of infected contacts and other carriers of infection has accordingly aroused the keenest interest and even controversy, for however desirable it may appear in theory it is attended with much difficulty in practice. Any hard and fast procedure is not warranted from our present knowledge of the subject bacteriologically, nor, so far as I can gather, from clinical experience.

ADMINISTRATIVE MEASURES REQUIRED FOR DEALING WITH DIPHTHERIA CONTACTS.

By Duncan Forbes, M.D.,
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The clinical and bacteriological aspects of latent diphtheria infections having been ably brought before you it only remains for me to deal with the matter from the administrative point of view.

Legal Powers.—All administrative action depends to some extent upon legal powers, and the first essential is to have clearly before our minds how far one can legally proceed.

Section 126 of the Public Health (England) Act 1875 and Section 56 of the Public Health (Scotland) Act 1897 give powers with regard to—"Any persons who while *suffering from* any dangerous infectious disorder expose themselves," etc. Section 52, Part 4 of thePublic Health Acts Amendment Act 1907 is as follows: (1) "If any person knows that he is *suffering from* an infectious disease he shall not engage in any occupation—unless he can do so without risk of spreading the infectious disease."

In each of those sections and in others relating to infectious disease it is specified that the person must be "suffering from" the infectious disease, and *primâ facie* definite illness seems to be implied. A strict interpretation of the words "suffering from," however, might lead to awkward consequences. In our fever hospitals many cases of scarlet fever and diphtheria are detained. not because there is any clinical manifestation of disease, but because in our opinion they remain in an infectious condition. If any such patient left hospital against advice, prosecution would probably follow although he is not suffering from the disease. When one remembers that the diphtheria carrier is, like the above-mentioned fever patient, in an infective state, although not suffering from the disease, one considers that legal powers are equal with regard to the two classes. As a matter of fact one takes no action

excepting peaceful persuasion with healthy diphtheria carriers. This is not only because of the weakness of the legal position but because no difficulty is experienced in having a large majority of known cases isolated, the few who refuse to take precautions being after all only a small percentage of diphtheria carriers at large. The more dangerous of those few are school children, and one always excludes such carriers from school and in this way considerably reduces their infective powers (Public Health Amendment Act, 1907, Sec. 57, or other powers). Hitherto one has talked of healthy carriers who have had no illness; in carriers, on the other hand, who have a history of *recent sore throat or cold,* one makes an effort, usually a successful effort, to get the general practitioner to notify. One works on the theory that diphtheria carriers with sore throat or nasal catarrh are much more infectious than healthy diphtheria carriers. Up to the present one has always been successful in having such cases fairly well isolated.

In concluding what has to be said regarding the legal aspect one would hope that in future Acts the word "*suffering*" will be omitted and be replaced by the phrase "*in an infective condition.*" This would give the necessary discretionary power to medical officers of health and clear away the present ambiguity.

The next matter of general interest is the taking of swabs. In a majority of cases swabs from the throat only are taken. Graham Smith[1] gives a table showing the proportion of persons affected with morphologically typical diphtheria bacilli in the nose, the throat being free, according to which 1·9 per cent. of contacts in schools had the nose infected while the throat was free.

Consideration of such a table as the above should convince anyone of the necessity of taking swabs from both throat and nose. In this connection the obvious fact that diphtheria bacilli lying on tonsils have much fewer chances of passing to another person than bacilli on the nasal mucous membrane should be considered. Up to the present too little attention has been given to the probability that nasal diphtheria is much more infectious than throat diphtheria.

