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Abstract:

Healthy infants and toddlers who attend day care centers are at increased risk for contracting common childhood illnesses such as viral upper and lower respiratory illnesses, viral gastrointestinal infections, and acute and chronic otitis media. The author proposes that this high frequency of common infections be termed *daycaritis*.

Daycaritis imposes significant social and economic burdens on both the family and the health care system. This review describes the most common infections seen in day care attendees, preventative measures to decrease the rates of illness, and a practical approach to diagnosis and management in the emergency department.

Keywords:

day care; children; respiratory tract infections; gastroenteritis; otitis media; vaccination; hygiene

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Daycaritis

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It is 0200 toward the end of respiratory syncytial virus (RSV) season, thank goodness, this year was rough, maybe I am too old to still be working overnights... Just one more toddler with rhinorrhea and cough, then I can rest a bit and catch up with my charting. I walk into the room and see a charming, active 14-month-old girl, sitting up on the bed, wide awake, and playing with mom's cell phone. She gives me a big smile. Mom looks very tired. "So," I say, "what's going on with little miss?" Mom's response to this seemingly benign question made me sit down and get ready for a tirade.

"Well, it started 8 months ago. First it was vomiting and diarrhea, followed by an ear infection. We started on antibiotics, which made the diarrhea worse. Then she got sores in her mouth and wouldn't eat or drink forever and then got another ear infection. Before she had even finished that course of antibiotics, she started wheezing, but the wheezing medicine didn't help and then the fever came back. I think the antibiotics gave her a diaper rash. She had been too sick to get her flu shot so she got flu and that was awful. The wheezing got a lot worse when she got RSV last month and no medicine helps her. Now she is coughing again, maybe she has pneumonia or another ear infection. Why doesn't her diarrhea ever go away? I am positive that her doctor is missing something, it is not normal for a baby to be sick so much! I am going to lose my job if I keep missing so much work..."

The child's physical examination, except for clear rhinorrhea, is completely normal. She started attending a neighborhood day care center 8 months ago. The differential diagnosis is very narrow. She has daycaritis.

"Daycaritis" is defined as frequent and recurrent episodes of common childhood infectious diseases such as "colds," bronchiolitis, diarrheal illnesses, otitis media (OM), conjunctivitis, and pharyngitis in young children attending day care that appear to be one long continuous illness to parents. Often the parents are concerned that there is something "seriously wrong" with their child because they are "sick all the time." If the child attends day care and a detailed history and physical examination reveals a well child with a common childhood illness, the diagnosis is usually daycaritis. It is estimated that approximately 50% (range, 20%-80%) of pediatric emergency department (ED) visits are nonurgent, with daycaritis being one of the most frequently encountered conditions.^{1,2} Convenience and perceived emergency are 2 major factors

associated with nonurgent ED use by children.³⁻⁵ Parents choose to use the ED because of anxiety about their children, ease of after-hours access, and the faster evaluation time associated with an ED visit.⁶

Child day care is a necessity for millions of working families. More than 50% of American mothers of preschool children work outside the home, with greater than 60% of their children attending day care.⁷ Increasing rates of single parenthood and maternal employment have led to increases in the need for and use of alternative child care arrangements.⁸ Single mothers are also more likely to have Medicaid insurance.⁹ Medicaid insurance and being a single parent are both predictors for nonurgent ED usage.¹⁰ It is not surprising that during peak viral season in the evening hours after parents have gotten off of work and picked their child up from day care, waiting rooms are filled with infants and toddlers. Rates of nosocomial infections in a pediatric ED are not found in the literature.

The 2 most common forms of out-of-home day care are the institutional day care “center” and the day care “home” setting established by nonrelatives in private households. Studies have shown that these children and their families are at increased risk for infection.¹¹⁻¹⁴ Children in day care center care are up to 18 times more likely to contract infections than children who stay at home.¹⁵ This increased risk is primarily for the first 2 years of attendance. By the third year of day care, the frequency of illness is similar to children being cared for in the home.¹⁶ These illnesses carry economic and social costs from parent loss of work and leisure time as well as the increased rates of infections in household members. The economic cost of day care illnesses in children is estimated to be \$1.8 billion per year.¹¹ Parents of children attending child care facilities miss from 1 to 4 weeks of work per year caring for their ill children.¹⁷

This article will review the links between day care attendance and increased risk of common respiratory and gastrointestinal illnesses, discuss successful infection control models to make day care safer, and briefly review the connection between day care attendance and childhood asthma, atopy, and acute lymphoblastic leukemia. A practical approach to the evaluation of daycaritis in the ED setting will also be described. The focus will be on children attending a child day care center (CDCC) rather than a day care home. Although serious and invasive bacterial infections can and do occur in day care settings, the discussion will be limited to the common and minor infections that result in the clinical syndrome of daycaritis.

