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REVIEW ARTICLE
Retrospective analysis of institutional scabies outbreaks from 1984 to 2013: lessons learned and moving forward

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SUMMARY

Scabies outbreaks can be disruptive in institutional settings, and are associated with considerable but under-researched morbidity, especially in vulnerable populations. In this paper, we describe key findings from a retrospective review of scabies outbreaks reported in the literature over the past 30 years. We undertook this review to gain insights into the impact of institutional outbreaks, the burden in terms of attack rates, economic costs, treatment trends, the types of index cases and outbreak progression. We found 84 reports over 30 years, with outbreaks most frequently reported in aged care facilities ($n = 40$) and hospitals ($n = 33$). On average, scabies outbreaks persisted for 3 months, and the median attack rate was 38%. While 1% lindane was once the most commonly employed acaricide, 5% permethrin and oral ivermectin are increasingly used. Crusted scabies represented the index case for 83% of outbreaks, and scabies was misdiagnosed in 43% outbreaks. The frequency of reported scabies outbreaks has not declined consistently over time suggesting the disease is still highly problematic. We contend that more research and practice emphasis must be paid to improve diagnostic methods, surveillance and control, health staff education and management of crusted scabies to prevent the development of scabies outbreaks in institutional settings.

Key words: Outbreaks, parasitic disease epidemiology and control, scabies.

INTRODUCTION

Scabies is a skin infestation by the mite *Sarcoptes scabiei*. The burrowing of mites into the stratum corneum of the skin causes inflammatory and allergic reactions, resulting in intense itching and papular rashes. As scabies is transmitted by close personal contact, institutional settings such as aged care facilities, hospitals, prisons, and childcare centres are at higher risk for outbreaks [1]. While the disease is readily treatable with topical or oral acaricides [2], the diagnosis and control of scabies in institutional settings can be notoriously difficult. Contributing factors include insufficient knowledge of the disease, prolonged incubation period, and the difficulty in assessing treatment efficacy due to the persistence of 'post-scabies itch' after treatment [3]. Management of scabies outbreaks is further complicated by the occurrence of crusted scabies, associated with the extreme proliferation of mites and the formation of hyperkeratotic skin crusts. These patients can be extremely contagious and thus commonly represent the index case in scabies outbreaks. While crusted scabies is generally rare, this clinical manifestation occurs more frequently in certain vulnerable groups, including geriatric populations,

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presumably due to immune-related decline. Other noted risk factors for crusted scabies include dementia, HIV or other immunosuppression, or iatrogenic corticosteroid use (reviewed in [4]).

Recent studies have revealed that scabies can have significant impact on quality of life [5, 6]. Itching can be intense enough to cause substantial discomfort, can affect sleep and impact on the psychological state of the sufferer. This is especially important for elderly patients who may not be able to effectively communicate their distress level. While the overall global prevalence of scabies is low at around 0·5% [7], this does not reflect the high incidence of scabies in vulnerable communities or institutional settings where epidemics are likely. Overall prevalence figures are also likely to be underestimated, as scabies is not a reportable disease, and as such current data is largely reliant on research literature.

In this paper, we describe key findings from a retrospective review of scabies outbreaks reported in the literature over the past 30 years. We undertook this review to gain insights into the impact of institutional outbreaks, the burden in terms of attack rates, numbers of individuals infested, economic costs, treatment trends, the types of index cases and outbreak progression.

METHODS

A literature search was conducted in November 2013 in Pubmed (http://www.ncbi.nlm.nih.gov/pubmed/). Search terms are listed in Supplementary Table S1. Years of publication were limited to a 30-year period, from 1984 to 2013, as previous reviews have examined reports prior to these dates. Veterinary outbreaks were excluded. Abstracts were perused individually for suitability and institutional focus. Although general reviews were not included in the tabulated list of outbreak reports, their reference lists were scanned for additional publications, as were the publication lists of the outbreak reports themselves. General epidemiological and community prevalence surveys were excluded. Our review was limited to articles published in English, unless an English abstract or translation was available with salient data that could be extracted. An overview of the search strategy is detailed in Figure 1. Initial literature searches were conducted by H.C.M. and K.E.M., with the final list of publications for inclusion evaluated by K.E.M. Data from papers was extracted and tabulated in Microsoft Excel (Microsoft Corp. USA) by M.K. and K.E.M. Where reported, the following information was noted: duration of outbreak, type of institution (aged care facility, hospital, other), numbers infested, attack or prevalence rates, costs involved, treatments utilized, method of diagnosis, details of index case, misdiagnosis and/or differential diagnoses.

