REFERENCES

Abraham, E.P., and Chain, E.B. Enzyme from bacteria able to destroy penicillin. **Nature.** 146:837, 1940.

Acar, J.F., Courvalin, P., and Chabbert, Y.A. Methicillin-resistant staphylococcemia:bacteriologic failure of treatment with cephalosporins. **Antimicrob. Agents Chemother.** 280-285, 1970.

Alkinson,. B.A, and Lorian, V. Antimicrobial agent susceptibility patterns of bacteria in hospitals from 1971 to 1982. **J. Clin Microbiol.** 20:791-796, 1984.

Altwegg, M., Hickman-Brenner, F., Farmmer J. III. Ribosomal RNA gene restriction patterns include increased sensitivity for *Salmonella typhi* strains. **J. Infect. Dis.** 160:145-149, 1989.

Aparicio, P., Richardson, J., Martin, S., Vindel.A., Marple,R.R., and Cookson, B.D. An epidemic methicillin-resistant strain of *Staphylococcus aureus* in Spain. **J. Epidemiol. Infect.** 108:287-298, 1992.

Arbeit, R.D., Karakawa, W.W., Vann, W.F., and Robbins, J.B. Predominance of two newly described capsular polysaccharide types among clinical isolates of *Staphylococcus aureus*. **Diagn. Microbiol. Infect. Dis.** 2:84-91, 1984.

Arbeit, R.D., Arthur, M., Dunn, R.D.,*et al*. Resolution of recent evolutionary divergence among *Escherichia coli* from related lineages: the application of pulsed field electrophoresis to molecular epidemiology. **J. Infect. Dis.** 161:230-235, 1990.

Archer, G.L., and Mayhall, C.G. Comparison of epidemiological markers used in the investigation of an outbreak of methicillin-resistant *Staphylococcus aureus* infections. **J. Clin. Microbiol.** 18:395-399, 1983.

Ardati, K.O., Thirumoorthi, M.C., and Dajani, A.S. Intraveneous trimethoprim-sulfamethoxazole in the treatment of previous infection in children. **Pediatr. Pharmacol. Ther.** 95:801-806, 1979.

Bacon, A.E., Jorgensen, K.A., Wilson, K.H. and Kauffman, C.A. Emergence of nosocomial methicillin-resistant *Staphylococcus aureus* and therapy of colonized personnel during a hospital-wide outbreak. **Infect. Control.** 8:145-150, 1987.

Barry, A.L., and Badal, R.E. Reliability of the microdilution technic for detection of methicillin-resistant strains of *Staphylococcus aureus*. **Am. J. Clin. Pathol.** 67:489-495, 1977.

Beck, W.D., Berger-Bachi, B., and Kayer, F.H. Additional DNA in methicillin-resistant *Staphylococcus aureus* and molecular cloning of *mec*-specific DNA. **J. Bacteriol.** 165:3733-378, 1986.

Berquist, S. Observations concerning the presence of pyogenic staphylococci in the nose and their relationship to the antistaphylolysin titre. **Acta. Med. Scand.** 136:343-350, 1950.

Blair, J.E., and Williams, R.E.O. Phage typing of Staphylococci. **Bull World Health Organ.** 24:771-784, 1961.

Blumberg, H.M., Rimland, D., Kiehlbauch, J.A., Terry, P.M., and Wachsmuth, I.K. Epidemiologic typing of *Staphylococcus aureus* by DNA restriction fragment length polymorphisms of rRNA genes: Elucidation of the clonal nature of a group of bacteriophage-nontypeable, ciprofloxacin-resistant, methicillin-susceptible *S. aureus* isolates. **J. Clin. Microbiol.** 30,2:362-369, 1992.

Boyce, J.M., Landry, M., Deetz, T.R., and Du Pont, H.L. Epidemiologic studies of an outbreak of nosocomial methicillin-resistant *Staphylococcus aureus* infections. **Infect. Control.** 2:110-116, 1981.

_____ ., Reevalution of the ability of the standardized disk diffusion test to detect methicillin-resistant strains of *Staphylococcus aureus*. **J. Clin. Microbiol.** 19:813-817, 1984.

Bradley, H.E., Wetmur, J.G., and Hodes, D.S. Tolerance in *Staphylococcus aureus*: evidence for bacteriophage role. **J. Infect. Dis.** 141:233-237, 1980.

Branger, C., Goullet, P., Boutonnier, A., and Fournier, J.M. Correlation between esterase electrophoretic types and capsular polysaccharide type 5 and 8 among methicillin-susceptible and methicillin-resistant strains of *Staphylococcus aureus*. **J. Clin. Microbiol.** 28:150-151, 1990.

Brumfitt, W., and Hamilton-Miller, J.M.T. Methicillin-resistant *Staphylococcus aureus*. **N. Engl. J. Med.** 320:1188-1196, 1989.

Bulger, R.J. *In-vitro* activity of cephalothin/kanamycin and methicillin/kanamycin combinations against methicillin-resistant *Staphylococcus aureus*. **Lancet i** :17-19, 1967.