VIRAL RESPIRATORY TRACT INFECTIONS

Respiratory tract infections occur 50% more often in children attending CDCCs compared with those in home care and cause more hospitalization.^{11,18,19} Presumably, this increase is caused by the frequent and close contact between the young children and the consequent increased exposure to infectious agents. The size of the group in the day care is the most significant risk factor for infection.²⁰ Transmission of respiratory infections to and between infants is largely dependent on the infection control practices of the care givers.²¹ In contrast to infants, toddlers themselves are effective transmitters of infectious agents because of their personal hygiene, ambulatory status, exploratory behaviors, and natural intimacy with each other. These characteristics of a toddler make the of control of respiratory infections in CDCCs inherently difficult. Although most respiratory tract infections are self-limited and not associated with long-term complications, their impact is significant in terms of discomfort to the children, disruption to the family and child care arrangements, and direct and indirect economic costs.

The introduction of molecular-based detection²² of respiratory viruses has resulted in the identification of significantly more viruses.²³ Molecular diagnostics for viruses allow the ED to quickly identify etiologic agents and viral coinfections in the clinical setting of an acute respiratory illness. Viruses for which real-time polymerase chain reaction and reverse transcriptase polymerase chain reaction assays are available, including RSV, human metapneumovirus, parainfluenza virus types 1 to 4, human rhinovirus (HRV), human bocavirus (HboV), adenovirus, human coronavirus, and influenza viruses A and B. Several studies of child care attendees have shown that coinfections with multiple viruses are common, ranging from 27% to 44%.^{19,23,24} Children with viral coinfections had a significantly longer duration of illness, although the severity of illness was not worse. This contrasts with a finding of more severe disease in viral coinfections among hospitalized children on an inpatient ward and in a pediatric intensive care unit.²⁵⁻²⁷ Coinfections with RSV tend to have higher disease severity.²⁵ Rhinovirus is the most commonly detected virus in outpatient studies of viral respiratory tract infections in CDCCs.^{19,23} Human rhinovirus is increasingly identified as a cause of more severe infection in healthy children and is considered a possible trigger for asthma and cause of hospitalization in children younger than 5 years, similar to RSV.^{28,29}

Martin et al²³ identified an inverse correlation between the detection of RSV and HRV, indicating the possibility of cosuppression where the immune response to the first infection decreases the rate of infection by the other virus owing to induction of cytokines or other factors. In a prospective study, these authors also reported that HboV was detected significantly more often than any other respiratory virus except HRV, although it did not correlate with the presence of symptomatic illness; HboV was detected in 44% of asymptomatic day care attendees.³⁰ Prevention of the spread of these infections is difficult because they are frequently encountered in preschoolers, are highly infectious, can be shed before or after the symptomatic period, and can survive for significant periods outside the host.³¹ Frequent cleansing of shared toys and material handled by the children is recommended, but hand washing is the most effective means of preventing the spread of respiratory tract pathogens.^{32,33}

GASTROINTESTINAL INFECTIONS

Infectious diarrhea is the second most common type of illness acquired by children in day care and is 3-fold more frequent than in children cared for at home.³⁴ Children who are not yet toilet trained comprise 30% of the total US population receiving out-of-home care, and this number is rising.³⁵ This group has no fecal continence, repeated mouth contact with hands and objects, and frequent hands-on contact by staff and has been shown to have a 17-fold higher rate of diarrheal illness than older children.³⁶

Rotavirus (RV), norovirus, and astrovirus have been identified as the most common viral agents in a single large prospective 15-year study.³⁷ Despite the introduction of the an effective RV vaccine in 2000, RV remains the most important viral agent in severe cases of pediatric gastroenteritis worldwide.³⁸ *Giardia lamblia*, *Campylobacter*, *Salmonella*, and *Shigella* have also been identified as causes of CDCC infectious diarrheal outbreaks³⁹⁻⁴¹ but less frequently than viral infections. Most episodes of diarrhea in the child care setting result from person-to-person transmission as food-borne outbreaks are rare.³² The increased rate of diarrheal infections is caused by the high infectivity of enteric pathogens, grouping large numbers of susceptible individuals, asymptomatic infections, and environmental fecal contamination. The most important factor seems to be the presence of diaper-aged children.³² Hand washing is the most effective means of preventing transmission.