During the taking of swabs a careful study should be made of the parts from which they are taken. This is especially so in the nose; one cannot fail to see one-sided nasal soreness and naturally inquires as to the presence of blood-stained secretion (these signs arouse grave suspicion), but one may easily miss fibrinous rhinitis if one does not examine the nose carefully. The membrane or

exudate in many cases of fibrinous rhinitis is crowded with diphtheria bacilli; but if one does not rub the swab on the membrane in such cases one may find no diphtheria bacilli in the culture; apart, therefore, from the risk incurred by not having such cases isolated at once,[1] there is the additional chance of no diphtheria bacilli being found in the culture and the case being missed altogether. Where much secretion is coming from the nose this should be wiped away before the swab is applied to the mucous membrane. It has frequently been found that the swabs from the secretion contain no diphtheria bacilli whilst swabs direct from the mucous membrane do. In taking throat swabs, if a spatula is not objected to it should always be used, the swab being applied to the tonsils and adjacent parts only; in children who are afraid, however, a more satisfactory swab is got without the tongue depressor, the doctor being better able to control the movement of the child's head.

A practical question which sometimes leads to friction is on whom should devolve the duty of taking swabs.

My routine has been to personally take swabs in the school, to take swabs also from absentees at their own homes who were not at the time being attended by a doctor. In cases notified from public dispensaries the dispensary doctors usually prefer one to take any necessary swabs from other members of the family. In practically all other cases the general practitioner is asked to take swabs.

The administrative measures for dealing with contacts depend on the situation of the primary cases. A few examples are given.

(1) *Primary Cases in a Ward of a Hospital for Children.*—In such cases the immediate orders are:

(*a*) Keep all patients in bed.

(*b*) Keep the same staff on duty.

(*c*) Admit no new cases.

(*d*) If possible exclude visitors.

(*e*) Use no douche or spray until after the swabs have been taken. Having thus prevented in great measure contact between the infected and non-infected, one proceeds to swab the patients and staff. All patients found to be diphtheria carriers are isolated.

If one could regard the swab result as an infallible guide one would at once admit fresh cases to the ward, but in ordinary

[1] In the presence of diphtheria, cases of fibrinous rhinitis or of unilateral sore nose in contacts should be isolated at once without awaiting the swab results.

practice one discharges all cases as quickly as possible, cleanses the ward, and reopens it for fresh cases.

(2) *Primary Cases in the Home.*—If one takes it that from 10 to 50 per cent.[1] of contacts in families are diphtheria carriers one at once realises with what large numbers one has to deal. In Brighton contacts in the home are swabbed only under exceptional circumstances.

All members of families are swabbed—(*a*) if any member is a teacher or other person associating with children outside the home.

(*b*) If any member sells or handles milk.

Individuals are swabbed—(*a*) if there be a history of cold or sore throat.

(*b*) If suspicion rests upon them as probable carriers; for instance, three or four cases of diphtheria had occurred in a Brighton school; a case was notified of a child of three who was not at school, but whose sister attended the school in question. A positive swab was obtained from this sister, who had no history of illness.

By taking swabs from such a small percentage one is well aware that many diphtheria carriers are missed, therefore exclusion from school is enforced for four complete weeks after the removal of the case to hospital, and the parents are advised to keep the children separate from others during that time.

(3) *Primary Cases in School.*—In schools in which diphtheria has occurred, according to tables collected by Graham Smith,[2] over 8 per cent. are diphtheria carriers.

Our first action in such cases is to make inquiries at the school as to absentees from the same class who returned shortly before the onset in the patient. If such are found, and if a history of sore throat or cold is elicited, swabs are taken. Swabs are also taken from all scholars present or absent in whom there is a history of sore throat or cold (all absentees from the class are visited, and inquiries are made as to the nature of their illness) *Even if the swabs are returned negative all persons with sore throat are excluded for a clear fortnight.* The theory on which this action is based is as follows :

A diphtheria carrier who has a sore throat, because of the presence of other virulent infective organisms (usually cocci) in the throat, is much more infectious than a carrier of diphtheria bacilli alone. One believes, indeed, that in the absence of other

[1] Graham Smith, p. 183.

[2] Graham Smith, p. 187.

virulent organisms diphtheria bacilli usually cannot infect. It is obvious that if the above is our working hypothesis we must exclude children with sore throats for a time, even although their swabs show no diphtheria bacilli, as these sore throats might provide complementary infecting agents.

