigo (also known as skin sores or pyoderma), scabies, crusted scabies and fungal skin infections (including tinea corporis, tinea capitis and tinea unguium - tinea of the skin, scalp and nails respectively).

The available evidence has been graded and synthesised into tables and text to guide the reader in understanding the treatment recommendations that are summarised at the end of each chapter. These recommendations have been aligned with key source references that are used in different regions of Australia for the management of skin infections including Therapeutic Guidelines: Antibiotic; the Central Australian Rural Practitioners Association (CARPA) Standard Treatment Manual; Northern Territory Healthy Skin Program: Guidelines for community control of scabies, skin sores, tinea and crusted scabies in the Northern Territory; Managing crusted scabies in remote communities (One Disease); and the Kimberley Skin Infection Protocol were also reviewed and the recommendations in this document were aligned with these documents where possible. Links to these documents can be found in Appendix A. This National Healthy Skin Guideline is available on the internet as a downloadable PDF. A companion visual clinical handbook including the evidence-based treatment recommendations has also been developed as a resource for health care workers. A quiz on the recognition and diagnosis of skin infections is also available (further details provided in Chapter 4: Recognition and diagnosis of skin infections). Both resources are accessible online via telethonkids.org.au/skinguidelines).

2. Process for development of the Guideline

A scientific working group was established in April 2015 to oversee the systematic review[24] that underpins this guideline. The systematic review was completed in April 2017. The scientific working group finalised the recommendations from the systematic review and these have been incorporated into this guideline. The protocol used for the systematic review is provided in Appendix B.

Levels of evidence for grading recommendations

Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach: an internationally recognised systematic and transparent approach to grading quality of evidence and strength of recommendations has been used.[26] The GRADE approach rates evidence across studies for specific clinical outcomes to link evidence-quality evaluations to recommendations in clinical guidelines. The GRADE codes according to the levels of evidence are shown in Tables 1a and 1b:

Table 1a. ***GRADE evidence grades***

Code	Quality of evidence	Definition
A	High	Further research is very unlikely to change the level of confidence in the estimate of effect. i.e. • Several high quality studies with consistent results
B	Moderate	Further research is likely to have an impact in current confidence in the estimate of effect and may change the estimate. i.e. • One high quality study • Several studies with some limitations
C	Low	Further research is very likely to have an important impact on the level of confidence in the estimate of effect and would likely change the estimate. i.e. • One or more studies with significant limitations
D	Very Low	Estimate of effect is very uncertain. i.e. • No direct research evidence • One of more studies with very significant limitations

Table 1b. ***GRADE strength of recommendations*** [27]

Code	Strength of recommendation	Implications when combined with evidence grade[27]
1	Strong	1A: Strong recommendation, applies to most patients without reservation. Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present. 1B: Strong recommendation, applies to most patients. Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present. 1C: Strong recommendation, applies to most patients. Some of the evidence base supporting the recommendation is, however, of low quality.
2	Weak	2A: Weak recommendation. The best action may differ depending on circumstances of patients or societal values. 2B: Weak recommendation. Alternative approaches likely to be better for some patients under some circumstances. 2C: Very weak recommendation. Other alternatives may be equally reasonable. 2D: No evidence available; expert consensus judgement.

3. History of skin disease control programs

Scabies infestations of humans have been a problem for thousands of years.[28] In recent decades, public health strategies for management of skin infections with a particular focus on scabies have changed the landscape of scabies treatment and control. In this chapter we outline the history of scabies control strategies throughout the world and the importance of scabies control in the management of impetigo and downstream complications of bacterial skin infections. In 2017 scabies was included on the World Health Organization's (WHO) program of Neglected Tropical Diseases.[29,30] This inclusion will provide a global drive for the promotion and implementation of scabies control programs in endemic countries.

Permethrin MDA, Panama

Taplin *et al.* conducted the first mass drug administration (MDA) study with permethrin between 1986 and 1989 in a remote Kuna Indian population in an island off Panama. Scabies and GAS impetigo prevalence at baseline were 33% and 32%, dropping to 1% and 2% respectively, three months later. The reduction in scabies was sustained with a simple treatment program for new arrivals to the island but the program was terminated with the political turmoil of late 1989 and scabies prevalence rebounded to 12%.[31]

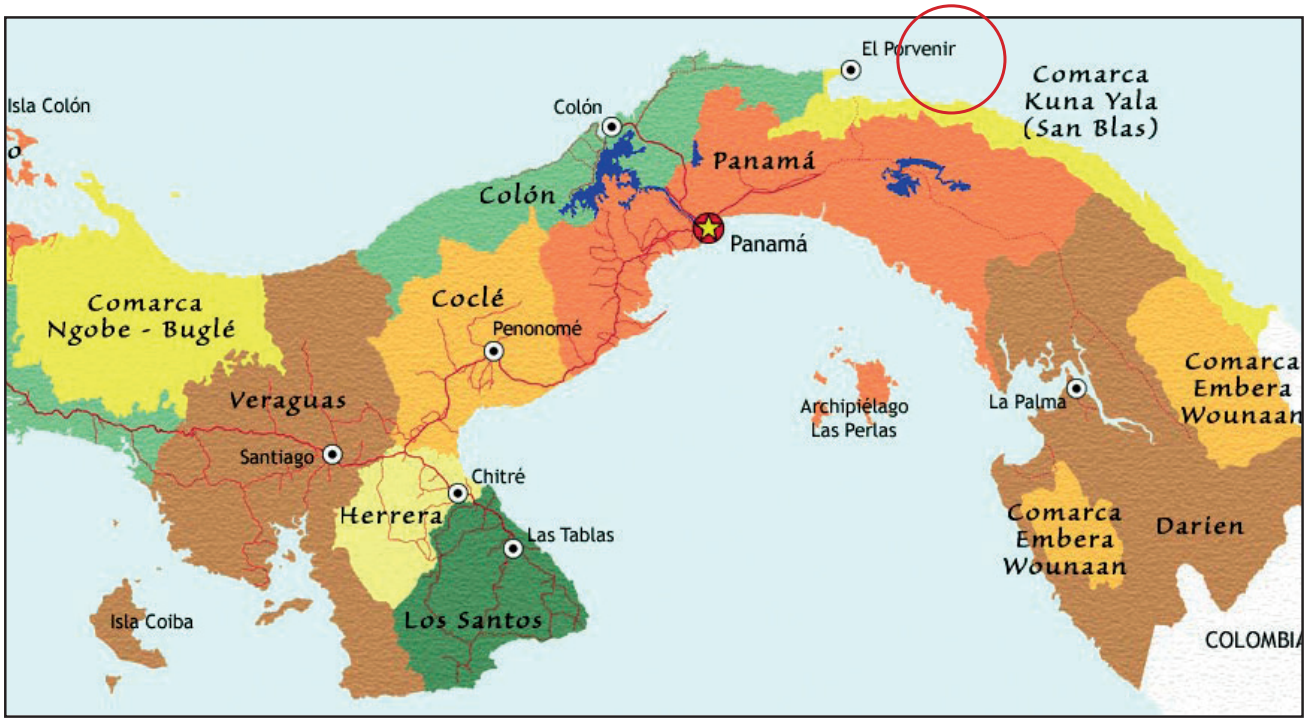


Figure 2. ***The San Blas islands of the Republic of Panama were the site of the first MDA study with permethrin.***

Permethrin MDA Croker Island, NT, Australia

In 1994, the knowledge gained from Panama was assessed in a permethrin MDA in a remote island Aboriginal community of the Northern Territory (NT) by Carapetis *et al*. In addition to the population MDA, scabies cases and contacts were re-treated with topical permethrin and impetigo cases were treated with IM benzathine penicillin. Scabies prevalence at 25 months fell from 32% to 6% (p<0.001) in children, and from 29% to 0% (p=0.003) in adults.[32] Impetigo prevalence in children fell from 69% at baseline to 30% at 9 months (p=0.0002) and remained stable for the remaining months of the study.

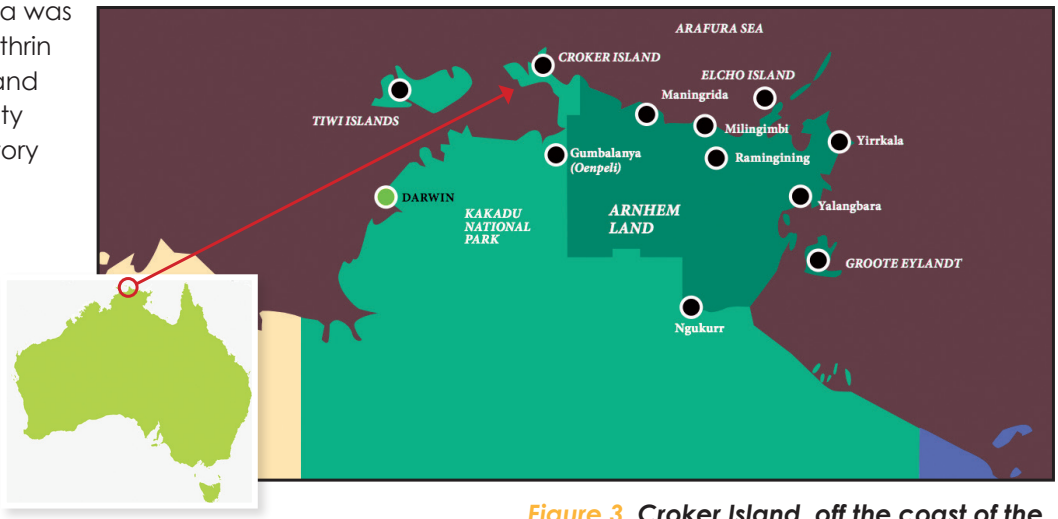


Figure 3. ***Croker Island, off the coast of the Northern Territory, Australia, was the site of the second MDA study with permethrin.***

Permethrin MDA, Wadeye, NT, Australia

Wong *et al.* conducted a permethrin MDA in a large, remote NT Aboriginal community in the late 1990s[33] as part of a broader community skin program. The program consisted of screening children under 5 years old for impetigo and scabies, and an education program regarding cleaning homes, including washing floors with detergent, washing clothes and sheets and airing mattresses in the sun. Adults in the same house as cases were re-treated with permethrin and houses were fumigated with a synthetic pyrethroid (Raid 25%). A community barbeque was held to encourage compliance with the permethrin application. Children with infected scabies were given intramuscular (IM) benzathine penicillin. Scabies prevalence was 35% at baseline. At 7-month follow up, prevalence had reduced to 4.1% in under 5-year-olds (p<0.0001). Impetigo prevalence (that was not a result of secondarily infected scabies lesions) was reduced from 11% at baseline to 3.3% at 7 months (p=0.002).

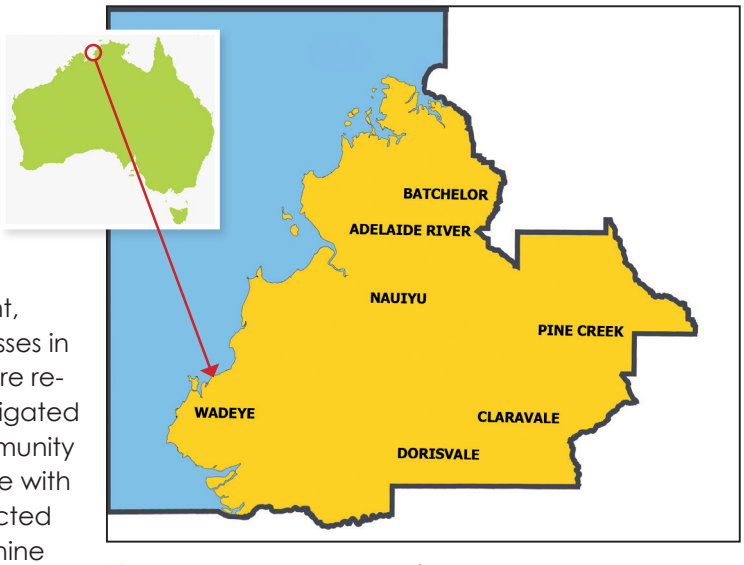


Figure 4. ***The Wadeye region (NT) where a permethrin MDA was conducted in the late 1990s.***

Wong *et al.* published a follow up study to describe additional strategies of a comprehensive community skin health program that helped to sustain reduced prevalence of scabies and impetigo in the population.[34] Twelve months following the initial MDA, a second community treatment day occurred with additional activities including a community clean-up, local treatment teams delivering cleaning items and 5% permethrin. Promotional T-shirts were distributed and a community barbeque was held to encourage compliance with treatment. Children were screened 6 weeks after the subsequent MDA and provided with permethrin for scabies or IM benzathine penicillin for impetigo. At 15-month follow up, scabies prevalence had reduced from 35% at baseline to 12% (p<0.0001) and non-scabies impetigo from 11% to 2% (p=0.0005).

Ivermectin MDA, Solomon Islands

Lawrence *et al.* conducted an MDA for scabies using oral ivermectin in five small lagoon islands in the Solomon Islands over a 3 year period between 1997 and 2000.[35] The trial examined the feasibility of treating the whole population for scabies once or twice within two weeks, and whether this mass treatment could maintain scabies control. Throughout the study, treatment was offered to returning residents and overnight visitors, regardless of whether they had obvious scabies or not, to prevent re-introduction of scabies into the community. Those who were not eligible to receive oral ivermectin were offered topical permethrin. The prevalence of scabies, impetigo, and kidney disease (measured by haematuria) was recorded at baseline and at the end of the study. Over 95% of the population were treated during the study period, and scabies prevalence fell from 25% at baseline to a sustained prevalence below 1% (p<0.001), with no adverse events recorded. Prevalence of skin sores fell from 40% to 22% (p<0.001) and the proportion of children with haematuria fell over time (p<0.002).

Figure 5. Five small lagoon islands in the Solomon Islands were the location of a MDA trial using oral ivermectin between 1997 and 2000.

Permethrin MDA, East Arnhem Healthy Skin Program, NT, Australia

Andrews *et al.* conducted a permethrin MDA from 2004 to 2007 in remote Aboriginal communities in the NT.[36] The permethrin MDA was delivered annually to reduce the prevalence of scabies and impetigo in the population. Flipchart health promotion materials were developed to increase awareness and understanding of the condition among community members, annual community skin days were held to raise awareness and children with diagnosed impetigo were referred to the local clinics for treatment. Impetigo prevalence reduced from 46% at baseline to 32% at 3 months and 35% at 3 years. Scabies prevalence was 16% at baseline, 13% at 3 months and 16% at 3-year follow up.[36]

Ivermectin MDA, Galiwinku, NT, Australia

Kearns *et al.* conducted an ivermectin MDA study in 2010-11, in a remote island Aboriginal community in the NT.[37] Ivermectin was provided to the entire community, with an additional dose 2-3 weeks later if scabies was diagnosed. Those ineligible to receive oral ivermectin were offered permethrin. The MDA was repeated 12 months later. Scabies prevalence reduced from 4% at baseline to 1% at 6 months, increased to 9% at 12 months and then reduced to 3% at 18 months after the second MDA.

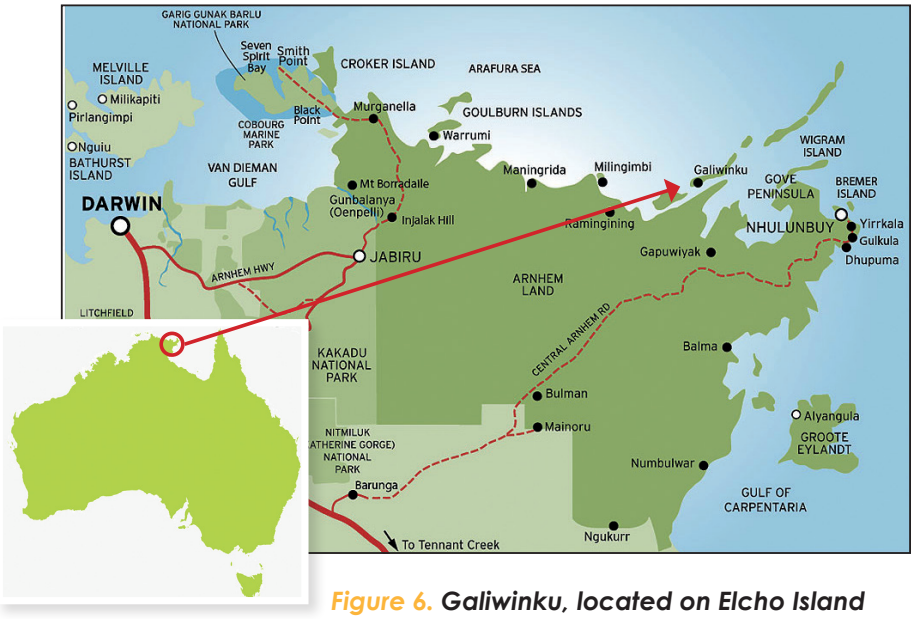


Figure 6. Galiwinku, located on Elcho Island was the location of the ivermectin MDA in 2010-11.

