Health and Population
-Perspectives & Issues 4(l):3-24, 1981

SOME THEORETICAL MODELS IN THE STUDY OF HEALTH BEHAVIOUR: IMPLICATIONS FOR HEALTH SYSTEMS IN INDIA

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ABSTRACT

This paper attempts to highlight some of the presently accepted models of health behavior and their usage in explaining illness sickness and utilization behavior. The limitations of each of the model have also been described. Finally an attempt has been made to visualize the applicability of such models on Indian health system. A viable model already tested has been proposed to assess the social patterns of seeking medical care in rural setting in India.

One of the most fascinating areas of research in health and medical system of any society has been the analysis of behavioral adjustments and the coping mechanisms that the members of a given society evolve for managing their sickness episodes and for maintaining the normal levels of health. Such arrangements and adjustments have been found to be varying from being most simple and primitive to highly scientific, complicated and complex. Secondly, most of these arrangements have been found to be normatively determined by their total social system rather than at individual level.

The phenomena of health, illness and sickness, have attracted the attention of social scientists from the disciplines of sociology, psychology, social work, health education, anthropology, public administration and also to some extent economics. The approaches developed for understanding the health behavior by these scientists have been guided by the area of investigation and the discipline under which such investigations have been carried out. Psychology and social work have been able to demonstrate their capabilities of helping the patient as well as the clinician to understand the health behavior under certain given conditions. However, the discipline of Sociology and Anthropology of medicine or

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Sociology of health (being used interchangeably) has attracted substantive interest recently as the nature and levels of health, illness and sickness have been seen to be historically and to some extent culturally determined. It has now also been recognized that in every known society definition of health problems and the responses required for managing sickness are organized and determined at collective level. Thus, a set of behavior that is linked to either sickness or maintenance of health would naturally be complex and diffused in nature, as in most cases, such behavior is. Formulated, shaped and maintained through the norms of a given society. The interplay of various complex variables which account for health behavior at individual level has been attempted to be understood in various ways. It is being maintained that the explanation of health behavior can be treated as a product of series of variables broadly classified as (a) socio-demographic, (b) socio-economic, (c) socio-psyetiological, (d) socio-cultural, (e) ecological (geographic), and (f) organizational. The common feature in most of these variables being that they are all socially determined.

The attempts so far made towards the understanding of health behavior have broadly been based on variables from one or more than one set of them mentioned above. The nature of most of the variables subsumed under broad categorization mentioned above cannot be treated as mutually exclusive as in many cases they overlap. Secondly, neither do any one set of variables claim to have the potential of explaining the totality of health behavior. Further, it is necessary to mention that the current level of knowledge of health behavior has been able to demonstrate only the strong association between the set of variables just outlined and thus it is difficult to claim that such association of variables have been able to show any casual relationship for predicting the health behavior.

As an outcome of continued research efforts on these variables, some amount of refinement has come about in them and consequently on our understanding of health behavior; and it is now possible to provide a holistic view of health behavior with the help of certain self-contained models. These health models are able to provide the possible directions and even to some extent the placement of various variables which form the content of* these models. Needless to emphasize that none of these models independently or even

jointly have been able to explain and predict precisely the nature and type of health behavior in a given social situation. The understanding of health behavior through models has certain proven advantages. Firstly, the assessment of health behavior is not deterministic as it takes into account a number of intervening and independent variables. Secondly, it provides a systematic understanding of the possible directions into which such behavior is expected to move. Thirdly, it provides an overview of the possible causes and consequences of health behavior which can sharpen our focus of attention and consequently help in programme planning or project implementation.

In this paper an attempt has been made to describe some of the health and illness behavior models highlighting the important elements in each one of them with a view to assessing the significant contribution that each one of them has been able to make in the understanding of health and illness behavior and utilization pattern of health facilities. An attempt has also been made to delineate the limitation of each of the model in order to understand the frame of reference under which these can be suitably utilized. This paper is only a modest attempt in describing various models at one place and assessing their role in understanding the Indian health culture and health behavior particularly with reference to the existing underutilization of health facilities.

There could be a number of ways in which various attempts at the understanding of health behavior through model approach could be classified. For our purpose it is worthwhile to look at them either in reference to personal characteristics of an individual or attempting even to place the individual at the nexus of a balance of social forces and account his behavior in terms of forces that impinge upon his personality. For this reason such models can conveniently be termed as "individualistic models" or "personality oriented models", because they rely heavily on the psychological characteristics of the individuals. In variance to this, there are a set of models relying heavily on the societal mechanisms developed for managing the sickness and maintaining the health. Such models can broadly be termed as "collective or socially oriented models" of health behavior. The two sets of models just described are not mutually exclusive and the major difference in them lies only in their emphasis rather than the nature of behavior.

Personality Oriented Models

Health Belief Model: Rosen stock (1966) - On theoretical premises, the insightful contribution of socio-psychological traditions of Levin (1935) in his concept of 'motivation' can be treated as significant- towards the understanding of health' behaviourl8,10. The concept of motivation in the field of health was first introduced by Rosen stock (1966) in his "Health Belief Model" in which an attempt was made to synthesize a number of earlier reports and studies conducted at different places with varying designs and methodologies. Rosen stock in his model pointed out that individual health behavior to a given health problem is determined by the extent *to* which a person sees a problem as having both serious consequences and high probability of occurrence and to the extent to which he visualizes that some course of action open to him will be effective. Health behavior according to this model emerges out of conflict among motives and course of action. ' An interesting dimension of this model relates to the fact that health related motives may not always give rise to health related behavior or conversely health related behavior may not always be determined by health motives. In this model, health behavior is seen as being dependent on two primary variables *i.e.* (a) the value placed by a person upon a particular outcome and (b) the person's belief that a given action will result in that outcome. The assumption in this model is that by taking a particular action, susceptibility would be reduced, or if the disease occurred, severity would be reduced. This model presents that decisions to seek medical attention are an outcome of the interaction of two variables. Firstly, there is the sufferer's psychological state of readiness to take action, which is derived from a person's perception of his susceptibility to a condition and of the seriousness of the consequences of having contracted that condition. Secondly, there is the extent to which the individual thinks that any particular course of action is likely to be beneficial in reducing the threat of illness. These two variables require some cue for action to trigger them. These three elements -readiness to act, assessment of benefit and triggering cues -are engaged in a balance of force. The graphic presentation of this model could be given in the following way (Fig. 1).

A number of studies have already been conducted to validate this model on *preventive health* behavior. The

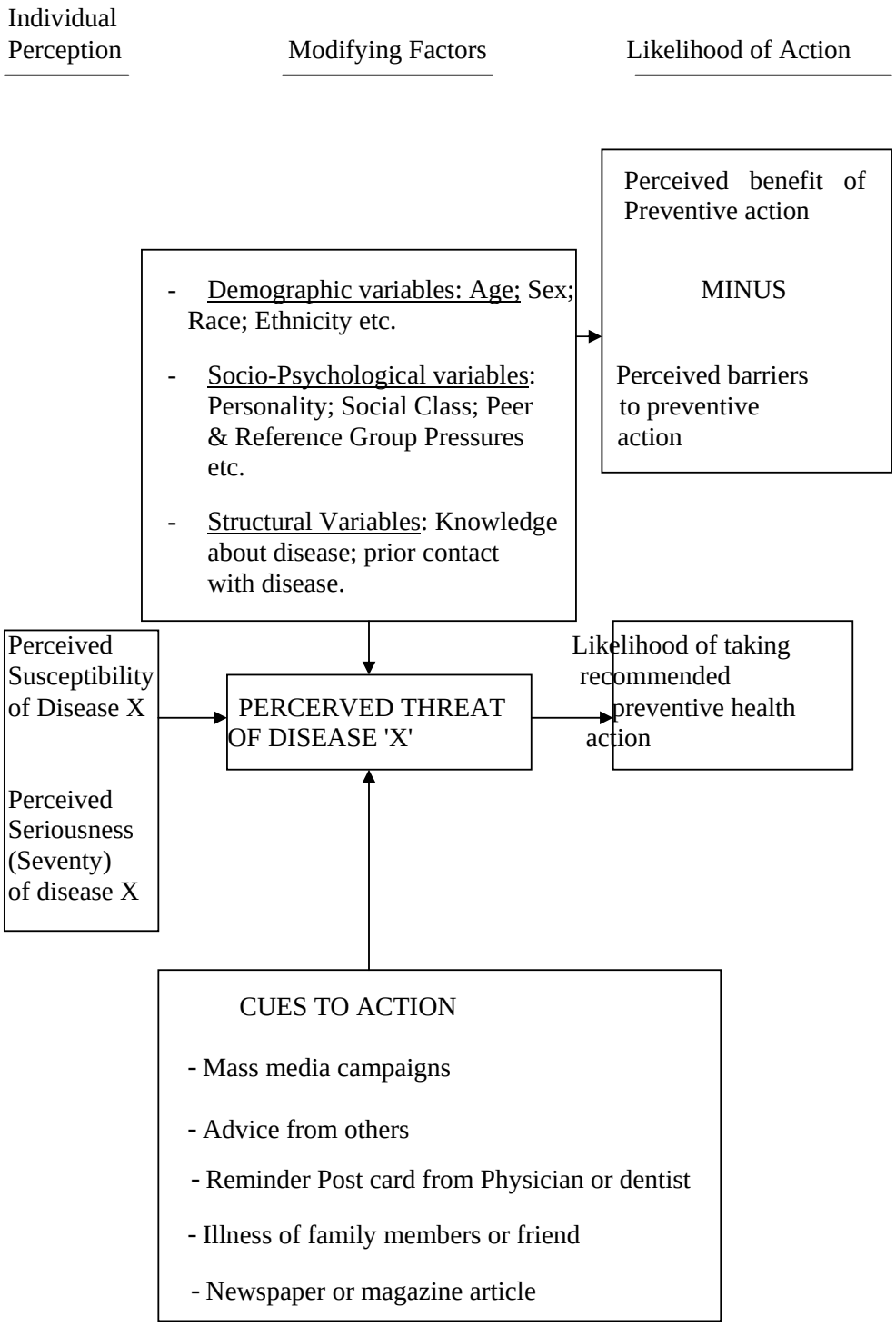

FIGURE 1

HEALTH BELIEF MODEL

Source: Dingwall Robert: *Aspects of Illness*, Martin Rovertson & Co. London, 1976

important studies conducted relate to taking of Penicillin Prophylaxis for health disease (Heinzelman 1962). Vaccination against Asian Influenza (Leventhal *et al.* 1960) and for seeking dental care (Kegeles, 1963, Gochman, 1971)5,9,6,4. In India, Rao (1978) attempted to assess the factors in adoption of health and family welfare practices7. She utilized this model in her study. Similar to this Louis Philip, from Institute of Public Health and Hygiene, Calcutta attempted to analyze health behavior towards adoption of DPT immunization. The importance of this model relates to the fact that its variables provide potential inter-venable (i.e. modifiable) links between the demographic, background and resource variables of other models and ultimate utilization of health and medical care services. Secondly, while the model was originally developed to account for preventive health action, it has been employed to explain illness and sick role behaviors as well.

The major limitation of this model is its inability to explain *curative health behavior* which in most cases may not always be voluntary in nature. Its usefulness has only been documented for explaining preventive health behavior. The second limitation of the model is linked to the structure of the model itself. It uses psychological variables - readiness to act - to explain why some action takes place, while the actors perception explains what action takes place. Attempts to treat these variables as independent are arbitrary and a great handicap in explaining the social distribution of psychological variables. Despite these two major limitations, Rosen stock model is considered as useful and scientifically validated model for the areas like health education, preventive measures of health behavior. However, the various elements of this model require extensive research in different settings and with different population groups, for purposes of drawing long-run recommendations and therapies.

Illness Behavior Model (Mechanic, 1962: Mechanic and Volkart, 1961) - The model developed by Mechanic is almost similar to the Rosen stock's in structure to explain illness behavior^, 13 $_4$ It explains the relative Influence of two important variables of 'social stress' and 'readiness to adopt' the sick-role or social psychological variables to explain such behavior. Mechanic adopts a simple form of psycho-metric testing in order to measure these two factors

and to determine their contribution to the observable conduct *i.e.* health behavior. He proposes that people under stress (characterized by anxiety, discomfort, emotional tension etc.) have a repertoire of coping responses. In other words, variations in use of medical care can be explained in, terms of variations in individual's propensity to experience stress and to adopt it by assuming the sick-role. The graphic representation "of his model can be given- as depicted in
Fig. 2.

In addition to perceived stress, Mechanic maintained that perceived symptomatology determines the inclinication to adopt sick-role. People with lower inclinication to adopt sick-role would likely seek treatment if they experienced unusual or severe symptoms only.

Mechanics model, however, suffers from one major limitation that it cannot account for social distribution of illness behavior. He also omits the relative influence of availability of medical services and its relationship with opting for adopting the sick-role. Thirdly, the problems associated with validating psychometric investigation are also true- in this model.

After six years, Mechanic in his textbook on 'Medical Sociology' attempted to abandon at model-building in favor of listing of ten heterogeneous variables that other studies have shown to be related to sickness behavior or health behavior. The combination of these variables reflect the recognition of sociological variables that may contribute to

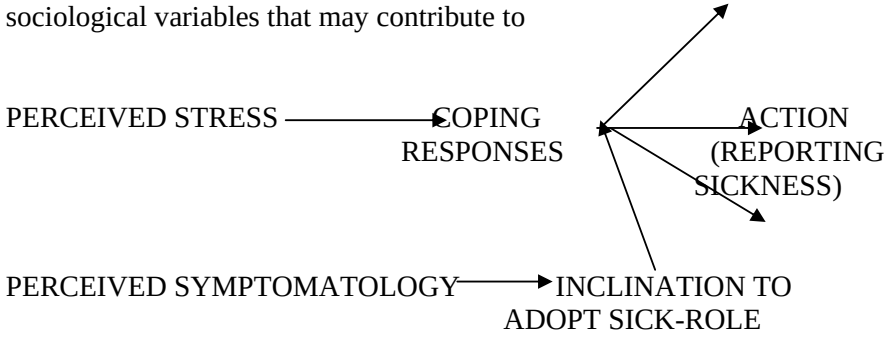

FIGURE 2

MECHANIC MODEL 1962

the explanation of health behavior in addition to psychological variables. The list of nine such variables is exemplified as follows:

i. perceptual salience of deviant signs and symptoms;

ii. the extent to which symptoms are perceived as serious;

iii. the extent to which symptoms disrupt family, work and social activities;

iv. the frequency of appearance and occupancy of deviant signs;

v. the tolerance threshold of others;

vi. the available information and cultural understanding of the sufferer;

vii. the needs competing for attention with response to illness;

viii. the cultural, social and economic availability of treatment resources; and

ix. the competing interpretations that can possibly be assigned to recognize symptoms.

The model was thus subsequently replaced by indicating ten variables which could summaries a large body of previous work and indicate general issues that are likely to be involved in any attempt to account for illness behavior. This inventory of variables given by Mechanic is meaningful for future research in the field of health behavior.

Medical Care Utilization Model (Anderson, .1968) - An equally interesting and widely accepted behavioral model has been developed by Anderson (1968) in which health behavior has conceptually been visualized as the use of medical carel. He visualizes three major components namely, *predisposing, enabling* and *need factors* as important determinants of health behavior or for the levels of utilization of health services. Among the predisposing factors, he includes demographic and social structural beliefs. It is these factors

that determine the propensity to use the health service. The *predisposing* beliefs are general values regarding health and illness, attitude towards health services and knowledge regarding disease etc. *Enabling* factors include factors and conditions that permit a particular action, *e.g.* socioeconomic status of the person. In other words, it includes the family and community resources, on individual level, the *need* component includes illness perceived, disability symptom and diagnosis also. Anderson proposed through this model that minimizing enabling factors and the determinants of need are not connected with morbidity (Fig* 3). The wide application of this model has been demonstrated on personal health services because the characteristics of predisposing and need factors which are so vital in explaining the health behavior are psychological in nature. Anderson's model includes two different measures of need component. The first is based on self reported illness and disability while the second is

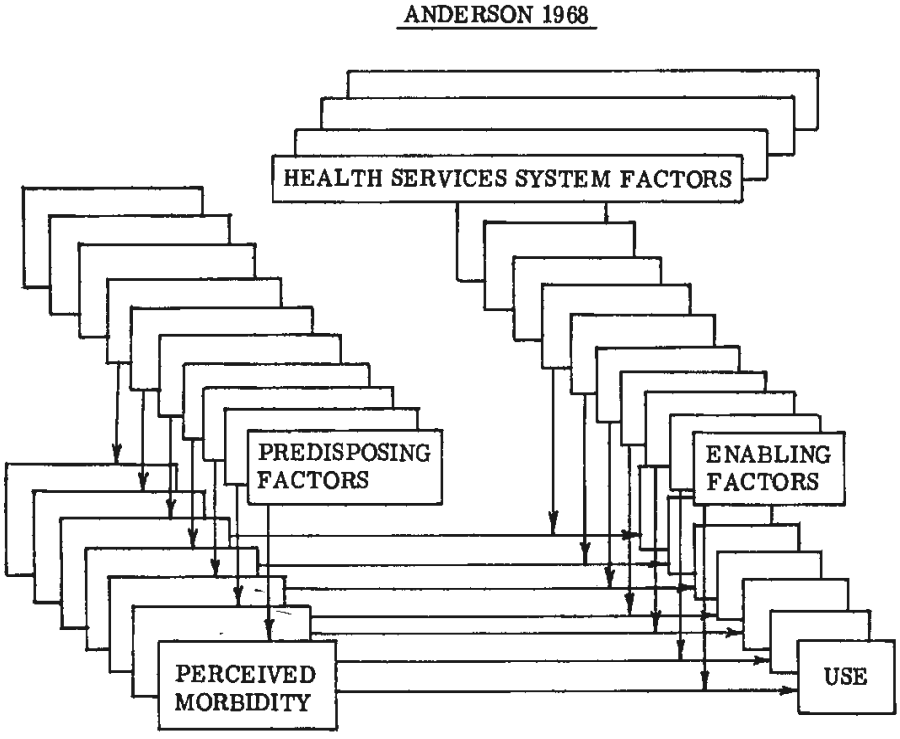

FIGURE 3

Model of Relationship System and individual level independent variables and use of health services as the dependent variables.

