

WORLD HEALTH
ORGANIZATION



ORGANISATION MONDIALE
DE LA SANTÉ

WHO/Mal/229 ✓
14 August 1959

ORIGINAL: ENGLISH

ANALYSIS OF DATA ON EVALUATION AND SURVEILLANCE QUOTED IN THE REPORT ·
ON DEVELOPMENT OF MALARIA ERADICATION PROGRAMME, PRESENTED TO
THE TWELFTH WORLD HEALTH ASSEMBLY¹ - MAY 1959

The data analysed and commented upon in these notes are based on the answers to the questionnaire for 1958 that was sent out to the Governments by the Division of Malaria Eradication, WHO. While the real purpose of this questionnaire and the report to the World Health Assembly, based on the replies from the countries, was to obtain an overall review of the status of malaria eradication programmes, and not specifically to procure data for an analysis of technical details, it seemed worthwhile to extract from the wealth of available material some data for a more thorough assessment of results obtained and obtainable by various methods of epidemiological follow-up in some later phases of malaria eradication. It should be borne in mind that no complete accuracy could be expected - and in fact was not found - in the answers to the questionnaire; all conclusions have to be drawn with a certain amount of reservation. Care was, however, taken to use only such data for which a comparatively high degree of reliability of the information could be assumed not only from the answers contained in the questionnaires themselves but also on the basis of other information available in the Division.

It is interesting to note that in 1958 there were already 35 countries with fairly extensive malaria detection or surveillance operations. A list of these countries by regions is given below:

<u>African Region</u>	2	Mauritius, Swaziland
<u>American Region</u>	12	Argentina, Costa Rica, Ecuador, El Salvador, Federation of the West Indies (Grenada, Jamaica, St Lucia, Trinidad and Tobago),

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Guadeloupe, Guatemala, Mexico, Nicaragua,

Panama, Peru, Venezuela

<u>Eastern Mediterranean Region</u>	4	Iran, Iraq, Lebanon, Syria
<u>European Region</u>	6	Greece, Romania, Spain, Turkey, USSR, Yugoslavia
<u>South-East Asia Region</u>	5	Afghanistan, Burma, Ceylon, India, Thailand
<u>Western Pacific Region</u>	3	Philippines, Sarawak, Taiwan (China)

32

Further information as to the type of surveillance operations used in these countries can be obtained from the relevant tables in the chapters for the various regions in the report presented to the Twelfth World Health Assembly.¹

I. Extent of case-finding operations in different countries as reflected by the proportion of slides examined per population

Wide variations exist in the number of slides per population examined in various countries. It is, however, becoming increasingly clear that apart from the problem of reliability of the surveillance work and the quality of epidemiological investigations carried out in respect of the cases found, there is a minimum proportion of persons in a population exposed that have to be examined in order to produce reasonably reliable information on the status of malaria. This minimum lies probably somewhere between 5 and 10 per cent. per year. In Table I, we have classified countries or areas of countries in four columns with: less than 1 per cent., 1 to 5 per cent., 5 to 10 per cent. and more than 10 per cent. slides taken per population. Taking into consideration that surveillance operations are only in the early stages in most countries, it is gratifying to see that out of these

¹ Report on Development of Malaria Eradication Programme, WHO document A12/P&B/10 of 4 May 1959.

countries, in 16 countries or parts of countries or islands, more than 5 per cent. slides per population were taken during 1958. In several instances not only the difference in these proportions between whole countries is of interest but also the difference within certain countries between areas in different phases or between sources of slides. It will also be seen that in these countries the principal source of slides was provided by active surveillance. The next important source is from surveys which in these instances signified extensive blood surveys carried out mainly on children of pre-school and school age.

