

Scabies outbreaks in ten care homes for the elderly: a prospective study of clinical features, epidemiology, and treatment outcomes

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Abstract

Background

Scabies outbreaks in Residential and Nursing Care for the elderly (RNC) are common, subject to diagnostic delay and hard to control. We studied clinical features, epidemiology and outcomes.

Methods

Dermatology-trained physicians examined residents during outbreaks in South East England. Scabies was diagnosed through pre-defined case definitions (definite/probable/possible), using dermatoscopy and microscopy as appropriate. Examinations were repeated following mass treatment.

Findings

230 residents were examined in ten outbreaks between Jan 23, 2014 and April 13, 2015. Median age was 86·9 years, 174 (75·7%) were female, and 157 (68·3%) had dementia. 61 residents (26·5%) were diagnosed with definite/probable/possible scabies, of which three had crusted scabies. Physical signs were atypical. Over half those diagnosed were asymptomatic and only 39·3% (24/61) had burrows. Mites were visualised with dermatoscopy in seven cases (11·5%) and further confirmed by microscopy in three. 35 (57·4%) cases only had signs on normally covered areas of the body. Dementia was the only risk factor for a scabies diagnosis (2·37 (95% CI 1·38-4·07)). At follow up, there were no new cases but scabies persisted in 10 individuals.

Interpretation

Clinical presentation of scabies in elderly RNC residents differs from classical descriptions familiar to clinicians. This is likely to contribute to delayed recognition and suboptimal management in this vulnerable group. Dermatoscopy and microscopy were of limited value.

It is important healthcare workers are aware of the different presentation of scabies in this group, and undertake thorough examinations, particularly in those with dementia.

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Research in Context

Evidence before this study

Scabies outbreaks in RNC are relatively little studied, with no research on the topic in the UK prior to our teams' work. This prospective study followed from a needs assessment, and a retrospective interview based study of scabies outbreaks in RNC in South East England carried out by team members (Hewitt *et al.*). The needs assessment combined epidemiological, comparative, and corporate assessments and included a literature review. PubMed was searched to identify articles in English published before September 11, 2010, using the search terms "scabies", "care homes", and "residential homes". An additional Google Scholar search was carried out using the phrase "scabies care homes". Studies or review articles were included that addressed scabies and/or its management in RNC and long term care facilities. Citations from included articles were screened for inclusion. 24 articles were included: eight case studies, six review articles, and five epidemiological studies. The data and literature examined in the needs assessment, alongside the retrospective study of scabies outbreaks in South East England, indicated outbreaks are common in RNC, and diagnosis is often delayed leading to avoidable transmission and distress. Case reports and small studies suggested the clinical appearance of scabies in this population is not what clinicians expected. Our team carried out a follow-on systematic review on July 19th, 2017 in PubMed, Cinahl, Embase, and Web of Science (search string in Appendix, page 7), with additional papers identified using Google Scholar citation searching. Two relevant case reports published subsequent to our pre-study literature review were identified, but neither

included additional themes or clinical data to that indicated by our needs assessment and retrospective study (Hewitt *et al.*).

Added value of this study

This study of ten scabies outbreaks in RNC assessed risk factors, outbreak characteristics, and clinical presentation, and to our knowledge is the largest prospective clinical study on this topic. We describe how scabies in this elderly population presents differently from classical descriptions, which are based on younger age groups. We found dementia is a risk factor for scabies in RNC, and described outbreak characteristics.

Implications of all the available evidence

Scabies outbreaks are a common public health problem in RNC. The atypical clinical characteristics of scabies in this elderly population, and the limited value of existing diagnostic tools, may contribute to delayed diagnosis. To achieve timely outbreak detection and minimise transmission and distress in this vulnerable group, clinicians require education on the presentation of scabies in RNC and novel diagnostics need to be developed. Topical mass treatments are distressing and labour intensive. Broader use of oral medication should be considered in those countries where they are not presently licensed for scabies.

