Diphtheria and scarlet fever in relation to school medical officers / by R.A. O'Brien.

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Diphtheria and Scarlet Fever in relation to School Medical Officers.

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The discussion which I have the honour to open will presumably deal with the prevention and treatment of these two diseases, but mainly with diagnosis. Diphtheria and scarlet fever occur but rarely in preparatory and public schools—how rarely I did not realise until supplied, by the courtesy of a number of medical officers, with the details set out later in Tables I. and II. The two diseases occur apparently somewhat more frequently in elementary schools and even oftener in residential institutions, such as poor-law schools, etc.

Table I.

Number of Boys.	Scarlet Fever.	Diphtheria.
About 100	0 in 2 years.	0 in 2 years.
,, 600	34 in 9 ,,	3 in 9 ,,
,, 100	3 in 17 ,,	1 in 17 ,,
,, 600	72 in 20 ,,	29 in 20 ,,
,, 600	"Rarely any trouble."	"Occasional case." "Recent epidemic 8 cases."
400,000 (London Schools). Medical students, a London Hospital.	About 3,000 a year. (1 per cent). 20 per cent. gave history.	About 2,000 a year. (0·5 per cent.). 15 per cent. gave history.

Table II.

Percentage of Boys suffering from Infectious Diseases.

	Large Public School.			Large Public School.	Prep. School.
	Before entry.	During School.	Total.	Before entry.	Partly before; Partly during.
Ch.P. ...	80	10	90	71	38
Me. ...	68	26	94	89	45
Wh.C. ...	74	1	75	68	54
Ge.M. ...	37	26	63	—	3
Mu. ...	26	11	37	35	16
S.F. ...	6	0	6	9	5
Diph. ...	1	1	2	2	3

Notwithstanding the rarity of diphtheria and scarlet fever, the possibility of their occurrence must always be present in the mind of the school medical officer. It may be that in the future prevention by active immunisation will be generally applicable to public and preparatory schools, but at present the main interest must centre in possible aids in diagnosis.

Diphtheria.

Schick Test. The Schick test and virulence test may be of great service to the school medical officer. Diphtheria toxin will produce a characteristic reaction in the skin of a normal guinea-pig. If the toxin be mixed with sufficient antitoxin before the injection, no reaction is produced. Nor is any reaction produced if the guinea-pig contain antitoxin, either the remains of a dose injected a short time previously or antitoxin in the animal's body resulting from active immunisation against diphtheria undertaken some time previously. When a certain small amount of toxin is injected intradermally into human beings, people susceptible to the disease give a positive reaction. Those who are immune, *i.e.*, the "negative reactors," show no reaction. Owing to the unfortunate complication caused by the presence of an unknown protein or "pseudo" constituent in toxin, two further classes are necessary, the positive plus pseudo and negative plus pseudo groups.

Fortunately, the Schick test when done on normal people with toxin of the proper strength gives readings which are easily made in the great majority of instances on the morning after the test. The perplexing positive plus pseudo reactions are rarely met with. In any case of doubt, a careful record made daily of the size and colour of the reactions on the two arms will practically always enable one to make a decision. We have on a few occasions been in doubt when examining a positive and pseudo reaction on the third or fifth day after a test, whereas a reading made on the 14th day enabled one to make a decision. If still in doubt after several readings, we repeat the test or take some 5 to 10 c.c. of blood from one of the veins at the elbow and test it in the laboratory for its content of antitoxin. If a reasonable amount of antitoxin is present we know that the patient is immune against diphtheria and must be a negative reactor to the Schick test.

The Schick test can aid in two ways. If the medical officer has a case of sore throat that raises only a slight suspicion of diph-

theria, he may, of course, give antitoxin at once and take a swab. The patient recovers, the soreness disappears and all is well—*but* one has not made a diagnosis. Even the "positive" report from a swab in such cases may be valueless unless the microscopic examination of a smear made from an overnight culture is followed by a virulence test of the organisms present. And even when the report "virulent" is received we still do not know whether the patient was a carrier of virulent diphtheria organisms (probably 2 per cent. to 3 per cent. of the population of crowded London are such carriers) suffering from a sore throat caused by some other agency, or whether he had had an attack of mild but true diphtheria.

The Schick test, on the other hand, gives us fairly definite information. Considerable numbers of patients suffering from indubitable diphtheria have been tested and have invariably given a positive response to the Schick test. If, therefore, a patient suspected to be suffering from diphtheria, who has not yet been given serum, gives an undoubted negative response to the Schick test, it is exceedingly improbable that he is suffering from diphtheria. (This procedure can obviously be applicable only in attacks of mild sore throat thought not to be diphtheria, for if a reasonable suspicion of diphtheria arises, serum must not be withheld. One may, however, compromise; one can do the Schick test and give antitoxin five or six hours later when it will not interfere with the development of the Schick test.)

