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Steen Hoffmann

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Use of Reference Specimens for Throat Swab Cultures on Streptocult

STEEN HOFFMANN

Statens Seruminstitut, DK-2300 Copenhagen, Denmark

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Seventy-five general practitioners (GPs) who regularly used Streptocult for culture of throat swabs participated in a study aimed at evaluating the need for and the possible educational effect of examining reference specimens. Their pre-study and post-study accuracy in the interpretation of cultures of simulated throat specimens were analyzed. One group of 38 GPs received instructions as well as supplementary reference specimens during the study, while no instructions were given to the remaining 37 GPs. There was no discernible difference in the post-study accuracy of the two groups. Before the study, 80 % of the GPs had felt to be in need of reference specimens; after the study, 61 % did so. A majority suggested that three reference specimens should be distributed once or twice a year. Eighty-six per cent had never checked the temperature in their incubator. After doing so, only 54 % measured a temperature within the recommended range of 35–37°C.

Key words: general practitioners, office bacteriology, quality assessment, reference specimens, throat cultures.

Steen Hoffmann, Kastanievej 1, DK-2840 Holte, Denmark.

Culture of throat swabs can be performed in the physician's own office using either standard blood agar plates or diagnostic culture kits such as the Streptocult (Orion Diagnostika, Helsinki, Finland) (1–3). It has been proposed that the use of office cultures of throat swabs should be controlled by a collaboration with local bacteriological laboratories (2). In one study, specimens containing either haemolytic or non-haemolytic streptococci were distributed to physicians who made office blood agar plate cultures, and their reading results seemed to indicate a need for quality control (4). Training of the staff of a primary health care center has been reported to have a beneficial effect on the accuracy of Streptocult culture interpretation (5).

The present study had two purposes: 1) to evaluate general practitioners' need of reference specimens as a control of their own interpretation of throat cultures on Streptocult; and 2) to evaluate whether there may be an educational effect of the use of reference specimens.

MATERIALS AND METHODS

Study design. 207 general practitioners (GPs) were asked whether they made throat cultures on Streptocult, and whether they considered themselves to be in need of reference specimens. According to their answer to the latter question the assigning GPs were randomized into two groups, one of which was to receive instructions during the study period (group 1), while the other was not (group 2).

The reference specimens were distributed in three rounds, with intervals of approximately one month. The specimens (prepared as described below) were inoculated by the GPs onto Streptocults, followed by incubation at 37°C for 18 to 24 hours before reading. In the first round, all participants received three specimens. On a postal reply card the GP noted which of the Streptocults that had shown growth of beta haemolytic streptococci (BHS). After receipt of the reply card in our laboratory, an account of the contents of the three speci-

Table I. *General practitioners' accuracy in the reading of Streptocult cultures of the three simulated throat specimens in the first round*

Number of general practitioners and number of readings

Patterns of readings	No. of GPs[b]	BHS-negative specimens[a]			BHS-positive specimens			Total no. of specimens
		TN[c]	FP[d]	(Total)	TP[e]	FN[f]	(Total)	
3 correct readings	58	89	0	(89)	85	0	(85)	174
1 FP	3	5	3	(8)	1	0	(1)	9
2 FPs	1	1	2	(3)	0	0	(0)	3
1 FN	9	13	0	(13)	5	9	(14)	27
2 FNs	2	2	0	(2)	0	4	(4)	6
3 FNs	2	0	0	(0)	0	6	(6)	6
Total	75	110	5	(115)	91	19	(110)	225

[a] BHS = beta haemolytic streptococci. [b] GPs = general practitioners. [c] TN = true negative readings. [d] FP = false positive readings. [e] TP = true positive readings. [f] FN = false negative readings.

mens was forwarded to the individual GP, provided he or she was a member of group 1. The GPs in group 2 did not receive such information.

In the second round, involving group 1 only, four specimens were distributed together with a description of the colony appearance of the bacteria contained. The GPs were to inspect the Streptocult cultures before and after having read the descriptions. These results were not registered. In the third round, three specimens were sent to all participants. After our receipt of the individual GPs' postal reply cards we informed them about the actual bacterial content of the specimens and asked them about the following: (i) their opinion about their own benefit of the reference specimens (positive, neutral, or negative); (ii) did they now consider themselves to need reference specimens, and if so, how often and how many would they like to receive at a time; (iii) how often did they check the temperature of their incubator; and (iv) what was the temperature currently in the office incubator, measured with an independent thermometer.

