Bull. Org. mond. Santé | *Bull. Wld Hlth Org.* 1957, **16**, 1083-1101

INDEX OF ENDEMICITY

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SYNOPSIS

The author discusses the difficulties involved in defining the term " endemicity ", and suggests a new approach to the problem—namely, the establishment of indices of endemicity, based on such data as are usually collected by national health administrations (mortality and morbidity rates, spleen-rates, case incidence in seaports, etc.). Examples are given of the calculation of the endemicity index for a number of diseases from different types of data obtained from various countries. An important advantage of the endemicity index is that it provides an easy means of studying the geographical pattern of endemic foci of disease.

Greenwood [1] states that Hippocrates " recognized that some forms of sickness were always present in a population, but that other forms either were not usually present or, if present, were not common at all times, but became very frequent at certain periods of the year and in certain years. He distinguished, as we say—using words taken from him—between endemic and epidemic disease."

Ever since Hippocrates coined the two terms " endemic " and " epidemic ", they have been used frequently by various writers to characterize different diseases. The term " endemic " has been employed both to describe an area in relation to a disease (endemic area) and *vice versa*, a disease in relation to an area (endemic disease). What is usually implied by this term is an area in which fresh cases of the disease can arise without importation of infection from outside. However, as far as the writer is aware, no satisfactory and workable definition of the term, internationally acceptable, has so far been put forward, nor has any general methodological technique been suggested whereby uniformity can be attained in judging the endemic status of a disease or an area. The weakness of the above-mentioned concept—namely, that an endemic area is one in which fresh cases can arise without importation of infection from outside—is that the size of the area needs to be specified. For instance, in connexion with cholera, the whole of India has frequently been called " endemic ", but there are certain large States with a population of some ten to twenty million each, where cases are not known to occur other than by importation from other States. Thus, a cholera endemic area in India must constitute only a part of the country, but which part and of what size? Should endemic areas be defined as comprising so many States, or so many administrative subdivisions of States, such as districts (one to three million people), or the still smaller subdivisions like " thana " or " taluk ", about ten of which constitute a district? Further, while this concept may be satisfying to an epidemiologist, it would be difficult to apply it on a country-wide scale without having recourse to epidemiological investigations of innumerable localities, a task which cannot possibly be administratively carried out throughout a large country. What is needed, therefore, is not only an unambiguous definition, but also a practical method of assessing endemicity status by means of the resources normally available to a public health administrator.

The purpose of this paper is to present an approach to this problem which utilizes such data in respect of diseases as are usually collected on a national scale.

Suggestions or Recommendations by WHO Expert Groups

Various expert groups of WHO have put forward criteria for defining the term " endemicity ", as, for instance, the following:

Cholera

In 1948, the Joint OIHP/WHO Study-Group on Cholera,[2] discussing at its second session the problem of the determination of cholera endemic zones, made the following statement:

" 1.3 *Definition of endemic areas*

The study-group agreed that an endemic area is one in which, over a number of years, there is practically continuous presence of clinical cholera with annual seasonal exacerbations of incidence.

" 1.4 *Criteria of endemicity*

In India, the following criteria have been suggested for the determination of endemic, non-endemic and intermediate areas :

" 1.4.1 *Percentage of months without cholera*

endemic	less than 30%
intermediate	30% to 50%
non-endemic	over 50%

" 1.4.2 *Mean length in months of intervals between prevalence of cholera*

endemic	less than 2.5
intermediate	2.5 to 4
non-endemic	over 4 "

The criteria which the Group stated as having been suggested in India have been found to be unworkable, because both the percentage of months without cholera and the mean cholera-free period are related directly to the size of the area chosen for study. In that the administrative divisions for which figures are available vary in size, and in that the two indices are not adjusted for this variation, the results arrived at would be open to criticism.

Plague

The WHO Expert Committee on Plague,[7] at its first session, in 1949, agreed to the following definition:

" *Definition of an endemic plague area.* An area in which the domestic rodents and their ectoparasites form permanent reservoirs of plague due to favourable ecological conditions which permit perpetuation of infection and from which human infection arises.

" The committee felt that there were large gaps in our knowledge of endemic areas. In many instances this was due to the fact that facilities for investigation and survey were not fully available to the local health-authorities."

This definition involves the subjective judgement of the investigator and does not offer precise workable criteria.

Malaria

The question of defining malaria endemicity was discussed in 1950 at the fourth session of the WHO Expert Committee on Malaria, as well as at the Malaria Conference in Equatorial Africa, held under the joint auspices of WHO and the Commission for Technical Co-operation in Africa South of the Sahara.[8] The following working classification of various degrees of malaria endemicity, based on spleen-rate, was recommended for trial:

"(1) *Hypoendemic malaria :* spleen-rate in children 2-10 years of age, 0-10 %

"(2) *Mesoendemic malaria :* spleen-rate in children 2-10 years, 11-50%

"(3) *Hyperendemic malaria :* spleen-rate in children 2-10 years, constantly over 50%; spleen-rate in adults, high

"(4) *Holoendemic malaria :* spleen-rate in children 2-10 years, constantly over 75%; spleen-rate in adults, low; it is in this type of endemicity that the strongest adult tolerance is found."

The above criteria are objective, but they would require a continuing spleen census in the countries.

Yellow fever

The story of attempts to evolve a concept of endemicity applicable to yellow fever is indeed of great interest. In 1944, the Expert Commission on Quarantine of the United Nations Relief and Rehabilitation Administration attempted to define and delineate yellow-fever endemic zones. Article III of the International Sanitary Convention for Aerial Navigation of 1944 stated that: " An endemic yellow fever area is a region in which yellow fever exists in a form recognizable clinically, biologically, or pathologically ".

