Infections in the Long-Term Care Setting

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Key Points

In the long-term care setting

- The diagnosis of infection is primarily based from the clinical assessment.
- Infection is a common cause of fever, when present, and acute change in functional status.
- Infection can often present atypically; usual symptoms, physical findings, and diagnostic abnormalities may be lacking.
- Evaluation of fever and suspected infection should initially focus on the most common clinical syndromes.
- Treatment should initially focus on the most common organisms that are present at the most likely suspect site of infection.

Significance of Infection in the Long-term Care Setting

In the past, infections in long-term care facility (LTCF) were thought to have been as common as those in hospital, but less severe (1). LTCFs were regarded as healthcare facilities that provided skilled care for an indefinite period of time predominantly for elderly patients who were no longer able to live independently. Resources in LTCFs were limited; patients with infections were frequently transferred to a hospital for diagnostic evaluation, intravenous treatment, and monitoring (1, 2). As the role of the typical nursing home (NH) within our healthcare system has evolved, this perception of LTCF's may be changing.

The acuity of the typical "modern" LTCF patient is increasing, as patients are now discharged from hospital to continue treatment for increasingly complex conditions and undergoing rehabilitation prior to being discharged home (1, 3). For example,

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a significant proportion of patients may have indwelling devices that may predispose the patient to infection. With the expansion of rehabilitative, subacute care, and acute-chronic care services, more chronic care facilities are providing a wider range of services for an increasingly ill patient population (1, 4). In this current environment, it is likely that the number, complexity, and severity of infections cared for in LTCF will continue to increase.

In contrast with the acute-care hospital setting, our understanding of the prevalence of infection within the chronic care setting remains relatively scant. Most studies of the chronic care setting primarily describe the typical skilled nursing facility experience that was described above. As a result, this discussion will be limited primarily to skilled nursing facilities/nursing homes, referred to in general as LTCFs.

How Common are Infections in LTCFs?

The prevalence of infection in skilled nursing or LTCFs has been reported to range from 1.8 to 13.5 infections per 1,000 patient-care days with an associated mortality ranging from 0.04 to 0.71 per 1,000 resident-days (1). It is thought that the wide-range of infection rates may reflect the diversity of populations that require chronic inpatient care. Infections of the urinary and respiratory tracts are most commonly followed by skin and soft tissue infections (SSTI); these three clinical syndromes account for the majority of infections seen in the chronic care setting (1–3, 5). Gastrointestinal (GI) and bloodstream infections (BSI) are less frequently documented and, perhaps, are less prevalent (3). Cultures of blood have not been recommended in part because BSI are perceived to be uncommon; when present death occurs rapidly, and most residents transferred to hospital before the diagnosis of BSI can be made or advanced directives preclude evaluation (2, 6).

The prevalence of specific infectious agents in LTCFs is uncertain. The frequency of infections reported is biased by the ease of specimen collection, diagnostic testing, and the likelihood that the results will alter treatment. The most prevalent infection, urinary tract infection (UTI), is also the most often over-diagnosed clinical syndrome, as cultures of urine are easily obtained and positive results are frequent even in the absence of symptoms (7, 8).

In contrast, the causes of lower respiratory tract infections (LRTI) frequently escape detection. Collection of sputum for culture is difficult; specimens may be collected in <30% of LTCF residents with pneumonia and half of them may be inadequate. Many common, but fastidious, bacterial respiratory pathogens may not grow on routine culture and diagnostic testing, for most viruses are not readily available or sensitive (2, 9–11). Without culture of blood or tissue, the etiology of SSTI is rarely known, and differentiation between infection and superficial colonization is difficult (12, 13). Diarrhea is also a common cause of infection in LTCFs and often self-limited unless *Clostridium difficile* is suspected, care is generally supportive. With the exception of *C. difficile*, fecal samples are rarely tested for viruses, as these tests are generally not available and parasites and other bacterial etiologies are relatively uncommon as causes of LTCF-associated diarrhea (2, 14, 15).

The organisms that cause common clinical syndromes in LTCF will be discussed under each entity below. Other mitigating factors that can influence the prevalence of microorganisms, specifically within the LTCF, such as the prevalence of device use, acquisition in hospital prior to admission, antecedent use of antibiotics, and the state of the host immune system, will also be discussed.

In general, antibiotic-resistant bacteria emerge and thrive in environments such as hospitals and intensive care units where the selective pressure of antibiotic use is the most intense. Colonization with antibiotic-resistant bacteria is common in the LTCF setting (1). An important area of investigation is predicting which residents who are colonized with resistant bacteria will develop infection (16).

Clinical Manifestations

Residents with impaired cognitive or communication abilities may not be able to provide a reliable history. Aging, comorbid illness, and medications may impair the host inflammatory response, leading to blunting of focal symptoms and physical findings. Thus, detection of infection by history and physical examination in LTCF residents can be especially difficult; findings suggestive of a specific clinical syndrome may be subtle or absent. In LTCF residents with other non-infectious illnesses, the significance of abnormalities noted on physical or laboratory examination may be misinterpreted. Changes in symptoms and signs associated with specific clinical syndromes will be discussed under those topics.

