Non-respiratory infections – specific considerations in care homes

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This paper has been accepted for publication and will appear in a revised form, subsequent to peer review and/or editorial input by Cambridge University Press, in **Reviews in Clinical Gerontology** published by Cambridge University Press.

Summary

This review provides an update on current evidence surrounding the epidemiology, treatment and prevention of non-respiratory infections in care homes. It covers urinary tract infection (UTI), methicillin-resistant staphylococcus aureus (MRSA), decubitus ulcers, scabies, tinea infections and viral and bacterial gastroenteritis. The care home sector provides a unique ecological niche for infections, housing frail older people with multiple co-morbidities and frequent contact with healthcare services in a semi-closed environment. This leads to differences in the diagnosis and management of infections – particularly of outbreaks – when compared with community-dwelling counterparts. It is essential that care home staff play a role in the early recognition, isolation and treatment of infections but they are often not trained as healthcare professionals – this presents a challenge to systematised response. Effective interface between care homes, public health and infection control services are essential to the delivery of care, yet it is not clear how most-effectively to structure such links.

Keywords: Nursing homes, residential facilities, Homes for the Aged, Infection, Infection Control

Introduction

Older people living in care homes are more dependent, have more co-morbidities and use health services more than age-matched community-dwelling counterparts[1, 2]. As a consequence, they are more vulnerable to infections and more likely to suffer significant sequelae[3]. Their living facilities may provide both opportunities for transmission of infection and the possibility of early identification and treatment[4].

Pneumonia and influenza constitute the most important infections in care home residents in terms of incidence, morbidity and mortality, and we have discussed these in a previous article[5]. We move on here to discuss important non-respiratory infections in this cohort. As with our previous article, we focus on considerations in the classification, epidemiology, diagnosis and management of these which are particular, or particularly relevant, to the care home setting.

Search Strategy

We searched Medline (1950-present) to week 4 January 2010. We used the search terms "nursing homes" OR "homes for the aged" OR "residential care facilities" AND "urinary tract infections" OR "gastroenteritis" OR "colitis" OR "soft tissue infections" OR "skin infections". We found 294 articles, of which 7 were duplicate entries, 20 were not relevant to care homes and 2 were about children. This left 265 articles which were read in full. Relevant publications from the reference lists of these articles were also reviewed.

What is a care home?

A care home is defined in the United Kingdom (UK) as "an establishment [which] provides accommodation, together with nursing or personal care, for persons who are or have been ill, who have or have had a mental disorder, who are disabled or infirm, or are or have been dependent on alcohol or drugs"[6]. All care homes provide support with activities of daily living but are classified as either residential care homes or care homes with nursing depending on whether they provide dedicated 24-hour professional nursing care. Considering the whole sector, only 8.6% of residents

are <70, with 76% overall requiring assistance with their mobility or being immobile, 78% having at least one form of mental impairment and 71% suffering incontinence[2].

Although most developed countries have a care home equivalent, the model of separate residential and nursing care is far from universal[7, 8]. Further, models of care differ between countries, ranging from the highly medicalised, where medical support is provided in hospital-style surroundings, to the highly socialised, where a primarily residential ethos is adopted, such as in the UK.

This residential ethos presents a number of challenges regarding infection control in the UK. Firstly homes are small, with a mean number of residents of 36 in 2009[9], which facilitates containment of infections but makes a structured response in the face of outbreaks difficult[10]. Secondly, most homes are decorated with carpets and soft furnishings which are difficult to keep clean[11]. Finally, the residential ethos of homes makes hospital-style isolation procedures difficult.

Not all aspects of the literature on infections in long-term care can readily be translated across national boundaries. We attempt here to present findings of sufficient generalisability to be useful in most contexts.

What is the prevalence of infection in care homes?

Data on the prevalence of infections in care homes come from the USA[3, 12, 13], Norway[14, 15], Germany[16], the Netherlands[17] and Belgium[18]. These studies adopted differing designs, ranging from point-prevalence studies to rolling surveillance programmes, identified and reported infections in different ways and used different classification systems for infection. All were compromised by the fact that acute infections resulting in hospital admission, such as viral gastroenteritis, are readily identified whereas endemic but unobtrusive infections, such as tinea corporis, are not. Regardless of these concerns, a clear hierarchy is evident with urinary tract infection (UTI) the most prevalent non-respiratory infection, followed by soft tissue and gastrointestinal infections, as summarised in table 1.