Later, in 1951, WHO incorporated the following definition of a yellow-fever endemic zone in the International Sanitary Regulations (WHO Regulations No. 2): [5]

" '*yellow-fever endemic zone*' means an area in which *Aëdes aegypti* or any other domiciliary vector of yellow fever is present but is not obviously responsible for the maintenance of the virus which persists among jungle animals over long periods of time; "

That this definition was not entirely free from objection is proved by the fact that it was deleted from the International Sanitary Regulations by the Eighth World Health Assembly in 1956.[6]

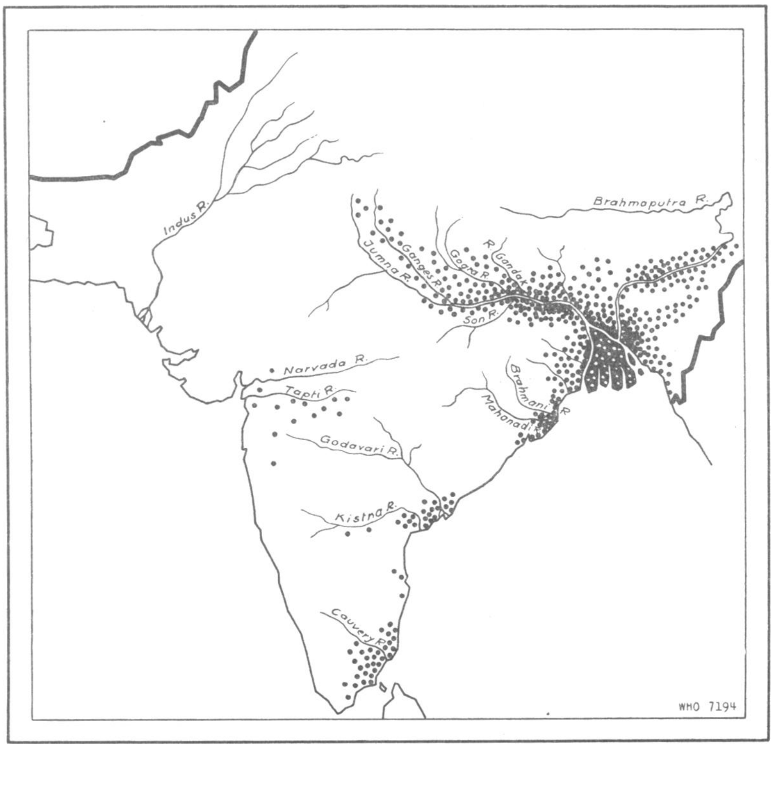
Suggested Approach to the Determination of Endemicity

If we consider the problem of determining endemicity from the point of view of locating zones where administrative action needs to be concentrated, and if we also keep in mind the fact that a search for endemic areas is needed on a country-wide scale, then a convenient approach would be to examine the data bearing on the disease collected through the routine statistical or disease-notification services of the country. In other words, we may ask ourselves to what extent the recorded information on the disease can be utilized for the purpose of determining endemicity. In this connexion we may note that in respect of many diseases provision has already been made over large areas of the world for the reporting of deaths from, and in many instances also cases of, certain diseases occurring throughout the country. It is true that these data are often incomplete and unreliable—incomplete because many occurrences are not recorded, and unreliable because of incorrect diagnoses. All the same, such information as is available has already been found to be of value for the study of disease trends, for noting years of abnormal incidence, and for determining seasonal variation. It is shown later in this paper that a fairly workable index of endemicity may also be established with the help of the available national statistical data on disease. The technique explained below, which the writer has applied, makes use of a simple index for the purpose of locating endemic foci. The application of this index to certain diseases is also illustrated.

Endemicity Index

The index of endemicity suggested in this paper may be explained by means of an illustration of cholera in India. Figures for annual cholera mortality relating to individual districts are utilized. It may be mentioned that the " district " is the smallest administrative unit in India for which separate cholera statistics are available from published reports. There were some 200 districts for which such figures were available. An allowance for population size was made in the first place by calculating separate annual cholera mortality rates per 100 000 population for each district of India for the period 1901-45. Thus, 45 separate annual cholera mortality rates were calculated for each district. In those districts which were liable only to occasional outbreaks of the disease, even though in some years the mortality rate was very high, there were a number of inter-epidemic years during which no death from cholera was recorded. On the other hand, in certain districts where cholera tended to be present continuously, there was hardly a year when the cholera mortality rate was zero or negligible. From the point of view of endemicity, the question of greatest interest was how low a level cholera attained. Thus the years with relatively low mortality rates were studied. In the first instance, therefore, the 45 annual death-rates for each district were arranged in descending order