Carle, G.F., Frank, M., Olson, M.V. Electrophoretic separations of large DNA molecules by periodic inversion of the electric field. **Science.** 232:65-68, 1986.

Cederna, J.E., Terpenning,M.S., Ensberg, M., *et al*. *Staphylococcus aureus* nasal colonization in a nursing home: eradication with mupirocin. **Infect. Control. Hosp. Epidemiol.** 2:13-16, 1990.

Center for Disease Control. Methicillin-resistant *Staphylococcus aureus*. **United Stated Morbid Mortal Weekly Rep**. 30:140-147, 1981.

Chambers, H.F., and Miller, M.H. Emergence of resistance to cephalothin and gentamicin during combination therpy for methicillin-resistant *Staphylococcus aureus* endocarditis in rabbits. **J. Infect. Dis.** 155:581-585, 1987.

_____ ., Methicillin-resistant staphylococci. **Clin. Microbiol. Rev.** 1:173-186, 1988.

Chu, G., Vollrath, D., Davis, R.W. Separation of large DNA molecules by contour-clamped homogeneous electric fields. **Science.** 234:1582-1585, 1986.

Clinical Microbiology Newsletter. Phage typing *Staphylococcus aureus*. **Clin. Microbiol. Newsl.** 17:112-114, 1981.

Cohen, M.L. *Staphylococcus aureus*: biology mechanisms of virulence, epidemiology. **J. Pediar.** 108:796-799, 1986.

Coia, J.E., Noor, H.I., Platt, D.J. Plasmid profiles and restriction enzyme fragmentation patterns of plasmids of methicillin-sensitive and methicillin-resistant isolates of *Staphylococcus aureus* from hospital and the community. **J. Med. Microbiol.** 27:271-276, 1988.

Cook, F.V., Farrar, W.E. Vancomycin revisited. **Ann. Intern Med.** 88:813-818, 1978.

Cooke, E.M. and Marples, R.R. Workshop on methicillin-resistant *Staphylococcus aureus* held at the headquarters of the Public Health Laboratory Service on 8 January 1985. **J. Hosp. Infect.** 6:342-348, 1985.

Cooksan, B., Webster, M., Phillips, I., Rahman, M. and Noble, W. Staff carriage of epidemic methicillin-resistant *Staphylococcus aureus*. **J. Clin. Microbiol.** 27:1471-1476, 1989.

Coudron, P.E., Jones, D.L., Dalton, H.P., and Archer, G.L. Evaluation of laboratory tests for detection of methicillin-resistant *Staphylococcus aureus* and *Staphylococcus epidermidis*. **J. Clin. Microbiol.** 24:764-769, 1986.

Danchaivijitr, S. Report from the Meeting on Proplem of Burn Patients. Division of Infectious Disease, Department of Medicine, Faculty of Medicine, Siriraj Hospital, Mahidol University, 1992

Dickson, D. and Czurylo, K. The nursing management of an MRSA outbreak in an acute care facility. **Nurs. Management.** 19:22-24, 1988.

Duncan, I.B.R., Collins, A.M., Neelin, E.M., and Roy, T.E. Nasal carriage of *Staphylococcus pyogenes* by student nurses. **Can. Med. Ass. J.** 77:1001-1009, 1957.

Dunkle, L.M., and Slippel, C.J. Rapid microprocedure for extraction of plasmid DNA from *Staphylococcus aureus*. **J. Infect. Dis.** 149,6:921-923, 1984.

Elwell, L.P., Wilson, H.R., Knick, V.B., and Keith, B.R. *In vitro* and *in vivo* efficacy of the combination trimethoprim-sulfamethoxazole against clinical isolates of methicillin-resistant *Staphylococcus aureus*. **Antimicrob. Agents Chemother.** 29:1092-1094, 1986.

Farrington, M., Ling, L., Ling. T., and French, G.L. Outbreakes of infection with methicillin-resistant *Staphylococcus aureus* on neonatal and burns units of a new hospital. **J. Epidemiol. Infect.** 105:215-228, 1990.

Fung-Tomc, J., Huezko, E., Gradelski, E., Denbleyker, K., Bonner, D.P., and Kessler, R.E. Emergence of homogeneously methicillin-resistant *Staphylococcus aureus*. **J. Clin. Microbiol.** 29,12:2880-2883, 1991.

Gaston, M.A., Duff, P.S., Naidoo, J., *et al*. Evalution of electrophoretic methods for typing methicillin-resistant *Staphylococcus aureus*. **J. Med. Microbiol.** 26:189-197, 1988.

Gillespie, M.T., May, J.W., and Skurray, R.A. Antibiotics susceptibilites and plasmid profiles of nosocomial methicillin-resistant *Staphylococcus aureus*: a retrospective study. **J. Med. Microbiol.** 17:295-310, 1984.

Goering, R.V., and Duensing, T.D. Rapid field inversion gel electrophoresis in combination with an rRNA gene probe in the epidemiological evaluation of *Staphylococci:* **J. Clin. Microbiol.** 28,3:426-429, 1990.