The authors attributed the increase at 12 months as being related to a scabies outbreak associated with a suspected case of crusted scabies in the community, although on review diagnosis of crusted scabies was unconfirmed and it is more likely that there were multiple re-introductions of scabies from surrounding communities that were not part of the MDA.

Ivermectin MDA, Fiji

Romani *et al.* conducted a controlled study of MDA for scabies in 2012-13 in three island communities in Fiji,[38] comparing permethrin MDA and ivermectin MDA to 'standard care' (administration of permethrin to affected persons and their contacts). In the permethrin group, permethrin 5% was administered at day 1 and, for participants who had scabies at baseline, another dose was administered 7 to 14 days later. In the ivermectin group, oral ivermectin was administered as a single oral dose and offered again for participants infected with scabies at baseline 7 to 14 days after the initial dose. In this group, permethrin was administered to those participants who were not able to use ivermectin (children aged under 5 years or weighing less than 15 kg, pregnant and breastfeeding women, and the very frail). At 12-month follow up, the greatest decline in prevalence was seen in the ivermectin group (from 32% to under 2%, relative reduction 94%). In comparison, scabies prevalence for those living in the community that had been randomised to the permethrin group reduced from 42% to 16%, and a 49% reduction in the standard care group (37% to 19%). A reduction in impetigo was also noted in all groups, with the greatest reduction in the ivermectin group (67%). Although adverse events were more common in the ivermectin group, all events were mild and resolved quickly. At 24 months, the reduction in scabies and impetigo in the ivermectin communities has been sustained. A larger study known as Big SHIFT (ACTRN12618000461291p) involving >100,000 people in Fiji is now underway.

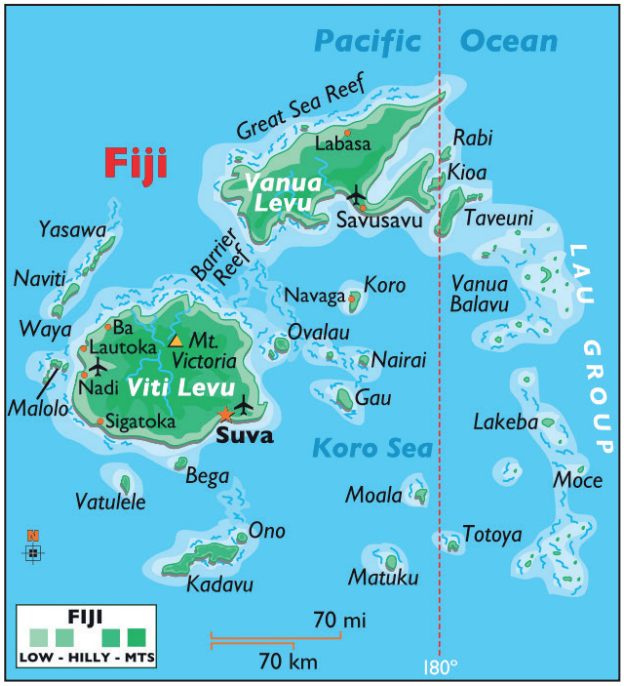


Figure 7. ***A MDA for scabies control was conducted in island communities in Fiji in 2012-13.***

- **Summary**

These studies show that MDA can be an effective strategy in reducing the burden of scabies and the associated prevalence of impetigo. The community setting and level of engagement have a large influence on the success of the program. The small island communities where these MDA programs have been performed have seen significant reduction in the burden of scabies and impetigo. However, in all cases scabies was sooner or later re-introduced from neighbouring communities, therefore addressing sustainability outside of the research context is an important element of implementation. There are also persistent evidence gaps, including determining the best strategies for implementation in populations with high mobility, the presence of crusted scabies, and where other strategies are already in place for public health management of skin infections.[39]

4. Recognition and diagnosis of skin infections

Skin infections are predominantly a visual diagnosis, or recognition of a pattern of skin signs. Training of health care providers in the correct recognition of skin infections is a priority to ensure the correct treatment is used. There are several elements to accurate diagnosis of skin infections discussed below. The availability and approach to collection of diagnostic tests is also outlined, although these remain a lower priority when access to diagnostic laboratories is limited in much of regional and remote Australia. Where diagnostic laboratories are available, these tests may be helpful where the infection does not respond to the standard treatment. There is also an increasing use of telehealth to send images, and more recently real-time video dermatoscopy, of skin pathology to specialists for advice.

Training resources

The correct identification of skin infections is challenging. Photographs have long been used in dermatology to assist in the recognition of skin infections. Recognising and Treating Skin Infections is a useful resource developed by the Cooperative Research Centre for Aboriginal Health (now the Lowitja Institute) and the Menzies School of Health Research in the NT as part of the East Arnhem Healthy Skin Program in 2004. The 2009 version has been widely used: (https://www.lowitja.org.au/sites/default/files/docs/Healthy-Skin-Flipchart-Aug09.pdf). The 2018 3rd edition Recognising & Treating Skin Infections: A visual clinical handbook, has been updated in conjunction with the development of this National Healthy Skin Guideline 1st Edition (2018) to be used as an accompanying learning resource. An online quiz for recognising skin infections is also available and may be used for training purposes. The National Healthy Skin Guideline, visual clinical handbook and quiz can be used together to aid in the recognition of skin infections (telethonkids.org.au/skinguidelines).

Training of health care providers working in settings where skin infections are endemic is a key priority to ensure accurate diagnosis. We strongly recommend training on the recognition of skin infections for all new health care providers working in endemic settings. We recommend these modules are regularly updated and available freely on the internet for ease of access and in paper format where internet connectivity is unreliable.

Several other high-quality guidelines and resources have been prepared within each State or Territory to assist healthcare providers in diagnosing and treating skin infections. In the absence of national guidelines, these resources have been valuable, and we have referred to many of these resources in preparing this document. The list of currently available resources can be found in Appendix A. Where possible, the recommendations in this National Healthy Skin Guideline are consistent with the guidelines in this list.

Normalisation

Skin infections often go untreated because they are extremely common, recurrent, and not always recognised as important. This 'normalisation' occurs at all levels, from the parents/carers[40] to the health care provider.[5] Interviews with parents and carers showed that children were only brought to the clinic if the skin infection resulted in pain or fever,[40] both of which are relatively uncommon symptoms for scabies or impetigo, where itch and irritation are more usual. Similarly, health care providers can also under-appreciate the burden of skin infection in their patients. A hospital-based study in WA in 2015-6 showed that only 21% of children were retrospectively documented to have a skin infection, whereas 50% of a matched cohort of children were prospectively found to have a skin infection ($P<0.001$).[5] This suggests

that skin infections are overlooked by health care providers in children admitted to hospital in a high prevalence setting. Overcoming this normalisation requires a more targeted approach to educating health care providers on the need to diagnose, document and treat skin infections. Familiarity with and recognition of skin infections is important in addressing the normalisation which may be a contributor to ongoing high burden. The National Healthy Skin Guideline and companion resources are available for health care providers to increase their knowledge about healthy skin practices. Knowledge about the serious consequences of skin infections and where, when and how to seek treatment for children with skin infections are priorities for families and communities. Increased awareness and knowledge of skin infection recognition and management amongst health care workers will hopefully translate to health promotion and education amongst Indigenous communities.

Diagnostic tests

Diagnostic tests can support clinical recognition of skin infections where access to diagnostic laboratories is available. In certain conditions, e.g. crusted scabies, diagnostic tests are strongly recommended to support the clinical diagnosis. Laboratory-confirmed presence of scabies mite is a mandatory requirement for confirming crusted scabies as a notifiable disease in the NT. However, access to laboratory diagnosis in the remote setting is limited where this condition is most common. In impetigo, swabs for bacteriological culture are useful if antibiotic resistance is suspected, but not essential for commencing treatment. Beyond skin scrapings, the diagnostic tests for scabies are less well developed and remain in the research phase. A point of care diagnostic assay (e.g. lateral flow assay, simplified dermatoscopy, PCR) is a priority for addressing scabies burden.

The below sections provide guidance on collecting the appropriate specimens for diagnostic confirmation, when available and indicated. When diagnostic testing is needed, we recommend contacting your local diagnostic laboratory to confirm the appropriate collection and transportation methods.

- **Skin swabs**

Skin swabs for bacterial culture (impetigo) are only recommended if the impetigo is NOT responding to standard treatment.

For detailed instructions on taking skin scrapings, please see Chapter 11: Pathology in the CRANAplus Clinical Procedures Manual for Rural and Remote Practice (4th Edition), available online at the Centre for Remote Health https://docs.remotephcmanuals.com.au/review/g/manuals2017-manuals/d/20326.html?page=1).

Swabs are used to identify bacterial pathogens resulting in impetigo:

1. Begin by labelling the frosted end of the slide, slide holder, swab tube and sample form with patient details. Use a sharp pencil to label the slide so that the details do not rub off.

2. If the wound is dry (no pus), wet the tip of the swab with a few drops of sterile normal saline and lift the crust with a sterile needle to swab the base of the sore.

3. Starting at the centre of the sore, roll the swab gently to edges, collecting any pus on the way.

4. Roll the swab once along the glass slide and leave the slide to air dry. Do not press too hard or rub the swab onto the glass.

5. Put the swab into the swab tube, and push the top down firmly.

6. When the slide is dry, return to the slide holder and close securely.

7. Store in a specimen collection bag with the sample form at room temperature for transport.

- **Skin scrapings**

For detailed instructions on taking skin scrapings, please see Chapter 11: Pathology in the CRANA*plus* Clinical Procedures Manual for Rural and Remote Practice (4th Edition), available online at the Centre for Remote Health (https://docs.remotephcmanuals.com.au/review/g/manuals2017-manuals/d/20326.html?page=1).

Skin scrapings are used for diagnosis of scabies, and fungal infections. For fungal infections, the patient should be asked not to use any antifungal topical treatment for at least 5–7 days, if practical, before skin scrapings are taken.

1. Begin by labelling the frosted end of the slide, and the slide holder, or the collection jar (a urine container with the yellow lid is suitable), with patient details. Use a sharp pencil to label the slide so that the details do not rub off.

2. **For scabies:** DO NOT scrape the sore. Use a magnifying glass to find the burrow marks and scrape firmly from the edge to collect as much skin as possible. Repeat in at least three different places. Place the scrapings onto a slide, leave them to dry, then cover the scrapings with a few drops of paraffin oil. Return the slide to the slide holder and close securely. Check that the slide is correctly labelled.

3. **For fungal infections:** Collect as many skin scrapings as possible by running a surgical blade held at a 90° angle to the skin across the affected area using light pressure, being careful not to break the skin. For skin scrapings for dermatophyte, scraping is suggested from areas where skin is friable, which is usually the edges. Hold an open urine jar underneath to collect the scrapings. For large lesions or multiple sores, scrape in several places using a new scalpel blade and collection jar each time. Replace lid on container and check it is correctly labelled.

4. For the safety of laboratory staff, the scalpel blade should not be included with the specimen.

5. Store the specimen jar in a specimen collection bag with the sample form for transport. Fungal infection skin scrapings should be stored in a cool, dark place, at less than 30°C, but not refrigerated.

Scabies has a low mite burden with an estimated 10 – 15 mites / person. In contrast, crusted scabies patients may have several million mites on their bodies. Skin scraping to observe the scabies mites is an essential component of the diagnosis of crusted scabies.

In skin scapings taken for the investigation of fungal infections, fungi will remain viable for about 30 days, however, delay between specimen collection and processing increases the chance of deterioration and contamination.

- **Nail samples (for nail tinea)**

Taking specimens from affected nails that are thickened and misshapen can be difficult. The nail should be clipped back until the crumbling portion of the nail is reached and clipped into a sterile specimen jar. Chalky debris from under the nail should also be scraped out and collected in a sterile specimen jar.

- **Hair samples (for scalp tinea)**

1. Begin by labelling the collection jar (a urine container with the yellow lid is suitable), with patient details.

2. Collect with a blunt scalpel, tweezers or disposable toothbrush from the scalp. Brush the toothbrush through the scalp several times. Cut hair is of no use as the fungi penetrate the upper hair follicle closest to the scalp. Replace lid on container and check it is correctly labelled.

3. Store in specimen collection bag with sample form at room temperature in a cool, dark location prior to transport.

Need for new technologies

New technologies that may aid in the recognition and treatment of skin infections include teledermatology, iPhone or cheap microscope adaptations to identify scabies mites, lateral flow and PCR assays for the diagnosis of scabies at the point of care and more. These will assist clinicians in differentiating the skin infection when uncertainty exists, but clinical recognition remains the most useful component of clinical care.

5. Impetigo

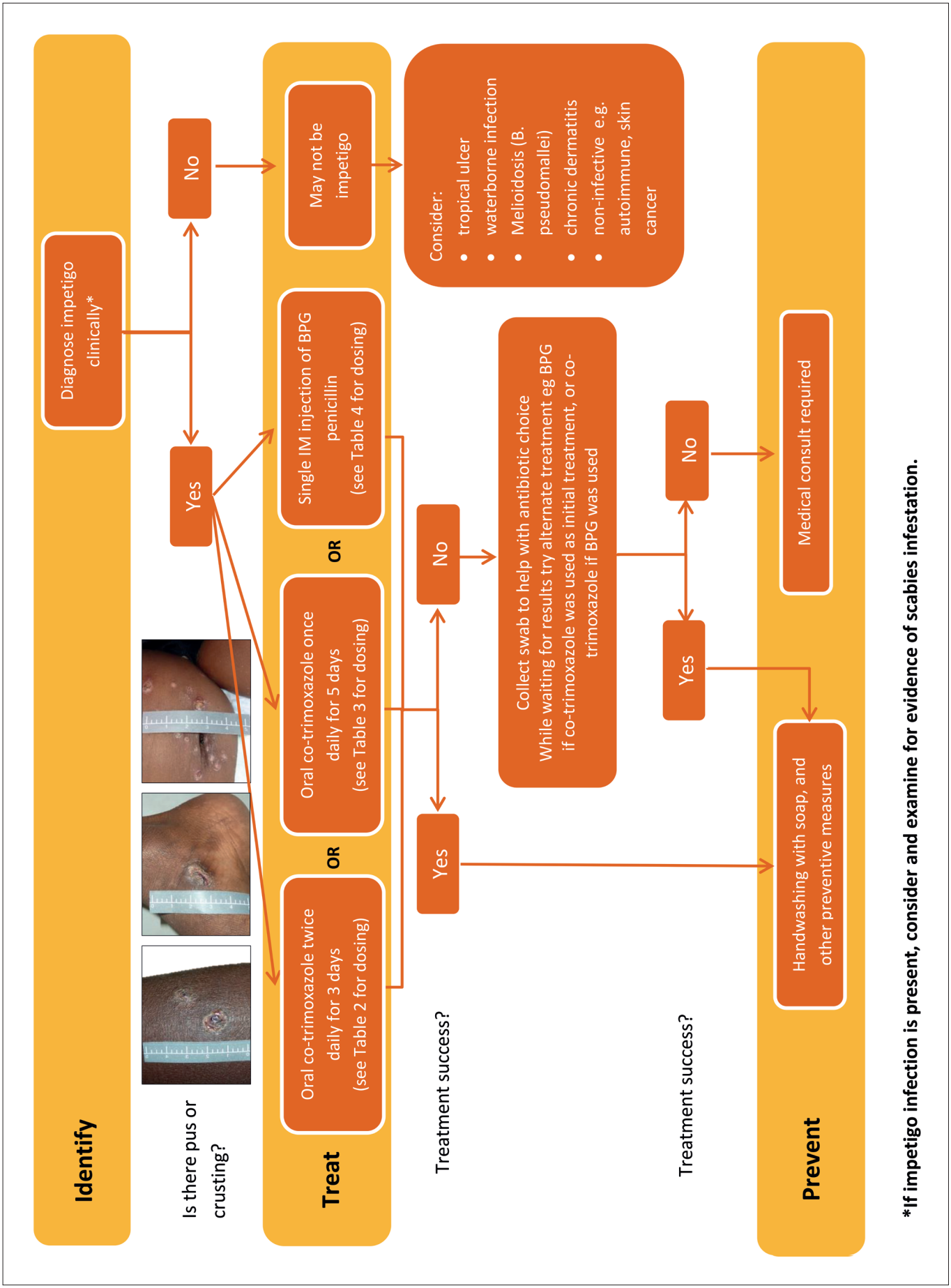
Summary of recommendations

Identify	
✓	Due to the serious consequences if left untreated, impetigo should be recognised and treated promptly as a high priority.