FIG. 1. CHOLERA ENDEMICITY LEVEL IN INDIA AND PAKISTAN, 1901-45



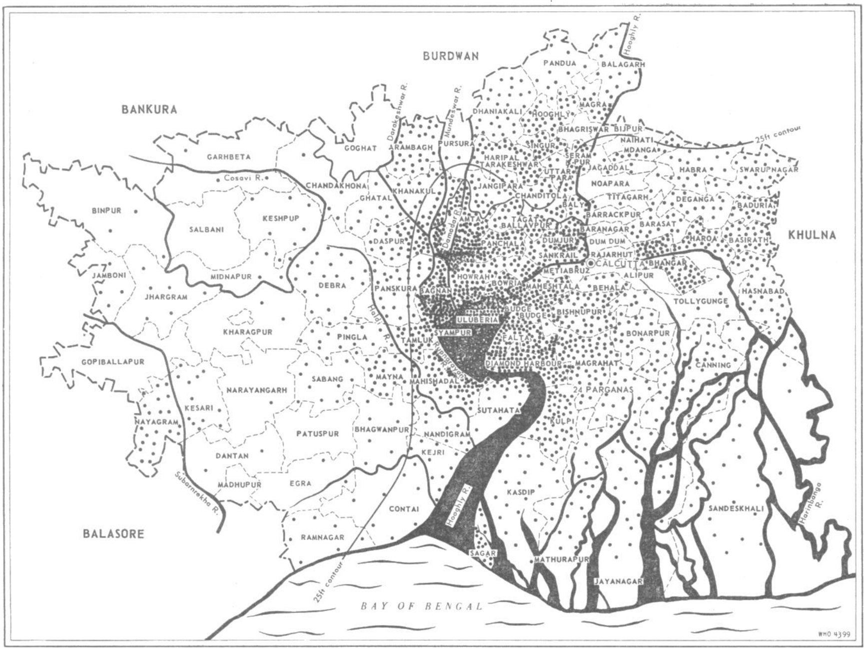
of magnitude. The 15 years with the lowest cholera mortality (one-third of the total number) could thus be separated from the rest of the series. For each district an average value of the 15 lowest rates was then calculated separately (see Annex, page 1099). As already stated, in some districts this figure was found to be zero or negligible; in others, high values were found. For example, in Bengal, which has often been called the home of cholera, the average figure was found to be zero for Darjeeling district, because in at least 15 years during the period 1901-45 no cholera occurred. On the other hand, in the same State, in Howrah district, the average mortality rate for the 15 years of lowest cholera mortality was found to be 125 per 100 000. Similarly, in the different districts of the other States of India, average figures of varying magnitudes were obtained, indicating numerically the relative levels of endemicity—the higher the average, the more endemic the district.

Although this approach to endemicity does not solve the problem of how to demarcate an endemic area, from an administrative point of view it is valuable in providing a relative measure of endemicity. One advantage of this approach is that the levels at which the disease persists can be estimated in numerical terms, thus providing what we may call the indices of endemicity. Such indices enable us to study the geographical pattern of the endemic areas. This point is illustrated in Fig. 1, which is based on the recorded indices of endemicity for individual districts of India. The number of dots shown against each unit area of the district is directly related to the level of the endemic index. An interesting geographical distribution of the highly endemic areas in the whole country is thus brought out. The largest of these foci are to be seen in Bengal (in both East and West Bengal, now parts of Pakistan and India respectively) and in the deltaic region of the Ganges and the Brahmaputra, extending eastwards into Assam and westwards into Bihar and possibly into the eastern districts of Uttar Pradesh. Other endemic foci of lesser magnitude are found in the deltas formed by the Mahanadi in Orissa State, and by the Cauvery, the Kistna and the Godavari in Madras State. Factors common to all these foci are that they are situated in close relation to surface-water systems, that they are densely populated areas on or near the coast, and that they lie at an altitude hardly exceeding 50 feet (15 m) above sea level.

Although this index of endemicity does not enable us to demarcate areas in any absolute sense, it does serve to show up the tracts of the country in which endemic zones of the disease are not likely to lie. It also indicates the areas where the endemicity level is high and where a more intensive search can be made by calculating similar indices of endemicity for subdivisions of individual districts. For the four districts of south-west Bengal which showed the highest endemicity indices, a further analysis was carried out on figures relating to subdivisions of districts—

namely, individual thanas. The geographical distribution of the endemicity index by thanas is shown in Fig. 2. This detailed examination enabled the writer to detect the existence of a major focus within south-west Bengal at the confluence of three rivers, the Hooghly, the Rupnarayan and the Damodar.[3] This is a very densely populated and low-lying district, situated about 40 miles (65 km) south-west of Calcutta. It lies in an area where the altitude is within 25 feet (8 m) of sea level.