Source: Health Care - An international study Edt. by Robert Kolin & Kerrl White, Oxford University Press, N. York, 1976

based on whether a member of a family responded to a symptom by seeking a physician and had obtained a physical examination.

This model has a great potential in analyzing the over-and under-utilization of health care services.

Illness Behavior Model (Kosa *et al.*, 1966: Kosa and Robertson 1969)7,8 - Kosa (1966) developed a model based on industrial absentee records and self reporting of symptoms by means of family health diaries^. He divided illness episodes into four major part: (i) assessment of disturbance, or threat to psychological health; (ii) arousal of anxiety by such episode; (iii) application of personal general medical knowledge to the given disturbance; and (iv) performance of manipulative actions for removing anxiety disturbance (Fig. 4).

In this model, 'anxiety' explains *why* some action takes place, 'application of general medical knowledge' explains *what* action took place. Secondly, this model attempts to claim that variations in the social distribution of this knowledge can lead to instances of culture clash between clients and professionals and account for the low rates of take up of official services by some group of patients. The emphasis for explanation of health behavior is more in terms of effectual rather than the cognitive dimension of action.

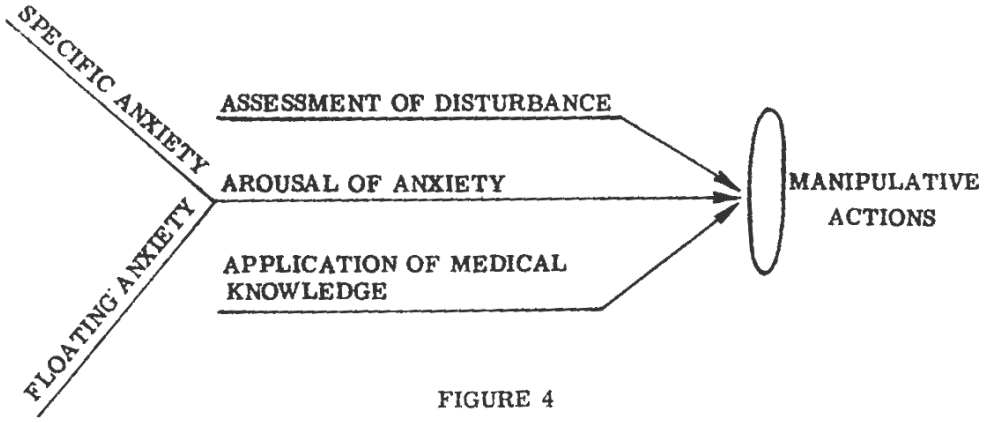

FIGURE 4

KOSA MODEL (1969)

It is difficult from this model to distinguish between the perception of disturbance in normal functioning from general medical knowledge. It is also equally difficult to draw distinction between application of medical knowledge and performance of manipulative action. This model would require to be tested with lay community level before certain generalizations about health behavior can be drawn.

The models of health and sickness behavior just described assess the role of the personality variables in determining health behavior. Such models suffer from one major limitation of not being able to explain Importance and relative influence of the sociological and socio-psychological variables in adoption of or seeking for relief from sickness or maintaining the normal levels of health. Another set of models which emphasize the group variables, are available which state that the personality variables are subsidiary to sociological variables. In this connection, an attempt has been made to highlight two to three important models. For our purpose they are designated as socially oriented model. .

Socially Oriented Models

Health Behavior Model: Zola (1965-66) - Zola (1965-66) attempted to investigate the illness behavior of different ethnic groups in Boston area^2»23$_t$ According to him, the decision to take action or to seek help on any particular occasion may not be related in any systematic fashion to the severity of symptoms. This proposition appears to be in contradiction to the model proposed by the Rosen stock and Kosa. Zola observed that the decision to act is based on five triggers which can be identified as:

1. Perceived interference with personal or social relations.
2. Occurrence of inter-personal crisis.
3. The sanctioning of sufferer's condition by others.
4. Perceived interference with vocational or physical activity and finally.
5. A sudden change in the normal symptomatology.

He further observed that the effective trigger to act is related to ethnicity, educational level or even the culture. An interesting hypothesis that he generated on this model states that the cultural influences on the perception, presentation and management of sickness account for variations in presentation of disorders to official medical agencies. This model while on the one hand, is able to highlight the importance of the social functioning as an important determinant for taking action at the time of sickness, on the other hand it is not immediately clear as to how the first four triggers can be taken independent of each other. The second major limitation of this model is that it is based on the people who have presented themselves at the institution where health services are developed and cannot thus be checked against the behavior of non-presenters. Thirdly, no attempt has been made in this model to suggest the links between the behavior and the cultural milieu. In spite of these limitations this model is probably the first of its kind to have identified the influence of culture not only on the perception and maintenance activities of health, but also in the management of sickness.

Seeking Care Model: (Suchman, 1964-65) - Edward Suchman (1964-65), Rosenblatt and Suchman (1965) attempted to account for observable variations in the take up rate of the official medical services in terms of the organization of an individual social relationship and his orientation to medical care!4,19,20. He hypothesized that the cohesive community groups may be more independent of official medical care| systems. In a series of articles, the late Edward Suchman' established the relationship between the socio-demographic variables, socio-cultural variables, and medical orientation. In doing so, he was able to demonstrate that people who participate in social cultural network characterized by 'cosmopolitan[1] are scientific in their orientation towards medical matters than those who participate in 'parochial' socio-cultural setting. Following the lead provided by Merton (1957), and others, Suchman associates that 'parochial' social groups are characterized as traditional, shared, affectional, and closed and the 'cosmopolitan groups' would be more progressive, individualistic, instruc-tional and openly. The fundamental postulate with which Suchman argues state that behavior is constrained by expectations and directions of social groups which bears significance for the individual. Medically relevant behavior

rather than being an exception is for many important reasons of type of behavior on which the constraining model of society rests heavily. Illness is a frequently recurring phenomenon which generates fundamental concerns and anxiety and which intimately involves many other people besides the sick individual. As a consequence, significant group norms and mores have been evolved which strongly influence individual attitude behavior in health areas (Fig. 5).

Suchman's model of decision to seek medical help is embedded in the account of the process of pre-patient career identifying three important stages. First, symptom experience, second, assumption of sick-role, third, medical care contact. At each of these stages new problems confront the sick individual and information is fed into the model to generate revised decisions. However, the status of each of these stages and the links between them continue to remain elusive since these stages have to be formulated at the level of abstractions. They usually tend to be only sociological legislations of what reality ought to look like and may not be a true generalization.

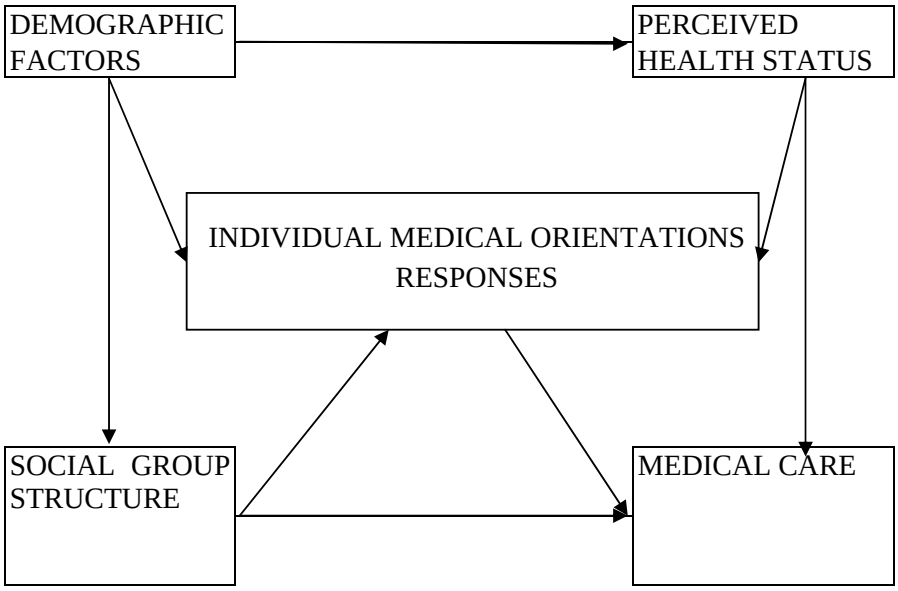

FIGURE 5

SUCHMAN REVISED MODEL – 1965

Mclemore 1970 developed another model involving several social, psychological factors that affect a person's choice once he decides that his symptoms warrant professional attention. The model views the 'decision' among the alternative health services have been affected by an information of the advocacy of the health services provided by the agency, his perception of other's attitudes towards these services and his ability to pay for the services. This model concludes that attitudes are crucial for understanding the variations in the choice amongst the alternative health services.

There have been a number of efforts to develop such models in the western world. In addition there are still a few studies that attempt to partially modify these models to understand the health behavior and even utilization behavior. In order to summaries the overall approach of understanding health and utilization behavior through model approach, an attempt has been made by Backer *et at*, (1977) to highlight the models thus far developed on individual health related behavior from psychological and sociological angles. The details of the summary are as follows:

SUMMARY OF SELECTED MODELS OF HEALTH RELATED BEHAVIOURS

Model	Predicted Variables	Predictors	Notes
(1)	(2)	(3)	(4)
Rosenstock and Becker	Health and sick role behaviors	Perceived susceptibility to and severity of health condition, Belief in benefit of recommended action, and views of possible barriers. Cues to action,	"Health Belief Model", Susceptibility + severity + threat, or "readiness to take action", Benefits + Barriers possibility of threat reduction.
Mechanic	Illness behaviour (including metal illness)	Symptoms salience, persistence, perceived severity of symptoms. Interference with activities. Tolerance for symptoms. Available information and assumptions regarding symptoms. Needs for avoidance, Competing needs. Availability of treatment. Costs of action.	Severity = estimate of present and future danger.

(1)	(2)	(3)	(4)
Kosa and Robertson	All health and illness	Disturbances or threat assessment as symptoms. Anxiety arousal (motive) Assessment of disturbance (these are structured by culture, situation, and interaction patterns).	Assessment of symptoms - threat assessment of disturbance includes classifying the episode, its potential effects and actions to deal with it. This is a process model with s tages, organized around the episode as a unit.
Suchman	Use of medical care systems for illness episode. Specific behaviors related to the stage of illness (symptoms, sick role, medical contact, patient role, recovery).	Social group structure-integration, cohesion, ethnocentrlsm (Parochial vs. cosmopolitan).Health orientation - popular vs. scientific medical beliefs.	Beliefs abo*ut threat and actions to take depend on groups structure and health orientation structure and orientation.t_are clearly related and tied to SES and ethnic group.
Kasl and Gobb	Likelihood of a specific behaviour in presence of symptoms.	Proximal-pain and discomfort of symptoms as mediated by threat, value of actions, and psychological distress, Distal-social characteristics personal tolerance for pain, disability, coping mechanics.	Threat components includes perceived importance of health, susceptibility to illness, severity of consequence, Value components include probability of action leading to desired results, cost of action vs. cost of inaction.
Anderson	Medical care utilisation	Individual determinants: Predisposing (prospensity to use services) includes demographics, social structural, beliefs. Enabling (conditions permitting action) include family and community resources. Illness level (perceived) include disability, symptoms diagnoses.	Predisposing beliefs are general (values re: health and illness attitudes to health services and knolwedge re: disease). Perceived illness level apparently involves beliefs. Actual use of service is a function of the three components, but the functions will vary by type of services.

(1)	(2)	(3)	(4)
Anderson and Barrkus	Choice of alternative health services	Appraisal of adequacy of care. Others' appraisal. Perception of symptoms and orientation to action. Need ability to pay. Availability os service. Social demographic factors (mediated through symptoms need, etc.).	Symptom perception includes threat, Adequacy relates to value of action. Meaning of "need" is unclear.

Mckinlay (1972) In his review of the studies on utilization behavior laments the general lack of consistency, coherence and coordination in empirical works and sound theoretical basis for researches in the area of health behaviour[12].

Implications for Indian Health Delivery System

In India although there has been an increase in the number of studies on health and its related aspects, most of these studies lack in respect of the application of any model which would help provide a holistic view of Indian health behavior. Some interesting evidences in the concepts like 'Health culture' developed by Banerjee are emerging to be as peculiarly different as what Is usually known about it elsewhere[2]. The other set of studies on health system in India have investigated in detail the role of the organization of operational research techniques on health services management and the utilization behavior. Such studies are mostly urban based and hospital oriented. There are only a few studies attempting to analyze health behavior through some experimental designs. For example Rao (1980) attempted to apply the Rosen stock model on health belief to identify factors associated with the adoption of practices prescribed in a hospital setting by hospital patients and their relatives This experimental study was designed to carry out appropriate educational measures amenable to manipulations which were analyzed and evaluated for the effects of a planned health education intervention on adoption of DPT immunization and family planning as Illustrative areas. The study found that both knowledge and attitudinal variables are significant in perception and beliefs and they might provide favorable results. Most of other studies on health behavior in rural 'areas are exploratory in nature attempting to

identify the probable variables which may either determine health behavior or utilization of services. Such studies are largely anthropological in nature which have utilized the ethnographic descriptions for either the systems of medicine being practiced or the folk practitioners or the nature of the manner in which the different types of episodes are managed among the people themselves. One important observation of such studies shows that there is a need to understand health behavior in relation to particular cultural milieu and thus develop a critical analysis of factors which determine or hinder the optimal utilization of existing health and family welfare services.

Health behavior has a strong association with the norms and value system of a given society. In this context studies conducted on models of health behavior in other countries have necessarily to be modified and suitably adapted before being applied in the Indian setting. Some important variables that may have potential in explaining the variation in seeking health facilities such as caste, social structure, have to be considered in greater details and depth in India. The differential pattern of health behavior on the basis of age, sex, placement of Individual in family and community nexus has not been investigated In greater details. It is not surprising to find that women in our rural setup tend to seek medical facility as a last resort rather than at the first instance. Similarly, the role of joint family, particularly the influence of social network which has been gaining ground as an important variable to influence the health and sickness behavior, has only partially been investigated. In this way the health and utilization behavior in India has to be seen in relation to a modified version of the models presented earlier. A recent study in this direction has been conducted by Trakroo (1981)21. This study investigated the social patterns of seeking medical care in rural setting of Haryana. This study essentially attempted and visualized health and sickness behavior to be influenced by independent and intervening variables. The model design of this study can be seen as follows (Fig. 6).

In this study the author has attempted to assess the pattern by adopting a 'Profile pattern approach', basically because there has been a conspicuous absence of any model or a profile which could delineate even unordered elements or variables. Through this study a beginning has been made in

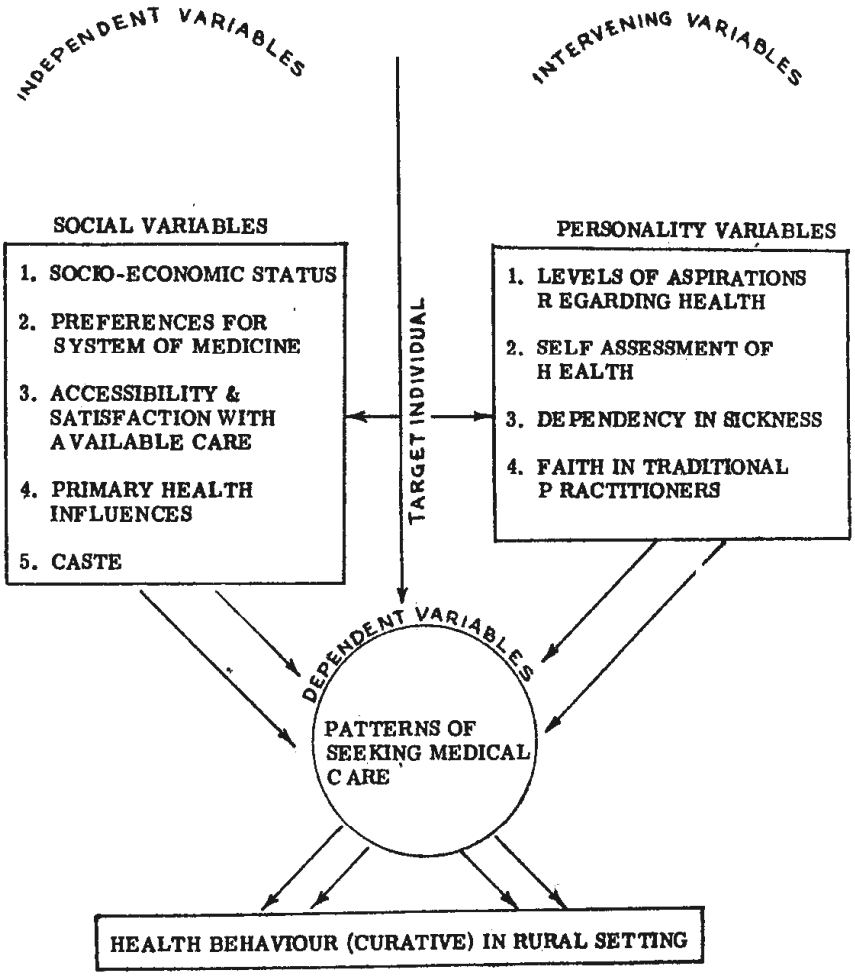

FIGURE 6.

