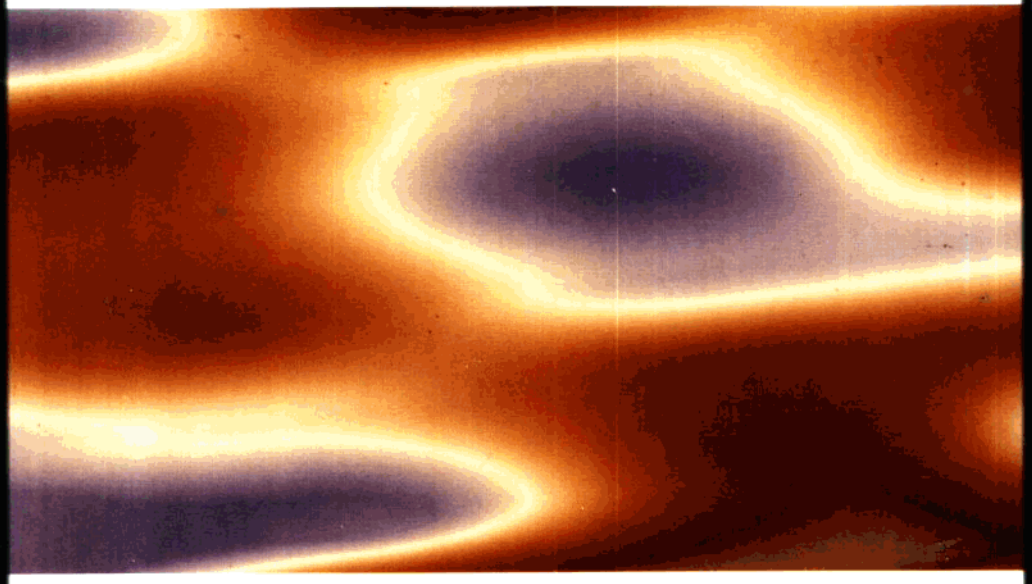
高等医学院校英语教材

COLLEGE ENGLISH FOR SENIOR MEDICAL STUDENTS

第四册



大学医学英语教程

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前　言

为了落实国家教委理工科大学新的专业英语阅读阶段教学大纲，遵照1997年5月济南全国医学外语研讨会面向21世纪专业英语为必修课和四（五）年不断线的精神，根据普通医学院校目前英语教学的实际状况，为把外语教学推上一个新台阶，我们组织编写了这套跨世纪的专业英语教材。

本教材分四册，第一册衔接大学英语四级内容为医学科普，第二、三册按人体系统排列，将基础医学与临床医学、疾病与健康相结合，供三、四年级学生使用；第四册为临床医学，供四、五年级学生使用。通过这套教材的学习，医学生不仅能掌握4 000～5 000个医学词汇，提高阅读专业书刊的能力，而且在会话、翻译和写作方面将会有长足的进步。

根据新老结合，以新为主的选材原则，努力做到语言规范，题材多样，融知识性、教育性、趣味性、可读性为一体。编排原则是精泛结合，以精为主，配合会话、翻译、写作和必备的医学知识，做到既是教科书，又是案头必备的参考资料。

全套教材由河南医科大学、广东医学院、新乡医学院合作编写，王熙瑞教授为总主编。

本书为第四册，由河南医科大学（1～5单元）和新乡医学院（6～10单元）共同编写。王熙瑞、马跃珂、王兰英为主编。编写分工为：麻哲（第一单元）、马跃珂（第二单元）、陈行洁（第三单元）、陈可猛（第四单元）、翟强（第五单元）、王兰英（第六单元）、平文江（第七单元）、王玉安（第八单元）、任多玉（第九单元）、尹景书（第十单元）。王熙瑞教授提供素材，负责总体设计和审订工作。

第四册为10个单元，每个单元包括8个部分（6～8学时授完），其中Directions of Medicine，Abstract and Case Report和Medical Conversation部分为参考，不包括在学时内，各校视具体情况而定。

