CHAPTER 17

MEDICAL ASPECTS OF THE OCCUPATIONAL ENVIRONMENT

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The Role of The Physician

Elucidation of Human Parameters of Response. The health of man in the working environment is the central theme of occupational health. While measurement of atmospheric concentrations of an environmental pollutant, per se, in the work place is of interest, it has little relevance to occupational health except in terms of what it means to man's health and well-being. Hence, measurements of environmental contamination must be evaluated in terms of their effects, or lack of them, upon humans. In order to elucidate the effects upon man of potentially deleterious physical or chemical agents found in the work place, the physician, as a specialist in human biology, must provide and interpret such "readouts" of human response. Only then can the main component of this "agent-host" interaction be defined. Only within such a frame of reference may the ultimate significance for man be ascertained of such quantifications of occupationally encountered biological, physical or chemical agents.

Promotion of Human Health. The physician's role in occupational health cannot be that of a mere passive interpreter of human response. He has a positive responsibility for utilizing his special expertise in conjunction with his societal status to actively promote health in industry. One aspect of this responsibility relates to occupationally-related disease and injury; the other to prevention, where feasible, of non-occupational health deterioration; e.g., diabetes or glaucoma detection. Regarding the former, the physician must be prepared to extend his capacities so as to detect early, even subclinical responses; in addition he must be unhesitating in his readiness to insist upon management's taking notice and acting upon his recommendations for amelioration and control of the working environment. In the industrial environment, the *ex cathedra* stance carries only limited impact as compared to the private practice physician-patient relationship. It is because of this reality that the physician requires all the available facts to buttress his opinion. Here the industrial hygienist with his quantitative evaluation of the situation provides the irreplaceable other portion of the equation, "man + agent = effect."

As to the physician's responsibility for prevention of the deleterious effects of non-occupational disease, here his duty parallels usual medical functions elsewhere. However, by virtue of the physician's place in the industrial setting, he has several advantages over the practitioner in the private sector. This largely stems from his knowledge of human interactions in the work place; he is in a unique position to evaluate the social as well as the physical demands made upon the worker in industry. Thus, hypertensive cardiovascular disease is a process which is not purely biological; its course is affected by the transactions between the patient and his socio-economic environment. A not insignificant segment of this environment is constituted by that setting in which the worker spends approximately one-fourth his life span, i.e., the work place. Operationally, this gives the physician the opportunity to manipulate within limits the human environment within the work place so as to favorably influence the course of the employees' health and well-being.

The Role of the Nurse

The nurse is the "front line" worker in occupational medicine. It is the nurse whom the worker meets 90% of the time when he encounters the medical department. She must be ready to keep a highly "tuned" ear. Information bearing upon the work environment or the individual's health will be imparted to her long before it is transmitted to others. Therefore, as the eyes and ears of the medical department she must guard against "tuning out" worker plaints and statements. Given human tendencies for just such response after years of listening, both the physician and nurse must be constantly alert to prevent the development of a hardened, unsympathetic auditor. While suspending value judgments as regards the merit, — or lack of same, — of employee complaints is difficult, nevertheless all such information inputs contain some value, positive or otherwise. Workers perceive through the nurse the attitude toward them of the medical organization. If they conclude that their statements are consistently ignored, disputed or denied, soon this invaluable intelligence concerning the total work environment within the plant will disappear. From these facts stem the reality that the actions and treatment afforded by the industrial nurse will primarily determine the effectiveness of the medical department.

However, the nurse is not merely a passive reporter. While not implying that she is practicing psychiatry, nevertheless as a skillful listener she fulfills many of the requirements for promotion of mental hygiene. As a sympathetic auditor, she provides the opportunity for verbal ventilation, a significant part of the therapist-patient transaction.

Beyond even this role, the nurse is being given greater responsibilities in worker evaluation. Many more components of the pre-placement and periodic medical evaluation process are being relegated by the physician to the nurse. While restrictions imposed by various of the Medical Practice Acts must be observed, nevertheless with the aid of new automated devices many of these examinations are being performed by the nurse. Execution of the amanuensis by use of appropriately designed printed forms can conserve significant portions of physician time. Indeed, it appears that given sympathetic listening, such historical portions of the medical examination can be more effectively performed by the nurse rather than the physician.

