UNIVERSITÀ
DEGLI STUDI
FIRENZE

FLORE

Repository istituzionale dell'Università degli Studi di Firenze

Is Streptococcus pneumoniae a nosocomially acquired pathogen?

Questa è la Versione finale referata (Post print/Accepted manuscript) della seguente pubblicazione:

Original Citation:

Is Streptococcus pneumoniae a nosocomially acquired pathogen? / F. Paradisi; G. Corti. - In: INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY. - ISSN 0899-823X. - STAMPA. - 19(1998), pp. 578-580.

Availability:

This version is available at: 2158/328271 since:

Terms of use:

Open Access

La pubblicazione è resa disponibile sotto le norme e i termini della licenza di deposito, secondo quanto stabilito dalla Policy per l'accesso aperto dell'Università degli Studi di Firenze (<https://www.sba.unifi.it/upload/policy-oa-2016-1.pdf>)

Publisher copyright claim:

(Article begins on next page)

From the Fifth International Conference on the
Prevention of Infection

Is *Streptococcus pneumoniae* a Nosocomially Acquired Pathogen?

Franco Paradisi, MD; Giampaolo Corti, MD

ABSTRACT

Streptococcus pneumoniae is most prominently a major cause of community-acquired infections of the respiratory tract, central nervous system, and bloodstream, but there is an increasing interest in its role in the epidemiology of hospital-acquired infections. Penicillin-resistant pneumococcal strains appeared 3 decades ago and now are present worldwide, often displaying multiple resistance due to antibiotic selective pressure. Horizontal spread can cause either sporadic cases or hospital outbreaks, primarily in younger children and elderly patients. Pneumococcal transmission from one patient to another can be documented by polymerase chain reaction or pulsed-field gel electrophoresis typing. Nosocomial acquisition of infection, along with pediatric age, previous hospitalization, and previous β -lactam therapy, are the main risk factors significantly associated with penicillin-resistant pneumococcal infections. Nosocomial

acquisition also is associated with higher mortality from pneumococcal disease. The importance of penicillin resistance as a risk factor significantly associated with higher mortality from pneumococcal infection is found in some studies, but not in others. Mortality from pneumococcal pneumonia is approximately the same for human immunodeficiency virus (HIV)-infected patients without acquired immunodeficiency syndrome (AIDS) as for HIV-negative subjects, but it is significantly higher in AIDS patients. Penicillin-resistant strains are involved in the vast majority of hospital outbreaks, whether presenting as clinically manifest infection or a simple colonization. Pneumococcal vaccination is recommended universally in order to lower the incidence of invasive infection, although a number of problems can limit its effectiveness (*Infect Control Hosp Epidemiol* 1998;19:578-580).

Streptococcus pneumoniae is a major and well-known cause of community-acquired infections. It is the most prevalent agent of acute sinusitis, acute otitis media, pneumonia, and bacterial meningitis, accounting for 30% to 42% of each syndrome,^{1,4} and is the second cause of bacteremia and of acute exacerbations of chronic obstructive pulmonary disease, accounting for approximately 22%.^{5,6}

S. pneumoniae was recognized as a common cause of hospital-acquired infection before the introduction of penicillin into clinical practice,^{7,8} but now it seems to be much less frequent, being responsible for 4% of nosocomial acute sinusitis, 5% of bacterial meningitis, 2% of bacteremias, and a low percentage of pneumonias.^{4,5,9,10} Nevertheless, *S. pneumoniae* is being recognized increasingly as a nosocomial pathogen in some subgroups of patients. For instance, in the elderly, up to 20% of hospital-acquired pneumonias are caused by *S. pneumoniae*,¹¹ and, in subjects admitted to oncology wards, outbreaks of pneumococcal pneumonia have been described.¹² Furthermore, nosocomial pneumococcal bacteremia afflicts patients with ultimately fatal diseases, such as malignant neoplasias, at rates higher than seen in the outpatient setting.^{13,14}