由于时间仓促，编者水平有限，不妥之处在所难免，希望广大读者批评指正。

《大学医学英语教程》编委会

2000年5月

CONTENTS

Unit One

New Words and Expressions

cement /si'ment/ *v*. to join or make firm (as if) with cement, to establish or strengthen (a friendship, etc.) 巩固,加强;把……结合在一起

antagonistic /æn,tægə'nistik/ *n*. hostile; opposed; contrary 敌对的,对立的,相反的

aeronautics /ɛərə'nɔ:tiks/ *n*. science and practice of aviation 航空学,航空术

presuppose /pri:sə'pəuz/ *vt*. imply; require as a condition 含示;以……为先决条件

impressionistic /im,preʃə'nistik/ *a*. based on impressions rather than on knowledge, fact or detailed study 印象主义(者)的

lavish /'læviʃ/ *a*. very generous or wasteful in giving or using 慷慨的,大方的

dispense /dis'pens/ *vt*. to give out; to distribute; to administer 分配,分发,施给

alleviate /ə'li:vieit/ *vt*. to reduce (pain, suffering, difficulties, etc.) esp. for a short time; to relieve 减轻(痛苦);易于忍受;使缓和

didactic /dai'dæktik/ *a*. (*fml*.) (of speech or writing) intended to teach, esp. to teach a moral lesson 说教的,教训的,教诲的

deemphasize /di:'emfəsaiz/ *vt*. to place less emphasis upon 使不重要,降低……的重要性

novice /'nɔvis/ *n*. a person with no experience in a skill or subject; beginner 生手,初学者

elicit /i'lisit/ *vt*. (*fml*.) to succeed in drawing out (facts, information, etc.) from someone, esp. after much effort; to cause to come out 引出,使发出,得出

ascribe /ə'skraib/ *vt*. consider to be the cause, origin, reason or author of 认为是……的原因,根源,理由或作者;归因于

arcane /ɑ:'kein/ *a*. (*lit*.) mysterious and secret; esoteric 秘密的,神秘的

akin /ə'kin/ *a*. of similar character; like 同性质的;类似的

cyclic /'saiklik/ *a*. *also cyclical* (*fml*.) happening in cycles 循环的,有周期性的

iterative /'itərətiv/ *a*. involving repetition 重复的

recursive /ri'kə:siv/ *a*. capable of being returned to or used repeatedly 循环的

pedantry /'pedəntri/ *n*. tiresome and unnecessary display of learning; too much insistence upon formal rules 卖弄学问;过于拘泥形式上的规则

irrefutable /iri'fju:təbl/ *a*. that cannot be proved false 不能驳倒的

counterproductive /,kauntəprə'dʌktiv/ *a*. tending to work against a desired aim; having an

opposite effect from the one intended 起反作用的

ensemble /ɑːnˈsɑːmbl/ *n*. (French word) sth. viewed as a whole; general effect (法)整体;总效果

normotensive /ˌnɔːməˈtensiv/ *a*. having blood pressure typical of the group to which one belongs 正常血压的

fidelity /fiˈdeliti/ *n*. (of something copied or reported) closeness in sound, facts, colour, etc. to the original; exactness; accuracy 正确;精确

dictum /ˈdiktəm/ *n*. (*pl*. ~s, dicta) formal expression of opinion, saying 宣言,声明,正式发表的意见,格言

sequential /siˈkwenʃl/ *a*. following in order of time or place; following as a result 按时间或顺序而来的;连续的;继起的;结果的

deprecation /ˌdeprəˈkeiʃn/ *n*. 反对

deprecate /ˈdeprəkeit/ *vt*. (*fml*.) feel and express disapproval of (正式用语)表示不赞成;反对

antithetical /ˌæntiˈθetikəl/ *a*. being an antithesis; directly and completely opposed 相反的

ancillary /ænˈsiləri/ *a*. providing help, support or additional services; subordinate (to)辅助的,附属的

inept /iˈnept/ *a*. unskillful; said or done at the wrong time 笨拙的;不适当的;非其时的

normacytic /ˌnɔːməˈsitik/ *a*. characterized by red blood cells that are normal in size and usu. also in hemoglobin content 正常红细胞的

macrocytic /ˌmækrəˈsitik/ *a*. of or relating to macrocytes 大红细胞的

microcytic /ˌmaikrəˈsitik/ *a*. of, relating to, being or characterized by the presence of microcytes 小红细胞的

detract /diˈtrækt/ *vi*. take away (something valuable, appealing, etc.) from 减损(价值等)

variance /ˈveəriəns/ *n*. at ~ (with): in opposition (to); not in agreement (with) 与……不和;意见不同

dubious /ˈdjuːbiəs/ *a*. (of things, actions, etc.) causing doubt; of which the value, truth etc. is doubtful (指事物,动作等)可疑的;其价值、真实性等有问题的;未定的

