The CARDSS project
Guideline-based decision support in multidisciplinary outpatient cardiac rehabilitation

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Content of presentation

• Guideline implementation problem
• Computerized Decision Support
• Cardiac Rehabilitation
• The CARDSS studies
• Status CARDSS
Guideline implementation problem

• Clinical practice guidelines propagate best practices
• However -> Guideline adherence in practice is low
  – Patient barriers, Professional barriers, Team barriers, Organizational barriers, External barriers
• Guideline implementation requires changing the existing working procedures
• Changes do not occur spontaneously; need to be actively pursued
• Instruments:
  – Conference meetings
  – Education
  – Audit and feedback
  – Computerized Decision Support
Computerized decision support

- **CDS** can provide patient-specific, guideline-based recommendations to professionals at the time and location of decision making.

- Among the **most effective** guideline implementation instruments:
  - Found effective in 14/18 guideline implementation studies [Shiffman 1999]
  - Found effective in 65/100 studies focusing on practitioner performance [Garg 2004]

But:

- **effect of CDS unknown in multidisciplinary setting**
  - Should affect behaviour of a team of professionals: social process
  - Therefore possibly less effective

- Still poorly understood which factors influence CDS usability

- Still poorly understood in which circumstances/for which barriers CDS is effective
Cardiac rehabilitation

- **Secondary prevention** therapy for patients with a cardiac incident or a cardiac intervention (ACS, PCI, CABG, Stable AP, ICD, etc)
- **Goals:**
  - Improve physical condition
  - Improve psychosocial condition
  - Learn to know own limits & deal with limitations
  - Speed up reintegration
  - Change of risk behavior/lifestyle – **disease management**

- Proven cost-effective
- Optimally effective with **multidisciplinary** approach
Cardiac rehabilitation
Cardiac rehabilitation in the Netherlands

- 100 clinics, 30,000 patients/year
- large variation in
  - referral patterns
  - decision making
  - organization of treatment
  - core: needs assessment for rehab therapy
  - 4 types of therapy: exercise, education, relaxation, lifestyle change
1. Is there an objective reduction of the exercise capacity in relation to the future functioning?

How do you want to answer this question?
- Relate the results of the maximal exercise test to the ‘MET’ list (preferred)
- Relate the results of the Shuttle Walk Test to the ‘MET’ list (preferred 2nd)
- Interpret the results of the maximal exercise test by my clinical experience

Yes  

Is group treatment impossible because of physical limitations? *4*

Yes  

Advice rehabilitation doctor *5*  
Individual coaching *6*

No  

Are cardiac contraindications for participation in the exercise program present? *7*

Yes  

Possible goals:
1. Get to know your own physical limits
2. Learn to cope with physical limitations
3. Optimising exercise capacity
Possible interventions:
- Exercise programme
- Relaxation programme

No  

Repeat screening of question 1 at later time
The CARDSS system

- **Cardiac Rehabilitation Decision Support System**
- **needs assessment procedure**
  - assessment of rehab goals and therapies
  - developed with the *Gastone* framework from Medecs
  - assists in structured information gathering (e.g. QoL questionnaire)
  - background information, scientific evidence
- **workflow-integration**
  - electronic patient record
  - generate useful output (summaries/reports)
  - evaluation of patient progress
  - generation of management data

-> For detailed information see: Goud R, Hasman A, Peek N. Development of a guideline-based decision support system with explanation facilities for outpatient therapy. Comput Methods Programs Biomed 2008
Needs assessment procedure

Domains
- Objective capacity
- Subjective capacity
- Psychol. condition
- Social condition
- Risk behaviour (0)
- Extra items (0)

Risk behaviour: Question 1
Did the patient smoke prior to his cardiac incident/operation?
- Yes
- No

Comments:

Personal info
- Mr. Peter Parker
- CABG
- Patient id 12345
- Birth date 10/1/1950
- Age 57 Years
- Length 188 cm
- Weight 83 kg
- BMI 23

- Formulate this patient’s rehabilitation programme
- Print a report of this patient’s record
- Messageboard (No messages placed for this patient yet)

Date of needs assessment 11/14/2007

Ready Cancel
Patient: Mr. Peter Parker (10/1/1950)

Formulate the patient's rehabilitation programme by selecting the patient's rehabilitation goals for and therapies that the patients will receive during cardiac rehabilitation

- **Cardiac rehabilitation goals**

- **Cardiac rehabilitation therapies**

<table>
<thead>
<tr>
<th>Therapies</th>
<th>Offer patient</th>
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<tbody>
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</tr>
<tr>
<td>Relaxation therapy</td>
<td>recommended</td>
</tr>
<tr>
<td>Educational therapy</td>
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</tr>
<tr>
<td>Lifestyle change therapy</td>
<td>Not recommended</td>
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**Exercise therapy is recommended for this patient by the guidelines based on the following criteria**