Table 1 – Point prevalence of common infections in care home populations(3, 13-15)	
Type of infection	Point prevalence (% of care home population)
Respiratory Upper Respiratory Tract Lower Respiratory Tract	0.3-3.7 0.13 0.3-1.6
Urinary Tract	0.6-21.8
Skin and Soft Tissue	1.0-8.8
Gastrointestinal	0.50

Urinary tract infections (UTI)

UTI is common amongst care home residents[15, 19] and is a major source of antibiotic prescribing in this group. Incidence and prevalence rates vary according to the diagnostic criteria used and whether they include patients with asymptomatic bacteriuria or catheters[20]. A study in Californian nursing homes using resident records and laboratory reports determined an incidence of 34.2%[21], whilst a prospective year–long surveillance study in a 103-bedded nursing home in Germany reported an incidence of 1 infection per 1000 resident-days[16]. Point prevalence rates have been reported at 1.58-3.8 in nursing homes[13, 15]. The prevalence of asymptomatic bacteriuria is much higher, with rates of 15-50% in non-catheterised US residents of long term care facilities[22] and similar rates documented in other countries [23, 24].

Bacteriology

The commonest causes of UTI in older people are *Escherichia coli* and *Proteus mirabilis*[22, 25]. However, care home residents more frequently experience UTI due to bacteria which are antibiotic-resistant or more commonly associated with hospital infection, including *Pseudomonas aeruginosa*, *Klebsiella pneumoniae, Citrobacter spp.* or *Providencia stuartii*[26]. This may, in part, be attributable to the high incidence of antibiotic prescribing in the older population, with studies suggesting a strong

link between the frequency with which an antibiotic is prescribed and subsequent antimicrobial resistance amongst urinary pathogens[25, 27].

Asymptomatic bacteriuria describes a positive urine culture, with or without pyuria and without associated clinical symptoms. It is commoner in women, with advancing age[28], is associated with pyuria in over 90% of cases[22], is inevitable in long-term catheterisation and has an incidence of 3-6% per day with short-term catheters[29]. Treatment has no effect on mortality or incidence of symptomatic infection and leads to morbidity from drug side effects and a higher incidence of antimicrobial resistance[22]. The number needed to harm (NNH) for antibiotic treatment of asymptomatic bacteriuria is 3 (95%CI 2-10)[29].

Diagnosis

The diagnosis of UTI is frequently overestimated in care home residents[30]. Asymptomatic bacteriuria should not be treated and symptomatic enquiry should therefore guide diagnosis. Symptoms are commonly divided into lower urinary tract symptoms (LUTS) – dysuria, urgency and frequency – and upper urinary tract symptoms (UUTS) – LUTS plus loin pain and fever.

Diagnostic criteria for UTI in residents of long term care facilities were developed in 2000 by a US expert-consensus panel using a modified Delphi approach[31]. They suggested, for patients without a catheter, that a UTI could be diagnosed on the basis of acute dysuria alone, or a fever of 37.9 ºC plus any of new or worsening urgency, frequency, suprapubic pain, macroscopic haematuria, urinary incontinence or costovertebral angle tenderness. In those with a catheter, LUTS were held to be less useful and it was therefore suggested that diagnosis be on the basis of a fever of 37.9 ºC or 1.5 ºC over baseline, new costovertebral angle tenderness, rigors or new onset of delirium. It is likely, however, that the false attribution of delirium to urinary tract infection because of the high prevalence of asymptomatic bacteriuria results in much of the overtreatment previously described[32] and these guidelines should therefore be applied with some degree of caution.

A study of 551 non-catheterised nursing home residents found dysuria (RR 1.58 95%CI 1.10-2.03), change in character of urine (RR 1.42 95%CI 1.07-1.79) and change in mental status (RR1.38 95%CI 1.03-1.74) to be associated with bacteriuria and pyuria[33]. Dysuria plus one or both other symptoms was the highest predictor of bacteriuria/pyuria, and identified 63.2% of people with a UTI.