Presently, most pneumococcal isolates remain susceptible to penicillin with minimum inhibitory concentra-

tions (MICs) lower than 0.1 mg/L.¹⁵ However, the clue of reduced sensitivity to penicillin (0.1-1 mg/L) has been well recognized for the last 3 decades.¹⁶ Strains with high-level penicillin resistance (MIC >1 mg/L) appeared in 1977 in South Africa, along with multiple antibiotic resistance (the latter being defined by resistance to three or more classes of antibiotics),¹⁷ and spread worldwide.^{18,19} Multiresistant pneumococcus is an important challenge to both microbiologists and clinicians on therapeutic grounds, where vancomycin or, alternatively, imipenem must be considered the drug of choice.²⁰

The infecting strain of *S. pneumoniae* may originate from the patient's upper respiratory tract bacterial flora, whether acquired before or after admission to the hospital, from subjects with pneumococcal disease, or from asymptomatic carriers.²¹ This latter case may be much more frequent than believed, if one considers that approximately 30% of children admitted at a South African hospital were nasopharyngeal carriers of pneumococci.¹⁷

Either sporadic cases or epidemics may derive from horizontal spread of *S. pneumoniae* in the hospital. Serological typing and antibiotic susceptibility profiles are not sufficiently discriminatory, so DNA fingerprinting by polymerase chain reaction (PCR)²² and pulsed-field gel

From the Infectious Disease Unit, University of Florence School of Medicine, Florence, Italy.
Address reprint requests to Prof. Franco Paradisi, Infectious Disease Unit, University of Florence School of Medicine, Nuovo San Giovanni di Dio Hospital, Via di Torre Galli 3, I-50143 Florence, Italy; e-mail infdis@cesit1.unifi.it.
98-RVC-071. Paradisi F, Corti G. Is *Streptococcus pneumoniae* a nosocomially acquired pathogen? *Infect Control Hosp Epidemiol* 1998;19:578-580.

electrophoresis typing²³ are now mandatory. In a pediatric intensive-care unit, a 5-month-old girl developed a severe pneumococcal pneumonia after staying in a bed adjacent to an 11-month-old boy with meningitis due to multiply antibiotic-resistant *S pneumoniae* serotype 23F. DNA fingerprinting by PCR revealed that both children were infected by the same strain.²² A very unusual route for transmission was suggested by Mehtar and coworkers, who reported the isolation of *S pneumoniae* type 6 in two neonates resuscitated consecutively with the same piece of equipment 48 hours apart.²⁴ In a 4-year-old boy with nosocomial epiglottitis caused by multiply antibiotic-resistant *S pneumoniae* serotype 15B, neither hospital acquisition of the infecting strain nor origin from the patient's upper respiratory tract could be ascertained.²⁵

Nosocomial epidemics of pneumococcal infection can occur as well, primarily in elderly patients. In 1992, an outbreak of penicillin-resistant *S pneumoniae* type 9 infection was described in an acute medical ward of a British hospital; four elderly subjects had pneumonia and three had septicemia, one of whom died.²⁶ The year after, in another British hospital for the elderly, 10 penicillin-resistant *S pneumoniae* type 9 infections were observed, 8 of which were hospital-acquired. This outbreak probably was favored by the fact that the index case remained unrecognized for more than 2 weeks and was treated with antibiotics without knowing the *in vitro* susceptibility profile. The outbreak probably would not have occurred if the index-case strain had been fully sensitive to the initial antibiotic treatment or if the patient had been isolated.²⁷

Hospital outbreaks of antibiotic-resistant *S pneumoniae* colonization have been described as well, most prevalently in the extreme ages. In younger children, exposed to relatively frequent hospitalization and concomitant administration of antimicrobials, it is important to restrict unnecessary antibiotic use to avoid the emergence of resistant strains.²⁸ In the elderly, the presence of underlying conditions (eg, chronic obstructive pulmonary disease, malignant neoplasias), frequent hospitalization, or stay in a nursing home facility maximize the risk for colonization by antibiotic-resistant *S pneumoniae*.²⁹