hyperthyroidism /ˌhaipəˈθairɔidizəm/ *n*. excessive functional activity of the thyroid gland 甲状腺功能亢进

authenticate /ɔːˈθentikeit/ *vt*. prove to be genuine; prove beyond doubt the origin, authorship, etc. of 证明……为真;证明……之来源、作者等无讹;鉴定;使……生效

costal /ˈkɔstəl/ *a*. of, relating to, involving or situated near a rib 肋的

quantize /ˈkwɔntaiz/ *vt*. to calculate or express in terms of quantum mechanics (物)使量子化;用量子论的术语表示

supine /ˈsuːpain/ 美 /suːˈpain/ *a*. lying flat on the back, face upwards 仰卧的; 仰着的

egophony /iˈgɒfəni/ *n*. a modification of the voice resembling bleating heard on auscultation

of the chest in some diseases (as in pleurisy with effusion) 羊音

tubercle /'tju:bəkl/ *n*. 结核

meningitis /ˌmenən'dʒaitis/ *n*. (*pl*.) -gitides /-'dʒitidi:z/ 脑膜炎

nuchal /'nju:kəl/ *a*. of, relating to, or lying in the region of the nape 项的

rigidity /ri'dʒiditi/ *n*. stiffness; inflexibility 僵硬;不变

analogous /ə'næləgəs/ *a*. (*fml*.) similar or alike in some ways; able to be compared (with) 相似的;(与…)类似的

tuberculin /tju'bə:kjulin/ *n*. 结核菌素

collateral /kə'lætərəl/ *a*. secondary or subordinate but from the same source 次要的;附属的;附带的(但系同一来源)

discomfiture /dis'kʌmfitʃə/ *n*. the act of discomfiting or state of being discomfited 困惑;混乱;窘迫

discomfit /dis'kʌmfit/ *v*. (*fml*.) to make (sb.) feel rather annoyed and uncomfortable; embarrass slightly 使窘迫;使困惑

accrue /ə'kru:/ *vi*. to come as a gain or addition advantage 自然增长或产生

asymptomatic /əˌsimptə'mætik/ *a*. presenting no symptoms of disease 无症状的

incremental /ˌiŋkrə'mentl/ *a*. of an increase in money or value 增加的,增长的

occult /ə'kʌlt/ *a*. not manifest or detectable by clinical methods alone; not present in macroscopic amounts; obscure 隐的,潜隐性

metastatic /ˌmetə'stætik/ *a*. 转移的,迁徙的

thrombocytopenia /ˌθrɔmbəˌsaitə'pi:niə/ *n*. persistent decrease in the number of blood platelets that is often associated with hemorrhagic conditions 血小板减少症

deterrent /di'terənt/ *a*. & *n*. (thing) tending to, intended to, deter 阻止性或用来阻止的(事物);防止的(物)

innocuous /i'nɔkjuəs/ *a*. causing no harm 无害的

tampon /'tæmpən/ *n*. 棉塞,止血塞

menorrhagia /ˌmenə'reidʒiə/ *n*. abnormally profuse menstrual flow 月经过多

pallor /'pælə/ *n*. deficiency of color esp. of the face; paleness 苍白

aforementioned /ə'fɔ:'menʃənd/ *a*. (that has been) mentioned before 前面提到的

grossly /'grəsli/ *adv*. extremely 极度地,十分地

glean /gli:n/ *vt*. to gather (facts or information) in small amounts and often with difficulty 一点点搜集(消息,事实)

import /'impɔ:t/ *n*. (*fml*.) importance 意义,重要(性)

hematemesis /ˌhi:mə'teməsis/ *n*. (*pl*.) -eses the vomiting of blood 呕血

intrinsically /in'trinsikəli/ *adv*. 内在地;本质地

expectorate /ik'spektəreit/ *v*. to eject matter from the throat or lungs by coughing or hawking and spitting 咳出

Text

The Approach to the Patient

To those who have chosen a career in medicine there can be no better basic motto than to strive to be a person with technical skill, broad scientific knowledge and wisdom, and with those personal characteristics of warmth and humility which serve to cement the art with the science of medicine. Such a person exemplifies the inscription on the statue of Edward Livingston Trudeau: "To cure sometimes, to relieve often, to comfort always."

Every student and practitioner of medicine should familiarize himself with the classic essay on *The Care of the Patient* by Francis Peabody.