Obtaining samples

Obtaining samples of urine from care home residents may be difficult due to frailty, incontinence and cognitive impairment. A mid-stream urine is non-invasive but is associated with a high contamination rate which, contrary to received wisdom, is not reduced by cleansing the urethra with water[34]. In men a urethral sheath can be used in patients who cannot produce a specimen whilst, in women, an in-and-out catheter may be the best option[22]. Newcastle urine collection pads (UCPs) represent a non-invasive way of collecting urine, however specimens collected from these are much more useful for dipstick urinalysis than microbiological analysis[35, 36].

Bedside tests

Bedside tests are useful only as an adjunct to clinical diagnosis. Visual inspection of urine has a 90.4% sensitivity but only a 66.4% specificity for bacteriuria, is dependent upon the experience of the observer and is not, therefore, a useful test [29]. Dipstick tests, meanwhile, are frequently positive for leucocytes due to the high prevalence of asymptomatic bacteriuria in the care home population. A dipstick positive for leucocytes and nitrites has a disappointingly low positive predictive value of 44%[33]. Dipstick tests can also miss UTI as a consequence of the fact that some organisms, including *Streptococcus pneumoniae, Enterococcus* or *Pseudomonas aeruginosa,* do not express bacterial nitrate reductase[37] and are therefore of limited value in care homes. Men have a high incidence of UTI secondary to organisms which may not form nitrites and should have urine sent for culture if they have symptoms of UTI, regardless of dipstick result[29]. Dipstick tests should not be performed in patients with long-term catheters as constant bacteriuria and pyuria means that the test is not useful.

Laboratory diagnosis

The threshold for laboratory diagnosis of UTI varies between countries. In the UK, 10^4 colony forming units per ml (cfu/ml) is used as a lower threshold of a positive culture[34]. However, counts as low as 10^2 cfu/ml may be accepted in women with definite symptoms of urinary tract infection ("low-count" UTI) [29]. In men, while there is less evidence to guide laboratory diagnosis , a lower cut-off of 10^3 cfu/ml with 80% predominance of one organism may be diagnostic of UTI[29]. This is lower than the current UK laboratory standard of 10^4 cfu/ml, and samples with 10^3 cfu/ml may be reported "no significant growth". Liaison with a microbiologist may be indicated if clinically a UTI is suspected but a sample is negative.

In catheterized patients, surveillance cultures are not necessary and may lead to harm of the patient through unnecessary treatment. Similarly, follow-up cultures after successful treatment are not required[34].

Prevention

A recent Cochrane review considering prevention of UTI suggested that antibiotic prophylaxis was beneficial in non-pregnant patients[29, 38]. The benefit of antibiotics ceased after discontinuation. However, the majority of studies were in younger patients and no studies were conducted specifically in the care home setting. Further, the incidence of clostridium difficile enteritis in care homes is high and the role of antibiotics in the aetiology of such infections well demonstrated.

The Scottish Intercollegiate Guideline Network (SIGN) suggest that high-dose cranberry tablets can be used to prevent recurrent UTI[29]. Only one head-to-head trial has compared the effectiveness of antibiotic prophylaxis with cranberry products, showing a modest but statistically non-significant advantage for antibiotics, with a relative risk of symptomatic UTI during treatment of 1.62 in the cranberry group compared with antibiotics[39]. The number needed to treat to prevent one infection with cranberry is 6.4 compared with for 1.1 antibiotics but the number of adverse events is

significantly lower[40]. Care is needed when advising cranberry for those on warfarin as the INR (international normalized ratio) may be increased.

Oral oestrogens appear to be less effective than antibiotic prophylaxis and are not recommended for prevention of UTI[29]. Vaginal oestrogens may be of some benefit.

Treatment

Women with LUTS may be treated with three day courses of antibiotics[29], though some older women will relapse and in this case longer courses of up to 10 days may be needed. A Cochrane review compared single dose, 3-6 days and 7-9 days of antibiotic therapy for UTI and concluded that 3-6 days was associated with fewer adverse effects than longer courses but had similar benefits[41]. Single dose therapy was least effective.