Nosocomial acquisition of infection is one of the many risk factors significantly associated in univariate and logistic regression analyses with penicillin-resistant pneumococcal infections, along with pediatric age, previous hospitalization, and previous β -lactam therapy.³⁰⁻³² In younger children, multiple risk factors can be present, eg, relatively frequent hospitalization and concomitant exposure to antibiotics.³¹ In the case of erythromycin-resistant *S pneumoniae*, only an age <5 years and nosocomial acquisition have been found to be independent risk factors.³³

Nosocomial acquisition of infection, along with advanced age and the presence of severe underlying conditions or complications (eg, shock, multilobar involvement, leukopenia), are risk factors significantly associated with higher mortality from pneumococcal disease.³⁴⁻³⁶ Surprisingly, recent studies have not found penicillin resistance to be related significantly to clinical course or mortality,

ty,^{34,35} in contrast with a former study in which the overall mortality rate was significantly higher in patients with penicillin-resistant pneumococcal bacteremic pneumonia (54% vs 25%; $P=.03$) than in subjects with penicillin-sensitive strains.³⁰

Although pneumococcal bacteremia is much more frequent in human immunodeficiency virus (HIV)-infected patients (9.4 cases/1,000 population per year) than in sickle-cell anemia (0.86/1,000), splenectomized (0.92-2.1/1,000), or healthy (7.5-16.4/100,000) subjects,³⁷ HIV-infected patients have the same³⁸ or even a significantly lower³⁴ mortality from pneumococcal pneumonia than HIV-negative subjects do. However, in patients with advanced HIV disease (acquired immunodeficiency syndrome), mortality is the highest observed in any subgroup of subjects with pneumococcal infection.³⁹

Lastly, the administration of pneumococcal vaccines is recommended universally in order to lower the incidence of pneumococcal invasive infection, although a number of problems can limit its effectiveness. First, the geographic distribution of serotypes varies greatly: types 6, 14, and 19 are present worldwide; type 18 is prevalent in developed countries; types 1 and 5 are common in developing countries; and types 3, 9, and 23 are important causes of otitis media. Consequently, the formulation of a complete vaccine suitable for use in all areas is difficult. For instance, a classic formulation containing types 6B, 14, 19F, 23F, 9V, 4, and 18C would include 65% of all pneumococcal isolates in Spain, more than 85% in Finland and the United States, 59% in Gambia, and less than 35% in Rwanda, Egypt, and Papua-New Guinea.⁴⁰ Secondly, an impaired response to pneumococcal vaccines can be observed on a genetic basis, in infants of less than 2 years, and in patients with congenital immunological disorders (a- or hypogammaglobulinemia), chronic renal disease, or HIV infection.⁴¹

REFERENCES

- Gwaltney JM Jr. Acute community-acquired sinusitis. *Clin Infect Dis* 1996;23:1209-1225.
- Soriano F. Microbial etiologies of acute otitis media. *Clin Microbiol Infect* 1997;3(suppl 3):23-25.
- Woodhead M. Pneumonia in the elderly. *J Antimicrob Chemother* 1994;34(suppl A):85-92.
- Durand ML, Calderwood SB, Weber DJ, Miller SI, Southwick FS, Caviness VS Jr, et al. Acute bacterial meningitis in adults: a review of 493 episodes. *N Engl J Med* 1993;328:21-28.
- Eykyn SJ, Gransden WR, Phillips I. The causative organisms of septicemia and their epidemiology. *J Antimicrob Chemother* 1990;25(suppl C):41-58.
- Ball P. Epidemiology and treatment of chronic bronchitis and its exacerbations. *Chest* 1995;108(suppl):43S-52S.
- Schroder MC, Cooper G. An epidemic of cold, bronchitis, and pneumonia due to type V pneumococci. *J Infect Dis* 1930;46:384-392.
- Stoneburner LT III, Finland M. Pneumococcal pneumonia complicating operations and trauma. *JAMA* 1941;116:1497-1504.
- Bert F, Lambert-Zechovsky N. Microbiology of nosocomial sinusitis in intensive care unit patients. *J Infect* 1995;31:5-8.
- National Nosocomial Infections Surveillance System. National Nosocomial Infections Surveillance (NNIS) report, data summary from October 1986-April 1996, issued May 1996. A report from the National Nosocomial Infections Surveillance (NNIS) System. *Am J Infect Control* 1996;24:380-388.
- Berk SL, Gallemore GM, Smith JK. Nosocomial pneumococcal pneumonia in the elderly. *J Am Geriatr Soc* 1981;29:319-321.
- Berk SL, Gage KA, Holtsclaw-Berk SA, Smith JK. Type 8 pneumococcal pneumonia: an outbreak on an oncology ward. *South Med J* 1985;78:159-161.

