Rehabilitation Risk Management: Enabling Data Analytics with Quantified Self and Smart Home Data

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Cost Drivers in Healthcare

- 30% of the increase in total health expenditure of the inpatient hospital sector is reflected in the cost of hospitals
- *Internal costs* (raises and lack of trained professionals) + *external influences* (inflation, demographic changes)

<table>
<thead>
<tr>
<th>Demographic Change</th>
<th>Medical Advances</th>
<th>Increasing costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population until 2050 in %</strong></td>
<td><strong>Research</strong>: Genome sequencing, Stem Cell, advanced medications and targeted therapies</td>
<td><strong>Research</strong>: Genomics, precision medicine, advanced medicine and targeted therapies</td>
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<tr>
<td>Population</td>
<td>Disease management and rehabilitation for individual care are less than optimal</td>
<td></td>
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<td>&lt; 20</td>
<td>➔ incomplete or <strong>delayed information sharing</strong> between stakeholders, heterogeneous sources for disease-related data, and lack of <strong>individually created support concepts</strong></td>
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<tr>
<td>20 - 64</td>
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<tr>
<td>65 - 80</td>
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<tr>
<td>&gt; 80</td>
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Rehabilitation is key for a variety of acute and chronic diseases.

After discharge, patients are challenged to continue the prescribed measures (e.g. exercise programs, nutrition plans) on their own.

The success of self-care application depends to a large extent on the patient’s adherence to the rehabilitation plan and the exercise quality.

Studies show that readmissions within 30 days can be reduced by 50% when patients are engaged.
Patients with chronic diseases account for the biggest part of readmissions

Renal failure, Septicemia, diabetes, psychotic disorders, airway disease and cardiac disease

The monitoring of simple values can heavily support the pre-emptive detection of patient deterioration.

The collection of data to support monitoring these diseases at home can range from simple devices, such as digital scales (e.g. to track fluid fluctuations with renal disease), more advanced, non-invasive sensors for blood sugar measurement (e.g. through contact lenses) to more complicated or invasive measures, e.g. testing for inflammatory markers.
How can **consumer technologies** be used to enable the *simple* and *automatic* collection and storage of *rehabilitation* and *monitoring data* to **optimize available information** for all involved professional actors and family members.
Ambient Assisted Living systems provide sensitive, adaptive electronic environments that communicate and interact with people and objects to gain insights and provide the aggregated information and services to different stakeholders.
Quantified self
consistently tracking movement data as well as health related information through wearable sensory

*Wearables - Worldwide Sales (in M devices)*

- **fitbit**: 22,0 (2015), 22,5 (2016)
- **mi**: 12,0 (2015), 15,7 (2016)
- **Apple**: 11,6 (2015), 10,7 (2016)
- **Garmin**: 5,8 (2015), 6,1 (2016)
- **Samsung**: 3,2 (2015), 4,4 (2016)
- **Andere**: 27,4 (2015), 43,0 (2016)

Quelle: IDC
Data Sources for Rehabilitation

Application Areas

Domain of Origin

Sensor Technology

Rehabilitation

Quantified Self

Smart Home

Biosignals (e.g. Heart rate, Breathing rate)

Physical Activity (e.g. Step count, Calories)

Activities (e.g. Meals, Sleeping Time)
Sensor Framework

- **SENSOR**: Smartphone, Smartwatch, Smart Scale
- **SENSOR DATA**: Time Provider, Location Provider, Activity Provider, Physical Effort Provider, User Type Provider, Biometric Data Provider, Cardiovascular Data Provider, Psychological Condition Provider
- **OUTPUT**: Timestamp, Position, Activity Type, Activity Intensity, Step Count, Distance Walked, Burned kcal
- **CONTEXT**: Age, Sex, Height, Weight, Body Fat Ratio, Body Mass Index, Heart Rate, Blood Pressure, Blood Glucose, Motivational State, Activity, Location, Time, Identity
Implications & Limitations

- **Implications for research and practice**
  - *Research*
    - “All in one approach” to integrate the management of various risks simultaneously
    - Extendable modular sensor framework
  - *Practice:*
    - Improve healthcare value through an enriched data collection
    - Early identification of issues can lead to fewer unnecessary readmissions and timely interventions
- **Limitations**
  - Data security and data interoperability have to be considered as important factors in this context
  - Responsibilities and quality of measurements for more complex diseases need to be tested and evaluated
References (1/2)


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References (2/2)


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- T. Horbach, Expert Interview on a Service Portfolio for Health Services.