The practice of medicine in its broadest sense includes the whole relationship of the physician with his patient. It is an art, based to an increasing extent on the medical sciences but comprising much that still remains outside the realm of any science. The art of medicine and the science of medicine are not antagonistic but supplementary to each other. There is no more contradiction between the science of medicine and the art of medicine than between the science of aeronautics and the art of flying. Good practice presupposes an understanding of the sciences which contribute to the structure of modern medicine, but it is obvious that sound professional training should include a much broader equipment.

The treatment of disease may be entirely impersonal; the care of a patient must be completely personal. The significance of the intimate personal relationship between physician and patient cannot be too strongly emphasized, for in an extraordinarily large number of cases both diagnosis and treatment are directly dependent on it, and failure of the young physician to establish this relationship accounts for much of his ineffectiveness in the care of patients.

What is spoken of as a "clinical picture" is not just a photograph of a man sick in bed; it is an impressionistic painting of the patient surrounded by his home, his work, his relations, his friends, his joys, sorrows, hopes, and fears.

Thus, the physician who attempts to take care of a patient while he neglects those factors which contribute to the emotional life of this patient is as unscientific as the investigator who neglects to control all the conditions which may affect his experiment. The good physician knows his patients through and through and his knowledge is bought dearly. Time, sympathy and understanding must be lavishly dispensed but the reward is to be found in that personal bond which forms the greatest satisfaction of the practice of medicine. One of the essential qualities of the clinician is interest in humanity, for the secret of the care of the patient is in caring for the patient.

These beautifully expressed thoughts about the physician and his relationship to the patient are even more important to emphasize today than when they were written over 50

years ago. Medicine has become, and will continue to become, much more a science, not less, so that the physician of tomorrow will have to be more a scientist, not less. Nevertheless, the art of medicine remains, and the physician must continue to be wise and understanding with a deep respect for the patient as a human being. The secret of success in the care of the patient is still in caring for the patient.

Clinical Information and Clinical Problem Solving

The kind of patient care described by Peabody in the introduction is the goal of all conscientious physicians. The effectiveness of patient care depends upon a number of factors, but two of the principal determinants of concern of physicians are 1) the quality of the diagnostic management; and 2) the quality of therapeutic management. Diagnostic management of a patient encompasses all of the steps which lead from the patient's complaints to a clear understanding of the patient's problems. Therapeutic management of a patient encompasses all of the measures directed toward correcting or alleviating the patient's problems. Taken together, these activities, diagnostic and therapeutic management, can be considered to be two aspects of clinical problem solving.

All textbooks have limitations. This is evident when one attempts to teach the basic precepts of medical practice by the written word alone. Attitudes, values, and professional integrity are acquired principally through precept and experience rather than by didactic means. That is why clinical teaching must go on around the bedside as well as through books. The fact that these aspects of the practice of medicine may often seem neglected in textbooks is in no way intended to deemphasize their importance. It is simply an acknowledgment of a reality: that much of the burden for imparting these precepts falls more heavily on clinical teachers than on textbooks. Wherever such material can be meaningfully rendered into print, we have attempted to include it in this book.

This initial chapter is designed to give the reader a summary overview of this process of solving a patient's clinical problem. The subsequent chapters address the process in more detail: the collection and the evaluation of clinical information, the ways in which information is analyzed and synthesized, and the basis of clinical decision making. The final chapter is devoted to the difficult issues in patient management.

Clinical Problem Solving

Experienced clinicians approach and solve the problems of their patients with apparent ease. The novice, in contrast, may have difficulty eliciting even the basic information about the patient's problem. This paradox has led some to ascribe this skill in problem solving to "experience", to the "art of medicine", clinical "insight", or "judgment". To be sure, problem-solving ability improves with experience, and there are important humanistic elements in obtaining clinical information which are artful. Nevertheless, such formulations are not instructive to the novice who wishes to learn these skills or to the practitioner who wishes to improve his clinical ability.

Clinical problem solving is neither an arcane art nor a mysterious process. It is a method which parallels the scientific problem-solving process, as will be described below. It is a method that can be both taught and learned. It requires both knowledge and skill, and these skills can be refined only through practice.

Clinical problem solving is the cornerstone of clinical medicine.

The Scientific Method

This analytic process by which clinical information leads to the diagnosis is closely akin to the scientific method — the process whereby experimentation leads to the discovery of new knowledge.

Through analysis of these data and an extraction of meaning from them, an hypothesis is formulated which will explain the observed facts. The process does not stop at that point. The scientist then designs a further experiment which will test (support or refute) the current hypothesis. The scientist may also have formulated alternative hypotheses and will design an experiment to distinguish between them.

