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Predicting Adverse Behavior with Early Warning Health Information Systems by Mining Association Rules on Multi-dimensional Behavior: A Proposal

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Summary

Today, one of the major challenges of Internet-based health interventions is the timely identification of adverse behaviors based on individual thresholds. For example, adherence variations related to medications and the degree of oxygen uptake of people with chronic obstructive pulmonary disease might significantly differ in individuals but may not always lead to critical outcomes such as an expensive hospital stay. By identifying multi-dimensional behavioral patterns that match adverse behavior regarding particular diseases, we hypothesize that so called Early Warning Health Information Systems (EW-HIS) have not only the potential to improve the quality of health interventions by predicting adverse behavior in advance but also to reduce costs of health systems in general by early diognoses and avoidance of false positives.

EW-HIS rely on three building blocks from the computer science discipline. First, automata theory (Hopcroft et al. 2013) is used to model health states of individuals whereas state transitions are triggered by actual behavior. Second, machine learning is used to mine association rules on multi-dimensional behaviors to identify patterns that are significantly related to a particular health state or disease and individual (e.g. Agrawal er al. 1993). Third, Internet of Things services are used to process various behavioral data (e.g. biosignals) to continuously innervate the health states (Fleisch & Mattern 2005, Fleisch & Weinberger 2014). A first EW-HIS will be implemented and empirically evaluated in the context of an organizational health promotion program.

It is expected that front-ends of EW-HIS will be mobile applications tailored to various diseases for which multi-dimensional behavioral patterns can be used as novel instruments for anamnesis, diognosis, behavior prediction and health interventions. The back-ends of EW-HIS will rely on a secure and scalable server infrastructure.

In summary, EW-HIS are assumed to provide a novel instrument for authors of Internet- based health interventions. That is, adverse health behavior can be identified and appropriate coping strategies proposed before the incidence of a serious and costly health-related event.

Problem

- People do have individual thresholds with regard to adverse health behavior
- Reaching these thresholds does not only negatively affect the individual but also the health system in general
- Prediction and management of adverse health behavior while considering inter-individual & intra-individual thresholds is one of the major challenges today

Proposal

Automata Theory

States represent the health condition of individuals; state transitions reflect changes in the health condition

Machine Learning

Prediction of adverse behavior by mining association rules on multi-dimensional behavior that is relevant to a particular disease pattern

Early Warning Health Information System

Internet of Things Services

Innervate health states and trigger state transitions with the help of sensor technology

Expected Results

- A novel instrument for anamnesis, diagnosis, behavior prediction and health interventions
- Improved and sustainable health status of individuals
- Reduced health system costs by early diagnoses and avoidance of false positives

Related Work

Agrawal R. Imieliski T. & A. Swami (1993) Mining association rules between sets of items in large databases. ACM International Conference on Management of Data. Washington, USA.

Fleisch E. & F. Mattern (2005) Das Internet der Dinge. Springer, Berlin, Germany.

Fleisch E. & M. Weinberger (2014) Business Models and the Internet of Things, Little Green Bags video clip: http://youtu.be/kYQ_PHOCjyg

Hopcroft, J.E., Motwani, R., Ullman, J.D.: Introduction to Automata Theory, Languages, and Computation. Pearson Education Limited, London, UK (2013).

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