OUTCOMES OF A NATIONWIDE ELECTROCARDIOGRAPHIC SCREENING PROGRAM TO DETECT CARDIOVASCULAR DISEASE IN YOUNG INDIVIDUALS

Harshil Dhutia
Cardiology Registrar
Glenfield Hospital, Leicester

Cardiology Research Fellow
St. George’s University of London
Declaration of Interest

• Research grant from non-profit making charity Cardiac Risk in the Young (CRY) to study cardiovascular disease in adolescents and young adults
CHAIN OF SURVIVAL

EARLY ACCESS
EARLY CPR
EARLY DEFIBRILLATION
EARLY ADVANCED CARE
Nationwide study of sudden cardiac death in persons aged 1–35 years

Bo Gregers Winkel¹,², Anders Gaarsdal Holst¹,², Juliane Theilade¹,², Ingrid Bayer Kristensen³, Jørgen Lange Thomsen⁴, Gysa Lolk Ottesen⁵, Henning Bundgaard², Jesper Hastrup Svendsen¹,²,⁶, Stig Haunso¹,²,⁶, and Jacob Tfelt-Hansen¹,²

<table>
<thead>
<tr>
<th>Place of death, (n = 417)</th>
<th>n</th>
<th>~%</th>
</tr>
</thead>
<tbody>
<tr>
<td>At home</td>
<td>285</td>
<td>68</td>
</tr>
<tr>
<td>In-hospital deaths</td>
<td>44</td>
<td>11</td>
</tr>
<tr>
<td>of which death in emergency room</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>of which death during hospitalization</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Public area</td>
<td>73</td>
<td>18</td>
</tr>
<tr>
<td>At work</td>
<td>15</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity at death, (n = 409)</th>
<th>n</th>
<th>~%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awake and relaxed</td>
<td>206</td>
<td>50</td>
</tr>
<tr>
<td>Sleeping</td>
<td>141</td>
<td>34</td>
</tr>
<tr>
<td>Eating</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Moderate to high intensity activity including sport</td>
<td>43</td>
<td>11</td>
</tr>
<tr>
<td>At general practitioner</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Waken up by loud noise</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Aroused state of mind (exaltated)</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Shower</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Screening athletes is recommended on ‘Legal, Ethical and Medical’ grounds
Leading Causes of Death in the Young

Heart disease was the fifth-leading cause of death among 15- to 24-year-olds in 2013, according to the most recent federal data. The No. 1 cause of death was unintentional injury, which includes car accidents, poisoning, drowning and falls.

Source: Centers for Disease Control and Prevention
Number screened

Vulnerability to sudden death

Professional athletes

Collegiate athletes

Young individuals who are not competitive athletes

(millions)

<table>
<thead>
<tr>
<th>Denmark</th>
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</thead>
<tbody>
<tr>
<td>Observation period</td>
</tr>
<tr>
<td>Age group</td>
</tr>
<tr>
<td>Total population, in thousands*</td>
</tr>
<tr>
<td>Age group population, in thousands*</td>
</tr>
<tr>
<td>Athletes in age group, %†</td>
</tr>
</tbody>
</table>

Incidence rate per 100,000 person-years (denominator)

| SCD, general population (general population) | 3.76 |
| SCD, athletes (athletes)                    | 1.21 |

Holst et al; Heart Rhythm 2010

[Data and analysis related to sports-related sudden deaths and age distribution presented.]
Currently in the UK.....

Figure 1: Care pathway for arrhythmia patients

- Symptoms and/or risk of arrhythmia
  - Refer to specialist service and give contact details of care co-ordinator
- Is diagnosis confirmed?
  - NO
    - Symptoms?
      - NO
      - YES
      - Further investigations
  - YES
    - ECG
Aims

• Report on the outcomes of a nationwide ECG screening program to identify conditions associated with sudden cardiac death in adolescents and young adults

• Diagnostic yield of the program
• Most effective strategy (Symptoms/Family history vs. ECG) to identify disease
• Impact of detection on disease management
• Cost to identify disease
Methods
Free heart test
For anyone aged 14 - 35
To book visit www.testmyheart.org.uk
or call CRY on 0203 691 0000

Date:
28th & 29th October 2015

Location:
The Grange School
Hadjonk Road
Monmouth
NP25 3NG

These screenings have been funded in memory of Jenny Bucknall

Every young person should have the choice to have their heart checked

CR in the Young
RAISING AWARENESS IN THE COMMUNITY
MOBILE CARDIAC SCREENING UNIT

Cardiac Risk in the Young
Tel: 01737 363222
www.c-r-y.org.uk
CARDIAC SCREENING 2012-2014

✓ N=26,900 (14-35 years)
✓ Nationwide
✓ Self presented
✓ Schools/community centres/health centres
✓ Excluded: Previously screened/ known disease

