Chapter 2.

Literature review

2.1 Social economic factors of malaria transmission

Banguero (1984) studied the impacts of socioeconomic factors changes on malaria transmission. The study reassessed the determinants of the malaria problem in order to identify social and economic factors that might be playing an important role by themselves or in association with epidemiological or health determinants of the disease. Economic variables are in relation to reduce malaria incidence.

Castilla and Sawyer (1993) examined behavioral risk factors for malaria in the Machadinho resettlement area in the Amazonian forests of Brazil. Analysis suggests that economic status and knowledge of the importance and behavior of the mosquito in transmitting malaria are significant factors in determining prevalence risk, irrespective of whether preventive measures (DDT spraying of houses, and clearing vector breeding sites) are undertaken in the endemic area. However, a higher economic status combined with better knowledge of the vector and DDT spraying decreases the risks of infection considerably. The results suggest that economic status--which is not easily subject to intervention -- plays a more important role in transmission than is normally suspected, although preventive actions diminish the disease burden significantly. One might conclude that the landless and impoverished migrants who seek income, and independence in the rain forest are destined to have malaria as one of their many burdens. A more positive implication is that control programs must work harder and more intensively on behalf of poorer migrants in order to diminish the disease burden for these groups.

Ettling et al (1994) conducted a nationwide malaria knowledge, attitudes, and practices (KAP) survey in Malawi in 1992. Expenditure on malaria prevention varied with household income level. Very low income households spend less resources on malaria prevention. Only 4% of very low income households spent resources on malaria preventive measures compared to 16% of other households.

Kwadwo (1994) studied socioeconomic factors in malaria control in Ghana. The author found that knowledge of people's perception of malaria and the socioeconomic implications of the disease were of considerable value when control programs are being planned and implemented. Many socioeconomic factors are considered to have substantial effect on malaria transmission. These factors include sanitation conditions, agricultural development, irrigation, the availability of drugs and pesticides, knowledge of and attitudes to the disease, migration and outdoor activities. Some of these correlations are observed in this country, for example, malaria is linked to poverty in a vicious cycle , the factors, excessive heat, excessive drinking, fatigue, dirty surroundings, unsafe water, bad air, and poor personal hygiene. It is widely understood that malaria has a major adverse impact on the ability of adults to work and of children to attend school.

2.2 Malaria control measures

Kamol-Ratanakul and Prasittisuk (1992) carried out a field trial to compare the effectiveness of permethrin-treated bed nets with that of untreated nets as a method of malaria control for migrant workers in eastern Thailand. During the 35 weeks of observation, 23 subjects using treated nets and 33 workers using untreated nets developed 28 and 51 episodes of malaria, respectively (P = 0.029). The reduction in risk per subject due to treated nets was 0.06. The residual effects of permethrin were tested using a World Health Organization standard bioassay. Anti-mosquito activity was found to be present in the nets for more than 16 months. We conclude that because of the failure of the development of safe, effective, long-lasting prophylactic agents, integrating the use of impregnated nets with large-scale primary health care programs may be a partially effective method for controlling malaria in eastern Thailand.

Petersen et al (1993) studied the effect of lambda-cyhalothrin impregnated bed nets and maloprim/placebo in approximately 1,500 children living in 17 villages in a rural area of Sierra Leone, approximately 150 miles south east of Freetown, 30 miles north of the town of Bo. Villages were selected randomly amongst those with impregnated bed nets and those with no nets at all. Within these villages, children with ages ranging between 3 months to 6 years were chosen to receive maloprim or a double-blind distributed placebo fortnightly. In the villages randomized to receive nets, all beds had received nets. Malaria morbidity was estimated from weekly active case detection, and the impact on the *Anopheles* vector was estimated by indoor spray catching, exit trap catching, human night landing catches and light trap catches. During the first 8 weeks of the intervention there was a significant reduction in slide positive rates, reported fever rates and children with temperature >or = 37.5 degrees C in the villages with impregnated bed nets.

Picard et al (1993) found that In Gambia, insecticide impregnation of bed nets, used alone or combined with Maloprim, reduced morbidity and mortality from malaria amongst children between one and 4 years of age. Taking expenditure of both time and money by public Authorities and village volunteers into account, the costs and cost-effectiveness of each intervention were estimated. Bed net impregnation alone and the combined strategy cost US $5.65 and US $7.49 per child-year protected, respectively (1990 figures). Insecticide (and drugs) accounted for more than 80% of the costs of each intervention strategy. They were both highly cost-effective. Estimated costs per death and per clinical episode of malaria averted were US $188 and US $28 for bed net impregnation and $257 and $19 for impregnation combined with chemoprophylaxis. Estimated costs per healthy year of life saved, discounted at 3%, were US $7.90 and US $10.84.

2.3 Study of cost-effectiveness on decision rule

Birch and Gafni (1992) claimed in an article that the decision rules of cost-effectiveness/utility analysis (CEA) fail to achieve their stated objectives, namely the maximization of health gains for a given amount of resources. The critique includes the following objections to CEA: First, they argue that CEA does not guarantee improvements in social welfare in situations where multiple health objectives exist (e.g., survival and functional status). Second, they argue that CEA does not consider the health gains forgone by reallocating resources from existing programs to fund new programs. Third, they argue that CEA can lead to inefficient resource allocation when there are alternative levels of programs that compete for budgetary resources. Finally, they argue that the decision rules of CEA are incorrect in the presence of program indivisibilities, and that integer programming techniques are needed.

