A DECISION THEORETICAL COMPARISON OF THREE PROCEDURES OF SCREENING FOR A SINGLE DISEASE

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1. Introduction

We should begin by making a distinction between the terms "screening" and "diagnosis." The purpose of screening is to select from an apparently healthy population those who display sufficient probability of an illness to warrant referral for diagnosis. As defined by the National Conference on Chronic Diseases [47] (cited in [16]): "Screening is the presumptive identification of unrecognized disease or defect by the applications of tests, examinations or other procedures which can be applied rapidly." Thus, screening is not a decision about therapy, but a method of case finding and a step toward diagnosis. Though the emphasis in this paper is on analysis for a single disease, this may be done as a part of a multiple or multiphasic screening program. In fact, the point of interest is how, from a multitude of data, relevant information may be recognized and combined to increase the precision of screening. We shall examine here three ways of using screening data: the single test, with positive or negative indication; the profile, an array of estimates of levels for each of a set of relevant factors; and the index, a single composite of weighted factors.

As a first stage in the medical care process, screening has evoked controversy over safety, effectiveness, and economy; and the purpose here is to examine some of the issues in a decision theory context. This paper is a continuation of two earlier discussions; that of Churchman [14] in his treatment of values, and Chiang, Hodges, and Yerushalmy [13] in the treatment of statistics.

The literature on screening is large, though scattered. References [7], [8], [16], [34], [47], [49], and [54], describe the problem from the medical historical point of view. Blumberg [4], Scheff [51], and Thorner [56] have introduced some of the value and decision theory considerations pursued here. Federer [20] has compiled an extensive bibliography on the generic problem of screening.

The decision process of interest in screening for disease is one of policy making. A large number of persons are to be examined and a wide range of manifestations is expected. The problem is to decide beforehand what action is to be taken over sets of manifestations, taking into account such factors as prevalence of

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