Preparation of specimens. All bacterial colonies on blood agar plate cultures of either a reference strain or a throat swab were suspended in phosphate buffered saline at pH 7.38 (PBS). Ten-fold dilutions were made, and charcoal-impregnated cotton-tipped wooden swabs were immersed in the appropriate suspension or a mixture of two suspensions for 60 sec and then transferred to semi-solid modified Stuart's transport medium (Statens Seruminstitut, Copenhagen, Denmark).

For the first round, only two *types* of specimens were made: "+", containing normal throat flora and BHS group A; and "−", containing normal throat flora only. These two types of specimens were used for making specimen triads with all eight possible combinations of contents, as follows (number of GPs in parentheses): −−− (9), −−+ (12), −+− (7), −++(10), +−− (11), +−+ (10), ++− (8), and +++ (8). The specimen triads were accompanied by fictive case stories of "streptococcal", "viral", or "non-specific" pharyngitis in order to judge whether this might influence the readings.

The four specimens in the second round had the following contents: BHS of group G; alpha haemolytic streptococci (*Streptococcus mitior*); beta haemolytic staphylococci (*Staphylococcus aureus*); and a mixture of normal throat flora and BHS group G, with predominance of the latter. The three specimens in the third round had the following contents: a mixture of BHS group G and non-haemolytic streptococci (*Streptococcus faecalis*) with predominance of the former; the same two strains, but with predominance of the latter; and normal throat flora only.

Statistical methods. Chi-square tests were made on relevant contingency tables, using $p=0.05$ as the level of statistical significance.

RESULTS

Ninety GPs participated, but three did not regularly use Streptocult, and nine did not complete the

Table II. *Proportion (%) of general practitioners who correctly interpreted all of three Streptocults in the third round, in relation to their initial accuracy, and in relation to whether or not they had received instructions during the study*

Initial accuracy	Group 1 (instructions given during the study)	Group 2 (no instructions given during the study)	Total
3 correct readings	15/26 (58)	23/32 (72)	38/58 (66)[a]
<3 correct readings	5/11 (45)	2/6 (33)	7/17 (41)[a]
Total	20/37 (54)[b]	25/38 (66)[b]	45/75 (60)

[a] $\chi^2=3.25$; d.f.=1; $p=0.07$. [b] $\chi^2=1.08$; d.f.=1; $p=0.30$.

study. The results reported by three other GPs had to be excluded, because they had required specific advice regarding the incubator temperature during the study. Thus, left for analysis were the results reported by 75 GPs, of whom 38 had been randomized to group 1 (i.e. the group that received instructions during the study period), and 37 to group 2 (i.e. the group that did not receive instructions). In both groups approximately 80% of the responders initially meant to be in need of reference specimens (29/36 and 28/35, respectively).

During the first round 58 GPs (77%) interpreted all three Streptocult cultures correctly (Table I). Four GPs (5%) had false positive readings of five (45%) of a total of 11 submitted BHS-negative specimens, and 13 GPs (17%) had 19 (79%) false negative readings of a total of 24 submitted BHS-positive specimens. Among the latter 13 GPs, nine had interpreted all their 27 Streptocult cultures as being negative, although 15 of the corresponding specimens had in fact contained BHS. There was no indication that the readings had been influenced by the fictive case stories.

In the third round 45 GPs (60%) interpreted all three Streptocults correctly (Table II). There was no discernible effect of the attempted education. All three Streptocults had been interpreted correctly by 54% of the GPs in group 1, and by 66% of those in group 2 ($\chi^2=1.08$, d.f.=1, $p=0.30$). Among those GPs who had had three correct results in the first round, 66% (38/58) also had three correct results in the third round. In contrast, three correct results in the third round were reported by only 41% (7/17) of those GPs who had had less than three correct results in the first round; however, these figures were not statistically different ($\chi^2=3.25$, d.f.=1, $p=0.07$).

The participants' post-study opinions of whether they now were in need of reference specimens were related to their accuracy in reading the specimens of the first and the third round (Table III). Fifty per cent (19/38) of those GPs who had had three correct results in both rounds felt a post-study need of reference specimens, as opposed to 73% (27/37) of those participants who had had less than three correct results in one or both of the rounds ($\chi^2=4.17$, d.f.=1, $p=0.04$). Among 45 responding GP's, approximately 85% suggested that two to four reference specimens should be submitted one to two times per year.

