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Kimberly Iracki  
kimberly.iracki@otterbein.edu

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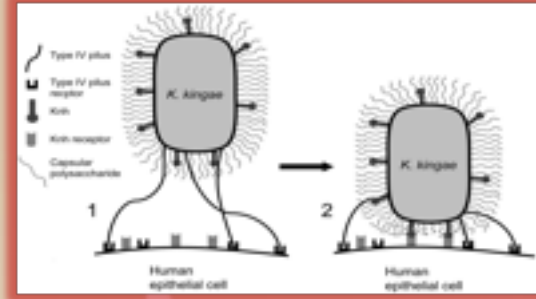
# Kingella Kingae: Emerging Outbreaks in Daycare Facilities

Kimberly Iracki, BSN, RN, CCRN, SRNA

Otterbein University, Westerville, Ohio

## Introduction

In today's Western countries, families are more likely than those of past decades to include two full-time working parents. This has led to an increase in the number of children attending daycare or some form of childcare outside the home. It is known that close quarters or semi-confined settings increase the risk of certain infections. Out of these infections, an emerging pediatric pathogen, that has also shown some prevalence in adults, is **Kingella kingae**.



(Image retrieved from <http://mbio.asm.org/content/3/5/e00372-12/F6.expansion.html>)

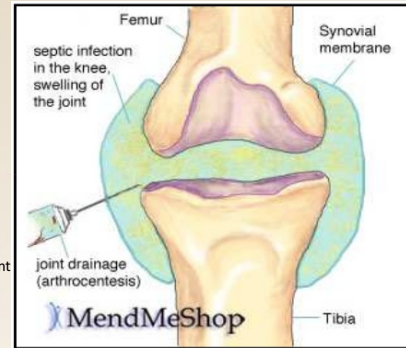
This pathogen has been found to inhabit the oropharynx of many infants and is thus respiratory in origin. Because of this, the chance of Kingella kingae spreading from one person to another enhances greatly in the daycare setting or similar close quarters. According to Yagupsky (2017), "outbreaks of bacteremia, skeletal system infections, endocarditis, and fatal meningitis caused by the emerging pediatric pathogen Kingella kingae. [...] This Gram-negative coccobacillary member of the upper respiratory tract microbiota increasingly is being recognized as the most common agent of skeletal system infections in children aged 6-36 months (pg. 14). Among these infections, septic arthritis is the most common in children (Williams et al., 2014). I have personally seen the burden and fear of this infection. Earlier this year, my 14 month old niece contracted K. Kingae from daycare which progressed to septic arthritis requiring surgical intervention. Much like the majority of the population, the prevalence and pathophysiology of this infection was unknown to me and my family. That being said, this project aims to identify the signs and symptoms, pathophysiology, significance, and implications of nursing care in regards to K. kingae infections. The ultimate hope is that this information may increase awareness and help reduce prevalence by preventing infection in the first place.

## Who is at Risk?

- Intimate contact between siblings and playmates can transmit the K. kingae organism that colonizes in the pharynx.
- Colonizing K. kingae strains can differ in their invasive potential:
  - certain clones are commonly found as respiratory colonizers but are seldom cultured from sites of disease
  - other clones are rarely detected in healthy children and, once acquired, readily penetrate into the bloodstream and disseminate to remote sites (Yagupsky, 2016).
- Colonization usually starts after the age of 6 mo, reaches a prevalence of 10% between 12 and 24 mo of age, and decreases in older children (Yagupsky, 2016c).
- Daycare attendance increases the risk for colonization and transmission. Clusters of invasive infection have been reported in childcare facilities (Yagupsky, 2017).

## Signs and Symptoms

- The presentation of Kingella Kingae is frequently mild and vague. Such a diagnosis requires a high index of clinical suspicion (Yagupsky, 2017). For example, patients can commonly present with benign signs and symptoms:
  - body temperature <38°C or 100.4°F
  - normal C-reactive protein concentration
  - normal white blood cell count
- The diagnosis of K. kingae disease is established by isolation of the bacterium or by a positive nucleic acid amplification assay from a normally sterile site such as blood, synovial fluid, or bone tissue (Yagupsky, 2017).
- The recovery of K. kingae from the mentioned exudates is frequently unsuccessful.
- Testing bone and joint specimens by nucleic acid amplification assays that target specific K. kingae genes such as qpn or those encoding the bacterium RTX toxin, have further improved detection of the organism and reduced the fraction of culture-negative septic arthritis in young children (Powell, 2013).
- My niece first presented with a swollen knee, refusing to walk or crawl tasks she loved to do. She never spiked a fever but did have an elevated white blood cell count. The synovial fluid aspirated from her knee eventually tested positive for Kingella Kingae, however this took several days to result and intervention was required prior to confirming the diagnosis in order to prevent other harmful complications.



(Image retrieved from <https://image.slidesharecdn.com/muscuclokeletaldisorderspart2boneinfectionscl4-120305095117-phapp02/95/bone-and-joint-infections-osteomyelitis-septic-arthritis-46-728.jpg?cb=133094258>)

## Pathophysiology

- When given a chance, the K. kingae organism adheres to the lining of the pharynx.
- K. kingae secretes a potent Repeat-in-Toxin (RTX)-a toxin common in bacteria, that kills the body's normal respiratory epithelial cells, macrophages, and synovialocytes.
- This cytotoxic activity suggests that the bacteria can promote its survival in the bloodstream, which then facilitates invasion of skeletal system tissues (Yagupsky, 2017).
- Children with K. kingae disease frequently present with symptoms of an upper respiratory infection, herpetic stomatitis, or buccalaphthous ulcers.
- These symptoms raise the possibility that viral-induced damage to the colonized mucosa facilitates invasion of the bloodstream (Yagupsky, 2017).