In the clinical setting, the experimental procedure may be the interrogation of the patient, the examination of the patient, or the performance of some laboratory test. The resulting information is analyzed by differential diagnosis (consideration of all reasonable possibilities) to yield a tentative hypothesis (tentative diagnosis or diagnoses). These, in turn, prompt the clinician to ask further questions, make further observations, or order tests which will support, refute, or distinguish between the diagnoses under consideration.

The discussion of these similarities is not mere pedantry. It leads to a number of practical points:

1. The collection and analysis of clinical information is essentially the application of the scientific method to the solution of a clinical problem.
2. These methods can be taught and learned; it is not an art in which one is either gifted or not. Proficiency can be improved by consciously considering the meaning of each piece of information as it is received.
3. It is a rapidly iterative process. The cycle is repeated within the time interval of asking a few questions or physical observations. This explains the mystery of why the novice fails to ask the key question or seek the key physical finding.
4. It is an ongoing process. There are no irrefutable hypotheses, only unrefuted hypotheses. In clinical terms, the physician should not arrive at a diagnosis and abandon any further consideration of alternative explanations. He must remain alert for information which does not fit with his current hypothesis and for sources of new information which might make him alter his considerations. When uncertain, he should continue to seek ways of testing the tentative diagnosis.
5. Consideration of a diagnosis that can neither be confirmed nor excluded fails to advance the decision-making process. This is directly parallel to a scientific hypothesis

that cannot be tested.

6. Finally, clinical problem solving is as sensitive to flawed or missing information as are scientific experiments. A major difference lies in the fact that often clinical decisions must be made on what is acknowledged to be incomplete evidence.

In summary, the diagnostic process is a dynamic one which begins with the initial contact with the patient. Each piece of information obtained from or about the patient prompts the physician to consider new hypotheses and to test or to discard others. Studies indicate that skilled physicians may consider 15 or 20 diagnostic possibilities during the initial contact with the patient, but they rarely have more than 5 or 6 possibilities under active consideration at any one time.

Many students are taught that differential diagnosis is limited to an orderly, formal consideration of all of the diagnostic possibilities which is performed only after all of the clinical information has been acquired. This is a counterproductive notion. A review of the diagnostic possibilities at that point is helpful, but it is the rapid iteration of the diagnostic process throughout the encounter with the patient that enables the physician to obtain the information that will lead him to the appropriate conclusion.

Information Versus Data

Clinical information can be obtained from the patient himself through dialogue (the history) or through observation (the physical examination). Information may also be obtained from laboratory or radiographic examinations. These sources of information (dialogue, observation, the laboratory) are quite separate and distinct. These distinctions, however, obscure the similar way in which the experienced physician uses clinical data whatever their source.

In each instance this collection of clinical information is not simply data collection. Data are a group of facts, whereas information implies the communication of knowledge. Thus, clinical information imparts meaning; it is meaningful data, not just an ensemble of facts. Furthermore, information may prompt the physician to take certain actions, actions which include seeking further information.

This distinction between data and information can be exemplified. A patient complains of weakness and breathlessness and is found to have a blood pressure of 135/80 mm Hg. The information content of this datum, 135/80, is usually taken to be that this patient's blood pressure is normal. However, the information, or the meaning of this, is quite different if last week the data included a blood pressure of 190/110 mm Hg. Now, the physician knows the patient was hypertensive and is presently normotensive. This prompts the collection of more information regarding the possibility of recent myocardial infarction, blood loss, and the like.

This distinction between data and information explains one of the mysteries of history taking. For example, the complete novice can ask all the "usual" questions and record the patient's answers with fidelity. Such an interview (data collection) may not impart much

knowledge about the patient's problem even when these data are subsequently reviewed by an expert. The communication of clinical information imparts meaning to the experienced interviewer which guides and directs his further dialogue with the patient. Thus, each datum communicates information to the experienced person. From this it is apparent that some important analysis occurs during the course of the collection of clinical information. Analysis is not simply a separate, subsequent event.

This leads to the following dicta: 1)The experienced clinician weighs each piece of clinical data as he elicits it for its meaning, for its information content. 2)He also analyzes it in the context of other information about the patient to determine if there is still more information which should be acquired. 3)The collection and analysis of clinical information proceed in parallel, not as separate, sequential steps.

