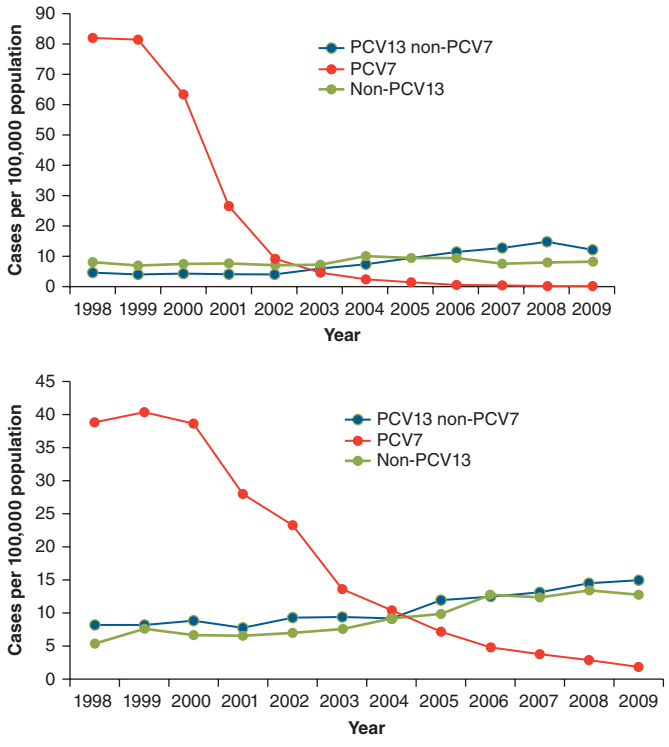

FIGURE 171-7 Changes in invasive pneumococcal disease (IPD) incidence, by serotype group, among children <5 years old (*top*) and adults >65 years old (*bottom*), 1998–2009. 7-Valent pneumococcal conjugate vaccine (PCV7) was introduced in the United States for routine administration to infants and young children during the second half of 2000, while PCV13 was introduced in 2010, the year following this surveillance period. PCV7 serotypes include serotypes 4, 6B, 9V, 14, 18C, 19F, and 23F as well as cross-reactive serotype 6A. PCV13 serotypes include the PCV7 serotypes as well as serotypes 1, 3, 5, 6A, 7F, and 19A. *(Reprinted with permission from Dr. M. Moore, Centers for Disease Control and Prevention.)*

antimicrobial resistance directly and indirectly perpetuates organism transmission and disease in the community.

WEBSITES

American Academy of Pediatrics RED BOOK. The report of the Committee on Infectious Diseases: *aapredbook.aappublications.org*; Pneumococcal Regional Serotype Distribution for Pneumococcal AMC TPP: *www.gavialliance.org/library/documents/amc/tpp-codebook/*

172 Staphylococcal Infections

Franklin D. Lowy

Staphylococcus aureus, the most virulent of the many staphylococcal species, has demonstrated its versatility by remaining a major cause of morbidity and mortality worldwide despite the availability of numerous effective antistaphylococcal antibiotics. *S. aureus* is a pluripotent pathogen, causing disease through both toxin- and non-toxin-mediated mechanisms. This organism is responsible for numerous nosocomial and community-based infections that range from relatively minor skin and soft tissue infections to life-threatening systemic infections.

The "other" staphylococci, collectively designated *coagulase-negative staphylococci* (CoNS), are considerably less virulent than *S. aureus* but remain important pathogens in infections that are primarily associated with prosthetic devices.

MICROBIOLOGY AND TAXONOMY

Staphylococci, gram-positive cocci in the family Micrococcaceae, form grapelike clusters on Gram's stain (Fig. 172-1). These organisms (~1 μm in diameter) are catalase-positive (unlike streptococcal species), nonmotile, aerobic, and facultatively anaerobic. They are capable of prolonged survival on environmental surfaces under varying conditions. Some species have a relatively broad host range, including mammals and birds, whereas for others the host range is quite narrow—i.e., limited to one or two closely related animals.

More than 30 staphylococcal species are pathogenic. Identification of the more clinically important species has generally relied on a series of biochemical tests. Automated diagnostic systems, kits for biochemical characterization, and DNA-based assays are available for species identification. With few exceptions, *S. aureus* is distinguished from other staphylococcal species by its production of coagulase, a surface enzyme that converts fibrinogen to fibrin. Latex kits that detect both protein A and clumping factor also distinguish *S. aureus* from most other staphylococcal species. *S. aureus* ferments mannitol, is positive for protein A, and produces DNAse. On blood agar plates, *S. aureus* tends to form golden β-hemolytic colonies; in contrast, CoNS produce small white nonhemolytic colonies. Increasingly, sequence-based methods (e.g., 16S rRNA) are being used to identify different staphylococcal species.

Determining whether multiple staphylococcal isolates from different patients are the same or different is often relevant when there is concern that a nosocomial outbreak is due to a common point source (e.g., a contaminated medical instrument). Molecular typing methods, such as pulsed-field gel electrophoresis and sequence-based techniques (e.g., staphylococcal protein A [SpA] typing), have increasingly been used for this purpose. More recently, whole-genome sequencing has enhanced the ability to discriminate among clinical isolates.

S. AUREUS INFECTIONS

EPIDEMIOLOGY

S. aureus is both a commensal and an opportunistic pathogen. Approximately 30% of healthy persons are colonized with *S. aureus*, with a smaller percentage (~10%) persistently colonized. The rate of colonization is elevated among insulin-dependent diabetics, HIV-infected patients, patients undergoing hemodialysis, injection drug users, and individuals with skin damage. The anterior nares and oropharynx are frequent sites of human colonization, although the skin (especially when damaged), vagina, axilla, and perineum may also be colonized. These colonization sites serve as a reservoir for future infections.

Transmission of *S. aureus* most frequently results from direct personal contact. Colonization of different body sites allows transfer from one person to another during contact. Spread of staphylococci in aerosols of respiratory or nasal secretions from heavily colonized individuals has also been reported. Most individuals who develop

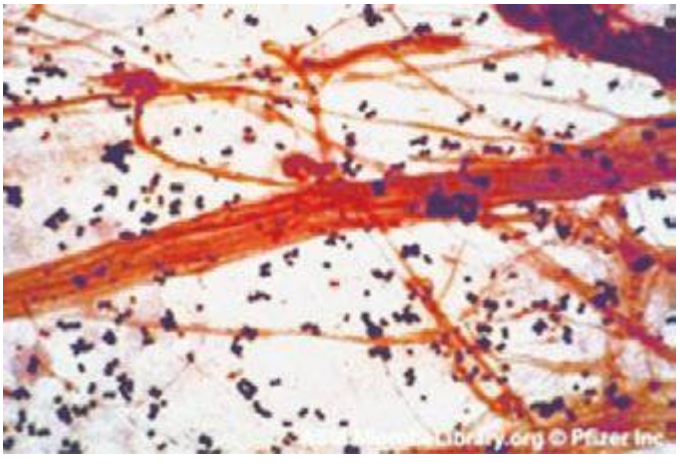

FIGURE 172-1 Gram's stain of *S. aureus* in a sputum sample. *(From ASM MicrobeLibrary.org.© Pfizer, Inc.)*