ABSTRACT The coupling of computer science and theoretical bases like non-linear dynamics and chaos, quite new for medicine theory, allows the creation of “intelligent” agents (Artificial Adaptive Systems [AAS]) able to adapt themselves dynamically to problems of high complexity. ASS are able to reproduce the dynamical interaction of multiple factors simultaneously, allowing the study of complexity; they can also draw conclusions on an individual basis and not as average trends. These tools can offer specific advantages within the outcome research arena, helping to answer some open issues like enhancing the internal validity of observational studies, transferring evidence derived from clinical research to a single patient level, and performing “virtual” clinical trials as a guide for more efficient clinical development. A remarkable contribution to this individual approach comes from Fuzzy Logic, according to which there are no sharp limits between opposite things, like wealth and disease. This approach allows for partially escaping from the probability theory trap in situations where it is fundamental to express a judgement based on a single case and favour a novel humanism directed to the management of the patient as an individual subject. Some examples of original applications in the authors’ experience are described. Drug Dev. Res. 67:227–244, 2006. © 2006 Wiley-Liss, Inc.

Key words: Alzheimer disease; Artificial Adaptive Systems (AAS); Artificial Neural Networks (ANN); Evolutionary Algorithms (EA); outcome research; non-linearity

INTRODUCTION

The aim of this article is to discuss the possible advantages derived from the use of Artificial Adaptive Systems (AAS), which can be considered the more advanced Artificial Intelligence tools available today, as an appropriate means of answering the emerging issues and “demands” of outcome research.

For this article on “Artificial Intelligence,” we focus on Artificial Neural Networks (ANN) and Evolutionary Algorithms (EA). ANN and EA are adaptive models analyzing data that are inspired by the functioning processes of the human brain and of evolution, respectively. They are systems that are able to modify their internal structure in relation to a function objective and are particularly suited for solving problems of the non-linear type, being able to reconstruct the approximate rules that put a certain set of data, describing the problem being considered, with a data set that provides the solution (ANN) or to reconstruct the optimal data for a given set of rules or constraints (EA) [Grossi and Buscema, 2004; Buscema, 2004].

*Correspondence to: Enzo Grossi, Medical Department, Bracco SpA, Via E. Folli 50 20136, Milano, Italy.
Email: enzo.grossi@bracco.com
Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/ddr.20081