13. Mylotte JM, Beam TR Jr. Comparison of community-acquired and nosocomial pneumococcal bacteremia. *Am Rev Respir Dis* 1981;123:265-268.
14. Alvarez S, Guarderas J, Shell CG, Holtsclaw-Berk S, Berk SL. Nosocomial pneumococcal bacteremia. *Arch Intern Med* 1986;146:1509-1512.
15. Tomasz A. Antibiotic resistance in *Streptococcus pneumoniae*. *Clin Infect Dis* 1997;24(suppl 1):S85-S88.
16. Hansman D, Bullen MM. A resistant *Pneumococcus*. *Lancet* 1967;2:264-265.
17. Jacobs MR, Koornhof HJ, Robins-Browne RM, Stevenson CM, Vermaak ZA, Freiman I, et al. Emergence of multiply resistant pneumococci. *N Engl J Med* 1978;299:735-740.
18. Doern GV, Brueggemann A, Preston Holley H Jr, Rauch AM. Antimicrobial resistance of *Streptococcus pneumoniae* recovered from outpatients in the United States during the winter months of 1994 to 1995: results of a 30-center national surveillance study. *Antimicrob Agents Chemother* 1996;40:1208-1213.
19. Baquero F, Martínez-Beltrán J, Loza E. A review of antibiotic resistance patterns of *Streptococcus pneumoniae* in Europe. *J Antimicrob Chemother* 1991;28(suppl C):31-38.
20. Caputo M, Appelbaum PC, Liu HH. Infections due to penicillin-resistant pneumococci. *Arch Intern Med* 1993;153:1301-1310.
21. Davies AJ, Lockley MR. A prospective survey of hospital cross-infection with *Streptococcus pneumoniae*. *J Hosp Infect* 1987;9:162-168.
22. Raymond J, Bingen E, Doit C, Brahimi N, Bergeret M, Badoual J, et al. Failure of cefotaxime treatment in a patient with penicillin-resistant pneumococcal meningitis and confirmation of nosocomial spread by random amplified polymorphic DNA analysis. *Clin Infect Dis* 1995;21:234-235.
23. Boken DJ, Chartrand SA, Goering RV, Kruger R, Harrison CJ. Colonisation with penicillin-resistant *Streptococcus pneumoniae* in a child-care center. *Pediatr Infect Dis J* 1995;14:879-884.
24. Mehtar S, Drabu YJ, Vijeratnam S, Mayet F. Cross infection with *Streptococcus pneumoniae* through a resuscitator. *BMJ* 1986;292:25-26.
25. Daur RS, Nachman JP, Leitch CD, Tenover FC. Nosocomial epiglottitis associated with penicillin- and cephalosporin-resistant *Streptococcus pneumoniae* bacteremia. *J Clin Microbiol* 1994;32:246-248.
26. A nosocomial outbreak of *Streptococcus pneumoniae* infection. *Commun Dis Rep CDR Wkly* 1992;2:29.
27. Millar MR, Brown NM, Tobin GW, Murphy PJ, Windsor ACM, Speller DCE. Outbreak of infection with penicillin-resistant *Streptococcus pneumoniae* in a hospital for the elderly. *J Hosp Infect* 1994;27:99-104.
28. Ridgway EJ, Allen KD, Galloway A, Rigby A, O'Donoghue M. Penicillin-resistant pneumococci in a Merseyside hospital. *J Hosp Infect* 1991;17:15-23.