Children in diapers should be separated from other attendees and cared for by separate staff.³² Caregivers participating in food preparation should not change diapers.

OTITIS MEDIA

Otitis media is the most common reason for an illness-related medical visit in preschool children⁴² and is the most common reason physicians prescribe antibiotics to children.^{43,44} Treatment of OM is expensive, costing Americans approximately \$3.5 billion annually.⁴⁵ There is evidence that OM, especially early onset (age <12 months), and recurrent OM can cause mild language and behavioral sequelae.⁴⁶⁻⁴⁸ The chronic middle ear effusion that often accompanies recurrent ear infections can lead to transient hearing loss during a critical time of language development.⁴⁹ Developmental problems associated with early chronic or recurrent OM include lower scores on language and speech tests,⁵⁰ poorer attention skills, more shy and inhibited behavior,⁵¹ and more distractible and fidgety behavior.⁵² Some studies have reported that early detrimental effects continue into middle childhood,^{53,54} whereas others have reported that the early language and social problems disappear by middle childhood.^{55,56}

Child care is a strong risk factor for developing both acute and chronic or recurring OM, particularly in children younger than 3 years, and in centers where there are 7 or more children.⁵⁷⁻⁵⁹ It is thought that child care is associated with an increased exposure to viral and bacterial pathogens, particularly antibiotic-resistant pathogens.^{59,60} The development and spread of resistant organisms are facilitated in CDCCs as a result of large numbers of children, frequent close person-to-person contact, and a wide variety of antimicrobial medications.⁶¹ Seasonal variation of acute OM coincides with the pattern of viral respiratory tract infections, which are a known antecedent of acute OM.⁶²

Colonization with *Moraxella catarhalis* occurs earlier in day care attendees, and this is associated with an increased risk of OM.⁶³ Recurrent viral upper respiratory infections with associated nasal congestion and reflux of nasopharyngeal secretions into the middle ear or blockage of the eustachian tube from mucosal inflammation are other mechanisms for the marked increase in episodes of OM in infants and toddlers in day care.⁵⁹

The use of a pacifier is also a risk factor for recurrent OM.^{33,64} The American Academy of Pediatrics specifically recommends weaning children from pacifiers starting after 6 months of age to

prevent OM.⁶⁵ If an older infant or toddler enters day care using a pacifier, it is this author's opinion that its use will continue as a tool to help quiet a crying baby or soothe one to sleep. In addition, children in day care centers are 4.5 times more likely to be hospitalized due to placement of tympanostomy tubes.⁶⁶

ARE THERE HEALTH BENEFITS TO DAY CARE?

Although daycaritis is quite burdensome on children, their families, and the economy, are there any potential health benefits from attending day care? It has been proposed that day care attendance reduces the development of atopy and asthma based on the hypothesis that infections in early life reduce the late development of allergic disease. However, the results of studies in this area are conflicting. In several studies, day care attendance during infancy was found to be protective against the development of asthma, hay fever, and skin-test reactivity in children with few or no siblings,⁶⁷⁻⁶⁹ but in others, no association was found between day care attendance and the development of atopic diseases.⁷⁰⁻⁷²

Nystad et al⁷³ reported that in children younger than 3 years attending day care full time, there is an increased risk of later asthma with early respiratory infections as a cause of the increased risk. Caudri et al⁷⁴ determined that early day care was associated with an increase in airway symptoms until age 4 years, fewer symptoms between the ages of 4 and 8 years, and no protection noted after age 8 years.

Wheezing in preschool children is primarily associated with infections, whereas in school-aged children, it is associated with atopy.^{75,76} Increased exposure to other children places preschool children at increased risk for wheezing from respiratory infections, but it may help protect them against immunoglobulin E-associated wheezing later in childhood.⁶⁷ The mechanism by which exposure to other children early in life may protect against later asthma is not known. Infections occurring during infancy may provide important signals to the newborn's maturing immune system.⁶⁴ Prescott et al⁷⁵ suggest that, as a response to infection, an infant's immune response shifts from type 2 helper T cells (similar to that in adults with atopy) toward one based more on cytokines derived from type 1 helper T cells (as in adults without atopy). They propose that infections that stimulate type 1 helper T-cell response inhibit the normal newborn type 2 response. Therefore, children not exposed to the

increased infections maintain the type 2 helper cell atopic phenotype.^{75,77}

These studies are not directly comparable in terms of size, family history, number of household siblings, and age at entry to day care. It is likely that there is some relationship between day care attendance, asthma, and atopy, but further studies are necessary to elucidate that relationship. Early day care should not be promoted for reasons of preventing asthma and atopy.