FIG. 2. CHOLERA ENDEMICITY LEVEL IN FOUR DISTRICTS IN SOUTH-WEST BENGAL, 1934-48 *

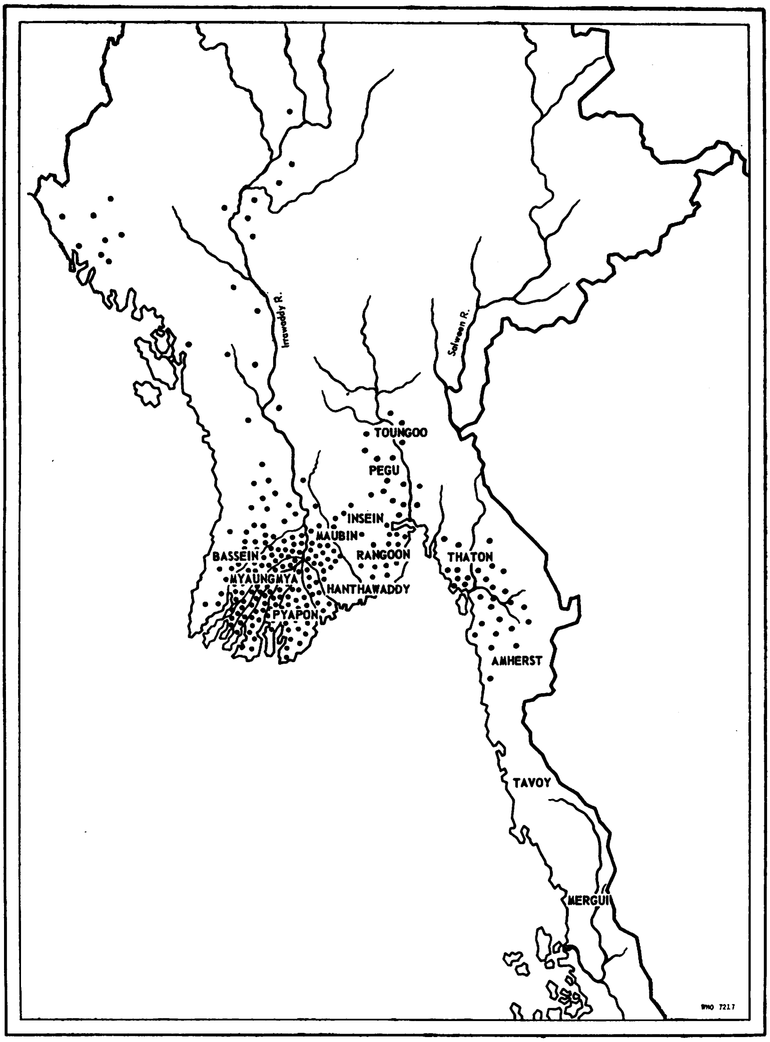


* Based on the average cholera mortality of the five years of lowest incidence

A similar study carried out on district figures for Burma (1918-38) is illustrated in Fig. 3. The endemic area is situated in the delta of the Irrawaddy River. The district of Myaungmya, the cholera endemicity of which is relatively the highest in Burma, lies in the southernmost part of this delta, at an altitude of 15-20 feet (4.5-6 m) above sea level; it is the most low-lying district of Burma.

It is likely that, owing to improvements in recent years, these endemic foci may have shrunk in size. Similar endemicity indices worked out on figures for more recent years would help to show not only the extent

FIG. 3. CHOLERA ENDEMICITY LEVEL IN BURMA, 1918-38

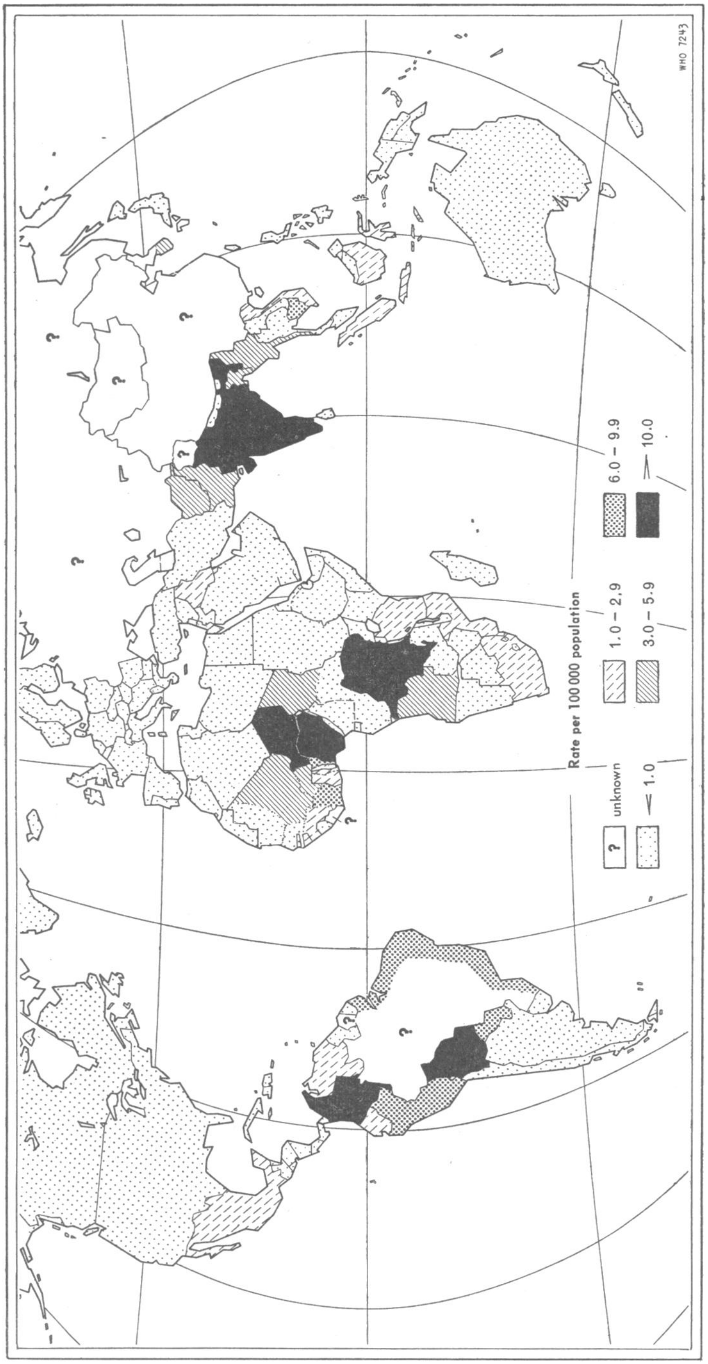


of this possible shrinkage, but also the reduction in the general endemicity level.

Endemicity Index derived from Morbidity Data

In the foregoing discussion, data relating to mortality from cholera were utilized for the purposes of illustration. A similar method of approach could of course also be applied to mortality data relating to other com-

FIG. 4. WORLD DISTRIBUTION OF SMALLPOX ENDEMICITY, 1940-54 *



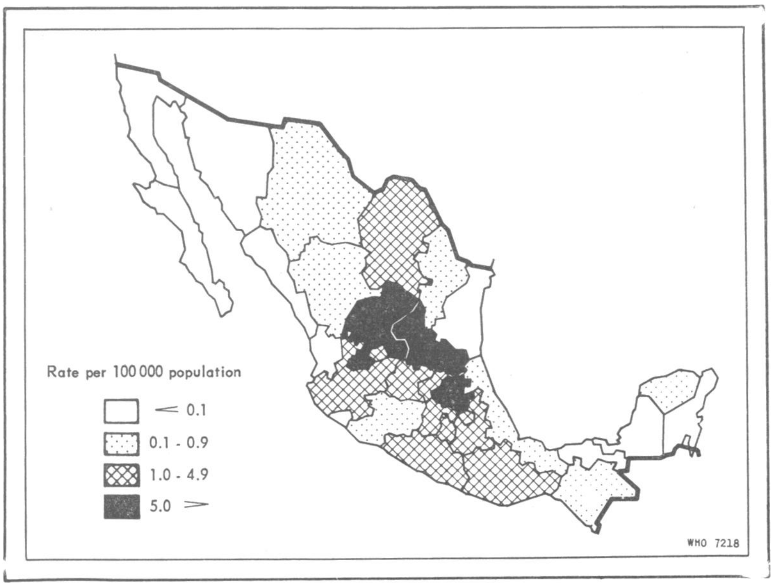
* Based on annual morbidity rates

municable diseases. An example of endemicity indices based on smallpox mortality figures appears later in this section.