The figures for Venezuela require special comment. While in general one would expect that more slides would be taken in an area in the consolidation phase "B" than in the attack phase area "C", in that country the percentage of slides per population taken in the "B" area was 9.9 per cent. (i.e. very satisfactory) but in the "C" area 50.8 per cent. slides per population were examined. This is due to the fact that in Venezuela there are some not very large areas where, in spite of many years of spraying, residual transmission is still present and special efforts are made to investigate and to eliminate the residual foci of transmission. Amongst these measures are large-scale drug administration procedures, which are checked by extensive blood examinations sometimes as often as once a week in the total population.

For Grenada (Federation of the West Indies) the figure for the proportion of slides taken is left blank as the malarious area to which this should apply is not clearly defined. Yet, the total number of slides collected during the year 1958 exceeds 10 per cent. of the entire population of the island.

In Table I as well as in Fig. 1, referring to the next section of this review, only percentages are given. Absolute figures on which these percentages are based can be found in the relevant tables of the "Report on Development of Malaria Eradication Programme" mentioned previously.

II. Proportion of slides and of positive slides obtained by four methods of case-finding in ten countries

From an economic and organizational point of view it is important to appraise the effectiveness of the different methods of case-finding in use. In the past

attempts have been made to evaluate this aspect by comparing only the "positivity rate" of slides taken by the various methods, with an underlying inference that the methods yielding the higher proportion of positive slides should be considered the most efficient. While this factor is certainly of importance, it is not the only one which indicates how the largest number of cases can be found most reliably and easily. In Fig. No. 1 we have contrasted for ten countries the slide positivity rates obtained by various methods with the proportions of slides and cases yielded by these methods in relation to the total number of slides and cases in the country. Slides taken and cases found through notification by private physicians and hospitals were not included in this diagram since the number of cases found through this source in relation to the total number of cases found is, on the average, very small, even though the rate of positive slides is usually high.

Some principal types of situations are well reflected in this diagram. A very frequent condition is the following: slide positivity rate is highest for passive surveillance (rural dispensaries), lower for passive surveillance (voluntary collaborators) and lowest for active surveillance. On the other hand, by far the largest number of cases (and usually also of slides) results from active surveillance while in this respect passive surveillance (and especially rural dispensaries) gives the lowest yield. Examples in the diagram are: Costa Rica, Ecuador, Greece, Taiwan and Venezuela.

In Guatemala the positivity rate pattern is similar to that of the Latin American countries mentioned above but passive surveillance (rural dispensaries) has also yielded the highest number of cases and slides. This indicates that apart from epidemiological factors, socio-economic factors are of great importance in surveillance. Obviously no hard and fast rules can or should be made for any country in the world.

Another not infrequent situation is when active surveillance produces not only the largest number of slides and cases but also positivity rates from this source are higher than those obtained from other sources. Examples of this situation are Ceylon and Romania. It would be interesting to analyse more closely the reasons for this situation, which is probably due mainly to the epidemiology of

local malaria though social and organizational causes also play some part. It is interesting to see that in Peru malarionetric surveys yielded both the largest number of cases and the highest positivity rate. This is no doubt due to the fact that in 1958 a large proportion of the evaluation operations were concerned with pre-eradication surveys.

III. Uses and misuses of Malarionetric Surveys

The term - malarionetric surveys¹ - is applied here primarily to surveys which are carried out in a comparatively small sample of the population, mostly restricted to young age-groups: infants, pre-school and schoolchildren, and conducted not more than once or twice yearly. Malarionetric surveys are still the best tool for evaluation in the phase of pre-eradication surveys and during the first years of the attack phase for the purpose of establishing base lines and measuring degrees of malaria prevalence. However, as soon as this coarse method of measuring shows, through the low percentages of positive slides obtained, that it has reached the limit of its usefulness, it should be substituted by methods of malaria detection and surveillance. Until now this principle has not been followed everywhere. In some countries the force of old tradition has resulted in undue prolongation of extensive malarionetric surveys even when malaria detection and surveillance activities had already started. While such duplication of effort is unjustified and will in future undoubtedly occur only rarely, it gives us a good opportunity (and probably the last) to compare the effectiveness of malarionetric surveys on the one hand and that of malaria detection (as part of surveillance) on the other. In Table II the percentage of positive slides found by malarionetric surveys on the one hand and by surveillance procedures on the other has been shown for a number of countries. In this table we have also included the absolute figures for the numbers of slides and the number of cases found because the usefulness of the method has to be judged not only by the slide positivity rate but also by the absolute number of cases detected and the relative effort required. It is our general impression that when children