Hall, L.M.C., JorDens, J.Z., and Wang, F. Methicillin-resistant *Staphylococcus aureus* from China Characterized by digestion of total DNA with restriction enzyme **J. Epidemiol. Infect.** 103:183-192, 1989.

Haly, R.W., Hightower, A.W., Khabbaz, R.F., Thornsberry, C., Martone, W.J., Allen, J.R., and Hughes, J.M. The emergence of methicillin-resistant *Staphylococcus aureus* infections in United States hospital: possible role of the house staff-patient transfer circuit. **Ann. Intern. Med.** 97:297-308, 1982.

Hartmann, B.J. and Tomasz, A. Expression of methicillin-resistant in heterogeneous strains of *Staphylococcus aureus*. **Antimicrob. Agents Chemother.** 29:85-92, 1986.

Hartstein, A.L., Morthland, V.H., Eng, S., Archer, G.L, Schoenknecht,F.D., and Rashad, A.L. Restriction enzyme analysis of plasmid DNA and bacteriophage typing of paired *Staphylococcus aureus* blood culture isolates. **J. Clin. Microbiol.** 27:1874-1879, 1989.

Heczko, P.B., Pryjma, J., Kasprowicz, A., and Krawiec, H. Influence of host and parasite factors on the nasal carriage of staphylococci. **In Contributions to Microbiology and Immunology**, Vol.1: Staphylococcal Infections, Karger, Basel:581-594, 1973.

Heezko, P.B., Bulanda, M., and Hoeffler,V. Nasal carriage of *Staphylococcus aureus* and its influence on hospital infections cause by methicillin-resistant strains. **Int-J. Med. Microbiol.** 274,3:333-341, 1990.

Hone, R., Cafferkey, M., Keane, C.T., Harte-Barry, M., Moorhouse, E., Carrol, R., Martin, F., and Ruddy, R. Bacteremia in Dublin due to gentamicin-resistant *Staphylococcus aureus*. **J. Hosp. Infect.** 2:119-126, 1981.

Hunt, J.L., Purdue, G.F., and Tuggle, D.W. Morbidity and mortality of an endemic pathogen: methicillin-resistant *Staphylococcus aureus*. **Am. J. Surg.** 156:524-527, 1988.

Ichiyama, S., Ohta, M., Shimokata, K., Kato, N., and Takeuchi, J. Genomic DNA fingerprinting by pulsed-field gel electrophoresis as an epidemiological marker of nosocomial infections caused by methicillin-resistant *Staphylococcus aureus*. **J. Clin Microbiol.** 29:2690-2695, 1991.

Jacobs, S.I., Williams, G.M., and Wills, A.T. Nasal abnormality and the carrier rate of *Staphylococcus aureus*. **J. Clin. path.** 14:519-521, 1961.

Jaffe, H.W., Sweeny, H.M., Weinstein, R.A., Kabin, S.A., Nathan, C., and Cohen, S. Structural and phenotypic varieties of gentamicin resistance plasmids in hospital strains of *Staphylococcus aureus* and coagulase-negative staphylococci. **Antimicro. Agents. Chemother.** 21:773-779, 1982.

Jawetz, E., Melnick, J.L., Adelberg, E.A.,*et al* **Medical microbiology** Norwalk, CT: Appleton and Lange, 1989.

Jevons, M.P. Celbenin-resistant staphylococci. **Br. Med. J.**1:124-125, 1961.

Joklik, W.K., ed. Zinsser Microbiology 20th International Edition, Appleton & Lange, USA, 1992.

Jorden, J.Z., and Hall, L.M.C. Characterisation of methicillin-resistant *Staphylococcus aureus* isolated by restriction endonuclease digestion of chromosomal DNA. **J. Med. Microbiol.** 27:117-123, 1988.

Karakana, W.W., Fournier, J.M., Vann, W. F., *et al*. Method for the serological typing of the capsular polysaccarides of *Staphylococcus aureus*. **J. Clin. Microbiol.** 25:1932-1933, 1987.

Khalifa, K.I., Heiba, A.A., and Hancock, G. Nontypeable bacteriophage patterns of methicillin-resistant *Staphylococcus aureus* involved in a hospital outbreak. **J. Clin. Microbiol.** 27,10:2249-2251, 1989.

Klimilk, J.J., Marsik, F.J., Bartlett, R.C., Weir, B., Shea, P., and Quintilliani, R. Clinical, epidemiologic and bacteriologic observation of an outbreak of methicillin-resistant *Staphylococcus aureus* at a large community hospital. **Am. J. Med.** 61:340-345, 1976.

Know, R. and Smith, J.T. Nature of penicillin-resistance in staphylococci. **Lancet ii**:520-522, 1961.

Kozarsky, P.E., Rimland, D., Terry, P.M., and Wachsmuth, K. Plasmid analysis of simultaneous nosocomial outbreaks of methicillin-resistant *Staphylococcus aureus*. **Infect. Control.** 7:577-581, 1986.

Krieg, N.R ed. **Bergey'manual of systematic bacteriology vol.1** Baltimore:Williams & Wilkins, 1984.

