Workplace hospital:
Noise as a strain for the medical staff
- state of knowledge -

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Questions

How loud are hospitals?

What are the main noise sources?

Which noise effects on the staff are found?

What about preventive measures?
1993: Meyer-Falcke et al.
„Anaesthesia and intensive care: Stressing the patient by noise?“

Rooms examined (24 hrs levels):
- operative intensive station
- anaesthesia initiation room
- Wake-up room

Measures: \( L_{eq} / L_{\text{max}} / L_{\text{min}} / L_{AIm} \)
and third-octave-band analyses

Results:
- intensive station:
  \( L_{AIm} \) never < 60 dBA
  \( L_{\text{max}} \) of equipment: 66 – 80 dBA
- anaesthesia initiation room:
  \( L_{\text{max}} \) equipment: 65 – 80 dBA
  \( L_{\text{max}} \) work noise: 79 – 95 dBA
- Wake-up room: \( L_{eq} \) 60 – 65 dBA
  \( L_{\text{max}} : 81.4 – 93.3 \) dBA
Daytime sound pressure levels measured in hospitals

Study results as a function of the year of publication (Busch-Vishniac et al. 2005)
Some reasons for diverging study results:

Hospital units with differing acoustical situations

- **Operation theatres** (sometimes extreme $L_{\text{max}}$!)
- **Intensive care units (ICUs)**
  of different specializations
- **other examination or treatment rooms**
- **Staff rooms** (doctors, nurses)
- **Patients’ rooms** of different type and occupancy
- **Public areas** (floors, visitors areas ……)

and with enormous **regional and national differences**
in terms of financial or cultural background

…not to mention the variety of study designs,
methodologies, statistical procedures…
Orientation values for noise abatement in hospitals

WHO Guideline on Community Noise (1999)

4.3.3 Hospitals

...The $L_{A_{\text{max}}}$ of sound events during the night should not exceed 40 dB indoors. For wardrooms in hospitals, the guideline values indoors are 30 dB $L_{A_{\text{eq}}}$, together with 40 dB $L_{A_{\text{max}}}$ during the night. During the day and evening the guideline value indoors is 30 dB $L_{A_{\text{eq}}}$...

VDI 2058 „Evaluation of noise at the working place with regard to different activities“ (Blatt 3):
Pt. 5.1 „Activities at workplaces with noise rating levels up to 55 dBA“:
„...examples for such activities:
Examinations, treatments and operations by medical doctors...“
General noise load in hospitals

Bush-Vishniac et al. (2005): recordings in 5 different clinics of John Hopkins Hospital, Baltimore – in each case 24-h measurements in a patient room, a nurses station, and an examination room

Main results:

- In general, $L_{eq}$ between 50 and 60 dBA with little variation during 24 hrs and between the clinics

- WHO recommendations are clearly exceeded by at least 10 dBA on average levels and 15 dBA on $L_{max}$

- With a typical speech level of 45 – 50 dBA, staff need to raise their voice for communicating
Implications of background noise during medical examination, i.e. hearing heart and lung sounds (Zun & Downey 2005)

normal body sound levels are 22-30 dBA in free space and 60 – 65 dBA through a stethoscope

1) Measurement of sound levels at 3 different ED rooms: mean $L_{eq}$: 58, 56, and 46 dBA maximum: 70, 81, and 62 dBA

2) Testing hearing ability of staff for heart and lung sounds in pink noise set to the levels in the ED

Test results:
3.8 % were unable to hear a heart tone
8.7 % were unable to distinguish lung sounds in the presence of the pink noise
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Noise sources in an intensive care unit (Schrader 2001)

- **Noise from devices** ($L_{\text{max}}$) e. g.:
  - Survey monitors: 73 – 80 dB(A)
  - Respiration devices: 69 – 81 dB(A)
  - Breathing gas regulation: 85,2 dB(A)
  - Infusion devices: 66 – 78 dB(A)
  - Telephone and pager: 80 – 85 dB(A)