Treat		
✓ ✓ ✓	Treatment for impetigo* • Oral co-trimoxazole (4mg/kg/dose of trimethoprim component) twice daily for 3 days OR • Oral co-trimoxazole (8mg/kg/dose of trimethoprim component) once daily for 5 days OR • A single weight band dose of intramuscular benzathine penicillin G	GRADE 1A
✓	Oral amoxicillin and oral erythromycin are suitable alternatives to IM benzathine penicillin G and co-trimoxazole if the patient is allergic or either is unavailable.	GRADE 2B
✗	Topical antibiotic creams e.g. mupirocin are NOT recommended in this setting due to the rapid development of resistance. Other topical therapies, e.g. papaya cream, are of unproven benefit.	GRADE 2C

*For doses see Tables 2 – 4.

Prevent		
✓	Washing hands with soap is effective in the treatment and prevention of impetigo. There is no benefit to the use of antibacterial soap over regular soap.	GRADE 1A
✗ ✓	Mass drug administration (MDA) for treatment or prevention of impetigo alone is NOT recommended. Oral ivermectin MDA above the standard of care permethrin treatment may reduce the burden of impetigo where scabies is prevalent.	GRADE 1B
✓	An adequate supply of water for washing and cleaning may reduce the incidence of impetigo and scabies in resource-limited populations.	GRADE 2C
✓	There is a likely role for community-based active screening for impetigo followed by referral for treatment, but more studies are required to determine benefit.	GRADE 2C
✓	There is insufficient evidence to recommend the installation of swimming pools in remote communities for the sole purpose of reducing the prevalence of impetigo, however swimming pools for recreation have health and wellbeing benefits.	GRADE 2C
✓	Children with impetigo should be excluded from school until treatment has commenced and open sores should be covered with watertight dressings.	GRADE 2D



***If impetigo infection is present, consider and examine for evidence of scabies infestation.**

Overview

Impetigo, also known as skin sores, school sores or pyoderma, is a highly contagious skin infection, and can be found on any part of the body where there are breaks in skin integrity (Figures 8-10, 12-13). Breaks in the skin occur from minor trauma due to cuts, lacerations, tinea, insect bites, head lice or scabies infestation (Figure 1, Chapter 1).[41-43] Infestation with the scabies mite (Chapter 6) is a major contributing factor to impetigo in resource-limited settings and tropical regions. [44-46] In Aboriginal populations living in remote northern Australia, an estimated 45% of children (almost one in every two children) have impetigo at any one time.[47] This equates to 16,000 children across Far North Queensland, the NT and northern WA with impetigo needing treatment.[47] The prevalence of skin infections elsewhere in rural and remote Australia is also likely to be high, but precise numbers are unknown. Children of all ages may have impetigo and infect those adults living with them. Crowded living conditions in hot climates are an important risk factor for impetigo.

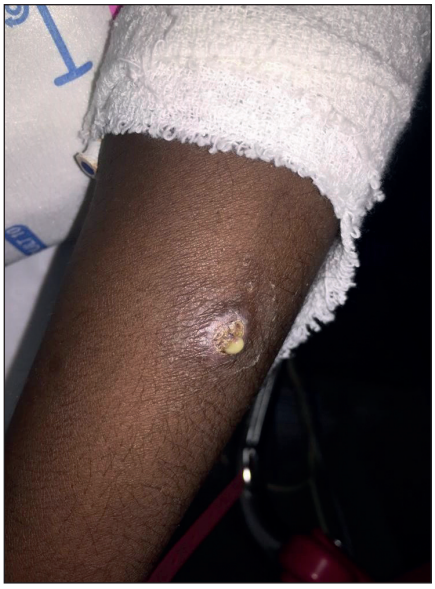


Figure 8. ***A sore with yellow pus dripping from it. The sore started with a small pink blister that filled with pus. Over the next day or two, this sore will develop a thick crust.***

Impetigo is the result of infection with either *S. aureus* or group A *Streptococcus* (GAS). Skin sores are most often caused by GAS in tropical areas [4,44] or *S. aureus* in temperate climates. Many healthy people carry *S. aureus* on their skin or in their nose without it causing any other symptoms. In contrast, GAS is usually transmitted between people in the days immediately before impetigo develops. The onset is sudden and often the sores are uncomfortable.

Consequences of untreated impetigo

Untreated impetigo has serious consequences, which include bone and joint infections, abscesses, cellulitis and sepsis (blood poisoning). Sepsis can lead to death in a small proportion of cases.

Infections from GAS can cause acute post-streptococcal glomerulonephritis (ASPGN), which can lead to chronic kidney disease. Skin infections may also lead to ARF, progressing to rheumatic heart disease in some individuals.[48]

Prompt treatment of impetigo should be a high priority.

Figure 9. ***Small (1-2 mm) pustules/pus filled bumps can be seen between each of the fingers in the web space.***

Impetigo protocol

Identify
Impetigo

Treat
Impetigo
Co-trimoxazole or BPG

Prevent
Impetigo
Prompt treatment. Handwashing, showering, washing clothes

Identify

The sores start as round or oval pus-filled bumps which progress into blisters, or the sores produce a clear honey-coloured fluid that forms a crust on the skin. When the crusts are removed the area underneath appears red and eroded.

Once impetigo is diagnosed based on the appearance of the sores, initiate treatment. Swabs may be useful in confirming the pathogen if the sores do not respond to standard treatment.

If impetigo is present, consider and examine for evidence of scabies infestation (see Chapter 6 and Figure 11).

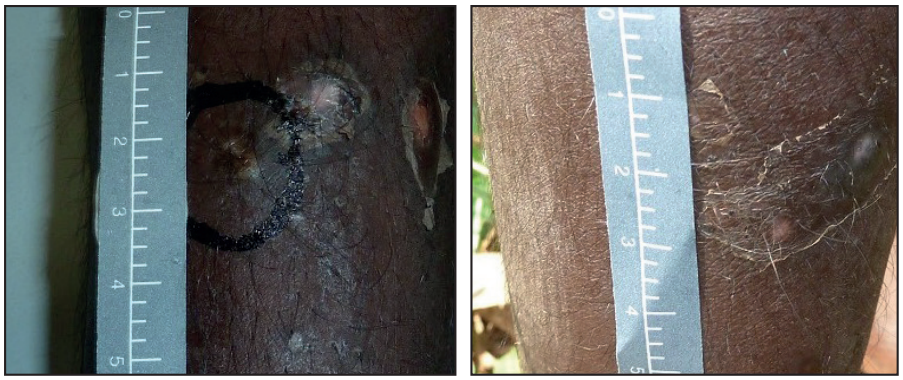


*Figure 10. **Skin sore before and after treatment. The left image (before treatment) shows purulence, crusting and peeling of sores. The right image (after treatment) has intact skin with no signs of purulence or crusting. There is very mild erythema (pinkness) to the lower sore; however the overall impression is that these sores have healed with treatment.***

Treat

First line treatment for impetigo

- Oral trimethoprim-sulphamethoxazole (co-trimoxazole) twice daily for 3 days (4mg/kg dose of the trimethoprim component twice daily)

OR

- Oral trimethoprim-sulphamethoxazole (co-trimoxazole) once daily for 5 days (8mg/kg dose of the trimethoprim component daily)

OR

- a single dose of IM benzathine penicillin G

Level of Evidence GRADE 1A

See Table 2,3,4

Not recommended:
Topical antibiotic creams e.g. mupirocin or fusidic acid are NOT recommended in this setting due to the rapid development of resistance. Other topical therapies, e.g. papaya cream, are of unproven benefit.

Level of Evidence GRADE 2C

Oral penicillin G is NOT recommended for treatment of impetigo in resource-limited settings.

Level of Evidence GRADE 2C

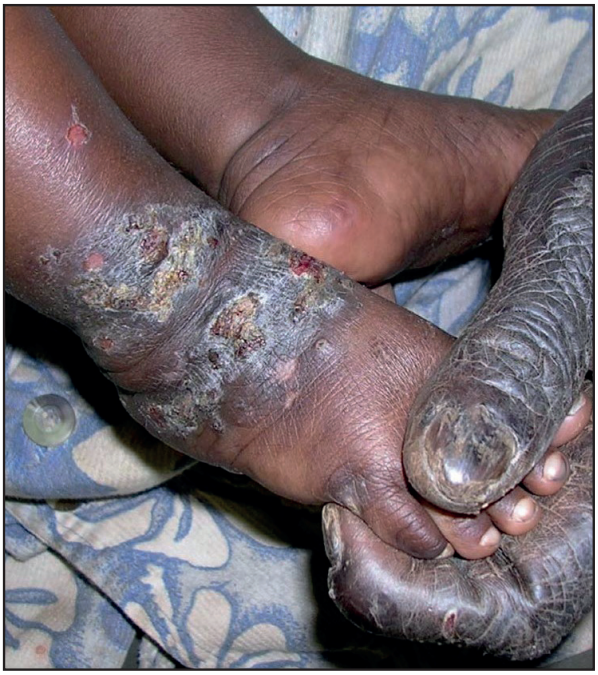


*Figure 11. **An infant with secondarily infected scabies papules with evidence of golden crust.***

Table 2. ***Weight band dosing for oral co-trimoxazole (4mg/kg/dose of trimethoprim component) twice daily for 3 days***

Weight band	Syrup Dose (Give morning & night) Cotrimoxazole syrup is 40mg trimethoprim/5mL	Tablet Dose (Give morning & night) Tablets are 160/800 of trimethoprim/sulfamethoxazole components
3 – < 6 kg	**1.5 mL** (12mg BD)	N/A
6 – < 8 kg	**3 mL** (24 mg BD)	N/A
8 – < 10 kg	**4 mL** (32 mg BD)	N/A
10 – < 12 kg	**5 mL** (40 mg BD)	N/A
12 – < 16 kg	**6 mL** (48 mg BD)	N/A
16 – < 20 kg	**8 mL** (64 mg BD)	N/A
20 – < 25 kg	**10 mL** (80 mg BD)	**½ tablet**
25 – < 32 kg	**12.5 mL** (100 mg BD)	**¾ tablet**
32 – < 40 kg	**16 mL** (128 mg BD)	
≥ 40kg	**20 mL** (160 mg BD)	**1 tablet**

Table 3. ***Weight band dosing for oral co-trimoxazole (8mg/kg/dose of trimethoprim component) once daily for 5 days***

Weight band	Syrup Dose (Once daily) Cotrimoxazole syrup is 40mg trimethoprim/5mL	Tablet Dose (Once daily) Tablets are 160/800 of trimethoprim/sulfamethoxazole components
3 – < 6 kg	**3 mL** (24 mg BD)	N/A
6 – < 8 kg	**6 mL** (48 mg BD)	N/A
8 – < 10 kg	**8 mL** (64 mg BD)	N/A
10 – < 12 kg	**10 mL** (80 mg BD)	N/A
12 – < 16 kg	**12 mL** (96mg BD)	N/A
16 – < 20 kg	**16 mL** (128 mg BD)	N/A
20 – < 25 kg	**20 mL** (160 mg BD)	**1 tablet**
25 – < 32 kg	**24 mL** (200 mg BD)	**1½ tablets**
32 – < 40 kg	**32 mL** (256 mg BD)	
≥ 40kg	**40 mL** (320 mg BD)	**2 tablets**

Table 4. ***Dose table for IM benzathine penicillin G (BPG)***

Weight band	Injection Dose 1 syringe of BPG is 900mg in 2.3mL
3 – < 6 kg	**0.5 mL** (225 mg)
6 – < 8 kg	**0.8 mL** (337.5 mg)
8 – < 10 kg	
10 – < 12 kg	
12 – < 16 kg	**1.0 mL** (450 mg)
16 – < 20 kg	**1.6 mL** (675 mg)
20 – < 25 kg	**2.3 mL** (900 mg)
25 – < 32 kg	
32 – < 40 kg	
≥ 40kg	

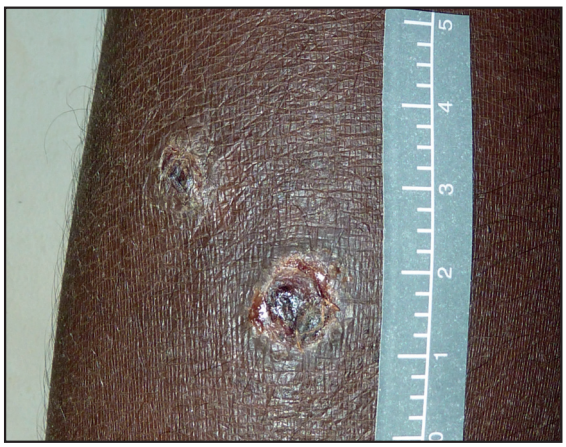


Figure 12. ***This is an early skin sore displaying redness and a thin crust. Following treatment, the crust will thicken, the skin will tether and eventually the crust will fall off leaving flat, dry, pink skin underneath.***

Discussion

There is no difference in clinical cure of impetigo between oral co-trimoxazole or intramuscular (IM) benzathine penicillin (BPG) in resource-limited settings (GRADE 1A),[46,49] but oral co-trimoxazole may have fewer side effects.[46]

The treatment regimen should be decided by the health care provider with the family, based on their knowledge of the patient and/or carer, their family circumstances and preference. The preferred regimen is twice daily oral co-trimoxazole for three days. If compliance with this regimen is uncertain, a single daily dose of oral co-trimoxazole for 5 days provides an opportunity for directly observed therapy at the clinic, school or other service

provider or may be simpler for the family. A single dose of IM BPG may be the best option for some families as no further doses are required. However, IM BPG is painful and children may then be reluctant to return to the clinic for future care.[46]

The microbiological clearance of *S. pyogenes* (GAS) was the same for oral co-trimoxazole as it was for IM BPG, but clearance of *S. aureus*, including MRSA, was significantly higher with co-trimoxazole.[46] Therefore, co-trimoxazole may be the preferred treatment in areas where *S. aureus* (and MRSA) rates are high.[46]

There is moderate quality evidence to support the use of oral amoxicillin and oral erythromycin as suitable alternatives to IM BPG and co-trimoxazole, if the patient is allergic to co-trimoxazole or IM BPG or they are not available at the time of treatment. Amoxicillin has a better safety profile than erythromycin (GRADE 2B).[50]

Topical antibiotic creams e.g. mupirocin are NOT recommended due to the rapid development of resistance (GRADE 2C).[51-54] There is no evidence that other topical therapies, e.g. papaya cream, are beneficial in treating impetigo.

Oral penicillin G is not recommended for treatment of impetigo in resource-limited settings (GRADE 2C). Treatment failure with oral penicillin was reported more often than with IM BPG.[17] Other β-lactam antibiotics (e.g cephalexin, flucloxacillin, amoxicillin/clavulanic acid [augmentin]) have not been studied in this context for treatment of impetigo. In non-resource-limited settings, oral penicillin has been shown to be less effective than most other oral antibiotics, such as erythromycin or cloxacillin.[11]

There was no evidence for or against the use of topical antiseptic washes or topical antiseptics in the control of impetigo.

