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[Reid DD \(1950\)](#). Statistics in clinical research. Annals of the New York Academy of Sciences 52:931-934.

Title pages

THE PLACE OF STATISTICAL METHODS
IN BIOLOGICAL AND CHEMICAL EXPERIMENTATION*

Conference Chairman: EDWIN J. DE BEER

Referee Editorial Committee

LLOYD C. MILLER

JOHN W. TUKEY

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*This series of papers is the result of a Conference on *The Place of Statistical Methods in Biological and Chemical Experimentation*, held jointly by the Section of Biology of The New York Academy of Sciences, The Biometric Society, and The New York Metropolitan Chapter of the American Statistical Association on January 28 and 29, 1949.

Publication made possible by grants-in-aids from Hoffmann-La Roche, Inc.; Lederle Laboratories Division, American Cyanamid Company; Parke Davis & Company; S. B. Penick & Company; Chas. Pfizer & Company; Schering Corporation; E. R. Squibb & Sons; Sterling-Winthrop Research Institute; and Wellcome Research Laboratories, Burroughs Wellcome & Co. (U. S. A.) Inc.; and the General Funds of the Academy.

Statistical analysis can be a powerful weapon in the medical armory, but it must be wielded with insight and discrimination. The mathematical arguments involved in tests of statistical significance, for example, depend for their accuracy on the strict comparison of like with like as in treated and control groups of patients. They will do nothing to eradicate any basic faults in the collection of the original data. Statistical analysis, therefore, should *not* be used rather as an afterthought at the “post-mortem” or autopsy of an experiment. Statistical reasoning is needed as soon as that experiment is conceived in the mind of the research worker and throughout its conduct. As Fisher remarked: “The statistician must be treated less like a conjurer whose business it is to exceed expectation, than as a chemist who undertakes to assay how much of value the material submitted to him contains.” Indeed, if you feel the need for technical assistance, you should consider your statistical colleague rather as an architect, to be consulted *before* the work is started, so that, by taking thought together, both experimenter and statistician can insure that the material will be collected in such a way as to give the maximum amount of accurate information. Only thus can the clinical research worker escape the vitriol of our comment. Only thus can we medical statisticians escape the ignominious label of arm-chair critic.

As the treatment of these patients went on, the results of objective tests of temperature ranges and sedimentation rates were recorded in a standardized manner, and routine X-ray checks were made by independent observers, unbiased by any knowledge of the patients’ identity or mode of treatment. In the final assessment again, there recurs this insistent theme of the elimination of personal bias, which is essential for success in clinical research.

The final statistical analysis by the application of the χ^2 and *t* tests (which conclusively demonstrated the beneficial effects of streptomycin) could thus be confidently made, since we were reasonably sure that the rain of chance events had fallen equally upon the just and the unjust. The differences observed, *e.g.*, in case-fatality rates, between treated and control groups may be due to chance, and it is the function of the technical test of significance to test just that hypothesis. Indeed, it is as well to reverse the normal processes of Anglo-American justice. Chance is always considered to be guilty or responsible for the differences until its innocence has been proved by the results of technical tests of significance. Then, and in general only then, can alternative explanations for these differences be considered. Last among these alternatives, you should consider the possibility that your own therapeutic brain-child was really producing a beneficial effect.