The Role of The Industrial Hygienist

As alluded to previously, the physician in private practice can frequently assume an authoritative relationship with the patient. However, in the world of business and industry decisions are usually made and action taken upon the basis of quantitative objective parameters. While by the use of clinical laboratory modalities the physician can provide many mensurable descriptions of human response, such data may or may not be a reflection of work environment-induced biological change. For example, while anemia may result from chronic benzene absorption, it may also stem from non-occupational medical causes. Thus, in any determination of the reality of possible benzene exposure, it is necessary to know whether sufficient benzene was present in the work environment to cause the observed anemia. Only the industrial hygienist can provide this necessary environmental quantification. Without this information it should be readily apparent that the physician can only guess at causal relationships between the worker's condition and the work place. Such "guesses" are not considered, and should not be, sufficient basis for action by industrial management.

The Need for Coordination of the Work of the Medical Team with the Industrial Hygienist

Evaluation of the Host-Agent Interaction. It should be apparent from the foregoing that measurement of environmental parameters, while intellectually interesting, has little relevance in industry except in terms of its human health implications. It is equally clear that human biological response is usually non-specific in nature. It is only when these two components, environmental and biological, are interdigitated does reality emerge. Accordingly, both medical personnel and industrial hygienists have their contribution to make in elucidating this reality. Since the host-environment interaction is a dynamic ever-changing relationship, an on-going relationship must be developed and maintained between these two disciplines, medicine and industrial hygiene. From the results of such quantitatively validated investigations appropriate engineering and medical control programs are developed.

Evaluation of the Efficacy of Occupational Hazard Control Programs. In response to validated needs for industrial hazard control, engineering measures (e.g., ventilation, enclosure, etc.) are instituted. Despite the highest quality of engineering design and performance, because such measures are controlled, operated and maintained by men, human imperfections impose themselves upon the efficacy of such controls.

While physical and chemical measurements of the effectiveness of such approaches to hazard control are useful, once more their relevance to the ends desired are man-oriented. Therefore, the adequacy of control performance must be measured in terms of human protection or its lack. Once more, the inputs of the biological scientist (the physician) and the physical scientist (the industrial hygienist) are required to round out the entire picture. Only by coordinating their interrelating investigational data can these two contributors to industrial health control be effective. Since these interactions may be long-term as well as immediate, adequately coordinated record systems must be developed. Such systems must not only provide records of events, they must be so designed as to provide adequate and early signals of ongoing failures or inadequacies of control systems. Once more, coordination of medical and work environment data must be carefully built into such recording methods.

Detection of New or Potential Problems. Among the greatest challenges to occupational health is the delineation of new occupational hazards. Early warning systems for new health conditions arising out of the working environment have only infrequently been achieved before harm has been done. As quantitative environmental and biological indicators develop greater sensitivities, the potential for detection of a problem before human harm occurs becomes more feasible. With thousands of new chemical agents entering the industrial scene there is an increasing opportunity for development of new knowledge as well as for preventing human damage. Only by coordinating the activities of the medical and industrial hygiene components of the occupational health team will this potentiality be realized.

The Special Qualifications of the Physician Specialist in Industry

Preventive Medicine in Industry

1. Primary prevention

(a) Definition: This has been defined as the prevention of the occurrence of disease or disability arising from pathological processes. While its accomplishment in relationship to the usual chronic or degenerative disease process has been less than spectacular, the potentials for realization of the concept of primary prevention are uniquely feasible in the industrial setting.

(b) Applicability to environmentally induced disease: While the mechanisms responsible for the common degenerative disease processes (e.g., cancer, heart disease, diabetes) remain obscure, the etiologies of environmentally induced diseases are relatively accessible. Thus, if the etiological agents causing occupational diseases can be prevented from contacting the human host, a potentially pathologic process can be totally prevented. Within the limits of an adequate perspective, one cannot imply that certain biological variables, e.g., age, sex, nutritional status, do not affect the course of an agent-host interaction. These variables, and other poorly defined, genetically controlled factors, will also affect the human response. But while the importance of these determinants of human response to environmentally encountered agents cannot be disregarded, the intrinsic potency of occupational chemical or physical agents can be prevented from being expressed. The knowledge that such agents are capable of inciting human damage upon absorption leads logically to design of measure directed toward prevention of this event. This in turn requires that the physician have the capability of *quantitatively* determining which level of contaminant presents no health hazard (viz., the "no-effect" portion of the dose-response relationship) so that control design criteria can be developed.

Another potential method of primary prevention depends upon detection of special susceptibilities of individual workers to certain occupational hazards. Obvious examples, such as crane operators with inadequacies in their visual fields, come to mind. More subtle potential opportunities for prevention arise out of detection of inborne defects in certain metabolic processes, e.g., a "serum antitrypsin," activity defect which interferes with normal cleansing of the lungs, should preclude such workers' contact with pulmonary irritants.

