

# The Nasopharyngeal Swab in the Diagnosis of Pertussis\*

T. M. SAITO, JOHN J. MILLER, JR., M.D., AND  
CHARLES W. LEACH, M.D.

*Department of Pediatrics, Stanford University School of Medicine,  
San Francisco, Calif.*

BRADFORD, Slavin, and Brooks<sup>1, 2</sup> have adapted the nasopharyngeal swab, which has been routinely used in the diagnosis of pneumonia, to the diagnosis of pertussis. The purpose of this communication is to compare the results obtained by this new method with that of the cough plate originally described by Chievitz and Meyer<sup>3</sup> in 1916. There have been numerous reports on the latter method.<sup>4-17</sup> It has been found highly satisfactory in the hands of the experienced but has not come into general use. Difficulties have been (1) inducing a cough at the time one has the plates (particularly difficult in infants), (2) transporting the plates, and (3) identifying *Hemophilus pertussis* on a plate crowded with colonies of other microorganisms. Another common problem is that of having sufficient sheep or horse blood available to make the media.

The nasopharyngeal applicator advised by Bradford and Slavin and used by the writers is "a small bit of cotton tightly wrapped about the end of a thin, flexible copper wire." It is passed through a nostril into the nasopharynx. Therefore, it must be much smaller than the usual swab used for taking nose and throat cultures for diphtheria. Great gentleness is required. The child's head

must be immobilized. If resistance (a large turbinate, deviated septum or adenoids) is encountered, the applicator should be withdrawn and inserted in the other nostril. It is, of course, sometimes quite impossible to pass even the smallest applicator.

The insertion of the applicator into the nasopharynx very often induces coughing. The applicator should be left there for two or three of the coughs. Incidentally this procedure is a very effective one for obtaining well exposed cough plates. We have usually exposed them at this time. The applicator is then withdrawn and placed in a sterile test tube.

Petri dishes of Bordet-Gengou medium (the same as used for cough plates) are then inoculated lightly by touching the medium three times with the applicator. A sterile platinum loop is used to "dolly" across the medium through the spots inoculated. We have routinely inoculated two dishes with each swab. If a purulent nasal discharge is present, the medium is touched only once with the contaminated swab and preferably more than two dishes are inoculated.

The cough plates herein reported were taken in duplicate on only about half of the individuals tested. If duplicate plates had been taken with more regularity, our results with them would have been better.

\* Read before the Laboratory Section of the American Public Health Association at the Seventieth Annual Meeting in Atlantic City, N. J., October 17, 1941.

The medium we have used is described in the footnote.\* We do not wish to go into the merits of the various formulae described. Ours is essentially that used at the Serum Institute in Copenhagen. The inoculated plates are examined after 2, 3, or 4 days of incubation. Colonies are selected for staining by their pearl-like, shiny appearance when the media is tilted toward a desk lamp in a darkened room. All strains isolated were identified by the usual cultural methods. Agglutination tests were performed only occasionally.

pected in a public health unit where tests were made by a large number of individuals.

Table 1 summarizes the results of 210 comparative tests on 152 cases of pertussis seen during the past 17 months. The recorded cases which were bacteriologically negative were diagnosed on the basis of typical clinical findings. There is no doubt that we missed the diagnosis in some atypical cases of pertussis, for a number of bacteriologically proven cases were very mild or atypical. These latter cases of *Hemophilus pertussis* in-

TABLE 1

*A Comparison of Results with Cough Plates and Nasopharyngeal Swabs  
210 Tests on 152 Cases in which Both Cough Plate and Swab Were Used*

Week of Disease	Both			Both		% + By Swab	% + By Plate	% + By Both
	Plate + Swab +	Swab -	Plate -	Plate -	Swab -			
1st .....	26	6	13	10	55	71	60	82
2nd .....	21	4	19	20	64	63	39	69
3rd .....	4	4	11	20	39	38	20	49
4th .....	7	3	3	9	22	45	45	58
5th .....	...	1	4	9	14	...	...	...
6th .....	...	...	...	6	6	...	...	...
7th .....	...	1	...	8	9	...	...	...
8th .....	...	...	...	1	1	...	...	...
Total ....	58	19	50	83	210	51	37	60

The nasopharyngeal swab and cough plates were taken by many different physicians and nurses often inexperienced in the procedures. The results therefore are by no means as satisfactory as might be obtained. The percentage of positive cough plates is definitely low as compared to results obtained by other workers.<sup>4-17</sup> On the other hand, our results indicate what might be ex-

fection would have been missed clinically. Two cases of parapertussis have been encountered since this study began. (The authors have recently reviewed 10 cases of this latter infection<sup>18</sup> seen during the past 4 years.)

Confirming the findings of Bradford and Slavin, Table 1 indicates that the nasopharyngeal swab yielded a higher percentage of positive tests than the cough plate. There were 50 tests in which the swab was positive and the plate negative as compared to 19 tests in which the swab was negative and the plate positive. The oft repeated observation that the earlier the cough plate is taken the more likely it will be positive, holds also for the nasopharyngeal swab.