Laverdiere, M., Wheeler, N., and SaBath, L.D. Cefuroxime resistance to staphylococcal beta-lactamases. **Proc R Soc Med (Lond).** 70(suppl. 9):72-73, 1977.

Lawrence, J.G., Dukhuizen, D.E., DuBose, R.F., and Hartl, D.L. Phylogenetic analysis using insertion sequence fingerpriting in *Escherichia coli*. **Mol. Biol. Evol.** 6:1-14, 1989.

Leedom, J.M., Kennedy, R.P.,Lepper, M.H., Jackson, G.G., and Dowling, H.F. Observations of the staphylococcal nasal carrier state. **Ann. N.Y. Acad. Sci.** 128:381-403, 1965.

Locksley, R.M., Cohen, M.L., Guinn, T.C., Tompkins, L.S., Coyle,M.B., Kirihara, J.M., and Counts, G.W. Multiply antibiotic-resistant *Staphylococcus aureus:* introduction, transmission and evolution of nosocomial infection. **Ann. Intern. Med.** 97:317-324, 1982.

Lorian, V. ed. **Antibiotics in laboratory medicine 3rd. ed.** Baltimore: Williams & Wilkins, 1991.

Lyon, B.R., and Skurray, R. Antimicrobial ressistance of *Staphylococcus aureus* : Genetic basic. **Microbiol. Rev.** 51:88-134, 1987.

Maple, P.A.C.,Hamilton-Miller, J.M.T. and Brumfitt, W. World-wide antibiotic resistance in methicillin-resistant *Staphylococcus aureus*. **Lancet i**:537-540, 1989.

Matthews, P.R. and Stewart, P.R. Resistance hetrogeneity in methicillin-resistant *Staphylococcus aureus*. **FEMS Microbiol. Lett.** 22:161-166, 1984.

McGowan, J.E., Jr., Terry, P.M., Huang, T.S.R., Houk, C.L., and Davies, J. Nosocomial infections with gentamicin-resistant *Staphylococcus aureus:* plasmid analysis as an epidemiologic tool. **J. Infect. Dis.** 140:864-872,1979.

_____ ., Gram-positive bacteria: spread and antimicrobial resistance in university and community hospitals in the USA. **J. Antimicrob. Chemother.** 21(Suppl.):49-55, 1988.

McMurray, L.W., Kernodle, D.S., and Barg, N.L. Characterization of a widespread strain of methicillin-susceptible *Staphylococcus aureus* associated with nosocomial infections. **J. Infect. Dis.** 162:759-762, 1990.

Miller, D.L., McDonald, J.C., Jevons, M.P., and Williams, R.E.O. Staphylococcal disease and nasal carriage in the Royal Air Force. **J. Hyg. (Camb.)** 60:451-465, 1960.

Miller, M.H., Wexler, M.A., and Steigbigel, N.H. Single and combination antibiotic therapy of *Staphylococcus aureus* experimental endocarditis:emergence of gentamicin-resistant mutants. **Antimicrob. Agents Chemother.** 14:336-343, 1978.

_____ ., Edberg, S.C., Mandel, L.J., Behar, C.F., and Steigbigel, N.H. Gentamicin uptake in wild-type and aminoglycoside-resistant small-colony mutants of *Staphylococcus aureus*. **Antimicrobiol. Agent Chemother.** 18:722-729, 1980.

Muder, R.R., Brennen, C., Wagenner, M.M., *et al.* Methicillin-resistant staphylococcal colonization and infection in a long term care facility. **Ann. Intern Med.** 114(2):107, 1991.

Mulligan, M.E., Kwok, R.Y.Y., Citron, D.M., John, J.F., Jr., and Smith, P.B. Immunoblots, antimicrobial resistance and bacteriophage typing of oxacillin-resistant *Staphylococcus aureus*. **J. Clin. Microbiol.** 26:2395-2401, 1988.

_____., Hartstein, A., Morthland, V., and Kwok, R. Recurrent *Staphylococcus aureus*. 30th **Interscience Conference on Antimicrobial Agents and Chemotherapy.** October 21-24, 1990. **Atlanta, Ga; Abstract.**

_____., and Arbeit, R.D., Epidemiologic and clinical utility of typing system for differentiating among strains of methicillin-resistant *Staphylococcus aureus*. **Infect-Control Hosp. Epidemiol.** 12:20-28, 1991.

Mulvey, M., Arbuthnott, J.P., and Coleman, D.C. Molecular typing of methicillin- and gentamicin-resistant *Staphylococcus aureus* in Dublin. **Eur. J. Clin. Microbiol.** 5:719-725, 1986.

Murray, B.E., and Moellering, R.C.Jr. Patterns and mechanisms of antibiotic resistance. **Med. Clin. North. Am.** 62:899-933, 1978.

Myers, J.P. and Linnemann, C.C. Bacteremia due to methicillin-resistant *Staphylococcus aureus*. **J. Infect. Dis.** 145:532-536, 1982.

Novak, S.M., Hindler, J., and Bruckner, D.A. Reliability of two novel methods, Alamar and E test, for detection of methicillin-resistant *Staphylococcus aureus*. **J. Clin. Microbiol.** 31,11:3056-3057, 1993.