A more generalized approach is necessary to detect infection in LTCF residents. Acute or worsening changes in the ability to perform basic activities of daily living such as toileting, mobility, dressing, or feeding can be a very sensitive indicator for infection in LTCF residents. Fever can be a very useful indicator if its definition is sufficiently sensitive to detect most infections in the population being evaluated. The most common definition of fever (temperature >101°F) is met in only 40% of LTCF residents. If the fever definition in this population is lowered to 100°F (37.8°C), then 70% of infections will be detected with a specificity of 90%. More than half of NH residents with a temperature of 100°F will have infection. Other investigators have suggested that baseline temperatures should be established for each resident; fever would be defined as an increase of 2°F (1.1°C) over the baseline temperature or >99°F (37.2°C) orally or 99.5°F (37.5°C) rectally (2, 5, 17). Signs of dehydration such as decreased oral intake, dry mucous membranes and tongue, or furrowed tongue may, indirectly, be an indicator that fever and possible infection is present in this population (2, 5).

Diagnosis

Often mentioned criteria for infection were primarily developed as a tool for retrospective infection detection for surveillance purposes, rather than for diagnosis. Criteria from the Centers for Disease Control and Prevention (CDC) were derived from the acute-care experience and rely heavily on laboratory results and diagnostic procedures. Alternate

definitions for LTCF have been sought. The McGeer criteria were developed specifically for LTCFs and rely primarily on readily available clinical criteria derived from history and physical examination (see Table 1) (18). The Minimum Data Set was developed to document resident problems on a quarterly basis during their LTCF stay, but recent studies suggest that this is not a reliable instrument for diagnosis of infection (19, 20).

Table 1 McGeer et al. criteria – adapted from definitions for infection surveillance in long-term care facilities: Reference (18)

General principles
  All symptoms must be new or worsening
  Consider non-infectious etiologies before making the diagnosis
  Identification of infection should not be based upon one piece of evidence.

Urinary tract infection
  Only symptomatic bacteriuria is included
  No indwelling urinary catheter and ≥3 criteria are met:
1. Fever ≥ 100.4°F (38C) or chills
2. New or increased dysuria, frequency, or urgency
3. New flank or suprapubic pain or tenderness
4. Change in character of the urine[a]
5. Worsening of mental or functional status
     Indwelling catheter and ≥2 criteria are met:
(a) Fever ≥100.4°F (38.C) *or* chills
(b) New flank or suprapubic pain or tenderness
(c) Change in character of the urine[a]
(d) Worsening of mental or functional status

Pneumonia
  Non-infectious causes must be ruled out
  Both of the following criteria must be met:
1. Chest radiograph demonstrating definite or probable pneumonia or a new infiltrate
2. ≥2 other symptoms of lower respiratory tract infection
(a) New or worsening cough
(b) New or increased sputum production
(c) Fever ≥100.4°F (38°C)
(d) New or increased physical findings (rales, rhonchi, wheezes)
(e) At least *one* indication of breathing difficulty
     (1) New or increased respiratory rate >25 breaths per minute
     (2) Worsening mental status
     (3) Worsening functional status
Cellulitis/skin and soft tissue infection
  One of the following criteria must be met:
1. Pus present at a wound, skin, or soft tissue site
2. Presence of *four* or more clinical manifestations:
     (a) Temperature >100.4°F (38°C) *or* worsening mental/functional status *and/or at the affected site*:
     (b) New or worsening warmth
     (c) New or increasing erythema
     (d) New or worsening swelling
     (e) New or increasing tenderness or pain
     (f) New or increasing serous drainage
Mucocutaneous fungal infection
  Both criteria must be met:

(continued)

Table 1   (continued)

1. Maculopapular rash
2. Physician diagnosis or positive smear for yeast

Herpetic infections (varicella zoster and simplex)
   Both criteria must be met:
1. Vesicular rash
2. Physician diagnosis or positive viral culture or direct fluorescent antibody test

Conjunctivitis[b]
   One of the following criteria must be met:
1. Purulence from one or both eyes for >24 h
2. New or increased conjunctival redness for ≥24 h
Scabies
   Both of the following criteria must be met:
1. Maculopapular rash and/or pruritic rash
2. Physician diagnosis or positive microscopic examination
Gastroenteritis
   Rule out non-infectious causes such as medications
   One of the following criteria must be met:
1. ≥2 loose or watery stools above what is normal within 24 h
2. ≥2 episodes of vomiting within 24 h
3. Both of the following:
   (a) At least *one* symptom compatible with a gastrointestinal infection (nausea, vomiting, abdominal pain, diarrhea)
   (b) Positive stool toxin for *Clostridium difficile* or culture for an enteric bacterial pathogen

[a]Urinalysis – new pyuria and hematuria in a patient with a previously negative test, observation – new gross hematuria, foul odor, sediment
[b]Symptoms must not be due to allergy or trauma

Few studies have assessed what laboratory procedures are useful in establishing the diagnosis of infection in LTCF residents. A complete blood count (CBC) is a useful diagnostic test to obtain in this setting. Evidence of leukocytosis and or left shift provides strong evidence that an older adult has an infection as defined as a white blood cell count >14,000 cells/mm^3, neutrophils >90%, or elevated total band count >6% or >1,500 cell/mm^3 (2). Suspicion of dehydration may be supported by the presence of hypernatremia and prerenal azotemia; 60% of LTCF residents may have at least one of these chemical abnormalities (2). Abnormalities of the complete blood count and serum chemistry can provide important clues that infection is present.

General Principles of Antimicrobial Treatment and Prophylaxis in the LTCF Resident

The need to start antibiotic therapy should be based on the patient's clinical condition; all LTCF patients do not require urgent treatment. Minimum clinical criteria required to initiate empirical antimicrobial therapy for infection have been developed based on expert opinion (21). The burden of evidence for infection required to start

antibiotic treatment is stratified by the presence of risk factors (e.g., devices), severity of symptoms, and presence of underlying diseases such as chronic obstructive pulmonary disease (COPD) (see Table 2).

