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NOTES

Statistical Analysis of the Incidence of Positives in the Examination of Parasitological Specimens

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Results of the examination of 2,000 parasitological specimens were analyzed for differences between results obtained by a technologist working in parasitology only and those obtained by general microbiologists who were also performing other laboratory work. The relative share of specimens determined to be positive by the specialist was approximately twice as high as the relative share determined by the general microbiologists.

In most medical laboratories, the volume of parasitological specimens received is insufficient to justify the employment of a full-time parasitologist. Typically, technologists work on such specimens intermittently with work from other departments.

At Marin Medical Laboratories, parasitological specimens are examined on 2 high-volume days a week by a part-time technologist who works in parasitology only and on the other 3 days by various members of a group of six full-time general microbiologists working in parasitology intermittently. This arrangement provided an opportunity for a comparison of the results obtained by specialized and nonspecialized workers in parasitology, which is described in this paper.

General characteristics of the patient population and of the specimens received are as follows. Marin County, just north of San Francisco, Calif., is a primarily residential suburban area with a population of about 230,000. Marin Medical Laboratories serve much of that population; they operate a main laboratory and 10 satellites throughout the county. All parasitological specimens are sent to the microbiology department of the main laboratory for examination. Nearly all specimens are fecal.

Physicians order laboratory work to be done on fecal specimens mainly for one of two reasons: because a screening test is needed to aid in the diagnosis of gastrointestinal disorders or because there are specific reasons to suspect a parasitic infection. When found, such infections can often be related to two types of patients: Marin residents who have traveled to tropical and/or subtropical areas and recent immigrants from such areas. Some patients are infected as a result of travel to other locales or indigenous exposure.

Parasites found are most frequently *Giardia lamblia*, *Blastocystis hominis*, *Endolimax nana*, *Dientamoeba fragilis*, and *Entamoeba coli* isolates and less frequently are *Entamoeba histolytica* and *Entamoeba hartmanni* isolates. Other protozoa and helminthic ova are found occasionally.

Protocol calls for examining the entire length of the stained smear at least once (more if needed) and reading of the entire coverslip prepared from the concentrated specimen.

Data were gathered, summarized, and analyzed as follows. A log was maintained which showed for each workday the total number of specimens examined, the number of positives specimens, the total number of patients providing specimens, and the number of patients for whom one or more specimens were found to be positive. The four sets of data were aggregated separately for the specimens examined by the parasitology specialist and those examined by the general microbiologists; the cumulative percent positives for both specimens and patients were calculated. Results are based on nearly 1,000 specimens and approximately 700 patients for each group; the average number of specimens per patient during the observation period was 1.47. The log format and sample entries are shown in Fig. 1.

Results are shown graphically for specimens (Fig. 2) and

Date	Day	Specimen		Patients		% Positive	
		Total	Positive	Total	Positive	Specimen	Patients
Jan 07	1	13	4	9	3	30.8	33.3
Jan 08	2	19	1	13	1	5.3	7.7
Jan 14	3	9	0	8	0	0.0	0.0
Jan 15	4	15	4	12	3	26.7	25.0
(etc.)							
Jul 09	62	11	1	7	1	9.1	14.3
Jul 15	63	21	10	13	4	47.6	30.8
Jul 16	64	13	0	7	0	0.0	0.0
Jul 22	65	24	6	17	4	25.0	23.5

Date	Day	Cumulative Number				Cumul. % Pos.	
		Specimen	Positive	Patients	Positive	Specimen	Patients
Jan 07	1	13	4	9	3	30.8	33.3
Jan 08	2	32	5	22	4	15.6	18.2
Jan 14	3	41	5	30	4	12.2	13.3
Jan 15	4	56	9	42	7	16.1	16.7
(etc.)							
Jul 09	62	940	169	645	109	18.0	16.9
Jul 15	63	961	179	658	113	18.6	17.2
Jul 16	64	974	179	665	113	18.4	17.0
Jul 22	65	998	185	682	117	18.5	17.2

FIG. 1. Excerpt from log of specimen examination. These data are from the specialist's log; an identical format was used for the nonspecialists' log.

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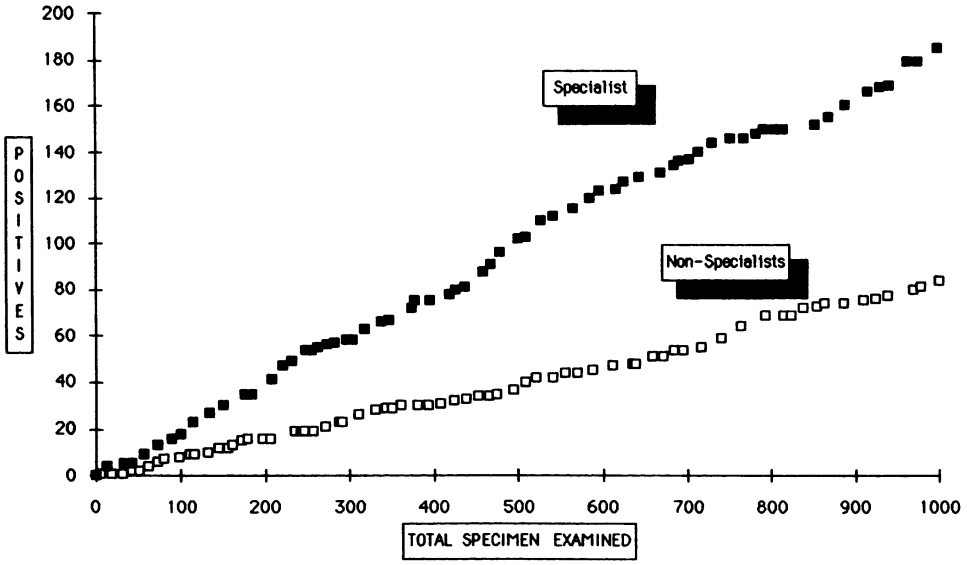