Source: Trakroo, P.L. "Social Patterns of Seeking Medical Care", 1981.

this direction to adopt a few models in this country of which the present study is modest approach. Although it was not possible to give sequencing or ordering of variables in this study, nevertheless from the view point of medical sociologists the findings of this study would become relatively of little use unless some ordering may be identified. Based upon these considerations, it was concluded in this study that socio-economic status is the main potent determining factor which even subsumes other Independent variables such as caste and even accessibility. It also seems to overlap some of the intervening variables such as dependency, skepticism about modern medical care and faith in folk practitioners. The findings revealed that those respondents having clearer perception of the health concept and concern for their wellbeing and, especially belonging to upper socioeconomic group, will more likely take an early and accurate decision to seek medical care and that too preferably allopathic system of medicine. This in brief is the type of pattern that emerged out of the interactions between the numbers of variables selected in the conceptual model of the study. The model, therefore» appears to be promising for future health planning and viable after re-testing it and reducing fewer variables in it.

There is ample evidence to show that people in India tend to respond to a particular illness episode or manage and maintain their normal level of health in terms of the expectations developed over a period of time from a given socio-cultural setting. There have been different systems of medicine, different 'levels[1] of tolerance', different perceptions about the concept of health living. This plurality of responses towards management of sickness and maintenance of health calls for a scientific understanding of health behavior of people living in different cultural and social habitats. Gradually, it is being realized that the emphasis has to shift from 'cure' to 'care' which implies that change has to be introduced in 'behavior' rather than the organic system. It is also being increasingly felt that accessibility to health care is gradually decreasing with an increase in infrastructure facilities. The doctor patient relationship is giving way to doctor-patient encounters, for relationship demand some reciprocity and encounters, may not. The healing practices, anticipated role of sick person in a given social order are only some of the complex human behavioral elements of health behavior which are required

to be understood in some broad framework. It is true that theoretical models already developed elsewhere; would have to be modified not only in terms of the direction of variables but also In terms of their strength so as to be able to utilize them in different socio-cultural setting. It is this plurality in response pattern in health behavior which calls for application of models on health behavior.

REFERENCES

1. ANDERSON RONALD (1968) *A Behavioral Model of Families use of Health Services*, Chicago: Centre for Health Administration. Studies Research Series No. 25 Chicago

2. BANERJEE, D. (1976) *Formulating an Alternative Rural Health Care System for India.* Centre of Social Medicine and Community Health, Jawaharlal Nehru University, New Delhi.

3. BECKER, MARSHAL H. & LOIS A. MAIMAN (1975) Socio-behavioral determinants of compliance with health and medical care recommendations. *Medical Care* 13 (January): 10-24.

4. GOCHMAN, D. S. (1971) some correlates of children's health care beliefs and potential behavior. *Journal of Health & Social Behavior** 1971, 12 (June) : 148-154.

5. HEINZELMAN, F. (1962) Determinants of prophylaxis behavior with respect to rheumatic. *Journal of Health & Human Behavior.* 2[S] 73-81.

6. KEGELES, S.S. (1963) Why people seek dental care: A test of conceptual formulation. *Journal of Health & Social Behavior.* 4 (Fall): 166-173.

7. KOSA, JOHN *et at.* (1966) The place of Morbid Episodes in the social interaction pattern. Paper presented to *Sixth Congress of the International Sociological Association,* Evrain, France.

8. KOSA, JOHN & LEON, S. ROBERTSON (1969) The Social Aspects of Health and Illness in John Kosa Aaron Autonovsky & Irvine K. Zola (eds) *Poverty and Health* Cambridge Mars, Harvard University Press.

9. LEVENTHAL, H.I.M., ROSENSTOCK, G.M. & HOCHBANN, B.K. (Carrger) (1960) *Epidemic impact on the general population in two cities. The impact of Asian Influenza on Community Life.* Washington; U.S. Public Health Service Publication No. 766.

10. LEVIN, K. (1935) *A Dynamic Theory of Personality.* New York, McGraw-Hill.

11. LEWIS, ANBREY C195 3) Health as a Social Concept. *British Journal of Sociology,* _4 (June): 109-124.

12. MEKINLAY, JOHN B. (1972) Some approaches and problems in the study of the use of services - An overview. *Journal of Health and Social Behavior.* 13 (June): 115-152.

13. MECHANIC, D. & VOLKAR, E.H. (1961) Stress illness behavior and sick-role. *American Sociological Review.* 26: 51.

14. MECHANIC DAVID (1962) The concept of illness behavior. *Journal of Chronic Disease.* 15, 189-194.

15. MERTON, R.K., READER, G.G. & KENDALL, P.L. (1957) *The Student Physician - Introductory Studies in the Sociology of Medicine,* Cambridge University Press.

16. ROSENBLATT, DANIEL & SUCHMAN, EDWARD A. (1965) Blue Collar Attitudes and information toward Health and Illness in Arthur B. Shostak and William Gomberg (ed) *Blue-Collar World,* Engleword Cliff.

17. RAO, KAMALA GOPAL, SINGH, V.K. & SINHA, S.K. (1980) *Factors Associated with adoption of Health and Family Planning Practices among Hospital Patients.* National Institute of Health and Family Welfare, New Delhi.

18. ROSENSTOCK, I.M. (1966) Why people use health-services. *Milbank Memorial Fund Quarterly:* 44 (July): 94-124.

19. SUCHMAN, E.A. (1964) Soclo-medlcal variation among ethnic groups. *American Journal of Sociology, 70,* 319-331.

20. SUCHMAN, E.A. (1965) Stages of Illness and Medical Care. *Journal of Health and Social Behavior,* 6(Fall), 114-128.

21. TRAKROO, P.L. (1981) *Social Pattern of Seeking Medical. Care - A Study of Curative Behavior in Rural Areas.* Ph. D. Thesis (Unpublished), Punjab University, Chandigarh.

22. ZOLA, I.K. (1965J A social scientist perspective on the problem of immotivated .clients. Education for Social Work with mmohrated clients. Branders University, Papers in Social Welfare No. 9.

23. ZOLA, I.K. (1966) Culture and Symptoms: An analysis of patients presenting complaints. *American Sociological Review.* 13 (October 615-630,

Health and Population
- Perspectives S Issues 4(1); 25- 41, 1981

FINANCIAL PLANNING AND MANAGEMENT OF HEALTH PROGRAMMES IN INDIA

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ABSTRACT

In this paper the author deals with the financial planning and control of health programmes in India. The techniques of cost-effectiveness analysis and of performance budgeting are highly useful aids to management for implementation of programme with efficiency and economy. Periodical monitoring and review of performance of the programmes are also essential for gauging the progress.*

Planning involves appraisal of current conditions and identification of problems and needs of the nation in the context of accepted societal values. At the macro level, the process of planning is conducted to decide on the broad strategy of growth. Within the framework thus outlined, inter-sect oral priorities are settled and investment decisions taken for planned development of each sector. The Planning Commission in India plays a significant role in this process of planning under guidance from the National Development Council.

Five-year Plans formulated by the Planning Commission specify allocation of resources among sectors. These investment decisions made for achieving a desired socio-economic development of the country need to be concretized into specific programmes for the growth of different sectors, like public health, social welfare, education, agriculture, industry, transport, etc. and are spelled out accordingly in the Plan document. The amount of resources allotted to a particular sector being limited. it raises the question of optimizing the allocation o f resources among pro grammes identified as serving the specified objective.

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Planning for the selection of best programmes is as important as their efficient and economical implementation. The best programme may be defined as the one which yields the highest amount of benefit at a given cost or the one which gives a pre-determined benefit at the least cost. The techniques of cost-benefit analysis and cost-effectiveness analysis become relevant as tools of policy analysis to help decision-makers in selecting best programmes.

Coat-Benefit Analysis

The technique of cost-benefit analysis, by relating benefits of a programme to its costs, helps the policy-maker in deciding whether the specific investment should be undertaken. It is also used to find out the best programme among the various alternatives available, and to appraise these programmes for establishing relative priorities and tradeoffs between them. This is done by determining the ratio of benefits to costs in respect of each programme, and by ranking the programmes in order of their social value, i.e. benefit-cost ratio.

For instance, if the objective is to secure reduction of infant mortality to a specified level in a particular area, the various alternative programmes for achieving the objective may be identified as: (i) pre-natal care programme, (ii) better nutrition, (iii) lower birth rate through family planning programme, (iv) or a programme which may be a combination of these three programmes. The benefits and costs associated with each programme can be related to find out the benefit-cost ratio in respect of each alternative. Benefits include the direct and indirect gains from the health programme, and costs comprise both direct and indirect costs. Of course, it would require a good amount of effort encountering serious problems to identify, enumerate and evaluate the various categories of benefits and costs associated with each programme to be analyzed.

The ultimate purpose of most health programmes is to save lives and reduce illness. At times, there may arise decision-making problems, like allocation of resources for disease control among generations, such as children, working age, and the aged, which require careful examination on the part of the policy-maker. In the past, in a foreign country, the analysis of health programmes in some selected cases has

been focused on the problem of valuing the benefits per life saved or per illness avoided as against the costs incurred. The benefits have been measured by estimating the subsequent contributions to their respective professions of individuals benefitting from the health programmes.

The purely economic benefits from deaths averted and illnesses avoided or reduced may be counted as gains in production achieved from the activities of those helped by the health programmes. It implies that the benefit calculations should take into account age, sex, and other features of those being helped by measures for saving lives or improving health.

It may, however, be difficult to disentangle the effects of health programmes from effects of many other happenings in an Individual's life which might have contributed to the benefits obtained. Also, putting economic values on human lives saved or improved may raise issues of morality to seriously challenge such an approach. The economic value of a life saved would vary according to a variety of factors, including age. It rises during childhood and falls after a certain age because of the twin influences of life earning patterns and discounting. Therefore, these calculations are worth undertaking only, if we believe that more resources should be devoted to saving a more "productive" life than a less "productive" life, *e.g.*, the average man in preference to the average woman of the same age, a young worker rather than a baby. Such an approach for valuing the benefits of a health programme may outrage the feelings of many people because of the absence in benefit calculations of any estimates of the human value of the different people and of the sorrow caused by their death to their families.

Cost-Effectiveness Analysis

It is, therefore, often difficult to formulate a satisfactory monetary measure of benefits arising from health programmes. Also, the benefit-cost ratio would not be possible to be worked out in respect of a health programme whose benefits cannot be properly translated into money terms. Accordingly, a conceptually logical technique of cost-benefit analysis becomes difficult to be applied to health programmes. Therefore, to overcome the problems

involved in the evaluation of benefits, the appraisal of health programmes, in most cases, is conducted by the application of cost-effectiveness analysis.

For the application of cost-effectiveness analysis, it is necessary to determine programme objectives in quantitative terms. Thereafter, the relative merits of alternative programmes for accomplishing these specified objectives are explored. Considering the earlier example of reduction of infant mortality to a specified level, the various alternative programmes to achieve the quantified objective may be identified as before, pre-natal care programme, better nutrition, lower birth rate through family planning programme, or a programme which may be a combination of these three programmes. Cost-effectiveness analysis is conducted to find out the least-cost alternative way of attaining the objective. The programme which is to cost the least among the various alternatives available is considered as cost-effective and is, therefore, preferred over the others.

Management of Health Programmes

The programmes selected need to be incorporated in the concerned organization's budget for their implementation. It is the approved budget provision for a programme which acts as the necessary authority for the administrative and executing agencies to undertake its implementation.

The programmes included in the Five Year Plan or the Annual Plan provide the guidance to the administrative authorities for inclusion of such programmes in the budget. It is the budget of the organization which lends the necessary authority to its functionaries for the implementation of these programmes. Planning partakes more of the nature of a consultative process. Budgeting, on the other hand, is done, both in its formulation and execution, within certain constitutional, legal and administrative constraints.

The manner in which a budget is arranged reflects to a large extent the thinking of the budget administrators. The form of budgeting matters importantly in the kind of calculations that enter into and the outcomes expected from the budget. Its classification brings out the main purposes it is required to serve. Traditionally, the considerations of securing financial accountability and control of expenditure

have been given priority in the process of budget formulation and execution. The classification used in the conventional budget has been in terms of objects of expenditure, which is helpful in ensuring legality and regularity of expenditure and control over inputs. The following provides an illustration of such a classification, which is called object-wise classification:*

Salaries
Travel expenses
Wages
Rent, rates and taxes
Publications
Advertising
Hospitality and entertainment
Machinery and equipment
Materials and supplies
Maintenance
Other charges
Motor vehicles
Office expenses
Depreciation
Scholarships and stipends
Publicity

Total:

Whereas object-wise classification lays emphasis on the inputs on which money is proposed to be spent thereby indicating the nature of expenditure, it does not convey anything about, the purpose of the budgeted expenditure. Therefore, the traditional budget format is considered as unsuitable for an active role of the Executive In the Implementation of governmental programmes.

A need has, therefore, been urgently felt to adopt a system of budgeting which may ensure an effective use of funds made available to the Executive for the implementation of developmental programmes. Budgeting In the changed situation, has come to be considered as a tool of management for the implementation of governmental programmes. It has been regarded as a process for systematically relating the spending of funds to the accomplishment of planned objectives.

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*The example has been taken from the Performance Budget for 1981-82 of Ministry of Health and Family Welfare, Government of India.

Performance Budgeting

The type of budget suitable for providing the necessary tool of management to the executing authorities for achieving efficiency and economy in the implementation of-programmes is called 'performance budget'. According to the concept of performance budgeting, the annual budget is, in essence, a work plan specifying the programme targets to be achieved by the agency concerned during the financial year. It emphasizes the purposes for which provision of funds is made. A meaningful programme and activity classification needs to be incorporated in the performance budget so as to facilitate achievement of the objectives of the organization. Programme and activity classification explains the objectives of the organization in terms of specific programmes and activities. An example of such a classification is provided by the following: *

Programme/Activity Classification:

Direction and administration
Prevention and control of diseases
Prevention of food adulteration
Drug control
Training
Health statistics and research
Health education and publicity
Public health laboratories
International cooperation
Other expenditure

Total:

Performance budget, being a tool of management, lays emphasis on accomplishments rather than means of accomplishments. It seeks to bring out, what the government proposes to do, how much of it, at what cost, and with what results. Instead of highlighting objects of expenditure, in performance budget, emphasis is laid on the purposes of government expenditure. It is sought to establish a meaningful relationship between inputs and outputs by a display of transactions, in a systematic manner, in terms of programmes and activities. Physical and financial aspects of each programme and activity are correlated by establishing relationship between outputs and the related Inputs. Performance

*The example has been taken from the Performance Budget for 1981-82 of Ministry of Health and Family Welfare, Government of India.

budgeting facilitates programme management and the measurement of physical achievements of activities as related to the costs incurred on them.

Norms and Standards

The concept of performance budgeting requires that output of a programme and activity in terms of physical targets should be related to the inputs required which are translated into financial terms and shown as the budget provision .asked for the implementation of the programme and activity. In a scheme of performance budgeting, therefore, it is essential to set physical targets for accomplishment in respect of each programme and activity to enable working out of corresponding financial estimates for incorporation in the budget.

The working of the system of performance budgeting depends importantly on the techniques evolved for the measurement of output in relation to inputs. The system envisages selection and development of suitable work measurement units, norms, yardsticks, standards, and other performance indicators for measuring physical quantum of the work proposed to be done or services to be rendered. These measurement norms are essential in deciding as to what is the proper relationship between the resources to be utilized and the results proposed to be achieved. These are also necessary to provide detailed justifications for the budget provisions asked for, and to furnish a scientific basis for the quantum of work proposed to be undertaken for the completion of an activity. Appropriate norms and standards supported by adequate data reduce subjective element and increase objectivity in the framing and examination of budget estimates.