Men usually need longer courses of antibiotics (7-14 days) due to high rates of prostatic involvement[29]. Some UTIs are described as "complicated" because bacteria are more difficult to eradicate, and longer courses of antibiotics are necessary. Examples of abnormalities which cause complicated UTI include renal or bladder stones, the presence of a urinary catheter, diabetes mellitus, neurogenic bladder, bladder outflow obstruction and ureteric reflux, all of which are common in care home residents. Because patients with catheters commonly present with multi-resistant organisms, treatment should be given according to antibiotic sensitivities. If treatment cannot be delayed, then antibiotic choice should take into account any previous positive urine cultures.

SIGN guidelines recommend ciprofloxacin for 7 days as first line treatment for patients with UUTS because of the possibility of bacteraemia[29]. Quinolones may be particularly useful in the care home setting because they produce similar plasma levels whether given orally or intravenously[37] and thus can mitigate the need to admit to hospital. It should be noted that quinolones should not be used for treatment of UTI in general due to a high associated incidence of clostridium difficile[29] and should probably only be commenced following discussion with a microbiologist.

Men in care homes should be referred to urology if they fail to respond to antibiotics, develop two UTIs within three months, or manifest UUTS[29].

Skin and soft-tissue infections

The prevalence of skin infections is 1.0-8.8% amongst the care home population but they may account for up to 50% of infections[15, 20]. Infections with Methicillin-Resistant *Staphylococcus aureus* (MRSA), infected decubitus ulcers, scabies and tinea raise specific issues for consideration in the care home setting.

Methicillin-Resistant Staphylococcus Aureus (MRSA)

22-23% of UK care home residents are colonised with MRSA[42, 43], compared with 0.8% of community-dwellers[22] and 15% of hospital in-patients >65[44, 45]. Colonisation is seen in 1.1-35% of residents of long-term care facilities depending on country[46-50]; though the reasons for such wide-ranging prevalence are unclear, they may include institutional factors such as the frequency of transfer to acute hospital, local infection control and antibiotic prescribing policies, and also the frequency of instrumentation.

Patients colonized with MRSA have a higher mortality than those colonised with methicillin-sensitive *Staphylococcus aureus* (MSSA), with an odds ratio of death of 1.93 (95% CI 1.54–2.42)[51], though this difference is less marked in the care home population than in hospitalised patients[52] possibly due to lower rates of instrumentation. Care-home residents are more likely to become colonized if they have invasive devices (such as indwelling catheters or gastrostomy)[53], decubitus ulcers[54], have previously been colonised with MRSA or have recently been on antibiotics[55].

The interaction between reservoirs of MRSA in care homes and hospitals is well recognised with recent transfer representing an independent risk factor for MRSA infection[56-58]. Failure to control infection rates in one reservoir can overwhelm the other[59] and controlling colonisation rates in care homes has therefore been seen as possible way to influence infection rates in acute hospitals[60]. Unfortunately, a Cochrane review revealed no evidence for effectiveness of eradication of MRSA

using either topical or systemic antimicrobial therapy in any setting, including care homes[61]. A second Cochrane review, which sought randomized-controlled trials evaluating barrier methods, hand-washing or environmental hygiene in a care home setting, found no studies to meet its inclusion criteria[60]. Clearly, further care home specific trials of MRSA-eradication and prevention strategies are needed if a cogent argument is to be made that such measures are either effective or beneficial.

Decubitus ulcers

Decubitus ulcers are common in care homes, with a prevalence of 11.9-39% compared to 8.3-23% of acute hospital inpatients[62]. There is considerable international variation with prevalence being six times higher, for example, in the Netherlands than in Germany, with no apparent explanation for the difference[63]. Incidence rates are at their highest in the first few days following admission to a home[64], suggesting that many ulcers are sustained during acute admissions, prior to transfer to the home, or in the recovery period immediately following acute illness. The higher prevalence of MRSA and other antibiotic resistant organisms[65] in care homes increases the likelihood that these ulcers will become colonized by multi-resistant bacteria. MRSA is more virulent and more likely to cause acute bacteraemia in active wounds such as decubitus ulcers than other bacteria[50].