Introduction

Scabies, a skin infestation with the mite *Sarcoptes scabiei*, is often intensely pruritic and distressing. Though clinicians frequently see scabies amongst children and young adults, the very old can be highly affected, and outbreaks are common in Residential and Nursing Care for the elderly (RNC).¹⁻³ The mean diagnosed incidence in the UK 1997–2005 was 2·27 in men and 2·81 in women per 1000.¹ The 2015 global burden was 5,268,900 Years Lived with Disability.⁴ Transmission is by direct close contact and to a lesser extent via fomites,⁵ with a

4–6 week incubation period in those never previously infested. Signs include papules (figure 1a), burrows (figures 1b, 1c), and nodules.⁶ Excoriation due to scratching and parasite induced inhibition of local immune response can facilitate secondary bacterial infection,⁷ with resultant risks of impaired renal function and rheumatic heart disease.^{5,8} The normal parasite burden is approximately 11 burrowing adult female mites per individual,⁹ however some develop “crusted” scabies, with hyperkeratotic skin lesions (figure 1d) harbouring >4700 mites per gram.¹⁰ These patients have an increased mortality risk and during outbreaks are core transmitters.^{10,11}

Scabies outbreaks in RNC are challenging to diagnose, stigmatising and costly to manage.¹¹ The close proximity of individuals and lengthy asymptomatic incubation period enables many residents and staff to become infested before detection, which is often delayed.³ Management includes repeated simultaneous mass treatments with topical scabicide applied over the whole body, alongside environmental decontamination.¹² Mass treatments are logistically challenging, labour intensive and distress some residents, many of whom have dementia and may not understand why they are receiving treatment.³ A retrospective review by Mounsey *et al.*¹¹ of institutional scabies outbreaks (primarily in RNC and hospitals) reported a median attack rate of 38%, and outbreaks usually persisting for many months, with cases of crusted scabies being the index in 83%. Previous work suggested clinical presentation may differ in the elderly from younger age groups,¹³ and diagnostic delay may contribute to outbreak size.³ However, no prospective studies have to date described the clinical presentation in multiple outbreaks using clear case definitions in the context of the host community. We hypothesised differing clinical presentation may contribute to delayed outbreak detection and suboptimal management.

We aimed to determine, (i) clinical characteristics of scabies in a UK RNC population during an outbreak, (ii) resident characteristics predictive of scabies diagnosis, (iii) outbreak characteristics, and (iv) treatment effectiveness.

Method

Study design and setting

This prospective observational study was carried out in South East England between Jan 23, 2014 and April 13, 2015, in ten homes which reported outbreaks to PHE Health Protection Teams (HPTs). An outbreak was defined as two or more cases of scabies (residents or staff) in a single RNC. Preliminary visits were undertaken to collect data on outbreak characteristics, assess residents' mental capacity, and recruit participants. Residents were examined at initial clinical visits, followed by two mass treatments with topical scabicide as per local HPT guidance. Follow up clinical visits were arranged for approximately six weeks after initial visits, as it is widely accepted symptoms may persist for up to six weeks after effective treatment,¹⁴ and experts suggest such symptoms should be investigated after four weeks.¹⁵

Participants

A prioritisation strategy for examinations was used (full details given in Appendix, page 1). Research staff carried out capacity assessments of residents with known cognitive impairment. Where residents lacked capacity to consent, advice was sought from personal consultees (normally relatives) or nominated consultees (RNC staff) as described elsewhere.¹⁶ Capacity was reassessed at both clinical visits before examination.

Data collection, processing, and statistical analysis

Data on age, sex, dementia diagnosis (as recorded in RNC records), continence, mobility, medical history, and current medication were collected. Characteristics of homes and

outbreaks were collected, including demographics, number and proportion of residents affected, number and proportion treated, time to diagnosis, time to treatment, ownership, classification (with or without nursing), number of residents and maximum capacity, number of sections and/or floors, how the outbreak was detected, and number of staff affected. Scabies diagnostic criteria were developed (table 1) and cases of crusted scabies graded using the clinical scale of Davis *et al.*¹⁷ Morphology and location of signs were recorded, with locations grouped into areas normally covered or uncovered (Appendix, page 2).