In the presence of only one or two cases no further action is taken, and usually no further cases occur.

On the occurrence of more than two cases in an infants' class one considers the advisability of swabbing and clinically examining the whole class, and this is frequently done.

Instructions given to the school teacher include the use as far as possible of separate pencils, etc., by each child, and at times instructions are given to stop singing lessons.

Having described the administrative procedure used in the discovery of diphtheria carriers, one now proceeds to make a statement regarding the action taken by various authorities with regard to isolation.

In Brighton infective contacts are sent to the diphtheria wards. Except in the case of adults antitoxin is usually injected on admission, and generally the contact is treated similarly to diphtheria patients, three negative swabs being obtained from nose and throat before discharge. During the last year fourteen such contacts were removed to the Infectious Diseases Hospital for periods varying from 9 to 80 days, the average stay being 33 days. Six of these, aged 5, 12, 14, 21, 27, and 30 had no antitoxin during stays of 25, 20, 20, 16, 16, and 9 days respectively with no bad results; the remainder, aged 8 months, 2, 3, 6, 6, 7, 10, and 12 had 4000 units on admission, and their lengths of stay were 52, 54, 29, 26, 64, 26, 24, and 20 days respectively.

If objection is raised to removal to hospital the child is left at home; the parent is advised to keep the child apart from other children, and four weeks' exclusion from school is enforced. At the end of that time the child may return on two sets of swabs from nose and throat giving negative results.

In Cambridge a private house was rented in 1900 for the isolation of carrier cases. One takes it that this was done in order that parents might more readily consent to have their children isolated, and also that these might not pick up fresh infection from acute cases. When one considers the inconvenience and expense caused in the providing of nurses and maids when this home is in use, and also the yearly rent of the house, one would look for substantial benefits to recompense for such an outlay. During my stay in

Cambridge, acting on my Manchester experience, I introduced the method of treating diphtheria carriers along with diphtheria cases in the Infectious Disease Hospital, and in most cases found no difficulty in having such persons isolated. I believe that at present the rented house is simply used as an overflow from the hospital. Below a note is given of the number of contacts isolated at the private home and their length of stay there.

Weeks isolated	-1	-2	-3	-4	-5	-6	-7	-8	-10	10+	
Actual numbers	16	53	53	26	14	11	9	4	5	5	=196

The 5 cases over 10 weeks stayed for periods of 74, 97, 110, and 122 days respectively.

Of the 196 cases 141 had 500 units of antitoxin on admission, 17 had 2000 units, and 38 had none.

Twelve of the cases were for a longer or shorter period nursed in the diphtheria wards.

None of those 196 cases developed clinical diphtheria.

The Bristol methods can perhaps best be grasped by perusal of Dr. Davies' annual report for 1902, pp. 49–52.

"The unsuspected cases upon bacteriological examination resolve themselves into two groups:

"(1) Those in which the bacillus is found in characteristic growth needing care in hospital (diphtheria 'carriers').

"(2) Those in which the short forms (Hofmann, pseudo?) are found, mostly in the nose, . . . they are not in our opinion suitable cases for isolation. . . . Home treatment amongst a working class population in the case of a disease producing no obvious illness is apt to be imperfect, and for these 'suspected carrier' cases we arranged at Avonmouth an out-patient service at the Isolation Hospital for the proper application of antiseptic washes . . . each child being furnished with a card spaced for a fortnight, at the end of which a further bacteriological examination is made to determine re-admission to school."

In Bristol diphtheria bacilli bearers are isolated in the infectious disease hospitals, or by their medical attendant; children who have been in direct association with cases of clinical diphtheria (in home or at school), and who are Hofmann bacilli carriers, attend an out-patient department at the Infectious Disease Hospital or elsewhere. The establishment of special out-patient departments is only in force during epidemic prevalence of diphtheria. The difference in administrative procedure between Brighton and Bristol is that, whilst Hofmann's bacilli contact-carriers are disre-

garded in the one, they are medically attended in the other. In both towns morphological and cultural characteristics are in the main relied on to distinguish true diphtheria bacilli from allied forms. In taking this line of disregarding Hofmann carriers, although they may have been in contact with cases of true diphtheria, one relies on the facts ascertained by the bacteriologist. The principal of these are mentioned below.