¹ Malarionetric surveys consist of spleen surveys and parasite surveys. The 1958 questionnaire only gave figures for parasite surveys and therefore no reference in this paper is made to any spleen rates.

and adult parasite rates, as revealed by malarionetric surveys, fall below 3 per cent., the method has become redundant and case detection should take over. (Surveys for infant parasite rates should, however, continue until they reach zero. In most instances these two events will be simultaneous i.e. by the time the general parasite rates have fallen to 3 per cent. or below, infant parasite rates will already be nil.)

Argentina "D",¹ Guatemala "C", Peru "C" and Philippines "C" are examples of countries where in areas still unsprayed or in the attack phase malarionetric surveys reveal parasite rates between 5 and 12 per cent., this being equal or superior to the number revealed by surveillance operations in the same area.

Mauritius, Romania, Turkey "B" and Burma are examples of countries in which, during the last stages of the attack phase or in the consolidation phase, malarionetric surveys yielded very low parasite rates and revealed, for the effort of examining huge numbers of slides, relatively small numbers of cases compared with the number of cases found by surveillance operations carried out simultaneously in the same areas. Thus in Mauritius the examination of over 60 000 slides by malarionetric surveys revealed 18 cases as opposed to the finding of 38 cases through surveillance operations in which only 1700 were examined. The example of Burma deserves further comment as not only was the number of cases found by the examination of 50 000 slides taken in malarionetric surveys comparatively small, but a further 67 000 slides taken during these surveys were not examined obviously because of lack of time and microscopists. (It has already been decided to reduce greatly the use of malarionetric surveys in Burma in those areas where surveillance operations are being established.)

IV. Annual malaria incidence in 1958 for some countries

It would seem desirable to have some measure of evaluation of the **status** of malaria eradication in countries not only from the operational point of view

¹ Area not regularly sprayed.

(extent of evaluation in surveillance operations, number of slides examined, number found positive, etc.) but also from a true epidemiological point of view. In particular, it would seem necessary to be able to judge the basis on which areas are declared as being in the consolidated phase on such grounds rather than on the fact that spraying has been withdrawn. It has been our impression that while the "permissible" incidence rate for such areas might vary quite widely according to different local epidemiological conditions, there is something like a maximum incidence that would be permissible for an area in the consolidation phase. In other words, the evidence of malaria incidence above this postulated maximum would show that there is still too much transmission and residual parasite reservoir present and that spraying should not have been withdrawn. On the basis of information extracted on this subject from sundry reports in the past, a preliminary conclusion was reached that this upper limit of annual incidence lies somewhere around the malaria incidence rate of 0.5 per thousand.¹ It is clear that such rates should not be calculated on the basis of incomplete notifications or incomplete malaria detection operations and on the basis of denominators which do not coincide exactly with the numerators (cases found). In future such accurate calculations will be possible on the basis of the proposed quarterly reports on surveillance but we have tried to obtain some data on this point by calculating incidence rates from information given in the questionnaires for 1958. These data are summarized in Table III. We have selected only countries in which at least the system of case-finding seemed to be comprehensive and complete. The areas and population to which these cases refer were not always clearly defined and for this reason populations of whole countries or of areas in a certain phase in a country had to be used as the denominators so that these rates cannot all be considered as accurate, and the true figures are probably somewhat higher. From the data in the questionnaire Taiwan so far is the only country for which an accurate rate for population under surveillance can be given.