Similar indices can also be worked out on morbidity figures, if available. As an example, we may study the problem of the endemicity of smallpox in different parts of the world, utilizing the annual figures for smallpox cases during the period 1940-54. Annual case rates per 100 000 population are first worked out for this 15-year period for each country or territory. From these 15 figures for case rates, the lowest five (one-third of the total number) in each country are selected and averaged, a relative measure of the level of endemicity of the different countries or territories thus being provided. The higher the value of this average figure, the more endemic relatively is the area in question. A map based on these figures is shown in Fig. 4, which focuses attention on the countries or territories where the endemicity of the disease has been at a high level. Some of these countries are of course large, and endemicity indices worked out separately for subdivisions of the area would have helped further to localize the foci.

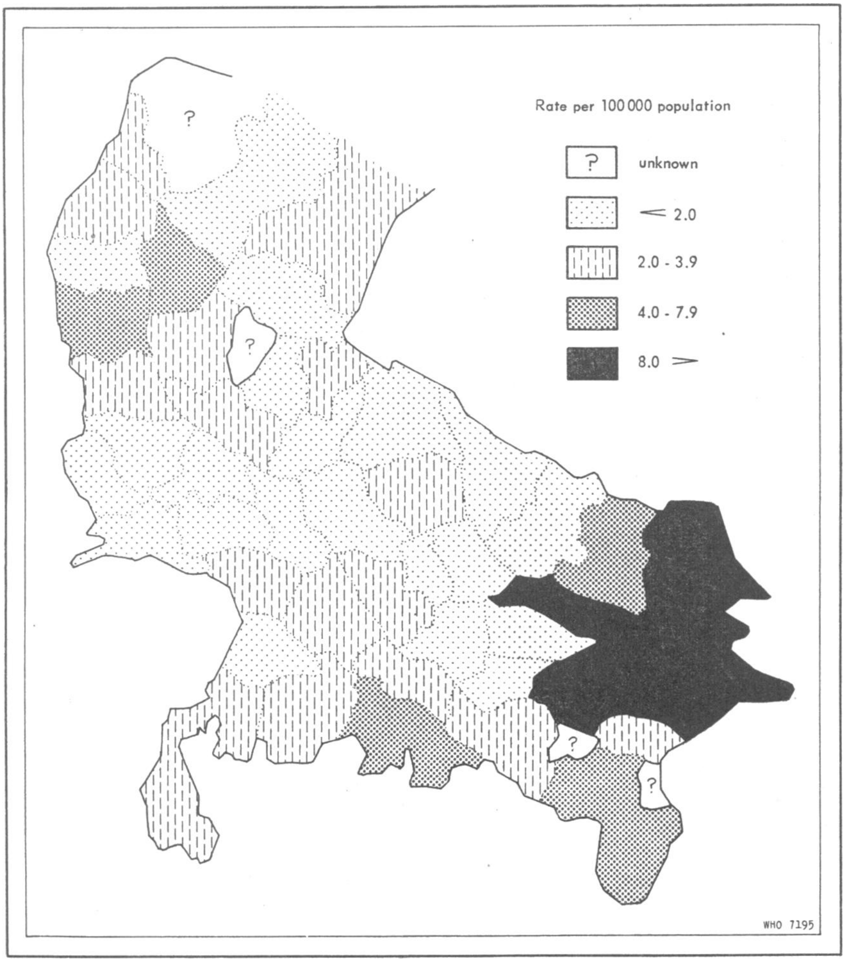
Morbidity figures for subdivisions of countries are not compiled by WHO and are therefore not readily available. But the possibility of localizing foci with the help of mortality data is illustrated by figures for Mexico and for the largest State of India, namely, Uttar Pradesh. Mexico was chosen because, by comparison with its neighbour, the United States of America, it showed a high smallpox endemicity.

