Infections in the Nursing Home: A Primer for the Practicing Physician
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More than 1.5 million Americans reside in nursing homes (NHs) nationwide, a number that exceeds the number of hospitalized patients at any given time. Over the last few decades, the illness severity and age of NH residents have increased. In addition, with the decline in acute hospital length of stays, many residents are admitted for post acute “skilled” care that approximates the severity of illness historically found in hospitals. Many of these skilled-level residents receive multiple antibiotics, have central or peripheral venous access, have long-term bladder catheters, require mechanical ventilation and/or hemodialysis, and require wound care. Given these facts, coupled with the communal living arrangements, it is not surprising that nursing home residents are at extreme risk for nosocomial infections.

The Centers for Disease Control and Prevention (CDC) estimates that 1.5 million nursing home-acquired infections occur each year. Infections are the most common reason for hospital admissions, and, collectively, the most common cause of death among NH residents. NH residents are at heightened risk for infection for a variety of individual and institutional reasons. Individual risk factors include impaired host immunity, malnutrition, medication use (e.g. immuno-suppressants, etc.) and co-morbid conditions such as dementia, diabetes, stroke, incontinence, and peripheral vascular disease. Institutional factors that predispose NH residents to infection include group activities such as meals, physical therapy, and recreational activities that allow for airborne, vehicle, and vector-borne transmission of infectious organisms.

While many of these infections are easily treated with oral antibiotics, ample evidence suggests that NH infections predispose to increased mortality and morbidity, including physical and cognitive decline, and increased re-hospitalization. Given the increased use of broad-spectrum antibiotics, there is also a disturbing trend towards infections caused by multi-drug resistant organisms (MDRO) and antibiotic-related infections such as *clostridium difficile*. These multiply resistant organisms, including Methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *enterococcus* (VRE), and multiply resistant gram negative rods, complicate the management of NH residents and are likely to increase the likelihood of future epidemics.

A review of the literature was conducted to sift through the current knowledge and recommendations relating to the more common NH acquired infections including urinary tract infections, pneumonia, multiply resistant organisms such as MRSA and VRE, and *Clostridium difficile*.

**Urinary Tract Infections**

Urinary tract infections (UTI) are one of the most common infections in NH residents. Inappropriate use of antibiotics for suspected UTI is also common – between 22% and 89% of antibiotic prescriptions. Asymptomatic bacteriuria is frequent in older patients, especially women. Differentiating between asymptomatic bacteriuria and an actual UTI is often difficult in older NH residents, especially those with dementia. In one study of Ontario NHs, one-third of antibiotics prescribed for UTI were for asymptomatic bacteriuria. Treatment of asymptomatic bacteriuria is not recommended even for chronically incontinent NH residents. In most NHs, however, the presence of bacteriuria usually triggers the reflex response of ordering an antibiotic.

Urinalysis showing pyuria (>5 white blood cells per high power field), a urine culture with > 10^3 organisms, and more than 2 symptoms (fever, dysuria, urgency, new incontinence, frequency, suprapubic pain, or gross hematuria) generally indicate an active infection. Delirium, cognitive, or functional declines are often the only manifestations of a UTI in cognitively impaired long-term care residents; treatment should be initiated if laboratory data confirm the presence of a UTI. Multifaceted interventions with algorithms and case scenarios for ordering urine cultures directed at NH physicians and nurses have been shown to reduce antibiotic use for UTI by 31%.

Risk factors for UTI include age, female gender, urinary incontinence, poor hygiene, and low urine output. Urethral instrumentation and/or catheterization are also significant contributors, increasing the risk of a UTI. Hospitalized NH residents will often have a urinary catheter placed, increasing their risk of a nosocomial UTI. Often urinary catheters are placed initially for appropriate reasons but the catheters are kept in place longer than necessary. It is estimated that older persons have a 5% risk of a UTI for every day of catheterization. In addition, 21% of catheters are placed for inappropriate reasons-most often for urinary incontinence.

First line or empiric antibiotic treatment for UTI can safely include trimethoprim-sulfamethoxazole or nitrofurantoin while awaiting culture and sensitivity results in patients with typical symptoms of a UTI and substantial bacteriuria with leukocytosis. Often it is preferable to wait until culture results are available if the patient has a history of recurrent UTI or resistant organisms - assuming the patient is medically stable. Older persons with a normal serum creatinine level generally have a low calculated creatinine clearance related to aging. Thus, it is important to dose-adjust antibiotics based on calculated creatinine clearance. Also, when starting antibiotics, it is essential to consider adjusting warfarin doses or increasing the monitoring of anticoagulation. In a recent population-based retrospective study, NH residents were found to be almost 4 times more likely than community dwelling elders to have renal impairment and 80 times more likely to require prolonged antibiotics for UTI. In addition, NH residents are 7 times more likely to have inappropriately dosed antibiotics, 9 times more likely to suffer...
adverse reactions, and 2.6 times more likely to receive repeat treatment than community dwelling elders.10

Residents with substantial exposure to antibiotics in the past are more likely to develop UTIs with resistant organisms. Nursing home residents with poor medication compliance who do not complete a full course of antibiotics may also have an increased risk of resistant organisms. In particular, NH residents with previous exposure to a fluoroquinolone are 20 times more likely to have fluoroquinolone-resistant *Escherichia Coli* infection.11

There is little evidence that nutritional supplements such as vitamin C and cranberry tablets have any impact on the rate or severity of UTI. However, these agents are low risk interventions and are often implemented in high-risk NH residents with recurrent UTI. Vaginal estrogen creams can improve the vaginal and urethral mucosal integrity and potentially increase urethral sphincter function, thus reducing the risk of bacterial migration up the urethra. Keeping nursing home residents well hydrated and increasing hydration at the first sign of a UTI can help prevent the progression to a UTI.