Humanistic Aspects

None of the foregoing emphasis on the scientific aspects of the collection and analysis of clinical information should be interpreted as deprecation of the importance of the humanistic aspects of dealing with patients. Indeed, disregard of these aspects can even prevent the collection of clinical information. The physician who appears impatient, or bored, or insensitive may be unable to elicit important information from the patient. The physician must be aware that the patient, especially the new patient, is scrutinizing him every bit as carefully and critically as he is examining the patient. The physician who is rough and uninterested in the patient's comfort may be unable to feel an abdominal mass. Thus, inattention to these important aspects may defeat the whole purpose of clinical information analysis — the solution of a patient's problem.

Economic Aspects

A major complaint of the lay public concerning modern medical care is its "excessive" cost. Many believe that the clinical problem-solving process, both diagnostic and therapeutic, is too costly. Yet the individual patient insists upon and is entitled to high quality medical care. Are these positions antithetical?

The direct answer is that these are not antithetical views. Every physician has as a part of his responsibility to his patients the obligation not to waste clinical resources. Irrelevant or redundant laboratory data do not improve the quality of care, but they do contribute substantially to the cost of care. This topic will be addressed later in this section when discussing the prudent use of ancillary studies in diagnostic management and in discussing prudent therapeutic management. It will also be addressed throughout the book in outlining the optimum sequence in the diagnostic management of specific clinical problems. Inept sequences are a major source of waste. For example, when dealing with the problem of anemia it is wasteful and pointless to obtain serum iron, folate, and B_{12} determinations simultaneously before determining whether the patient's red cells are nomocytic, macrocytic, or microcytic. We shall outline a series of questions that a clinician can ask when selecting ancillary tests and proce-

dures in the investigation of a problem in which he is not experienced.

Other aspects contributing needlessly to the expense of hospital medical care include 1) hospitalizing patients for problems that can readily be managed on an ambulatory basis; 2) failing to use effectively the time during which the patient is hospitalized; and 3) failing to plan in advance for the patient's discharge from hospital. These, too, are items of expense that detract from rather than contribute to the quality of care given to the patient.

Summary

This chapter supports the view that the collection and analysis of clinical information, whatever its source, is the cornerstone of patient care. The skills involved can be taught and learned. The approach is similar to any scientific problem-solving endeavor, but the effective physician must have an understanding of the humanistic elements involved in the care of the sick.

In the subsequent chapters of this section the various ways of acquiring and analyzing clinical information will be discussed. Furthermore, attention will be given to the use of this information in the diagnostic and therapeutic management of patients.

The Collection and Evaluation of Clinical Information

Clinical information encompasses information obtained by conversing with the patient and his relatives (the history), information obtained by observing and examining the patient (the physical examination), as well as information obtained through laboratory examinations of the patient or specimens obtained from the patient (laboratory tests), and from special procedures such as endoscopy. Different techniques are required for the collection and evaluation of these different kinds of information. Before discussing these specific examples, we should consider certain common features which influence the selection of what information should be obtained and how it should be evaluated whatever its source.

Attributes of Clinical Information

It is neither possible nor desirable to obtain all clinical information on every patient. As a consequence, there must be some selectivity in choosing what information to obtain. How does one make this decision? A number of attributes of clinical information are important in making this selective judgment. These include the information's 1)accuracy; 2)precision; 3)variance; 4)specificity; 5)sensitivity; 6)validity; 7)risk; 8)cost; and 9)benefit. For example, the wise physician would not choose to obtain information of dubious validity, particularly if its collection is associated with some risk.

Physicians are accustomed to think that these attributes apply only to laboratory tests. They apply to all types of clinical information, including historical facts and physical findings as well. Does the absence of a history of rheumatic fever exclude the possibility of rheumatic mitral insufficiency? Does a lid-lag specifically mean hyperthyroidism? Is a liver edge palpable 1 cm below the costal margin normal? These questions are as amenable to assessment as the question: Does a fasting blood glucose concentration of 124 mg/dl mean diabetes mellitus?

A clear understanding of these attributes is fundamental to the selection and evaluation of all kinds of clinical information. In the discussion which follows, we shall draw upon non-laboratory examples wherever possible to emphasize the breadth of applicability of these concepts.

Accuracy

Accuracy is the measure of how closely the given piece of clinical information represents the correct and true state. The usual examples drawn from clinical chemistry indicate that the accuracy of blood glucose concentrations are assessed by analyzing replicates of an authentic glucose standard. The test is deemed to be accurate if there is close agreement between the observed and the true value.