(Image retrieved from <http://www.mychildwhat.com/archives/83>)

## Significance of Pathophysiology

- Kingella kingae is being increasingly recognized as the most common etiology of joint and bone infections in young children yet many in the science community have little or minimal knowledge of it let alone the general public.
- Because initial detection is so difficult, providers need to have it on their radar in order to properly diagnose (Yagupsky, 2016a).
- Various complications can arise from the infection:

- Septic Arthritis**- acute presentation, children are brought to medical attention after a median of 3 days. The leukocyte count in the synovial fluid shows less than 50,000 white blood cells/ $\mu$ L in almost 25% of the patients, and the Gram stain of synovial fluid is positive in only a small percentage of cases.
- Osteomyelitis**- involves the long bones of the extremities. The calcaneus, talus, sternum, and clavicle are also frequently affected. Onset is insidious and diagnosed after 1 week or more in 70% of patients. MRI shows mild bone and soft tissue changes. Involvement of the epiphyseal cartilage appears to be specifically associated with the organism. Despite the frequent diagnostic delay, chronic osteomyelitis and functional orthopedic disabilities are unusual.
- Spondylodiscitis**- organism penetrates into the rich network of blood vessels that cross the cartilaginous vertebral endplates and enter the annulus in young children during a bacteremic episode. Usually involves the lumbar intervertebral spaces and, with decreasing frequency, the thoracolumbar, thoracic, lumbosacral, and cervical discs. Patients present with limping, lumbar pain, back stiffness, refusal to sit or walk, neurologic symptoms, or abdominal complaints. Radiography or MRI studies demonstrate narrowing of the intervertebral space. Patients respond well to appropriate antibiotic treatment and recover without complications, although residual narrowing of the intervertebral space may occur.
- Occult Bacteremia**- No focal infection. Commonly present with mild to moderate fever, symptoms suggestive of a viral upper respiratory infection, a mean C-reactive protein level of 2.2 mg/dL, and a mean white blood cell count of 12,700/ $\mu$ L. Respond favorably to a short course of antibiotics.
- Endocarditis**- Also diagnosed in school-age children, adolescents, and adult patients. May affect native as well as prosthetic valves. Predisposing factors include congenital cardiac malformations or rheumatic valvular disease, but some patients have previously normal hearts. Typically, the left side of the heart is involved, usually the mitral valve. Fever and acute-phase reactants are more elevated. Despite the exquisite susceptibility of K. kingae to antibiotics, cardiac failure, septic shock, cerebrovascular accidents, and other life-threatening complications are common, and the mortality rate is high (~16%). Because of the potential severity of K. kingae endocarditis, routine echocardiographic evaluation of children with isolated bacteremia is indicated (Sanghvi et al., 2012).

## Implications for Nursing

- Currently, there is a lack of specific guidelines for treating K. kingae disease. Patients have been administered a variety of antibiotic regimens according to protocols developed for infections caused by other traditional pathogens.
- The first-line therapy for skeletal infections in young children usually consists of intravenous administration of a second- or third-generation cephalosporin, pending culture results.
- Antibiotic regimen is frequently changing to ampicillin or cephalosporin once K. kingae is identified.
- A favorable clinical response and decreasing C-reactive protein levels to  $\leq 20 \mu$ g/mL are used to guide switching to oral antibiotics and defining duration of therapy. Antibiotic treatment has ranged from 2-3 weeks for K. kingae arthritis, from 3-6 weeks for K. kingae osteomyelitis, and from 3-12 weeks for K. kingae spondylodiscitis.
- Although some children with septic arthritis have been managed with repeat joint aspirations and lavage, most patients promptly respond to conservative treatment with appropriate antibiotics and do not require invasive surgical procedures.
- Because the risk of asymptomatic pharyngeal carriers for developing an invasive K. kingae infection is low (<1% per year), in the absence of clinical disease, there is no indication to eradicate the organism from the colonized mucosal surfaces.
- Nonetheless, in the reported outbreaks of K. kingae infections in children daycare centers, 14 of 75 (18.7%) classmates developed a proven or presumptive infection, including fatal endocarditis, within a 1 month period.
- Administration of prophylactic antibiotics aimed to eradicate colonization in contacts and prevent further cases of disease has been attempted, employing either rifampin 10 mg/kg or 20 mg/kg twice daily for 2 days alone or in combination with amoxicillin (80 mg/kg per day) for 2 days or 4 days.
- The effectiveness of these regimens has ranged between 47% and 80%, indicating that eradication of K. kingae from colonized mucosae is difficult to achieve.
- Routine use of prophylactic antibiotics in the above setting is recommended (Yagupsky, 2016b).

## Conclusion

Over the past few years, several outbreaks of K. kingae infections have occurred in daycare centers across the globe. However, due to the low rate of testing for this pathogen, it is possible that many events may have been overlooked. Detection of these outbreaks requires a high level of clinical suspicion and use of proper culture techniques. Many issues remain unsettled, including whether antibacterial drugs should be administered prophylactically to daycare center contacts of an infected patient, to young siblings of infected patients, to asymptomatic carriers, or just limited to children with a confirmed diagnosis. If administration of antibacterial drug prophylaxis is decided on, the preferred drug regimen will have to be determined. Regardless, improving hand hygiene and instituting infection control measures, such as disinfecting playroom areas is always encouraged. In addition, when children display symptoms of any illness it is encouraged that they refrain from attending daycare until reaching their previous state of health. When a K. kingae infection is diagnosed, notifying the daycare facility in which the child attends is of utmost importance in order to prevent spread of the infection. Increased knowledge of Kingella kingae, by health care providers, parents, family members and daycare employees, will not only help diagnose potentially infected children but prevent infection in the first place.

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