The crux of a scheme of performance budgeting is to ensure that activities are performed with maximum efficiency and economy. A proper assessment of the efficiency of operations in the execution of activities is, therefore, important. Efficiency of an operation may be measured in different ways. It may be compared with certain pre-deter-mined norms and standards. Alternatively, the results of an activity may be compared with those previously obtained from similar operations of the same organization. In such a case, however, care has to be taken to ensure that inefficiency was not built into the earlier operations. Another approach to determine efficiency of operation of an organization could be

by comparing it with similar operations of other like organizations.

Pre-determined norms and standards can provide a good yardstick for evaluating performance. Different types of norms and standards have been suggested to be used depending on the nature of activity, and their suitability to a particular situation. A simple approach to the problem is to develop workload factors. For example, in the case of a programme like Mass Education, Information and Extension Services, meant to promote Family Welfare Planning, the workload units could, in numerical terms, be: (I) cinemas, dramas; (ii) conferences; (iii) group meetings; (iv) publication of literature; (v) press advertisements; (vi) radio programmes; (vii) exhibitions, etc. Taking another example of medical services, the workload units could be: (1) number of beds maintained; (2) number of patients admitted; (3) number of patients discharged; (4) outpatient department attendance; (5) number of emergency admissions; (6) number of laboratory tests; (7) number of X-Rays; (8) number of operations: major, minor.

There are also other norms available which provide indices of efficiency by relating inputs to the corresponding output at different levels. Productivity ratio provides an Index of input-output relationship established at the programme level. Performance ratios refer to input-output relationships established at lower levels where physical output reflects the accomplishment of work or tasks. Also, performance ratio is expressed in terms of unit cost by relating an unit of physical output of an activity to the costs of all the resources used in its production. Another norm used is work measurement ratio which is arrived at by relating the volume of work to the staff time utilized in terms of man-hours, man-days, etc. In certain cases, related staffing patterns are specified as they are dictated by technical and other considerations. As for instance, the norm for the number of nurses and other staff necessary to assist a doctor in a particular job is pre-determined. In such a case, the workload units would need to be decided for the doctor only and the related staffing pattern has to be accepted as already prescribed.

It is important to recognize that the applicability of work norms has to be related to quantifiable physical output.

Also, the end products comprising the output must be of a homogeneous character to admit application of the same measurement norm. However, in the case of many of the activities, the end product may not be homogeneous. The .work involved for a doctor may differ as a "patient is attended in the surgical, maternity, eye-nose-throat or pediatric departments. Therefore, for the application of work norms, it is necessary to group homogeneous units of output into one category and to determine as many categories and the related * performance standards as there are different types of end products or output.

It is important that the measures of (work devised are realistic and acceptable to the various participants of the activities. They must be acceptable to the operating officials whose work is to be evaluated in terms of these norms: They must also be acceptable to the higher management levels who would be evaluating the performance of executing authorities by using these norms. Also, such norms or measures of work should be acceptable to the authority responsible for scrutinizing and approving budget estimates framed on the basis of these norms. A complete understanding of the nature of work is necessary before standards of performance are set. These standards need to be related to the local conditions and not transplanted from other different social and economic systems.

The emphasis in a scheme of performance budgeting on relating inputs to outputs makes prominent the problem of identifying the relevant output to be measured as indicator of performance. The development of performance indicators is as important as it Is difficult. It does not pose much of a difficulty in the case of activities whose output can be measured in quantifiable physical units. But, activities like research, direction and policy-making present serious problems in evolving standards for performance measurement. In the case of some other activities, particularly in the area of Public Health, surrogate measures are used and output is measured in terms of social indicators instead of economic indicators. For instance, expenditure on a programme for malaria eradication may be related to output in terms of reduction in the incidence of disease in the particular area in which the programme is implemented.

Delegation of Financial Powers

Performance budgeting is a technique which requires for its successful operation a style of management based on decentralized responsibility structure. Performance budgeting can achieve results only when the various levels of management in the organization perform and accomplish their tasks. Their involvement in a meaningful way in the formulation of the performance budget is calculated to inspire them in its efficient implementation.

The assignment of responsibilities in a scheme of performance budgeting to different levels of management ensures better accountability of these levels against their budgeted plans, tasks and targets. The accountability for assignments would, of course, require provision of facilities necessary for the discharge of the functions by the various responsibility levels. One such important facility is delegation of financial powers.

A decentralized responsibility structure under the scheme of performance budgeting necessitates delegation of financial powers down the line commensurate with responsibilities to be discharged at various levels. Adequate delegations are necessary for an efficient discharge of responsibilities at various levels of management.

A proper scheme of delegations yields many advantages. It enables the top management to devote its valuable scarce resource, *i.e.,* time, to the most important managerial responsibilities, such as planning, policy-making, coordination, review, and control. It reduces time-span of decision-making, and in the process also saves time of the functionaries. Another advantage of a proper scheme of delegations is that it reduces use of communication channels and provides an organization with the necessary flexibility to react to its changing circumstances. A sound scheme of delegations also brings about improvements in the operating procedures of administration resulting in enhancement of the administrative capacity available to the organization. Delegations also develop staff capabilities at different levels of the organization.

A system of delegations would yield optimum results, if delegation is preceded by a proper analysis of the objectives,

programmes and activities, methods of work, and workloads at various levels, in order to ascertain the nature and extent of delegations required. The technique of job analysis may also be of help in this matter. -The need for delegations would vary in the case of different organizations depending on their respective programme requirements and activities.

It may be necessary to establish internal control by having a system of inspection reports and returns woven Into the scheme of delegations. These reports and returns should indicate whenever things go awry, to enable the higher authorities to initiate timely and corrective action. It may, however, be borne in mind that when the delegation of powers is accompanied by too much detailed reporting or by too much preliminary checking of details, it might amount to thwarting the very objectives of delegations.

In the Government of India, delegations of financial powers have been increasingly made starting with the delegation scheme of August 1958, followed by the delegation schemes of June 1962 and October 1968. Two recent schemes enhancing the powers of administrative ministries and departments were introduced: one from April 1975 and another from January 1978. These delegations made from time to time show the willingness of the Ministry of Finance for delegating more and more powers to the administrative authorities and executing agencies, whenever a convincing case existed for the purpose. In any case, the trend of delegations in the past indicates that it is no more difficult to bring the Ministry of Finance around to delegating enhanced powers to administrative ministries, if a suitable case for the same could be established. The. Issue which has assumed importance for debate now is that why the delegations after they are made are not exercised by the delegates in many cases. Unless the delegations are used by those to whom they are given, the very purpose of a scheme of delegations is defeated. It, therefore, becomes important to identify the factors which inhibit the exercise of powers by the delegates.

Whereas adequate delegations commensurate with responsibilities are essential, it is equally important that the necessary environment is created in which these delegations can be actually exercised. The various factors inhibiting the use of powers by the delegates should be removed.

Any measure of delegation has to be a positive one, meaning that authority is parted with by the delegator, but responsibility is shared by him. Though the fact of delegation does not relieve the delegator of his overall responsibility, he should make it a point not to interfere, as far as possible, within the delegated sphere. Trust should be the basis of delegations; even the best of delegation schemes could flounder in an atmosphere of distrust amongst those responsible for operating the scheme.

The structuring of delegations is also important. Sometimes it becomes necessary to prescribe conditions subject to which a delegation could be exercised.- If these conditions are too many or are too difficult to be satisfied,, it .would inhibit exercise of delegated powers. A balanced view, therefore, needs to be taken in prescribing such conditions, as between the considerations of providing the necessary operating facility and of ensuring proper financial control. Also, the attitudes of the various parties concerned, namely, the executing agency, the administrative department, the Ministry of Finance, and the audit authority, would matter a lot in interpreting and reviewing the exercise of delegated powers. In any case, unless full protection is provided to a delegate in the event of a genuine mistake committed in good faith, and his performance is judged on overall basis, it is difficult to expect him to show initiative and to take bold decisions by exercising delegated powers. The environment in which delegations are to be used, therefore, needs to be improved considerably to render it conducive to the types of management actions necessary under a system of performance, budgeting.

There exists a multiplicity of rules and regulations which continue to increase or change without the redundant ones being removed with the same speed as the new ones are added. In such a situation, it generally happens that the delegates do not feel sure of knowing all the relevant rules while exercising their powers. This acts as a damper to them in making use[1]of their delegations. In their eagerness to avoid mistakes, they are prompted to consult other authorities, both horizontally and vertically, to seek their concurrence. There is, therefore, an, important need for the simplification and rationalization of rules and regulations. These should also be made available to the delegates in their updated form through manuals.

Sometimes delegations are related to monetary limits fixed on the basis of the prices prevailing at the time of the introduction of the delegation scheme. This would be the case for such administrative actions as purchases, contingent expenditure, award of contracts, insurance, write-off losses, etc These delegations loose meaning when the price situation undergoes, a perceptible change. A revision of such delegations would, therefore, be called for as soon as there is a significant change in the price level.

Delegation schemes once introduced cannot remain static for all times. They should be modified to suit the changing circumstances and needs. Renewal of the schemes based on periodic review may, therefore, become .necessary. For this consultations with the delegates may help to rectify some of the specific weaknesses of the schemes, revealed through their experience.

Monitoring of Performance

Measurement of actual performance both in physical and financial terms in relation to the budgeted plan is an extremely important aspect in the use of a performance budget. This, however, needs to be done in a manner as would help decision-making and control at the various levels of management. In this context, designing meaningful information and reporting system assumes vital importance.

The type of information that needs to be generated for decision-making and control purposes depends on the needs of the management levels concerned. Each level of management in an organization has its own requirements of information for •discharging its functions to achieve the tasks assigned to it. For developing an effective reporting system, it is essential that information needs of the various levels of management are identified. It must become clear as to what information is required by which management level and at what time. Time dimension is also important. It is necessary to determine the periodicity or frequency with which information should be supplied to different levels of management.

A budgeted plan of action is required to be divided into convenient periods depending upon the nature of the organization and its functions. For each of these periods (bimonthly, quarterly, four-monthly, etc.) a budget plan for the

tasks or targets to be achieved should be available. The monitoring of expenditure and the related physical accomplishment needs to be done in terms of these periods and compared with the budgeted plan for the same period. The purpose is to enable the management to make 'on course corrections' in the event of deviations occurring between actual accomplishments and the plan of action. The information reports furnished to various management levels, apart from identifying deviations, should also contain analysis to detect the causes for the shortfall in performance and to isolate the key factors responsible for the same. These reports should also pin-point responsibility, indicating the controllable elements and suggesting remedial measures.

The rationale of such a reporting and review system is to influence and help the concerned responsibility levels to correct the shortfall in performance before it is too late. These reports on performance can be used on the principle of management by exception. Only when the actual achievement deviates from the budgeted targets, the report should be sent to the concerned responsibility level, for it to take the required corrective action. The responsibility level would, thus, become accountable for taking the necessary action as indicated in the report.

A proper evaluation of the performance of the various responsibility levels in an organization presupposes the existence of an adequate information system. This system is necessary to furnish information regarding what has actually been achieved and at what cost as against what was planned to be accomplished and at what cost.

Evaluation

A regular stream of information regarding financial and physical aspects of a programme or scheme should flow to each responsibility level for decision-making and control purposes. Such a flow of information to different levels is necessary for performance evaluation. The information needed for performance measurement has to flow from two channels. Physical accomplishments would be monitored through one type of reporting channel. Accounting information has to flow through another channel. When these two sets of information are put together in terms of various responsibility centers for the period under consideration, a picture of actual

performance in terms of physical accomplishment and the related cost would emerge. The actual performance as monitored from the information system can then be compared with the budgeted plan.

The accounting structure, in addition to recording information in terms of programmes, schemes, and activities, should also collect and supply information regarding progressive expenditures in respect of different responsibility and cost centers. A suitable coding scheme may be of help in monitoring information regarding progressive expenditures in terms of programmes, activities, etc., as related to different responsibility and cost centers. An efficient accounting system is essential for monitoring and analysis of expenditure. The speed and accuracy with which accounts are prepared are the necessary ingredients for the accounts information to prove useful to management for various purposes.

Evaluation of health programmes can be conducted both by an internal agency as also by an external agency. The evaluation exercise carried out by an internal agency will be done within the organizational framework of the department whose programmes are to be evaluated. Evaluation conducted by the external agency can further be of two types. One type can be the evaluation by agencies like Programme Evaluation Organization of the Government of India. The other type of evaluation of programmes can be conducted by a statutory authority of the Comptroller and Auditor General (C&AG) through the Indian Audit and Accounts Department. Whereas the former external evaluation agency is independent of the department whose programmes it evaluates, the latter evaluating authority of the Comptroller and Auditor General is in addition also independent of the Government. The Indian Audit and Accounts Department under the C&AG conducts efficiency-cum-performance reviews of selected programmes and schemes.

The various purposes of audit conducted by the C&AG are: (1) to ensure correctness and completeness of accounts, (2) examination of accounts to ensure regularity of expenditure, (3) looking into the propriety of financial transactions, and (4) ensuring that the resources expended by the executive have produced the desired results. Among its various purposes, the C&AG's audit has been extending its

scope, in recent years, to cover efficiency-cum-performance evaluation of programme and schemes. It is more concerned with the achievements as related to the expenditure incurred on specific programmes, schemes, activities, etc. It has been seeking to know whether the results achieved have been commensurate with the expenditure of resources.

Regularity audit and propriety audit, generally, involve audit of individual transactions. They do not, by and large, focus on the evaluation of the scheme or the programme to which these transactions relate. Therefore, both the approaches to audit, i.e. audit against*- regularity and propriety audit, have been considered Inadequate for an assessment of the performance of a programme or a scheme. The need for performance audit to' assess whether the programmes or schemes are being implemented so as to result in the achievement of their objectives "is, therefore, apparent.

However, the effectiveness of performance audit or evaluation, whether conducted by the internal agency or an external body, is dependent upon the soundness with which the objectives of the organization are formulated for achievement. The performance appraisal of a scheme or an activity can only be done in the light of the objectives which it is directed to achieve. Before it can be ascertained how well a job has been performed, it is necessary to know as to what should have been done or what were the objectives of the job.

Objectives spell out the results desired from a programme or scheme. Unless the objectives are properly defined, it would be difficult to evaluate the various processes gone through by the organization in achieving them. If objectives are not well-defined and spelled out in clear and specific terms, it would be difficult to evolve a scientific and universally acceptable approach for evaluation of performance. Also, objectives which are not quantifiable would leave enough area for conflicting interpretations between the evaluating agency and the executing authorities. Performance evaluation of a programme or scheme should be conducted against the specific objectives framed for it, and in terms of the pre-determined norms, yardsticks, and standards. Effectiveness of performance evaluation would depend upon how best the yardsticks of performance have been evolved, whether in terms of doctor-patient ratio, or number

of patients treated, or hospital beds maintained, or hospital beds utilization rate, etc. The technique of performance evaluation can be used effectively in cases where agreed upon work measurement norms, yardsticks, standards, etc. are available for application.

In the absence of measureable objectives and realistic norms for performance appraisal, conducting evaluation of performance becomes a formidable task. Therefore, it is imperative to evolve indicators of performance spelled out in specific and well-defined terms as measures for assessing the accomplishment of programmes or schemes. In cases of health programmes where it is difficult to find economic indicators as measures of performance, relevant social indicators may be employed for the purpose. For instance, for relating expenditure to the resulting output of a programme like 'Eradication of Malaria[1], social indicator in terms of reduction of incidence of disease in the area of its operation may be a relevant measure of performance. In any case, there needs to be a quantified indicator of performance for relating expenditure on a health programme to its resulting accomplishment.

Conclusion

The selection of a right programme for making investment on is as important as its efficient and economical Implementation. In the area of health, the technique of cost-effectiveness analysis can prove of great help in selecting the best programme. Further, such a programme needs to be implemented with efficiency and economy, for which the technique of performance budgeting would be a highly useful aid to management. A periodical monitoring and review of performance of the programmes are essential for taking stock of their progress. This is also necessary for deciding on remedial measures to be taken, if the programme is not progressing according to the plan of action, in order to correct the situation.

Health and Population
- Perspectives & Issues 4(l):42-58, 1981

MATHEMATICAL MODELS AND THEIR APPLICATIONS IN MEDICINE AND HEALTH

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ABSTRACT

Mathematical models have great potentialities as regards their utility in different disciplines of medicine and health. This paper attempts to elucidate their uses in the field. A brief mention of some models has also been made. Mathematical models are useful in epidemiologic research planning and evaluation of preventive and control programmes clinical trials measurement of health coat-benefit analysis diagnosis of patients and in maximizing effectiveness of operations aimed at attaining specified goals within existing resources.

Of late, there has been increasing use of sophisticated mathematical and statistical methods In various disciplines of medicine and health. Advanced methods and new tools such as - operational research, system analysis, multifactorial approach, cost7benefit analysis and mathematical models etc. have been developed and utilized In planning and evaluation of health programmes, demographic studies, clinical trials and therapeutic as well as epidemiologic research.

The development of mathematical models and their application in different fields of medicine and health are relatively newer concepts. Though, their construction and application to the epidemiology and control of tropical diseases was initiated by Ross about 72 years ago and important contributions have been made since then, yet the literature in this connection is still scanty and the subject is in its early phase of development^. It has been pointed

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out that, in developing countries like India, very little use of mathematical models has been made in designing, administering and evaluating community health services2. In the present paper, an attempt has been made to elaborate the utility of these models in various disciplines of medicine and health.