FIG. 5. SMALLPOX ENDEMICITY IN MEXICO, BY STATE, 1932-46 *



* Based on annual mortality rates

FIG. 6. SMALLPOX ENDEMICITY IN UTTAR PRADESH, BY DISTRICT, 1931-47 *

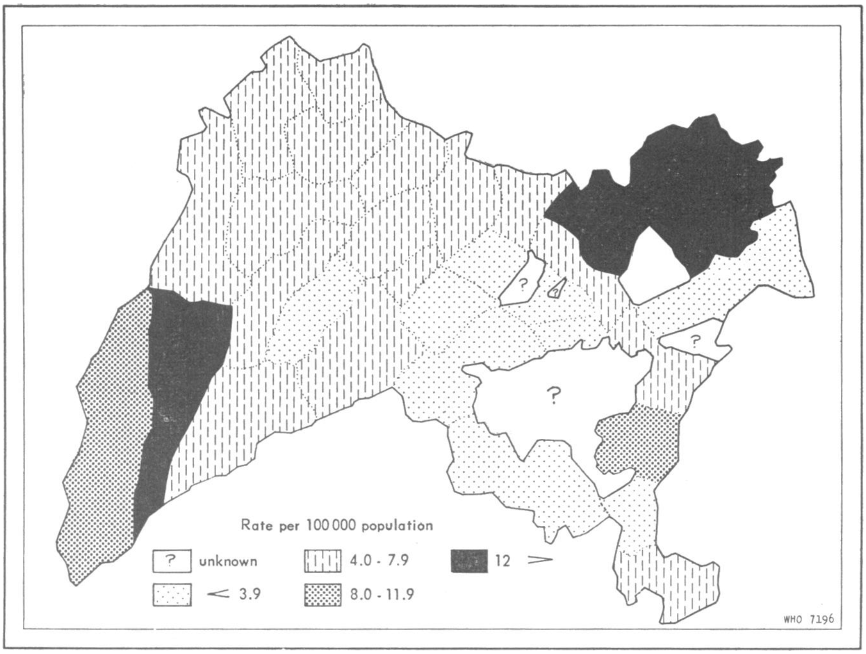


* Based on annual mortality rates

Smallpox endemicity in Mexico

Annual smallpox mortality rates were calculated separately for the 32 States comprising the country, for the 15-year period 1932-46. Average figures for the five years of lowest incidence were calculated separately for each State. The geographical distribution of the endemicity death-rates thus obtained is shown in Fig. 5. It is of interest to observe that the main endemic foci of smallpox lay in the centre of the country.

FIG. 7. MALARIA ENDEMICITY IN THE PUNJAB, AS JUDGED BY SPLEEN-RATE IN JUNE, 1914-43



Smallpox endemicity in Uttar Pradesh, India

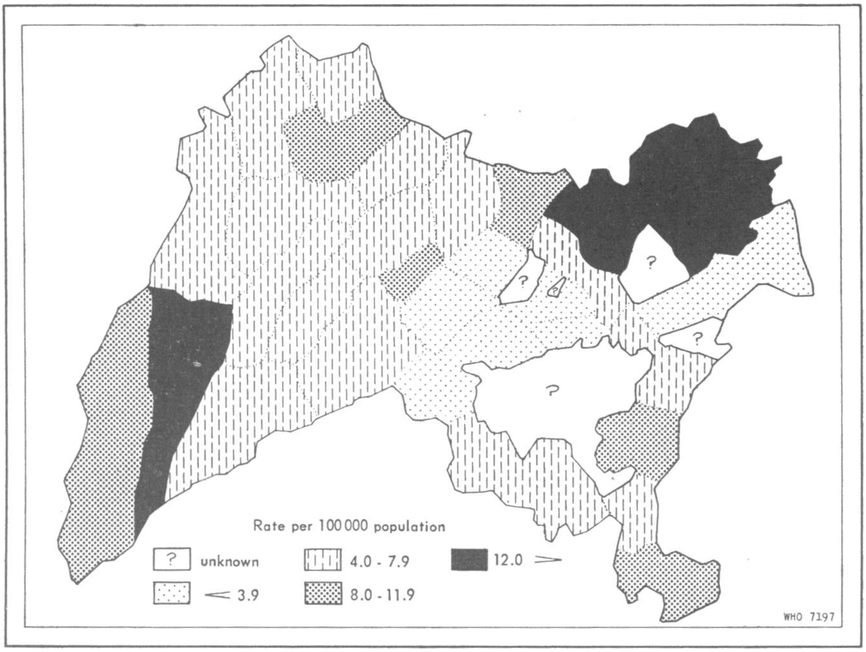
Endemicity rates for individual districts of Uttar Pradesh were calculated by averaging the figures of smallpox mortality rates for the five years during 1931-47 which had the lowest values. The geographical distribution of these endemicity rates is shown in Fig. 6. The area of high endemicity is thus found to be situated in the extreme east of the State.

Endemicity Index derived from Spleen-rate Data

If comparable spleen-rate figures are available for several years in succession, the same method of deriving an endemicity index could be applied to spleen-rate figures as to malaria mortality or morbidity data.

Since 1914, it has been the practice in one State of India, the Punjab, to conduct a spleen-rate census in all districts twice a year—namely, in June (before the onset of the malaria season) and November (when malaria epidemics are expected to have declined). Naturally, the spleen-rates in November are generally of a higher order than those in June. These spleen-rate data are available for 30 years—i.e., from 1914 to 1943. The

FIG. 8. MALARIA ENDEMICITY IN THE PUNJAB, AS JUDGED BY SPLEEN-RATE IN NOVEMBER, 1914-43



above concept of endemicity has been applied to the annual spleen-rate figures separately for June and November for each district. The figures for the 10 years of lowest spleen-rates (one-third of the total number of years) were averaged separately for each district, and a relative measure of endemicity was obtained. The geographical distribution indicated by these average figures is shown in Fig. 7 and 8.

Both maps indicate two isolated areas of relatively high malaria endemicity.

Disease Endemicity in Ports

A continuous record is maintained of cases of pestilential diseases occurring in different sea- and air-ports. These data could also be used in the manner described earlier (see pages 1086-1090) to study the endemicity of various diseases in sea- or air-ports. As an illustration we may examine the endemic level of cholera in recent years in the sea-ports of India, Pakistan and Burma. A continuous series of figures is available from 1946 to 1955; owing to the Second World War, the series was interrupted for some ports during the period 1941-45. The averages calculated for the three years with the lowest annual cholera case rates per 100 000 population during this period are shown in the table overleag.