Currently, there is no evidence for or against the use of complimentary therapies, Indigenous or traditional treatments for impetigo in resource-limited settings. We encourage further research in this area to ensure that care and treatment of impetigo bridge Western and Indigenous values.

Prevent

Hygiene practices

Washing hands once a day with soap is effective in the treatment and prevention of impetigo in resource-limited settings. There is no benefit to the use of antibacterial soap over regular soap.

Level of Evidence: GRADE 1A

Mass drug administration (MDA)

MDA for treatment or prevention of impetigo alone is NOT recommended in resource-limited settings. However, where scabies is commonly seen, oral ivermectin MDA above the standard of care permethrin treatment for scabies may also reduce the burden of impetigo.

Level of Evidence: GRADE 1B

An adequate supply of water for washing and cleaning may reduce the incidence of impetigo and scabies in resource-limited populations. High-quality water supplies are essential to good health and access to this is a human right.

Level of Evidence: GRADE 2C

Community-based surveillance and skin health programs

There is a likely role for community-based active screening for impetigo followed by referral for treatment, but more studies are required to determine benefit.

Level of Evidence: GRADE 2C

Swimming pools

There is insufficient evidence to support the installation of swimming pools in remote communities for the sole purpose of reducing the prevalence of impetigo, however swimming pools for recreation have health and wellbeing benefits.

Level of Evidence: GRADE 2C

Housing improvement programs

Currently, there is no evidence for or against housing improvement programs for the reduction of impetigo alone in resource-limited settings. Evidence exists, however, for the general improvement in skin health with housing improvement programs. Taken together, it is likely that housing improvement programs will reduce the burden of impetigo. This is a priority for future research.

Level of Evidence: GRADE 2C

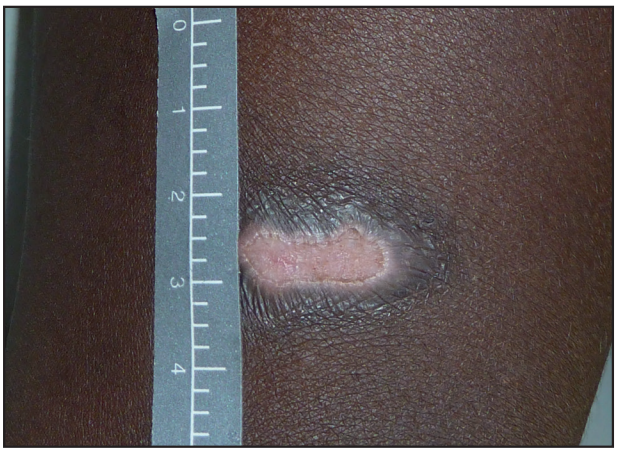


Figure 13. ***A healed or flat, dry sore where the crust has recently fallen off. Over time, this will fade.***

Discussion

Washing hands once a day with soap is effective in the treatment and prevention of impetigo in resource-limited settings (GRADE 1A).[55,56] There is no benefit to the use of antibacterial soap over regular soap.[55,56]

Scabies and impetigo often co-exist. Anti-parasitic agents used in MDA programs (e.g. ivermectin, permethrin) have shown an additional benefit in reducing the burden of impetigo indirectly. While there was not enough evidence to support MDA for impetigo alone in resource-limited settings, there is moderate quality evidence where scabies is common to support the use of oral ivermectin MDA above standard of care permethrin treatment to reduce the burden of impetigo (GRADE 1B).[38] However, as most MDA studies for skin disease control have been conducted in island communities, whether these findings can be applied to highly mobile populations living in resource-limited mainland communities is unresolved. Additionally, MDA programs require a high level of community ownership and engagement to achieve the success that has been seen in research trials.

There is low quality evidence that an adequate supply of water for washing and cleaning will reduce the incidence of impetigo in resource-limited populations (GRADE 2C).[57] Further studies are required to determine whether these show a measurable benefit in the prevention of impetigo. However, improved high-quality water supply, adequate sanitation, improved housing and promotion of good hygiene practices in resource-limited settings are encouraged. High-quality water supplies are essential to good health and access to this is a human right.

There were no studies that assessed the effect of a community skin health program on impetigo alone. There was one study describing the effect of a community skin health program on the prevalence of scabies and impetigo.[34] Active screening by trained local community workers over a 3-year period was associated with increased treatment uptake and led to a 15% absolute reduction in prevalence of impetigo. There is a likely role for community-based active screening followed by referral for treatment (GRADE 2C).

Treatment combined with comprehensive skin control measures such as health promotion, environmental interventions and screening are likely to have added benefit to conventional clinical treatment regimens in sustaining a reduction in population prevalence of scabies and impetigo (GRADE 2C).[34] High quality,

randomised studies with control communities who do not receive the additional interventions would define the measurable benefit over standard treatment alone.

The regular use of swimming pools leads to improvements in skin health, with other health benefits including social and emotional wellbeing. Currently there is limited, low quality evidence to support the installation of swimming pools in remote communities for the sole purpose of reducing the prevalence of impetigo.[58]

Currently, there is no available evidence to confirm the need for housing improvement programs for the reduction of impetigo alone in resource-limited settings. Evidence exists, however, for the general improvement in skin health where housing improvement programs have been evaluated. Taken together, it is likely that housing improvement programs will reduce the burden of impetigo. This is a priority for future research. Improvements in housing are likely to lead to improvement in the general health of these communities.

Current research underway

The SToP Trial (See, Treat, Prevent skin sores and scabies), (ACTRN12618000520235) to commence in the Kimberley, WA in 2018, aims to reduce skin sores in school aged children by 50%. The SToP trial will combine surveillance, health promotion, environmental health and evidence-based treatment as a package of interventions that will be evaluated. The trial will commence in 2018 and run for five years, with results expected in 2022.

A study in New Zealand (ACTRN12616000356460) commenced in 2017 to investigate the effectiveness of three interventions to treat mild-to-moderate impetigo in Maori and Pacific Island children. The trial will compare topical fusidic acid (2%) ointment twice a day for 5 days, topical hydrogen peroxide (1%) ointment applied twice per day for 5 days or simple wound care. This trial will determine whether hydrogen peroxide or simple wound care are as effective as fusidic acid, the current recommended antibiotic treatment in New Zealand for impetigo. Alternative treatments are needed because of the increasing rate at which *S. aureus* is developing resistance to fusidic acid.[54] Whether the outcomes of this trial will be applicable in the Australian context remains to be determined.

Unanswered questions for future research

An MDA using antibiotics for impetigo in high prevalence settings has not been conducted as yet, but would provide useful information about the effectiveness of MDA as an intervention against endemic impetigo. In an MDA using azithromycin in children with trachoma and their contacts, rates of impetigo were measured and were significantly reduced at 2 months post-treatment but had returned to baseline by 6 months.[59]

Internationally, MDA is being used as a key strategy for management of Neglected Tropical Diseases endorsed by WHO with azithromycin (for trachoma and yaws)[60-62] and ivermectin for lymphatic filariasis.[63] Data collection on the burden and resolution of impetigo and scabies as a secondary outcomes of these MDA programs is needed to continue to inform this strategy as an effective public health intervention.[64]

No studies were available to compare school exclusion approaches for impetigo. Future studies assessing whether school exclusion is a useful strategy to reduce the burden of impetigo in remote communities are needed. School exclusion for health reasons is a high priority, but must be balanced against the need for improved educational outcomes to Close the Gap. Currently, guidelines recommend excluding children with impetigo until the day after treatment has commenced providing the sores are also covered with a dressing. Without new evidence, we are unable to modify the current, consensus measures recommended by the NHMRC until new evidence directs otherwise.[65] Therefore, we recommend that children with impetigo should be excluded from school until treatment has commenced.

Aboriginal and Torres Strait Islander people's traditional management of skin infections with accumulated knowledge is an area for future study to confirm the active ingredients, and efficacy against the current standard of care. In addition, the role for traditional remedies alongside standard treatments needs to be explored.

6. Scabies

Summary of recommendations

Identify		
✓	Due to the serious consequences if left untreated, scabies should be recognised and promptly treated as a high priority.	
✓	Treatment of scabies reduces itch leading to better sleep and daytime concentration.	

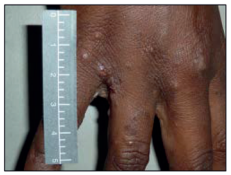
Treat		
✓	Topical permethrin 5% is recommended as first line treatment in Australia for all age groups. Repeat dose in 1 week.	**GRADE 1A**
✓	Oral ivermectin is recommended if topical treatments have failed and with a medical consult. Repeat dose in 1 week.	**GRADE 1A**
	Ivermectin **CAN NOT** be used in pregnant or breastfeeding women, or children under 5 years of age or less than 15kg.	
✓	Application of topical treatments should cover the entire body from head to toe.	**GRADE 1D**
✓	Modified applications are not recommended. Instructions on applying scabies creams are provided in Box 1.	
✓	Topical crotamiton is safe in infants, but permethrin is recommended above topical crotamiton.	**GRADE 2C**
✓	Topical permethrin is recommended for the treatment of scabies in pregnant women.	**GRADE 2C**

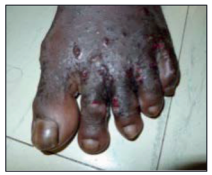
Prevent		
✓	Mass drug administration (MDA) to control scabies may be of benefit in resource-limited communities.	**GRADE 1B**
✓	Comprehensive control programs combining health promotion, education and hygiene practices are likely to be of benefit when added to standard scabies treatment regimens.	**GRADE 2B**
✓	Scabies treatment combined with comprehensive skin control measures such as health promotion, environmental interventions and screening are likely to add benefit to conventional clinical treatment regimens to sustain a reduction in the population prevalence of scabies and impetigo.	**GRADE 2C**
✓	Treatment of household contacts is recommended for the community control of scabies in resource-limited settings.	**GRADE 2C**
✓	Treatment of cases and contacts is recommended in scabies outbreak situations.	**GRADE 2C**
✓	An adequate supply of water for washing and cleaning may reduce the incidence of impetigo and scabies in resource-limited populations. Although practical, there is not enough evidence to recommend washing clothing and bed linen to prevent impetigo and scabies, but these measures may be helpful and should not be discouraged. High-quality water supplies are essential to good health and access to this is a human right.	**GRADE 2C**
✗	Dog control programs are of no benefit to the community control of human scabies infestations.	
✓	Children with scabies should be excluded from school until treatment has commenced and open sores should be covered with watertight dressings.	

Identify

Diagnose scabies clinically*

Intensely itchy rash with scratches or small bumps between fingers or toes, on wrists, elbows, knees ankles or bottom?





Yes

No

Treat

Topical permethrin 5% applied head to toe**, repeated in 1 week

May not be scabies

Treatment success?

Yes

No

Consider:
- eczema or other dry skin condition
- papular uticaria (from insect bites)
- impetigo

Oral Ivermectin **CAN NOT** be used in children under 5 years or pregnant/breastfeeding women

Medical consult required
Oral ivermectin single dose, repeat in 1 week

Treatment success?

Yes

No

Consider crusted scabies in community/household - medical consult

Prevent

Household and community control programs, Mass Drug Administration (MDA)

***If scabies infestation is present, consider and examine for evidence of impetigo.**

**** Follow instructions from CARPA manual**

Overview

Scabies infection of the skin is the result of an infestation by the mite *Sarcoptes scabiei* var. *hominis*.[23] Scabies only occurs in humans, and results in intensely itchy skin lesions.[14,66] Scratching due to scabies breaks the usual skin barrier,[66] resulting in secondary bacterial infection.[14,66] Scabies mites crawl, but do not fly or jump, so the main mode of transmission occurs through skin-to-skin contact. Transmission through contact with infected objects such as sheets or clothing,[15,28] although much less important, can occur because the mite can survive for several days off the human host.[15,67]

Scabies is a very common skin infection in tropical climates. The estimated global prevalence of scabies in 2010 was over 100 million people.[68] A recent systematic review reported the highest point prevalence of scabies in the resource-limited settings of Panama (78% of children <2 years), Fiji (44% of 5 to 9 year olds) and Australia, where 33% of Aboriginal children in remote communities are affected.[69] Scabies has been classified recently by WHO as a Neglected Tropical Disease (NTD)[70] because it is a surrogate for poverty, causes significant stigmatisation, is associated with chronic kidney disease and rheumatic heart disease in tropical settings,[71] and is highly responsive to control through MDA.

Consequence of untreated scabies infection

Scratching the skin as a result of scabies may lead to secondary bacterial skin infections, which can result in bone and joint infections, abscess, cellulitis and sepsis (blood poisoning). Sepsis can lead to death in a small proportion of cases.

Infections from GAS can cause acute post-streptococcal glomerulonephritis (ASPGN), which can lead to chronic kidney disease. Skin infections may also lead to acute rheumatic fever (ARF), progressing to rheumatic heart disease in some individuals.[48]

To prevent secondary bacterial infections, prompt treatment and prevention of scabies is a high priority.

Scabies protocol

Identify
Scabies

Treat
Scabies
Topical permethrin

(or oral ivermectin if treatment fails and with a medical consult)

Prevent
Scabies
Mass Drug Administration

Investigate recurrent cases and environment - may indicate crusted scabies in the household

Identify

Scabies mites are transferred by direct contact with skin and can burrow into the skin very quickly. The intense itching is caused by the host's immune response to the mite and its eggs, and is more severe at night. The itching may not commence immediately after infection. In the first infection, itch may be delayed for up to six weeks. Itch occurs within days in those who have previously been infected with scabies. Even after treatment, the itching can persist for up to 2 weeks.

The mites burrow into the skin leading to the development of small bumps (papules), blisters and/or tiny linear burrows that contain the mites and their eggs. Scabies papules and scratch marks are commonly found in the web spaces between fingers and toes, and on the outer surfaces of the wrists and elbows (Figures 14 and 18). Other common sites include the armpit, belt line, thighs, abdomen, buttocks, genitals (male and female) and breasts (in women).

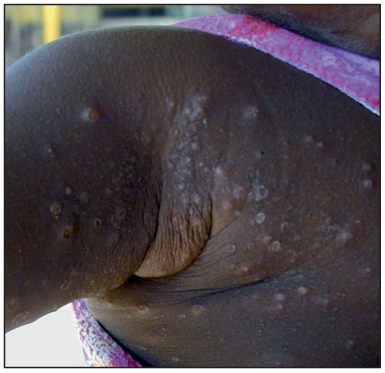


Figure 14. ***The multiple papules or bumps in the arm pit are classical for scabies. These papules are very itchy and may get infected with bacteria.***

Infants may have widespread lesions involving the head, neck, palms of the hands and soles of the feet, but typically present with pustules on the palms and soles. This is also a common finding in the frail elderly. Scabies papules are usually absent on the head and face except in the immunosuppressed and those under 1 year of age.

Scabies remains predominantly a clinical diagnosis, although diagnostic tools are in development and may be used in resource-rich settings e.g. dermatoscopy. Point of care tests would improve the sensitivity of scabies diagnosis and will be needed to license new treatments in the future. The case definition of scabies is an intensely itchy rash with small bumps on the skin in a typical distribution pattern involving the web spaces between the fingers or toes or other parts of the body.[72]

If scabies infestation is present, consider and examine for evidence of impetigo (see Chapter 5 and Figures 15-17).

Treat

First line treatment for scabies

Topical permethrin 5% applied to the entire body (head to toe) as described in Box 1 below. Application should be repeated again 1 week after initial treatment.

Level of Evidence GRADE 1A

Oral ivermectin, (200mcg/kg by weight band dosing) given on day 1 and again in 1 week is recommended if topical treatment fails or is contraindicated. Oral ivermectin cannot be used in children less than 5 years of age or under 15 kg, and in pregnant or breastfeeding women.

Level of Evidence GRADE 1A

Application of topical treatments should cover the entire body from head to toe.

Level of Evidence GRADE 1D

Modified applications of topical permethrin are NOT recommended.

Level of Evidence GRADE 1D

Topical crotamiton is safe in infants. When unavailable, topical permethrin is recommended.

Level of Evidence GRADE 2C

Topical permethrin (5%) is recommended for the treatment of scabies in pregnant women.