(c) Limitations in primary prevention: One considerable limitation placed upon the efficacy of primary prevention stems from the fact that at present there are few existant physical or clinical laboratory indicators of special susceptibility to environmental agents. Thus, which worker, upon exposure to benzene, will develop a leukemic response cannot be adequately predicted; similarly, predictors of special susceptibility to low back injury are not existent.

2. Secondary Prevention

(a) Definition: By secondary prevention we refer to the precluding of progression of disease or disability resulting from some pathologic process.

(b) Work and disease acceleration: While the causation of the usual degenerative disease process rarely directly results from occupational exposure, there is sufficient reason to believe that certain work demands may unfavorably influence the course of common degenerative disorders. Thus, the requirement of the brittle diabetic for strict and regular dietary control makes rotating shift work difficult for such an individual. The anxiety, physical and mental strain associated with jobs requiring rapid, weighty decisions or excessive travel may aggrevate coronary artery disease. Workers with chronic bronchitis hardly make fit candidates for jobs wherein there exists risks of exposure to pulmonary irritant gases and vapors. Since medical evaluation can detect such individuals, even though medical measures have not prevented the occurrence of such disease processes, exclusion from such risk can prevent acceleration or aggravation of those pathological processes.

(c) Limitations upon secondary prevention: As previously discussed, it is our inability to predict response or understand the inherent nature of many diseases which limits our ability to prevent disease. Similarly, in many cases which factors associated with work or a pathologic process may accelerate or aggravate such conditions also remain obscure. Furthermore, peculiar to the problem of prevention at the secondary level is the fact that such activity is usually most productive when directed to an early stage of development. Accordingly, effectiveness here depends upon preexistence indicators of minimal or subliminal disease; unfortunately our abilities in this regard are at present somewhat limited.

Understanding the Patho-physiology of Human Response to Environmental Change

1. Physiological principles

(a) Mechanism of human response: While previously discussed (see Chapter 6) extensively, some mention of the interplay of homeostatic mechanisms should be reviewed. Because the human organism lives within a dynamic ever-changing environment and receives a constant stream of external stimuli, the ability to adapt to such continuous change is a necessity of existence. In effect, this means that the body must be able to change the rate at which various activities were previously occurring.

While physiologically at the whole organ level of organization this is readily perceived, e.g., as a tachycardia in response to running, at the cellular level similar changes in rates of metabolic activities must occur. Similarly as with the previous example, until an optimal new rate which meets the new demand is achieved, activity may overshoot and then compensate by slackening in attempting ultimately to ascertain what the optimum might be. Thus oscillation about an optimum rate, i.e., the eventual new steady state, has been characterized as a "hunting phenomenon." This control system also has an information gathering component which reports all activity changes to control centers; the latter, in response to such information directs the activity to hasten or slacken. In turn, it is receptive to new information which assesses the result of the control center's previous directions. In effect, what we have described is a self-regulating dynamic system.

It should be emphasized that this system can meet new conditions within limits. Essentially, the rate at which it may function has finite limits, i.e., "rate limits," at all levels of biological organization. It is such "rate limits" at the cellular level which determine the response of the body to agents encountered at this level. Among the most prominent at this level of organization are the physical and chemical agents; these rate limits are at the heart of such encounters which constitute the science of toxicology.

2. Toxicologic principles

While these are described in more detail in Chapter 7, review of the dose-response relationship is especially pertinent to the role of medicine in industry. The physician clearly recognizes that the effectiveness of therapeutic agents are a function of the quantity of a medication given as well as the time period over which such agent is administered. However, for unknown reasons the same considerations are not usually applied to non-therapeutic elements, e.g., lead. In short, "poisons" are considered to be "poisonous" regardless of dose and time consideration. Regardless of such a viewpoint, the fact remains that the same dynamic principles of dose and time apply to *all* elements or compounds entering the bodily economy. That is, when the organism encounters a material in its internal milieu, as long as too much is not presented over too short a time period, i.e., the body's rate limit for handling such a compound is not exceeded, such a foreign material will have little if any effect. *For most practical purposes, this appears true regardless of the material.* That this must be the case is reflected in the fact that sophisticated analysis will find all 92 original elements in the body. It should, therefore, be apparent that the dose-response relationship (Chapter 7) is basic to an understanding of the effect of "foreign" elements or compounds in the body.

(a) Measurement of response or body loadings

The numerous methods utilized by the body to bind, transport or readily excrete a foreign element have been reviewed in Chapter 7. Thus detoxification mechanisms which depend upon the formation of polar conjugates, e.g., glucuronates, sulfates, also present an opportunity to measure the body's effectiveness in dealing with a chemical. Measurements of such or similar metabolites in various body excreta provide a readily utilized technique to both detect such responses as well as measuring any effectiveness of metabolic handling.