RESULTS

Overview of institutional scabies outbreaks

We found 84 scabies outbreaks reported in 74 articles between 1984 and 2013 (Table 1). A full list and publication details are provided in Supplementary Table S1. The rate of outbreaks described in the literature has remained steady over 30 years (Fig. 2), with the highest number of reports in 2000 (six outbreaks). Outbreak reports were distributed relatively evenly between aged care facilities ($n = 40$) and hospitals ($n = 33$), noting that a single scabies outbreak can involve multiple institutions (where a resident of an aged care centre is hospitalized, for example) [8, 9]. Other institutions experiencing scabies outbreaks included prisons [10], workshops for the mentally or physically disabled [11], schools [12], kindergartens, orphanages and childcare centres [13, 14] (Fig. 2).

Direct and indirect impacts of scabies outbreaks

While the average number of people infested per outbreak was 26, numbers varied markedly, from as low as three [15], to as high as 883 [10] in a prison setting. Particularly problematic were outbreaks involving multiple linked facilities [9], or where outbreaks recurred over several years [16]. The median attack rate for scabies was high, at 38%. While we did not differentiate between staff and residents/patients in this current analysis, a previous review by Utsumi *et al.* [17] estimated that median attack rates for scabies in aged care facilities was 70% for residents, and 30% for staff. These attack rates were among the highest for any disease outbreak in this setting. Attack rates within an institutional outbreak can vary depending on the burden of infection and level of mobility of the index case, for example in highly contagious crusted scabies. A retrospective analysis of a Japanese outbreak revealed that dementia patients with no mobility restrictions were significantly more likely to acquire scabies during an outbreak [18], and a long-term outbreak in a nursing home for dementia patients had exceptionally high attack rates (97% [19]). Outbreaks with high attack rates

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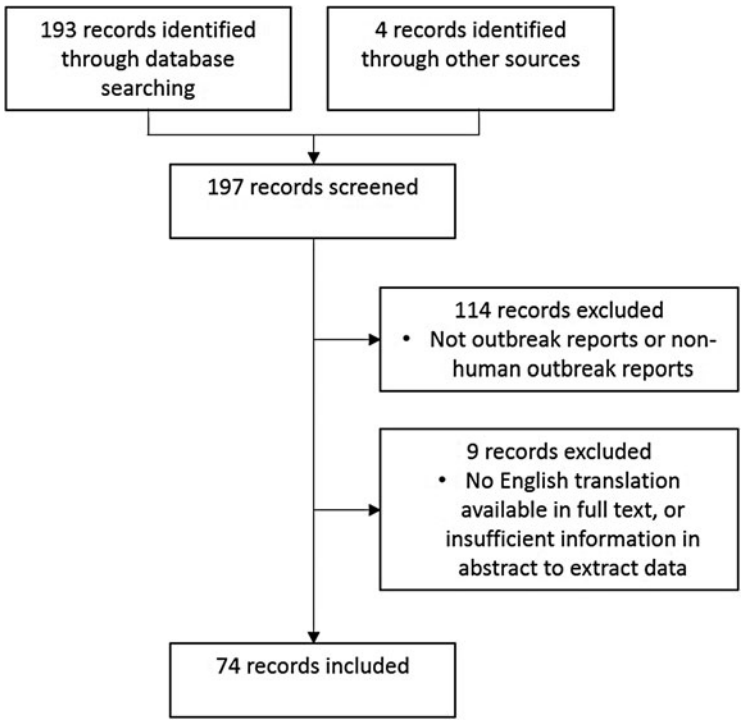

Fig. 1. Search strategy.

were also noted in a hospital for HIV patients (88% [20, 21], and a prison (78% [21]). There were also cases where staff members themselves represented the index case and unknowingly transmitted the disease to residents [13, 22].