(1) "The immunisation of animals with Hofmann's bacillus does not confer any protection against diphtheria bacilli injected subsequently.

"(2) The local reaction in guinea-pigs produced by the subcutaneous injection of large doses of pseudo-diphtheria bacilli is not influenced by the injection of antitoxin."

Also (3) considerable doubt is thrown by Petrie [1] on the production of toxoids by Hofmann's bacillus.

Again, one would be inclined to attach more importance to Hofmann's bacillus were it not that so great a number of *true diphtheria bacilli carriers are present* during every outbreak of clinical diphtheria, *and those themselves appear rarely to give rise to clinical cases*. In this connection a letter of May, 1909, from Claude B. Ker, of the Edinburgh City Hospital, is of considerable interest.

"It is the case that return cases of diphtheria were practically unknown in Edinburgh during the period that no cultures were taken before the patients were discharged. Nevertheless, when five years ago our laboratory was opened it was felt that cultures were necessary, if only to keep in touch with medical opinion. Since then, therefore, cultures have been taken as a routine, and the object has been to obtain two negative cultures (consecutive) before the patient is allowed home. We have not hesitated, however, in the light of our previous experience, to discharge the small minority of patients in whom, after six weeks' detention, the cultures remain steadily positive.

"One or two 'alleged' return cases have resulted, certainly not more than four in five years, and in every case, as it happens, negative cultures had been obtained from the discharged case."

J. H. Meikle mentions the discharge of twenty-seven diphtheria bacilli carriers without the occurrence of a return case (in five cases, however, experiments on rabbits gave no proof of virulence).

[1] Graham Smith, p. 224, *Edin. Med. Journ.*, September, 1906.

In Manchester, where, until recently,[1] only one negative swab was obtained from the throat before discharge of diphtheria cases, and where, therefore, many diphtheria carriers were discharged, Dr. Niven tells me that the number of return cases was trifling.

In view of the Edinburgh and Manchester experience one cannot regard it as a rash line of action to take no notice of Hofmann carriers; indeed, one would go further and disregard morphologically typical organisms avirulent to guinea-pigs were it not that at present the work of proof of virulence cannot be overtaken.

One now passes to the question of *the prophylactic injection of antitoxin.* The main object in avoiding such injections is in order that carrier cases may not be created. It has been proved that antitoxin has no influence on length of infectivity. It is, however, probable that attacks of diphtheria in contacts are rendered milder by such injections, and are, therefore, the more readily overlooked. It follows that extensive injection of antitoxin would lead to the non-isolation of certain highly infective individuals. Minor deterrents to such injections are the expense, the trouble, and the friction likely to be caused by adopting such measures. Neither must it be forgotten that itching rashes, with temperature and joint pains, may follow even small doses; more recently attention has been called to the disadvantage of "sensitising" contacts.

One warns the parents of the great danger incurred by not calling in a doctor at the *onset* of even slight illness in any other member of the family.

A natural question which arises is, "If prophylactic injections of antitoxin in the home are not advised, why should one give healthy carrier children any injection on admission to the diphtheria wards?" It would, in my opinion, be much better not to do so, but as one usually states to the parent that there is practically no risk of even slight illness, one has in these cases to consider the individual rather than the public health of the community. No carrier case has in my experience ever developed diphtheria during isolation, but if any one of them had developed an attack and no antitoxin had been injected, one might have been accused of taking unnecessary risks.

Before concluding it should be mentioned that the administrative procedure outlined is that which appears suitable for urban districts in which whole-time Medical Officers of Health are employed; in my experience the action recommended produces a maximum of benefit with a minimum of labour and expense.

[1] Two consecutive negative swabs are now required from throat and nose.