If urgent treatment is needed, then the empirical choice of antimicrobial should be based on the most likely clinical syndrome and the most likely organism causing an infection at that site. The prevalence of pathogens and their antimicrobial susceptibilities do vary with institutional and geographic factors. Consultation with

Table 2 Minimum criteria for the initiation of antibiotics in residents of long-term care facilities: Adapted from (21)

Urinary tract infection
No indwelling urinary catheter:
1. Acute dysuria *alone*
2. Fever ≥100°F (37.9°C) or 2.4°F (1.5°C) above baseline plus ≥ one of the following:
   (a) New or worsening urgency
   (b) Frequency
   (c) Suprapubic pain
   (d) Gross hematuria
   (e) Costovertebral angle tenderness
   (f) Urinary incontinence
Indwelling urinary catheter:
1. ≥ One of the following criteria must be met:
   (a) Fever as defined above
   (b) New costovertebral angle tenderness
   (c) Rigors
   (d) New onset of delirium as defined by the DSM IV
Respiratory tract infections
1. Fever >102°F (38.9°C) *and* ≥ *one* of the following
   (a) Respiratory rate > 25 breaths per minute
   (b) Productive cough
2. Fever >100°F (37.9°C) ≤ 102°F (38.9°C) *with* cough *and* ≥ *one* of the following:
   (a) Pulse > 100 beats per minute
   (b) Delirium (DSM IV criteria)
   (c) Rigors
   (d) Respiratory rate > 25 breaths per minute
3. Afebrile and high risk COPD (defined as age ≥ 65 years)
   (a) New or worsening cough *and* purulent sputum
4. Afebrile without COPD
   (a) New cough, purulent sputum *and* ≥ *one* of the following:
      Respiratory rate > 25 breaths per minute
      Delirium (DSM IV criteria)
Skin and Soft Tissue Infection
1. New or increasing purulence at the site of the lesion or wound *or* ≥ *two* of the following:
   (a) Temperature >100.4°F (37.9°C) or an increase of 2.4°F (1.5°C) over baseline
   (b) Erythema
   (c) Tenderness/pain
   (d) Warmth
   (e) New or increasing swelling increasing at the affected site

DSM IV Diagnostic and Statistical Manual of Mental Disorder, 4th edition; *COPD* Chronic Obstructive Pulmonary Disease

the LTCF infection control practitioner and pharmacist can be useful in determining what bacteria and antibiotic resistance profiles are common.

The choice of route for antibiotic administration will be influenced by the severity of the patient's clinical condition, treatment plan, and advance directives. Intravenous (IV) or intramuscular (IM) therapy may be required in the patient with a non-functioning GI tract where absorption of an oral antibiotic is not guaranteed. In the severely-ill LTCF resident who is to remain in the facility and receive IV therapy, broad-spectrum penicillins, second-and third- generation cephalosporins, and carbapenems treat a wide array of beta-lactam-susceptible streptococci, methicillin-susceptible *Staphylococcus aureus*, and aerobic and anaerobic gram-negative bacilli (GNB). Enterococci are not generally susceptible to cephalosporins. Some penicillins cannot be given intramuscularly because of the large doses required and pain with infection; use of broad-spectrum penicillins and some carbapenem antibiotics can be limited by their frequent dosing intervals. If the patient is penicillin-allergic or antibiotic-resistant bacteria are a concern, then treatment with a combination of antibiotics may be necessary.

Treatment should be altered once organisms are identified and antimicrobial susceptibilities are available. Duration of therapy is based on the presumed clinical syndrome to be treated and the organism isolated. Oral therapy can be considered for some clinical syndromes and pathogens, especially if the medication is 100% bioavailable (e.g., fluconazole, linezolid), the patient is clinically stable, and the patient has a functional GI tract. Cost, drug interactions, and toxicity are other factors which should influence the choice of an antibiotic for a LTCF resident. If renal and hepatic dysfunction is present, then adjustments in dose and frequency of administration should be made.

Prevention

To prevent infection, risk factors must be minimized. Risk of infection may relate to exogenous exposures (other patients, healthcare workers (HCW), or the LTCF environment) or factors intrinsic to the patient (see also chapter "Infection Control Programs in Nursing Homes"). Frequent hand disinfection and adherence to infection control procedures are essential to prevent LTCF-associated infection. Reduction in patient risk factors that contribute to the most common infectious syndromes will be discussed later.

Intrinsic patient factors (underlying disease and debility) frequently lead to presence of extrinsic factors (use of medications and devices) with their side effects and complications. Improvement in function and treatment of comorbid conditions can minimize the use of devices and medications that lead to infection. For example, antimicrobial drugs inhibit and kill the growth of normal flora and allow pathogens to grow. Non-antimicrobial medications can alter the host environment leading to unfavorable growth conditions for normal local flora with subsequent overgrowth of pathogenic flora. Minimizing the use of antibiotics and other unnecessary medications may help prevent infection in LTCF residents. Devices can breech

normal host defenses and allow pathogens to invade and to cause infection. Use of devices contributes to the development of infections of the urinary tract (urethral catheters), respiratory tract (tracheostomy tubes), GI tract (feeding tubes and thermometers), and IV catheters (phlebitis and BSI). To reduce the risk of infection, devices should be removed as soon as they are no longer necessary.

Clinical Infectious Syndromes

In this section, the major focus will be on how the clinical presentation and management of common causes of infection differs in the LTCF. For a more general overview, please refer to specific chapters on each topic.