Level of Evidence GRADE 2C

Box 1. Application of scabies creams and lotions

- Rub the cream on clean, dry skin after bath/shower at the end of the day. The cream needs to be left on overnight.
- Start with the head including scalp and face — avoid eyes, lips, mouth

  If hair very thick or infestation very bad — the head may need to be shaved, with permission.
- Work carefully down the whole body. Always include:
  - Between fingers and toes, soles of feet, under nails
  - Body creases — behind ears, under jaw, neck, armpits, groin, bottom, under breasts
  - Joints and joint creases — elbows, knees, heels
- Put on hands again after washing, put on child's hands again before bed

Discussion

The recommendations for treatment of scabies in this guideline is based on available evidence, but must also take into account 'real world' conditions experienced by health care providers working in Aboriginal communities.[73] We evaluated the evidence available from around the world and recommendations from other state-based guidelines. However, while there may be evidence for the efficacy of a particular treatment, if that treatment is not always easily available (e.g. crotamiton), or not registered in Australia for scabies treatment (e.g. topical ivermectin), we provided suitable alternatives. Side effects of topical therapies were also considered, as benzyl benzoate can cause irritant dermatitis (as can permethrin but less commonly). Future updates of this guideline will take into consideration changes in treatment availability or regulatory changes in therapeutic indications.

There was a small amount of evidence supporting the use of permethrin cream over and above oral ivermectin in people with classical scabies[74-76] due to the faster clinical cure and symptomatic relief achieved in some of the studies.[74,75] However, this effect was not sustained over the course of any of the studies, and oral ivermectin was equally effective at achieving clinical cure after several weeks of follow up. In resource-limited settings not experiencing epidemic rates of scabies, or communities with high re-infection rates due to resident cases of crusted scabies, topical permethrin cream for the treatment of classical scabies may be preferred by affected community members due to the faster clinical response. However, clinicians can also use oral ivermectin with the confidence that this agent is equally effective over time – and is much simpler. In Australia, oral ivermectin is registered for use only if treatment with topical agents has failed.

There is no evidence to support modified applications of topical treatments for scabies over standard treatment regimens. The standard application of head to toe treatment is recommended (GRADE 1D). Access to a private space to apply topical therapy to the entire body can be a key to success, particularly in overcrowded living environments. See Box 1 for details on permethrin application .

There is low quality evidence to support the use of topical permethrin above topical crotamiton[74,77] in adults and children aged over four years of age (GRADE 2C). Crotamiton can be difficult to source, therefore we recommend using topical permethrin over crotamiton in all age groups.

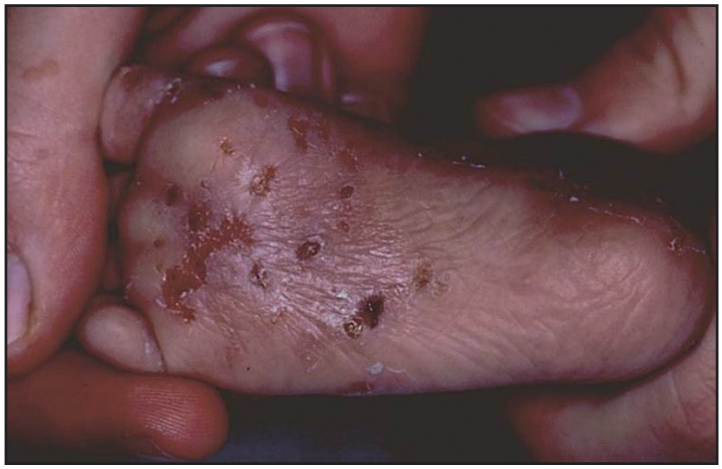


Figure 15. ***Infant's foot with evidence of secondarily infected scabies. The thick crusts are evidence of the bacterial infection.***

Either topical permethrin or topical benzyl benzoate is safe for the treatment of scabies in pregnant women living in resource-limited settings (GRADE 2C).[78] For consistency with other guidelines, comfort and availability, we have recommended topical permethrin in pregnancy.

Prevent

Mass drug administration (MDA)

MDA to control scabies may be of benefit in resource-limited communities. MDA is strongly recommended in communities where there is a high prevalence of scabies, when communities are supportive, fully informed about the risks and benefits, and are provided with the opportunity to inform the planning, implementation and evaluation of the MDA program.

Level of Evidence: GRADE 1B

Comprehensive community skin health programs

Comprehensive control programs combining health promotion, education and hygiene practices are likely to be of benefit when added to standard scabies treatment regimens.

Level of Evidence: GRADE 2B

Scabies treatment combined with comprehensive skin control measures such as health promotion, environmental interventions and screening are likely to add benefit to conventional clinical treatment regimens to sustain a reduction in the population prevalence of scabies and impetigo.

Level of Evidence: GRADE 2C

Communicable disease control and prevention

Treatment of household contacts is recommended for the community control of scabies.

Level of Evidence: GRADE 2C

Treatment i.e. with topical permethrin of cases and contacts is recommended in scabies outbreaks.

Level of Evidence: GRADE 2C

Hygiene practices, water provision and housing programs

An adequate supply of water for washing and cleaning may reduce the incidence of impetigo and scabies in resource-limited populations. High-quality water supplies are essential to good health and access to this is a human right.

Level of Evidence: GRADE 2C

Environmental co-interventions

There is not enough evidence to recommend washing clothing and bed linen for the control of scabies. However, these measures are unlikely to cause harm and should not be discouraged. Pragmatic activities such as storage of items in plastic bags, exposure to sunlight and household spraying with insecticides have been incorporated into some skin control programs. Whilst practical and common in many of the scabies skin control programs, there is limited evidence for or against these activities, as they have not been compared with a control where these additional activities were not incorporated.

Dog control programs are of limited benefit to the community control of human scabies infestations.

Discussion

An MDA for scabies may be a useful intervention in a community with significant burden and the appropriate planning, consultation and community ownership. The details of scope, consent, logistics, ethics and adverse events need to be clearly discussed with stakeholders and community members before embarking on an MDA. Without this consultation, the reported success rates of MDA may not be achieved locally. In contrast, an MDA is strongly recommended in communities that are supportive, are fully informed about the risks and benefits, and are provided with the opportunity to inform the planning, implementation and evaluation of the MDA program.[34,39,73]

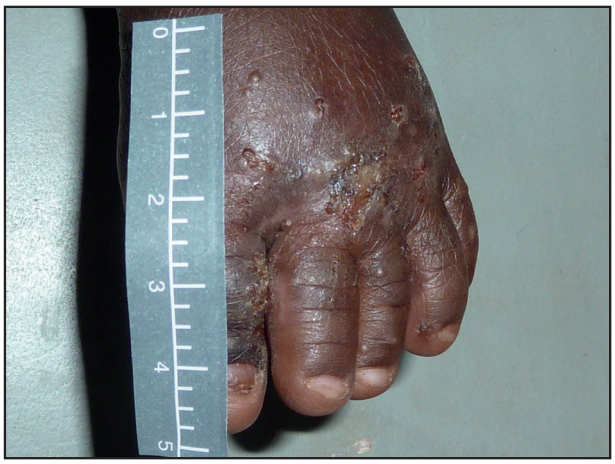


*Figure 16. **The small lumps due to scabies infestation between the toes and on the forefoot have an erythematous, glistening appearance suggestive of secondary infection with bacteria.***

In areas where scabies are endemic and outbreaks are common, there is a greater availability of evidence to support the use of oral ivermectin[79] over topical agents.[38] In communities preferring the MDA

method to reduce the prevalence of scabies and impetigo, rather than individual treatment of only those with scabies, oral ivermectin may be a superior agent for community-wide use in older children and non-pregnant adults[38] as well as being more practical to administer to a large number of people. There is evidence of moderate quality to support the use of MDA to control scabies in resource-limited communities (GRADE 1B).[80-82]

For the treatment of contacts of individual cases of scabies, there were no studies comparing efficacy between agents. Therefore, treatment with topical permethrin as first line therapy in Australia is currently recommended.

Comprehensive control programs combining health promotion, education and hygiene practices are likely to be of benefit when added to standard treatment regimens for scabies (moderate quality evidence - GRADE 2B).[83] Further studies are required to determine whether there is any additional benefit of these comprehensive measures.

Treatment combined with comprehensive skin control measures such as health promotion, environmental interventions and screening are likely to add benefit to conventional clinical treatment regimens to sustain a reduction in the population prevalence of scabies and impetigo (low quality evidence - GRADE 2C).[34] However, high quality studies using control communities who do not receive the additional interventions would be useful in determining the measurable benefit over standard treatment alone.

Treatment of household contacts is recommended for the community control of scabies in resource-limited settings (GRADE 2C).[84] Treatment of cases and contacts is recommended in scabies outbreak situations (GRADE 2C), however, high quality studies comparing treatments during outbreaks are required before different treatments can be recommended over the current first line therapy recommended for routine use.

There is low quality evidence that an adequate supply of water for washing and cleaning will reduce the incidence of scabies in resource-limited populations (GRADE 2C).[57] Promotion of a safe water supply, better housing and good hygiene practices should be advocated for general health improvements in resource-limited settings. This approach may be a target for future research to determine whether there is a measurable benefit in the management of scabies. High-quality water supplies are essential to good health and access to this is a human right.

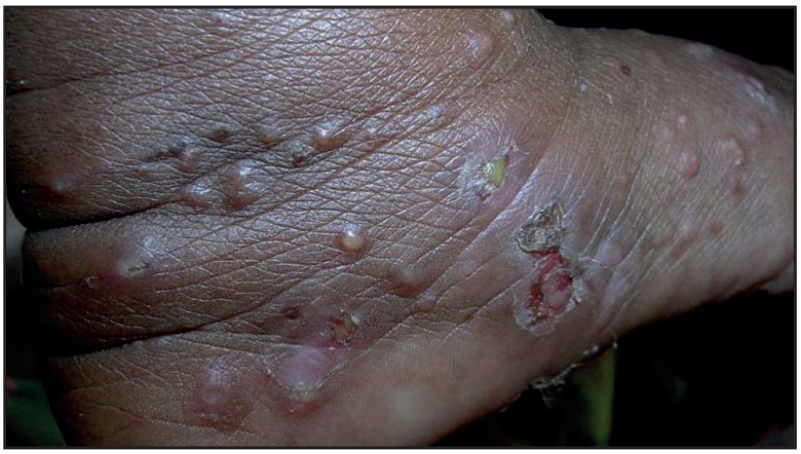


Figure 17. ***Infant with scabies mite papules. The central blister looks golden, evidence of emerging impetigo as a secondary infection of scabies.***

High quality studies assessing the clinical effectiveness of washing clothing and bed linen, storage of items in plastic bags, exposure to sunlight and household spraying with insecticides are required before these measures can be strongly recommended as adjuncts in the control of scabies in resource-limited settings. Whilst practical and common in many of the scabies skin control programs, there is limited evidence for or against these activities, as they have not been compared with a control where these additional activities were not incorporated.

The scabies mite that infects dogs (causing mange) does not cause human infestation.[85,86] Dog control programs are of no benefit to the community control of human scabies infestations.

Current research underway

A community-based safety study of 2-drug (Diethylcarbamazine and Albendazole) versus 3-drug (Ivermectin, Diethylcarbamazine and Albendazole) therapy for lymphatic filariasis, scabies and soil-transmitted helminths has completed initial enrolment in Fiji (ACTRN12617000738325). Ivermectin given to communities as an MDA has been proven to be effective in reducing the community prevalence of scabies. This trial will determine the effect of one dose versus two doses of ivermectin as part of MDA for scabies and impetigo prevalence within a community randomised community study.

A trial of an ivermectin MDA in a large population in Fiji (>100,000 people) is underway (ACTRN12618000461291p) in preparatory stages and will measure the effect of MDA on the complications of scabies including complicated skin and soft tissue infections.

Two Phase 3 Trials of a new agent are underway in the USA. These trials will treat the index case and their household contacts with a single application of the topical anti-parasitic Natroba (spinosad) suspension or placebo to assess for the cure of scabies (NCT02485704 and NCT02485717).

Oral ivermectin versus topical permethrin to treat scabies in children (SCRATCH: NCT02407782) is a French study that aims to compare the efficacy and safety of two drug treatments against scabies in children and their close contacts. One group will apply topical permethrin 5% and the other group will receive oral ivermectin. Whether the results of this study will be applicable in an Australian setting is unknown.

Moxidectin is a well-established anti-parasitic medication used in animals and has been proposed as an alternative treatment for scabies in humans.[87] Several clinical trials have been completed assessing safety and pharmacokinetic properties in humans, including pregnant and breastfeeding women. Two trials have compared ivermectin to moxidectin in the treatment of the nematode Onchocerca volvulus infection, with promising safety and efficacy results for moxidectin compared to ivermectin.[87] Whether moxidectin will be as useful in the treatment of scabies remains to be determined.

Tea tree oil has in vitro effects against the scabies mite and is used in the management of crusted scabies. A clinical trial to compare tea tree oil with permethrin in children with scabies has been registered in the NT (ACTRN12617000902392).

Unanswered questions for future research

No evidence is currently available to determine whether permethrin or oral ivermectin is favoured by patients and clinicians. Research on this issue would be useful to support future recommendations in this guideline.

Community control of scabies using MDA has been well established in island communities. What remains unclear is whether this would also be of benefit in highly mobile, mainland communities. Further data are needed to address this gap in knowledge. In addition, the threshold at which an MDA should be introduced for scabies control is also unclear. Comparison studies to determine the most effective agent for use in an MDA program are also required. Much of this work will be coordinated in the coming years by the WHO Neglected Tropical Diseases Department.

Further studies are required assessing control programs combining health promotion, education and hygiene practices added to standard treatment regimens to determine whether there is any difference between the provision of these comprehensive measures and simply additional applications of permethrin. High quality studies assessing treatment combined with comprehensive skin control measures such as health promotion, environmental interventions and screening, using control communities who do not receive the additional interventions, would be useful in determining the measurable benefit over standard treatment alone in sustaining a reduction in the population prevalence of scabies and impetigo.

High quality studies comparing pharmaceutical treatments of cases and contacts during outbreaks are required to determine the most effective therapy for routine use in endemic populations.

Further studies are required to determine whether there is a measurable benefit of good hygiene practices, improved water supply and improved housing in resource-limited settings in the management of classical scabies. Similarly, more studies are required before recommendations can be made about the effectiveness of washing clothing and bed linen, storage of items in plastic bags, exposure to sunlight and household spraying with insecticides as adjuncts in the control of cabies.

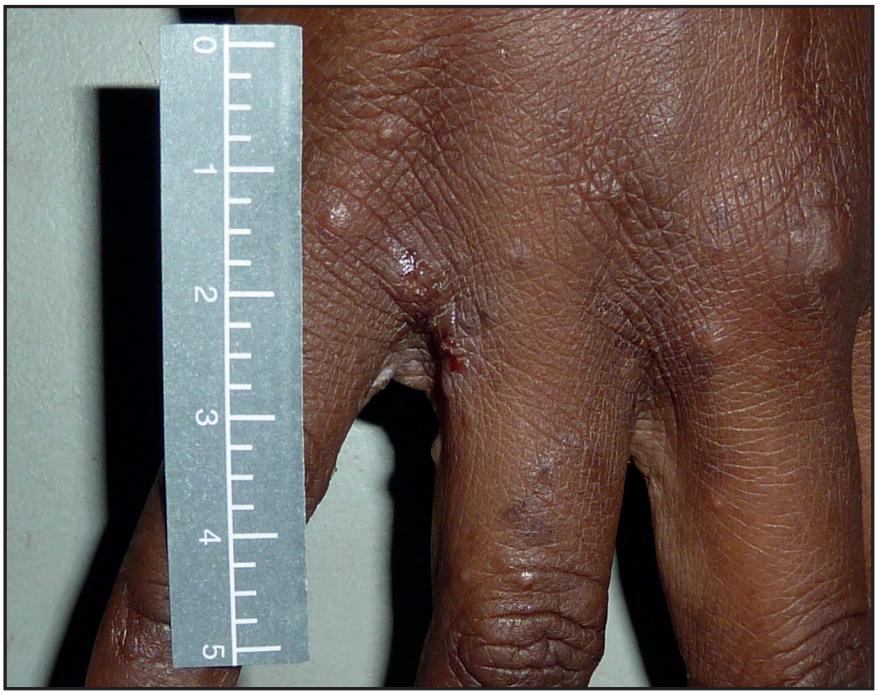


Figure 18. ***Papules between fingers of 1-2 mm are evidence of burrowing scabies mites that are very itchy.***

No studies were available to compare school exclusion approaches for scabies. Future studies assessing whether school exclusion is a useful strategy to reduce the burden of scabies in remote communities are needed. School exclusion for health reasons is a high priority, but must be balanced against the need for improved educational outcomes to Close the Gap. Currently, guidelines recommend excluding children with scabies until after treatment has commenced providing the scabies are also covered with a dressing. Without new evidence, we are unable to modify the current, consensus measures recommended by the NHMRC until new evidence directs otherwise.[65] Therefore, we recommend that children with scabies should be excluded from school until treatment has commenced.