When possible, examinations were conducted by two clinicians together (13 of 20 visits), using dermatoscopes (Heine Delta 20 Plus) and taking clinical photographs as appropriate. The clinical team consisted of two consultant dermatologists and two primary care physicians with dermatology certification, and the same clinicians attended initial and follow up visits (Appendix, page 3). Skin scrapes obtained from participants with definite or probable scabies were examined next day under microscopy by senior specialist biomedical scientists.

Demographic and medical data were collected by consulting RNC staff and records (resident files, medication sheets, reports of clinician visits, hospital discharge letters, and ambulance service assessments). Time to diagnosis (in days) for individual residents with scabies was defined as the time between first awareness of signs or symptoms (earliest report from resident or staff, or RNC records) to date of diagnosis. Managers were interviewed about home and outbreak characteristics using a structured questionnaire. Death certificates were obtained from the UK General Register Office for all participants who died before follow up. To reduce potential for bias at follow up, study clinicians were not informed of diagnoses given at initial visits. Study size was determined by the number of outbreaks reported to HPTs that agreed to participate and could be visited before mass treatment within the funding period. Full details of the approach to statistical analysis are given in Appendix, page 1.

Camberwell St Giles NRES Committee approved the research, and the protocol is available at: <http://sro.sussex.ac.uk/66209/>.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication. Some team members had honorary or substantive employment contracts with HPA/PHE.

Results

Characteristics of participants, homes, and scabies outbreaks

Thirty-three outbreaks were reported to the study. Seven homes did not wish to take part, and for 16 we were unable to schedule visits without delaying mass treatment. Ten homes with 430 residents were visited. A variety of reasons prevented the seeking of consent or examination, which are detailed in figure 2 (cohort diagram). The mental capacity of 295 residents were assessed: 144 (48.8%) had capacity to consent, 151 (51.2%) did not. 230 were examined at initial clinical visits, 186 at follow up. The age distribution of participants was similar to national estimates of age at admission to RNC^{webref1} and median age was 86.9 years (IQR 81.5–92.3). 174 residents (75.7%) were female and 157 (68.3%) had dementia (table 2). The extent of polypharmacy and comorbidity was similar in the group diagnosed with scabies and those not.

Seven homes were owned privately, three by local authorities. Four provided nursing care. At two homes all residents were registered with a single primary care practice, at all others residents had primary care physicians from multiple practices. Two homes had experienced outbreaks in the previous five years. Six homes were smaller than the UK mean of 40 beds, and all were located in a region where the proportion of self-funded residents is relatively high^{webref2}

The median number of residents per home diagnosed with scabies at initial clinical visits was six (range 2–11). Four homes had at least one crusted scabies case: in two these were diagnosed by the study team, and in two they had already been diagnosed by other clinicians. Overall median time to diagnosis was 22 days (IQR 7·5–186, n=48). In eight homes, at least one staff member was diagnosed with scabies, by study clinicians or others. Though offered, staff examinations were not carried out in the remaining two homes. Scabies outbreaks reported to HPTs are overwhelmingly located in RNC and attributed to transmission within that setting. The outbreaks we attended had no unusual features and were similar to those described in our previous non-clinical study in the same region.³ Further data on individual homes and outbreaks are in Appendix, page 6.

Clinical features and resident characteristics predictive of scabies

At initial clinical visits 61 residents (26·5%, n=230) were diagnosed with scabies: seven definite (including two crusted), 28 probable (including one crusted), and 26 possible (figure 2). Burrows were detected in 25 cases (41·0%), papules in 52 (85·2%), hyperkeratosis in eight (13·1%), nodules in four (6·6%). Figure 3 illustrates the distribution of signs (resident profiles in Appendix, page 3). The torso was the most common location for burrows, hyperkeratosis, and papules. Over half of diagnosed residents only had signs at locations which would normally be covered by clothing, including 72·0% of residents with burrows (18). A scabies mite was visualised using dermatoscopy in only seven cases (11·5%). Three of these cases also had positive microscopy. Amongst residents not diagnosed with scabies, none had burrows, nodules, or hyperkeratosis, but five had papules (torso, three; hands, one; legs, one). Table 3 lists signs and symptoms prior to initial clinical visits. Of residents with scabies diagnoses, staff reported 31 had not complained of itch, rash, or scratching. 24 of these asymptomatic residents had dementia. Of the 16 diagnosed residents who had complained, only nine had complained of itch. Staff had not noticed skin signs on 12

subsequently diagnosed residents (19.7%, n=61). Thirteen asymptomatic residents with scabies only had signs in areas normally covered by clothing (27.7%, n=47).