¹ The USSR defines malaria as a mass disease if the annual incidence rate exceeds 1 per thousand. (WHO/Mal/222, page 48.)

Keeping these general reservations in mind we still find it possible to draw some conclusions from the figures presented. It will be seen from Table III : : that in all countries where true consolidation has been reached either in the whole country or in part of it, the annual incidence of malaria is less than 0.5 per thousand and in most instances far below that figure. Examples of this are Mauritius, Swaziland, Venezuela and Trinidad (area "B"), Israel, Lebanon, Romania, Bulgaria, and in the South-East Asia Region a small area in the consolidation phase in India. In the Western Pacific Region there is Taiwan. It is interesting to note that in Greece the relevant figure is 0.5 per thousand in contrast to the much lower figures for Romania and Bulgaria; this indicates that in Greece there are still some problems to be solved.

A comparison between the incidence rate in consolidation phase areas "B" and attack phase areas "C" for the same countries also seems to confirm the quantitative hypothesis put forward above. In Venezuela the incidence in the consolidation phase is 0.07 while in the attack phase area it is 1.9. In Iran the figure for the "B" area is 0.06 and that for the "C" area 0.5 (it should be noted that for this country both rates are probably far below the true incidence). In Swaziland the incidence for the "B" area is 0.1 and for the "C" area 3.0.

TABLE I. EXTENT OF CASE-FINDING OPERATIONS IN DIFFERENT COUNTRIES EXPRESSED THROUGH THE PROPORTION OF SLIDES TAKEN AND EXAMINED PER POPULATION

Proportion of slides per population *			
More than 10%	5%-10%	1%-5%	Less than 1%
African Region:			
Mauritius 11.1 MS		Dahomey 1.0 MS French Cameroun 1.5 MS Ghana 1.46 PH Liberia 1.1 MS Senegal 4.0 MS Swaziland 4.8 AS Uganda 2.4 PH	Southern Rhodesia 0.73 MS Union of South Africa 0.4 MS** Upper Volta 0.83 ** According to questionnaire surveillance operations also carried out but no data given
American Region:			
British Honduras 10.8 MS Costa Rica 14.7 AS Federation of the West Indies: Grenada 14.6 AS St Lucia 11.8 S Panama 10.7 AS Venezuela 50.8 AS "C" 50.8 AS	Mexico "B" 7.5 AS Trinidad (without Tobago) 5.7 AS Venezuela "B" 9.9 AS	Argentina 1.8 AS Colombia 1.6 MS British West Indies: Dominica 2.4 ET Jamaica 2.5 MS Ecuador 2.5 AS El Salvador 3.6 MS French Guinea 2.5 PSb Guadeloupe 3.2 AS Guatemala 4.2 PSb Honduras 2.1 PH Martinique 1.2 MS Mexico 2.4 AS Paraguay 1.8 PH	Bolivia 0.76 MS Brazil (Sao Paulo) 0.17 PSb British Guiana 0.3 MS Dominican Republic 0.73 MS Haiti 0.5 MS Nicaragua 0.8 AS Peru 0.8 AS
Eastern Mediterranean Region:			
Lebanon 15.1 AS Lebanon 25.0 AS Syria 22.2 MS	Iraq 5.0 AS Lebanon "B" 8.6 MS	Egypt 2.0 MS Iran 3.0 AS Jordan 1.8 MS Somalia (Ital.) 3.8 PH Sudan 3.6 PH Syria 1.8 MS	Ethiopia 0.09 MS Fr. Somaliland 0.25 PSb Libya 0.2 MS Saudi Arabia 0.57 MS
European Region:			
USSR 9.5 S Turkey "B" 6.0 MS	Portugal 1.2 MS Greece 3.2 AS Romania 3.8 PSb Turkey 4.8 MS Yugoslavia "B" & "C" 1.5 PSb	Algeria 0.1 PSb Spain 0.31 PSb Yugoslavia 0.62 PSb Total 0.62 PSb	

