General Trends of New Technologies
Demographic change

- **Total world population**
  - 2015: 7.3 B
  - 2030: 8.2 B
  - 2050: 9.6 B
  - **Percentage increase**: 32%

- **Population over 65**
  - 2015: 600 M
  - 2030: 973 M
  - 2050: 1.5 B
  - **Percentage increase**: 105%

- **Stroke survivors**
  - 2015: 33 M
  - 2030: 70 M
  - **Percentage increase**: 112%
Increase of neurological diseases

Worldwide neurological diseases affect:

• up to **one billion people** irrespective of age, sex, education or income
• **cause 6.8 million annual deaths**
### Costs of Neurological Diseases (in Europe/2010)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Costs/person [€]</th>
<th>Total Costs [Billion €]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep disorder</td>
<td>790</td>
<td>35.4</td>
</tr>
<tr>
<td>Stroke (chronic)</td>
<td>5368</td>
<td>37.4</td>
</tr>
<tr>
<td>Parkinson</td>
<td>11,153</td>
<td>13.9</td>
</tr>
<tr>
<td>Dementia</td>
<td>16,584</td>
<td>105.0</td>
</tr>
<tr>
<td>Stroke (acute)</td>
<td>21,000</td>
<td>26.6</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
<td>26,974</td>
<td>14.6</td>
</tr>
</tbody>
</table>
Costs of neurological diseases (in Europe/2010)

1/3 of total costs in Europe are related to neurological diseases

Over 50% of elderly diagnoses are neurologically related

220 million EU people have a neurological disease

Overall costs for neurological and psychiatric diseases in Europe: **798 billion €**

- **37%** Direct/Non-medical costs (e.g. rest home)
- **40%** Direct costs (e.g. industrial accidents)
- **23%** Healthcare (e.g. therapy)
Therapy for stroke patients: reality today?

Patient day in a “good” rehab hospital

- Idling
- Sleeping
- Therapies (total)
Human resources for rehabilitation
(example Germany)

today
future (2040-60)

Stroke patients
- 280,000 today
- 460,000 future

Healthcare costs
- 520 B € (19% BIP) today
- 1039 B € (24% BIP) future

Hospitalization
- 17 M today
- 19 M future

Physical therapists
- 170,000 today
- ? future

General Trends of New Technologies
Clinical evidence of new technologies

- The last ten years have resulted in more clinical evidence-based literature.
Trend towards advanced technologies

Demographic change

Increase of neurological diseases

Increase of healthcare costs

Lack of resources for therapy

Efficient and effective use of advanced technologies

Clinical Evidence (Motor Learning)
MedTech industry worldwide

**Asia Pacific**
- 2012: $55 Billion
- 2015: $71 Billion
- Annual Growth: >10% next 3 years

**North America**
- 2012: $134 Billion
- 2016: $200 Billion
- Annual Growth: 6.4% 2012-2017

**Latin America**
- 2012: $10.5 Billion
- 2015: $20 Billion
- Annual Growth: 4%

**Europe**
- 2012: $100 Billion
• **Global sales** of service robots are estimated to **jump more than 26-fold** to $85.5 billion in 2018 from $3.2 billion in 2008
• **Rehabilitation robot market** will **grow significantly** from $43.3 million to $1.8 billion by 2020 (Wintergreen report)
• **demand for robotics skills** as job requirement increased (13% year-over-year)

• bulk of hiring is in the **healthcare sector** (physicians had the most growth, up 23%)
Tech trends shaping the future of medicine I

Rehabilitation robotics support an **effective and efficient** way to treat patients through a state-of-art therapy.

Use of **electrical energy** as a medical treatment.

Combining fun and games into healthcare can **motivate the patient** and **collect data** needed to make informed decisions on daily activities that contribute to one’s health.
Tech trends shaping the future of medicine II

Empowered patients

The Internet has led to many people **researching their symptoms** and **diagnosing and treating themselves**.

Telemedicine and remote care

Home healthcare services and innovative technology will allow for **doctor-patient connectivity**.

Re–thinking the medical curriculum

Medical schools will **prepare future physicians** for a world full of **e-patients** and **technology**.
Tech trends shaping the future of medicine III

- Surgical and humanoid robots
- Genomics and truly personalized medicine
- Body sensors
- Medical tricorders and portable diagnostics

Robots will become much more integrated into surgical teams as already established in the area of radiotherapy.

DNA analysis will become a standard step when prescribing medicine or treatment, to ensure it is personalized and optimized for that particular patient’s metabolic background.

Technology is allowing us to measure critical health parameters in convenient and inexpensive ways.

Diagnostic procedures are shifting towards devices that are portable and able to be performed from home.
Cheaper technology and a DIY spirit are generating a new generation of scientists and engineers who see no limitations in research. Community biology labs are popping up around the world - the resulting innovation in biotech has the potential for disruptive solutions that will further change the way medicine is practiced.

3D printers can manufacture medical equipment, prostheses, or even drugs.

Exoskeleton suits have enabled partially-paralyzed individuals to walk again.
Acceptance and usability of technology

Personal features:
• Physical (age, gender, health condition, impairments, disability)
• Psychological (personality, cognition, motivation, emotion, the subjective importance of the rehabilitation intervention, the sense of coherence)

Technology features:
• Friendly interface of rehabilitation technology
• Ergonomy and safety of rehabilitation technology
• Ease of achieving benefits
• Quality of the rehabilitation using technology

Social influence:
• The subjective norm
• Self image
• The degree of tutelage from rehabilitation professionals, rehabilitation technology engineers, caregivers, family members, friends
Acceptance and usability of technology

Objective factors:
- accessibility of RT
- involved costs
- information and training on RT use

Subjective factors:
- persuasion, satisfaction and rewards
- trust in the provider
- sense of person’s utility
- sense of coherence
- perceived level of disability

RT = Rehabilitation Technology
Issues of technologies in rehabilitation

- Poverty in developing countries - barrier to support the welfare programs
- Increase access to technology
- «luxury object»
- To justify payment, rehabilitation researchers are called to show evidence of outcomes, efficacy, and effectiveness of technologies
- joint work between clinicians and engineers
- Development challenges vs clinical needs
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