Johannesson and Weinstein (1993) stated to the contrary if the decision rules of cost-effectiveness analysis are used in an appropriate way, they do lead to their stated goal, i.e., the maximization of health effects for a given amount of resources. A more workable approach to obtaining a useful decision rule for cost-effectiveness analysis is to determine a price per unit of health effects. Once this price is determined, the decision rule for cost-effectiveness analysis reduces to that of comparing the correct cost-effectiveness ratio for a program with this standard. Cost-effectiveness is not without problems. Results are often interpreted incorrectly, e.g., by failing to calculate incremental ratios for mutually exclusive programs, and results are often compared with dominant alternatives. There are also several conceptual problems such as the definition of cost. The decision rules of cost-effectiveness analysis, however, are consistent with the objectives of maximizing a specified effective for a given amount of resources.

More recently, Stinnett and Paltiel (1996), made use of established optimization techniques to demonstrate that a general mathematical programming framework can accommodate much more complex information regarding returns to scale, partial and complete indivisibility and program interdependence. Methods are also presented for incorporating ethical constraints into the resource allocation process, including explicit identification of the cost of equity.

2.4 Analysis of allocative efficiency and equity

All papers mentioned above only deal with mutually exclusive programs, but actually in infectious diseases control, integrated measures have usually been implemented.

Mills (1993) assessed the value of malaria control through a cost-effectiveness study of the vertically-organized malaria control program in Nepal. It presents a methodological framework for analyzing cost-effectiveness which includes resource-saving consequences as well as health consequences The methods used to collect data on control costs, cases and deaths prevented, treatment costs averted and production gains are described and the assumptions required by the analysis are made explicit. A variety of cost-effectiveness ratios are calculated, sensitivity analysis applied and the policy implications of the results considered. The results from Nepal are compared to estimates for parasitic disease and other health programs in other countries: it is concluded that the Nepalese program appears no less cost-effective than many other health interventions. It can also be justified by reference to the population groups benefiting from malaria control.

Bitran-Dicwsky and Dunlop (1993), build an exponential and multiplicative function in order to ensure that scarce resources are used to best effect and to develop a financing strategy package which will help to cover all or some of the cost involved in operating such institutions, to know how hospital costs are influenced by output levels and other variables, and they evolved an expressions for marginal cost of in- and out-patient services from the function and estimated marginal expenditure on an inpatient day and a laboratory test.

Pornchaiwiseskul (1993) conducted an economic analysis of communicable disease malaria control. He developed a model to estimate the morbidity rates of communicable disease.

$$\log C_T - \log C_{T-1} = \eta_T - \rho_T \qquad (2.4.1)$$

C_T: the morbidity rate at year T

η_T: the transmission rate

ρ_T: the patients recovery rate

The model describes a steady state of communicable disease. Three basic components in determining the disease-specific morbidity and mortality rates are i)the transmission rate ii) the patient recovery rate and iii)the patients death rate. All three rate components can be more or less controlled or influenced by the disease control measures. Based on equation 3.4.1 another model was built :

$$\begin{aligned}\Delta \log MORBi_{KT} = {} & \alpha_{i0} + \alpha_{i1} * MORB1_{K,T-1} + \alpha_{i2} * MORB2_{K,T-1} \\ & + \alpha_{i3} * MORB3_{K,T-1} + \alpha_{i4} * \log Q_{k,t-1} + \alpha_{i5} * RVAG_{kt} \\ & + \alpha_{i6} * HC_{KT} + \alpha_{i7} * FORDEN_{KT} + \alpha_{i8} * DDT_{KT} \\ & + \alpha_{i9} * ABER_{KT} + \alpha_{i10} * ABER_{K,T-1} \qquad (2.4.2)\end{aligned}$$

$\alpha_{i8}, \alpha_{i9}, \alpha_{i8}$ <or = 0

$\alpha_{i8} = \alpha_{i9} = \alpha_{i10} = 0$, i =2, 3

I=1, 2, 3 1= malaria; 2= acute diahrrea; 3= tbuclosis.

K = subscript index for cross section

T = subscript index for year

MORB = morbidity of i diseases

DDT = amount of DDT use per population per year as a proxy for malaria preventive measures.

ABER = annual blood examination rate

Rvag = ratio of the agricultural sector output to total economic output as a proxy for rural population proportion.

HC = number of health centers per population

FORDEN = forest density or proportion of forest land.

Q = per capita output measured in real terms.

The model presents the morbidity rates and annual blood examination rate which will have a lagged effect on the morbidity rate in the future.

He explained the effects of disease on health risk economic output, an algorithm for calculating marginal effects of different control measure was created. The optimal conditions of allocative efficiency and equity of malaria control distribution among health districts and between preventive and surveillance measure were analyzed. These optimal conditions can be used to evaluate over time, and to identify the areas which allocated resources inefficiently and inequitably. He evaluated the allocative efficiency between different activities and different time periods. At same time health resources allocative equity in different regions was analyzed. In order to achieve overall allocative efficiency, the malaria control agency has to allocate its resource in such a way that the national lifetime social welfare is maximized.