TABLE I. EXTENT OF CASE-FINDING OPERATIONS IN DIFFERENT COUNTRIES EXPRESSED THROUGH THE PROPORTION OF SLIDES TAKEN AND EXAMINED PER POPULATION (continued)

Proportion of slides per population *			
More than 10%	5%-10%	1%-5%	Less than 1%
<u>South-East Asia Region:</u>			
.		Afghanistan Ceylon Thailand India	Burma Ceylon Nepal Portuguese India (Goa)
		1.2 MS "C" 1.8 PSb 1.4 AS "B" 1.7 AS	0.5 MS "B" 0.61 PSb 0.13 MS 0.08 ?
<u>Western Pacific Region:</u>			
Sarawak	10.2 AS	Brunei Taiwan West New Guinea	Hong Kong Laos
		5.65 MS 7.5 AS 6.8 PH	0.11 MS 0.91 MS

* Nos. indicate the proportion for each country.
 Letters indicate principal sources: MS = malariometric surveys; S = surveillance, not specified; "AS" = active surveillance; PSb = passive surveillance (rural dispensaries);
 PH = private hospitals; EM = evaluation team
 "B" = Area under consolidation; "C" = Area regularly sprayed; "D" = Area not regularly sprayed.

FIG 1
PROPORTION OF SLIDES AND POSITIVE SLIDES BY FOUR METHODS OF CASE-FINDING IN TEN COUNTRIES*

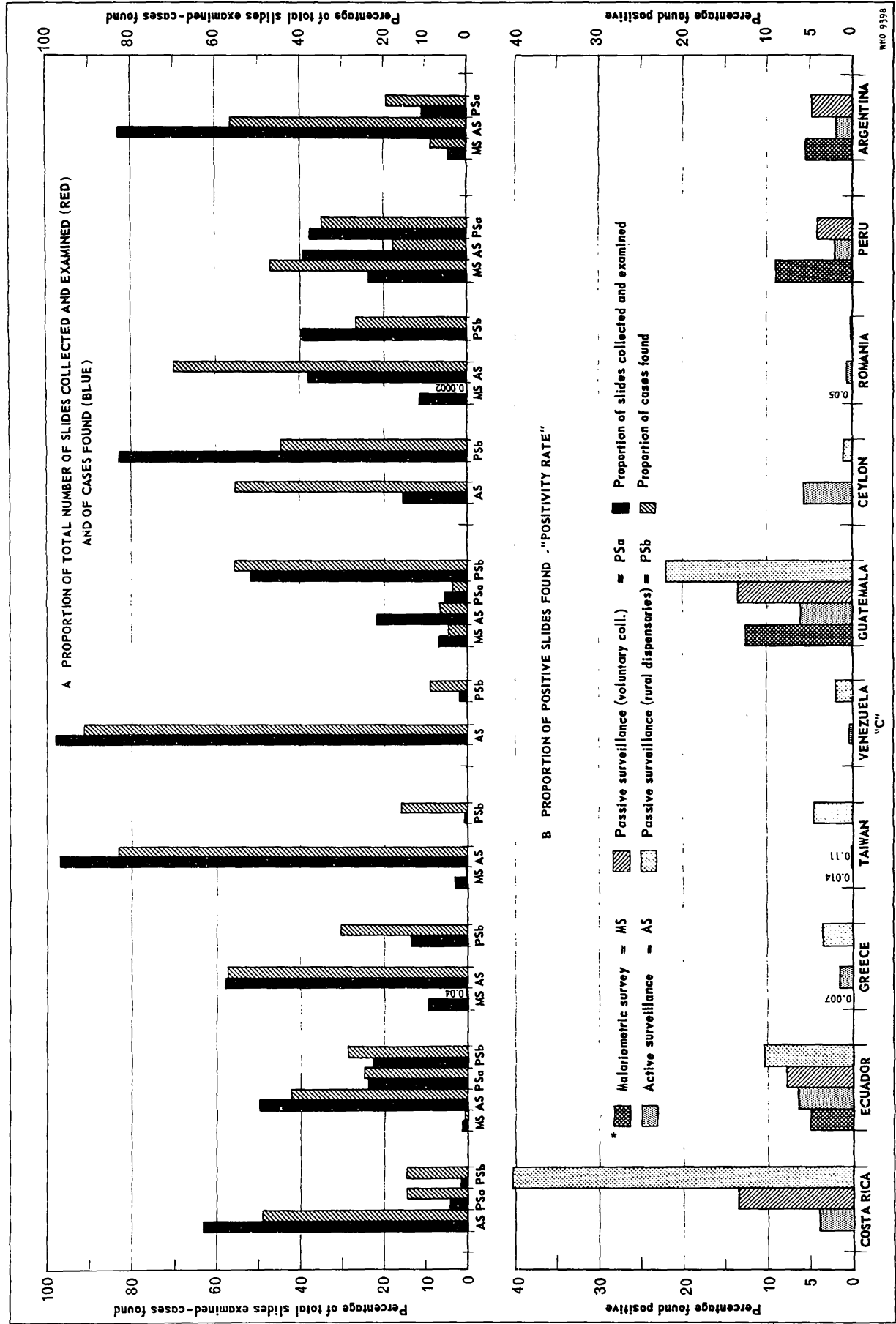


FIG 1
PROPORTION OF SLIDES AND POSITIVE SLIDES BY FOUR METHODS OF CASE-FINDING IN TEN COUNTRIES*

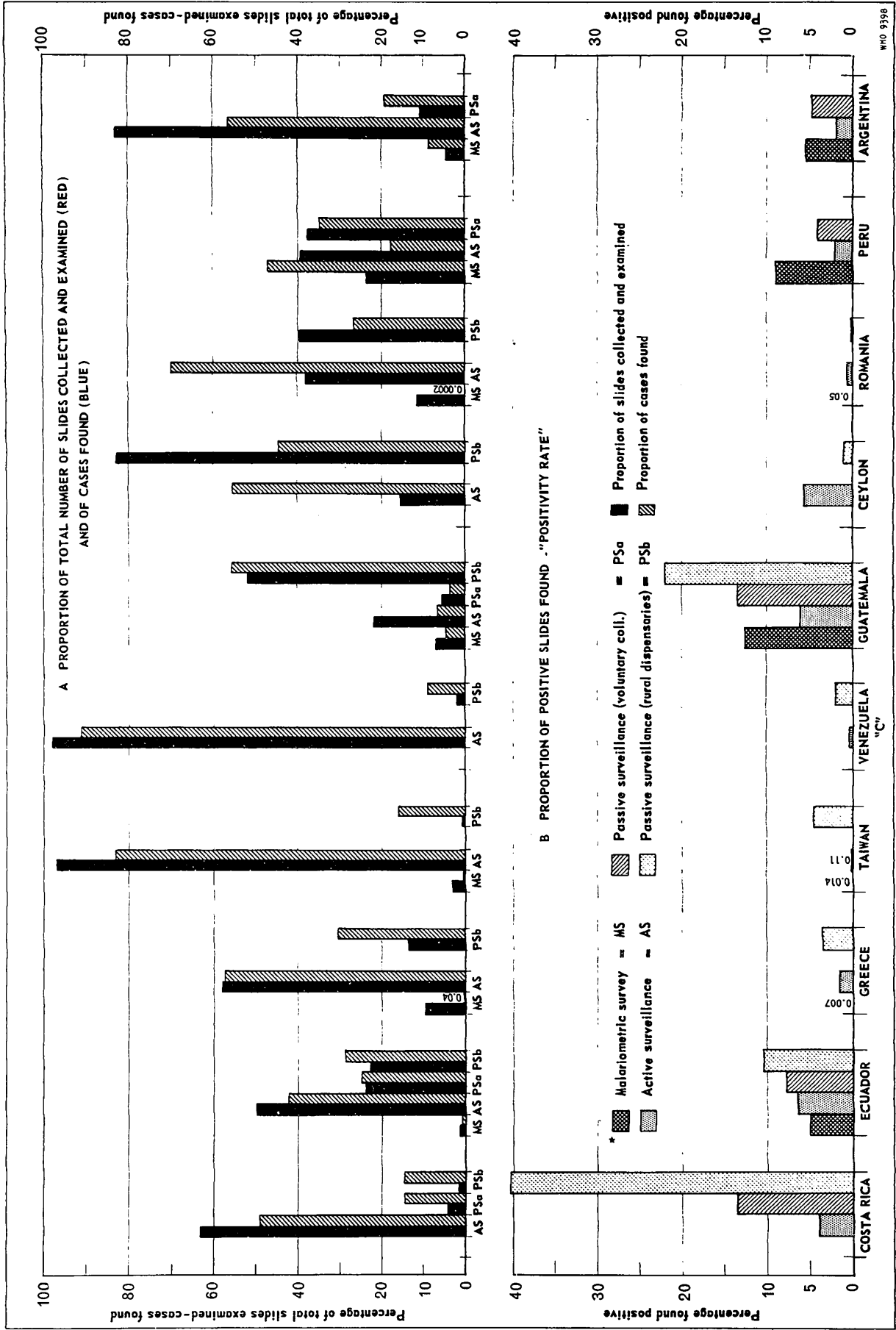


TABLE II. COMPARISON OF PERCENTAGES OF POSITIVE SLIDES FROM MALARIOMETRIC SURVEYS AND SURVEILLANCE PROCEDURES

Country	Phase	Proportion of		Malarionetric survey (MS)			Surveillance (S)			Comments on methods used	Remarks
		popula- tion examined	slides found positive	No. of slides examined	Cases found	Proportion of slides found positive	No. of slides examined	Cases found	Propor- tion of slides found positive		
<u>African Region:</u> Mauritius		11.1	0.17	62 180	18	0.03	1 684	38	2.3	AS distinctly superior to MS	
<u>American Region:</u> Argentina	D	0.53	7.5	1 708	94	5.5	3 623	204	5.6	Effectiveness of both methods equal	