Urinary Tract Infection

Epidemiology and Clinical Relevance

It is not surprising that the urinary tract is the most common source of infection in the LTCF setting (see also chapter "Urinary Tract Infection"). Risk factors that contribute to the development of urinary stasis, in older populations, have been associated with increased rates of bacteriuria (22). Whether urinary stasis alone leads to UTI remains a source of controversy (23). Risk of perineal soiling and urinary contamination by pathogenic bacteria increases in patients with poor functional status who are dependent upon healthcare personnel for toileting. As a result of these factors, a significant proportion of men (15–40%) and women (25–50%) residing in LTCF have bacteriuria and are at risk for UTI (22).

Urinary catheters also introduce potential pathogens into the urinary tract. All residents with a catheter present for more than 30 days will have bacteriuria (24). In a recent nation-wide point prevalence survey of all Veterans Affairs LTCF residents, the indwelling urinary catheter was the most common device in use (3). Residents were 40-fold more likely to have an indwelling urinary catheter than intermittent urinary catheterization; they were also 6-fold more likely to have such a device compared with a suprapubic catheter (3). Residents with an indwelling urinary catheter were significantly more likely to have a UTI (5.5%) as compared with residents without such a device (1.1%) ($p < .0001$). Condom catheters for men have been associated with significantly lower rates of bacteriuria and UTI than indwelling catheters (25).

Etiologic Pathogens

The pathogens causing UTI in LTCF residents are not predictable; urine cultures and antimicrobial susceptibilities must be obtained. The diversity of urinary pathogens

is due in part to the intense selection pressure of antibiotic use in this setting. It is estimated that 20–60% of all antibiotics used in the LTCF setting are given to treat presumed UTI (26). *Escherichia coli* remains the most common pathogen in women, and *Proteus mirabilis* is more common in men (22). Gram-negative bacilli (GNB) predominate such as *Providencia stuartii*, *Pseudomonas aeruginosa*, *Citrobacter* spp., *Morganella* spp., *Serratia* spp., *Enterobacter* spp., and *Klebsiella pneumoniae* (22). Enterococci, group B streptococci, and *Candida* spp., also cause infection in this setting.

Diagnosis

Many NH residents will have significant high-grade bacteriuria ($>10^5$ colony forming units/ml) without symptoms. Pre-emptive trials of treatment for bacteriuria has been shown to be of no benefit in terms of improved well-being, relief of chronic symptoms, prevention of future UTI, or improved survival (7). With the selective pressure of increased antibiotic use, emergence of resistance is inevitable.

Pyuria of any degree does not help differentiate the infected from the uninfected patient, as 30–50% of asymptomatic residents have chronic inflammation as well. It has been known that absence of pyuria strongly correlates with absence of bacteriuria on urinalysis. Urinalysis may not be readily available in most nursing homes; a recent study has shown that use of urine dipstick testing may be an appropriate substitute. If the leukocyte esterase and nitrate are negative, then the possibility of UTI is virtually excluded (27).

There is little diagnostic dilemma if bacteriuria and pyuria are present in addition to typical symptoms and signs referable to the urinary tract such as new or worsening frequency, urgency, dyuria, or flank pain. UTI is a common cause of infection in LTCF residents, but it is rarely a cause of fever (8, 22). These classic symptoms may be lacking particularly in the frail or cognitively impaired patient.

The McGeer et al., criteria require the documentation of significant bacteriuria by culture in addition to new or worsening symptoms. Also, non-infectious causes of nonspecific symptoms such as worsening mental or functional status must also be considered before the diagnosis of UTI is assumed. Asymptomatic bacteriuria should not be treated. These criteria have also stratified definitions for UTI based on the presence or absence of an indwelling urinary catheter (see Table 1). The amount of evidence required for UTI is reduced in the catheterized resident, given that the frequency and severity of infection is greatest among these patients (see Table 1) (18).

To confirm the diagnosis of UTI, the Loeb et al., criteria similarly require the documentation of significant bacteriuria by culture in association with new or worsening symptoms (12). They too agree that asymptomatic bacteriuria, and foul urine, or cloudy urine in the absence of other symptoms, are not sufficient to suspect the diagnosis of UTI or to initiate the use of antibiotics. In the absence of dysuria, the presence of other symptoms such as frequency, urgency, or incontinence requires that a positive urine culture be confirmed to assure that symptoms are likely related

to UTI prior to initiation of antibiotics. The Loeb et al., criteria also lower the quantity of evidence required for the diagnosis of UTI, particularly in residents with indwelling catheters due to their increased risk of severe infection and secondary bloodstream infection (see Table 2) (21). Residents who perform intermittent urinary catheterization are considered to be less likely to have severe UTI - a risk similar to that seen for patients without indwelling catheters (21).

The diagnostic accuracy of criteria developed for the diagnosis of UTI has been prospectively assessed in LTCF residents (28). In general, the McGeer et al., and Loeb et al., criteria were not very sensitive (30%) but were highly specific (79–82%) with a positive predictive value (PPV) (52–57%) and negative predictive value of 60–61%. While more sensitive methods are needed for the diagnosis and treatment of UTI, use of diagnostic algorithms, based on the Loeb et al., criteria, have been shown to reduce unnecessary antibiotic use in LTCFs (29).

Pneumonia/Lower Respiratory Tract Infection (LRTI)

Epidemiology and Clinical Relevance

Pneumonia is typically the second most common infection in LTCF. Rates of infection vary from 0.3 to 2.5 episodes per 1,000 days of resident care (1, 3). In past years, there here have been many risk factors attributed to an increased risk of LTCF-acquired pneumonia, including increasing age, debility, inadequate oral care, swallowing disorders, presence of a feeding tube or tracheostomy, medications that are sedating or reduce gastric-acid, neurological diseases, and many others. Factors that contribute to aspiration appear to be the strongest predictors of pneumonia in LTCF residents (10, 30).

