

Trends in the distribution of *Staphylococcus aureus* phage patterns in New York State during 1966–1975 *

MEHDI SHAYEGANI,¹ MARIE L. BOBNICK,² & FERDINAND C. HAASE³

Abstract

The phage patterns of 15 790 S. aureus isolates collected from human sources in New York State (exclusive of New York City) during the 10-year period 1966–1975 were analysed. The results showed changes in the distribution of phage groups and a steadily increasing incidence of nontypable S. aureus.

An extensive collection of phage-typing data for 15 790 *S. aureus* isolates has been analysed to identify changes in the distribution pattern over the decade 1966–1975. The isolates were submitted for phage typing at the bacteriological laboratories of the Division of Laboratories and Research, which provide diagnostic and reference services for institutions throughout New York State (exclusive of New York City).

Materials and methods

Cultures submitted to our laboratory for phage typing were first confirmed as *S. aureus* by colonial and cellular morphology and by the results of a coagulase test.

Staphylococcus reference reagents for phage typing were obtained from the International Staphylococcus Reference Laboratory, Colingdale, England via the National Reference Center for Staphylococcus Phage Typing, Center for Disease Control, Atlanta, Georgia, USA. Phage typing was performed by the method described in the instructions accompanying the phage and propagating strains received; the method has also been reported elsewhere (1, 2).

The international basic set of 22 phages used consists of five groups: group I: 29, 52, 52A, 79, 80; group II: 3A, 3C, 55, 71; group III: 6, 42E, 47, 53, 54, 75, 77, 83A, 84, 85; group IV: 42D; and miscellaneous: 81, 187. In 1966 and the early part of 1967 (January–April), phage 3B was included in group II and phage 7 in group III.

The phage type of each staphylococcal isolate was first determined at the routine test dilution (RTD); isolates that were not lysed with RTD phages were then typed with 1000×RTD (concentrated). In 1973, the system was adapted to use 100×RTD (concentrated) for concentrated phages, while phages 83A, 84, and 85 were employed at RTD only.

Some subsequent changes are not reflected in the present report. According to the most recent recommendation of the International Subcommittee on Phage Typing of Staphylococci (3), the new phages 94, 95, and 96 have been added to the miscellaneous group of the international basic set. Phages 42D and 187 are no longer used and phages 83A, 84, and 85 are now to be used at 100×RTD with cultures nontypable with RTD. These changes were adopted by our laboratory in the latter part of 1975 but in order to maintain the continuity of this study, the previous procedure was also used up to the end of the year.

Results

From 1966 to 1975, a total of 15 790 isolates of *S. aureus* were phage-typed in our laboratory. The results for typable and nontypable phages are reported separately, and the typable phages are assigned to their phage groups. Since the phage pattern of an isolate may be included in more than one phage group, a total number of phage patterns greater than the number of staphylococcal isolates may be obtained.

The number of isolates tested each year and their distribution into phage groups are shown in Table 1.

* From the Division of Laboratories and Research, New York State Department of Health, Albany, NY 12201, USA.

¹ Senior Research Scientist.

² Laboratory Technician.

³ Biochemist.

Table 1. Distribution of phage groups among 15 790 isolates of *S. aureus* from New York State, exclusive of New York City, during 1966–1975

Year	Phage group ^a						Total	
	I	II	III	IV	Misc.	NT	Phage groups	Isolates
1966	771	182	649	50	418	91	2161	1402
1967	811	349	739	36	472	186	2593	1767
1968	462	187	447	6	227	309	1638	1342
1969	389	290	399	17	177	272	1544	1275
1970	197	206	209	24	110	159	905	720
1971	281	250	295	54	154	170	1204	865
1972	680	518	692	145	240	337	2612	2141
1973	542	548	476	4	245	376	2191	1844
1974	486	300	389	56	115	641	1987	2007
1975	563	308	400	2	67	1118	2458	2427
Total	5182	3138	4695	394	2225	3659	19 293	15 790

^a Misc. = miscellaneous group; NT = nontypable. For some isolates the phage pattern is included in more than one group.

Phage group I predominated from 1966 to 1968 and was replaced by phage group III during 1969–1972. Group II phages were the most common in 1973, but nontypable phages predominated during 1974 and 1975.

Discussion

Different distributions of phage patterns have been reported in various locations by other investigators; in addition, some long-term studies show broad shifts in these distributions. In a study among hospital patients in Boston City Hospital (4), 1550 staphylococcal isolates from 5 different years between 1950 and 1960 were tested with RTD and 1000×RTD phages. A predominance of phage group III was found in 1950 and of group I (phage 81 was included in this group) in 1955. The proportion of nontypable isolates varied each year but averaged 26%.

In a study in hospitals in London, England, during 1961–1972 (5), a total of 7043 isolates were tested. Thirty-three percent were typable with phage group I (including phage 81). Seven percent of the staphylococci typed fell in group II, 29% in group III, 0.3% in group IV, and 18% in miscellaneous; 12% were nontypable. A similar percentage of nontypable isolates was reported for 66 219 *S. aureus*

strains received between 1961 and 1965 by the Danish Central Laboratory (6).

The predominance of groups I and III reported by the above investigators was similar to that observed in New York State during this study. Our results differ markedly, however, in the high percentage of nontypable isolates found and the sharp increases in this category in 1974 and 1975; this is of interest, particularly since the use of the new phages 94, 95, and 96, introduced in the latter part of 1975, should have sharply reduced the number of nontypable staphylococci. A study of the typing of these isolates by means of the new phages and a different approach will be the subject of a separate paper.

ACKNOWLEDGEMENT

The authors wish to acknowledge the work of the technicians engaged in staphylococcal phage typing during 1966–1975.

REFERENCES

- BLAIR, J. E. & WILLIAMS, R. E. O. Phage typing of staphylococci. *Bulletin of the World Health Organization*, **24**: 771-784 (1961).

2. SMITH, P. B. Bacteriophage typing of *Staphylococcus aureus*. In: Cohen, J. O., ed. *The staphylococci*. New York, Wiley-Interscience, 1972, p. 431-441.
 3. Report (1970-1974) of the Subcommittee on Phage Typing of Staphylococci to the International Committee on Systemic Bacteriology. *International journal of systemic bacteriology*, **25**: 241-242 (1975).
 4. WALLMARK, G. & FINLAND, M. Phage typing and antibiotic susceptibility of pathogenic staphylococci. Results at Boston City Hospital 1959-1960 and comparison with strains of previous years. *Journal of the American Medical Association*, **175**: 886-897 (1961).
 5. PARKER, M. T. ET AL. Endemic staphylococcal infections in hospitals. *Annals of the New York Academy of Science*, **236**: 466-484 (1974).
 6. ROSENDAL, K. & BULOW, P. *Staphylococcus aureus* strains isolated in Danish hospitals. *Acta pathologica et microbiologica scandinavica*, **71**: 422-438 (1967).
-