O'Brien, T.F., and Task Force 2. Resistance of bacteria to antibacterial agents: report of Task Force 2. **Rev. Infect. Dis.** 9:s244-s260, 1987.

O'Callaghan, C.H., Morris, A., Kirby, S.M., and Shingle, A.H. Novel method for detection beta-lactamase by using a chromogenic cephalosporin substrate. **Antimicrob. Agents. Chemother.** 1:283-288, 1972.

Parker, M.T. and Hewitt, J.G. Methicillin resistance in *Staphylococcus aureus*. **Lancet** 1:800, 1970.

Patel, A., Foster, T., and Pattee, P. Physical and genetic mapping of the protein A gene in the chromosome of *Staphylococcus aureus* 8325-4. **J. Gen. Microbiol.** 135:1799-1807, 1989.

Peacock, J.E. Jr., Marsik, F.J., and Wenzyl, R.P. Methicillin-resistant *Staphylococcus aureus* and spread with a hospital. **Ann. Intern Med.** 93:526-532, 1980.

_____., Moorman, D.R., Wenzel, R.P., and Mandell, G.L. Methicillin-resistant *Staphylococcus aureus:* microbiologic characteristics, antimicrobial susceptibilities, and assessment of virulence of and epidemic strain. **J. Infect. Dis.** 144,6:575-581, 1981.

Piercy, E.A., Barbaro, D., Luby, J.P., and Mackowiak, P.A. Ciprofloxacin for methicillin-resistant *Staphylococcus aureus* infections. **Antimicrob. Agents. Chemother.** 33:128-130, 1989.

Preheim, L.C., Rimland, D., and Bittner, M.J. Methicillin-resistant *Staphylococcus aureus* in Veterans Administration Medical Centers. **Infect. Control.** 8:191-194, 1987.

Richmond, M.H. Dominance of the inducible state in strains of *Staphylococcus aureus* containing two distinct penicillinase plasmid. **J. Bacterio.** 90:370-374, 1965.

_____ ., Jack, G.W., and Sykes, R.B. The beta-lactamases of gram-negative bacteria, including pseudomonads. **Ann. N.Y. Acad. Sci.** 182:243-257, 1971.

_____ ., Wild type variants of exopenicillinase from *Staphylococcus aureus*. **Biochem J.** 94:584-593, 1965.

Rhinehart, E., Shlaes, D.M., Key, T.F, Serkey, J., Kirkley, B., Kim, C., Currie-McCumber, C.A., and Hall, G. Nosocomial clonal dissemination of methicillin-resistant. *Staphylococcus aureus* elucidation by plasmid analysis; **Arch. Intern. Med.** 147:521-524, 1987.

Ryffel, C., Strassle, A., Kayser, F.H., and Berger-Bachi, B., Mechanisms of heteroresistance in methicillin-resistant *Staphylococcus aureus*. **Antimicrob. Agents. Chemother.** 38,4:724-728, 1994.

Sabath, L.D., Barrett, F.F., Wilcox, C., Gerstein, D.A., and Finland, M. Methicillin resistance of *Staphylococcus aureus* and *Staphylococcus epidermidis*. **Antimicrob. Agents. Chemother.** 302-306, 1968.

_____ ., and Wallace, S.J. Factors influencing methicillin resistance in staphylococci. **Ann. N.Y. Acad. Sci.** 182:258-266, 1971.

_____ ., Wallace, N., Laverdiere, M., Blazevic, D., and Wilkinson, B.J. A new type of penicillin resistance of *Staphylococcus aureus*. **Lancet.**1:443-447, 1977.

_____ ., Garner, C., Wilcor, C., and Finland, M. The effect of inoculum and the beta-lactamase on the anti-staphylococcal activity of thirteen penicillins and cephalosporins. **Antimicrob. Agents Chemother.** 8:44-49, 1975.

_____ ., Mechanisms of Resistance to beta-lactam antibiotics in strains of *Staphylococcus aureus*. **Ann. Int. Med.** 97:339-344, 1982.

Sambrook, J., Fritsch, E.F., and Maniatis, T. **Molecular cloning a laboratory manual 2 ed., vol.3** U.S.A.: Cold Spring Harbor Laboratory Press, 1989.

Saravolatz, L.D., Markowitz, N., Arking, L., Pohold, D.J., and Fisher, E. Methicillin-resistant *Staphylococcus aureus*: epidemilolgic observations during a community-acquired outbreak. **Ann. Intern Med.** 96:11-16, 1982.

Schaefler, S., Jones, D., and Perry, W. Emergence of gentamicin and methicillin resistant *Staphylococcus aureus* strains in New York city hospital. **J. Clin. Microbiol.** 13:754-759, 1981.

Schaefler, S. Methicillin-resistant strains of *Staphylococcus aureus* resistant to quinolones. **J. Clin. Microbiol.** 27:335-336, 1989.