On average, scabies outbreaks persisted for a median of 3 months, and again, this is longer than other infectious disease outbreaks experienced in institutional settings [17]. Difficulties with making a definitive diagnosis was a contributor to delayed detection of outbreaks, which was further exacerbated if the index case left the facility, or died, complicating outbreak investigations [23, 24]. With good management practices, outbreaks were limited to $\leqslant$1 month [21], but mismanaged outbreaks persisted for years [25].

The direct economic costs of managing scabies outbreaks were infrequently reported. Of the 14 publications where costs were noted, the average cost per outbreak was around US$25 000, with one Canadian facility reporting a staggering cost of CAD 200 000 (about US$176 000) [26]. Costs primarily related to staff absences, dermatology consultations, and acaricide prescriptions. There was limited consideration given to the indirect costs of outbreaks, environmental control measures, nor the psychosocial impacts on individuals. Where mentioned, themes related to feelings of anxiety and frustration among medical staff, patients, and their families [11, 26, 27]. The workforce burden and perceived ethical implications of applying a topical treatment to physically and mentally impaired people was identified as an issue by staff [11, 28]. Potential conflicts within the healthcare workforce, blame shifting and 'diagnostic confrontations' between general practitioners (GPs), dermatologists, and front-line nursing staff were also an underlying theme in several outbreak reports [11, 29, 30]. Scabies outbreaks within institutions also had effects on the broader community, with a high risk of occupational exposure and the potential for staff to transmit the disease to family members and subsequent requirement for them to also participate in prophylactic treatment [15, 26, 29]. Other indirect impacts related to ward closures [26, 31], and the considerable amount of stigma and negative publicity surrounding scabies outbreaks [9, 26, 32].

Misdiagnosis of scabies and crusted scabies: a frequent cause of prolonged outbreaks

Patients suffering crusted scabies represented the index case in 83% of the outbreak reports presented (Table 1). The first case of HIV-associated crusted scabies was published in 1986 [33], with the first HIV-associated scabies outbreak reported in 1989

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Table 1. *Summary of reported institutional scabies outbreaks, 1984–2013*

Total outbreaks reported	84
Type of institution*	
Aged care facility	40
Hospital	33
Other institution	12
Median infested per outbreak (no. reported, range)	26 (83, 3–883)
Median attack/prevalence rate (no. reported, range)	38% (51, 2–97%)
Median duration, months (no. reported, range)	3 (71, 1–42)
Estimated cost (no. reported, range)	US$22 500 (14, US$2000–200 000)
Number (%) where crusted scabies reported as index case	68 (83%)
Number (%) where crusted scabies was reported as misdiagnosed	36 (43%)
Method of diagnosis†	
Clinical	52 (62%)
Skin scraping	36 (43%)
Other	6 (7%)

* One outbreak affected multiple institutions

† More than one method may be used in diagnosis. Diagnosis of index case/crusted scabies not included.