In the control of small epidemics we advocate the use of the Schick test instead of the method ordinarily pursued in public health work. The ordinary practice is to swab the throats of all the contacts and to isolate those with "positive swabs." Such a proceeding is unsound. Amongst those isolated there will be many Schick positive children with avirulent bacilli which morphologically resemble the diphtheria bacillus but, according to all the available evidence, are incapable of causing diphtheria; there may be also one or more carriers of virulent diphtheria bacilli who are also "swab positive." The latter children will be Schick negative and immune to diphtheria but capable of giving the disease to the unfortunate Schick positive susceptible children segregated in close contact with them. We have seen as the result of isolating all "swab positive" children, a "virulent carrier" (L.M.), whose swab culture showed as many virulent diphtheria bacilli as a case of frank diphthera, in close contact in a small room with a number of Schick positive and therefore susceptible children.

TABLE III.

CHILDREN TOGETHER IN ISOLATION AS RESULT OF "POSITIVE SWABS."

			Swab.
F.P.	Schick	+	Avirulent.
F.R.	,,	−	Virulent.
J.O.	,,	−	Avirulent.
E.H.	,,	+	Avirulent.
T.W.	,,	+	Avirulent.
A.R.	,,	−	Virulent.
E.G.	,,	+	Avirulent.
M.M.	,	+	Avirulent.
B.C.	,,	−	Avirulent.
L.M.	,,	−	Virulent (+++).

The variant of this method consists in giving antitoxin to all the contacts. This is a short cut and for the moment removes all danger, but the immunity so given to the members of the school fades in from two to four weeks, and if the original cause of the epidemic be not detected, it is not an uncommon experience that cases of diphtheria again begin to occur and the whole uncertainty and dislocation of school arrangements again face the authorities.

When a case of diphtheria occurs in a school the plan we have advocated consists in Schick testing all the possible contacts as the first and most important measure. If the danger is urgent, the positive and negative reactors can be put into separate groups within 48 hours. One knows now that if any further cases of diphtheria are to occur they will occur amongst the positive reactors. This group should therefore be inspected frequently and any one showing the least departure from normal health should be isolated and treated as may be necessary. If a carrier of virulent diphtheria bacilli be present in the school, he will be found among the Schick negative reactors. It is, therefore, worth while swabbing all the boys in this group and repeating the swabbing a few days later. Any bacilli present which resemble the diphtheria bacillus must then be tested for virulence. This method is the surest and simplest way of finding a virulent carrier if one be present amongst the members of the school or the school staff.

By placing the first importance on a thorough application of the Schick test, one can gain control of the whole situation within 24 to 48 hours and have a justifiable feeling of confidence that one knows where to direct one's efforts to the best advantage.

Prevention of Diphtheria.

In a whole-time residential institution, *e.g.*, an orphanage, if a series of cases of diphtheria occurs the only radically satisfactory plan of ending the trouble is to Schick test the whole of the inmates and immunise actively those who are positive reactors. (My colleagues and I have had the pleasure during the past few years of watching the success of this work in several residential schools in which we have tested the inmates and immunised the positive reactors.)

It can be taken for granted to-day that by active immunisation one can make a given group of people within two or three months immune against diphtheria. If, therefore, diphtheria becomes troublesome in a large public school, we have the means at our disposal of ridding the school of diphtheria.

Table IV.

Diphtheria in Nursing Staffs of Fever Hospitals.

Year.	Percentage (Aberdeen).	Average Percentage.	Percentage (Edinburgh).
1912	6		
1913	15		
1914	15		
1915	9		
1916	10	= 11	
1917	10		
1918	7		
1919	5		11
1920	18		7
1921	18		10
1922	2		9
1923	0	= 1.5	4
1924	3		3
1925	1		2

From the results in Table IV., we see that in Aberdeen in the hospitals under the care of Dr. Kinloch the incidence of diphtheria amongst the ward staff has been reduced materially during the past four years when Schick testing and immunisation were applied to the nursing staff. The Edinburgh hospital results, kindly supplied by Dr. Benson, show a considerable drop during the past three years ; during this time testing and immunisation have been gradually made applicable to all ward staff. The cases of diphtheria during the past two years have occurred in nurses imme-

diately after admission and before testing and immunisation could be completed. The same decrease in incidence has been noted by Sir John Robertson at Birmingham in the hospitals under the care of Dr. Harries.