Similarly, certain non-polar solvents, because of their low solubility in blood (essentially an aqueous medium), readily diffuse from the lungs upon cessation of exposure. This too can be measured to gain insights into the amounts which have previously been taken up in the body. Following the breath concentration of such solvents as they leave the lungs over a time course permits even more exact estimates of such body loadings.

Other possible indirect measurements of body loadings may be elucidated by measurements of altered bodily functions induced by such foreign materials. For example, exposure to SO_2 will produce bronchial constriction; the increased airway resistance which ensues can be readily measured and the amount of effect determined.

While this last measurement can be derived from human experimental exposures, at least at relatively low concentrations, other metabolic insights frequently require analysis and extrapolation from animal data.

(b) Extrapolation from animal data

(1) Values

By loading animals with varying concentrations of toxic materials, both the threshold for effect as well as related excretory and metabolic handling rates can be ascertained. Data require the study of multiple species, since some of these animal species may not handle certain agents in a similar fashion as man; nevertheless, where sufficient data are collected such information *may* be applicable to setting levels which are not deleterious as well as determining the rates at which man might safely handle such material (see Chapter 8). By construction of appropriate curves describing lung excretion over time periods, it is possible to estimate from similar curves in exposed workers the quantity of a chemical they have absorbed; thus the means of estimating risk as well as identifying the absorbed agent, can aid the occupational health team in determining its course of action for both treatment and prevention. That is, this latter end can be achieved since indications of overexposure suggest the failure of established control measures.

(2) Limitations

Unfortunately, the use of animal testing to predict human response has limitations arising from the fact that man is a higher and different mammal from species used for such test purposes. This problem in extrapolation from animals to man is exemplified by the fact that because of metabolic pathway differences, aromatic amines, e.g., beta naphthyl amine, which clearly produce urinary bladder tumors in man, have not such effect in rats, mice or other rodents. Likewise sensitization processes, e.g., to toluene diisocyanates, which occur in man, cannot be reproduced in animals. Accordingly, in view of such extrapolation problems negative results found after animal exposure to toxic chemicals is no guarantee of safety to man. Though this risk may be minimized by testing several different species, the results of such investigations must be applied to man with caution.

Understanding Manufacturing Processes

1 Periodic plant inspection

(a) As with production and management personnel, the physician in industry should be totally aware of everything that occurs in the plant from its roof to sub-basement. In order to place any human aberration in its occupational context he should be familiar with every step of every process in the plant. In order to attain such understanding, it is useful if plant tours be made with technical and production personnel who can explain any ramifications of any process, work station relationships, job requirements, material used or product produced within the plant. This may require an understanding of chemistry, physics or mechanics which such personnel can impart. The physician must be familiar with every job, its title (official or otherwise) and demands in order to visualize it when such are referred to by workers who come to the medical department. Since every industrial plant is a dynamic, organic entity, what occurs within the plant is subject to constant change. Accordingly, such tours should be frequent and regularly repeated.

(b) Plant tours can be of even more value to the physician if carried out with an industrial hygienist. Many of the health ramifications of materials and processes which are unknown to production or other plant technical personnel can be readily recognized and their significance estimated by industrial hygienists. For example, while the safety hazards of Stoddard solvent are self evident, the industrial hygienist should recognize and be prepared to answer the question of how much benzene may be present. Furthermore, by careful use of environmental measurement devices in the plant, he comes to be recognized as having a responsibility for protecting health. Such tours with the industrial hygienist, and especially working tours, serves to demonstrate to employees that there is a serious team effort directed toward making the work place safe and healthy (see below).

The Position of the Physician in the Management-Labor Relationship

1. The honest broker

The physician, as a staff member of the management group, does not have executive responsibility (except in the medical department) within the plant hierarchy. As any other staff person, he is essentially an advisor, with management having the executive rights and responsibilities for action. Thus management need not heed the advice of any staff member, although if untoward results ensue it is the executive who is held responsible. While it is obvious to much of management that technical advice, e.g., engineering, marketing, etc., should be heeded, this occasionally may not be so apparent to management as regards medical questions. Since the executive is subject to multiple pressures and demands, frequently they may be inclined to "trade-off" long-term requirements to solve "short-term" needs. Thus, it can be seen that while production requirements make immediate demands on management, that on occasions when health or safety requirements might impede production, they might be induced to "short-cut" such inhibitions upon production.