This concept of accuracy is equally applicable to historical information. When asking about alcohol consumption, the patient may indicate he drinks only one or two cocktails before dinner. This is accurate information if it reflects the true state. It is not accurate if he in fact has two cocktails before lunch, three before dinner, and several more drinks after dinner. Thus, if a piece of information is of particular importance (or if there is reason to question its accuracy), the physician should take steps to authenticate it before using it in his analysis of a problem. This principle of authentication applies to historical information and physical findings as well as laboratory tests and special procedures.

Precision

Precision is a measure of the reproducibility of a piece of information. A common measure of precision is to note the variability, or variance, in the results when the observation is repeated on replicates or on successive occasions. Blood pressure measurements by auscultation may be consistent and reproducible in a hypotensive patient, but they may not accurately reflect the true intra-arterial pressure. In this example the measurement would be precise, but inaccurate. It is a common error to consider information which is highly reproducible (precise) to be accurate. Precise information may or may not be accurate.

Variance

The variability in observations, including clinical observations, come from several sources. Some are attributable to the observational method itself, some to the observer, and some to the feature being observed. A simple example — determining the location of the liver edge by palpation — can illustrate these points.

Suppose one observer reports the liver edge to be two fingerbreadths below the right costal margin and another reports it to be 4 cm below. One source of variance stems from using a variable unit of measurement of size, distance, and the like (fingerbreadths, hen's eggs, golf balls); this source of variance is easily avoided. Apart from this, there is variance from quantizing: On one occasion a 3.5 cm measurement might be rounded up to 4 cm and on another down to 3 cm. Even greater variance can be introduced by the methodology. Was the measurement made with the patient fully supine? Was it in full inspiration? These all

contribute to the variance of the method.

There may be differences in the way the observer performs the measurement from time to time which leads to intraobserver variance. There are also differences between the way different observers perform the measurement, interobserver variance.

Still another kind of variance relates to differences in the location of the liver edge from one person to another. This kind of variance of an attribute will be discussed in the context of normality and the normal range.

Diagnostic Specificity and Sensitivity

The specificity of clinical information and its sensitivity are important in assessing its meaning, yet these terms are often only vaguely or imperfectly understood. Specificity and sensitivity relate to the inferences which may be drawn about the patient's condition based upon the presence or absence of a certain finding. The condition may be a disease, e.g., diabetes mellitus, or an abnormality, e.g., pulmonary consolidation, and the finding may be a laboratory test result, historical fact, or physical finding.

It would be ideal if a positive finding were invariably associated with the condition; this would be perfect specificity. It would also be ideal if a negative finding invariably meant that the condition were absent; that would be perfect sensitivity. Unfortunately, such perfection rarely obtains, and there are falsely positive findings (the condition is actually absent) and falsely negative findings (the condition is actually present).

The clinician must have some insight into the likelihood that a positive finding is a true positive or a false positive when interpreting a finding. Similarly, a negative finding must be interpreted in view of the likelihood that it is a false negative. Furthermore, the choice of a procedure which is highly specific or is very sensitive will depend upon whether the objective is to confirm (rule in) the condition or exclude its presence (rule out).

Specificity. Egophony over the right lower lobe is a finding which has a high degree of specificity for the condition, pulmonary consolidation of the right lower lobe. This positive finding is useful in ruling in pulmonary consolidation. The reason that it is useful is that most positive findings are true positives ($FP << TP$), and it is highly specific ($FP << TN$). The absence of egophony, however, cannot be used to exclude the presence of consolidation.

An example of specific test is the finding of M. tuberculosis on sputum culture. It is highly predictive of the presence of the condition, active pulmonary tuberculosis. Again, the failure to culture tubercle bacilli in the sputum does not exclude the possibility of active pulmonary disease.

Sensitivity. Stiffness of the neck is a sensitive test for acute meningitis. This means that if there is no evidence of stiffness of the neck, it is unlikely that the patient has an acute meningitis. Most negative findings are true negatives, there are very few false negatives, i.e. patients with acute meningitis who have no stiffness of the neck.

Nuchal rigidity is certainly not a specific test for acute meningitis, for most positives are

not true positives. Indeed, its predictive value is poor since most patients with stiff necks do not have acute meningitis, but have some other condition.

The analogous sensitive test would be the tuberculin skin test. A negative test result makes active tuberculosis unlikely, but a positive test is not necessarily associated with active disease.