This method of prevention involves a moderate amount of work, a Schick test, three injections for the positive reactors, another Schick test a few months later to detect those not yet immunised, and a further injection of prophylactic with subsequent Schick test for the small percentage of "obstinate" people who fail quickly to become immune. We are hoping to improve this procedure. My colleague, Mr. Glenny, has recently made various mixtures which indicate in guinea-pigs with reasonable accuracy the Schick condition of the patient and at the same time act as immunising or prophylactic injections. They are therefore called Diphtheria Prophylactic Immunising Mixtures (D.P.I.M., formerly D.P.M.). Dr. Harries, of Birmingham, has made a number of observations on the action of these mixtures. He very kindly supplied me with clinical details which show that those mixtures already prepared indicate approximately though not exactly the same level of immunity as the Schick test, and that they also act as immunising agents. I have not much doubt that we shall soon have a mixture which will in a dose of 0·2 c.c. injected intradermally indicate exactly the same level of immunity as the ordinary Schick test, and at the same time will produce as much immunity as 1 c.c. of the ordinary diphtheria prophylactic. With such a combination one will at each injection discover how the patient's immunisation is progressing and one can cease the injections as soon as a negative response occurs.

Scarlet Fever.

Here the modern methods help in the diagnosis of 'doubtful cases,' in active immunisation, in passive immunisation in the presence of epidemics, and finally in treatment with antitoxin. In scarlet fever 'swab diagnosis' does not at present help much. In America a few workers treat all hæmolytic streptococci found in the throats of patients convalescent from scarlet fever as potential causes of scarlet fever, but public health administrators are not at present prepared to accept this line of action for we have no readily applicable means of deciding whether a given streptococcus is the scarlet fever streptococcus. The final and probably the only really reliable proof is that a suspected organism makes a toxin giving a skin reaction and that the toxin can be neutralised by

scarlet fever antitoxin. This proof, however, is a lengthy and troublesome affair.

The **Dick test** resembles the Schick test in many respects. The general theory is the same and the applicability of the test is similar, though one must be somewhat more cautious in drawing conclusions than when using the Schick test in suspected diphtheria. Whereas all patients suffering from indubitable diphtheria give a positive Schick reaction to the Schick test, not all patients suffering from scarlet fever give a positive Dick reaction, though the great majority do so.

The Schultz-Charlton or Blanching Test. A small quantity of scarlet fever antitoxin when injected intradermally into the rash of a patient within about 70 hours of the first appearance of the rash will, in the great majority of instances, cause a local blanching. If, therefore, a 'doubtful scarlet fever case' with a typical rash gives a negative Dick reaction and a negative Schultz-Charlton reaction, the probability that the disease is not scarlet fever becomes very strong. If, moreover, the serum of the patient taken about ten days after convalescence, fails to produce the Schultz-Charlton reaction in other patients suffering from scarlet fever, the evidence against a diagnosis of scarlet fever becomes almost convincing.

Treatment. Sufficient evidence has accumulated in America and England to justify the belief that scarlet fever antitoxin has a specific curative effect on scarlet fever and that if given in adequate doses early in toxic cases, it will cut short the disease. It is evidently also possible to concentrate the antitoxin and so produce a serum of higher antitoxic titre.

Passive Immunity. As in diphtheria, passive immunity can be conferred by an injection of 10 c.c. or less of scarlet fever antitoxin to all "contacts" showing a Dick positive reaction. The patient tested 24 hours later, gives a negative Dick reaction, and one may assume that he is adequately protected for the moment against an attack of scarlet fever.

Prevention. It is apparently possible to immunise people against scarlet fever. The dosage used by different workers varies, some using 200 to 2,000 skin doses, others using up to 20,000 skin doses. But little discomfort is caused by the injection and the procedure is "safe," for even if one were unfortunate enough to make a gross error in dosage, the only result is to produce a temperature and rash lasting from 24 to 48 hours, *i.e.*, a miniature and limited attack of mild scarlet fever. As with diphtheria, it is probable that active immunisation will be used by school medical officers

only under exceptional circumstances where persistent epidemics occur in the same group of people.

Summary. In the diagnosis of "doubtful" cases of diphtheria, the Schick test and virulence test of the organisms isolated may give valuable help. When an epidemic occurs, Schick test the contacts, separate the positive from the negative reactors, watch for further cases amongst the positive reactors, and seek for virulent carriers amongst the negative reactors. In preventive work, simultaneous indicating and prophylactic mixture (D.P.I.M.) may give much greater control over the process of Schick testing and immunisation.

In the diagnosis of "doubtful" cases of scarlet fever, the Dick and the Schultz-Charlton tests may give valuable aid. When an outbreak occurs, Dick-test the contacts, watch the positive reactors carefully, or if preferred, immunise them passively with antitoxin. Treat scarlet fever as early in the disease as possible with antitoxin. Active immunisation is apparently successful and practicable.