\* Preparation of medium: 500 gm. of peeled, sliced potatoes are cooked until soft in 1 liter of tap water containing 40 ml. of glycerine. The potato mixture is filtered through 4 thicknesses of cheesecloth; 125 ml. of filtrate are added to 12.5 gm. of agar, 5 gm. of neopeptone, and 375 ml. of 0.6 per cent sodium chloride in a 1 liter flask. The medium is sterilized for 30 minutes at 15 lb. pressure. For use, 250 ml. of defibrinated horse blood, slightly warmed, are added to the melted agar, cooled to approximately 45° C. About 20 thick plates of medium can be poured from this volume.

TABLE 2

*The Isolation of Hemophilus Pertussis by Cough Plate and Nasopharyngeal Swab From 154 Cases of Pertussis*

(Some of these cases were not seen until the 5th or 6th week of cough)

Number of Cases.....	<i>Both</i>			<i>Both</i> Negative	Total	Total Swab +	Total Plate +
	Plate + Swab +	Plate + Swab -	Swab + Plate -				
Cases.....	60	15	38	41	154	98	75
% of Total Cases.....	39	10	25	27	73+	64	49
% of + Cases.....	53	13	34	...	...	87	66

It is also apparent that the use of both procedures is superior to the use of nasopharyngeal swabs alone.

Table 2 lists 154 cases studied and shows the percentage of cases (not the number of tests) which were positive. It should be mentioned that a few of these cases were not seen until the 5th or 6th week of cough. Sixty-four per cent of all cases were positive by swab at some time during their course, whereas 49 per cent were positive by plate. Eighty-seven per cent of the bacteriologically proven cases were positive by swab as compared to 66 per cent positive by plate.

In order to determine the viability of *Hemophilus pertussis* on the nasopharyngeal applicator, a considerable number of the applicators were placed in the electric refrigerator at 2° C. after they had been used to inoculate media. Of 41 applicators which were subsequently found to be positive on the initial streaking, 4 of 11 were again positive after 1 day of refrigeration, 3 of 19 were again positive after 2 days of refrigeration, and 2 of 10 were again positive after 3 days of refrigeration. It is apparent that *Hemophilus pertussis* may occasionally remain viable in mucus imbedded in cotton for 3 days at this temperature. It is also apparent that isolation of the organism is facilitated

by prompt inoculation on media and incubation.

Bradford and Slavin<sup>1</sup> noted that "sometimes the growth from the nasopharyngeal cultures was practically pure." We have also noted this. Very heavy growth is often encountered.

Further studies are being made to determine in particular, (1) the duration of carriage of *Hemophilus pertussis* in the nasopharynx during pertussis, and (2) the presence of *Hemophilus pertussis* in the nasopharynx of contacts.

The advantages of the nasopharyngeal swab technic as compared to the cough plate appear to be:

1. Higher percentage of positive cultures
2. Ease of transportation
3. Speed in obtaining the inoculum

The disadvantage to the method is the discomfort involved.

#### SUMMARY

The nasopharyngeal swab of Bradford and Slavin has been compared with the cough plate in the bacteriological diagnosis of pertussis. Two hundred and ten duplicate tests were made on 152 cases in all stages of the disease. *Hemophilus pertussis* was isolated more frequently by swab than by plate. The use of both procedures, however, was superior to the swab alone.

## REFERENCES

1. Bradford, W. L., and Slavin, B. *Proc. Soc. Exper. Biol. & Med.*, 43:590, 1940.
2. Bradford, W. L., and Brooks, A. M. *Am. J. Dis. Child.*, 62:436, 1941.
3. Chievitz, J., and Meyer, A. H. *Ann. Inst. Pasteur*, 30:503, 1916.
4. Madsen, T. *Boston M. & S. J.*, 192:50, 1925.
5. Lawson, G. M., and Mueller, M. *J.A.M.A.*, 89:275, 1927.
6. Debre, Marie, and Pretet. *Gaz. méd. de France*, Jan. 15, 1930.
7. Culotta, C. S., and Harvey, D. F. *Yale J. Biol. & Med.*, 5:69, 1932.
8. Gardner, A. D., and Leslie, P. H. *Lancet*, 1:9, 1932.
9. Kline, E. K. *A.J.P.H.*, 23:493, 1933.
10. Kristensen, B. *J.A.M.A.*, 101:204, 1933.
11. Sauer, L. W. *J. Pediat.*, 2:740, 1933.
12. Kendrick, P., and Eldering, G. *A.J.P.H.*, 24:309, 1934.
13. Stallings, M., and Nichols, V. C. *Am. J. Dis. Child.*, 48:1183 (Dec.), 1934.
14. Miller, J. J., Jr. *California & West. Med.*, 43:138 (Aug.), 1935.
15. Straker, E. A., and Westwater, J. S. *Lancet*, Sept. 4, 1937, p. 565.
16. Donald, A. B. *Brit. M. J.*, 2:613 (Sept. 17), 1938.
17. Silverthorne, N., and Fraser, D. T. *Canad. M. A. J.*, 38:556, 1938.
18. Miller, J. J., Jr., Saito, T. M., and Silverberg, R. J. *J. Pediat.*, 19:229 (Aug.), 1941.