Among those examined dementia was significantly associated with a scabies diagnosis at initial clinical visit (OR 2.37, 95% CI 1.38–4.07). However, age (OR 0.99, 95% CI 0.93–1.04), mobility (OR 0.53, 95% CI 0.22–1.25), sex (OR 1.61, 95% CI 0.84–3.07), continence (OR 1.28, 95% CI 0.53–3.11), and any effect on immunity (OR 0.95, 95% CI 0.51–1.76) were not statistically significantly associated with scabies diagnosis (Appendix, page 2). The intracluster correlation coefficient for residents within homes was 0.214, indicating clustering of data had a large effect.

Treatments and follow up

In all homes two mass treatments with topical scabicide were carried out a median seven days apart (IQR 7–7) (Appendix, page 5). Eight residents were not included in first treatments (3.5%), five in second (2.2%). As most homes obtained prescriptions from primary care physicians at multiple practices, arranging prescriptions and sufficient scabicide delayed treatment. Two participants living in separate homes were given oral ivermectin (Appendix, page 6). RNC staff reported mass treatments were labour intensive and many residents found the process distressing. Some staff suggested oral treatment would be preferable.

No new cases were detected at follow up visits, which were carried out a median 44 days after initial clinical visits (IQR 41–48) and a median 35 days after second mass treatments (IQR 31–39). 50 of the 61 previously diagnosed by the team were examined, 40 had no signs, ten had either probable or possible scabies. Nine of these had been included in the first mass treatment, all in the second. None had deteriorated and all but three had improved clinical classification (figure 2). A greater proportion of those with scabies died before follow up (six of 61) compared to those with no signs of scabies (seven of 169) (Appendix, page 5). One

resident with crusted scabies (confirmed on microscopy) died in hospital four days after the initial clinical visit, with scabies recorded on their death certificate as a significant condition contributing to death (Appendix, page 7).

Discussion

Key findings

In investigating characteristics of scabies in RNC we found signs and symptoms were atypical. More than half of diagnosed residents were asymptomatic. In contrast to “classical” scabies, signs were distributed largely in areas normally covered by clothing, including in the minority of cases in which burrows were detected. A dementia diagnosis was predictive of scabies. Outbreaks were often characterised by substantial diagnostic delay and in nearly half the homes there was a crusted scabies case. Topical mass treatment was effective, but distressing for residents, labour intensive, and did not result in complete resolution of signs of scabies in 20%.

Limitations

Scabies outbreaks attract stigma.¹¹ Selection bias may thus have been introduced at recruitment which was dependent upon homes informing HPTs and agreeing to participate. The majority of our diagnoses were based on clinical signs rather than visual confirmation of mite presence. We were unable to examine all residents for the reasons described in Methods, figure 2, and Appendix, page 6. As we could not examine all residents, we did not report attack rates. We did not access primary care or hospital records, and the accuracy of RNC records is difficult to determine. Our presence may have encouraged more thorough treatments, biasing measurement of their success.