While top management most frequently can see the long-term objective, the daily demands imposed upon middle or lower management more frequently leads them to such "short-term" observations. While this is yet another reason why the medical departments should report at the highest levels, this does not relieve them of the responsibility for vigorously presenting the rationale behind their judgments.

Most assuredly, the position and responsibility of the medical organization is to consistently promote all activities designed to protect employee health and welfare. This reinforces the fact that as a staff individual, given the responsibility for health and welfare, he should take a position based upon only these questions. While such health controls as are required to meet these demands may indeed intrude upon "short-term" production requirements, these latter requirements are clearly *not his responsibility,* and should not intrude upon professional judgments. Thus the medical department should be the "honest broker," always acting upon the basis of health need requirements. While this may make for some short-term problems for management, if such health and safety positions are soundly based they are more profitable for all concerned in the long-run. If such a consistent position is taken by the medical department, the trust of all — management and labor — will follow. If the medical department thus sincerely follows up all health and safety problems brought to their attention by employees, such a position of integrity is further re-inforced. Both the physician and the industrial hygienist have their responsibilities for equitable, fair and consistent evaluations based upon facts, uncolored by either the desires of management or labor.

2. The medical department and the confidence of labor and management — privileged communications. All information dealing with health and welfare matters should be treated carefully and within the context of a written management policy. Personal medical questions especially should be dealt with as priviledged information. Thus the "need to know" should govern how information is handled, e.g., while personal medical details are not necessary for the ends of management, such information should only be made available in terms of management needs and comprehension. Therefore, *detailed* information describing the medical status of any individual is neither needed nor useful to management. The functional ability of a worker in terms of his ability to do a specific job is pertinent and necessary. Similarly the relationship of health hazards to production rather than the intimate medical details of the situation, are required by management.

MEDICAL APPROACHES TO CONTROL OF THE OCCUPATIONAL ENVIRONMENT

Medical Examination Procedure — A Re-Orientation of Medical Practices

The historical examination. While medical practitioners generally have been trained to reflexly think in terms of the diseased patient, in the industrial setting it becomes necessary for him to appreciate that he is dealing in the main with essentially healthy individuals. While the historical examination of any person should consider him in terms of deviation from normal, it is also important to evaluate the worker in terms of his functional, total health status. Accordingly, it becomes appropriate to carry out the medical history by use of self completion questionnaire. Thus, not only is greatest economy of physician time and cost achieved, it is possible for him to readily obtain an entire health inventory. This is in contrast to the usual situation wherein an individual consults a physician because of some health complaint, and the historical examination becomes oriented to elaboration of some specific pathologic process, affecting a specific organ system.

The physical examination. The same principle as elaborated above applies here also. Thus, investigations directed toward the whole person rather than toward a single organ system directs the physical examination. It should, therefore, be obvious that in dealing with the relatively HEALTHY person the physical examination should take another form. For example, in a cost-yield basis the relative cost of percussion and auscultation of the chests of large numbers of individuals is high in terms of the information obtained. Thus, for large numbers of persons it becomes less costly, for example, to obtain a chest X ray and a timed vital capacity determination rather than to laboriously perform a chest examination. This is especially true since essentially the same information is obtained. Thus any deviations obtained by such a "screening examination" can be followed up by the usual more elaborate examination procedures. Certainly, in view of the relatively few deviations expected in an essentially healthy population, such procedure has its obvious cost-effectiveness savings and yields.

Much of the physical as well as historical examination can be performed by paramedical personnel. With the rapid development of medical-electronic investigative techniques, increasingly more of the examination can be achieved by these means.

Use of the clinical laboratory for examination of ostensibly normal individuals. Our increasing capability to inexpensively and rapidly carry out clinical laboratory tests makes use of such determinations ever more fruitful. As automated laboratory procedures develop, the per unit cost decreases. In this fashion, a complete health profile can be more adequately and rapidly achieved. Problems arising out of the work environment may cause changes which can be detected by tests, such as multiphasic examination (i.e., medical, laboratory). This profile provides a useful baseline which aids in the detection of any possible subsequent health deviations. Should any physical or chemical agent produce health change, a health profile previously obtained has obvious comparison values for use in the control of health hazards.

Where small numbers of workers are involved, consideration should be given to the purchase of multiphasic laboratory services. The cost per worker for such services in this case will be far less expensive than the cost of setting up a laboratory. Accordingly, medical services for small plants should seriously investigate contract proposals and performance of such commercial laboratories.