Schlichting, C., Branger, C., Fournier, J.M.,Witte, W., Boutonnier, A., Wolz, C., Goullet, P., and Doring, G. Typing of *Staphylococcus aureus* by pulsed-field gel electrophoresis, zymotyping, capsular typing, and phage typing: resolution of clonal relationships. **J. Clin. Microbiol.** 31,2:227-232, 1993.

Selander, R.F., Caugant, D.A., Ochman, H., *et al*. Methods of multilocus enzyme electrophoresis for bacterial population genetics and systematics. **Appl Environ Microbiol.** 51:873-884, 1986.

_____., Caugant, D.A., and Whittam, T.S. Genetic structure and variation in natural populations of *Escherichia coli*. In: Neidhardt, F.C., Ingraham, K.L., Magasanik, B., Low, K.B., Schaechter, M., Umbarger, B.E. eds. *Escherichia coli* and *Salmonella typhimurium*. Cellular and Molecular Biology. Washington, DC: **American Society for Microbiology.** 1625-1648, 1987.

Seligman, S.J. Penicillin-resistant staphylococci genetics of the minority population. **J. Gen. Microbiol.** 42:315-322, 1966.

Shanson, D.C. Antibiotic-resistant *Staphylococcus auerus*. **J. Hosp. Infect.** 2:11-36, 1981.

Shoop, N.M. **Infection control. Gastroenterol-Nurse** 13,3:169-171, 1991.

Smith, C.L., Warburton, P.E., Gaal, A., and Cantor, C.R. Analysis of genome organization and rearrangements by pulsed field gradient gel electrophoresis. In: Setlow, J.K., *ed.* **Genetic Engineering, Principles and Methods.** Vol. 8. New York, NY: Plenum Press; 45-70, 1986.

Solberg, C.O. A study of carriers of *Staphylococcus aureus* with special regard to quantitative bacterial estimations. **Doctor Thesis, University of Bergen**, 1965.

Sommers, H.B. in The indigenous microbiology of the human host p.86 in The biologic and clinical bases of infectious disease: Youmans-Paterson-Sommers. W.B. Saunders Co./ Philadelphia/ London/ Toranto, 1975.

Sorrell, T.C., Packham, D.R., Shanker, S., Foldes, M., and Munro, R. Vancomycin therapy for methicillin-resistant *Staphylococcus aureus*. **Ann. Intern Med.** 97:344-350, 1982.

Southern, E.M. Detection of specific sequences among DNA fragments separated by gel electrophoresis. **J. Mol. Biol.** 98:503-517, 1975.

Spink, W.W., and Ferris, V. Quantitative action of penicillin inhibitor from penicillin-resistant strains of Staphylococci. **Science.** 102:221-223, 1945.

Standiford, H.C. Methicillin-resistant *Staphylococcus aureus* infections: it's time to get tough. **Infect. Control.** 8:187-189, 1987.

Stephenson, J.R., Crook, S.J., and Tabaquchali, S. New methods for typing *Staphylococcus aureus* resistant to methicillin based on sulphur-35 methionine labelled protein: its application to an outbreak. **Br. Med. J.** 293:581-583, 1986.

Stewart, G.T., and Holt, R.J. Evolution of natural resistance to the new penicillin. **Br. Med. J.** 1:308-311, 1963.

Storrs, M.J., Courvalin, P., and Foster, T.J. Genetic analysis of gentamicin resistance in methicillin- and gentamicin-resistant strains of *Staphylococcus aureus* isolated in Dublin hospitals. **Antimicrob. Agents. Chemother.** 32:2702-2708, 1988.

Stull, T.L., LiPuma, J.J., and Edlind, T.D. A broad-spectrum probe for molecular epidemiology of bacteria: ribosomal RNA. **J. Infect. Dis.** 157:280-286, 1989.

Sutherland, R., and Rollison, G.N. Characteristics of methicillin-resistant staphylococci **J. Bacteriol.** 87:887-889, 1964.

_____ ., Croydon, E.A.P., and Rolison, G.N. Flucloxacillin and new isoxazolon penicillin, compared with oxacillin, cloxacillin and dicloxacillin. **Br. Med. J.** 4:455-460, 1970.

Tesch, W., Strassle, A., Berger-Bachi, B., O'Hara, D., Reynolds, P., and Kayser, F.H. Cloning and expression of methicillin resistance from *Staphylococcus epidermidis* in *Staphylococcus carnosus*. **Antimicrob. Agents. Chemother.** 32:1494-1499, 1988.

Thornsberry, C. Methicillin-resistant (hetero-resistant) staphylococci. **Antimicrob. Newslett.** 1:43-50, 1984.

Trees, D.L., and Iandolo.,J.J. Identification of a *Staphylococcus aureus* transposon (In 4291) that carries the methicillin-resistance gene(s). **J. Bacteriol.** 170:149-154, 1988.

Van Enk, R.A., and Thompson, K.D. Use of a primary isolation medium for recovery of methicillin-resistant *Staphylococcus aureus*. **J. Clin. Microbiol.** 30,2:504-505,1992.

Van Ketel, R.J. Similar DNA restriction endonuclease profiles in strains of *Legionella pneumophilia* from different serogroups. **J. Clin. Microbiol.** 26:1838-1841, 1988.