We are not aware of any research in the use of Indigenous or traditional treatments for scabies in resource-limited settings. We recommend further research in this area should be encouraged to ensure that care and treatment of impetigo bridge Western and Indigenous values. Nevertheless, it is important to note that scabies is not documented as a problem for Australian Aboriginal communities prior to European colonisation and is likely to have been introduced only in more recent times. Therefore the 'bush medicines' of the traditional Aboriginal pharmacopoeia are unlikely to have covered scabies as a recognised illness.

7. Crusted scabies

Summary of recommendations

Identify		
✓	Crusted scabies is highly infectious and causes further scabies outbreaks in affected communities. Prompt treatment and control efforts are essential.	

Treat		
✓	Oral ivermectin with topical keratolytics and topical antiparasitics.	**GRADE 1B**
✓	Intensive supportive treatment is required for patients.	**GRADE 1B**
✓	Coordinated case management in the home may be of benefit.	**GRADE 2C**

Prevent	
✓	Keep individuals scabies free and in a scabies free environment to break the cycle of transmission.
✓	Comprehensive community skin control programs are likely to be of benefit to individuals with crusted scabies.

Identify

Diagnose crusted scabies clinically*
Grade according to 'One Disease' Severity Grade
Grade 1: follow algorithm; Grade 2 & 3 require hospitalisation

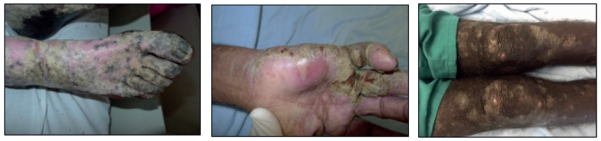
Call a doctor to discuss crusted scabies

Grade 1

Yes

No

Confirmed with skin scrapings?



Treat

Oral ivermectin, single dose repeated on day 1, 2 and 8 (see Table 6 for dosing)

PLUS topical antiparasitic** (permethrin or benzyl benzoate) every second day for the first week then twice per week until cure

PLUS keratolytics** (lactic acid or urea) on days when not using scabicide cream

May not be crusted scabies

Consider:

- severe scabies with secondary bacterial infection
- tinea
- psoriasis
- eczema
- dermatitis
- crusted school sores

Treatment success?

Yes

No

Medical consult required

Prevent

Household, community and environmental control measures

Oral Ivermectin **CAN NOT** be used in children under 5 years or when pregnant/breastfeeding

***If crusted scabies is present, consider and examine for evidence of impetigo.**

****Follow instructions from CARPA manual**

Overview

Crusted scabies is due to *Sarcoptes scabiei* var. *hominis*, the same mite that causes scabies. Crusted scabies occurs because the host's immune system cannot control the infestation, and the mites multiply rapidly. Scabies infestations are thought to involve only 5 to 15 scabies mites,[28,66] but people with crusted scabies are infested with thousands to millions of mites.[14,66] There is a spectrum of severity, from mild cases to severe hyperkeratotic (crusting) dermatosis involving the skin and nails.[66] In Central Australia, crusted scabies has been associated with human T-cell lymphotropic virus 1 (HTLV–1) infection[88] a virus which suppresses the immune system. However, most cases have no identifiable immunological defect.

The crusted scabies burden in remote Aboriginal communities of the Northern Territory, Australia has been estimated at 2.4 per 1000 people. The burden of crusted scabies in other remote regions of Australia is not known. Individuals with crusted scabies are extremely infectious as shed skin contains live mites that can infect other household or community members.[37,66] The social stigma associated with scabies, particularly crusted scabies, is significant. Affected individuals often do not present to health services because they are ashamed of the condition, fearful of being hospitalised and therefore must be approached with respect and sensitivity.[66,89]

Consequence of untreated crusted scabies infection

Individuals with crusted scabies have lower life expectancy, frequent hospitalisations and may develop secondary bacterial complications.

Household contacts of unmanaged crusted scabies have high risk of recurrent scabies, skin sores, poor sleep, disruption of school and work. GAS skin sores are associated with chronic heart and renal disease.

Crusted scabies is highly infectious and individuals with crusted scabies may act as core transmitters for further scabies outbreaks in affected communities. Effective management of individuals with crusted scabies is essential to the community-wide control of scabies.

Crusted scabies protocol

Identify
Scabies
Seek specialist help

Treat
Scabies
Oral ivermectin with topical keratolytics and antiparasitics

Prevent
Scabies
Environmental control/ home hygiene

Identify

Crusted scabies is often not itchy and the rash appears as scaling and crusting of skin, usually on the buttocks, elbows and arms,[90-92] and palms and soles of feet may be cracked (Figures 19-21). Cases can range from mild, with only a few patches of crusting, to severe infestation covering the entire body. Crusted scabies may be misdiagnosed as other conditions such as psoriasis or fungal infection.

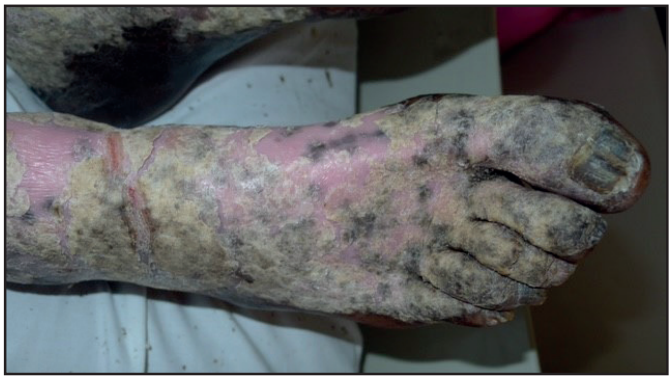


Figure 19. ***Depigmented skin with areas of thick crust as evidence of crusted scabies.***

Prompt and correct diagnoses of crusted scabies is important to save time and resources, and to prevent further outbreaks of scabies in the community. Crusted scabies is a clinical diagnosis (A), confirmed with laboratory testing (B).[93]

A: Clinical appearance

- Thickened, scaly skin patches, often not itchy compared to scabies.
- Often, but not always, on buttocks, hands, feet, elbows, armpits.
- Scale may have distinctive creamy colour.
- Tinea, psoriasis, eczema or dermatitis may look similar.

B: Skin scrapings to detect mites

- Positive results that confirm the presence of mites greatly increases the likelihood of crusted scabies. The absence of mites from skin scrapings does not rule out the possibility of crusted scabies as transport, delays or insufficient sampling may contribute to a false negative result.

In the NT, a positive skin scraping is required to meet the case definition of crusted scabies.
If crusted scabies is present, consider and examine for evidence of impetigo (see Chapter 5).

Severity grade of Crusted Scabies at Diagnosis [90]

Grade 1 may be managed in the community if appropriate supports are in place. Grade 2 and 3 need hospitalisation. Refer to Table 5 for further details.

Table 5. ***Crusted Scabies Grading Scale***

Category	Description	Score
A. Distribution & extent of crusting	Wrists, web spaces, feet only OR <10% total body surface area (TBSA)	1
	As above + forearms, lower legs, buttocks, trunk OR 10-30% TBSA	2
	As above + scalp OR >30% TBSA	3
B. Crusting/shedding	Mild crusting (<5mm deep); minimal skin shedding	1
	Moderate crusting (5-10mm deep); moderate skin shedding	2
	Severe crusting (>10mm deep); profuse skin shedding	3
C. Past episodes of crusted scabies	Never had it before	1
	1-3 prior hospitalisations OR depigmentation of elbows and/or knees	2
	≥4 prior hospitalisations OR depigmentation as above and/or legs/ back OR residual skin thickening or scaly skin	3
D. Skin condition	No cracking or pus	1
	Any of- multiple pustules, weeping sores, superficial skin cracking	2
	Deep skin cracking with bleeding, widespread pus	3

Grade 1 = 4-6	Grade 2 = 7-9	Grade 3 = 10-12		Total	

Treat

Treatment for crusted scabies

Oral ivermectin (Table 6 for dosing) with topical keratolytics and topicalantiparasitics. .

Level of Evidence GRADE 1B

Intensive supportive treatment is required for patients with crusted scabies.

Level of Evidence GRADE 1B

Coordinated case management in the home may be of benefit.

Level of Evidence GRADE 2C

Table 6. ***Weight band dosing for oral ivermectin* (200mcg/kg)***

Weight band	Dose 1 tablet contains 3 mg of ivermectin
15 – <25 kg	**1 tablet** (3 mg)
25 – <35 kg	**2 tablets** (6 mg)
35 – <55 kg	**3 tablets** (9 mg)
55 – <65 kg	**4 tablets** (12 mg)
65 – 80 kg	**5 tablets** (15 mg)
≥80 kg	**6 tablets** (18 mg) or **200 mcg/kg** (rounded up to the nearest 3 mg)

*Oral ivermectin cannot be used in children less than 5 years of age or under 15 kg, and in pregnant or breastfeeding women.

Treatment regimen [94]

The described treatment regimen has been developed over many years by clinicians in the NT. [91,95] This has been the basis for the One Disease Crusted Scabies treatment guidelines summarised below.

1. Once diagnosed with crusted scabies, daily reviews are recommended. Give single dose of oral ivermectin (Table 6) with food or milk on days 1, 2 and 8 (Grade 1). See Chapter 6 for contraindications for ivermectin. Longer treatment is needed for Grade 2 and 3, but this is done in a hospital.

2. Apply Benzyl benzoate 25% lotion every second day after bathing for 1 week, then 2-3 times every week until cured. Apply head to toe as per Box 1. Wash off after 24 hours. Permethrin can be used if benzyl benzoate is not available or if skin irritation occurs. Do not use benzyl benzoate on infants less than 6 months, and dilute if under 12 years old or there is skin irritation.

3. Apply Calmurid (10% urea, 5% lactic acid in moisturising cream) after bathing on alternate days to benzyl benzoate/permethrin application and only to areas of crusted or thickened skin. Calmurid will soften the skin crusts and help the benzyl benzoate or permethrin cream penetrate the skin better. Soaking or scrubbing crusts with a sponge the next day and before applying benzyl benzoate will also help the cream penetrate the skin better.

4. Clothes, bed sheets and towels should be washed in hot water daily and dried in the sun. If a washing machine is not available, leave clothes, linen and bedding in a sealed plastic bag to kill any mites. Vacuum the floors and furniture in the house, and the floors and seats in cars, to remove mites or skin flakes.

5. Household contacts should be treated for scabies and regularly checked for scabies infections as part of a comprehensive approach to keeping the person with crusted scabies free of future infections.

Discussion

Improvements in the management of crusted scabies over two decades in the NT have resulted in a combined focus of initial guideline-directed management in hospital,[73,96] followed by coordinated case management and family support once discharged to community and home.[89] This coordinated approach to crusted scabies in the NT is underpinned by crusted scabies now being a notifiable disease and the non-profit organisation One Disease implementing coordinated chronic care management in the home community.

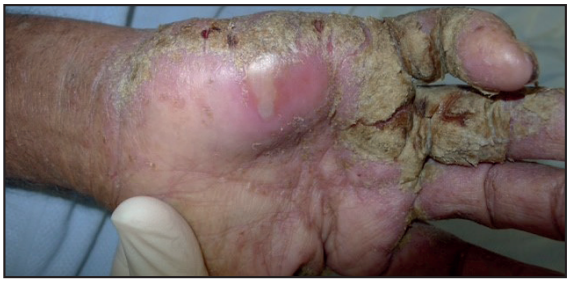


Figure 20. ***Thickened skin, crusting and scaling off with underlying pus due to a secondary bacterial infection.***

There is evidence of moderate quality to support the use of oral ivermectin with topical keratolytics and topical antiparasitics for crusted scabies (GRADE 1B).[91,95] Further trials in resource-limited populations would be beneficial to explore more effective treatments.

Patients with crusted scabies in resource-limited settings require intensive supportive treatment (moderate quality evidence - GRADE 1B).[91,95]

Coordinated case management in the home may be of benefit (low quality evidence - GRADE 2C).[89]

Prevent

Models of care

Community-based support for individuals with crusted scabies remaining in their homes has been effective in the NT using a chronic disease model of care.[89] However, there is currently not enough evidence to recommend any one preventive measure for crusted scabies control in other resource-limited settings.

Environmental control

Environmental measures are recommended to decontaminate the environment, where the heavy infestation of scabies mites can survive for several days in the absence of the human host, including the washing of clothing and bed linen.[66] In addition, household spraying or fogging with insecticides has been recommended by expert consensus in some clinical guidelines to prevent transmission via fomites.[93,96]

Crusted scabies control programs

The high transmissibility of crusted scabies from an index case[37] has implications for scabies control in communities where individuals with crusted scabies reside;[37,89] hence, a review of the evidence for effective and socially acceptable methods of crusted scabies management and control is needed.

The East Arnhem Scabies Control Program (EASCP) led by One Disease (www.onedisease.org) began in early 2011 to reduce the burden of crusted scabies, improve the quality of life of those affected, and to develop a broader strategy for scabies control.[89] This scabies-focused program was built on the NT Department of Health and Menzies School of Health Research East Arnhem Healthy Skin Program of the prior decade. The scabies program was trialled in three communities with seven patients and their sentinel household contact (a child living with the patients). The preventive care regimen included regular (1-4 weekly) skin checks to look for recurrent crusted scabies, frequent use of keratolytic cream combined with a moisturiser to prevent the build-up of keratin crusts where the mites proliferate, and regular (2-4 weekly) use of benzyl benzoate scabicide cream. Benzyl benzoate was chosen because of the reduced risk of resistance developing to this agent. The protocol was implemented through a long-term household case management approach, focusing on self-management. Patients identified as having crusted scabies were followed for up to 3 years of the preventive care regimen, and the rate of presentations

and hospitalisations over that time was compared (using medical records) to the same time frame before the program. There was a 44% reduction in episodes of recurrent crusted scabies (p=0.025) in the seven cases enrolled, and an 80% reduction (p=0.09) in the number of days spent in hospital (reduced from 175 to 35 days). There was an associated 75% reduction in scabies-related presentations (p=0.017) in the sentinel household contacts.[89] This chronic disease model of care has now been adopted more broadly in the NT by One Disease and further evaluations are anticipated.

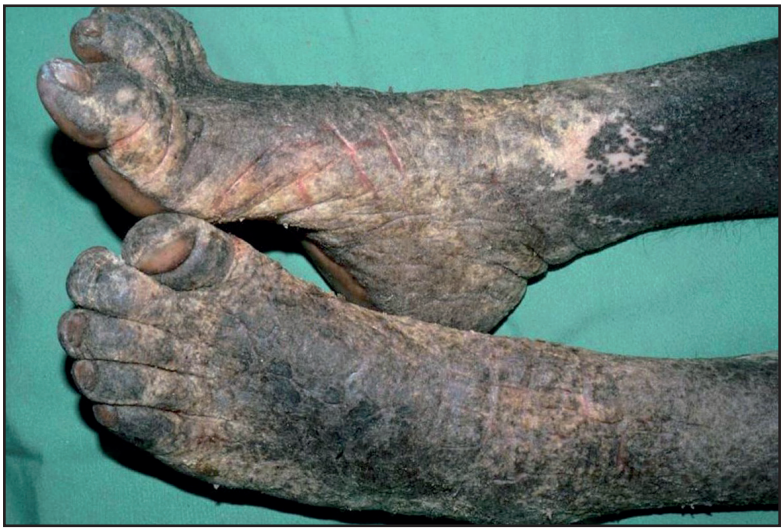


Figure 21. ***Areas of thick crust and depigmentation are visible, affecting both feet. This is consistent with crusted scabies, especially if the crusts are flaking off.***

Current research underway

An efficacy study between two different dosages of an antiparasitic in patients with crusted scabies (GALECRUSTED, NCT02841215) is being planned in France. Ivermectin is a recommended treatment in common forms of scabies and represents a promising treatment in crusted scabies. However, response to ivermectin remains variable between studies, and there is no consensus on dosages and method of administration (oral or topical). Ivermectin at 400 µg/kg has been used without signs of toxicity in treatment of head lice. Investigators propose to demonstrate that 400µg/kg ivermectin will be more effective than 200µg/kg in patients with severe forms of scabies (crusted and profuse).