Types of Models

Mathematical models may be defined as the expressions involving mathematical relationships - either equations or inequalities - representing variables and parameters that define a particular phenomenon. Of late, there has been growing literature on theoretical modeling and a variety of models have been constructed and used for varied purposes in different disciplines of medicine and health. The literature on the subject, however, is extensive and variable in content.

The classification of mathematical models on the basis of a sound scientific reasoning is not possible in view of their wide complexity. They may, however, be categorized into following groups considering their mode of construction, nature and uses in various fields. Here, it may be stressed that these groups are not mutually exclusive and overlap each other to a certain degree. Thus, a particular model may be put easily in more than one category. This classification has, therefore, been introduced solely for the sake of convenience in the description. An extensive description of all the models evolved hitherto is beyond the scope of this paper; only broad groups will be discussed with the help of relevant illustrative examples.

Descriptive Models

Models which simply summaries or describe a set of data in few numbers or in terms of simple mathematical relations are called descriptive models. Such models do not attempt to elucidate the mechanism of a system nor predict future course of the phenomenon. These models are useful in the diagnosis of community for health problems and other epidemiologic researches.

A descriptive model for studying the relationship between performance or output of the maternity care system

amongst local authorities in England and Wales and corresponding input of medical and ancillary resources has been suggested recently^. It considers 88 descriptive variables, representing characteristics and general environment of each local authority. The models, besides providing many important epidemiologic findings, indicate a close relationship between performance measure and descriptive variables. A similar model has been proposed for identifying environmental indicators, significant to community health^. After application to a study of child mortality, it has been recommended to be very useful in monitoring and health care planning.

Predictive Models

These models elucidate the mechanism of a phenomenon and predict future course of systems. Such models are, sometimes, also called *simulation models.* Prediction by these models is based on the assumption that the future dynamics of different forces will conform to the present happenings; they do not take into account other unknown forces entering the scene at the later dates. Simulations are made from mathematical equations, derived from the *Flow chart[1] - showing graphical representation of the mechanisms of phenomena or transmission dynamics of the diseases. Suitable epidemiological information is used to provide values to different independent variables to simulate desired results.

In fact, majority of the models evolved; aim to make predictions in one way or the other irrespective of the approaches in their construction. Models developed by Uemura *et al.*, Cvjetanovic *et al.*, Dietz and Grab *et at.* for cholera, typhoid fever, tetanus, infectious diseases and cerebrospinal meningitis respectively are a few examples of such models^»6,7,8,9.

Probabilistic and Stochastic Models

A random phenomenon is defined as an empirical phenomenon that obeys probabilistic rather than deterministic laws of Randomness, however, may be of two sorts - true randomness, and pseudo randomness[10]. True randomness is see where it is impossible to provide any ultimate explanation as to why a given value should take place instead of the other. At certain instance, however, random characteristics of the phenomenon are observed because of our failure

to take certain factors into account while designing experiments, interpreting results and building mathematical models. Such randomness is labeled as pseudo randomness or ignorance engendered apparent randomness.

A probabilistic model is one whose construction is based on random approach; involving true randomness or ignorance engendered apparent randomness. Such models usually deal with a single random phenomenon at a time. The models of Newell and Pike *et al.*, evolved for the efficient planning of casualty wards in a hospital are examples of such models 11,12.

Further, a random phenomenon that arises through a process which is developing in time in a manner controlled by probabilistic laws is called stochastic process. Such processes are, indeed, dynamic parts of probability theory in which one studies a collection of random variables from the point of view of their interdependence and limiting behavior. Mathematical models which deal with stochastic processes are known as stochastic models. In other words, probabilistic models where the phenomenon involves many random variables are called stochastic models. Development of these models is essentially based on a set of assumptions which, *inter alia*, ensure random behavior of the system involved. Stochastic models, at times, are difficult to handle in full details, particularly when situations are nonlinear in nature such as epidemicsl3. Examples of such models are those developed by Hillis, Verma *et al.* for infectious diseases and malaria respectively and by Gupta for follow up of IUD clinical trialsl4, 15, 16, 17.

Deterministic Models

Models whose formulation is based on completely deterministic approach are known as deterministic models. Obviously, construction of these models does not assume any type of randomness. Since the behavior of most of biological phenomena may be regarded as deterministic, such models have relatively wider range of applicability. Further, deterministic models can be easily used in non-linear situations also.

Many models of this kind have been formulated in medical science and used in its different disciplines. The models of

Muench, used by Srivastava *et al.* and Indrayan *et al.* for the assessment of Infective force of filariasis & of Dietz developed for malaria and helminthes diseases respectively, are examples of such models18,19,20,21,22.

Operation Research Models

Operation research is the scientific study of effectiveness of operations; an operation being defined as a human activity in which certain set of means is directed to achieve a specified goal. The models, aimed to design the operations to achieve specified effectiveness within existing environment and resources and to predict effects of changes in conditions on such effectiveness are known as operation research models. Such models suggest how the effectiveness of operations can be maximized. In these models, effectiveness of operations is measured with the help of various indices such as - cost-benefit ratio, probability of occurrence of a favorable event, ratio of present performance to the past and time rate of output etc.

Many operation research models have been built for their use in health planning and management of hospitals. Kramer *et al.* Suggested an operational model for the assessment of adverse drug reactions (ADR)24. The model is arranged in an algorithm from which emerge scores for six axes of decision strategy. The sum of scores, ordinarily partitioned, allows one to rate candidate's ADR as - definite, probably, possible or unlikely. A similar model has also been brought forth by Singh *et al.* for holding down the cost of hospitals and clinics26,

Diagnostic Models

In clinical medicine, diagnosis of patients depends upon clinical judgment arising from subjective impressions and previous experience of individual clinicians. Because of many points being in favor and against for a disease in a patient, it sometimes becomes extremely difficult for a clinician to apply right judgment for the diagnosis. In order to introduce objectivity and thus, to make accurate diagnosis, many models have been suggested and are in use. Such models are known as diagnostic models. These models are formulated by assigning suitable scores, in order of importance, to various signs and/or symptoms. The sum of

scores of a patient are grouped suitably to indicate presence or otherwise of a certain disease or conditions. Such models facilitate clinicians to diagnose patients for a certain disease at least in probability.

Diagnostic models for many diseases such as - rheumatic fever, hyperthyroidism and endogenous depression have been suggested and are being used widely27, 28, 29, and 30.

Rational Models

Models, derived in a logical way, starting from basic observational knowledge, theory and reasonable supposition about physical components of a system and their behavior are known as rational models. Such models, often predict parametric values of a phenomenon for different values of independent variables, even for those which fall beyond the range of data. Further, the best predictability is attained by introducing rationality in models, as much as possible. The model developed by Uemura for cholera, Dietz *et al** and Molineax for malaria and by Cvjetanovic and Grab for whooping cough may be regarded as rational models5,21,31,32.

Empirical Models

An empirical model is one, chosen with little regard to the characteristics of the system but having enough flexibility to reflect sufficiently and faithfully the main features of available data. Such models may lead to bad predictions particularly, for those values of independent variables which fall beyond the limits of data but have been used to fit the model.

The examples of empirical models may be taken as polynomials of various sorts, relating a dependent variable with many independent variables. More specifically, models of Verma *et al.*, used to predict malaria endemicity in terms of various meteorological conditions in Jhansi district of Uttar Pradesh and of Chaurasia and Pattankar for detecting hypertensive patients in a group of people may be regarded as empirical models33,34.

Since beyond a certain point, empiricism enters almost all the models because of lack of perfect basis observational knowledge, theory and supposition; all mathematical models have both - rational and empirical aspects.

Use fullness of Models

The importance of mathematical models in public health is very useful. They are important tools for the practitioners of community health. Models in different disciplines of medicine and health have been used for varied purposes. Some important areas of their applications are outlined.

Epidemiologic Research

Significance of mathematical models in epidemiology has been indicated by several workers2, 18, 35. Epidemiology as a scientific basis of disease prevention and control, has to explain prevalence and incidence of diseases as the function of corresponding risk factors. In case of communicable diseases, for instance, the key risk factor is the contact rate per individual per unit of time. There may be direct person-to-person encounters or the latter may be made via disease vector. The aim of epidemiology can be viewed as the quantification of individual factors of the reproduction rate* such as - duration of infection, man-biting rate and probability of an infection given a contact etc. An estimate of the magnitude of reproduction rate allows one to assess the efforts to control and eradicate the disease. If the objective is control (i.e. reduction to a 'tolerable' level), then the relationship between endemic level and reproduction rate would be required. This problem can well be solved by the use of mathematical models.

A descriptive model developed by Wright has been utilized by Pless *et al.* to suggest chronic physical disorder as an important condition in children and to identify 'high risk' groups36,37, The deterministic models suggested by Muench have been used by Indrayan *et al.* and Srivastava *et al.* to assess the endemic force of filariasis acting on the population at a timelS,20,19, Epidemiological features of many other diseases such as - cholera, tetanus, malaria, whooping cough, helminthes diseases, cancer and leprosy have been studied by evolving and applying different types of mathematical models 5,7,21,31,32,22,38,39.

*Reproduction rate is defined as the number of secondary cases generated by one case during his entire infectious period.

Prediction

Considerable utility of mathematical models lies in their predictive behavior. Almost all models attempt to predict and simulate one thing or the other. The point that how closely a model predicts' actual situations of the phenomenon depends upon the extent of rationality used while developing a relevant model which, in turn, depends on close collaboration between epidemiologists and health statisticians.

Cvjetanovic *et al.* used their deterministic model to simulate the incidence of and death rates from tetanus in the immunized and un-immunized groups of new-born and in general population'. Berger developed a predictive model to study the number of foxes to be immunized to stop the spread of rabies in a population. He simulated the weekly incidence of rabies in relation to the population density of foxes. Similarly, force of infection and death rates from typhoid, incidence of infectious diseases under the influence of seasonal fluctuations and leprosy control costs have been simulated by using different kinds of mathematical models6»8,39,

A model is useful only when it can make verifiable predictions which may even lead to its rejection. This procedure however requires more scientific progress to be made.

Planning of Preventive and Control Measures

International and national agencies are aimed to prevent, control and eradicate important diseases as far as possible and thus, to enhance the level of individuals health. For the diseases in which the special programmes are in operation, there are alternative methods of prevention, *viz.*, immunization, sanitation, health education; and of control such as - chemotherapy and vector-control. The question often asked by health planners calls for an advice on 'optimal' allocation of resources to the various preventive and control measures available. Often, it is not specified what should be optimized; whether control, for instance, is aimed at reduction in infection, diseases, mortality or incidence. Given an explicit target, mathematical models can profitably be used to specify best method of achieving it.

Models of Cvjetanovic *et at.* have been found useful in organization of preventive and control measures such as anti-tetanus, anti-typhoid immunization and sanitation programmes^*?. Newell and Pike *et al.* evolved probabilistic models for planning a casualty ward in a hospital effectively 11,12. These models predict number of beds that would be required in a casualty ward, giving proper allowance to the random fluctuations in daily admissions.

Evaluation of Preventive and Control Programmes

Mathematical models allow simulating time course of prevalence and incidence of diseases which are expected for effectiveness of control measures. These simulations can then be compared with the actual observations in order to estimate the achieved effectiveness of the control measures or to test the model. The latter objective applies to the situations where the model has been fitted to the baseline data only and one is not sure how well the model would be able to extrapolate the transmission under the influence of control measures. A careful evaluation of control programmes can improve the model for the benefit of subsequent control programmes.

A stochastic model based on multiple decrement life-table technique with competing risks has been constructed recently to study the experiences of a group of Indian women who had accepted IUD[17]. The model predicts retention rates and expectancy of IUD life, and can well be used for the evaluation of follow-up IUD clinical trials. Evaluation of effectiveness of health strategies in different health programmes by mathematical models has been demonstrated by many workers for various diseases5, 6, 39„

Measurement of Level of Health

A population is supposed to have a level of health which rises or falls over a time. In our society, health is positively valued and improved health status is an accepted goal of communities and of nations. Health, as defined by World Health Organization, is conceptually a wide term and its accurate measurement is a difficult task indeed.

Traditional measures of levels of health of a population, *viz.*, morbidity and mortality rates, expectation of

life and counts of health service activities are, no doubt, useful but have their own limitations. Measurement of the level of health is frequently required while studying cost-benefit analysis of various community health programmes. Mathematical models can be used to measure levels of health of a population successfully. A stochastic model, developed by Chiang and Cohen is a significant contribution in this directional. This model can be used for the evaluation of health service programmes and may also serve as a basis for a national health index, to be used to describe the state of nation's health.

Cost-Benefit Analysis

The results of control measures against the diseases, obtained by simulations are of great significance but, they cannot be judged on the basis of the effect of control measures on incidence rates only. Their relative costs and benefits have to be taken into consideration since public health administrators will only apply measures that are economically sound and feasible. In order to respect economic and logistic constraints, the effect of each measure and its cost should be examined to determine its merits and advantages.

Simulation models evolved on the basis of deterministic approach have been utilized in cost-benefit analysis of control programmes of many diseases such as cholera, typhoid, tetanus, cerebrospinal meningitis and whooping cough etc.5, 6, and 7,9,32.

Assessment of Risk of Getting Infection/Disease

Information's on the risk, past and present, evaluation of disease in a community are essential for its valid description and for predicting both - risk and prevalence. A predictive model based on French epidemiological data on tuberculosis has been constructed by Lotte and Uzan to calculate estimated annual risk of tuberculosis in a population. They utilized these estimates for comparing risk of disease for the years 1960 and 1970 and also predicted the same for 1980.

A stochastic model, developed by Hillis has been used to estimate the risk of getting poliomyelitis in about 15

different populations of the worldly. Verma *et al.* also used such models to assess the intensity of risk of malaria in infant and in general population respectively, utilizing longitudinal data15,16.

Diagnosis of Patients

Mathematical models have been found to be of immense help in diagnosing many diseases. Diagnosis of rheumatic fever, for instance, is based on many complex points. Jones developed a diagnostic model and suggested a set of combinations consisting of different minor and major criteria to conclude about the correct diagnosis of rheumatic fever27. Wayne formulated a model to distinguish euthyroid cases from toxic ones, on the basis of weighted scores for 13 best discriminatory items, derived from discriminate function analysis^. Patients scoring less than eight were diagnosed as euthyroid, those scoring more than 11 as toxic, whereas score of 9-10 denoted a doubtful diagnosis.

Similarly, Apgar formulated a diagnostic model for clinical scoring for asphyxia neonatorum which has been found to correlate well, both - with immediate prospects of survival and likelihood of permanent brain damage^ i_n the model, score of 10 denotes an infant to be in excellent condition while a gravely asphyxiated infant would be assigned a score of zero. A score below 6 indicates respiratory distress and urgent need of treatment. A diagnostic model has also been designed for endogenous depression and its response to E.C.T.30,

Maximizing Effectiveness of Operations

As indicated earlier, mathematical models developed on operation research approach, maximize the effectiveness of human operations for attaining a specified goal within available resources. Srikantaramu *et al.* developed an operational model to identify the problems of District Tuberculosis Programme in India[23]. This model suggests as to which class of functions has to be varied for better objective fulfillment. Besides enabling authors to compare effectiveness of two major activities - case findings and treatment at peripheral health institutions, it also suggests ways to enhance case finding efficiency and improvement In treatment activities.

Further, Nair has brought forth many points to emphasize that National Tuberculosis Programme in India can be made more effective by applying operation research models A, Similarly, Verma has recommended the application of such models in the field practice area of the medical college hospitals to increase the operational efficiency of health units of the area"^5.

Conclusions

In different areas of medicine and health, mathematical models are of profound significance. However, models developed so far are based mainly on deterministic approach. Those based on probabilistic laws and stochastic approach is very few. Moreover, available models are, by and large, computer-based having been formulated mainly by the workers of developed countries; depending upon their resources and disease patterns. Some models, therefore, are not of much use in developing countries like ours, either because the epidemiologic behavior of the diseases and their patterns here are relatively different or the computer facilities are not in abundance. Attempts should be made to formulate simple models, particularly those based on probabilistic and or stochastic approach, keeping resources and conditions of the developing countries like ours into account.

Further, there are many problems in assessing any model for its general applicability. Lack of adequate data forms major difficulty in this regard. Thus, there, is need to undertake surveys to make relevant data available. Such data can be obtained from control projects for which careful evaluations are planned. After a phase of baseline data collection, the model can be fitted to the local situations; projections of likely intervention effects can be made and later compared with the actual observations. The success would, however, depend upon the close cooperation between epidemiologists and model builders35.

Acknowledgement

The authors wish to thank to Dr. G.D. Shukla, M.D., Head of the Department of Psychiatry, M.L.B. Medical College, Jhansi (Uttar Pradesh) for his comments on certain points of this paper.

REFERENCES

1. ROSS, R. (1908) *Report on the Prevention of Malaria in Mauritius,* London.

2. SRIVASTAVA, R.N. (1975) Role of epidemiology in community health - Mathematical models. *Indian Journal of Preventive and Social Medicine,* _6:59.