**Domains:**

**Objective exercise capacity**

-Criterium: Is there an objective reduction of the patient's exercise capacity in relation to his future functioning? **Answer: Yes**

--> Criterium: Does the patient have any physical limitations that hinder participation in a group-based therapy? **Answer: No**

----> Criterium: Is there a contraindication for the patient's participation in the exercise therapy? **Answer: No**
The CARDSS studies

- Effect of CDS on multidisciplinary decision making cluster randomised trial
- CARDSS usability assessment quantitative questionnaire study
- Effect of CDS on barriers to guideline implementation qualitative study
- CARDSS with feedback and outreach visits cluster randomised trial
The CARDSS trial

- **Research question**: Do patient-specific guideline-based therapy recommendations improve multidisciplinary team decision making?
- **Cluster randomisation**
  - intervention group: CARDSS with advice
  - control group: CARDSS without advice
- **Duration**: 6 months
- **Outcome measure**: guideline adherence
  - measured at patient level
  - for all four types of therapy
Patient: Mr. Peter Parker (10/1/1950)

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- Cardiac rehabilitation goals
- Cardiac rehabilitation therapies

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--> **Criterion:** Does the patient have any physical limitations that hinder participation in a group-based therapy? **Answer:** No

----> **Criterion:** Is there a contraindication for the patient's participation in the exercise therapy? **Answer:** No
Trial results

- Trial started in Jan 2005 ended July 2006
- 31 outpatient clinics were randomized
  - Stopped participation: 5 centres
  - Excluded based on data audit: 5 centres
- Data of 21 centres with 2787 patients were analyzed
- Guideline adherence to therapy recommendations significantly increased by CDS
  - Exercise therapy: 84.7%→92.6%.
  - Education therapy: 62.1%→87.6%.
  - Relaxation therapy: 34.0%→59.6%.
  - No (significant) increase lifestyle change therapy (54.1%→57.4%)
However: Large variation in concordance with therapy recommendations between centers
Conclusions of trial

• CARDSS improved decision making of MD teams with respect to exercise, relaxation, and information therapy
  – CDS also effective in a MD setting: not previously studied!

• but:
  – no effect for lifestyle change therapy
  – considerable undertreatment of patients
  – a lot of variation between clinics

• Remaning question:
  – What usability factors influenced CARDSS’ ‘succes’?
  – What caused was CARDSS not able to increase adherence for the lifestyle change therapy and why does considerable variation exist?
CARDSS Usability Assessment

- **Aim:** to gain more understanding in factors that influence CDSS usability
- **Questions:**
  - How did users judge CARDSS’ usability?
  - What (CDSS specific) factors influenced CARDSS’ subjective usability?
- **Methods:**
  - Questionnaire to all CARDSS trial participants
  - Linear regression to analyze factors affecting subjective usability
CARDSS Usability Questionnaire

• Based on IBM Computer System Usability Questionnaire (CSUQ) which measures Overall usability (19 7pt Likert scale items)
  – Ease of system use (8 items)
  – Information Quality (5 items)
  – Interface Quality (3 items)
• Extended with questions to measure
  – Age, Gender, Computer Literacy
  – Clinical experience
  – Integration of CARDSS into working procedures
  – Time increase per patient caused by using the system
  – Agreement with content national CR guideline (12 items)
  – General attitude towards CDSSs (2 items)
## Results: Demographics

- 63 out of 68 users responded (93%) from 27 out of 28 outpatient clinics

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (mean ± SD)</td>
<td>42.8 ± 8.2</td>
</tr>
<tr>
<td>Male gender (%)</td>
<td>32%</td>
</tr>
<tr>
<td>Self-judged computer experience</td>
<td></td>
</tr>
<tr>
<td>Low literacy (%)</td>
<td>11 (18%)</td>
</tr>
<tr>
<td>Moderate literacy (%)</td>
<td>34 (54%)</td>
</tr>
<tr>
<td>High literacy (%)</td>
<td>18 (29%)</td>
</tr>
<tr>
<td>Clinical experience, years (median [interquartile range])</td>
<td>5 [2.5-14]</td>
</tr>
<tr>
<td>Integration of CARDSS into clinical workflow</td>
<td></td>
</tr>
<tr>
<td>Concurrent: use CARDSS during patient visit (%)</td>
<td>16 (27%)</td>
</tr>
<tr>
<td>Serial: fill in paper during patient visit and use CARDSS afterwards (%)</td>
<td>44 (69%)</td>
</tr>
<tr>
<td>Time spend on needs assessment procedure per patient, minutes (median)</td>
<td>40-50</td>
</tr>
<tr>
<td>Time increase caused by CARDSS, minutes (median [interquartile range])</td>
<td>10 [0-10]</td>
</tr>
</tbody>
</table>
### Results: Satisfaction / usability