<u>Federation of the West Indies:</u> Grenada		More than 10%	0.5	4 662*	5	0.11	5 328	44	0.8	AS superior to MS	* Data from PASB/WHO Evaluation Team
Jamaica		2.5	0.4	21 024	0	0	9 073	139	1.5	S distinctly superior to MS	
St Lucia	C	14.3	0.35	3 710	2	0.05	6 951	36	0.5	S superior to MS	
Guatemala	C	4.2	20.6	4 316	541	12.5	49 710	8 122	21.2	MS superior to S	
Panama	C	11.8	6.5	1 121	235	23.5	77 203	2 153	2.8	MS clearly superior to S, though much smaller no. of slides	
Paraguay	C	1.8	3.7	5 714	154	2.7	744	8	1.0	MS slightly superior to AS	
Peru	C	0.8	4.5	5 514	490	8.9	17 629	546	3.1	MS superior to S	
<u>Eastern Mediterranean Region:</u> Iran		3.0	1.0	19 451	377	2.0	362 646	3 430	0.95	MS superior to AS	Main activities in area under "C"
Syria	B	22.2	0.41	15 598	116	0.75	12 656	0	0	MS superior to AS	

TABLE II. COMPARISON OF PERCENTAGES OF POSITIVE SLIDES FROM MALARIOMETRIC SURVEYS AND SURVEILLANCE PROCEDURES (continued)