3. ASHFORD, J.R., READ, K.L.G. & RILEY, V.C. (1973) An analysis of variations in perinatal mortality amongst local authorities in England and Wales. *International Journal of Epidemiology,* 2.31

4. BERTRAND, W.E., BROCKETT, P.L. & LEVINE, A. (1979) A methodology for determining high risk components in urban environments. *International Journal of Epidemiology,* 8_: 167.

5. UEMURA, K.., CVJETANOVIC, B., SUNDARESAN, T.K., BARUA, D., GRAB, B. & WATANABE, Y. (1971) Epidemiological model of cholera and its use in cost effectiveness and cost-benefit analysis. *WHO Document* BD/Cholera/71.4,Rev. 1,* (Mimeographed), 1-27

6. CVJETANOVIC, B., GRAB, B. & UEMURA, K. (1971) Epidemiological model of Typhoid fever and its use in the planning and evaluation of ant typhoid immunization and sanitation programme. *Bulletin' of World Health Organization,* 45: 53.

7. CVJETANOVIC, B., GRAB, B., UEMURA, K. & BYTEHENKO, R. (197,2) Epidemiological model of tetanus and its use in the planning of immunization programmes. *International Journal of Epidemiology, 1:* 125.

8. DIETZ, K. (1976) The incidence of infectious diseases under the influence of seasonal fluctuations. In *Mathematical Models in Medicine,* Edited by J. Berger, W. Bubler, R. Repges and P. Tauta. Springer-Verlag, Berlin, 1-14.

9. GRAB, B. & CVJETANOVIC, B. (1975) Epidemiological model of cerebrospinal meningitis. *WHO Document* BD/CSM/75.Id HSM/75.11* (Mimeographed), 1-33.

10. LUCAS, H.I. (1964) Stochastic elements in biological models – Their sources and significance. *In Stochastic Models in Medicine and Biology.* Edited by J. Gurland, The University of Wisconsin Press, Madison, 355-383.

11. NEWELL, D.J. (1954) Provisions of emergency beds in hospitals. *British Journal of Preventive and Social Medicine, 8:* 77.

12. PIKE, M.C., PROCTOR, D.M. & WYLLIE, J.M. (1963) Analysis of the admissions to a casualty ward. *British Journal of Preventive and Social Medicine,* 1_7: 172.

13. BAILEY, N.T.J. (1980) Spatial models in the epidemiology of infectious diseases. *World Health Organization,* Geneva (unpublished).

14. HILLIS, A. (1979) A mathematical model for the epidemiologic study of infectious diseases. *International Journal of Epidemiology,* _8: 167.

15. VERMA, B. L., RAY, S.K. & SRIVASTAVA, R. N. (1980) Stochastic approach to the estimation of infective force and daily malaria parasite incidence rate in infants from longitudinal data. *The Journal of Communicable Diseases* (under communication).

16. VERMA, B.L., RAY, S.K. & SRIVASTAVA, R.N. (1980) A stochastic model for estimating daily malaria parasite incidence and recovery rates in general population from longitudinal data. *Annals of National Academy of Medical Sciences (India)* (under communication)

17. GUPTA, H.D. (1978) A stochastic approach to the construction of a life table for follow up of IUCD clinical trials. *Indian Journal of Medical Research,* 67: 632.

18. MUENCH, H. (1959) *Catalytic Models in Epidemiology.* Harvard University Press, Cambridge, Massachussetes.

19. SRIVASTAVA, R.N., INDRAYAN, A. & BAGCHI, S.C. (1971) Observations on endemic force of filariasis in rural and urban areas of Lucknow. *Annals of Indian Academy of Medical Sciences, 1:* 165.

20. INDRAYAN, A., SRIVASTAVA, R.N. & BAGCHI, S.C. (1971) Observations on endemic force of filariasis in rural and urban areas of Lucknow. *Annate of Indian Academy of Medical Sciences,* 1_: 165.

21. DIETZ, K., MOLINEAUX, L. & THOMAS, K. (1974) A malaria model tested in African Savannah. *Bulletin of World Health Organization,* 50_: 347.

22. DIETZ, K. (1976) The transmission dynamics of some helminthes diseases. *Proceedings of the 9th International Biometric Conference,* Boston, 175-188.

23. SRIKANTARAMU, N., BAILEY, C.V.J. & NAIR, S.S. (1976) An operational model of the District Tuberculosis Programme. *Indian Journal of Public Health,* 20: 3.

24. KRAMER, M.S., LEVENTHAL, J.M., HUTCHINSON, T. A. & FEINSTEIN, A.R. (1979) An algorithm for operational assessment of adverse drug reaction. I. Background description and instruction for use. *Journal of American Medical Association,* 242: 623.

25. HUTCHINSON, T.A., LEVENTHAL, J.M., KRAMER, M.S., ARCH, F.E., LIPMAN, A.G. & FEINSTEIN, A. R. (1979) an algorithm for operational assessment of adverse reactions - II, Demonstration of reproducibility & validity. *Journal of American Medical Association,* 242: 633."

26. SINGH, A.J., MAY, P.R., MESSICK, J.M. (1978) The role of operation research and system analysis in holding down the costs of hospitals and clinics. *J. PsychiatrNurs.* 16: 24.

27. JONES, T.D. (1944) the diagnosis of rheumatic fever. *Journal of American Medical Association,* 126: 481.

28. AMERICAN HEART ASSOCIATION (1955) Jone's criteria (modified) for guidance In diagnosis of rheumatic fever. *Modern Concepts in Cardiovascular Diseases** 24: 291.

29. WAYNE, E.J. (1960) Clinical and metabolic studies in thyroid disease. *British Medical Journal, 1:* 78.

30. CORNEY, M.W.P., ROTH, M. & GARS IDE, R.F. (1965) The diagnosis of depressive syndromes and the prediction of ECT response. *British Journal of Psychiatry,* 111: 659.

31. MOLINEAUX, L., DIETZ, K. & THOMAS, A. (1978) Further epidemiological evaluation of malaria model. *Bulletin of World Health Organization,* 56_: 565.

32. CVJETANOVIC, B. & GRAB, B. (1976) Epidemiological model of whooping cough and its uses. *WHO Document, BAC/76.2 Corr.* (Mimeographed), 1-34.

33. VERMA, B.L., VERMA, S.D. & SRIVASTAVA, R.N. (1977) Contribution of meteorological conditions in malaria transmission - A multifactorial analysis of malaria cases. *Annals of National Academy of Medical Sciences (India),* 13:1.

34. CHAURASIA, A.R. & PATTANKAR, J. (1979) A mathematical model for detection of hypertension. *Annals of National Academy of Medical Sciences (India),* 15: 68.

35. DIETZ, K. (1977) Dynamic models of tropical parasitic diseases. *WHO Scientific Working Group of Epidemiology TDR/MPD/SWG - Epid. (1) 77.14* (Mimeographed) 1-7.

36. WRIGHT, A.B. (1960) *Physical disability - A Psychological approach.* Harper and Row, New York.

37. PLESS, I.B. (1972) Chronic illness, family functioning and psychological adjustment - A model for allocation of preventive mental health services. *International Journal of Epidemiology, 1:* 272.

38. FEARS, T.R., SCOTTO, J. & SCHREIDERMAN, M.A. (1977) Mathematical models of age and ultraviolet effects on the incidence of skin cancer among whites in the United States. *American Journal of Epidemiology,* 105: 420.

39. LECHAT, M.F., VELLUT, C, MISSION, C.B. & MISSION, J.Y. (1978) Application of an economic model to the study of leprosy control costs. *International Journal of Leprosy,* 46: 14.

40. BERGER, J. (1976) Model of rabies control. In *Mathematical Models in Medicine;* Edited by J. Berger, W. Biihler, R. Repger & P. Tautu. Springer-Verlag, Berlin, 74-88.

41. CHIANG, C.L. & COHEN, R.D. (1973) How to measure health - A stochastic model for an index of health. *International Journal of Epidemiology, 2:* 7.

42. LOTTE, A. & UZAN, J. (1973) Evaluation of the rates of the tuberculosis infection in France and calculation of the annual risk by means of mathematical model. *International Journal of Epidemiology, 2:* 265.

43. APGAR, V. (1953) Proposal for new method for evaluation of new born infants. *Anaesthesia and Analgesia,* 32: 260.

44. NAIR, S.S. (1977) Application of operation research approach "in evolving a National Tuberculosis Programme. *Indian Journal of Public Health, 21:* 3.

45. VERMA, 0. P. (1973) Operational research in the Field Practice Area. *Indian Journal of Public Health,* 17: 113.

Health and Population
- Perspectives & Issues 4(1):59-65, 1981

A STUDY ON THE FERTILITY OF MIGRANTS

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ABSTRACT

This study explores the impact of temporary separation due to the migration of males leaving their wives at home on fertility through a theoretical model proposed under reasonable assumptions. The application of this model to an observed set of data relating to migrants from a rural area indicates that although the fertility of such separated couples is slightly lower than the couples living together but their fecund ability is quite high (0.18) in comparison to the fecund ability (0.05) of the couples living together.*

Demographers and other social scientists have gathered extensive data concerning the relationship between fertility and migration. A study of the inter-relation between migration and reproduction and the implications of such interrelation for demographic policy and socio-economic planning provides unique opportunity for integrated research, especially when pursued within the broader context of urbanization and modernization. It is a well known fact that the human reproduction process is affected not only by biological factors but also by a number of socio-economic and cultural factors. Migration especially in developing countries plays an important role in changing the socio-economic condition and culture of the people living in rural areas and hence it is expected that whenever human mobility exists, it may have an important bearing on fertility. Thus, it becomes desirable to study the impact of migration on couple fertility.

For the purpose of this study, the migration of married males can broadly be classified in two types: (I) the wife accompanying the husband; and (ii) the husband migrating, leaving his wife at home and visiting the home at different intervals of time. The first type of migration may have its

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effect on fertility mainly through the environmental, behavioral and cultural changes while the effect of the second type may be mainly due to the temporary separation of husband from wife.

It may be observed that although, the migration in developing countries is mainly of the first type yet in rural India it is of the second type which is most common. The study of fertility behavior of such migrated persons from rural areas as a significant population group has not yet received much attention from social scientists.

The purpose of the present paper is to study the fertility behavior of such migrated couples in a given interval of time, taking into account the temporary separation of males from females, through the development of an appropriate probability model. The model has been applied to the data of 'A Demographic Survey of Varanasi (Rural)'.

Proposed Model

A probability distribution to describe the variation in the number of conceptions leading to live births to a female in an interval (0, T) whose husband is migrated is derived under the following assumptions:

i. The female is living in the village home permanently and the husband visits his residence once in a year at an interval of approximately one year. In fact, generally the persons migrated at long distance places visit their home once in a year especially on occasions like marriage, house construction, etc. which usually are performed in a fixed season in the year.

ii. The probability that conception occurs in year (unit of time) equals, p, if the female is susceptible to the risk of conception *i.e.* she is neither pregnant nor in the post partum amenorrhea period.

iii. Let 8 be the probability that a conception results in a live birth so that (1-0) is the probability that it terminates into a foetal loss. Let h1 and h2 be the rest periods, consisting of gestation plus post partum amenorrhea associated with the above two types of pregnancy terminations respectively. Usually h2

is less than a year (on an average 3 months of gestation plus 1 month of post partum amenorrhea) whereas hi is more than a year (9 months of gestation and an average duration of about 8-9 months of post partum amenorrhea). Thus, we assume that if, there is a conception in a year which terminates in a foetal loss then the probability of conception in the next year is p whereas if, the conception results in a live birth then the probability of conception in the next year is zero.

iv. Let l- α be the probability that the female is sterile or chooses to be so during the interval (0, T). Thus α be the probability that the female is fecund (except' during the rest period).

Then the maximum number of conceptions leading to live births during the period (0, T) cannot be more than n, where $n < \left[\frac{T}{2}\right] + 1$ and $\left[\frac{T}{2}\right]$ stands for the greatest integer not exceeding $\frac{T}{2}$.

Let X denotes the number of concentrations leading to live births to a female during the time interval (0, T).

Under the above assumptions the distribution of X is easily obtained as[1]:

$$P_o = P\left[X = 0\right] = 1 - \alpha + \alpha\left[H_o(T) - H_1(T)\right], \quad H_o(T)=1$$

$$P_r = P\left[X = r\right] = \alpha\left[H_r(T) - H_{r+1}(T)\right]; \quad r = 1,2, \ldots, n-1$$

$$P_n = \alpha H_n(T) \quad \text{where} \quad n = \left[T + 1/2\right] \quad \text{and}$$

$$H_{r+1}(T) = \theta^{r+1} \sum_{V=0}^{Z_r} \binom{r+V}{V} (1-\theta)^V \sum_{x=r+V_1}^{n'_r} \binom{n'_r}{x}$$

$$p^x \quad q^{n'_r - x}$$

$$\text{where} \quad Z_r = \left[(T - 1 - 2r)\right] \quad \text{and} \quad n'_r = T - r$$

where P_r denotes the probability of r conceptions leading to live births during the time interval (0, T).

The model involves three parameters α, p and Θ. It is difficult to estimate all these parameters. However, the parameters α and p can be estimated using the technique obtained in Singh (1968) assuming that 9 are known[2].

Application

The proposed model is applied to the data of Varanasi Survey 1969-70. For the sake of convenience, a short description of the survey is given below:

The demography survey of Varanasi (rural) was conducted in the year 1969-70 by the staff of the Demographic Research Centre, Banaras Hindu University. About 2,200 households were selected following a two-stage stratified random sampling procedure from villages of Varanasi tehsil. The data from the selected households were collected by personal interview method. The information on household structure, household facilities, migration, fertility, mortality and morbidity was obtained from each selected household in the sample. The migration record consisted of questions relating to present age, age at migration, year of migration, place of migration, occupation for each migrated person of the house-! hold. The information on migration could successfully be included by adopting a 'special definition* of a household.

In the survey, a household was defined as a group of persons who usually live together and take food from a common kitchen. It, however, included those who lived outside the village but claimed the household to be their own. Persons of this category work outside the village and often send remittances. Really speaking, such persons are the 'migrated persons' of the household. Because of this concept of household, only those migrants could be ascertained who were included in the household? Naturally, 'complete household migration* is not included[3].

For the present study, the migrated males leaving their wives at home were classified into two categories:

i. those migrated to short distance places and usually visiting the home at an interval of 1-2 months or even earlier; and

ii. those migrated to long distance places (mainly at

TABLE 1

OBSERVED AND EXPECTED NUMBER OF COUPLES ACCORDING TO THE NUMBER OF BIRTHS IN THE LAST FIVE YEARS WITH E.M.D. (7-20) YEARS

Number of births	Observed No. of couples	Expected number of couples for		
		$\theta = 0.85$	$\theta = 0.90$	$\theta = 1$
0	20	20.0	20.0	20.0
1	56	51.8	51.8	51.8
2	36	39.4	39.4	39.4
3	3	3.8	3.8	3.8
Total	115	115.0	115.0	115.0
X^2 :		0.74	0.74	0.74
d.f. :		1	1	1
$\hat{\alpha}$:		0.96234	0.96234	0.962341
$\hat{p}$:		0.38071	0.35956	0.32360

TABLE 2

OBSERVED AND EXPECTED NUMBER OF COUPLES ACCORDING TO THE NUMBER OF BIRTHS IN THE LAST SEVEN YEARS WITH E.M.D. (7-20) YEARS

Number of births	Observed No. of couples	Expected number of couples for		
		$\theta = 0.85$	$\theta = 0.90$	$\theta = 1$
0	9	9.0	9.0	9.0
1	25	22.3	22.3	22.3
2	30	32.6	32.6	32.6
3	12	14.4	14.4	14.4
4	2]			
5	1]	0.7	0.7	0.7
Total	79	79.0	79.0	79.0
X^2 :		0.53	0.53	0.53
d.f. :		1	1	1
$\hat{\alpha}$:		0.94328	0.94328	0.94328
$\hat{p}$:		0.38818	0.36661	0.32915

Bombay and Calcutta) and usually visiting the home once in a year.

The assumptions of the model are appropriate only for second type of migrants and hence only such couples are included for the present case.

The model is applied to the data on the number of births to migrated couples in Varanasi survey for T = 5 and T = 7 years taking three alternative values of Θ *vis,* Θ = .85, .90 and 1.00. The observed and expected distributions for different values of Θ and estimates of α and p for T = 5 and T = 7 years are given in Tables 1 and 2. It is seen from the tables that estimate of α remains unaffected with the change in the values of Θ whereas estimate of p changes in such a way that p^{Θ} remains almost constant. The expected distributions also remain unaffected for different values of Θ**.** Thus, it seems that effect of assuming Θ = 1 is simply the lowering of estimate of p. The values of 2 are insignificant at 5 per cent level of significance. Thus, the proposed distribution seems to be a reasonable approximation.