Unanswered questions for future research

Crusted scabies was included on the Notifiable Disease Register in the NT from 1 January, 2016[97] facilitating a robust description of the burden of crusted scabies. The need to adopt this approach in other jurisdictions remains to be determined. Epidemiological surveillance for crusted scabies is required before any recommendation can be made as the prevalence of this condition elsewhere in Australia is poorly understood.

Whether case management of crusted scabies will reduce the overall burden of scabies in remote communities with high scabies prevalence is unknown. Research studies underway such as the SToP trial in the Kimberley, WA are attempting to answer this question. Identification, treatment and prevention of crusted scabies may also lead to reduction in all skin infections.

Discussions have commenced on the possibility of a Northern Australia MDA to break the ongoing cycles of transmission of scabies. The high mobility of people in mainland communities in Australia may be a limitation of this approach. As such, the success of such a strategy will depend on extensive planning and coordination so that the previously recognised problem of scabies re-introduction from neighbouring communities not undertaking MDA can be avoided.

8. Fungal infections (Tinea)

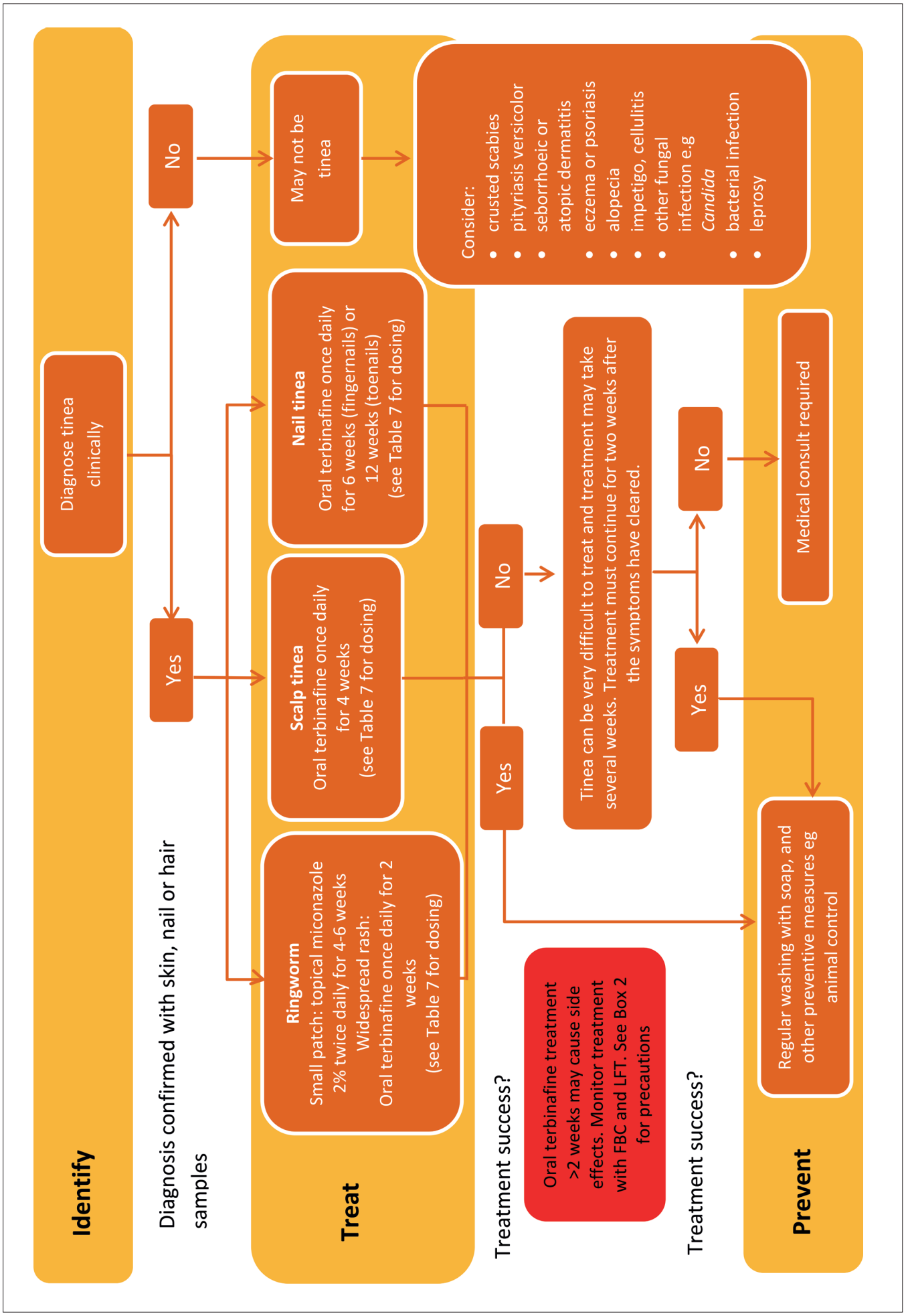
Summary of recommendations

Identify	
✓	Fungal infections should be recognised and treated as a priority.

Treat		
All Tinea ✓	Fungal infections should be recognised and treated as a priority.	**GRADE 2C**
Ringworm ✓	Topical miconazole 2% for small patches OR Oral terbinafine* or fluconazole for widespread tinea.	**GRADE 2C** **GRADE 2C**
Scalp ringworm ✓	Oral terbinafine* is most commonly used. Oral griseofulvin or oral fluconazole, if available, are also appropriate. Antifungal shampoo eg ketoconazole in conjunction with oral treatment may limit the spread of scalp ringworm.	**GRADE 1B** **GRADE 2D**
Nail Tinea ✓	Oral terbinafine.*	**GRADE 1A**
✗	Combinations of topical therapy and oral therapy for nail tinea are NOT recommended.	**GRADE 1B**
✗	Surgical avulsion prior to treatment of nail tinea is NOT recommended.	**GRADE 2D**

*See Table 7 for dose schedule

Prevent		
All Tinea ✓	Soap is recommended as an adjunct to treatment of general skin infections and as a preventive measure against tinea.	**GRADE 1C**
✓	Comprehensive community skin control programs are likely to be of benefit to individuals with crusted scabies.	


Identify
Diagnose tinea clinically
Diagnosis confirmed with skin, nail or hair samples
Yes
No
Treat
Ringworm
Small patch: topical miconazole 2% twice daily for 4-6 weeks
Widespread rash:
Oral terbinafine once daily for 2 weeks
(see Table 7 for dosing)
Scalp tinea
Oral terbinafine once daily for 4 weeks
(see Table 7 for dosing)
Nail tinea
Oral terbinafine once daily for 6 weeks (fingernails) or 12 weeks (toenails)
(see Table 7 for dosing)
May not be tinea
Consider:
crusted scabies
pityriasis versicolor
seborrhoeic or atopic dermatitis
eczema or psoriasis
alopecia
impetigo, cellulitis
other fungal infection e.g *Candida*
bacterial infection
leprosy
Treatment success?
Yes
No
Oral terbinafine treatment >2 weeks may cause side effects. Monitor treatment with FBC and LFT. See Box 2 for precautions
Tinea can be very difficult to treat and treatment may take several weeks. Treatment must continue for two weeks after the symptoms have cleared.
Treatment success?
Yes
No
Medical consult required
Prevent
Regular washing with soap, and other preventive measures eg animal control

Overview

Fungal infections of the skin are known as tinea. Infections are classified according to the site of the human body affected.[98] Tinea can involve the body (tinea corporis, ringworm), feet (tinea pedis, athlete's foot), scalp (tinea capitis, kerion), groin folds (tinea cruris, jock itch) or nails (tinea unguium, onychomycosis). Tinea is caused by infection with dermatophytes of the genera *Epidermophyton, Microsporum* and *Trichophyton*.[13,99] Tinea versicolor (white hanky) is caused by an overgrowth of yeast on the skin. Dermatophytes can be anthropophilic (person-to person spread), zoophilic (spread from animals such as cats, dogs and cattle to humans) or geophilic (spread from the environment to humans). The extensive tinea corporis commonly seen in remote northern Australian Aboriginal communities is predominantly caused by the anthropophilic dermatophyte *Trichophyton rubrum*.[100,101] As such, even with successful individual treatment, re-infection from untreated contacts and family members is very common.

Tinea is common in hot, wet climates. Between 10 and 20% of the world's population are affected by fungal skin infections.[13] Estimates of the disease burden have generally focused on the prevalence of the organisms causing tinea, rather than the clinical disease.[102,103] However, the World Health Organization has estimated that 7–33 % of children in resource-limited countries are affected by scalp tinea,[104] and 11% are affected by nail tinea.[105]

Tinea is highly contagious, and if one person in a household is infected, it is likely that other household members will also be infected. Tinea is usually spread between humans by direct contact, from floors/ bathrooms, or sharing contaminated objects (e.g. combs, shoes, clothing, beds). Some species are present in dogs or cats and can transfer to humans, but this is not the most common source of infection. Infections often last a long time and are difficult to cure.

Consequence of untreated tinea

All forms of tinea can cause discomfort and itch. Breaks in the skin as a result of scratching and lesions themselves may become secondarily infected with GAS and *S. aureus*. Treatment of fungal infections should be a high priority, including to prevent secondary infections with *S. aureus* and GAS.

Tinea protocol

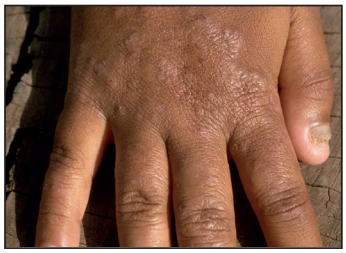
Identify
Tinea

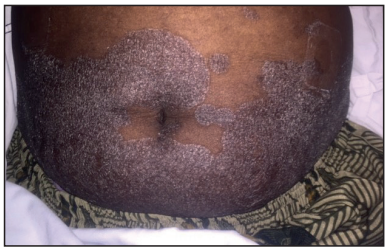
Treat
Tinea
Topical or oral antifungals

Prevent
Tinea
Early treatment of small lesions, washing hands with soap

Identify

Ringworm (Tinea corporis) starts as an itchy, scaly patch on the body, that spreads outwards with a clear patch at the centre, forming ring-shaped lesions (Figure 22). Multiple small patches can spread to join and form a single large patch. Sometimes the skin is darker and tougher than the skin around it, except on the face, where the skin may be paler.





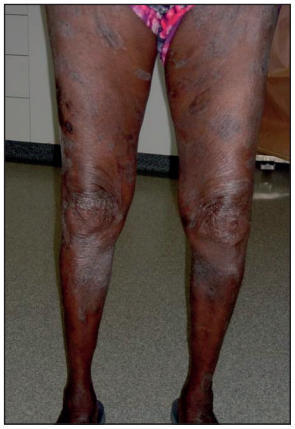


Figure 22. ***These images show the scale and irregular edge of tinea corporis.***

Scalp tinea (Tinea capitis) usually presents as hair loss, but other presentations include:

- grey patches - where the hair has broken off close to the scalp leaving patches of scaling scalp
- black dot - where the hair follicles appear as swollen black dots, spread all over the scalp, rather than in one section
- kerion - wet, infected, boggy, painful patches with lots of pus (fungal abscess)
- favus - patches of redness and scaling covered by a yellow crust, sometimes accompanied by an unpleasant odour. Favus is usually seen after many years of chronic infection.

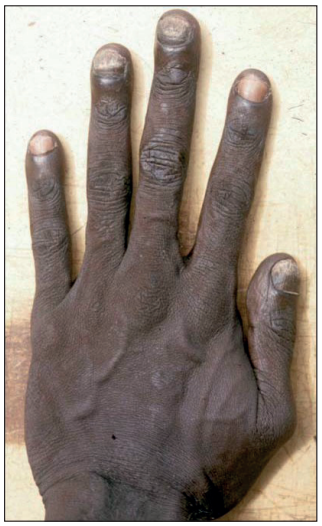


Figure 23. ***Thickened, irregularly shaped nails due to fungal infection of the nail bed.***

Nail tinea (Tinea unguium) presents as white or yellow discolouration, thickening and an uneven surface of the nail. There may also be chalky, flaky debris between the nail and the nail bed (Figure 23).

White hanky (Tinea versicolor) appears as pale patches on dark skin, most often on the upper trunk, including shoulders and back, chest, upper arms, neck and occasionally the face (Figure 24). White hankyspot is not contagious or itchy, but patients may want treatment to improve the appearance. White hankyspot is not discussed further in this guideline.

Diagnosis of tinea is generally made based on appearance of the skin, but if there is any uncertainty about the cause, the infection is not responding to treatment, or has increased in severity, skin scrapings or hair follicles (for scalp tinea) may be useful to confirm diagnosis and treatment.

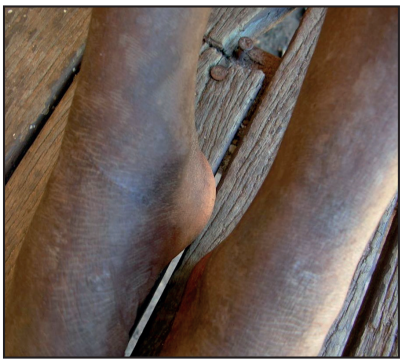


Figure 24. ***Smooth, round edges to the depigmented lesions of tinea versicolor.***

Treat

All tinea

Daily soap use may be beneficial in the treatment of all tinea in combination with oral or topical antifungal treatment.

Level of Evidence GRADE 2C

Ringworm

For small patches

Topical miconazole is recommended over other agents. 2% miconazole is applied twice daily for 4 to 6 weeks including 2 weeks after the rash has completely disappeared.

Level of Evidence GRADE 2C

For widespread rash

Oral terbinafine,* once daily for 2 weeks.

Level of Evidence GRADE 2C

Tinea of the scalp

Oral terbinafine* once daily for 4 weeks.

Oral griseofulvin or oral fluconazole, if available, are also appropriate.

Level of Evidence GRADE 1B

Antifungal shampoo e.g. ketoconazole in conjunction with oral treatment may limit the spread of scalp ringworm.

Level of Evidence GRADE 2D

Level of Evidence GRADE 1B

Nail tinea

Oral terbinafine* once daily for 4-6 weeks (fingernails) or 12 weeks (toenails).

Level of evidence GRADE 1A

Not recommended

Combinations of topical therapy and oral therapy for nail tinea.

Level of evidence GRADE 1B

Surgical avulsion prior to treatment of nail tinea.

Level of evidence GRADE 2D

* See Table 7 for dose schedule and Box 2 for precautions with oral terbinafine.

Table 7. ***Oral terbinafine weight band dosing***

Weight band	Dose 1 tablet contains 250 mg of terbinafine
10 – < 20 kg	**¼ tablet** (62.5 mg)
20 – < 40 kg	**½ tablet** (125 mg)
≥ 41 kg	**1 tablet** (250 mg)

*If possible, wait until after pregnancy and breastfeeding before treating.

Box 2. ***Precautions for oral terbinafine***

- Serious side effects can develop after 4 weeks of treatment including skin rashes, raised liver transaminases and neutropenia. Treatment lasting for more than 2 weeks needs medical supervision and blood testing.
- In a person with acute or chronic liver disease, kidney disease, aged >40 years, or drinks too much alcohol — check LFT and FBC before treatment
  - If LFTs abnormal — retest after 2 weeks of treatment
  - If LFTs get worse — consider giving half the usual dose
  - Retest LFTs and FBC again after another 2 weeks
- If adult with no risk factors — check LFT and FBC after 2 weeks then every 4 weeks of treatment.
- If child on treatment > 6 weeks — check LFT and FBC at 4 weeks.
- If symptoms of low white cell count or liver toxicity (e.g. fever, nausea, jaundice, abdominal pain, sore throat) — **Cease medication** and check LFTs and FBC.
- Wait until after pregnancy and breastfeeding before treating, if possible.