Diagnostic challenges in the elderly

The most common sign or symptom of scabies is itching, with interdigital web spaces of the hands being classical locations for signs.^{14,18} However, case reports and small studies have reported “atypical” presentation in the elderly.^{13,15,19} Our study confirms presentation in older individuals may differ considerably from the standard description of scabies¹⁴ and from clinical phenotypes which are based primarily on paediatric populations and do not differentiate elderly populations as a distinct group.²⁰ In our study over half of cases were asymptomatic, with many having subtle clinical signs at locations usually covered that may be missed by clinicians focusing on sites commonly affected in younger age groups. Skin signs had gone unnoticed by staff in many cases. Burrows are pathognomonic of scabies and hands are a typical site, with one study (whose participants were soldiers) detecting occupied burrows on hands or wrists in 85% of cases.²¹ By contrast in our study burrows were observed in less than half of cases, on the hands in only 11.5%. The extent of atypical hidden signs and symptoms in this population may partly explain reported delayed diagnosis. Educational materials are needed to support diagnosis of scabies in RNC by primary care physicians and others. Dermatoscopy was of limited value in our study with only 11.5% of cases having a mite visualised. In a French hospital based study (mean participant age, 33y) dermatoscopy had 91% sensitivity, whilst a Brazilian community-based study (median participant age, 14y) reported 83% sensitivity (Appendix, page 7). In the French study 75% of cases had ‘involvement of typical body areas’. Our dermatoscopy findings may differ from those of these studies due to the significant age difference and less typical clinical features in our cohort. The review by Mounsey *et al.*¹¹ included 40 outbreaks in ‘aged care’ facilities, but only one study reported using dermatoscopy (Appendix, page 7) and the proportion of affected individuals in whom a mite was visualised was not reported. The role of dermatoscopy in elderly individuals with suspected scabies warrants further study. In line with previous reports,^{22,23} inspection of skin scrapings under microscopy, whilst useful in confirming positive diagnoses, was not highly sensitive. Alternative diagnostics need to be developed. In their absence diagnosis will remain clinical. Primary care physicians may be

reluctant to diagnose scabies in individuals without “classical” signs, especially if they are asymptomatic, because of the implications for homes and residents.³ Our case definitions (table 1) may be helpful, and are given weight by the fact that of those examined at post treatment follow up, all but three cases had improved clinical classification (e.g. probable to possible), with 19 of the 21 cases previously classified as possibles improved to the extent of being classified as ‘no signs’ (see figure 2). We suspect the two possible cases at follow up that had not improved, did not have scabies.

Dementia and scabies in RNC

Our study is the first to confirm dementia is a risk factor for scabies in RNC. The explanation for this association remains unclear, but wandering behaviours and increased number of physical contacts may heighten transmission hazard.²⁴ Once affected, cognitive impairment may also support infestation by reducing removal of mites by scratching.¹³ This increased risk should be considered when deciding whether to examine residents with dementia, who can have difficulty understanding and communicating symptoms. It is possible distress caused by scabies may lead to changes in behaviour being attributed to the underlying cognitive impairing condition rather than the effect of scabies.

Outbreak characteristics

Mounsey *et al.*¹¹ outlined common characteristics of institutional scabies outbreaks, many of which were evident in our study. These included protracted delayed diagnoses (months to years in some homes in our study), residents with crusted scabies (nearly half of the outbreaks in our study included at least one case), and infestation of staff (present in all homes in our study in which staff examinations took place). In agreement with some studies in the review, staff reported considerable anxiety and frustration amongst patients and themselves. 80% of homes in our study did not have a sole primary care practice responsible

for all residents. In homes with similar arrangements this may hamper communication and contribute to delayed case diagnosis and outbreak detection.

Treatments

Though topical scabicide treatments appeared successful, this may have been exaggerated by early exit of some participants with scabies, in particular the relatively high number of deaths. In two of the four homes with cases of crusted scabies, residents with crusted scabies died before follow up or indeed treatment completion. These may have been core transmitters, and given the difficulty treating crusted scabies topically their removal from the cohort may have contributed to lack of outbreak recurrence. The distress and logistical challenges of topical mass treatments reported by RNC staff in this study and previous work,³ indicate broader use of oral medication should be considered. A suggested link between ivermectin treatment for scabies and excess deaths in the elderly²⁵ in a much criticised 1997 study has not been reproduced.¹² Indeed ivermectin appears extremely safe when used in Mass Drug Administration programmes for filariasis and onchocerciasis.²⁶ In settings where scabies prevalence is of epidemic proportions oral ivermectin appears more effective than topical therapy.²⁶ France has licensed oral ivermectin for scabies outbreaks in RNC, but in the UK it remains available only on a named patient basis, recommended only for treatment resistant crusted scabies.¹² We recommend research in RNC comparing oral ivermectin, or novel oral treatments such as moxidectin,²⁷ with topical scabicides.