The Pre-Placement and Pre-Employment Examination

Philosophy and Purposes. The basic purpose of the pre-placement examination is to determine the capability of the job applicant to perform a specific job for which he is to be hired. Thus such an evaluation is directed toward *capabilities, not disabilities.* While not all employees necessarily require testing of color perception, such evaluations become highly pertinent for workers for jobs requiring this adequacy; e.g., in color printing, color-coded electrical wiring, etc. While this theory applies in part, in reality many corporations recognize the point that they accept the *whole worker* with all his immediate health problems and possibly his long-term medical problems. This becomes especially pertinent as more and more of health and medical benefit costs are assumed through employer purchased health insurance. Accordingly, pre-placement examinations increasingly have become pre-employment examinations, so that total health evaluation becomes increasingly the rule.

Nevertheless, there is still required an evaluation of physical and psychological capabilities to perform a specific range of jobs. It therefore becomes necessary for the medical department to determine that a prospective employee does not have a pre-existing health problem that can be aggravated by his expected range of work duties. What has been previously stated regarding the use of electronic medical modalities and paramedical personnel applies equally here. However, it still remains the responsibility of the occupational health team to be fully cognizant of the job requirements and work environment so as to design an appropriate examination regimen. This once more underlines the necessity for the occupational health group to be comprehensively knowledgeable concerning any and all jobs, their peculiarities or needs within the plant.

Values and limitations. While fitting the right man in the right job is the aim of these examinations, the limitations inherent in this procedure must be recognized. These largely stem from the limitations inherent in medical prognostication of special susceptibility or inherent biological risk. The inability to clearly determine which individual possesses an inherent weakness of the lower back immediately comes to mind. Certainly the present inability to clearly evaluate the state of psychological fitness of an individual to fit into a specific social and physical environment presents even more serious problems. Recognizing these inherent weaknesses makes even more apparent the need for periodic re-evaluation of workers.

Job restrictions and transmission of information to management. Once more, the executive is primarily interested in being informed of the job applicant's ability to do a job. Accordingly, all *medical* information derived from such examinations *should remain privileged information,* inaccessible to all but medical personnel. Management should be fully informed of job abilities; *why* limitations are necessary in terms of specific *medical* diagnoses is neither necessary to his needs nor pertinent. Management should be kept informed *through established channels* (usually through the personnel departments) largely in terms of fitness to do a certain job. If medical conditions require job limitations or restrictions, such restrictions upon activities should be clearly and simply stated; the medical details as to "why" should not be divulged.

The purpose of these job restrictions is to prevent deleterious effects upon the employee's health. Since each person undergoes dynamic changes with time, the medical department has a responsibility for following and re-evaluating the appropriateness of such restrictions as time passes. As regards the need for follow-up of individuals placed under job restrictions, plant tours will also serve to determine whether the persons with restrictions are performing in appropriate jobs. As for re-evaluation, this too requires periodic re-examination to determine the current appropriateness of work restrictions previously applied.

The Periodic Health Examination

Philosophy and purposes. As related to the working environment, present limitations in our knowledge of human response to environmental changes requires that the periodic re-evaluation of exposed workers be performed. Thus, early detection of health changes becomes the primary orientation of this examination. In addition, because of the inexorable course of aging, those responsible for health protection need detect such changes so that work conditions do not accelerate or aggravate the aging process.

Method of execution. General health maintenance: Too often the pathology oriented physician seeks only to elucidate the presence of disease. However, equally important is a careful evaluation of the individual's hygiene of living. Due consideration should be directed toward elaboration of life habits, e.g., smoking, diet, social interactions and mental health, sleep patterns, etc. Out of such a matrix of life habits and styles emerges a picture of the whole man, and the effects of his life style upon health and well being. While inquiry into medical status is appropriate and accepted, the physician in industry must carefully direct such evaluation of a personal nature along the same lines of action of the medical practitioner whose appropriate concern is the whole man. Only insofar as he is recognized as being *primarily* concerned with the employee's well being, this approach is proper. Otherwise, this all-encompassing approach may represent an encroachment by the employer upon a realm of employee's personal life which is wholly inappropriate. Obviously, the methods employed in these examinations should be consistent with the cost-yield considerations noted above.

Examination of workers exposed to occupational risk. Such examinations should be oriented toward medical and health evaluation procedures which delineate human responses to special environments. For example, workers handling defatting solvents should be carefully examined to determine that dermatoses do not ensue. Other examples of special occupational risks, e.g., potentially hepatotoxic solvent, pulmonary irritants, etc., will determine which clinical and laboratory examinations are required. Again, the health protection team must be completely familiar with the risk potentials of *all* jobs in the plant so as to intelligently design such examinations.