Country	Phase	Proportion of		Malarionetric survey (MS)			Surveillance (S)			Comments on methods used	Remarks
		popula- tion examined	slides found positive	No. of slides examined	Cases found	Proportion of slides found positive	No. of slides examined	Cases found	Propor- tion of slides found positive		
European Region:											
Greece		3.2	1.56	13 918	1	0.007	100 556	1 942	1.9	S far superior to MS	
Romania		3.8	0.3	26 921	14	0.05	179 613	710	0.4	S far superior to MS	
Turkey	B	6.0	1.0	72 743	88	0.12	64 561	1 357	2.1)	AS far superior to MS but under "C" more than under "B"	
Turkey	C	8.6	1.7	448 824	774	0.17	93 235	8 032	8.8)		
Yugoslavia	C	1.57	5.0	4 288	4	0.1	22 581	1 143	5.0	S far superior to MS	
South-East Asia Region:											
Afghanistan		1.2	3.36	21 852	371	1.7	8 640	652	7.5	AS superior to MS	
Burma		0.5	1.1	49 461 *	210	0.43	14 852	503	3.4	AS superior to MS	* Further 67 000 slides not examined
Thailand		1.4	1.05	84 369 *	4 835	5.6	85 104	12 945	15.2	AS superior to MS	* Mostly collected in area under "C"
Western Pacific Region:											
Philippines *	B			606 573	1 097	0.18	156 451	6 957	4.45	AS superior to MS)	* MS data from 1957
Philippines *	C			89 445	6 272	7.0	446 414	31 360	7.0	AS and MS equally effective)	AS data from 1958
Sarawak	C	7.1	3.5	11 722	429	3.7	13 004	427	3.3	MS slightly superior to S	
Taiwan		7.5	0.12	14 584	2	0.014	494 877	625	0.12	S superior to MS	

MS = malarionetric surveys:

S = surveillance (active and passive combined):

AS = active surveillance.

TABLE III. ANNUAL MALARIA INCIDENCE
(RATES PER THOUSAND OF POPULATION) IN 1958 FOR SOME COUNTRIES

Region and country	Total	B	C	Remarks
<u>African Region</u>				
Mauritius	<u>0.2</u>			
Swaziland	<u>0.3</u>	<u>0.1</u>	3.0	
<u>American Region</u>				
El Salvador	6.5			
Ecuador	2.0			
Guatemala	8.0			
Venezuela	0.2	<u>0.07</u>	1.9	Rate for area with malaria eradicated 0.0%
Trinidad	0.5	0.06*	0.6	*Rate for Island of Tobago for which complete eradication is claimed.
<u>Eastern Mediterranean Region</u>				
Iraq	0.17	0.06	0.4	(The rates for these two countries are only important for comparison of B & C areas in the same country. The cases are those found mainly by surveillance activities but as no figures for populations under surveillance were available the rates are calculated for the whole population, and the true rates are therefore probably considerably higher.
Iran	0.3	0.06	0.5	
Israel	<u>0.015</u>			
Lebanon	<u>0.05</u>	0.03	0.07	
<u>European Region</u>				
Greece	0.5	0.6		
Romania	<u>0.01</u>			
Turkey	<u>0.8</u>	0.6	1.5	
USSR	<u>0.03</u>			
Bulgaria		<u>0.2</u>		

TABLE III. ANNUAL MALARIA INCIDENCE
(RATES PER THOUSAND OF POPULATION) IN 1958 FOR SOME COUNTRIES (continued)

Region and country	Total	B	C	Remarks
<u>South-East Asia Region</u>				
Afghanistan	2.0			Information from detailed reports in areas under surveillance This rate refers only to one small area in the consolidation phase.
Ceylon		0.02	0.26	
India				
Thailand	1.4			
<u>Western Pacific Region</u>				
Taiwan		<u>0.3</u>		Accurate rate for population under surveillance. For areas under surveillance during six months (estimated annual incidence).
Philippines		1.3(2.6)	20.9(41)	

The underlined figures are all rates under 0.5 per thousand

B = Consolidation phase C = Attack phase