Telecardiological System CARDI O.NET. Promises and Pitfalls

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Outline

- Background
- Aim
- Elements of the system:
  - EHR,
  - Database,
  - Expert system for risk stratification
- Results
- Risk stratification and ethics
- Promises and Pitfalls
Mortality rate in Poland per 100 000 inhabitants

Mortality caused by cardiovascular diseases

Data from the Institute of Cardiology - 2001
Hemodynamic procedures in Poland 1999-2002

From The Institute of Cardiology - 2001
Acute Coronary Syndromes

- The acute coronary syndromes (ACS) contain all three clinical types of events (heart attack, unstable coronary heart disease, some cases of cardiac death) and are one of the most frequent diagnoses of ischemic heart disease.

- Credible epidemiological data on the incidence of ACS of all types in Poland is unavailable, but the estimate is 250,000 cases per year.
Aims

- The design and implementation of prototype telecardiological system in Mazovia District.
- Improvement of cooperation among cardiological centers.
- Rationalization of the specialized clinical resources and access to unified digital archives.
- Reduction of time from symptoms to intervention (possible reduction of mortality).
The structure of Cardio.net

Layer 1
Reference Center

Layer 2
Regional hospital 1
Regional hospital 2
Regional hospital n

Layer 3
Ambulance 1
Ambulance 2
Ambulance n
Tools

- Electronic Health Record (accessible via Internet)
- Relational database MySQL
- Expert System for risk assessment
Electronic Health Record (accessible via Internet)
Electronic form 1
Electronic form 2

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DIAGNOSIS AT ADMISSION

Patient:
PERS number:

Please mark primary and secondary reason for hospitalization

Ischemic heart disease:

1. ST-elevation acute coronary syndrome
2. Non-ST-elevation acute coronary syndrome
3. Stable angina

Chronic Heart failure:

4. Pulmonary edema
5. Decompensated heart failure

Arrhythmia:

6. Cardiac arrest
7. Ventricular tachycardia
8. Ventricular fibrillation
9. Paroxysmal atrial fibrillation
10. Chronic atrial fibrillation
11. Supraventricular tachycardia
12. Second degree atrio-ventricular block
13. Complete heart block
14. Sinus node dysfunction
15. Morgani-Adams-Stokes Syndrome

Add
Client-sever architecture with 3 layers:

1. Client – Internet Explorer min. ver. 5.5.x
2. Middleware – PHP
3. Database server - MySQL (Apache)
Expert system (ES) for risk stratification

Input data:
- BNP
- SIMPE
- TIMI
- GRACE
- ZWOLLE

Voting System

Output:
- high risk or low risk
ES consultation – final step

--- > TIMI Risk Score: 6

Killip class?
II class

--- > High Risk patient

--- > Early invasive treatment indicated

Is it possible to perform coronary angiography?
Yes

Does patient agree to invasive treatment?
Yes

--- > Coronary angiography and GP IIb/IIIa blocker indicated

> End of consultation
BNP levels add additional prognostic information to risk scores in STEMI patients treated with PCI.

![Diagram showing mortality percentages for different risk scores: SIMPLE Low, HIGH; TIMI LOW, HIGH; GRACE LOW, HIGH; ZWOLLE LOW, HIGH. Mortality rates range from 0% to 60%.]
ROC curves for risk scores and BNP in prediction of 30-day mortality

- SIMPLE: 0.832
- TIMI_STEMI: 0.869
- GRACE: 0.819
- ZWOLLE: 0.9
- BNP_1: 0.892
ES – data input

System ekspertowy - Cardio_net : Formularz

Wiek: 66  Płeć: mężczyzna 292

- De novo <2tyg
- De novo 2tyg -2_mies
- D spoczynkowa
- D pozawałowa
- Czas bólu (h): 5

- NZK przedszp.
- pMI
- pPTCA
- pCABG
- pUdar
- NT
- Palenie
- Cukrzyca

- Dyslipid
- POChP/Astma
- NYHA III/IV
- Ch. nacz. obwodowych

Możliwość transportu do pracowni hemodynamiki w przeciągu 90-120 min
- Nie
- Tak

HR: 60  RR: 100  80

Osłuchowo: brak / przypadkowo

Wzrost: 176  Waga: 78

- ASA PR
- ASA IP

- Przeciwwskazania do leków

- Przewlekłe leczenie przeciwczapliwe

- Przeciwwskazania do fibryny

TnI: 50  BNP: 361

Kreatynina: 0,85

TIMI NSTEMI/UA  TIMI STEMI: 3  SIMPLE: 3,96  GRACE: 153  ZWOLLE 3

- I, aVL
- II, III, aVF
- V1-V4
- V5-V6

Rytm: zatokowy

Miarowość: miarowy

Częstość: 60

Ilość odprowadzeń z obniżeniem ST-T
- VT
- SVT
- AVB II/III
- AF
- LBBE
- RBBE
- LAH
- LPH
ES – results and explanation module
Inter-rater agreement between real physician and developed ES

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<th>Indication for Pharmacotherapy</th>
<th>Aspirin</th>
<th>ACE inhibitor</th>
<th>Beta-adrenolitics</th>
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</table>

$\kappa < 0.2$ poor
0.21 – 0.4 fair
0.41 – 0.6 moderate
0.61 – 0.8 good
0.81 – 1.0 very good
Risk stratification in STEMI by different strategies

Classification errors

- BNP: 12.00%
- SIMPLE: 8.50%
- TIMI: 6.00%
- GRACE: 5.00%
- ZWOLLE: 4.00%
- Voting system: 2.00%
EHR has been created for over 100 patients from SP CSK AM Hospital (reference center) and for a few patients from regional centers remotely. This confirmed functioning of the system and verified applied solutions.
Promises

- 2 main elements of the system: EHR and database are functioning properly.

- The project of presented telecardiological system supports e-health strategy for Poland for 2004-2006 and the National Program of Health.

- Both initiatives mention the fight against coronary diseases as one of their strategic aims.
Pitfalls

- Ambulance network is a crucial factor in improvement of health care of the ACS patients and also its integration with regional and reference centers.

- Better cooperation of ambulances with the regional and reference centers is required (organizational pitfall).

- The ambulances require new equipment for ECG data transmission over mobile phones.

- Internet connection in regional centers is a problem. The staff needs training in EHR and database operation.