Since engineering controls may fail or personal protective devices may be inadequately utilized, such examinations of workers at special risk should be *regularly and periodically* carried out. Record and scheduling systems should be so designed that these examinations are not missed and so that the information gathered can be rapidly and rationally reviewed. This requires both careful organizational efforts and design of medical records.

Sources of information regarding occupational risks. The clinical literature in occupational medicine and industrial hygiene is a rich mine of information. Herein will usually be found, to varying degrees of adequacy, much information regarding human response to environmental agents. In addition, the literature concerning experimental investigation of these special risks also becomes essential (see suggested readings).

However, the occupational health team should be aware of the shortcomings inherent in that body of information. Newly encountered occupational chemicals may be associated with little available data concerning *clinical* effects. However, the experimental literature can contribute to an understanding of risk potentials. For example, while there is little clinical data concerning N-dimethylnitrosoamines, the experimental literature extensively documents that agent's potential for carcinogenesis in animals. Accordingly, that agent should be treated as a potential carcinogen in the work place, despite an absence of such recorded effects on man.

The problems of extrapolation of data derived from animal experiments to man are self evident (see Chapter 7). Therefore, the experimental literature while potentially useful for health control requires that it be used with appropriate care. This makes even more important the need for careful periodic clinical evaluation being performed with due consideration of such animal data.

Other Examinations

Separation Examinations. If a worker has been exposed to some occupational hazard and is to be separated from employment, it is the employer's responsibility to ascertain his health status before such an event. While the legal responsibility of the employer ends only in part with discharge, any subsequent change may represent an aggravation or progression of a disease state incurred while at work. If a later status represents disease progression caused by work, the employer should be made aware of his legal and moral responsibility. If his future condition is unrelated to a work incurred condition, then equity demands that this ascertainment also be made.

It should be apparent that the role of the medical department is to accumulate and evaluate all health information so that the best medical opinion can be clearly and equitably applied to the matter in question.

THE ROLE OF THERAPY IN OCCUPATIONAL MEDICINE

For Occupational Disease

The Occupational Medical Practitioner as a Specialist. In the treatment of occupational disease of a non-surgical nature, the occupational medical practitioner should be prepared to provide definitive therapy. Certainly, in the area of clinical toxicology, such physicians more frequently encounter these problems, e.g., as in chemical plants, than do their fellow practitioners. Thus all ramifications (diagnosis, treatment and management) should be clearly within his competence. Should such medical problems arise, the occupational health specialist should be prepared to assume responsibility for all such cases, making use of appropriate medical or surgical consultants as the patient's complications may require.

The Use of Consultants

(1) Principles governing choice

Since the occupational medical specialist should know more about occupational diseases and the conditions of the work place, it follows that he should assume responsibility for medical management and direction of such occupationally caused problems. However, as noted above, should complications involving special organ systems arise, e.g., cardiovascular, respiratory, etc., it is appropriate that such specialists be consulted. Nevertheless, except for unusual reasons the responsibility should remain in the occupational medical specialist's hands. A close working relationship with such specialists should be developed in each case, as such physicians are invariably non-cognizant of in-plant conditions or the effects of toxic or physical agents. While it becomes the occupational medical specialist's responsibility to cooperatively aid the outside specialist in becoming aware of those problems, the latter should not nevertheless abandon his primary responsibility.

In one case of surgical problems, it is axiomatic that the best specialist help is the least expensive in the long-term prospect as well as being the most effective. While full responsibility for surgical treatment and management should be in such specialist's hands, the occupational medical specialist still has an important role to play. Again, since he is the most knowledgeable regarding work requirements or opportunities for less demanding tasks, he is in the best position to guide the rehabilitation of the injured worker during the recovery phase. Close cooperation with physicians, utilizing both extra- and intra-mural (i.e., plant) facilities can lead to the most effective programs of rehabilitative therapy.

(2) Limitations

It should be pointed out that in many, if not most, jurisdictions the worker has the final and definitive choice of who should treat his occupational disease or injury. Thus, the occupational medical specialist must observe this legal right. However, if the work force has confidence in the medical capabilities and the probity of the plant physician, most often the worker will accept his ministrations. However, should he decide otherwise, the plant physician has an ethical responsibility for cooperating with and aiding the management of the outside physician.

Therapy of Non-Occupational Disease

Stated Positions. It has been the position of organized medicine that plant medical departments should not become involved in the treatment of non-work conditions. The only qualification of this position is related to treatment of minor conditions, e.g., headache, indigestion, of a non-recurring nature for which the patient would not ordinarily seek medical help. Except for making it medically possible for the worker to safely finish his work-shift, he was to refer other medical problems to the private practitioner.

