“The Internet of Things for personalized Health”

Assistive Healthcare Information Technology
Digital Safety & Security Department
AIT Austrian Institute of Technology GmbH

Internet der Dinge
Quo vadis?
Dienstag, 10. Mai 2016, 09:00 – 14:00 Uhr
Festsaal des Ingenieurhauses
Eschenbachgasse 9, 1010 Wien
Four P terms in pHealth

- **Participatory**
  - Give patients an active role - co-production of health
- **Personalized**
  - Tailor healthcare to the particular needs of the individual patient
- **Predictive**
  - Detect situations with significant risk of negative health impact
- **Preventive**
  - Intervene specifically to avoid or ameliorate negative impacts

Inhalt

- Telehealth für Patienten mit Herzschwäche
- Die technologische Evolution eHealth, mHealth, pHealth, ...
- Zukünftige Herausforderungen
- Zusammenfassung und Schlussfolgerung
Heart Failure (Herzinsuffizienz, Herzschwäche)

- Numbers in Austria
  - 25,000 hospitalisations
  - 2,500 Deaths
  - Length of stay 9.3 days
  - Estimated Hospitalisation costs: €300 Mio

- Increasing prevalence

U.S. Census Bureau. NEJM 2003, 347:1442

Treatment strategies in heart failure

- Just in case
  - Optimization in hospital
  - Changes remain unknown
  - Re-hospitalisation

- Just in time
  - Telemonitoring
  - Detection of critical changes
  - Early intervention
  - Avoiding escalation
mHealth - Closed Loop Healthcare

MOBITEL - randomised multicentre clinical trial

- Clinical Partner: Medical University of Graz
- Safety
- Efficacy
  - Re-hospitalisation rate
  - Quality of life

Manual data entry
MOBITEL - Ergebnisse

<table>
<thead>
<tr>
<th></th>
<th>T-Gruppe</th>
<th>K-Gruppe</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anzahl der Patienten, per Protokoll (m/f)</td>
<td>54(40/14)</td>
<td>54(39/15)</td>
<td></td>
</tr>
<tr>
<td>Alter (Median IQR)</td>
<td>65 (62 – 72)</td>
<td>67 (61 – 72)</td>
<td>n.s.</td>
</tr>
<tr>
<td># kombinierter Endpunkte (Rehosp. / Tod)</td>
<td>8 (8/0)</td>
<td>18 (17/1)</td>
<td></td>
</tr>
<tr>
<td>Risiko / Eventrate [%]</td>
<td>15%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Relative Risiko-Reduktion [%] (CI)</td>
<td></td>
<td>56% (7 – 79)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>NYHA – Klasse (Median vorher / nachher)</td>
<td>III / II</td>
<td>III / III</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Dauer der Hospitalisierungen [Tage]</td>
<td>6,5 (5,5 – 8,25)</td>
<td>10 (7 – 13)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Gesamte Hospitalisierung [Tagen]</td>
<td><strong>52</strong></td>
<td><strong>180</strong></td>
<td></td>
</tr>
</tbody>
</table>

Bei Patienten mit Herzinsuffizienz und einer akuten Episode einer kardialen Dekompensation kann mittels mobilfunkbasiertem Telemonitoring die Anzahl und Dauer von Krankenhausaufenthalten vermindert und die Prognose verbessert werden.

Closed Loop Healthcare

Patient Terminal for Anything & Anyone?

Anywhere

Anytime
Trial & error
Interacting with the real world …

by touching symbols and abstractions

By touching things using NFC
“Keep in Touch”

mHealth based on Near Field Communication (NFC)

- Short range (5 cm), low-power, wireless communication technology
- “Bring-in-Touch” – paradigm
  - Touch contactless smartcard to
    - start software application automatically
    - read data for identification and authentication
  - exchange data with NFC enabled devices
  - read out static data from RFID tag
- all without prior pairing
- In 2017, there will be 1.67 billion NFC-enabled handsets in use*

The Internet of Things (IoT)

- draws on earlier concepts like
  - Ubiquitous Communication
  - Pervasive Computing
  - Ambient Intelligence

- smart objects with four technological attributes
  - Identification
  - Location
  - Sensing
  - Connectivity

- enables communication between people and things, and things and things
RFID/NFC – a key technology for pHealth

- The enabler of „The Internet of Things“
- „Touch“ paradigm let patients participate actively, they stay in control
- Low power - safety
  - Low SAR rates
- Low power - security
  - Near field, magnetic coupling – decays with $1/r^3$
- Low power - NO power
  - Passively powered sensors
IoT - Integration medizinischer Sensorgeräte

- Spirometer
- ECG Event Recorder
- Pedometer
- Smart Blisters
- Blutzucker-Messgerät
- Blutdruck-Messgerät
- Körperwaage
- ID-Karte
- Insulinpen

Patients and Doctors *keep in touch*

Heart Failure Patients

Doctors

KIT Telehealth Solutions

- Heartfailure / HerzMobil
- Diabetes / DiabMemory
- Coronary Heart Disease / MyCor
- Smart Homes / moduLAAr
- Hypertension / CardioMemory

Experience with more than 500,000 Telemonitoring Days
Waves of enabling ICTs (Pubmed Literature Query)
What's next?

Anywhere
+ Anytime
+ Anything
+ Anyone

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Text mining
Machine learning
Predictive modeling
Visual analytics

Data driven healthcare - > dHealth
Environmental
Is blood pressure influenced by weather conditions?

- Yes, initial study indicates that blood pressure increases when temperature decreases rapidly

Geographical distribution of patients and associated closest weather stations (lines mark equidistant locations between the neighbouring weather stations)

Advanced Adherence Monitoring and Management

Predictive Health Information Systems @ AIT

data driven Healthcare (dHealth)
Summary

 Today - just in case
   adjust from time to time

 Tomorrow – just in time
   Choose therapy based on data from Biomarkers, Electronic Health Records, Telehealth, Lifestyle, Environmental sensors, …
   Monitor and adjust when risk increase is detected

 Vision - the Internet of Things + Data Sciences → Healthcare 4.0
   Participatory
   Personalized
   Predictive
   Preventive
More on eHealth, mHealth, pHealth, ...

- www.eHealth2016.at

- Vienna, Conference Centre Schloss Schönbrunn
- May 24 – 25, 2016

- Motto
  “Predictive Modelling – from Prediction to Prevention”