LINK BETWEEN EARLY INFECTIONS AND PROTECTIONS AGAINST LEUKEMIA

There is growing evidence for the role of early childhood infections in the development of acute lymphoblastic leukemia (ALL).⁷⁸⁻⁸² Greaves et al^{78,79} proposed a "delayed infection" hypothesis in which a delay in a child's exposure to infectious agents may result in an improperly modulated immune system and a subsequent risk of aberrantly high levels of lymphoblastic cell division after the infections when an older child enters school.⁸³ Urayama et al⁸⁴ performed a systematic review and meta-analysis on the relationship between day care attendance and risk of childhood ALL to test the "delayed infection" hypothesis. Many, although not all, of the studies suggested a reduced risk of developing ALL associated with day care attendance or social contact in early childhood.^{85,86} The strongest reduction in risk occurred when day care attendance was started at younger than 6 months.^{87,88} Increasing hours per day in child care and increased social activity in day care were also noted to be associated with a lower risk of subsequent ALL.^{87,88} An implication of a possible link between infections and the immune response and childhood ALL suggests that some type of prophylactic intervention in infancy may ultimately be possible.⁸⁴

STRATEGIES TO REDUCE THE IMPACT OF DAYCARITIS

Pneumococcal Conjugate Vaccine

The pneumococcal conjugate vaccine (PCV), available since 2000, has been shown to reduce nasopharyngeal carriage of *Streptococcus pneumoniae*⁸⁹ with a subsequent reduction in the incidence of invasive pneumococcal disease (IPD) attributable to the serotypes of *S pneumoniae* contained in the vaccine.⁹⁰ However, IPD attributable to serotypes not included in the initial vaccine, PCV7 (Prevnar),

Wyeth Pharmaceuticals, Collegeville, PA), increased in frequency, prompting the development of a pneumococcal vaccine with expanded coverage.⁹¹ In 2010, the Food and Drug Administration licensed a new 13-valent conjugate vaccine, PCV13 (Prenar 13), which has replaced the previously recommended PCV7 for use in routine and catch-up immunization schedules.⁹⁰ There is also a 23-valent pneumococcal vaccine that is used primarily in adults. The PCV23 is recommended for children 2 through 18 years of age who are at increased risk for IPD, such children with functional or anatomic asplenia or other immunocompromising conditions.⁹⁰ Children younger than 2 years fail to mount an adequate response to the 23-valent adult vaccine.⁹⁰

Dagan et al⁹¹ showed a significant reduction in upper and lower respiratory tract infections, acute OM, and antibiotic use in day care attendees after pneumococcal conjugate vaccination. A herd effect of the vaccine was demonstrated by Givon-lavi et al,⁹² which showed a lower rate of carriage of vaccine serotype and antibiotic-resistant *S pneumoniae* in the younger siblings of vaccinated day care center attendees. PCV7 was effective in reducing the rates of frequent (5 episodes during the past 6 months or 6 episodes in the past year) OM by 17% and 28% in 4 birth cohorts of children from Tennessee and New York.⁹³ In another study, PCV7 prevented 8.9% of all OM episodes and up to 22.8% of recurrent episodes. The most marked effect was in the children with the highest frequency of episodes.⁹⁴ Pneumococcal conjugate vaccine has also been shown to prevent upper and lower respiratory infections thought to be of viral origin or triggered by viral infections such as coryza, pharyngitis, and sinusitis.^{91,73}

Influenza Vaccine

Influenza vaccines have shown conflicting results in regard to their effectiveness in reducing the rates of OM in children in day care.⁶² There are several studies that show that both the inactivated trivalent intramuscular and live attenuated intranasal influenza vaccines are effective in reducing episodes of acute OM in children during flu season by 30% to 50%.⁹⁵⁻⁹⁸ Clements et al⁹⁶ showed that inactivated intramuscular influenza vaccine recipients had a 32% reduction in acute OM during the flu season and a 28% reduction in serous OM. In addition, Vesikari et al⁹⁹ reported greater than 90% efficacy against all episodes of acute OM associated with culture positive influenza after immunization of children 6 to 36 months with a live attenuated vaccine administered intranasally. A study from Italy and Switzerland showed an impressive 43.7% reduction in

the number of acute OM episodes after vaccination with the live attenuated intranasal influenza vaccine.⁹⁷ As was demonstrated with the pneumococcal vaccine,⁹⁴ the greatest reduction was seen in children with recurrent acute OM. However, Hoberman et al¹⁰⁰ reported that the use of the inactivated vaccine in day care attendees aged 6 to 24 months during 2 respiratory seasons did not reduce the burden of acute OM or the estimated time with middle ear effusion. They suggest that the proportion of viral respiratory infections due to influenza virus may be lower in children younger than 24 months so that the complications of noninfluenza viral infections may have obscured any effect of influenza vaccination. Decreases in noninfluenza respiratory illnesses and in the amount of antibiotic consumption have also been noted after live intranasal vaccine administration.^{97,101}

