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“Big data and dynamics” – the key to model-driven personalized medicine?

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Bridging the gap between the highly focused research strategies in drug R&D, with tight control of the experimental protocols, and the “real world” in clinics is a major challenge on the route to sustainable health care systems. Hence, “Big Data” analysis on real world data offers great promises to industry, clinics and society. However, the system to be analyzed, namely the patients, is not only extremely complex in terms of its entities, it is controlled by multi-scale mutual control mechanisms and exobiotic impact factors which are unexplored in detail. Moreover, biological systems can change their structure in response to stress, thus they exhibit complex dynamic features. To tackle this challenge requires systematic analysis of very large, heterogeneous and multi-variate data sets, which fortunately have become available today. It requires the development of new computational methods and workflows enabling one to extract the information on the mechanisms controlling the respective diseases and therapies. Moreover, they have to tackle the inherent “biological noise” in order to cope with the heterogeneity of clinical practice. We demonstrate on examples that integrated data analysis and dynamic hybrids allows the unsupervised identification of biological mechanisms from heterogeneous, MIMO-data sets and allows the utilization of the biological noise.