Scabies - a neglected disease in a neglected healthcare setting

RNC residents are a vulnerable population requiring advocacy. In 2011 291,000 people aged ≥ 65 y lived in RNC in England and Wales,²⁸ many with complex healthcare needs, yet the sector is arguably under-researched. Our study enabled participation in research by those with dementia. Key findings would not have been discovered had we not included them, which

was made possible by advice on innovative methodology from patient representatives. We recommend researchers consider our methodology¹⁶ in outbreak and other time-critical studies in RNC. Ours was the first funded UK research on scabies outbreaks in RNC. The burden, impact, and management of scabies in RNC warrants further study, not least because as the global population ages the burden of skin disease in the elderly is expected to become a significant challenge,²⁹ and institutional disease outbreaks place greater demand on limited resources.

Conclusion

RNC residents with scabies may be asymptomatic, with subtle signs in covered sites not typically involved in the young. We recommend thorough, careful examination, particularly of individuals with dementia, who are at higher risk of scabies. The need for thorough clinical examination is highlighted by the limited value of existing diagnostic tools. Scabies outbreaks are difficult to manage, distressing, and highly stigmatising. Increased awareness of how scabies presents in the elderly, alongside development of diagnostics and evidence based treatment regimens, would aid detection and control of scabies outbreaks, which often affect the vulnerable elderly, often at the end of life.

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Contributors

AN, JAC, JM, KH, MGH, SL, and SLW designed the study. JB provided advice on ethical issues and interpretations. AN, CD, JM, SL, and SLW were involved in recruitment and data

collection. CJ, JAC, JM, SK, SL, and SLW carried out data analysis. All authors contributed to multiple drafts and have read and agreed the final version of this article.

Conflicts of interest

We declare that we have no conflicts of interest. Readers may note that JB is a member of the National Health Service Research Ethics Committee that reviewed the scabies study.

However, she did not review the scabies study nor did she attend the meetings where the study was discussed. She became involved with the scabies study after ethics approval was granted in 2012. The decision to involve her in the scabies study was not influenced in any way by her role within the ethics committee.

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References

- 1 Lassa S, Campbell MJ, Bennett CE. Epidemiology of scabies prevalence in the U.K. from general practice records. *Br J Dermatol* 2011; **164**: 1329–34.
- 2 Bennett C, Bennett S. Scabies epidemiology from UK THIN data 1997–2005. 2006. <http://web.archive.org/web/20160806142935/http://www.southampton.ac.uk/~ceb/Scabies%202006.htm> (accessed 6 August 2016).
- 3 Hewitt KA, Nalabanda A, Cassell JA. Scabies outbreaks in residential care homes: factors associated with late recognition, burden and impact. A mixed methods study in England. *Epidemiol Infect* 2015; **143**: 1542–51.
- 4 GBD Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; **388**: 1545–602.
- 5 Fuller LC. Epidemiology of scabies. *Curr Opin Infect Dis* 2013; **26**: 123–6.
- 6 Walton SF. The immunology of susceptibility and resistance to scabies. *Parasite Immunol* 2010; **32**: 532–40.
- 7 Swe, Reynolds PM, Fischer SL, K. Parasitic scabies mites and associated bacteria joining forces against host complement defence. *Parasite Immunol* 2014; **36**: 585–93.
- 8 Chung SD, Wang KH, Huang CC, Lin HC. Scabies increased the risk of chronic kidney disease: a 5-year follow-up study. *J Eur Acad Dermatol Venereol* 2014; **28**: 286–92.
- 9 Mellanby K. The Development of Symptoms, Parasitic Infection and Immunity in Human Scabies. *Parasitology* 1944; **35**: 197–206.
- 10 Roberts LJ, Huffam SE, Walton SF, Currie BJ. Crusted scabies: clinical and immunological findings in seventy-eight patients and a review of the literature. *J Infect* 2005; **50**: 375–81.
- 11 Mounsey KE, Murray HC, King M, Oprescu F. Retrospective analysis of institutional scabies outbreaks from 1984 to 2013: lessons learned and moving forward. *Epidemiol Infect* 2016; **44**: 2462–71.