Discussion and Conclusions

The estimated values of p (for 6=1) to the distribution of births in last five and seven years are 0.32 and 0.33 respectively. This represents the probability of a conception in one unit of time which is one year in this case. It should, however, be noted that migrated couples are not exposed to the risk of conception throughout the year but the males migrated to long distance places usually visit the homes only for about one to three months in a year. Thus if, as a first approximation, we assume that the migrated couples are exposed for conception for two months in a year, the probability of conception in one month comes out to be nearly 0.18. This may be taken as an estimate of fecund ability for such couples. A comparative study of the fertility performance of the migrated and non-migrated couples of the area has revealed that the total marital fertility rate for the two types of couples is 6.4 and 7.5 respectively^. The value of fecund ability for non-migrated couples of the area has been estimated to be nearly 0,055. Thus, it is seen that although the difference between fertility performance of the two types of couples is not large, there Is a big gap between their fecund abilities. This may be perhaps due to high

coition rate of migrated couples whenever male partners visit their households. The low value of fecund ability of females living in the rural areas is perhaps due to many social and cultural taboos.

It should, however, be pointed out that the level of fecund ability of migrated couples is quite near to values reported for females of developed countries 6,7.

REFERENCES

1. BHATTACHARYA, B.N. (1970) On some stochastic models for couple fertility. Unpublished Ph.D. thesis in Statistics, Banaras Hindu University, India.

2. SINGH, S.N. (1968) A chance mechanism of variation in number of births per couple. *Journal of American Statistical Association,* j>3: 109.

3. SINGH, S.N., YADAVA, R.C. & BHADURI, T. (1970) A Demographic Survey of Varanasi (Rural) 1969-70. *Prajna** 16: 176.

4. YADAVA, K.N.S. (1977) some aspects of out-migration and its effect on fertility. Unpublished Ph.D. thesis in Statistics, Banaras Hindu University, India.

5. SINGH, S.N., BHATTACHARYA, B.N. & YADAVA, R.C. (1974) A parity dependent model for number of births and its applications. *Sankhya,* 36B: 93.

6. POTTER, R.G. & SAKODA, J.M. (1967) 'Family Planning and Fecundity. *Population Studies,* 20: 311.

7. SHEPS, M.C. (1964) On the time required for conception. *Population Studies,* 18: 85.

Health and Population
- Perspectives & Issues 4(1):66-78, 1981

COMMUNICATION SYSTEM BETWEEN DISTRICT HEALTH OFFICE AND PRIMARY HEALTH CENTRE

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ABSTRACT

This is a pilot study undertaken by the authors to analyze the communication system as prevalent in health services at District Health Office (DHO) and five Primary Health Centers (PHCs) under it. The five PHCs were randomly selected under DHO Bellary. The authors study the nature of communication of correspondences pertaining to establishment matters health intelligence and health activities for the first quarter of the financial year between the DHO and PHCs level* pinpoint deficiencies and list out suggestions.*

Communication is an important factor in human relationship. Human beings can be motivated or alienated by communication process. The techniques, medium and devices of communication have been developed to suit varying objectives, situations, interests, needs and desires. Communication is an activating force in any organization. The communication system that has been developed for the organization of health services constitutes the subject matter of the study.

In health administration it is well recognized that communication is an important factor for its effective management. In the organizational hierarchy, the communication system by its very nature is a two way flow process. Under the overall health services administration in the country, the Government of India formulates national policies on health programmes and provides technical guidance and substantial financial assistance to State Governments. The State Health Directorates are responsible for the management of the programmes. The District Health Office (DHO) Is

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responsible for the management of the programmes in the district. The Primary Health Centre (PHC) as the peripheral unit Implements the programmes as per directions from DHO. The PHC personnel are the ones who make available the benefits of health programmes to the people. In the health administration, communication includes issue of orders, directives, guidelines, etc. from higher level down to health personnel at the PHC level to achieve proper administrative control and follow up action.

The role of PHC personnel in the health services is very important since, apart from carrying out the health policies of the government to the people, they are engaged in compiling health intelligence and feedback of information on the felt needs of the people and the acceptable methods to the policy makers for crucial task of decision making. Thus, a substantial number of communications are taking place in the upward (DHO) direction. The communication process in these areas is not only confirmed in the form of written communications but also in an oral manner.

Information on the operation of communication system and its components has been very inadequate. In the present policy of integration of specific health programmes with the general health services, it has become necessary for the health administration and officers connected with specialized health programmes to know the nature, frequency and magnitude of communications followed in health - services. In view of the very significant role played by the PHCs in the health services, attention is focused on communication system between the DHO and the PHC level.

Methods

The study was conducted on a pilot basis in five randomly selected PHCs and the District Health Office, Bellary. Communications or correspondences pertaining to establishment matters, health intelligence and health activities of the selected institutions for the period 1st April, 1977 to 30th June, 1977 was considered for the study. The rationale for selecting this period was that the first quarter of the financial year would include several important directives, instructions, messages, etc., on budgetary provisions and physical targets under health programmes.

A team consisting of one Statistical Assistant (SA) and one Computer visited the selected PHCs and DHO Bellary and collected data for the study. Three schedules were used to collect the data. The first schedule (Officers Schedule) was used to collect data from the District Health Officer and the Office Superintendent at the DHO, and from the Medical Officer and the senior most ministerial staff at the PHC on staff position, type of postal facilities available, adequacy of ministerial staff, availability of other facilities for efficient communication, details regarding the receipt and disposal of letters during the previous quarter, the method followed for feedback reports on implementation, and the suggestions for improving the communication system.

The second schedule was used to collect the information on each communication about clarity, actions taken, duration of disposal, number of subsequent communications and the classification of letters by subjects and types. Separate sheets were used for outward and inward communication. The third schedule was used to collect additional details on communications which were originated before the study period but continued to be pending during the study period.

The team before starting the work at each centre explained to officials that the intention of the study was to make an objective review of the communication system and not to make assessment of the performance of individuals. With suitable clarifications on doubts raised, necessary cooperation from the concerned personnel was sought. Information was first collected at the DHO. From the inward and outward registers, the number of letters received and sent to the selected PHCs during the study period was collected. Then each file was taken up, one by one and each communication was examined. The details of each communication covered by the scope of the study were recorded in schedules drawn out for the purpose. Separate schedules were used for outward and inward communications and for each PHC. Communications of confidential nature on establishment matters were excluded from the study.

Similarly at the selected PHCs, the list of files and the relevant details from the outward and inward registers for the study period were prepared. The files were taken up, one by one, and eligible communications were matched with the communication references recorded in the schedule filled at

DHO. Letters received at PHC from DHO but not recorded at DHO were listed with a note. Additional information like clarity, and actions taken with reference to the PHC were collected and recorded in the schedule.

Definitions

For the purpose of this study definitions on a few concepts were adopted for a correct understanding of the communication process.

Communication: All types of correspondence exchanged, including information and decisions conveyed or sought, between DHOs and PHCs are considered as communication. Communication Is sent In both directions and there can be a number of communications on the same 'subject[1]. The communication issued from the DHOs to PHCs are treated as 'outward* and those received at the DHO from the PHCs are treated as ' inward'.

Subject: A subject refers to a particular matter being dealt with or described in the communication in succession till a satisfactory conclusion is arrived at. This is generally identical to the subject specified at the top of the communication. A communication generally dealt with one subject. The subjects were broadly classified as 'establishment' , 'equipment and supplies , 'supervision', 'implementation', 'assessment', 'finance', 'health intelligence' and 'others'.

Findings

Existing Communication System

The existing communication system between DHO and PHC is presented in a simple model as responded in Appendix. The lines with dashes indicate the system which was covered in the study.

The DHO communicates with the PHCs on health activities through correspondence or orally through supervisory staff during the supervision visits and *vice Versa.* Apart from this, regular monthly meetings were held wherein oral form of communication process was taken place. The PHC Medical Officers met at the DHO in the first week of every month.

During these meetings the progress made in the health programmes were discussed and instructions or guidance, if any, were obtained. Periodical progress reports were submitted. Some of the common administrative problems health intelligence' on programmes, staff position, vehicle situation etc., were discussed and decisions arrived at. Minutes of these meetings were recorded.

At the PHC level, the field staff met at the PHC in the first or second day of every month and submitted reports on health activities of their area and achievements to prepare the monthly report of the PHC. The achievements under each health programme in the area allotted for each person were reviewed and instructions or guidance's, if any, were given. Any directions received from DHO or from the higher authorities through DHO or direct from State Health Directorate were also read out and explained. Minutes of these meetings were recorded in the minute's book. It was reported that instructions and guidelines were communicated to field workers verbally. Similarly, the feedback on implementation of instructions was orally conveyed during the monthly meetings or through supervisory staff. Thus, the monthly meetings held at primary health centers and district health office were important forums wherein considerable verbal communications took place on health intelligence and other administrative problems. The nature and extent of verbal communications that had taken place in these meetings could not be quantified. However, available information, though briefly recorded in minute's books, were examined and collected to the extent possible.

Infrastructure for Communication

The infrastructure of the communication system studied were adequacy of ministerial staff, availability of typewriter, adequate supply of paper, printed forms and registers and other equipment as well as availability of full-fledged post office, road and rail services. It was found that all PHCs of the district are having full-fledged post office facilities needed for communication. They were also connected by bus services to DHO whereas; train services were available only for two PHCs. The .ministerial staff were inadequate and PHCs wanted one - more typist-cum-clerk to assist. The sanctioned posts were not always filled, either post of computer or clerk was vacant most of the time, and work was

being done by other technical staff. It was also observed on the day of the visit at DHO that 26 per cent of the ministerial posts and 17 per cent of the technical posts were not filled in. The corresponding figures for PHCs were 40 per cent and 25 per cent respectively. Typewriter, a basic need for communication was not provided to PHCs. Supply of stationeries especially white paper was very much inadequate. Further, there was no supply of printed forms or registers for the routine reports and records. This resulted in Inadequate and improper maintenance of records.

CTOB8 Section of the Communication System Prevalent

In this section only the written form of communications (correspondence) were studied for the purpose of this study.

Quantum of Communication

The study encountered difficulties to check whether all letters were included or not. In most of the PHCs inward registers, to list the correspondence received were not maintained and the papers were not filed properly. Mostly letters were kept in one folder. It was also observed that maintaining the office copy of the correspondence was not done uniformly. These deficiencies may be seen as recorded in table 1.

TABLE 1

DIFFERENCES IN NUMBER OF COMMUNICATION LISTED AT DHO AND PHCs

PHC	Outward			Inward		Routine Reports			
	Listed at DHO	Verified at PHC	Added at PHC	Listed at DHO	Added at PHC	Sent from DHO Verified at PHC	Sent from Listed at PHC	Added at DHO	Total Reports
Sidiginraola	51	26 (51.0)	52 (102.0)	32	44 (137.5)	6	115	12	127
Hampasagar	44	31 (70.5)	71 (161.4)	13	39 (300.0)	6	110	7	117
Gudekota	41	21 (51.2)	37 (90.2)	42	48 (114.3)	-	205	-	205
Kottur	45	12 (26.7)	27 (60.0)	26	21 (80.8)	6	126	15	141
Arasikere	47	31 (66.0)	62 (131.9)	10	51 (510.0)	6	154	9	163
Total	228	121 (53.1)	249 (109.2)	123	203 (165.0)	24	710	43	753

Figures in parenthesis are percentages to the number listed at DHO.

The table 1 shows that communications listed as outward at DHO level were 228. Of these, only 121 (53.1%) were seen in the files of PHCs but an addition of 249 (109.2%) letters eligible for the study were added from PHC files. Similarly, 123 inward letters, besides routine reports, were listed at DHO but from the files of PHC additional 203 (165%) were added for the study. These figures confirm the study team's observations on the maintenance of files. It was also not possible to get the actual number of communications which took place from the, inward and outward registers since they were not entered. Hence, the total number of communications included for the study could not be verified. However, the above system of updating the information at DHO and PHCs on quantum of communications helped to get a fairly representative picture of the situation.

Nature of Communication

Communications studied were classified in three aspects *viz.* the main subject matter covered, the type of communication and the urgency of the matter to understand their nature and quantum. In table 2, the details of classification of letters by subjects are given.

TABLE 2

DISTRIBUTION OF THE COMMUNICATION BY THE MAIN SUBJECTS COVERED AT DHO

Subject	Outward		Inward	
	Number	Per cent	Number	Per cent
Establishment	130	25.9	111	10.3
Finance	27.	5.4	11	1.0
Equipment and supplies	69	13.8	47	4.4
Implementation	108	21.6	92	8.5
Supervision	8	1.6	4	0.4
Assessment	3	0.6	-	-
Health intelligence - routine	24	4.8	753	69.8
Health 'intelligence - others	85	17.0	50	4.6
Others	47	9.4	11	1.0
Total	501	100.0	1,079	100.0

It would be seen from table 2 that the DHO had issued letters to PHCs mostly on 'establishment* and 'implementation' matters which accounted for 25.9 and 21.6 per cent respectively. Communications on 'equipment & supplies' and 'finance' accounted for 13.8 and 5.4 per cent respectively. It was seen that very few communications on 'supervision' and 'assessment' problems were sent from DHO. Among the inward receipts at DHO about 70 per cent of communications from PHCs related to submission of periodic reports containing health information.

As regards communications received from the PHCs at the office of the DHO, it was seen that nearly 70 per cent of the communications related to dispatch of records and reports on health programmes. This situation was very well anticipated in the communication system between DHO and the PHCs. Further, the inward communications received from PHCs at the office of the DHO revealed that communications on 'establishment' matters occupied an important place which accounted for 10.3 per cent of the total communications to the DHO. Number of letters sent by PHCs to DHO on subjects like supervision and finance were very low.

Type and Importance

An attempt was made to classify the communications on the basis of their type and importance, the details of which are presented in table 3.

TABLE 3

DISTRIBUTION OF THE COMMUNICATION BY TYPE AND URGENCY OF THE MATTER

Type/Urgency	Outward		Inward	
	Number	Per cent	Number	Per cent
Initial	426	85.0	913	84.6
Reminder	54	10.8	15	1.4
Interim reply	7	1.4	10	0.9
Final reply	14	2.8	141	13.1
STD	285	56.9	-	-
Specific	216	43.1	1,079	100.0
Ordinary	320	63.9	1,048	97.1
Immediate	46	9.2	1	0.1
Urgent	135	26.9	30	2.8
Total	501	100.0	1,079	100.0

STD: Addressed all PHCs (Standard Distribution)

It will be seen from table 3 that about 85 per cent of the communications issued both from DHO and PHCs were initial ones *i.e.* initiated once. Communications involving replies were rather low indicating that communications were mostly in one direction. As anticipated, the office of the DHO had issued as many as 57 per cent of its communications which were of standard in nature meant for all PHCs. Communications received at the office of the DHO from the selected PHCs were entirely on specific issues but not of standard replies. Of the communications sent from DHO to PHCs, more than half were addressed to all PHCs and 36 per cent were requiring either immediate or urgent action. Even the PHCs had issued urgent letters to the DHO which accounted for nearly 3 per cent of the total Communications, which mainly related to administrative matters.

Communication Processes

The communication system studied here was a joint process of dynamic interaction and was studied from the point of view of the number of subsequent communications that had taken place on the same matter, duration of disposal, clarity and action taken which are given in table 4. In this analysis, only the initial communications originated from DHO and PHC were considered.

TABLE 4

'FREQUENCY OF IN BETWEEN COMMUNICATIONS AND DURATION OF DISPOSAL

No. of subsequent communication/ Duration of disposal	Outward		Inward	
	Number	Per cent	Number	Per cent
NRA*	235	52.3	873	94-0
One	89	19.8	26	2.8
Two	18	4.0	3	0.3
Three or more	3	0.7	-	-
Reply not received	61	13.6	12	1.3
Not known	43	9.6	15	1.6
Less than 15 days	76	16.9	17	1.8
15-30 days	21	4.7	1	0.1
1-3 months	8	1.8	5	' 0.5
More than 3 months	3	0.7	1	0.1
NRA*	235	52.3	873	94.0
Reply not received	61	13.6	12	1.3
Not known	45 -	10.0	20	2.2
Total	449	100.0	929 '	100.0

*NRA: No reply anticipated.

Above data of subsequent communications on the same subject matter showed that very few follow-up letters in the form of reminders, interim reply, clarifications, final reply etc. were issued. A considerable proportion of communications did not require any reply which accounted for 52 per cent of outward and 94 per cent of inward letters. The number of communications pending disposal upto three months was very negligible. Communications which took more than a month for disposal were few in number and mostly administrative in nature involving additional subsequent communication. Out of the 108 outward communications disposed off, 21 (19.4%) had two or more subsequent communications and 11 (10.2%) had taken more than one month to dispose off the case.

Communications were clear to the receiving end and mostly action was taken. For all communications for which no action was taken, the difficulties faced, if any, were not always clarified.

Suggestions from the Staff for Improving the System

As part of the study one senior most member of the ministerial staff and the medical officer were asked to give their suggestions to improve the communication system. The suggestions were mostly on the improvement of the infrastructure of the communication at PHCs. The suggestions given were filling up of the post of computer and First Division Clerk (FDC) without much delay, creation of a post of one typist-cum-clerk and a gazette assistant, adequate supply of stationery, printed report forms and registers and the provision of a typewriter and a duplicating machine. Regarding the system, the suggestions were related to avoiding delay in replying the communication and maintaining proper recording, or filling or routine systems at DHO so that repeated communication or sending duplicate reports could be avoided. Some of the reminders could be avoided, if enough time was given for reply.

