STATISTICAL PROBLEMS IN MEDICAL DIAGNOSES

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1. Introduction

The purpose of this report is to present some comments on a number of loosely related problems in the field of medical diagnosis which have some implications in statistical theory. The application of statistical theory to medical diagnosis is relatively new and only the simpler questions have been treated in a rigorous manner thus far. It was suggested that rather than select a single topic and provide a solution to a single well-specified problem, it would be more useful and interesting at such a symposium as this to touch on a number of matters and to formulate, at least partially, the statistical problems which they involve. Our report, therefore, will be concerned with questions and concepts rather than answers; it will be statistical in the broad sense, without being at all mathematical. We shall feel that our efforts are well repaid if some of these problems are found to be of sufficient interest to stimulate research or experimentation.

2. The uses of a diagnostic aid

It might be well first to delineate the area with which we are concerned. This does not, and in fact cannot, embrace the entire subject of clinical diagnosis. The latter is a complex operation and consists in identifying a disease process through a number of different operations, such as the obtaining of an individual history and a familial history, the results of physical examination and the findings of a number of different tests, including roentgenographic examinations and a host of different laboratory tests. The evaluation of diagnosis in this broad sense has not been, and possibly cannot be, the subject of a statistical analysis. Instead, we shall consider only that phase of the process of diagnosis which has been the subject of statistical evaluation and is related to what we shall term a *diagnostic aid:* that is, the findings obtained by the application of a certain diagnostic procedure as an aid in this complex process of diagnosis. Some examples are blood counts, the evaluation of a chest X-ray film, blood pressure measurement, reaction to a skin test, urinalysis, etc.

It may be well to consider first the different uses to which the findings of a given diagnostic aid are put since they would lead to different kinds of statistical problems. A diagnostic aid may be employed in at least four different ways:

(1) As an aid to the physician in the clinical diagnosis of a case. This relates primarily to the process of differential diagnosis, that is, to differentiate between several possible diagnostic categories, all of which may have common symp-