CHOLERA ENDEMICITY IN SEA-PORTS OF INDIA, PAKISTAN AND BURMA DURING 1926-40 AND 1946-55

Port	Endemicity rate per 100 000	
	1926-40	1946-55
Calcutta	105.6	83.8
Negapatam	3.0	19.4
Chittagong	20.6	10.9
Madras	2.3	0.7
Tuticorin	0	0.3
Rangoon	1.5	0.2
Bombay	0.02	0.04
Bassein	10.1	0
Karachi	0	0
Vizagapatam	0	0

Minimum Period for Calculation of Endemicity Index

In the foregoing illustrations, periods of varying duration have been considered for the estimation of relative levels of endemicity, depending mostly upon the availability of a continuous series of annual data; for instance:

45 years (1901-45) for cholera mortality by districts in India
30 years (1914-43) for spleen-rates by districts in the Punjab, India
21 years (1918-38) for cholera mortality by districts in Burma
15 years (1940-54) for smallpox morbidity in various parts of the world
15 years (1932-46) for smallpox mortality by States in Mexico
15 years (1934-48) for cholera mortality by thanas in south-west Bengal
10 years (1946-55) for cholera cases in sea-ports of India, Pakistan and Burma

In each case the figures for one-third of the years with the lowest rates were averaged to estimate the relative level of endemicity.

If such a long period as 45 years is taken, it may fail to take into account the possible and varying degrees of improvement brought about in more recent years. On the other hand, a short period of about 9-10 years, of which figures for only the lowest three years are used, may not provide indices of reliable stability or precision. For these reasons, as well as for the purpose of securing international comparability, it may be advisable to consider annual data for the most recent 15-year period and take the figures for the five years of lowest incidence into account for the purpose of establishing endemicity indices.

If figures are available for a much longer period it would, however, be of interest to calculate endemicity indices separately for each period of 15 years (or even for overlapping successive periods of 15 years) and find out how, with the progress of time, the pattern of endemicity has changed. In the table opposite, the endemicity rates—i.e., the average annual case rates calculated on the basis of the five years of lowest incidence—for various sea-ports in India, Pakistan and Burma during the period 1926-40 are compared with the corresponding rates for the recent period 1946-55. In each case the rates have been worked out on an annual basis and are therefore comparable.

Fraction of Total Number of Years Desirable for Calculation of Endemicity Index

In the various illustrations given so far, the periods for which data were considered differed, but in each case one-third of the total number of years was taken into consideration in the calculation of the endemicity index. Is this the most suitable fraction? In the absence of any mathematical justification so far, it may be regarded as a satisfactorily simple and workable fraction. From what has been explained earlier (see pages 1086-1090) it is clear that our interest lies in finding out how low an average level the annual figures can attain. If the annual figures were not liable to chance variations, then data for only a few years would suffice. But the larger the degree of chance variation, the larger should be the proportion of years to be taken into consideration in working out an endemicity index. On the other hand, if we take an unduly large number of years of least incidence we may be including the effect of occasional epidemics which may have had a tendency to last for more than 2-3 years. It is presumed, therefore, that until some better argument is put forward for another fraction, we may in the interests of uniformity use one-third—that is, five out of 15 years—to estimate the relative endemic level of different areas.

Advantages and Criticism of Suggested Endemicity Index

In an attempt to derive a simple objective technique for studying the problem of endemicity, an average figure based on one-third of the total number of years showing the lowest annual rates is suggested. Based as this index is on the recorded experience of each area, it fails no doubt to take into account all the ancillary information that may be available in regard to the relative importance of the host, vector and infection, as well as the continued existence of such topographical, climatic and other factors as are known, on epidemiological considerations, to affect the persistence of the disease. In the simple concept of endemicity suggested in this paper, reliance is placed only on the final outcome of the interaction of all these factors—the manifestation of disease in man. If infection persists in an area but does not affect man, this index will fail to indicate it. Nevertheless, as a preliminary step for localizing areas of possible danger to man it is shown to have value.

Some advantages of this index may be briefly summarized:

(*a*) It provides an objective method of approach, so that the relative level of endemicity can be numerically assessed and compared.

(*b*) It utilizes data which are usually available to national health administrations in respect of their administrative subdivisions, so that a country-wide search can be made for endemic foci.

(*c*) It provides an easy method for studying the geographical pattern of endemic foci.

(*d*) It is easy to calculate and interpret.

(*e*) It can be used for any series of figures expressed as rates reflecting incidence, prevalence or other manifestations of the disease.

It is to be hoped that, on the basis of the approach suggested in this paper, objective and uniform criteria may be agreed upon to categorize areas as " endemic ", or further to classify them into different degrees of endemicity, in respect of different diseases.

RÉSUMÉ

Le terme d'« endémie », introduit par Hippocrate, et l'adjectif « endémique » s'appliquent aujourd'hui aussi bien à une maladie qu'à la zone où elle sévit. On n'a cependant pas encore mis au point une définition de ces mots qui soit acceptable sur le plan international, ni choisi des critères généraux du degré d'endémicité ou de l'étendue minimum de la zone que l'adjectif « endémique » peut qualifier valablement.

L'auteur cherche à préciser ces définitions et propose de recourir à un *indice d'endémicité*. Il prend, pour en expliquer le principe, l'exemple du choléra dans l'Inde. Cet indice, fondé sur les statistiques de mortalité par district (ou éventuellement les statistiques de morbidité selon les maladies ou les pays), est un chiffre moyen établi sur la base du tiers du nombre total d'années présentant les taux annuels de mortalité ou de morbidité les plus bas. Ce chiffre ne tient pas compte de plusieurs facteurs qui influent sur la pérennité d'une infection : les hôtes et vecteurs, le climat, la topographie, etc. Seule la résultante de l'action de ces facteurs, c'est-à-dire la maladie chez l'homme, est prise en considération. L'indice d'endémicité n'indique donc pas la persistance dans une zone d'une infection qui ne se manifeste pas chez l'homme. Malgré ces limitations, cet indice peut rendre des services. Il constitue une évaluation objective et numérique permettant la comparaison. Il se fonde sur des données accessibles aux autorités nationales de santé et permet le dépistage des foyers d'endémie sur le plan national. Il est facile à calculer et à interpréter. Il peut être adapté à l'analyse de toutes sortes de taux et d'indices. L'auteur en propose l'usage, afin que l'on parvienne à découvrir les régions où se trouvent des zones « endémiques » et ensuite à classer ces dernières selon le degré d'endémicité qu'elles présentent.