Signs of infection in pressure ulcers are erythema at the ulcer margin, malodour, new pain, warmth or purulent discharge. The International Guidelines on Pressure Ulcer Management recommend that infection be confirmed by either tissue biopsy or quantitative swab techniques before commencing antibiotics[66]. Randomized controlled-trial level evidence to guide treatment is unavailable but expert consensus suggests use of silver and iodine impregnated dressings as a first-line, with topical antibacterial agents reserved for patients slow to respond[66, 67]. Systemic sepsis as a complication of decubitus ulcer has a high mortality in the care home population, and physicians should have a low threshold for instituting hospital admission in patients who develop signs of sepsis[68].

Osteomyelitis secondary to decubitus ulcer is significantly more likely in full-thickness ulcers involving bone[68]. It cannot be diagnosed clinically in the care home setting, and when suspected, patients should be admitted to hospital for definitive imaging, usually Magnetic Resonance Imaging, followed by deep bone biopsy to guide treatment[69]. Clearly, such decisions need to be shaped by an understanding of a resident's overall prognosis.

Scabies

Scabies is common in care homes: in one survey of 179 Canadian long-term care facilities, 25% reported a scabies outbreak over a 1-year period[70]. It is caused by irritation from the eggs, faeces and saliva of the *sarcoptes scabiei* mite, which reproduces in the interdigital spaces of the hands and feet, axillae and genital regions of infected patients. The usual response is for a patient to scratch, killing the mite and therefore keeping the number of infesting organisms low.

The classical presentation is of intense pruritis, widespread papules, vesicles and excoriations and, most characteristically, serpiginous burrows a millimetre or two in length in the interdigital spaces or on the forearm. On close inspection, the lesion can sometimes be seen to have a burrow entrance, with a vesicle (and sometimes a mite, visible as a black dot) at the opposite end[71]. Scabies can be sexually transmitted and it is important to remember this as a differential diagnosis for genital pruritis in the care home population[72].

Norwegian, or crusted, scabies is a fulminant version of the infection, characterised by high levels of infestation with thousands of mites on a single patient[71] due to frailty, immunosenescence and a reduced ability to scratch[71, 73]. A consequence of such high levels of infestation is the formation of atypical crusted skin lesions which can be indistinguishable from psoriasis or eczema. Eosinophilia is seen in just over half of cases, which may raise suspicion[74]. Serum IgE levels are increased in up to 98% of cases but this test is not routinely conducted in clinical practice.

Classical (non-Norwegian) scabies is contagious where there is prolonged skin-to-skin contact[75], which is common in care homes. Further, patients are often asymptomatic but contagious during the

3-week incubation period[76] – during which time they could easily infect staff members or other residents. Norwegian scabies is highly contagious because of the high parasite load and can spread by even transient skin-to-skin contact[73, 76].

Current guidelines tend to favour the use of topical permethrin on the basis of proven efficacy and a favourable side-effect profile[77, 78]. Malathion is probably better tolerated but has less evidence supporting its efficacy and, in particular, no head-to-head trial with permethrin is available[78]. Effective application, with complete body coverage below the neck and concordance with treatment is essential for efficacy – permethrin requires two applications lasting twelve hours and malathion, one application lasting 24 hours. A key issue in care homes is that all residents with scabies, along with all residents or staff who have had contact with them, are treated simultaneously – this in practice often means treating all residents and staff in the home[79].

Oral ivermectin is an effective but controversial treatment against scabies[80] because of excess deaths following treatment amongst 47 residents of a Canadian long-term care facility[81]. However, most authorities assert that the treatment is safe, as these findings were not reproduced in cohorts of 47 Colombian[82] and 220 Dutch[83] nursing home residents. It is available in the UK on a named patient basis for treatment of Norwegian scabies[77] but is not recommended by the Food and Drug Administration in the US[84].

Following treatment, the patient's bedding and clothing should be washed at minimum 50°C and all soft furnishings and carpets vacuumed[77]. The scabies mite is incapable of surviving outside of the body for longer than 24 to 36 hours in conditions typically found in centrally-heated care homes[85], and is dependent on shed skin cells for survival, which are readily removed by modern vacuum cleaners.