Etiologic Pathogens

Practically speaking, adequate sputum specimens are rare and are obtained in only 5–10% of older adults with suspected pneumonia in the LTCF (2). Therefore, it is difficult to state precisely what organisms are most prevalent in this setting (31). In few carefully performed studies in the LTCF setting, the bacterial causes appear to most closely mirror those seen in older adults in the community rather than those seen in hospitals. *Streptococcus pneumoniae* (13%), aerobic GNB (13%), non-typeable *Haemophilus influenzae* (6.5%), *S. aureus* (6.5%), and *Moraxella catarrhalis* (4.5%) are most common (1, 9, 31). Compared with the acute care hospital, pneumonia due to aerobic GNB is relatively uncommon; when it does occur, *Klebsiella* spp., are the most common genera isolated.

Atypical pneumonia due to *Legionella* spp., *Chlamydia pneumoniae*, and *Mycoplasma pneumoniae* is uncommonly described in LTCFs (31). Influenza and other viruses are common causes of upper respiratory tract infections (URTI) that

can lead to secondary bacterial pneumonia due to pneumococci or *S. aureus* (see also chapter "Viral Infections"). Primary atypical pneumonia due to due to influenza is uncommon; respiratory syncytial virus, parainfluenza, adenoviruses, coronaviruses, rhinoviruses, and metapneumovirus are rarely diagnosed except during outbreaks because access to laboratories is lacking or the sensitivity of currently available tests themselves is poor (11). Tuberculosis (TB) should be considered in LTCF residents with persistent infiltrates and symptoms that do not respond to conventional antimicrobials, particularly if they involve the upper lobes and if there is a history of prior exposure (32) (see also chapter "Tuberculosis in Older Adults").

Clinical Manifestations

Typical symptoms of bacterial pneumonia are relatively infrequent among older residents of LTCF. Most will present with some symptom referable to the respiratory tract, but fever may be lacking in almost half of patients with pneumonia. Symptoms such as cough (60–75%), dyspnea (40%), fever (44–65%), and altered cognition (50–70%) are found in LTCF residents with LRTI (2, 9, 31). Less than 60% of residents will present with a classic triad of cough, shortness of breath, or fever (2, 9, 31). New or worsening tachypnea, respiratory rates >25 breaths per minute, is thought to be a sensitive and specific indicator for pneumonia, but some studies have challenged that assumption (33). On physical examination of the LTCF resident, rales may be present less than 60% of the time (2).

Diagnosis

Measurement of oxygen saturation by pulse oximetry can provide additional evidence that pneumonia is likely. In a controlled trial of pulse oximetry in LTCF, residents with pneumonia were significantly more likely to have hypoxemia than residents without pneumonia. A single oxygen saturation of <94% was 80% sensitive and 91% specific for the diagnosis of pneumonia with a PPV of 95%. A decrease in oxygen saturation of 3% from baseline was less sensitive (73%) but more specific (100%) for pneumonia with a PPV of 100% (33).

   Oxygen saturation measurements can also assist in decisions to transfer residents with suspected pneumonia to hospital, if allowed by advance directives. Patients with oxygen saturations of < 90% generally require more intensive monitoring available in an acute care setting. When this degree of hypoxemia is coupled with a respiratory rate of >25 breaths per minute, the decision to transfer the resident to acute care must be made quickly, as respiratory failure is imminent (2).

   Despite technical difficulties or lack of prior films for comparison, a chest radiograph has been shown to confirm the presence of pneumonia in 75–90% of LTCF residents with pneumonia. It has been suggested that chest radiographs could also provide prognostic information (multi-lobar disease) or evidence of empyema or mass lesions that might alter treatment decisions (2).

The diagnosis of pneumonia should not be made upon an isolated symptom, sign, or finding. For the diagnosis of pneumonia, the McGeer et al., criteria requires that a chest radiograph be done, that evidence for pneumonia or an infiltrate be present, and that other non-infectious causes such as heart failure be excluded. In addition, the patient must also have at least two other symptoms or signs of lower respiratory tract infection, including measures of breathing difficulty (see Table 1) (18).

Despite the difficulties in obtaining sputum from LTCF residents, culture and antimicrobial susceptibilities have been recommended, as the results can help guide therapeutic decisions if the patient is not responding to empirical antibiotic therapy. The presence of antibiotic-resistant bacteria in the facility or uncommon bacteria might alter infection control isolation decisions (2).

Rapid diagnostic tests for respiratory pathogens that do not rely on careful collection of sputum are increasingly available. Urine antigen testing for *S. pneumoniae* and *Legionella pneumophila* serotype 1 has also been proposed, but testing in LTCF populations is limited. During a suspected outbreak of respiratory infection, particularly during winter months, nasopharyngeal swabs for culture and antigen-based testing for viruses may be useful to confirm that an epidemic is present for infection control, and less commonly, treatment and prophylaxis purposes.

If influenza is detected in the facility, then antiviral prophylaxis may be initiated or continued and more intensive infection control measures considered. Use of rapid testing during influenza outbreaks in LTCFs has been associated with reductions in the duration of outbreaks and hospital cost (34). Unfortunately, these antigen-based tests may be only 40–80% sensitive for the detection of influenza (11). The clinician may have to rely on an equally sensitive clinical definition of influenza such as fever and new respiratory symptoms of less than 48 h duration, if rapid testing is negative (35). While diagnostic testing for bacterial and viral pathogens have been recommended as part of an evaluation for pneumonia by an expert panel, there is a need for further evidence that their use will lead to improved outcomes for residents of LTCF (36).