FIG. 2. Number of positive specimens as a function of the total number of specimens.

for patients (Fig. 3); each figure shows results for the specialist and the nonspecialists. Regression analysis yielded a line of best fit and a coefficient of correlation (Table 1) (3). Strong linearity is apparent and was confirmed by a coefficient of correlation for specimens and patients for both specialist and nonspecialist data of 0.999. The values of b in the linear equation $y = a + bx$ for the specimen function are 0.185 for the specialist category and 0.081 for the nonspecialist category; corresponding values for the patient function are 0.171 and 0.094, respectively. These values indicate the slopes of the regression lines and correspond closely to the cumulative percent positives.

Analysis of the specialist's time log yielded a mean time of 16.0 min per specimen. No comparable information is available for the nonspecialists.

Data and analysis led to the following observations. The relative shares of positives for both specimens and patients are consistent in both the specialist and the nonspecialist categories; the coefficients of correlation with the line of best fit are high. Considering the diversified patient population, less linearity and more randomness might have been expected. An attempt was made to compare our results with those of similar studies elsewhere; a computer search and a review of relevant journals in English and German failed to locate any comparable data or analyses.

The results show a difference between the work of the specialist and that of the nonspecialists; the specialist-to-nonspecialist ratio for percent positives is about 2:1 for both specimens and patients. All persons involved are experienced licensed medical technologists; while there may be some individual differences in training and experience in parasitological work (the specialist worked in China for the first 3 years of her career), it appears more likely that the difference is due to the intermittent nature of the work of the

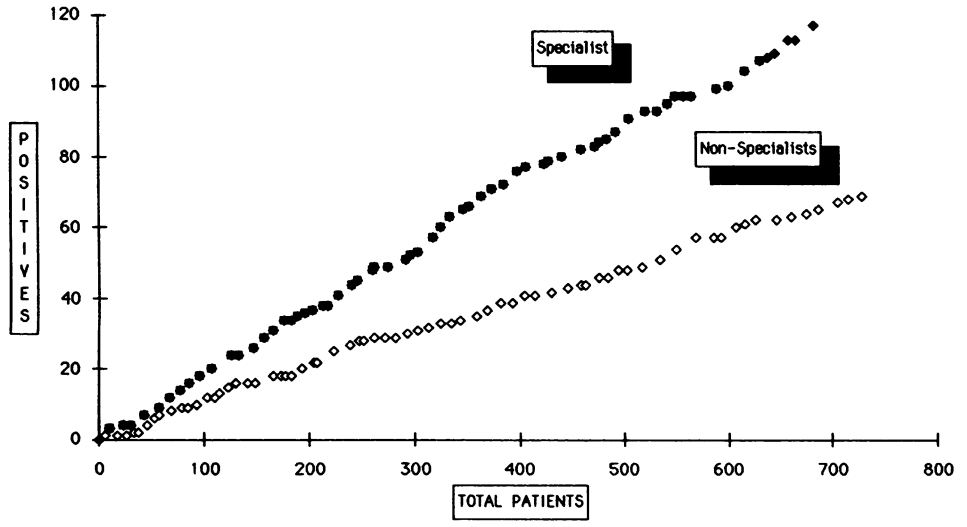

FIG. 3. Number of patients with positive specimens as a function of the total number of patients.

TABLE 1. Linear regression analysis

Category	Positives (y) as a function of total (x)	Correlation coefficient (r)
Specimens		
Specialist	$y = 0.185x$	0.9989
Nonspecialists	$y = 0.081x$	0.9989
Patients		
Specialist	$y = 0.171x$	0.9992
Nonspecialists	$y = 0.094x$	0.9991

nonspecialists, which does not allow them as much time and concentration for specimen examination as the specialist has.

The Centers for Disease Control's *Laboratory Procedures* (3) recommends minimal examination times of 10 min for wet mounts and 15 min for stained fecal smears, or a combined minimum of 25 min per specimen. The College of American Pathologists' *Manual for Laboratory Workload Recording Method* (2) recommends a combined time of 17 min (7 min for microscopic examination after concentration, 8 min for examination of a trichrome-stained slide, and 2 min for recording and reporting). The specialist's mean examination time of 16.0 min per specimen is close to the time listed in the College of American Pathologists' manual.

The results presented here are based on the data obtained from one laboratory and a limited number of technologists. The results can be made more useful if they are generalized; to do so, the following questions need to be answered. (i) To what extent are the specialist-nonspecialist differences a function of examination time? If both specialists and nonspecialists use approximately the same examination time per specimen, will their results be comparable? (ii) To what extent are the specialist-nonspecialist differences technologist specific? Given comparable examination times, individual technologists may still arrive at different incidences of positives, depending on training, experience, and reading rates. (iii) Is the incidence of positives population specific? Intuitively we would expect it to vary with the composition of the population. Our results should be compared with those from other patient populations to confirm or refute the expectation.

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