Tinea

Tinea pedis, corporis and capitis describe fungal infections of the feet, body and scalp respectively. These are characteristically superficial skin infections of tricophyton or microsporum species and are

usually sporadic and readily controlled by routine topical antifungal therapy[86]. Both outbreaks and epidemics of tinea have been described in care homes [87, 88] and involved atypical fungal organisms, spread by staff and personal hygiene utensils (combs and razors). Staff also contracted the infection. Staff therefore need to ensure both prompt medical attention and close attention to barrier nursing methods when index cases of tinea are identified.

Gastrointestinal infections

Although the incidence of gastroenteritis is relatively low in older patients, care home residents are much more likely than their community-dwelling counterparts to be hospitalised or die as a consequence of infection[89]. A US review conducted 1995-1997 reported the death rate in nursing home residents due to gastroenteritis as 38.91 (95% CI, 38.55–39.27) per 100,000 persons, compared with 8.50 (95% CI, 8.47–8.53) for all over-65s[90]. Gasteroenteritis can be split into viral and bacterial aetiology, with special consideration given to *Clostridium difficile* given its high mortality in this group.

Viral gastroenteritis

Epidemiology

The incidence of viral gastroenteritis, of which the two most common causes are norovirus (synonyms “Norwalk-like viruses” and “small, round-structured viruses”) and rotavirus, considerably outstrips that of bacterial gastrointestinal infections in care homes[91]. In 2006, norovirus was the cause of 96% of acute gastroenteritis outbreaks in the US. Of these, 50% of the non-food related outbreaks occurred in long-term care facilities[92]. In Europe, 34-39% of norovirus outbreaks occur in care homes[93, 94].

Norovirus infections in care homes are commonly associated with person-to-person spread, predominantly via the faecal oral route, even when the index case is acquired from food[92, 95]. A characteristic winter peak in incidence occurs, which coincides almost exactly with the winter peak in respiratory infections[94].

Diagnosis

Kaplan et al [96] suggested that viral gastroenteritis can be diagnosed clinically and is characterised by a short incubation period (24-60 h), a short infection duration (12–60 h) and a high frequency of vomiting (>50% of cases). These criteria are, however, based upon studies in healthy volunteers and critics suggest that infections are both less typical and less benign in care home residents[94].

Infection Control

Because norovirus is environmentally very stable, difficult to eradicate and highly infectious, particular attention is required to infection control measures. Chadwick et al[97] provided useful recommendations for the containment of norovirus outbreaks in the hospital setting, most of which also apply to the care home setting, and these are summarised in box 1.

Box 1: Measures for containment of norovirus infection, from Chadwick et al(97)
• Isolate or cohort symptomatic residents. • Wear gloves and apron for contact with affected patients and change these between patients. • Wash hands with soap and water after contact with an affected patient. • Exclude affected staff from duties until symptom-free for 48 hours. • Close of the facilities to new admissions. • Limit visits and advise visitors on handwashing. • Promptly clean body fluid spillages. • Increase the frequency of routine cleaning. • Use 0.1% (1000 ppm) hypochlorite to disinfect hard surfaces and clean soft furnishings with either steam or detergent and hot water.

Chlorhexidine and alcohol are ineffective against norovirus and therefore bleach must be used for cleansing surfaces, and soap and water for washing hands[97, 98]. Staff must wear protective clothing

during contact with infected residents, as exposure to vomitus increases the risk of contracting the illness, though concordance with wearing gowns in particular appears poor [95].

Isolation and cohorting of residents can prove difficult in care homes due to shared bathroom facilities and wandering residents. Minimising the amount of time for which residents are isolated helps considerably. For norovirus, viral shedding in stool normally peaks between 24 and 72 hours[99] but can last longer, and has been reported up to 45 days following resolution of symptoms in care home residents[100]. On the basis of pragmatism, most authors recommend isolating patients for 48-72 hours after symptom resolution[98].

The recommendation that staff be excluded from work for 48 hours following resolution of symptoms is similarly pragmatic, however longer periods of staff exclusion may be both desirable and cost-effective. A UK case-control study comparing staff exclusion for either 48 or 72 hours showed significantly lower infection and attack rates in the 72 hour group and suggested that the net effect on staff availability was minimal[101]. Staff education and a no-blame culture are essential to maintain staff compliance with such protocols, as staff presenteeism during illness is common [95].