Discussion

In the hierarchy of health services, the district health office and the primary health centers occupy a significant place since the various health benefits to the people are channeled through the primary health centers under the overall supervision of the district health office, which involves

a continuous communication process. Communications cover various aspects like administrative matters relating to manpower management, establishment, finance, implementation of health programmes, health care and its supervision and health intelligence.

It was expected that the district health office vested with the responsibility of implementation and supervision of health programmes would issue a large number of communications. The frequency of communications on implementation and supervision of health programmes was quite low,

Further, it was observed that more than 50 per cent of the written communications were addressed to all PHCs which indicated the minimal assessment by the DHO on the specific performances of the individual PHCs. To maximize the efficiency of health programmes, constant supervision, guidance and suitable corrective actions are essential on individual PHC performance. More communications on the above aspects from DHO to PHC will greatly improve the efficiency of health programmes.

Apart from issuing written communications, the holding of monthly meetings both at DHO and PHCs has come to stay as a permanent feature to review and assess the performance and problems of field staff. Thus, these monthly meetings served as a forum for communication between higher officers-and the field staff and *viae versa.* The deliberations of these meetings included several verbal communications on Important and routine matters involving instructions, guidelines etc. The minute's book maintained at the DHO and the PHCs contained only very brief recording of the deliberations of the meetings. Thus, a large part of the discussions on health intelligence, administrative matters, etc. remained unrecorded. There is a great need to record the details of discussions and decisions arrived at in the minute's book and their communication to concerned staff for necessary compliance.

Another feature observed was that the maintenance of outward and inward registers were not complete since many of the communications from DHO were not duly entered in the outward register while they were found in the PHC. In this connection, it may also be mentioned that the maintenance of files at DHO was not properly followed. Filing of the office

copies of the letters Issued were not done uniformly, A similar situation prevailed in the primary health centers also. Such a situation may weaken the communication system and the programme administrators were handicapped with inadequate and outdated information.

Some of the reasons for such a situation are inadequate ministerial staff for long periods, posting of untrained persons in the secretarial practices, lack of adequate stationery items, etc. The success of communication system depended on the availability of adequate trained ministerial staff, stationeries like paper, files, registers and type- writer and office equipments like furniture, etc. It is, therefore, very necessary that the various PHCs should be posted with sufficient trained ministerial staff and field workers for programme activity s. Administrative action for filling of vacant posts should bedone expeditiously. Unless the above basic requirements provided to a satisfactory level, any communication system developed on scientific lines may suffer considerably and thereby affecting the implementation of the health programmes and functioning of the district health administration.

In this connection, it may be mentioned here that for the purpose of National Tuberculosis Programme, the National Tuberculosis Institute (NTI), Bangalore has been imparting training to medical officers and other Para-medical personnel in the health intelligence system specific for this programme, and also supervision methods. Job manuals for each category of personnel have been prepared for day-to-day guidance which would be highly useful in performing their functions in the right manner. The use of manuals by the health workers would greatly eliminate unnecessary communication besides helping quick delivery of health benefits to the suffering people.

In the light of the recently introduced multipurpose health worker's scheme to cover the various health programmes, there is need for developing a rational communication system for satisfactory administration of health programmes.

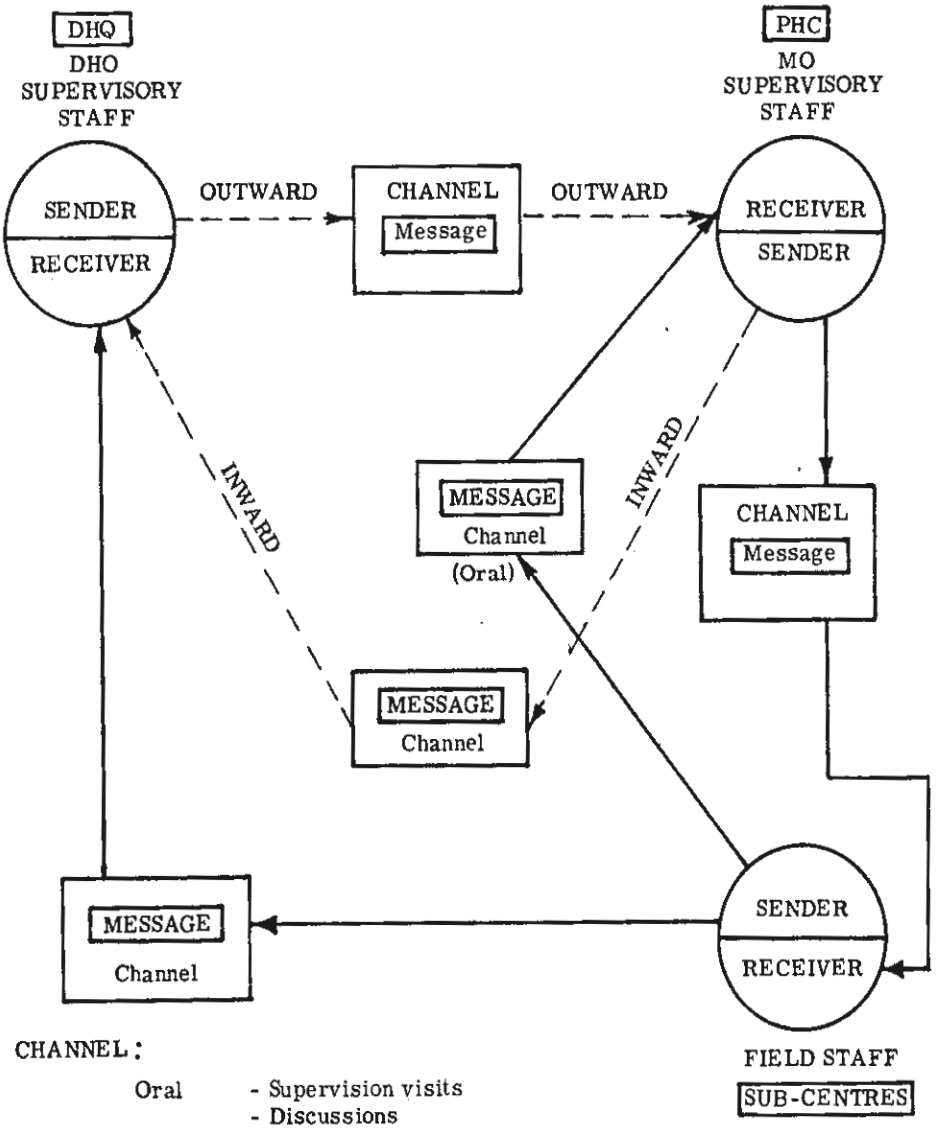
Acknowledgement

This study could not have been possible without the active cooperation of the District Health Officer, Bellary District and his staff at District and PHC levels. Our thanks

are also to the Director of Health Services, Karnataka for permitting to conduct the study, to Mrs. R. Narayan, Mr. Naganathan of NTI for their helpful suggestions, to Mr. Mehter M. Islam for the collection of data and the statistical assistance and to Mrs. Kamala Ratnaswamy for secretarial help.

APPENDIX

COMMUNICATION MODEL



CHANNEL :

Oral
- Supervision visits
- Discussions
- Monthly meetings

Written
- Letters/Memorandums/Circulars/Office orders
- Reports

Health and Population
- Perspectives & Issues 4(1):79-85, 1981

PERCEIVED MORBIDITY, UTILISATION OF HEALTH SERVICES AND FACTORS AFFECTING IT IN A RURAL AREA

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ABSTRACT

A survey of perceived morbidity was carried out in rural population in eight villages and four wards of Saoner town covering a total population of 8*876. The nature of illness was assessed by weekly visits to- the families. History regarding treatment taken for disease and its source was taken.*

The overall incidence of perceived morbidity was 176.35 spells of sickness per 1000 population per month. Health care agency was contacted for 36.7 per cent spells of sickness.

Utilization of health services was found to be affected significantly by factors like age (X^2 = 138.36) literacy (X^2 = 14.123)* type of occupation (X^2 = 433.74)* nature of illness (X^2 = 83.578) and accessibility of health services.*

A health behavior model of the population has also been discussed in this paper.

Health care utilization is concerned with the extent to which personal determinants of health and health behavior, such as psycho-biological, social and behavioral factors, affect the use of health services and how this relationship is modified by selected characteristics of the prevailing health services system. The objective of the present study is to examine the relationship of these factors *vis-a-vis* utilization of health services.

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Materials and Methods

Perceived morbidity has been taken as an indicator of ill-health for reasons explained in subsequent paragraphs. The study was carried out at health unit Saoner which is a rural field practice area attached to Preventive and Social Medicine Department of Government Medical College, Nagpur, The study covered eight villages included under family care programme and environmental sanitation promotion programme and four wards of Saoner town. The total population covered is 8,876.. The house-to-house visits were carried out to gather information on age, income and occupation of family members. After this information was collected, weekly visits on fixed day of the week were carried out by a Para-medical worker. A responsible member of the family was asked to recall whether any member of the family had any health complaint, howsoever, minor during previous week. The details of symptoms, their duration and severity were recorded. Enquiry was also made whether the patient had taken any treatment, if so, wherefrom. If some record was available, information supplied by the patient was verified and corrected from the records. If the duration of illness was more than a week, care was taken that same person for the same spell was not included during next week's resurvey. Thus, all families were visited at least four times in a month.

Results

Table 1 shows the number of families surveyed In the area and number of visits paid. There were 1,447 spells of sickness. The incidence of spells is 176.70 spells per thousand populations per month. Out of 1,447 spells of sickness, information regarding utilization of health services could be obtained only for 1,441 spells. The further analysis pertains to this population only. Out of 1,441 spells health care agency was contacted during 529 (36.7%) spells only.

Table 2 shows that utilization of health services depends on age. The difference between various age groups is statistically significant. The children are taken to health care agency more commonly than the adults.

Education of a person is an important determinant of values, beliefs', attitudes and goals. Since these factors

TABLE 1

TABLE SHOWING THE VILLAGES SURVEYED, PERIOD, POPULATION AND SICKNESS SPELLS

Villages	Period	Census population	Population surveyed	No. of families	No. of visits	Spells
	1978					
Rampuri	January	593	576	128	507	117
Malegaon	February	1,172	1,162	232	950	225
Khursapar	March	433	434	63	242	59
Pandharakhedi	April	307	302	41.	168	48
Patkakhedi	May	567	517	107	403	111
Bhedala	June	826	823	134	518	196
Borujwada	July	397	361	94	317	118
Manegaon	August	570	487	132	328	94
Saoner						
Ward No. 18	September	1,051	1,024	113	419	168
Ward No. 19	October	971	917	110	398	74
Ward No. 2	November	1,294	865	118	190	128
Ward No. 4	December	695	721	86	334	109
Total		8,876	8,189	1,240	4,474	1,447

TABLE 2
AGEWISE DISTRIBUTION AND UTILISATION OF HEALTH SERVICES

Age In years	Health Services				
	Utilised		Not utilized		Total
	No.	%	No.	%	
0-5	166	31.4	133	12.39	279
5-15	204	38.6	264	28.95	468
16-55	121	22.9	482	52.85	603
55 and above	36	7.1	53	5.81	91
Total	529	100.0	912	100.00	

$X^2 = 138.336$ $P < .01$

influence behavior, education influences the use of health services through similar mechanism. Generally speaking, better education leads to a better understanding of one*s environment including disease and processes related to it. Table 3 shows that educated persons avail themselves of health service more frequently than those with little education. Educated persons perceived morbidity and benefits of health care differently from those with little formal education, all other things being equal (Table 3).

Table 4 shows that there is greater association between the type of occupation and health services utilization.

Table 3

LITERACY STATUS AND UTILISATION OF HEALTH SERVICES

Literacy	Health Services				Total
	Utilized		No utilized		
	No.	%	No.	%	
Illiterate	76	14.4	152	16.66	228
Primary	212	40.10	390	42.76	602
Secondary	54	10.2	77	8.44	131
Matric	187	35.5	293	32.12	470
Total	529	100.0	912	100.0	1441

X2 - 14.1232 P < .01

TABLE 4
TYPE OF OCCUPATION AND HEALTH SERVICES UTILISATION

Type of occupation	Health Services				Total
	Utilized		Not utilized		
	No.	%	No.	%	
Self employed	156	29.489	27	2.96	183
Service	166	31.379	61	6.89	227
Daily wage earner	207	39.13	824	90.35	1031
Total	529	100.0	912	100.0	1441

X^2 - 433.74 p < 0.01

Occupation of an individual affects the health services utilization in many ways. Most important are the economic factors which enable him to meet the expenses on account of sickness. The capacity of family to meet these unusual expenses depends on factors like savings with the family which is affected by source of income. A daily wage earner having limited income which is just sufficient to meet his daily necessities can hardly save for, such accidental expenditure on health services utilization.

Certain types of social security facilities can be availed of by persons who are in service, such as facilities like sick leave without having monetary loss. A daily wage earner is likely to lose his wages on account of sickness which refrains him from utilizing health care service unless labor and minimum wages acts protect him.

Table 5 shows that intensity of illness affects utilization of health services. More the severity, the higher is the degree of utilization.

Social dysfunction as measured by inability to perform usual occupational, domestic, educational or social activities because of being bedridden or ill health which restricts

TABLE 5
NATURE OF ILLNESS AND HEALTH SERVICES UTILISATION

Nature of illness	Health Services				Total
	Utilized		Not utilised		
	No.	%	No.	%	
Severe	158	29.87	129	14.14	287
Moderately severe	209	39.51	297	32.56	506
Mild	162	30.62	486	53.289	648
Total	529	100.00	912	100.00	1441

X^2 - 83.579 $P < 0.01$

Severe illness = Bedridden for any duration or chronic symptoms more than 7 days
Moderately severe = Impairement activities
Mild = Normal activity with symptoms

normal activities is an important determinant deviation from state of health. The intensity or severity of morbidity is affected by composite factors which reflect the reported extent to which the respondent is bothered, worried or concerned about the physical or emotional distress associated with health problem.

Availability or accessibility of health care is an important determinant of use. If health care is available at low cost and is accessible to the needy (defined as time required to travel to reach the health care centre) then it has been observed that the facility is availed of to a greater extent. The accessibility or ease with which the care is received has two dimensions (1) distance, (2) transport means, whenever the distance required to be travelled is small or efficient means of transport and communication are available, health services are easily availed of.

Discussion

The use of health services Is a major tangible expression of the demand, though not of need, of health services. The use of health services can be universally and readily recognized by both providers and consumers. Perception of illness, not the disease, prompts the person to complain, to consult a health worker and seek care. Interactions between family, friends, employers and neighbourers may influence health behavior, such as whether to assume sick role, to participate In formal medical care process or whether or not to consult the practitioners of other medical systems.

TABLE 6

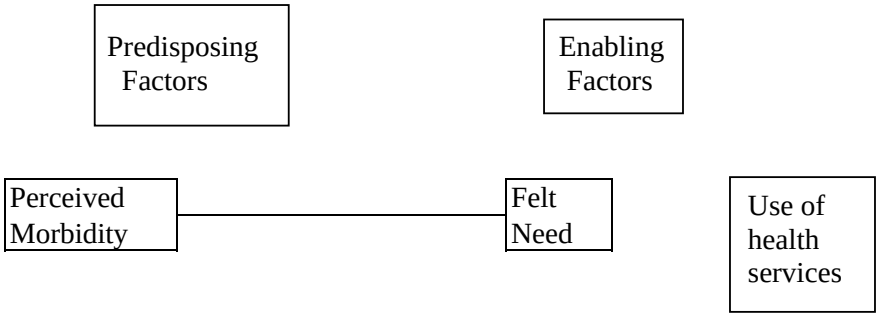
HEALTH FACILITIES UTILISATION AND AVAILABILITY OF HEALTH SERVICES

Facility	Health Services				Total
	Utilized		Not utilized		
	No.	%	No.	%	
Availability in same village	407	76.94	453	49.67	860
Not available in same village	122	23.06	459	50.32	581
Total	529	100.00	912	100.00	1441

X^2 - 100.87 P <0.01

Medical care is sought not only to correct the disturbance in the individual's internal psycho-biological system but also to correct disharmony between it and the external social system.

CONCEPTUAL MODEL SHOWING RELATIONSHIP BETWEEN PERCEIVED MORBIDITY, PREDISPOSING AND ENABLING FACTORS AND UTILISATION OF HEALTH CARE



Once people have reasons for seeking medical care -*i.e.* perceived morbidity, the choice of using health services is influenced at the individual level by socio-cultural factors that predisposes the use of formal health services (predisposing factors) and by the. cost of pursuing that cause of action (enabling factors). The term cost is used in broader context which includes convenience and opportunity cost as well as the financial cost. Enabling factors also include expenditure such as transportation, expenditure of energy and effort and losses due to absence from, work and other desirable activities.

The perception of need does not lead to use unless the need itself is of sufficient severity to warrant action and unless the resources are perceived to be appropriate, sufficient, available, accessible at the cost which consumer can afford to bear. This decision-making appears to be a process in which the individual moves through stages. Perception, therefore, is a complex interaction of past experience, factual knowledge, scientific orientation and other personal factors like education and income. The relationship is cybernetic because the decision to seek or ignore the health services system and the level of entry, in turn, affects further behavior in response to perception of the same needs.