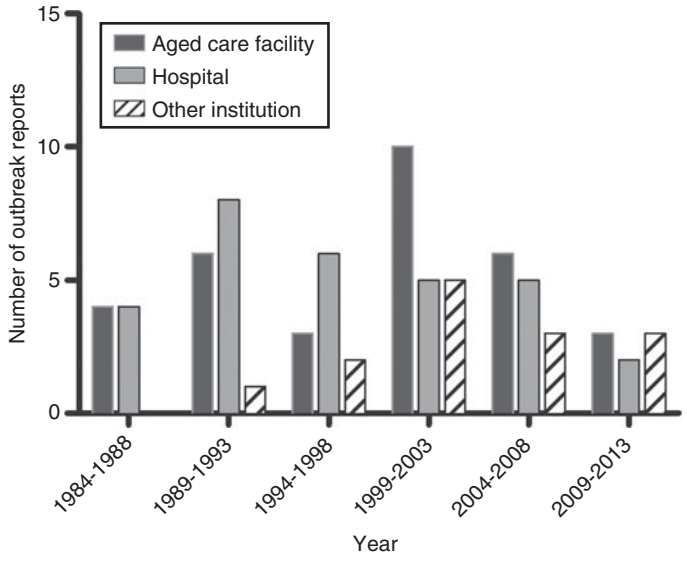

Fig. 2. Number of published scabies outbreaks by facility type, 1984–2013.

[34]. Twelve reports (14%) described HIV-related outbreaks (Supplementary Table S1), with most of these reports occurring in the early 1990s when HIV was first emerging. Other risk factors reported as contributing to crusted scabies included generalized or chemotherapeutic immunosuppression [21, 29], renal disease/dialysis [35] and Down's syndrome [36]. Corticosteroid use was frequently associated with an index case of crusted scabies, noted in 24% of outbreak reports. While some patients were initially treated with corticosteroids for unrelated conditions and developed crusted scabies as a result [23], some reports related to scabies being misdiagnosed, prescription of corticosteroids to relieve symptoms, which then facilitated the establishment of crusted scabies [37, 38].

Misdiagnosis and delayed diagnosis of scabies, and especially crusted scabies, was common and clearly identified as a major contributor to scabies outbreaks. A total of 43% reports presented were subject to initial misdiagnosis (Table 1). The most common differential diagnoses of crusted scabies included atopic, seborrhoeic, or generalized dermatitis (12 outbreaks), psoriasis (six outbreaks), drug hypersensitivity reactions (four outbreaks) and uraemic or senile pruritus

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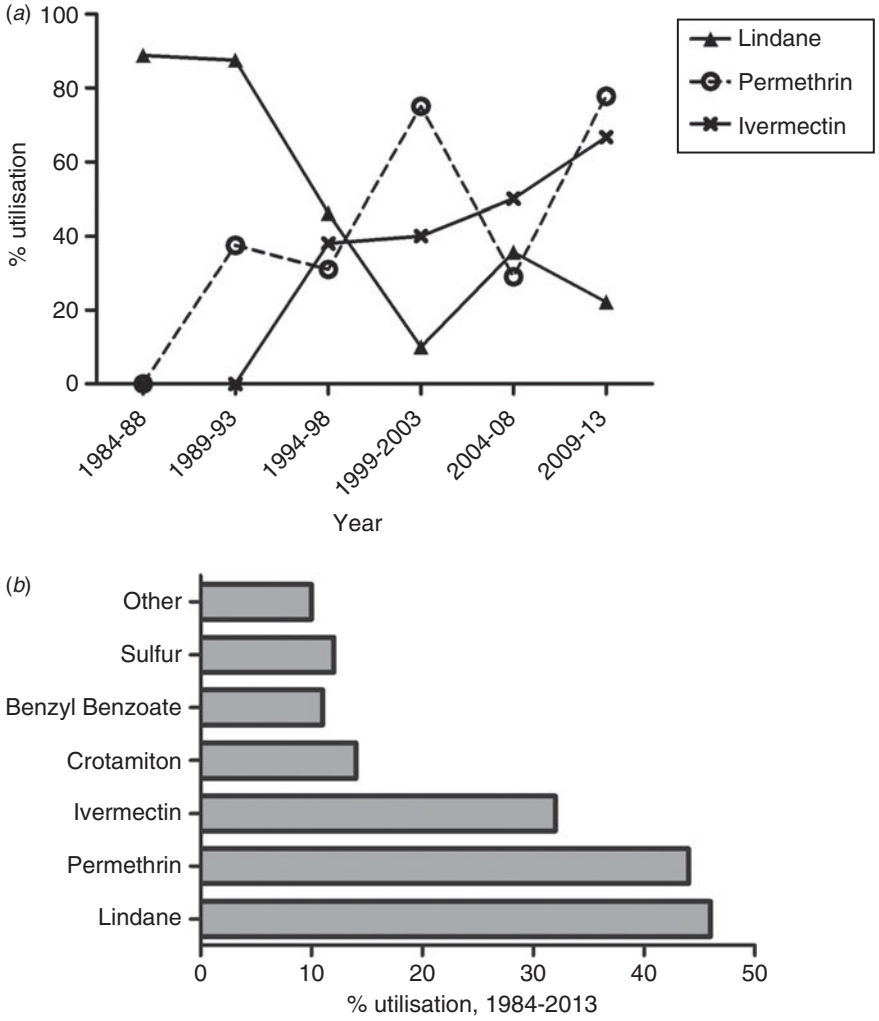