Management Decisions

Specific antimicrobial treatment is discussed elsewhere. The major focus of this section is devoted to general management issues in the older LTCF resident with pneumonia. There have been a number of recent studies devoted to addressing important decisions, primarily in patients with pneumonia.

If a decision is made treat with antibiotics, then when should they be started? For the Loeb et al., criteria, the minimum recommended findings required to initiate antibiotic treatment are stratified by amplitude of fever, productive/non-productive cough, and presence of underlying COPD (see Table 2) (21). High fever with tachypnea or productive cough was felt to be a bacterial pneumonia clinically until proven otherwise. For the resident with low fever and non-productive cough, more evidence based on symptoms and signs were required for the initiation of antibiotics.

For high-risk patients with COPD and no fever, new or worsening productive cough was sufficient to initiate antibiotics. For afebrile patients without COPD, non-productive cough for less than 24 h was likely to due to aspiration and chemical pneumonitis that would not benefit from antibiotics. In addition to these criteria, a CBC demonstrating leukocytosis, and left shift in the setting of fever, might provide more evidence that bacterial infection was present.

Should the patient be treated with antibiotics? In fact, most LTCF patients are treated regardless of the prognosis. In one study, more than half of patients with advanced dementia developed pneumonia within 6 months of death (37). Despite poor prognosis, 91% of patients received antibiotics, 29% were given IV, and 25% were given IM therapy.

If antibiotics are given, then will they be likely to be beneficial? In a multi-center study from Ontario, adherence to published guidelines for antibiotic use in LTCF was uncommon; only 28% of antibiotic courses were appropriate. Even when recommended antimicrobials were given, residents with pneumonia were more likely to die or have adverse reactions than those who did not receive appropriate treatment (38).

Does the route of antibiotic administration affect mortality? When patients from the United States were compared to patients in the Netherlands, U.S. patients with pneumonia were more likely to be hospitalized, receive parenteral antibiotics, and have a lower 1-month mortality (15% vs. 28%) than the Dutch (39). No differences were seen at 3 months, suggesting that an aggressive antibiotic treatment approach confers, at best, a very short-term survival benefit.

What is the effect of antibiotics on the quality of life? LTCF residents with dementia and pneumonia do suffer. The use of oral antibiotics may be associated with less suffering for patients who receive antibiotics vs. those who that do not receive them (40).

Do LTCF residents with infection get better care if they are transferred to hospital? There have been several studies suggesting that hospitalization for infection has been associated with a greater reduction in function, development of pressure ulcers, and mortality and development as compared with patients who remain in the nursing home (41).

Prevention

Prevention of pneumonia in LTCF residents should focus on vaccination efforts, prevention of aspiration, and infection control. While influenza vaccine may not prevent influenza illness in LTCF residents, it is highly effective in preventing cardiopulmonary complications, including secondary bacterial pneumonia and death (35) (see also chapter "Vaccinations").

While there is increasing evidence that prophylaxis with neuraminidase inhibitors is effective in LTCF residents, these drugs are not a substitute for vaccination. Vaccination of healthcare workers has continued to be associated with a significant reduction in influenza infection and in death in LTCF residents (42). While the

efficacy of the pneumococcal polysaccharide vaccination in LTCF residents remains controversial, its use is recommended (43).

The possibility of tuberculosis (TB) as a respiratory pathogen can be reduced through a screening program requiring a baseline chest radiograph and two-step tuberculin skin test for residents upon admission to the facility and annually thereafter (32) (see also chapter "Tuberculosis in Older Adults"). Healthcare workers should be screened upon hiring. More frequent testing may be required and an outbreak investigation initiated if a new case of TB is identified in the LTCF.

Reduction of aspiration risk may be important in pneumonia prevention. Feeding tubes of any kind increase aspiration and pneumonia risk; they should be avoided. It has been proposed that feeding techniques, modified diets, oral hygiene, and positioning strategies be tried first. As a way to prevent overgrowth and colonization with pathogens, elimination of medications that have sedating effects or inhibit gastric acid has also been proposed. Unfortunately, there is little consensus that any strategy to prevent aspiration and pneumonia has been proven to work in the LTCF resident (44, 45).

Skin and Soft Tissue Infection (SSTI)

Epidemiology and Clinical Manifestations

SSTIs are the third most common infectious clinical syndromes in NH (see also chapter "Skin and Soft Tissues Infections"). Rates of 1–9% [specify for what these rates have been reported] have been reported or a prevalence of 0.5–2.1 per 1,000 patient days (3, 46). Risk factors for SSTI are discussed in more detail elsewhere (chapter "Skin and Soft Tissues Infections"); needless to say, conditions such as peripheral vascular disease and those that contribute to peripheral edema such as chronic venous insufficiency, lymphedema, and immobility, are common in the LTCF resident population. Physical trauma, maceration, pressure, or use of devices allow secondary infection [to do what?] by pathogens found among the resident's own endogenous flora or exogenously via the hands of personnel, from other residents, or by contact with contaminated environment or fomites (1, 2).

Primary mucocutaneous infections (erysipelas, cellulitis, folliulitis, and impetigo), conjunctivitis, and secondary infection of pressure ulcers are some of the most common manifestations of SSTI seen among LTCF residents. Other common infections include mucocutaneous fungal infections due to *Candida* spp., (thrush, denture stomatitis, chelitis, paronychia,and intertrigo) and dermatophytes (tinea corporis, tinea pedis, tinea cruris and tinea ungium) (47). Rashes, due to ectoparasitic infestations, and reactivation of latent viruses occur as well (12, 13). Many of these common and less severe primary skin infections are not reportable; whether these infections are more prevalent in the LTCF than in the community is not known (12, 13). For some infections, some prevalence estimates are available. For example, it has been reported that ~10,000–20,000 cases of herpes zoster occur in LTCF residents each year. Conjunctivitis is reported in 0.3–3.4% of LTCF residents or at rate of 0.1–1.0 cases per 1,000 resident days (3, 48).