HYGIENIC MEASURES TO PREVENT THE SPREAD OF INFECTIONS

Decreasing the spread of infections in CDCCs depends on the actions of the child care staff who may have had little training on disease transmission and prevention.

Numerous studies have found that rates of illness in child care settings can be reduced by implementing simple hygiene measures such as a hand washing program.^{99,102} A meta-analysis found a 47% reduction in diarrhea in community-based hand washing trials.¹⁰³ The reduction in upper respiratory infections is more modest and estimated to be 20%.¹⁰⁴ Despite the effectiveness of hand washing with soap and water, compliance requires convenient access to a sink and sufficient time to perform the procedure for all children and staff. Experts recommend using running water (either warm or cold), at least 20 seconds of friction between hands (sing/hum the Happy Birthday song twice), make numerous bubbles, dry hands with a paper towel, and turn off the faucet with the paper towel. Developmental and physical barriers impede the implementation of this simple skill.¹⁰⁵ It may take up to 2 hours for a large room of children to perform this activity 4 times a day.¹⁰⁶

The use of antimicrobial gel hand sanitizer is an effective and more convenient alternative to hand washing.^{107,108} Alcohol-based hand sanitizers contain emollients that are gentler on the hands than soap and water. Teachers and child care staff favor using hand sanitizers because of less mess, skin irritation, and time spent away from activities.¹⁰⁷ Soap and water hand washing has traditionally been thought to be superior to hand sanitizer for removing visible dirt, but recently,

Pickering et al¹⁰⁹ showed that hand sanitizer was significantly better than soap and water in removing *Escherichia coli* and fecal streptococci in field conditions in Tanzania. Kotch et al¹⁰² showed that seamless, impermeable counters and touch-less faucets and cabinet doors are associated with significantly fewer episodes of diarrhea among children and fewer sick days among CDC staff. The average cost for installation of this equipment was more than \$10,000, a cost that is likely to be prohibitive for many CDCs.¹¹⁰⁻¹¹⁴

PRACTICAL APPROACH TO DAYCARITIS IN THE ED

The most important part of establishing a diagnosis of daycaritis is to listen to the parent. The history will be extensive, and more often than not, the parent will be tired, frustrated, and/or angry. This diagnosis is particularly prone to cause parental anxiety—they may feel they are being told that it is their fault that their child is sick “all the time.” It is crucial to establish trust with the family when you explain the diagnosis and what can be done to decrease the frequency of the common infections. Families frequently want unwarranted diagnostic testing such as blood work or radiographs, so it is necessary to fully explain the condition in ways that they can understand and why it is not considered a serious condition. A disconnect between parental and physician perceived severity of illness is a significant risk factor for parental dissatisfaction. It is important to demonstrate interest in the child and an understanding the disruptive nature of daycaritis. Compassion and empathy will help the family accept the diagnosis and listen to advice. Parents should be educated on the etiologies of daycaritis, the importance of immunization, hand washing techniques, and the reasoning behind general day care illness exclusion policies. They should be instructed to start hand washing lessons at home and make sure that their children's blankets and toys are vigorously cleaned at least weekly.

It is also important to reassure parents that although their child is frequently ill, there is no evidence that it causes long-term morbidity or mortality. It is not unreasonable to tell parents that there is a chance that their older preschooler may have a lower risk of childhood ALL and they may have a lower chance of asthma as an older child despite frequent wheezing episodes occurring now.

SUMMARY

Daycaritis is a very common diagnosis seen in the pediatric ED, and it is unlikely that a practical

cure will be found in the immediate future. Child care environments predispose young children to illnesses with a variety of highly infectious viral pathogens. Age-specific hygiene behaviors and the immunologic immaturity of infants and toddlers contribute to increased risk. Vaccines and hygienic interventions play a large role in daycaritis prevention. Parental education is also a very influential factor in the management of this very frequent childhood infection. **□**

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