- 12 White LCJ, Lanza S, Middleton J, et al. The management of scabies outbreaks in residential care facilities for the elderly in England: a review of current health protection guidelines. *Epidemiol Infect* 2016; **144**: 3121–30.
- 13 Wilson MM, Philpott CD, Breer WA. Atypical presentation of scabies among nursing home residents. *J Gerontol A Biol Sci Med Sci* 2001; **56**: M424–7.
- 14 Monsel G, Delaunay P, Chosidow O. Arthropods. In: Griffiths C, Barker J, Bleiker T, Chalmers R, Creamer D. *Rook's Textbook of Dermatology*. Ninth ed. Chichester, West Sussex; Hoboken, NJ: John Wiley and Sons Inc.; 2016: 1073–1129.
- 15 Chosidow O. Scabies. *N Engl J Med* 2006; **354**: 1718–27.
- 16 Head MG, Walker SL, Nalabanda A, Bostock J, Cassell JA. Researching Scabies Outbreaks among People in Residential Care and Lacking Capacity to Consent: A Case Study. *Public Health Ethics* 2015; doi: 10.1093/phe/phv011.
- 17 Davis JS, McGloughlin S, Tong SY, Walton SF, Currie BJ. A novel clinical grading scale to guide the management of crusted scabies. *PLoS Negl Trop Dis* 2013; **7**: e2387. doi: 10.1371/journal.pntd.0002387.
- 18 Chosidow O. Scabies and pediculosis. *Lancet* 2000; **355**: 819–826.
- 19 Moberg SAW, Löwhagen G-BE, Hersle KS. An epidemic of scabies with unusual features and treatment resistance in a nursing home. *J Am Acad Dermatol* 1984; **11**: 242–4.
- 20 Boralevi F, Diallo A, Miquel J, et al. Clinical phenotype of scabies by age. *Pediatrics* 2014; **133**: e910–6. doi: 10.1542/peds.2013-2880.
- 21 Mellanby K. Scabies in 1976. *J R Soc Promot Health* 1977; **97**: 32–6.
- 22 Heukelbach J, Feldmeier H. Scabies. *Lancet* 2006; **367**: 1767–74.
- 23 Walton SF, Currie BJ. Problems in diagnosing scabies, a global disease in human and animal populations. *Clin Microbiol Rev* 2007; **20**: 268–79.
- 24 Tsutsumi M, Nishiura H, Kobayashi T. Dementia-specific risks of scabies: retrospective epidemiologic analysis of an unveiled nosocomial outbreak in Japan from 1989-90. *BMC Infect Dis* 2005; **5**: 85. doi:10.1186/1471-2334-5-85.

- 25 Barkwell R, Shields S. Deaths associated with ivermectin treatment of scabies. *Lancet* 1997; **349**: 1144–5.
- 26 Romani L, Whitfeld MJ, Koroivueta J, et al. Mass Drug Administration for Scabies Control in a Population with Endemic Disease. *N Engl J Med* 2015; **373**: 2305–13.
- 27 Mounsey KE, Bernigaud C, Chosidow O, McCarthy JS. Prospects for Moxidectin as a New Oral Treatment for Human Scabies. *PLoS Negl Trop Dis* 2016; **10**: e0004389. doi: 10.1371/journal.pntd.0004389.
- 28 ONS. Changes in the Older Resident Care Home Population between 2001 and 2011. 14 August 2014.
<https://web.archive.org/web/20160822091407/http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/articles/changesintheolderresidentcarehomepopulationbetween2001and2011/2014-08-01> (accessed 22 August 2016).
- 29 Hay RJ, Fuller LC. Global burden of skin disease in the elderly: a grand challenge to skin health. *G Ital Dermatol Venereol* 2015; **150**: 693–8.