Logical and Strategic Errors

A negative specific finding does not exclude the condition, and a positive sensitive test does not necessarily mean the condition is present.

Strategic errors are also possible. The first kind of strategic error is to fail to weigh the consequences of being wrong. For example, the consequences of failing to treat acute bacterial meningitis are grave. Accordingly, in a patient with fever, headache, and mental confusion one would pursue the diagnosis of meningitis with a specific test, such as lumbar puncture, even if there were no stiffness of the neck. Where the cost of error is high, even a slight risk of a false negative result is unacceptable.

Similarly, it is a strategic error to embark upon a risky diagnostic or therapeutic venture based upon a solitary positive specific finding, especially if there is no collateral evidence to support it.

Finally, there is the problem which arises from screening patient populations for conditions with a low prevalence. Let us assume the use of a highly specific test for a certain kind of cancer has a specificity of 0.98. This is equivalent to having only 2 percent false positives among those not having the condition. If this test is applied to a population whose prevalence of this cancer is 100 per 100,000, we would expect approximately 100 true positives and 2,000 false positives per 100,000. Thus, among those having positive tests, only 5 percent would have cancer and 95 percent would not. All of these patients would be subjected to the anguish and to the expense and perhaps risk of having further examinations to determine whether their test was truly or falsely positive. In this example the benefit to the 5 percent may outweigh the discomfiture to the 95 percent. If, however, the test has only slightly less specificity, say 0.90, the expected false positive would be 99 percent of all positives.

The two key points are that the physician must have some notion of 1) the prevalence of the condition *in the population being screened* (not some other population); and 2) the specificity of the test or finding being used. The implication of the first point is that a screening procedure that is appropriate for patients consulting a cardiologist may be totally inappropriate when applied to patients consulting a general practitioner. For example, the prevalence of coronary artery disease would be much higher in the former group.

Risk, Cost, and Benefit

Risks and costs relate to the *collection* of clinical information, not to the information itself. The benefits, if any, accrue from the *use* to which the information is put, not from simply possessing the information. Consideration of risks, costs, and benefits are important

in determining what clinical information to collect. As will be shown, these considerations are not limited to high-risk or high-cost decisions, nor should consideration be limited to those interested in medical ethics (risk vs. benefit) or medical economics (cost vs. benefit).

Benefits from clinical information may be diagnostic, therapeutic, or prognostic. Since the collection of information is almost always associated with some cost, and perhaps even some minimal risk, there is no merit in collecting a piece of clinical information if it is of no benefit to the patient.

There are three common problems concerning benefit. First, there is the problem of clinical information obtained by habit. For example, there may be reason to repeat a patient's white blood cell count, but was the differential count beneficial or was it simply requested by habit? Is 12 months the appropriate interval for a "check-up" for an asymptomatic, apparently disease-free person? What information should be collected in such a "check-up"? Even acknowledging that sometimes it is cheaper and more efficient to collect certain information than it is to decide whether or not to obtain it, we should periodically pause to question the benefit of some of our "routine procedures".

Second, physicians sometimes fail to distinguish between clinical interest and patient benefit. It may be of considerable interest to repeat a liver biopsy on a patient with hepatitis, but it is not justifiable unless the information would alter the patient's management. A good test is to ask, "What would I do differently if the result is A vs. B vs. C?" If the course of action is the same whatever the result, there is usually no clinical benefit from possessing the information.

This issue of clinical interest should not be confused with clinical investigation. In that latter circumstance it may be justified to obtain information that is of no benefit to the patient (if the legal and ethical requirements are met). The justification is based on the fact that a nontrivial question has been asked and that the information being sought will contribute to the answer.

The third problem is the most difficult, the notion of marginal benefit. This issue arises most often in obtaining information to exclude a diagnostic possibility. Take the case of a patient for whom there is reason to suspect infective endocarditis. There is clearly potential benefit from obtaining several blood cultures. If the first five cultures are negative, what is the benefit (the marginal, or incremental, benefit) of obtaining one more? If ten are negative, what is the benefit of obtaining one more? Since the patient may not have infective endocarditis, and since in some patients with endocarditis the bacteria cannot be demonstrated on culture, when should one stop collecting information? Put another way, the probable benefit form collecting additional information is steadily decreasing. Similar questions may arise in seeking the site of occult gastrointestinal bleeding or seeking the primary site of a metastatic carcinoma. In each, the issue is how far to go in the face of negative results and a declining marginal benefit. In the example of suspected endocarditis there are data to suggest