Approximately 6% of pressure ulcers in LTCF residents will become secondarily infected or 1.4 infections per 1,000 resident days (49). The prevalence of pressure ulcers stages II and greater varies widely, likely reflecting the heterogeneity of the resident population; rates range from 1 to 11% (49). Risk of acquiring a pressure ulcer increases with length of stay; ~20% of NH residents will develop an ulcer within 2 years of admission (49–51).

Etiologic Pathogens

Primary Skin and Soft Tissue Infection

Common bacterial causes [for what] include *S. aureus* and beta-hemolytic streptococci, especially group A (2). Mucocutaneous fungal infection is most commonly caused by *Candida* spp., particularly *C. albicans*, and dermatophytes (47), while viral etiologies include those causing herpes zoster and herpes simplex (13). The ectoparasites scabies (*Sarcoptes scabiei*) and head, body, and pubic lice (*Pediculus humanus capitus, P. humanus corporis, and Phthirus pubis*) may also be found (13).

Conjunctivitis

Most cases of acute infectious conjunctivitis in LTCF residents are probably viral. Adenovirus has been associated with outbreaks attributed to fomites such as contaminated ophthalmologic diagnostic equipment or medications. A bacterial cause of acute conjunctivitis may be present in less than 40% of cases; most are due to *S. aureus*, *M. catarrhalis,* or *Haemophilus* spp. Epidemics of group A streptococcal conjunctivitis have been reported (48).

Secondary Infections

Most secondary infections of pressure ulcers are due to the polymicrobial flora that colonizes the surrounding perineum. Aerobic flora such as *E. coli, Proteus, Pseudomonas*, staphylococci, and enterococci may be mixed with anaerobes such as *Peptostreptococcus, Bacteroides,* and *C. perfringens* (49–51).

Diagnosis and Treatment

Most SSTIs affect populations outside of LTCFs; the diagnosis and treatment of these conditions do not substantially differ and are discussed elsewhere with a few exceptions below. In general, the McGeer et al., criteria for the diagnosis of SSTI and conjunctivitis emphasize that the definition of infection does not rely on the presence of just one piece of evidence (see Table 1) (18).

However, the diagnosis of scabies in LTCF residents deserves special comment. The diagnosis of scabies infection in LTCF residents can be particularly difficult; symptoms of pruritus, burrows, inflammatory changes in intertrigenous areas, and pruritus may be absent., Due to the lack of typical features, the diagnosis may not be suspected for a long-time. Hyperkeratosis or crusted (Norwegian) scabies with abundant organisms can result with long-term infestation. The diagnosis is finally made when more typical rash is found in healthcare workers or visitors (13, 52).

Treatment of scabies in LTCF residents can also be very difficult. While permethrin 5% cream is the treatment of choice, due its lack of central nervous system toxicity, invermectin has been shown to be effective for severe or refractory cases. Nails should be trimmed and cream should be applied from the neck to toes and left in place for up to 12 h. Secondary cases among other patient contacts should be sought and treated (1, 13).

Prevention

The foremost means of preventing primary skin infection is use of contact isolation where appropriate. Decolonization therapy has been tried in staphylococcal carriers who have recurrent infection; however, it is not clear whether or not infection is prevented (53).

Prevention of secondary infection of pressure ulcers should be directed towards prevention of pressure ulcers themselves through education of healthcare workers, identification of residents at risk, and attention to appropriate use of techniques to reduce pressure, position, and turn patients. Treatment of incontinence is also essential to reduce skin maceration. Finally, use of good nursing, wound care, surgical, and infection control techniques are essential to prevent contamination of wounds by feces and urine and by dirty instruments and hands (1, 49, 50).

Herpes zoster may be transmitted to immunocompromised patients or to healthcare workers who have not had primary infection or vaccination. At minimum, residents with active herpes zoster should be in a private room with contact precautions until all vesicles have crusted. In patients with disseminated disease, some experts recommend airborne isolation (1).

For scabies, washable patient items should be laundered in hot water. The floors should be vacuumed and inanimate surfaces cleaned. Non-washable items can be sealed in plastic for 96 h. Secondary symptomatic cases should be sought and treated. Some experts recommend treating all roommates and persons providing direct care even if they are asymptomatic (1, 13, 54).

Infectious Gastroenteritis and Diarrhea

Epidemiology and Clinical Relevance

In most surveys of LTCF residents, GI infection is manifested most commonly as gastroenteritis or diarrhea (see also chapter "Infectious Diarrhea"). During one

nation-wide point prevalence survey, 7.0% of LTCF-associated infections were due to gastroenteritis (3). Within the closed environment of the LTCF, spread of enteric pathogens can be facilitated by devices, environmental sources, direct contact with other infected residents or on the hands of personnel, inadequate food preparation, contaminated waters, or following visits by children and pets (55).

Sporadic diarrhea, due to infectious and non-infectious causes, is common in LTCFs. While the exact incidence of gastrointestinal outbreaks in LTCFs is not known, anecdotal reports in numerous facilities suggest that the problem is common (1, 14, 15). It is also known that a significant proportion of reported food-borne illnesses in this country come from LTCFs resulting in high mortality (56). Most deaths due to diarrhea occur in older adults; >50% of all deaths attributed to diarrhea occur in adults aged 74 and older and one-third of these deaths in LTCF residents (2, 14, 15).