Volk, W.A.ed. **Essentials of medical microbiology. 2nd ed.** Philadelphia: J.B. Lippincott company, 1982.

Vorachit, M. Methicillin-resistant *Staphylococcus aureus*. Faculty of Medicine, Ramathibodi Hospital, Mahidol University, 1988.

Wachsmuth, K. Genotypic approaches to the diagnosis of bacterial infections: plasmid analyses and gene probes. **Infect. Control.** 6:100-109, 1985.

Walsh, T.J., Vlahov, D., Hansen, S.L., Sonnenberg, E., Khabbaz, R., Gadaez, T., and Standiford, H.C. Prospective microbiologic surveillance in control of nosocomial methicillin-resistant *Staphylococcus aureus*. **Infect. Control.** 8:7-14, 1987.

Ward, T.T., Winn, R.E., Hartstein, A.F. and Sewell, D.L. Observations relating to an inter-hospital outbreak of methicillin-resistant *Staphylococcus aureus*: role of antimicrobial therapy in infections control. **Infect. Control.** 2:453-459, 1981.

Watanakunakorn, C. Treatment of infections due to methicillin-resistant *Staphylococcus aureus*. **Ann. Intern Med.** 97:376-378, 1982.

Weber, D.A., and Goering, R.V. Tn 4201, a Beta-lactamase transposon in *Staphylococcus aureus:* **Antimicrob. Agents. Chemother.** 32:1164-1169, 1988.

Williams, R.E.O. Healthy carriage of *Staphylococcus aureus*: its prevalence and importance. **Bact. Rev.** 27:56-71, 1963.

Writte, W., and Braulke, CHR. Multiply and methicillin-resistant *Staphylococcus aureus* strains isolated in the German Democratic Republic in 1985 and 1986. **J. Epidemiol Infect.** 99:603-612, 1987.

_____., Van Dip, N., and Dunnhaupt, K. Methicillin-resistant *Staphylococcus aureus*(MRSA) in the German Democratic Republic incidence and strain-characteristic. **J. Hyg-Epidemiol-Microbiol. Immunol.** 30,2:185-193, 1986.

Zierdt, C.H., Robertson, E.A., Williams, R.L., *et al*: Computer analysis of *Staphylococcus aureus* phage typing data from 1957 to 1975, citing epidemiologic trends and natural evolution within the phage typing system. **Appl. Environ Microbiol.** 39:623-629, 1980.

Zuccarelli, A.J., Roy, I., Harding, G.P., and Couperus,J.J. Diversity and stability of restriction enzyme profiles of plamid DNA from methicillin-resistant *Staphylococcus aureus*. **J. Clin. Microbiol.** 28,1:97-102, 1990.

APPENDIX

I. Reagent for Gram staining

1. Gram crystal violet solution

a. Solution A:

Crystal violet	2.0 g.
Ethanol (95%)	20.0 ml.

Crystal violet was dissloved in ethanol to make a solution.

b. Solution B:

Ammonium oxalate	0.8 g.
Distilled water	80.0 ml.

Ammonium oxalate was dissolved in distilled water. Then, solution A and solution B were mixed to make gram's crystal violet solution.

2. Gram iodine solution

Iodine	1.0 g.
Potassium iodide	2.0 g.
Distilled water	300.0 ml.

Iodine and potassium iodide were mixed in a mortar and distilled water was added to make the solution.

3. Gram safranin solution

Safranin	0.25	g.
Ethanol (95%)	10.00	ml.
Distilled water	100.00	ml.

Safranin was dissolved in ethanol and distilled water was added. The solution was filtrated by filter paper.

Staining procedure

1. The organisms were smeared on a clean slide and allowed to dry.

2. The slide was heated with a flame to fix the smear.

3. Gram crystal violet was dropped on the smear. After 1 minute, the slide was then washed with water and drained.

4. Next, gram iodine solution was dropped on the smear, and washed with water after 1 minute.

5. The smear was decolorized with ethanol (95%) and then washed with water.

6. Gram safranin solution was next dropped on the smear in oder to use as counterstain for 30 second. The smear was allowed to dry.

7. The smear was examined by microscopy under 100x objective len over the entire smear.

II. Catalase test

Several colonies of *S. aureus* was smeared on a clean slide. The 3% hydrogen peroxide was dropped and mixed with the organisms.

The positive result was shown as bubbles formation.

III. Coagulase test

3.1 Slide coagulase test

Several colonies of *S. aureus* was mixed generously with a dropped of human plasma on a clean slide.

The positive result was shown as the white precipitates formation within 5 minutes.

3.2 Tube coagulase test

The 0.5 ml of staphylococcal broth culture or a loopful of staphylococci was mixed with 0.5 ml of human plasma in a clean tube. The tube was incubated at 37°C for 3 to 4 hour.

The positive result was developed as a clot gel.

VI. Media

4.1 Mannitol salt agar

Proteose peptone No.3, Difco	10.0	g.
Bacto beef extract	1.0	g.
Bacto D-mannitol	10.0	g.
Sodium chloride	75.0	g.
Bacto agar	15.0	g.
Phenol red	0.025	g.
Distilled water qs.	1000.0	ml.