29. Gould FK, Magee JG, Ingham HR. A hospital outbreak of antibiotic-resistant *Streptococcus pneumoniae*. *J Infect* 1987;15:77-79.
30. Pallares R, Gudíol F, Linares J, et al. Risk factors and response to antibiotic therapy in adults with bacteremic pneumonia caused by penicillin-resistant pneumococci. *N Engl J Med* 1987;317:18-22.
31. Lee H-J, Park J-Y, Jang S-H, Kim J-H, Kim E-C, Choi K-W. High incidence of resistance to multiple antimicrobials in clinical isolates of *Streptococcus pneumoniae* from a university hospital in Korea. *Clin Infect Dis* 1999;20:826-835.
32. Bedos J-P, Chevret S, Chastang C, Geslin P, Régnier B, and the French Cooperative Pneumococcus Study Group. Epidemiological features of and risk factors for infection by *Streptococcus pneumoniae* strains with diminished susceptibility to penicillin: findings of a French survey. *Clin Infect Dis* 1996;22:63-72.
33. Moreno S, Garcia-Leoni ME, Cercenado E, Diaz MD, Bernaldo de Quirós JCL, Bouza E. Infections caused by erythromycin-resistant *Streptococcus pneumoniae*: incidence, risk factors, and response to therapy in a prospective study. *Clin Infect Dis* 1995;20:1195-1200.
34. Pallares R, Linares J, Vadillo M, Cabellos C, Manresa F, Viladrich PF, et al. Resistance to penicillin and cephalosporin and mortality from severe pneumococcal pneumonia in Barcelona, Spain. *N Engl J Med* 1995;333:474-480.
35. Gómez J, Baños V, Ruiz Gómez J, Herrero F, Núñez F, Canteras M, et al. Clinical significance of pneumococcal bacteremias in a general hospital: a prospective study 1989-1993. *J Antimicrob Chemother* 1995;36:1021-1030.
36. Marín AA, Sporrer J, Moore PS, Siefkin AD. Risk factors for adverse outcome in persons with pneumococcal pneumonia. *Chest* 1995;107:457-462.
37. Carey J, Glauser MP, Bille J. Bactériémies à pneumocoques: quoi de neuf? *Schweiz Med Wochenschr* 1995;125:952-958.
38. Garcia-Leoni ME, Moreno S, Rodeño P, Cercenado E, Vicente T, Bouza E. Pneumococcal pneumonia in adults hospitalized patients infected with the human immunodeficiency virus. *Arch Intern Med* 1992;152:1808-1812.
39. Pesola GR, Charles A. Pneumococcal bacteremia with pneumonia: mortality in acquired immunodeficiency syndrome. *Chest* 1992;101:150-155.
40. Sniadack DH, Schwartz B, Lipman H, Bogaerts J, Butu JC, Dagan R, et al. Potential interventions for the prevention of childhood pneumonia: geographic and temporal differences in serotype and serogroup distribution of sterile site pneumococcal isolates from children. *Pediatr Infect Dis J* 1995;14:5-10.
41. McIntyre P. Epidemiology and prevention of pneumococcal infections. *McClure Opin Pediatr* 1997;9:9-13.