Discussion

Daily soap use may be of benefit in the treatment of all tinea.[106] Due to low quality evidence this is recommended in combination with oral or topical antifungal treatment (GRADE 2C). There is no evidence to support any added benefit of antibacterial soap over normal soap.

There is low to moderate quality evidence supporting the use of miconazole, clotrimazole or terbinafine topically over other agents to treat ringworm (GRADE 2C).[107-110] Oral alternatives for ringworm are oral terbinafine or fluconazole (GRADE 2C).[111,112]

Scalp tinea is difficult to treat, takes several month and mycological cure is challenging. There is moderate quality evidence that oral terbinafine, oral griseofulvin and oral fluconazole have similar efficacy in resource-limited settings, so first line treatment should be the agent that is most affordable and available (GRADE 1B).[113] To streamline treatment regimens in remote communities, terbinafine has been recommended for scalp tinea. Topical antifungal shampoos e.g. ketoconazole may limit the spread of tinea capitis (GRADE 2D).

Nail tinea should be treated with oral terbinafine (moderate to high quality evidence GRADE 1A).[114,115] There is no added benefit to the use of combinations of topical therapy and oral therapy for nail tinea (GRADE 1B).[115] Surgical avulsion prior to treatment of nail tinea is not recommended (GRADE 2D).[116]

Complimentary/alternative therapy

There are no robust studies of complimentary therapy for tinea.

Prevent

Mass drug administration

There is no evidence currently available to support the use of MDA for the reduction in prevalence of ringworm, scalp tinea or nail tinea.

Communicable disease prevention and control

There is no available evidence applicable to resource-limited settings to inform disease prevention and control activities for fungal infections in endemic populations.

Hygiene practices

Soap is recommended as an adjunct to treatment of general skin infections and as a preventive measure (GRADE 1C). High quality studies are required before alternative formulations of soap can be recommended above normal soap.

Water provision

There were no included studies assessing the effect of increased water supply or swimming pools on fungal infections on which to base relevant recommendations for resource-limited settings. High-quality water supplies are essential to good health and access to this is a human right.

Housing programs

There were no included studies assessing the effect of housing improvement programs on fungal infections on which to base relevant recommendations for resource-limited settings.

Discussion

Although there were a large number of studies for tinea, there were no studies identified that addressed prevention of fungal infection. Fungal infections had by far the highest number of clinical studies available to guide practice, however no studies addressed prevention. This is a research gap that should be addressed.

Current research underway

There are many clinical trials currently recruiting to improve the treatment of tinea (www.clinicaltrials.gov). The majority (13/20) relate to improved treatment of nail tinea, one related to improved diagnosis of tinea capitis and two related to treatment of tinea pedis. There were nine trials registered that are not yet recruiting, seven for treatment of nail tinea, one for tinea pedis and one for general tinea. Most of these studies are not in resource-limited settings but the results may help to inform future studies.

Unanswered questions for future research

The overwhelming majority of studies assessing the efficacy of antifungal treatments for fungal skin infections were conducted in hospital settings in middle income countries, rather than remote Aboriginal communities or community settings in resource-limited countries. For example, the recommendations for treatment of scalp tinea are mostly based on studies assessing the effectiveness of topical treatments conducted in dermatology outpatient departments in Iran and India.[107-110] Whether these finding can be applied in resource-limited settings in other population groups remains unclear. Studies assessing the effectiveness of topical treatments in a range of resource-limited populations would be of benefit to make recommendations applicable to real life and uncontrolled settings.

Additional studies of antifungal treatments for ringworm conducted in community settings would be beneficial in assessing the effectiveness of treatment at the population level in resource-limited settings. High quality studies assessing photodynamic therapy (PDT) regimens for nail tinea are also required to determine whether this therapy will be useful in resource-limited settings.

No studies were available to compare school exclusion approaches for tinea. Future studies assessing whether school exclusion is a useful strategy to reduce the burden of tinea in remote communities are needed. School exclusion for health reasons is a high priority, but must be balanced against the need for improved educational outcomes to Close the Gap. Currently, guidelines recommend excluding children with tinea until the day after treatment has commenced. Without new evidence, we are unable to modify the current, consensus measures recommended by the NHMRC until new evidence directs otherwise.[65] Therefore, we recommend that children with tinea should be excluded from school until treatment has commenced.

9. Social determinants of health and primordial prevention of skin infections

Skin infections are prevalent in Australian Aboriginal communities, the consequences of social disruption, socioeconomic disadvantage, systemic discrimination and consequent poverty. Improvements in overall socioeconomic and environmental conditions are likely to result in declines in skin infections. Until this occurs, strategies to prevent skin infections are important and fall into one of four categories: primordial, primary, secondary or tertiary. Primordial (focusing on environmental health) and primary prevention are the most developed strategies for management of impetigo, scabies, crusted scabies and tinea.

Primordial prevention strategies are the social, economic and environmental initiatives that can be undertaken to reduce the risk of skin infection and are priorities. Strategies to improve living conditions through health hardware maintenance, community based environmental health activities and housing programs are examples that have been recommended to reduce the transmission of scabies or GAS skin infections. Improvements in nutrition and food security, equal access to high quality primary health care and health infrastructure, culturally relevant employment and education opportunities, and improvements in community infrastructure including housing, transport, sanitation and high-quality water supply are all needed. These socio-economic and structural issues are even more problematic in remote communities, and require urgent improvements to support good health for Aboriginal people. The evidence basis for primordial prevention activities is limited, due to a lack of high-quality research to answer these questions.

Primary prevention strategies aim to find the skin infections and treat these in a timely manner. Correct recognition of skin infections in children and adults who present for health care and prescription of the appropriate treatment are part of primary prevention. In addition, school surveillance and treatment programs or community-wide skin control programs can also add benefit when skin infections are common and recurrent. Primary prevention strategies are applied to a whole population or those at increased risk. Treatment of impetigo and scabies is also a key component in the primary prevention of acute post-streptococcal glomerulonephritis or acute rheumatic fever.

Secondary and tertiary prevention aims to limit the progression and reduce the severity of the disease through early recognition of complications and improved treatment. Secondary prevention strategies are in response to an initial infection and aim to prevent more serious sequelae from occurring. For example, following the initial treatment of crusted scabies, secondary prevention strategies aim to keep the patient scabies free and living in a scabies free environment.

Preventing the morbidity and mortality that arise from bacterial infections with the skin as an entry point, e.g. skeletal infections, sepsis and severe soft tissue infections are an example of tertiary prevention.

Environmental health

The environment in which people live has an impact on their health e.g. air and water quality, waste disposal and maintenance of sewerage infrastructure. For Aboriginal people living in remote communities, there is a constant struggle to maintain the basic standards of environmental health enjoyed in the rest of Australia. The distance from regional towns means that access to service providers and tradespeople is restricted, and fixing problems with power, water or sewerage can be slow and expensive.

State and Territory governments established Aboriginal Environmental Health units in recognition of the importance of maintaining a healthy environment in closing the health gap between Aboriginal and non-Aboriginal people. Aboriginal Environmental Health units support local communities in a range of activities such as:

- suitable water and power supply
- dust control
- pest and mosquito control
- waste management
- food safety
- infection control
- dog health
- community education
- monitoring & reporting of environmental health issues

These programs are important in skin infection control because they remove some of the risk factors associated with skin infections. For example, an adequate, safe, well maintained water supply means that hygiene activities such as washing hands, showering and washing clothes can be sustained and avoids the dry, cracked skin that can occur when water quality is low; removing hard waste (cars, household rubbish) reduces mosquitoes and other insect bites that cause breaks in the skin where bacteria can enter; controlling the dog population may help reduce transmission of fungal diseases and minor trauma to people.

Environmental control of skin infection

During the systematic review, we looked for studies that trialled environmental interventions to reduce the risk of skin infection in resource-limited settings. Despite rigorous searching, there were no high-quality papers that addressed this question. This is a significant research gap into what environmental interventions may be most useful in the control of skin infections. Most of the studies incorporated pragmatic, practical activities designed to prevent skin infection (and in particular scabies) through regular washing of clothes/bedlinen or storing these items in plastic bags or exposing them directly to the sun when access to washing machines was a problem.[18,75,79-81,84,117-122] Only one study included household spraying[123] as a co-intervention. Since none of these co-interventions were tested in isolation or against a control group, we cannot make a strong recommendation for or against any of these interventions at this time. Despite the paucity of evidence, we recognise that these are practical, pragmatic and often used strategies in the prevention of skin infections.

Treatment combined with comprehensive skin control measures such as health promotion, environmental interventions and screening are likely to add benefit to conventional clinical treatment regimens in sustaining a reduction in the population prevalence of scabies and impetigo (GRADE 2C),[34] however, high quality studies using control communities who do not receive the additional interventions would be advantageous in determining the measurable benefit over standard treatment alone.

Close living and household overcrowding

Housing improvement programs may assist in the prevention and control of skin infections in resource-limited populations (GRADE 2C).[124,125]

Bailie *et al.*[125] conducted an evaluation of a housing intervention in ten remote Australian Aboriginal communities in the Northern Territory. Outcomes included 'skin infections' without scabies and 'skin infections' with scabies. The intervention included construction of new houses according to specific environmental standards and recommendations for demolition of houses deemed uninhabitable. Prevalence of skin infections, other common childhood conditions and risk factors were calculated at 10 months follow up. While there was a strong association between improvement in household infrastructure and improvements in hygienic conditions of the houses, the prevalence of skin infection increased over the study period from 20% at the beginning to 25% at 10-month follow up, suggesting no effect. No significant reductions in household crowding were reported. This large and important study, had significant

methodological flaws resulting in a low-quality study that it is difficult to make firm recommendations from. The study interval of only 10 months may have been too short to observe health improvement. It is likely that any benefit from improved living conditions on reducing the rate of skin infections would require a sustained effort over a longer timeframe.

A New South Wales government report from rural Aboriginal communities described a housing improvement program run from 1997 to 2008 using a 'before and after' design with a control group. The intervention group received household improvement based on health and safety priorities in a 'survey and fix methodology' compared with no housing intervention. The program also included training of Aboriginal staff members to increase capacity in the communities.[124] Reporting of the results of this low-quality study used hospital data for skin infection presentations. The effect size was not reported. Similar programs are difficult to recommend based on this study as it is not clear how much reduction in skin infections was achieved.

In 2014, a healthy skin initiative in an Aboriginal community in the Kimberley was implemented in response to an outbreak of APSGN. The initiative was designed to reduce factors in the community that placed children at risk of APSGN - specifically scabies and skin infections. The community in which the study was conducted was one of 106 sites in the Kimberly identified as having 'inadequate home design and equipment for healthy living' in a 2008 survey.[126] The environmental health component included improving health hardware and addressing other plumbing problems in homes, improving water and sewage drainage outside the homes and dog health. The children were assessed and treated at each visit for skin infections and a comprehensive health promotion campaign aimed to increase awareness of the link between skin infections and other diseases. Analysis of the data before and after the initiative revealed a significant reduction in scabies (9.5% to 2.2% $p<0.0001$), as well as a reduction in APSGN cases.[126] The authors speculated that the overall incidence of skin infections may have shown a greater reduction after the initiative but the generally poor reporting of skin disease prior to the initiative meant that the 'before' data under-represented the true prevalence of skin infections in this community.

Current research underway

The SToP trial in the Kimberley will commence in 2018 (ANZCTN12618000520235). This cluster randomised, stepped-wedge clinical trial to see, treat and prevent skin infections will provide controlled data on the impact of environmental health activities on the overall outcome. The data will also include information about the costs of providing these activities, which will help to inform the economic evaluation.

Unanswered questions for future research

There is limited evidence to inform environmental interventions for skin infection control. Although sound attempts have been made by researchers and governments in evaluating the effect of housing on the control of endemic skin infections through observational studies,[124-126] there is not enough evidence to guide recommendations on small scale environmental interventions for individual conditions due to a lack of comparative studies. For example, there were no studies that compared the effect on scabies or crusted scabies of household spraying against the scabies mite versus no intervention, or the effect of hot washing of clothing compared to not washing clothing in the control of impetigo, scabies or fungal infections. Although environmental measures are unlikely to cause harm in combination with the treatments we recommend for specific conditions described above, research to determine any demonstrable or measurable benefit of individual and combined interventions would be beneficial for environmental health teams tasked with managing scabies outbreaks, clinicians managing skin infections or governments and communities intending to include environmental policy recommendations in comprehensive skin health programs in endemic areas.

Research regarding environmental interventions for public health prevention and control of skin infections is urgently needed. Comprehensive skin health programs implemented without the support of government policies and community empowerment to improve equity in the social determinants of health are unlikely to achieve sustained improvements in skin health.

10. Appendix

Appendix A: Other skin resources

The following resources have been used in the development of this National Guideline:

Recognising and treating skin conditions 2nd edition, 2009 https://www.menzies.edu.au/page/Resources/Recognising_and_treating_skin_conditions/

Skin Infection protocol (KAMSC and WACHS) [http://kamsc.org.au/wp-content/uploads/2015/04/oth-Skin-Infections.pdf]

CARPA Remote Primary Health Care Manuals - *Standard Treatment Manual* [link https://www.crh.org.au/remote-phc-manuals-overview]

*Managing Crusted Scabies in Aboriginal Communities (*2017 Ed), One Disease [http://onedisease.org/]

Managing Households with Recurrent Scabies (2017 Ed), One Disease [http://onedisease.org/]

Healthy Skin Program: Guidelines for Community Control of scabies, skin sores, tinea and crusted scabies in the Northern Territory. [http://digitallibrary.health.nt.gov.au/prodjspui/handle/10137/698]

Therapeutic Guidelines: Antibiotic [https://tgldcdp.tg.org.au/index]

International Foundation for Dermatology Protocols [http://www.ifd.org/protocols]

Appendix B: Literature review process

The National Healthy Skin Guideline is underpinned by a systematic review conducted in line with the Preferred Reporting items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[127]The methods and search strategies for the systematic review have been described previously.[24] Refer to Figure 25 for the number of studies included and appraised.

Databases and websites searched:

- PubMed
- Excerpta Medica dataBASE (EMBASE)
- Global Health
- Australian Institute of Health and Welfare (AIHW)
- Australian Indigenous HealthInfoNet
- Informit
- Oalster
- World Health Organization (WHO)
- Australian New Zealand Clinical Trials Registry (ANZCTR)
- ClinicalTrials.gov
- WHO International Clinical Trials Registry

Search Terms

- impetigo or skin sores or pyoderma
- scabies
- crusted scabies or Norwegian scabies
- tinea capitis
- tinea corporis
- tinea unguium (onychomycosis)
- dermatophyte or ring worm
- treatment or anti-infectives or antibiotic or complementary medicine
- public health practice or preventative health service or communicable disease control
- health promotion or health education or preventative education or wellness program or health campaign

Limits

- Date range 1960 – 'current' (30 April 2016)
- Articles in English
- Studies with humans of any age or sex

Figure

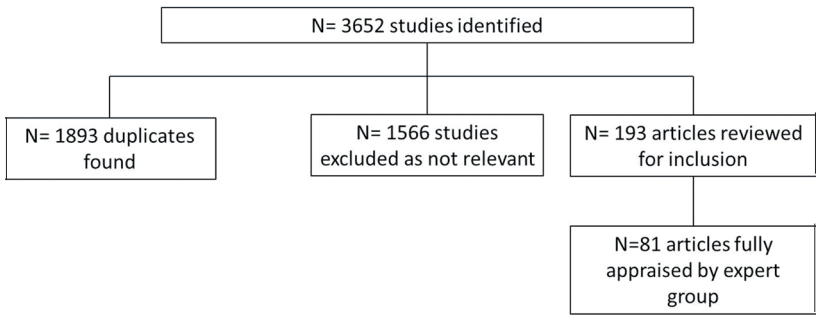


*Figure 25: **Structure of literature review***

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Notes

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