Etiologic Pathogens

For most causes of sporadic diarrhea in the LTCF resident, the cause is frequently not identified, there is no specific diagnostic test available for most causes, most treatment is symptomatic, and the course is self-limited. For many cases of diarrhea where an infectious etiology was defined, the cause was only known because sufficient numbers of patients were ill to undertaken an outbreak investigation, or a reportable pathogen was isolated. Viral and bacterial etiologies are most common; parasitic infections are reported infrequently.

C. difficile is the most readily identified cause of infectious diarrhea in LTCF, in part, because the tests for toxins A and B are readily available and are easily performed, treatment is available and effective, and the presence of the organism has infection control implications (15, 55, 57). Sporadic cases and outbreaks of C. *difficile* have been identified in the LTCF setting. Within 2 weeks of receiving antibiotic therapy, up to one-third of LTCF residents will acquire *C. difficile* (55).

Exposure to *C. difficile* spores in the LTCF environment is common and the introduction of the organism into the resident's GI tract can be facilitated through the contaminated hands of personnel and devices such as feeding tubes and thermometers. Asymptomatic colonization can persist in this population because the host response to *C. difficile*, particularly protective antibody to toxin A, is impaired with increasing age and debility. With the suppressive effect of broad-spectrum antibiotics on the anaerobic flora of the gut, toxin-producing *C. difficile* can emerge and cause diarrhea (55). Newer strains of *C. difficile* that produce higher levels of toxins A and B, and perhaps novel toxins, have led to higher rates of complications among older people including toxic megacolon and death (58).

Most other pathogens are identified only after an outbreak of gastroenteritis is identified and viruses or other bacteria are suspected. Most outbreaks have been due to calciviruses such as norovirus (Norwalk virus), rotaviruses, and adenoviruses. Outbreaks of *Salmonella*, *E. coli 0157:H7*, *S. aureus*, and *C. perfringens* have been associated with improper handling of food. Other uncommon bacterial causes of outbreaks in NH have been due to *Shigella, Aeromonas*, *Campylobacter,* and

Bacillus species. Rare outbreaks due to parasitic infections such as *Entamoeba histolytica, Giardia lamblia*, and *Cryptosporidium parvum* have also been noted (2, 14, 15, 56).

Clinical Manifestations and Diagnostic Considerations

The clinical manifestations of gastroenteritis and diarrhea in older adults are discussed elsewhere (chapter "Infectious Diarrhea"). All LTCF residents with diarrhea will require careful monitoring of fluid status. Adherence to infection control and isolation procedures is also required regardless of etiology, particularly if an outbreak of diarrheal illness is suspected. A diagnostic evaluation would be pursued primarily to determine if more specific treatment options were available, and if increased rates of diarrhea were due to the spread of a single organism. Diarrheal illnesses may be stratified in two ways as gastroenteritis or small bowel infection vs. colitis or large bowel infection (2).

Small bowel infections are manifested by mid-epigastric pain with large-volume watery stools that typically do not contain blood or pus. Viruses and protozoa typically cause small bowel infection. Enterotoxins produced by *Bacillus cereus*, *C. perfringens*, and *S. aureus* also cause nausea and vomiting in addition to watery diarrhea. Most of these pathogens cannot be readily diagnosed by methods available to a LTCF. If the resident is stable with symptoms consistent with small bowel infection, then conservative treatment should be pursued. If symptoms do not remit by 7 days, then stools should be sent for ova and parasites to look for evidence of chronic infection with protozoa (2).

Large bowel infections (colitis) are associated with fever, rectal or lower abdominal cramps, and stools that may contain blood and inflammatory cells. Colitis is caused by *C. difficile*, toxigenic enterohemorrhagic *E. coli, Shigella, Salmonella, Campylobacter, Yersinia*, and *Entamoeba histolytica* (2). Stool toxin assays should be done for *C. difficile,* particularly if the patient has had antibiotic treatment within the past 30 days (2). Stool should be sent for culture and susceptibility.

Treatment

All residents should have fluid repletion, treatment of nausea and vomiting, and monitoring and correction of electrolyte imbalances are the primary goals of treatment until results of stool studies are known. For *E. coli* 0157:H7, antibiotic treatment is not recommended due to an increased risk of development of hemolytic uremic syndrome (14, 59).

For LTCF residents with moderate to severe illness consistent with toxigenic or invasive diarrhea, antecedent antibiotics should be stopped if possible and empirical treatment for *C. difficil*e initiated. Complications such as toxic megacolon may develop rapidly and transfer for more intensive monitoring and surgical consultation should be considered. Residents found to have *C. difficile* in their stool, but

who no longer have diarrhea, should not be treated (55, 58). For invasive diarrheas, treatment should be individualized, based on the organism identified, the resident's clinical condition, and antibiotic susceptibilities. This topic is discussed in more detail elsewhere (14, 15, 60) (see chapter "Infectious Diarrhea").

Prevention

Fecal-oral spread of infectious gastroenteritis and diarrhea can be prevented by good personal hygiene and hand disinfection on the part of residents, visitors, and healthcare workers. Adherence to appropriate infection control procedures and food preparation guidelines can also prevent spread by contaminated food, water, and other means. Expert consultation should be sought if cases persist despite optimum measures. To eradicate the environmental reservoir of *C. difficile*, disinfection with a sporocidal agent is recommended. Hand washing with soap and water is preferred over the use of alcohol gel. In general, asymptomatic carriers of *C. difficile* do not require routine isolation unless outbreaks and severe disease are occurring despite routine measures (2, 55).

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