Trends in Occupational Medicine Regarding Management of Non-Occupational Conditions. Because of increased medical care utilization, rising health expectations and modes of medical practice, the availability of primary medical care has become somewhat diminished. Accordingly, strict application of the foregoing principles have been tempered by present realities. Especially in areas where medical care resources are limited, the plant physician is seen as providing a scarce capability. As health care delivery systems become integrated, it would appear that the occupational health specialist will play a more active role within such systems.

In addition, since the employer assumes increasingly more financial responsibility for general medical care, he demands that medical care utilization become optimized. All of these forces cannot but help affect the present and future patterns of occupational health practice. While the form such activity will take is unclear, given the present dynamism of this system, changes in such patterns of care are and will be occurring.

OPPORTUNITIES FOR RESEARCH IN THE PRACTICE OF OCCUPATIONAL HEALTH

Research in the Natural History of Disease. Use of Medical Records. At present, medical records in industry are largely oriented toward providing a data base for the several immediate responsibilities of the medical department. They are primarily directed toward providing the medical information necessary to adequate management of medical conditions. Except where they also provide health base lines needed for estimation of alteration due to environmental factors encountered in the work place or because of periodic health evaluation program needs, they are frequently ill-suited for long-range assessments.

In the past such records consisted of hand entries into medical forms. As such, ready assessments of large populations could not be achieved. Until the development of electronic tape and disc data storage systems, existent record systems inhibited worker-population studies. However, it is becoming increasingly possible to store and readily retrieve discrete data "bits" involving large numbers of workers. As such capabilities become increasingly more available, it should be possible to more readily use the masses of industrial health data presently unavailable. Given these capabilities, invaluable opportunities for the development of new medical knowledge will present themselves. Because working populations represent a useful cross-section of the active, non-hospitalized, the opportunity for delineation of the long-term, natural history of disease arises. In addition, study of the long-term effects of environmental stresses upon health should be accessible.

As an example of the former type information, industrial populations have been useful in developing new insights upon the effects of diabetes, hypertension and cardiovascular disease on long-term health status and productivity. Because such non-hospitalized populations can be studied, the misapprehensions derived from biased populations investigated in hospitals are avoided.

Elucidation of the Effects of Environmental Pollution upon Health

The Work Population as an Exposed Population. Because occupational exposures usually are more intensive than that incurred by the general population, working groups represent ideal study groups for the evaluation of such environmental effects. Relatively higher doses of common environmental pollutants (e.g., CO, SO_2) encountered in industry should, theoretically, accelerate the rate of development of deleterious health effects, if any, as compared to the rate of development possible because of lower doses in the community. Coupled with the advantage of the possibility of long-term observations is the fact that large numbers of exposed groups are concentrated in one area. Given adequate record systems the opportunities for epidemiological investigation are unparalleled.

The Use and Limitations of the Epidemiologic Method. The epidemiologic method depends upon the systematic collection of information which makes possible the comparison of one population's behavior with that of another similar group. Thus one assumes that the variables determining, e.g., health status, are completely similar in all regards except for a specific variable acting on only one of these two groups.

Obviously, as many of these variables are operating upon *both* groups they must be defined, since *assumptions* of such comparability in all regards (except for the one under scrutiny in the group at risk) are unacceptable. Thus, data collection involves large numbers of variables, e.g., age, sex, activity and residence. These must be adjusted for in both groups. The use of industrial populations in this connection given adequate data collection, should be obvious. Especially pertinent is the opportunity for construction of a control group derived from a working population in order to estimate health or mortality experience. Such comparison groups are essentially the only group with which a working population at a special environmental risk can be compared.

Nevertheless, the use of industrial populations for delineation of occupational health risks presents some attendant problems. One of these relates to assessment of exposure to a risk, since frequent in-plant job turnover may make tracing individual work or exposure experience difficult, especially in certain occupations, e.g., chemical operations. In addition, workers who are no longer on the rolls are a source of loss to a population of some consequence. This follows since they may have left employment because of incurring the health consequence under study. While conclusions indicating a *positive* association between work and some condition might only lead, at worst, to underestimation of risk, the significance of absence of an association becomes severely compromised because of such losses. This points up the obvious need for careful, painstaking follow-up of those separated from the groups under study. However, *carefully* performed multi-corporation or industry-wide studies, e.g., of mortality, have succeeded in providing valuable medical knowledge.[1] Studies of morbidity have been less satisfactory, yet present a considerable potential source of valuable medical information.

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Preferred Reading

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