A Home-based Information and Communication Technologies Solution to Predict and Prevent Falls in Older People

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EU Project
iStoppFalls
General Information

iStoppFalls - ICT based System to Predict & Prevent Falls

ICT for Ageing and Wellbeing
ICT-2011-7.5.4.b

iStoppFalls
ICT based System to Predict and Prevent Falls

- Funded under: 7th Framework Programme
- Area: Information Society (ICT-2011-7.5.4)
- Project reference: 287361
- Total costs: 5.35 million euro
- EU contribution: 3.29 million euro
- Australian contribution: 0.42 million euro
- Execution: from 2011-10-01 to 2014-09-30
- Duration: 36 months
- Project status: Execution
- Contract type: Collaborative project

Consortium
Objectives & Impacts
iStoppFalls - ICT based System to Predict & Prevent Falls

Objectives

- **Objective 1**
  iStoppFalls will help to **reduce fall risk**, and thus **improve quality of life**

- **Objective 2**
  iStoppFalls will offer improved **fall prediction & prevention** measures

- **Objective 3**
  iStoppFalls will fit very well inside **basic daily behavioral settings**

- **Objective 4**
  iStoppFalls will provide **self-learning solutions** with advanced reasoning

- **Objective 5**
  iStoppFalls will provide advanced HCI (**usability & accessibility**)

Impacts

- **Impact 1**
  reduced fall risk

- **Impact 2**
  improved quality of life

- **Impact 3**
  reduced costs

End-User Setting

- **Community-dwelling older adults**
  (aged 65/70+ years)
End-User Setting

iStoppFalls - ICT based System to Predict & Prevent Falls

Living Lab @home
System Overview
System Components

iStopFalls - ICT based System to Predict & Prevent Falls

System Components:

1) Set-Top-Box (iTV)
2) Mini-PC (Exergame)
3) Kinect (Gesture/Voice)
4) SMM (Mobility Monitor)
5) Tablet (Diary, Control)
iStoppFalls Main Menu (iTV)

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Strength Training

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- Strength Training
  - Side Hip
  - Back Knee
  - Front Knee
  - Calf Raises
  - Toe Raises

- 3 Times per Week (60 min total duration)

- Timely progression + add. weights...
Balance Games

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- Balance Games
  - Bending
  - Stepping
  - Leaning

- 3 Times per Week (60 min total duration)

- Up to 50 levels per game incl. Dual Task (exercise & cognitive)
Fall Risk Assessment

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- Physical Tests
  - Sit-to-Stand
  - Tandem Stand (3)
  - Reaction Time Hand/Foot

- Plus Questionnaires & Icon FES per month
Individual Risk Score

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Scoring Model

Last fall risk assessment: 20 Aug 2013

Score

Fall Risk Score

Previous Falls

Medical Measures

Fear of Falling

Physical Tests
(Kinect & SMM)
SMM Activity Tracker
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Daily Activity Tracking

Most active six hours

Druckknopf zur kabellosen Datenübertragung
Stecker zum Aufladen
Kordel mit Schnellbruchfunktion
iStoppFalls Impacts

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iStoppFalls Living Lab
User sample

- 15 participants (9 females, 6 males)
- 6 participants live alone (4 females, 2 males) and 9 live together with his/her spouse (5 females, 4 males)
- 63-80 years old (average age: 72.6 years (± 6.2))
- 3 drop-outs (one couple at the beginning and one female in the first month) → personal time restrictions, technical malfunctions
iStoppFalls Exergaming Habits

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Exergame Activities over Time
iStoppFalls Living Lab Results

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- Technology Acceptance
- Exergaming Habits & Gender Effects
- Integration into daily routines
- Self-monitoring & Fall Risk Control
- Transferring exercises into daily routines
- Improvement of Quality of Life and Self-Efficacy
- Increased activity and social engagement
- Extended Use
iStoppFalls Impacts

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iStoppFalls

Randomized Controlled Trial
iStoppFalls RCT
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Clinical Trial (4 month)
2 month follow-up

Recruitment (Oct-Dec 2013)

In- and exclusion criteria

Baseline assessment (Jan-Feb 2014)
Quality of life, strength, balance, mobility, cognitive functions, dual task, user experience

2 months

Intervention group (training)
Control group (education material)

Midterm assessment
Quality of life, fall risk

2 months

Intervention group (training)
Control group (education material)

Post assessment
Quality of life, strength, balance, mobility, cognitive functions, dual task, user experience, usability, acceptance