Table III. *Post-study proportion (%) of general practitioners who felt to be in need of reference specimens, in relation to their initial and final accuracy in reading Streptocult cultures of simulated throat swabs*

Initial accuracy	Final accuracy		Total
	3 correct readings	<3 correct readings	
3 correct readings	19/38 (50)	15/20 (75)	34/58 (59)
<3 correct readings	3/7 (43)	9/10 (90)	12/17 (71)
Total	22/45 (49)	24/30 (80)	46/75 (61)

Sixty-four (86%) among 74 responders had never checked the incubator temperature. One had done it once, and another twice. Two had checked the temperature "when needed", two once a year, two did it three or four times a year, and two with intervals of months or years.

Measurements of the incubator temperature with an independent thermometer showed no consistent relationship between this temperature and the number of correct Streptocult culture readings.

The three GPs, whose results had been excluded because of recognized temperature disturbances had each had one (1 GP) or two (2 GPs) false negative Streptocult culture results in the first round. After having corrected the temperature the two latter interpreted all three specimens correctly in the third round.

DISCUSSION

Cultures of throat swabs performed in the offices of GPs are usually read by untrained personnel. The GPs themselves may have had some practical pregraduate microbiological education, and in recent years, a course in practical office bacteriology has been included in the post-graduate education of general practice candidates; however, the long-term effect hereof may be insufficient. In some offices, the throat cultures are read by the GPs' assistants, some of whom may be nurses or secretaries without training in bacteriology, while some may be experienced technicians.

This study was performed because a previous multicenter study of acute pharyngo-tonsillitis in general practice had revealed a false negative rate of 22% in the reading of Streptocult cultures from patients for whom laboratory culture of throat swabs had demonstrated BHS (1). Even in cases where corresponding throat swabs had given heavy growth of BHS on laboratory culture, 18% of the office Streptocults were negative.

In another previously published study 15 GPs or paediatricians made blood agar plate cultures of streptococcal reference strains (4). In 82% of the cases the strains were correctly classified as being beta haemolytic. These results were obtained after adjustment of the temperatures in the incubators, because initially in the study, the staff of eight of the offices had noted an incubator temperature of $\geq$38°C.

Only 54% of the GPs in this study found temperatures in the range of $\geq$35°C to $\leq$37°C. As noted previously, three participants discovered that the thermostat of their incubators was not in proper function. A majority (86%) among the participants, however, had never checked the temperature, and the remaining GPs rarely did so. Hamrick & Schwartz (6) found that daily checks of the office incubator temperature was conducted by 68% among 178 pediatricians in private practice. In the same study, 26% had some kind of formal proficiency testing in co-operation with reference laboratories, 54% agreed on the need for periodic assistance with quality control, and 58% wanted to attend update courses in practical bacteriology. An even more pronounced interest in quality assistance was expressed by the participants in the present study: initially, 80% of the assigning GPs indicated that they were in need of reference specimens; after completion of the study, it was 61%.

In a proficiency study involving microbiological laboratories an inverse relationship was found between the number of specimens routinely tested in the individual laboratory and its accuracy in identifying the content of quality assessment specimens (7). It is conceivable that a similar relationship may exist as regards the processing of throat cultures in general practice offices. Danish GPs are contacted by an average of approximately 3 patients with sore throat per week (8). Thus, even if a GP performed office throat cultures for all such patients, the experience in interpreting the findings would accumulate at only a slow rate. In the above mentioned study, a throat swab was obtained from 27% of the patients (8); however, 60% of the participants had swabbed none of their patients, 5% had swabbed 11–25%, 16% had swabbed 31–50%, and 14% had swabbed 80–100% of their patients (previously unpublished results).

No educational influence of the specimens was detectable (Table II), and it is likely that the model used here is not the optimal means of providing quality assistance in general practice, at least not as an isolated means. Regular performing of duplicate swabs, one of which is to be cultured in the office and the other at a regional microbiological laboratory probably is a suitable alternative; furthermore, presumedly positive as well as equivocal Streptocults should, from time to time, be submitted to the regional laboratory for evaluation.

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