FROM: Hantavirus pulmonary syndrome—Colorado and New Mexico, 1998. *MMWR* 1998;47(22):449-452.

KENNETH ORRILL
 Captain, United States Army
 Oregon
 1940-1942
 1943-1945
 1946-1948
 1949-1951
 1952-1954
 1955-1957
 1958-1960
 1961-1963
 1964-1966
 1967-1969
 1970-1972
 1973-1975
 1976-1978
 1979-1981
 1982-1984
 1985-1987
 1988-1990
 1991-1993
 1994-1996
 1997-1999
 2000-2002
 2003-2005
 2006-2008
 2009-2011
 2012-2014
 2015-2017
 2018-2020
 2021-2023
 2024-2026
 2027-2029
 2030-2032
 2033-2035
 2036-2038
 2039-2041
 2042-2044
 2045-2047
 2048-2050
 2051-2053
 2054-2056
 2057-2059
 2060-2062
 2063-2065
 2066-2068
 2069-2071
 2072-2074
 2075-2077
 2078-2080
 2081-2083
 2084-2086
 2087-2089
 2090-2092
 2093-2095
 2096-2098
 2099-2101
 2102-2104
 2105-2107
 2108-2110
 2111-2113
 2114-2116
 2117-2119
 2120-2122
 2123-2125
 2126-2128
 2129-2131
 2132-2134
 2135-2137
 2138-2140
 2141-2143
 2144-2146
 2147-2149
 2150-2152
 2153-2155
 2156-2158
 2159-2161
 2162-2164
 2165-2167
 2168-2170
 2171-2173
 2174-2176
 2177-2179
 2180-2182
 2183-2185
 2186-2188
 2189-2191
 2192-2194
 2195-2197
 2198-2199
 2200-2202
 2203-2205
 2206-2208
 2209-2211
 2212-2214
 2215-2217
 2218-2220
 2221-2223
 2224-2226
 2227-2229
 2230-2232
 2233-2235
 2236-2238
 2239-2241
 2242-2244
 2245-2247
 2248-2250
 2251-2253
 2254-2256
 2257-2259
 2260-2262
 2263-2265
 2266-2268
 2269-2271
 2272-2274
 2275-2277
 2278-2280
 2281-2283
 2284-2286
 2287-2289
 2290-2292
 2293-2295
 2296-2298
 2299-2301
 2302-2304
 2305-2307
 2308-2310
 2311-2313
 2314-2316
 2317-2319
 2320-2322
 2323-2325
 2326-2328
 2329-2331
 2332-2334
 2335-2337
 2338-2340
 2341-2343
 2344-2346
 2347-2349
 2350-2352
 2353-2355
 2356-2358
 2359-2361
 2362-2364
 2365-2367
 2368-2370
 2371-2373
 2374-2376
 2377-2379
 2380-2382
 2383-2385
 2386-2388
 2389-2391
 2392-2394
 2395-2397
 2398-2399
 2400-2402
 2403-2405
 2406-2408
 2409-2411
 2412-2414
 2415-2417
 2418-2420
 2421-2423
 2424-2426
 2427-2429
 2430-2432
 2433-2435
 2436-2438
 2439-2441
 2442-2444
 2445-2447
 2448-2450
 2451-2453
 2454-2456
 2457-2459
 2460-2462
 2463-2465
 2466-2468
 2469-2471
 2472-2474
 2475-2477
 2478-2480
 2481-2483
 2484-2486
 2487-2489
 2490-2492
 2493-2495
 2496-2498
 2499-2501
 2502-2504
 2505-2507
 2508-2510
 2511-2513
 2514-2516
 2517-2519
 2520-2522
 2523-2525
 2526-2528
 2529-2531
 2532-2534
 2535-2537
 2538-2540
 2541-2543
 2544-2546
 2547-2549
 2550-2552
 2553-2555
 2556-2558
 2559-2561
 2562-2564
 2565-2567
 2568-2570
 2571-2573
 2574-2576
 2577-2579
 2580-2582
 2583-2585
 2586-2588
 2589-2591
 2592-2594
 2595-2597
 2598-2599
 2600-2602
 2603-2605
 2606-2608
 2609-2611
 2612-2614
 2615-2617
 2618-2620
 2621-2623
 2624-2626
 2627-2629
 2630-2632
 2633-2635
 2636-2638
 2639-2641
 2642-2644
 2645-2647
 2648-2650
 2651-2653
 2654-2656
 2657-2659
 2660-2662
 2663-2665
 2666-2668
 2669-2671
 2672-2674
 2675-2677
 2678-2680
 2681-2683
 2684-2686
 2687-2689
 2690-2692
 2693-2695
 2696-2698
 2699-2701
 2702-2704
 2705-2707
 2708-2710
 2711-2713
 2714-2716
 2717-2719
 2720-2722
 2723-2725
 2726-2728
 2729-2731
 2732-2734
 2735-2737
 2738-2740
 2741-2743
 2744-2746
 2747-2749
 2750-2752
 2753-2755
 2756-2758
 2759-2761
 2762-2764
 2765-2767
 2768-2770
 2771-2773
 2774-2776
 2777-2779
 2780-2782
 2783-2785
 2786-2788
 2789-2791
 2792-2794
 2795-2797
 2798-2799
 2800-2802
 2803-2805
 2806-28

\$7