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement with content of cardiac rehabilitation guidelines (mean ± SD)</td>
<td>5.07 ± 0.72</td>
</tr>
<tr>
<td>Attitude towards use of CDSSs in general (mean ± SD)</td>
<td>5.65 ± 1.26</td>
</tr>
<tr>
<td>Overall usability (mean ± SD)</td>
<td>5.10 ± 0.85</td>
</tr>
<tr>
<td>Ease of system use (mean ± SD)</td>
<td>5.14 ± 1.08</td>
</tr>
<tr>
<td>Information quality (mean ± SD)</td>
<td>5.05 ± 0.87</td>
</tr>
<tr>
<td>Interface quality (mean ± SD)</td>
<td>5.10 ± 1.18</td>
</tr>
</tbody>
</table>
## Results: Factors affecting usability

<table>
<thead>
<tr>
<th></th>
<th>Ease of system use (B ± SE)</th>
<th>Inform. quality (B ± SE)</th>
<th>Interface quality (B ± SE)</th>
<th>Overall (B ± SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical experience</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4 years or less</td>
<td>0.78 ± 0.45</td>
<td>0.40 ± 0.37</td>
<td>0.28 ± 0.55</td>
<td>0.62 ± 0.36</td>
</tr>
<tr>
<td>5 to 12 years</td>
<td>0.40 ± 0.42</td>
<td>0.54 ± 0.35</td>
<td>0.23 ± 0.51</td>
<td>0.47 ± 0.33</td>
</tr>
<tr>
<td>more than 12 years</td>
<td>--</td>
<td>--</td>
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<td>--</td>
</tr>
<tr>
<td><strong>Time increase by CDSS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No time increase</td>
<td>1.22 ± 0.39 *</td>
<td>0.25 ± 0.38</td>
<td>1.18 ± 0.54</td>
<td>0.83 ± 0.31 *</td>
</tr>
<tr>
<td>1 to 10 minutes</td>
<td>0.81 ± 0.36</td>
<td>0.44 ± 0.36</td>
<td>1.08 ± 0.51</td>
<td>0.75 ± 0.29</td>
</tr>
<tr>
<td>more than 10 minutes</td>
<td>--</td>
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</tr>
<tr>
<td><strong>Workflow Integration CARDSS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent use</td>
<td>1.08 ± 0.39 *</td>
<td>0.57 ± 0.34</td>
<td>0.75 ± 0.47</td>
<td>0.71 ± 0.31</td>
</tr>
<tr>
<td>Serial use</td>
<td>--</td>
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</tr>
<tr>
<td>Attitude decision support</td>
<td>0.48 ± 0.09 *</td>
<td>0.27 ± 0.08 *</td>
<td>0.56 ± 0.11 *</td>
<td>0.39 ± 0.07 *</td>
</tr>
<tr>
<td>Agreement guideline content</td>
<td>0.73 ± 0.18 *</td>
<td>0.69 ± 0.13 *</td>
<td>0.97 ± 0.19 *</td>
<td>0.75 ± 0.12 *</td>
</tr>
</tbody>
</table>

**Note:** Adjusted for Age, Sex, Intervention arm, and Computer literacy

‡: reference category

*: Statistically significant at level p<0.01
Conclusion CARDSS usability study

• **Usability of CARDSS CDSS was influenced by:**
  – **Workflow integration:** concurrent use and less additional time needed leads to higher satisfaction
  – **Attitude towards guideline** concerned: Higher satisfaction with guideline correlates to higher subjective usability
  – **Attitude towards CDS in general:** Higher satisfaction with CDS correlates to higher subjective usability

• **Limitations:**
  – **Evaluation** was performed after trial
  – **Limited power:** For most factors minimal differences between 0.8 and 1.0 could be measured with 63 respondents: if difference exist it is smaller than 1.
Current situation & Future work

- **+40 clinics** in NL use CARDSS for CR
- Most provide their **dataset** for scientific research and quality improvement projects
- Registry contains data from **>15,000 individual CR patients** since 2005

Future work:

- **CARDSS-II Project** (Jan 2008-2011)
  - Adjust and elaborate needs assessment procedure and CR data set
  - Consultation & periodical feedback to clinics
- **Professionalize CARDSS**: cooperation with industry to maintain, update, support, and upgrade CARDSS.