SCREENING PROTOCOL

✓ Personal & family history (AHA protocol)
✓ ECG (2010 ESC recommendations)
✓ Conducted by cardiologist

FURTHER INVESTIGATION & FOLLOW-UP

✓ Regional
✓ Prospective follow-up (2 yrs.)
✓ Family practitioner questionnaire
✓ Serious & other cardiac disease
✓ Workload and cost implications (2014/15 UK NHS Tariffs)
Results
## Demographics

<table>
<thead>
<tr>
<th>Demographic</th>
<th>N=26,900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>19.4 ± 4 years</td>
</tr>
<tr>
<td>Gender</td>
<td>Male 59%; Female 41%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Caucasian 90%; Afro-Caribbean 2%; Other 8%</td>
</tr>
<tr>
<td>Exercise</td>
<td>4.5 ± 4 hours per week</td>
</tr>
</tbody>
</table>
| Venue             | Schools 20%  
|                   | Community centres 72%  
|                   | Healthcare providers 8% |
Abnormalities on Health Questionnaire

Abnormal Symptoms
- According to Participant

Abnormal Family History
- According to Participant
- According to Cardiologist
ECG Abnormalities

- T-Wave inversion: 3.5%
- ST depression/Q-waves: 2.5%
- Axis Deviation: 2%
- Atrial enlargement/RVH: 1.5%
- Abnormal QRS duration: 1%
- Abnormal QT interval †: 1%
- Pre-excitation: 0.5%
- Other: 0.5%

8.6% >1 ECG abnormality
Proportion of Positive Screening Evaluations

Total N=26,900

- Health Questionnaire abnormality: 933 (3.5%)
- ECG abnormality: 2,168 (8.1%)
- Referred for further investigations: N= 3,223 (12%) (95% CI 11.6%-12.3%)
Investigations Following Screening

- **Echocardiography**: 11.7% (95% CI 11.3%-12.1%)
- **Exercise test**: 1.7% (95% CI 1.5%-1.8%)
- **Holter**: 1.7% (95% CI 1.6%-1.9%)
- **Cardiac MRI**: 0.9% (95% CI 0.8%-1.0%)
- **Other**: 0.5% (95% CI 0.1%-0.8%)
Method of Disease Identification

- Health Questionnaire (symptoms/FH) abnormality
- Health Questionnaire (symptoms/FH) and ECG abnormality
- ECG abnormality

- **Serious Disease**
  - N=90 (0.3%)
  - 80% ECG abnormality
  - 18% Health Questionnaire (symptoms/FH) abnormality
  - 2% Health Questionnaire (symptoms/FH) and ECG abnormality

- **Other Disease**
  - N=60 (0.2%)
  - 60% ECG abnormality
  - 35% Health Questionnaire (symptoms/FH) abnormality
  - 5% Health Questionnaire (symptoms/FH) and ECG abnormality

- **All Cardiac Disease**
  - N=150 (0.6%)
  - 72% ECG abnormality
  - 25% Health Questionnaire (symptoms/FH) abnormality
  - 3% Health Questionnaire (symptoms/FH) and ECG abnormality
Disease Detection and Management

Serious disease detected (N=90)
- N=16
  - 9 Brugada syndrome
  - 2 CPVT
  - 1 LQTS
  - 1 High grade AV block
  - 3 Marfan syndrome

Disease modifying therapy @ 2 years (excl. lifestyle)
- N=7 (44%)
  - 6 Pharmacotherapy
  - 1 Pacemaker

N=2
- 2 LQTS

N=43 (60%)
- 15 Pharmacotherapy
- 2 ICD
- 26 Ablation

N=72
- 15 HCM
- 3 ARVC
- 5 DCM
- 7 LQTS
- 42 WPW
Add non-invasive risk stratification
Add genetic testing
Add EPS (+/- ablation) for WPW ECG pattern
Add all variables

Cost per cardiac disease associated with SCD identified (£+95%CI)

Cost (HQ & ECG strategy)

Cost per serious disease identified

+ £14,732 per disease (36%↑)
Limitations

• We could not calculate the sensitivity or specificity of the programme for detecting cardiac disease

• Self-presentation to screening → potential for inherent selection bias

• Conservative UK National Health Service costs

• Further investigations were at the discretion of the attending cardiologist → influenced by personal clinical practice ± local availability
Conclusions

• First reported nationwide screening program outside competitive sport

• Prevalence of disease associated with sudden cardiac death identified is 0.3% at a cost of $\approx$ £ 26,000 per potentially life-threatening disease

• 80% of individuals with these diseases may not have been diagnosed within current healthcare systems
Young individuals self present to medical care

Symptoms
Family history

Cardiovascular investigations

Adding ECG as Routine

ECG

↑ diagnostic yield by 5 fold

↑ rate of disease modifying therapy by 20%

↓ cost per serious disease detected by 40%

Current UK Healthcare System
Acknowledgements

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