Annex

MEAN VALUES OF ANNUAL CHOLERA MORTALITY RATE PER 1000 POPULATION BY DISTRICTS IN INDIA IN THE 15 YEARS RECORDING THE LOWEST INCIDENCE DURING THE PERIOD 1901-1945

Madras

Tanjore	0.35	Kistna	0.06
South Arcot	0.26	Cuddapah	0.05
Trichinopoly	0.25	Guntur	0.05
Godavari West	0.19	Madras	0.05
Coimbatore	0.11	Bellary	0.03
Madura	0.11	Anantapur	0.02
North Arcot	0.11	Kurnool	0.02
Salem	0.11	Tinnevelly	0.02
Chingleput	0.10	Vizagapatam	0.02
Nellore	0.10	Godavari East	0.01
Ramnad	0.10	Malabar	0.01
Chittoor	0.09	Nilgiris	0.00
South Kanara	0.08		

Bombay

East Khandesh	0.06	West Khandesh	0.01
Sholapur	0.06	Bombay City	0.00
Ahmednagar	0.04	Dharwar	0.00
Bijapur	0.03	Ahmedabad	...
Nasik	0.03	Broach	...
Bombay Suburban	0.02	Kaira	...
Belgaum	0.01	Kanara	...
Kolaba	0.01	Panch Mahals	...
Poona	0.01	Ratnagiri	...
Satara	0.01	Surat	...
Thana	0.01		

Bengal

Howrah	1.25	Nadia	0.56
24-Perganas	1.20	Pabna	0.55
Bakarganj	1.07	Burdwan	0.47
Dacca	1.04	Rajshahi	0.39
Khulna	0.99	Birbhum	0.32
Tippera	0.99	Bankura	0.29
Faridpur	0.97	Malda	0.23
Calcutta	0.92	Rangpur	0.23
Jessore	0.85	Chittagong	0.22
Mymensingh	0.72	Bogra	0.18
Hooghly	0.61	Dinajpur	0.09
Midnapur	0.61	Jalpaiguri	0.08
Noakhali	0.60	Darjeeling	...
Murshidabad	0.56		

United Provinces

Ghazipur	0.24	Dehra Dun	0.04
Gorakhpur	0.24	Sitapur	0.04
Basti	0.20	Etah	0.03
Ballia	0.18	Fatehpur	0.03
Azamgarh	0.16	Moradabad	0.03
Banaras	0.16	Muttra	0.03
Mirzapur	0.15	Naini Tal	0.03
Gonda	0.13	Shahjahanpur	0.03
Fyzabad	0.12	Budaun	0.02
Jaunpur	0.10	Cawnpore	0.02
Allahabad	0.08	Garhwal	0.02
Rae Bareli	0.08	Meerut	0.02
Bareilly	0.07	Unao	0.02
Kheri	0.07	Agra	0.01
Pilibhit	0.07	Banda	0.01
Bahraich	0.06	Etawah	0.01
Bara Banki	0.06	Farrukhabad	0.01
Bijnor	0.06	Hardoi	0.01
Partabgarh	0.06	Jalaun	0.01
Saharanpur	0.06	Jhansi	0.01
Sultanpur	0.06	Mainpuri	0.01
Lucknow	0.05	Muzaffarnagar	0.01
Aligarh	0.04	Almora	0.00
Bulandshahr	0.04	Hamirpur	0.00

Punjab

Ambala	0.01	Ludhiana	0.00
Amritsar	0.01	Lyallpur	0.00
Gujranwala	0.01	Montgomery	0.00
Jullundur	0.01	Rawalpindi	0.00
Karnal	0.01	Shahpur	0.00
Lahore	0.01	Sialkot	0.00
Sheikhupura	0.01	Attock	...
Ferozepore	0.00	Dera Ghazi Khan	...
Gujrat	0.00	Jhang	...
Gurdaspur	0.00	Mainwali	...
Gurgaon	0.00	Multan	...
Hissar	0.00	Muzaffargarh	...
Hoshiarpur	0.00	Rohtak	...
Jhelum	0.00	Simla	...
Kangra	0.00		

Bihar

Gaya	0.51	Purnea	0.21
Bhagalpur	0.46	Santhal-Perganas	0.21
Patna	0.46	Manbhum	0.19
Monghyr	0.44	Hazaribagh	0.14
Shahabad	0.31	Saran	0.13
Muzaffarpur	0.22	Palamau	0.09
Champaran	0.21	Singhbhum	0.03
Darbhanga	0.21	Ranchi	0.01

Central Provinces and Berar

Bilaspur	0.05	Nimar	0.01
Drug	0.03	Wardha	0.01
Chanda	0.02	Balaghat	...
Nagpur	0.02	Betul	...
Raipur	0.02	Chhindwara	...
Bhandara	0.01	Mandla	...
Hoshangabad	0.01	Saugor	...
Jubbulpore	0.01		

Berar

Akola	0.06	Buldana	0.04
Yeotmal	0.06	Amraoti	0.03

Assam

Sylhet	0.72	Goalpara	0.21
Kamrup	0.40	Nowgong	0.11
Cachar	0.30	Sibsagar	0.10
Darrang	0.30	Lakhimpur	0.03

Orissa

Balasore	0.91	Sambalpur	0.05
Cuttack	0.81	Angul	0.01
Puri	0.71		

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