Treatment

Much of the excess morbidity and mortality associated with viral gastroenteritis in the care home cohort is likely to be due to the effects of dehydration[94] and treatment largely focuses on avoiding this. UK care homes are unable to provide intravenous fluids and such therapy necessitates transfer to hospital. Clearly such transfer is problematic both because it spreads infection and exposes a frail patient to the risks of the acute hospital. An alternative is to use antimotility drugs, such as loperamide or racecadotril[102], whilst pursuing aggressive oral rehydration.

Food-borne gastroenteritis

Food-borne gastroenteritis outbreaks can readily take place in care homes because food is often prepared in a central kitchen and served communally, and outbreaks due to *Bacillus cereus*[103],

Salmonella enteritidis[104] and verotoxin producing *Escherichia coli* serotype O157[105] have been described. Depending on the organism, these outbreaks can either be self-limiting or perpetuated by person-to-person spread. The potential for spread is greater in care homes than in the community due to the combination of close contact between residents and the high rates of faecal incontinence, especially during diarrhoeal illness. *E. coli* O157 is particularly important because of its association with haemolytic uraemic syndrome and excess mortality is reported over the age of 50[106]. It can present non-specifically in care home residents, with visible bloody diarrhoea in only 65-75% of patients[106]. Of the four outbreaks reported in the literature, the rate of conversion to haemolytic uraemic syndrome ranges from 0-14.2% and the mortality rate from 3-14.2% [106-110].

Clostridium difficile *enteritis*

Residence in a care home, especially in the first year after admission, is an independent risk factor for *Clostridium difficile* infection, which occurs in 7-9% of residents compared with 2% of healthy adults[111]. Reasons for this include high levels of antibiotic prescribing, the increased incidence of proton-pump inhibitor mediated achlorhydia and the frailty of care home residents[111, 112]. Once established in a home, clostridium difficile can spread via the faecal-oral route and through contact with contaminated surfaces and attention to isolation measures is, again, important. Handwashing using soap and surface cleansing using hypochlorite based substances are essential because these, unlike alcohol, are sporicidal[112].

Generic issues around gastroenteritis in care homes

Analysis of stool specimens is particularly important in care home residents because it allows correct selection of treatment with loperamide, for example, which is best avoided in haemorrhagic *E. coli* or *Clostridium difficile* infections[113] but represents an important therapy in viral gastroenteritis. It also allows epidemiological analysis of infections to identify the infecting strain of each organism and track its spread.

Regardless of the cause of enteritis, it is likely that the early parts of recognition and management will be conducted without input from a doctor or possibly even a nurse. Thus, operational definitions for gastroenteritis outbreaks are essential[98, 104]. These should, ideally, be written in lay language and presented alongside clear guidelines about early isolation, specimen collection and fluid management. Such guidelines are not, at present, universally available.

Conclusion

Because of the concentration of frail older people in a semi-closed environment, care homes present particular challenges in the diagnosis and management of infection. Infections which are frequently inconsequential in community-dwelling adults can be life-threatening in care home residents, as is the case with UTI. Infections can also behave in atypical ways in this cohort, as is the case with Norwegian scabies or epidemic tinea.

A further challenge when dealing with such frail patients is deciding when to admit them to acute hospital care – which is fraught with risk. There is often an alternative, for example by using intramuscular antibiotics or oral quinolones for UTI, or by using antimotility agents in viral gastroenteritis. Occasionally, however, there is none, for example the need for detailed imaging and bone biopsy in suspected osteomyelitis complicating decubitus ulcer. When such difficult decisions are required they should be made with attention to the patient's overall prognosis and stated wishes.

At an individual home level, prompt recognition and treatment coupled to rigorous infection control are needed to minimise the impact of infection. The fact that care, in the UK at least, is often provided by staff without healthcare qualifications is a challenge to such systematic response. Consideration must be given as to what role care home staff can and should play. Guidelines for the sector should be written with them in mind and, almost certainly, with their input.

At a public health level, antibiotic stewardship and improved links from homes to microbiology and infection control services seem intuitive responses. How to provide such support consistently to a highly heterogeneous sector is a genuine challenge for health service providers and an area for research and development going forward.

Conflict of interest

The authors declare that they have no conflict of interests.

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