Europe
- Cologne: 30/30
- Valencia: 20/20

Australia
- Sydney: 30/30

Main RCT
N=80/80
### Participant Characteristics

**iStoppFalls - ICT based System to Predict & Prevent Falls**

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group</th>
<th>Control Group</th>
<th>Overall</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD n (%)</td>
<td>Mean ± SD n (%)</td>
<td>Mean ± SD n (%)</td>
<td>ANOVA</td>
</tr>
<tr>
<td>Age (years)</td>
<td>74.71 ± 6.66</td>
<td>74.65 ± 6.03</td>
<td>74.68 ± 6.34</td>
<td>.960</td>
</tr>
<tr>
<td>Gender (n)</td>
<td>43 (55.8%)</td>
<td>50 (66.7%)</td>
<td>93 (61.2%)</td>
<td>.185</td>
</tr>
<tr>
<td>Drugs (n)</td>
<td>3.52 ± 3.12</td>
<td>3.14 ± 2.49</td>
<td>3.34 ± 2.83</td>
<td>.413</td>
</tr>
<tr>
<td>EQ-5D (index)</td>
<td>0.860 ± 0.120</td>
<td>0.860 ± 0.113</td>
<td>0.860 ± 0.128</td>
<td>.979</td>
</tr>
<tr>
<td>PPA (score)</td>
<td>.615 ± .886</td>
<td>.546 ± .901</td>
<td>.581 ± .891</td>
<td>.635</td>
</tr>
<tr>
<td>Fall history (n)</td>
<td>25 (32.5%)</td>
<td>26 (35.6%)</td>
<td>51 (34%)</td>
<td>.732</td>
</tr>
</tbody>
</table>
Total Exergame Adherence
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Mean Duration (per person)

- Exercises
- Games
- Assessments

Cologne: 300 minutes
Valencia: 600 minutes
Sydney: 100 minutes
Mean Value: 300 minutes

Cleaned Data
Excluding outliers & instructions
SMM Wearing Time

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Mean SMM wearing time per person (hours)

<table>
<thead>
<tr>
<th>Location</th>
<th>Mean (hours)</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cologne</td>
<td>627.23</td>
<td>26</td>
</tr>
<tr>
<td>Valencia</td>
<td>742.05</td>
<td>22</td>
</tr>
<tr>
<td>Sydney</td>
<td>261.32</td>
<td>22</td>
</tr>
<tr>
<td>Mean</td>
<td>544</td>
<td>70</td>
</tr>
</tbody>
</table>

## Drop-Outs

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<th>Intervention Group</th>
<th>Control Group</th>
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</thead>
<tbody>
<tr>
<td><strong>N (%)</strong></td>
<td>N (%)</td>
<td></td>
<td>N (%)</td>
</tr>
<tr>
<td>Full Drop-Outs</td>
<td>10 (12.8%)</td>
<td>13 (17.3%)</td>
<td>23 (15%)</td>
</tr>
<tr>
<td>Drop-Outs ITT</td>
<td>5 (6.4%)</td>
<td>0 (0%)</td>
<td>5 (3.3%)</td>
</tr>
</tbody>
</table>

### Reasons for drop-outs:

**Intervention group:**
- technical (5), health (5), moving away (2), new furniture (1), family issues (1), other (1)

**Control group:**
- health (7), randomization (3), caring for partner (1), going away (1), other (1)
Fall Risk – PPA (total score)

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PPA (score) [Mean±SE]

p < 0.05 (time*group) ANOVA
Quality of Life  EQ-5D (index)
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p = N.S. (time*group)  
ANOVA
Subgroups

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- Adherence
  - Cut-Off: 90 minutes per week

- Fall Risk
  - Cut-Off: .540 risk score
Subgroup Analysis: PPA-Sway

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**PPA Sway ap*ml (mm²) [mean±SE]**

<table>
<thead>
<tr>
<th></th>
<th>Pre (High-adherence Group n=18)</th>
<th>Post (High-adherence Group n=18)</th>
<th>Pre (low-adherence Group n=53)</th>
<th>Post (low-adherence Group n=53)</th>
</tr>
</thead>
</table>
| p < 0.05 (time*group) ANOVA

High-adherence Group (n=18)

Low-adherence Group (n=53)
Subgroup Analysis: EQ-5D VAS

EQ-5D VAS [mean±SE]

p = 0.052 (time*group) ANOVA

Pre Post Pre Post
High-adherence Group (n=18) low-adherence Group (n=53)

Subgroup Analysis: PPA-Total Score

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ANOVA

p < 0.001 (time*group)
iStoppFalls Stakeholder Analysis

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- Market Acceptance
- Stakeholder Analysis
- Health Economics
# iStoppFalls Socioeconomic Results

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<table>
<thead>
<tr>
<th></th>
<th>Fallers (Emergency Department)</th>
<th>Total societal impact (million €)</th>
<th>% of health expenditure</th>
<th>Societal savings. (30% falls prevented, 3% users 1 year use)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Germany (2012)</strong></td>
<td>350.000 (a)</td>
<td>2.100 – 3.800 (b)</td>
<td>0.54 – 0.98 % (b)</td>
<td>27.7 Mio € (e)</td>
</tr>
<tr>
<td><strong>Spain (2012)</strong></td>
<td>Unknown</td>
<td>423 (c)</td>
<td>0.33 % (c)</td>
<td>3.8 Mio € (e)</td>
</tr>
<tr>
<td><strong>Netherlands (2012)</strong></td>
<td>84.000 (d)</td>
<td>820 (d)</td>
<td>0.9 % (d)</td>
<td>7.4 Mio € (e)</td>
</tr>
</tbody>
</table>

(a) Böhm Clemens & Ziese 2009  
(b) Heinrich et al. 2012  
(c) Campo Martín 2012  
(d) VeiligheidNL 2013  
(e) Sherrington et al. 2008