Fig. 3. Treatments utilised in published scabies outbreaks, 1984–2013. (*a*) Proportional usage of lindane, permethrin and ivermectin per 5-year period. (*b*) Overall treatment utilization, 1984–2013.

(three outbreaks). Diagnosis of scabies mostly relied on clinical presentation and case history, with clinical diagnosis employed for 62% of outbreaks reported. Skin scrapings were utilized as a diagnostic method in 43% of reports (Table 1). Other less commonly used diagnostic techniques methods included dermoscopy [39], adhesive tape [40] and surveys of exposed individuals [27].

Treatment choices

Gamma-benzene hexachloride 1% (lindane) has been frequently utilized for the treatment of scabies since its development in the 1940s. Our review reflects its initial popularity as a first-line treatment, used for 87·5% of reported outbreaks from 1984 to 1993 (Fig. 3*a*). After this time concerns about environmental toxicity and safety of lindane emerged (reviewed in [41]). With the development of safer alternative acaricides, the use of lindane has fallen (46%, 1994–1998; 10%, 1999–2003; 22%, 2009–2013; Fig. 3*b*), with several of the outbreak reports documenting treatment failures with lindane and the requirement to switch to an alternative acaricide [25, 38, 42]. The first documented use of 5% permethrin in an outbreak setting was in 1990 [25]. From there it steadily gained popularity in the late 1990s and early 2000s (Fig. 3*a*), and is now a first-line treatment in many countries. Overall, its utilization has been similar to that of lindane (Fig. 3*b*). In the reports examined, permethrin and lindane were often utilized together, or permethrin was employed after a lack of success with lindane. Only one report noted treatment failure with permethrin [15].

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The broad spectrum antiparasitic ivermectin is the only oral therapy currently available for scabies. Its first documented use for a scabies outbreak was in 1994 [43]. From then it has been employed for over 40% of reported outbreaks, with utilization increasing over time (Fig. 3*a*). Serious concerns were raised about the use of ivermectin in the elderly in one case report, with higher death rates reported in patients receiving ivermectin in the preceding 6 months [44]. However as these patients received multiple acaricidal treatments, including lindane, and the analysis was not matched for potentially confounding comorbidities, the validity of these observations has been questioned [45, 46]. One case of ivermectin treatment failure was described in the outbreak reports presented [38]. Other acaricides used less commonly in outbreak settings included benzyl benzoate (14%), crotamiton (12%) and sulfur (11%) (Fig. 3*b*). Malathion [12, 30], and allethrin spray [47] were used infrequently.

Crusted scabies can be difficult to manage due to the extreme mite burden, inadequate drug penetration in hyperkeratotic skin crusts, and high probability of mites in shed skin crusts making decontamination of fomites an important consideration. For example, fomite-implicated transmission contributing to an outbreak was recorded when a crusted scabies patient shared a communal lounge chair [48], or via clothing and bedding associated with a crusted scabies patient [32]. Twenty-six percent of the outbreak reports mentioned specific environmental decontamination procedures. A specific treatment regimen for index cases with crusted scabies was only stated in 35% of outbreak reports. Crusted scabies treatment strategies included combining two or more acaricides (20%), repeated applications of a single acaricide (10%), or the incorporation of keratolytic therapy (8%).