4.2 Mueller-Hinton agar medium

Beef, Infusion from	300.0	g.
Bacto casamino acids, Technical	17.5	g.
Starch	1.5	g.
Bacto agar	17.0	g.
Distilled water qs.	1000.0	ml.

For Mueller-Hinton agar containing 5% sodium chloride, 50 grams of sodium chloride was added.

4.3 Mueller-Hinton broth medium

Beef, Infusion from	300.0	g.
Casamino acid, Technical	17.5	g.
Bacto soluble strach	1.5	g.
Distilled water qs.	1000.0	ml.

4.4 Tryptose blood agar base medium

Bacto tryptose	10.0	g.
Bacto beef extract	3.0	g.
Sodium chloride	5.0	g.
Bacto agar	15.0	g.
Distilled water qs.	950.0	ml.

Media Preparation

All of ingredients were dissolved in distilled water and then steriled by autoclaving at 121°C, 15 pounds /inch^2 pressure, for 15 minutes. The sterile medium was cooled to 45°C to 50°C, and dispended into sterile plates or tubes. For sterile tryptose blood agar base medium, 50

ml of sterile defibrinated blood was added aseptically into sterile plates before dispension.

4.5 0.8% Agarose Gel

The correct amount of powdered agarose electrophoresis medium type was added to a measured quantity of TBE buffer and made 0.8% agarose gel. The slurry was heated in a autoclave at 15 pound/inch^2 121°C 15 minutes to dissolve the agarose and was cooled to 50°C. The edge of a clean, dry, plastic plate (10 by 15 cm) was sealed with the autoclave tape so as to form a mold. The edge of the mold was sealed with a small quantity of agarose solution using a pasteur pipette. When the seal was set, the rest of the warm agarose dilution was poured into the mold and was immediately clamp the comb. The sample wells were formed by using the teeth of the comb into position near one end of the gel. The depth of agarose between the bottom of the teeth and the base of the gel was approximately 0.5 to 1.0 mm. After the gel was completely set (30 to 45 minutes at room temperature), the comb and autoclave tape were carefully removed, and the gel was mounted in the electrophoresis tank.

V. Reagents

5.1 Lysis buffer (Treat buffer for plasmid extraction)

Sucrose	8%
Triton X100	5%

EDTA	50 mM
Tris.HCl	50 mM

All of ingredients were dissolved in deionized water and was adjusted the pH to 8.0. (Tris-base was used if it was necessary.)

5.2 Loading buffer (x6)

Bromophenol blue	0.25	g.
Sucrose	40.0	g.
Deionized water qs.	100.0	ml.

Sucrose was dissolved in double distilled water and bromophenol blue was added to make the solution.

5.3 Tris-borate buffer (TBE)

Concentrated stock solution (x5)

Tris base	54.0	g.
Boric acid	27.5	g.
0.5 M EDTA	20.0	ml.

All of ingredients were dissloved in deionized water and adjusted the pH to 8.0. Then deionized water was added to 1000.0 ml.

Working solution

The 100 ml of concentrated stock solution was added into 900 ml. of double distilled water. The working solution consisted of 0.089 M Tris- borate, 0.089 M boric acid and 0.002 M EDTA.

5.4 Ethidium bromide

Ethidium bromide stock solution (5 mg/ml in water) was diluted to 0.5 μg/ml in TBE.

5.5 10 mM Tris, pH 8.0

121.2 mg of Tris- base was dissolved in 800 ml. of deionized water, and adjusted the pH to 8.0 by adding concentrated HCl. The solution was made up the volume to 1000.0 ml.

5.6 TE buffer

10 mM Tris-base

1 mM EDTA

Tris-base and EDTA were dissolved in deionized water and adjusted the pH to 8.0 by adding concentrated HCl.

5.7 Saturated phenol

Phenol was dissolved in 1 M Tris-base, pH 8.0 to make saturated phenol emulsion. The emulsion was stored at -4°C until used.

5.8 1% Potassium phosphate buffer, pH 6.0

Dibasic potassium phosphate	2.0	g.
Monobasic potassium phosphate	8.0	g.
Distilled water qs to	1000.0	ml.

Dibasic potassium phosphate and monobasic potassium phosphate were dissolved in distilled water, and

adjusted the pH to 6.0 with 18 N phosphoric acid or 10 N potassium hydroxide.

5.9 0.5 Mc Farland standard solution

0.5 ml of 0.048 M Barium chloride (1.175% w/v Barium chloride-$2H_2O$) was added into 99.5 ml of 0.35 N H_2SO_4 (1% v/v). The suspension was agitated on a vortex mixer just before use. The turbidity of standard should give an optical density of 0.08 to 0.10 at 625 nm when tested in a spectrophotometer with a 1-cm light path.

All of the reagents except ethidium bromide and saturated phenol were steriled by autoclave at 121°C, 15 pounds pressure, for 15 minutes. Reagents were stored at 4°C until used or 2 weeks.

VITAE

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