**Take home points:**
- Asymptomatic bacteriuria need not be treated.
- Wait for organism identification and sensitivity information prior to treatment whenever possible.
- Urinary catheters are a significant risk factor for infection and should be removed whenever possible.
- Always adjust antibiotic dosing for calculated creatine clearance and monitor coumadin levels during treatment.

**Nursing Home-Acquired Pneumonia**

Nursing home-acquired pneumonia (NHAP) was first defined as a clinical entity in 1978. The reported incidence of NHAP is 0.27 to 2.50 cases per 1000 patient days, a ten-fold increase compared to age-matched community dwellers.12 NHAP is a frequent cause of hospitalization; mortality rates rival those seen in community dwellers admitted to the ICU.13 Despite these facts, NHAP can be difficult to diagnose in NH residents. Though cough and fever are present in about 60% of cases, more subtle clinical signs frequently occur including delirium, appetite loss, falls, incontinence, and weakness.14 Delays in obtaining laboratory evaluation and chest x-rays contribute to the need to make presumptive decisions about hospitalization and empiric decisions on antibiotic therapy.14

**...in 2004, 63% of staphylococcus infections in health care facilities were resistant.**

In many cases, NHAP can be treated safely in the nursing home with antibiotics and supportive therapy. In a retrospective cohort study conducted in a large university-affiliated nursing home, investigators noted similar mortality rates in NH residents with pneumonia who were hospitalized, compared with those treated in place.15 In addition, those who remained in the NH appeared to have less functional decline over the following 60 days. A large prospective study of 36 Missouri nursing homes also noted that initial hospital therapy did not improve mortality compared to those treated appropriately in the nursing home.16 Finally, Loeb et al. utilized a cluster randomized trial of 680 Canadian NH residents to assess whether a clinical pathway for on-site treatment of pneumonia could reduce hospital admissions, mortality, subsequent functional loss, and cost.17 The investigators found no change in overall mortality or morbidity between groups, but noted significant cost savings (over $1000 per patient) in the NH-treated group. They concluded that a clinical pathway for treatment of NHAP could reduce hospitalizations and achieve cost savings, without worsening clinical outcomes.

Both the American Thoracic Society and the Infectious Disease Society of America recommend one of three regimens for the treatment of NHAP: (1) a fluoroquinolone alone; (2) a second generation cephalosporin in combination with a macrolide; and (3) a non-anti pseudomonas third generation cephalosporin with a macrolide.18, 19 Current recommendations emphasize the importance of rapid delivery of care for pneumonia. A consensus panel convened in 2002 recommended hospitalization for NHAP when the NH cannot provide rapid antibiotic therapy within 8 hours of diagnosis. Recommendations for care in the NH included: the availability of every 4 hour vital signs, laboratory access, parenteral hydration, and the presence of at least two licensed nurses.20 Recommendations for hospitalization included the presence of 2 or more of the following conditions: oxygen requirement over 3L per minute; oxygen saturation < 90% at sea level; respiratory rate > 30/minute; uncontrolled congestive heart failure, diabetes, and/or chronic obstructive pulmonary disease; stuporous mental status; and increased agitation.20

**Take Home Points:**
- NHAP can be safely treated in the nursing home in many circumstances without change in outcome and overall cost savings.
- There are three recommended regimens outlined by IDSA and ATS for NHAP treatment.

**Multi-Drug Resistant Organisms**

Since the first published reports of resistant organisms in long term care facilities during the 1970s, nursing homes have been viewed as a reservoir for MDROs.21 Estimates from the Centers for Medicare and Medicaid Services (CMS) for 2005 suggest that 27,000 NH residents have antibiotic resistant infections.22 A Veterans Administration (VA) study published in 1991 from a NH unit in Washington noted prevalence rates for colonization with resistant organisms of 34% among residents and 7% of staff.23 In a 2001 study, 43% of 117 participants from a nursing home were colonized with one or more resistant pathogens including 24% with MRSA and 3.5% VRE.24 Given the increased usage of broad-spectrum antibiotics and epidemiological studies conducted in the acute care setting, it is likely that these numbers have increased in recent years.

The development of resistance in the NH occurs for multiple reasons. First, resistant organisms are frequently brought into the nursing home from outside sites—most often acute care hospitals where residents are colonized or infected with resistant organisms.25 These residents are then admitted to the NH for continuing medical care, frequently requiring dressing changes, and catheter care with ample opportunity to colonize other residents and staff. Second, resistant organisms are selected for as a conse-