Strategies for successful outbreak control

As awareness of scabies prior to an outbreak is often low, many authors stressed the importance of education, communication and dissemination of relevant information. This commonly took the form of staff in-service training [31, 36], fact sheets, and provision of regular written updates regarding the status of the outbreak [9]. The role of active surveillance and early detection in preventing the spread of outbreaks was emphasized [23, 49]. There was limited follow-up data available regarding whether the above control efforts had any prolonged success in the prevention of future outbreaks.

DISCUSSION

The continued reporting of scabies outbreaks at a steady rate over the past 30 years suggests that they remain a problematic issue in institutional settings. Scabies outbreaks reported were often of prolonged duration and were associated with high attack rates. The direct and indirect costs of managing such outbreaks were substantial. Our review showed that most outbreaks reported were linked to an index case with crusted scabies, and these patients were commonly misdiagnosed. From this we suggest that more emphasis on general awareness of scabies, particularly of crusted scabies, is essential for healthcare practitioners. As scabies is relatively uncommon in developed countries, even limited cases in an institutional setting should be cause for immediate suspicion and careful monitoring.

Although low awareness of scabies was identified as a contributing factor to suboptimal outbreak responses, only limited information exists assessing baseline levels of knowledge regarding scabies biology, transmission, and control. A Belgian study found GPs to only have a satisfactory knowledge of scabies (59% *vs.* 79% in dermatologists) [50], and a comparison of GPs and pharmacists found their diagnostic recognition of scabies to be similar [51], with these authors noting that dermatology training for healthcare professionals is limited. Thus, staff at the front line, such as aged care workers and nurses, may lack confidence in their ability to recognize scabies, instead referring to a GP or dermatologist, which was linked to delays in case recognition and treatment, exacerbated by poor communication between practitioners [8, 9]. This was reflected by Hewitt *et al*. [52], who examined factors associated with scabies outbreak control in UK nursing homes. They found that GPs commonly misdiagnosed the condition, were reluctant to give definitive diagnosis and often ignored best practice guidelines regarding treatment. They also noted that the absence of national guidelines for scabies control were a barrier to successful control.

The diagnosis of scabies was clearly a challenging area. Delays inevitably occur due to the incubation period between transmission and the appearance of symptoms, which can be from 2 to 6 weeks for a primary infestation [53], during which time outbreaks can become well established. As scabies often mimics other more common dermatological conditions, accurate clinical diagnosis can be difficult, and case definitions in the literature are met with substantial

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heterogeneity. There are also failings in traditional clinical criteria for scabies where distribution of disease is atypical – facial and scalp involvement is rare in adults, for example, but more common in infants and the elderly [54]. While a definitive diagnosis can be obtained via the identification of mites or mite parts in skin scrapings, and skin scrapings were utilized frequently in scabies outbreaks, this technique has poor sensitivity (<50%) in ordinary scabies where mites are sparsely located [53]. Establishing clear clinical diagnostic criteria and alternative diagnostic approaches has been identified as a priority area of future research effort [3].

There is still a lack of consensus regarding optimal treatment strategies for both scabies and crusted scabies and regimens varied considerably in the outbreak reports presented. Permethrin and ivermectin are currently the most widely utilized treatments in scabies outbreaks. While lindane is now banned in Europe and Australia, it is still utilized in some Asian countries, and remains as a second-line treatment in the United States. Previous meta-analysis demonstrates the inferiority of lindane compared to ivermectin and permethrin [55]. While most adverse events with lindane have been associated with inappropriate use (e.g. applying after a warm bath resulting in increased absorption), safety concerns are especially valid for elderly and vulnerable populations [41]. Permethrin is considered to be a safe and efficacious alternative to lindane, with low systemic absorption and minimal side-effects, although one disadvantage is the high price of permethrin, precluding its application for mass treatment in some settings and countries where lindane may be a cheaper alternative, if still available.

Oral administration of ivermectin is useful in institutional settings when mass treatment is required, with ease of application logistically very beneficial in an institutional setting. Although the efficacy of one *vs.* two doses of ivermectin in mass treatment has not been fully evaluated, two doses are recommended due to its short half-life and lack of ovicidal activity, and meta-analysis suggests that two doses has similar clinical efficacy to a single dose of permethrin [55]. Ivermectin is also commonly utilized for the treatment of crusted scabies, and while there is limited evidence on best practice for the treatment of this extreme manifestation, current recommendations suggest multiple doses of ivermectin in combination with topical and keratolytic therapy [56]. Clinical and *in-vitro* resistance of *S. scabiei* to ivermectin has been documented in crusted scabies [57], with one case of treatment failure in the outbreak reports presented [38]. Some uncertainties around the efficacy of ivermectin in the elderly remain, where a reduction in skin lipids may contribute to reduced penetration and retention of ivermectin in the skin, a potential issue that has been raised but not explored in detail [58, 59]. Indeed, a recent case report documents treatment failure of multiple doses of ivermectin in a 90-year-old patient with crusted scabies [60]. The development of alternative therapies for scabies, ideally orally administered, would be beneficial to achieving more sustainable control of scabies in both epidemic and endemic settings.

Control of scabies outbreaks requires the implementation of rapid and stringent measures to prevent further transmission. Elimination of the disease requires synchronous treatment of all patients, staff and visitors that have been exposed to infected individuals [15]. A recent Cochrane review [61] attempted to evaluate the efficacy of prophylactically treating contacts of people with scabies, but was unable to do so based on insufficient eligible studies (i.e. randomized controlled trials) for inclusion. However, as full control of scabies outbreaks is often not achieved until all contacts are treated [42], mass treatment encompassing these contacts is recommended due to the aforementioned difficulties with diagnosis and incubation period where patients are asymptomatic.

It is important to acknowledge that this study was not intended to be a comprehensive systematic review, with our search primarily limited to the Pubmed database, and relaxed inclusion criteria and quality assessment. Previous systematic reviews of scabies have been precluded by considerable heterogeneity in study designs, with the majority of published studies not meeting quality criteria for inclusion [55, 61, 62]. For this reason we attempted to gain as much information as possible regarding the number of reported outbreaks while capturing and collating salient data where it was presented. Like previous reviews, we also found that details of diagnosis, treatment regimens and definition of cure were often reported poorly or not at all. Furthermore, in some reports the numbers of individuals infected *vs.* the overall numbers of people exposed or prophylactically treated was not stated, hampering assessment of attack rates. Nevertheless, our collated findings are in accordance with earlier reviews [17].

Another limitation is that these published reports only represent a small glimpse of scabies outbreaks occurring worldwide and cannot be used as a measure of

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prevalence. Reporting bias is also inherent with such a review, with some data possibly reflective of 'worst case scenarios', as it is more likely that problematic or noteworthy outbreaks will be reported compared to those successfully controlled without major disruption. This may also confound the information on where outbreaks occur- with settings involving active health care practitioners and/or academics possibly more motivated to publish than those from non-health care settings (such as child care facilities or schools).

In conclusion, responding to a scabies outbreak requires a highly coordinated effort between facility infection control or public health departments, management, clinicians and nursing staff. Education and active surveillance must be ongoing and can potentially reduce the duration and impact of outbreaks. The development of consensus guidelines for the diagnosis of scabies, adapted for atypical clinical presentation in specific vulnerable populations such as the elderly are essential, as are the dissemination of clear national guidelines for control of scabies outbreaks. A comprehensive programme overview presented by Stoevesandt and colleagues [11] is an excellent example. With an ageing population worldwide and likely increasing reliance on aged care services, control of scabies is expected to remain a priority.

SUPPLEMENTARY MATERIAL

For supplementary material accompanying this paper visit http://dx.doi.org/10.1017/S0950268816000443.

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DECLARATION OF INTEREST

None.

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