- **Noise from staff** ($L_{\text{max}}$) z. B.:
  - Four persons talking (inspection): 75 dB(A)
  - Scissors dropping on hard surface: 79,4 dB(A)
  - Opening a cardboard box: 79,5 dB(A)
  - Ripping up a package with sterile gloves: 86 dB(A)
  - Falling of a kidney basin: 90 dB(A)
  - Pulling off the wall socket for gas: 103 dB(A)
  - Dropping a stainless steel container: 106 dB(A)
### Most frequent noise sources in acute care wards

<table>
<thead>
<tr>
<th>Rank</th>
<th>Source</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rubbish bins</td>
<td>551</td>
<td>13.9%</td>
</tr>
<tr>
<td>2</td>
<td>General activity</td>
<td>524</td>
<td>13.2%</td>
</tr>
<tr>
<td>3</td>
<td>Talking</td>
<td>486</td>
<td>12.3%</td>
</tr>
<tr>
<td>4</td>
<td>Alarms</td>
<td>219</td>
<td>6.5%</td>
</tr>
<tr>
<td>5</td>
<td>Chair scraping</td>
<td>213</td>
<td>5.4%</td>
</tr>
<tr>
<td>6</td>
<td>Dropped object</td>
<td>186</td>
<td>4.7%</td>
</tr>
<tr>
<td>7</td>
<td>Door closing/squeaking</td>
<td>155</td>
<td>3.9%</td>
</tr>
<tr>
<td>8</td>
<td>Phone ringing</td>
<td>151</td>
<td>3.8%</td>
</tr>
<tr>
<td>9</td>
<td>Cough</td>
<td>143</td>
<td>3.6%</td>
</tr>
<tr>
<td>10</td>
<td>Ring binders</td>
<td>131</td>
<td>3.3%</td>
</tr>
<tr>
<td>11</td>
<td>Trolleys</td>
<td>105</td>
<td>2.7%</td>
</tr>
<tr>
<td>12</td>
<td>Bed clinking/bed rail</td>
<td>79</td>
<td>2.0%</td>
</tr>
<tr>
<td>13</td>
<td>Cupboard door</td>
<td>77</td>
<td>1.9%</td>
</tr>
<tr>
<td>14</td>
<td>Equipment noise</td>
<td>76</td>
<td>1.9%</td>
</tr>
<tr>
<td>15</td>
<td>Plastic ripping</td>
<td>52</td>
<td>1.3%</td>
</tr>
<tr>
<td>16</td>
<td>Talking on phone</td>
<td>51</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

(MacKenzie et al. 2007)

3 different wards in Edinburgh, 24 hrs measurements each

- **Red**: totally avoidable
- **Violet**: partially avoidable

Most frequent levels of the single noises: 60 – 70 dBA, then 70 – 80 dBA
To sum up:

- totally avoidable: 28.4%
- partly avoidable: 21.6%
- avoidable: 50.0%

Avoidable noises caused by a range of different sources:

- behaviour of staff and patients
- deficits in furniture and fixtures
- technical equipment (alarms, technical devices etc.)
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Noise effects on the staff

Results from a German study (n = 104) in some ICUs of the university clinics Duesseldorf (Schrader & Schrader 2001):

How often are you disturbed by acoustical alarms?
- sometimes: 55 %
- frequently: 27 %
- always: 9 %

What is most disturbing about the alarms?
- the high number of alarms: 55 %
- the high sound level: 50 %
- the high frequencies: 48 %
- the tonal quality: 34 %
- the kind of alarm: 28 %
I am aware that noise may negatively affect me in my daily work environment.

I have experienced fatigue due to the sound environment.

I have experienced irritation due to the sound environment.

I have experienced concentration problems due to the sound environment.

I have experienced tension headaches due to the sound environment.

I often discuss the sound environment with my colleagues.

I often discuss the sound environment with my supervisors.

It is important that sound measurements are being carried out.

Acutely ill patients can risk developing Intensive care syndrome due to the noise.

from: Ryherd et al. 2008
German study in ICUs of two hospitals including 21 nurses and doctors (Salandin et al. 2011):
• **80 %** feel disturbed by noise with slightly higher values in the morning and night shifts as compared with the noon shift
• **76 %** feel disturbed by noise generated by sounds of medical devices as well as by phones and other IT-equipment

**Effects of alarms** (Ryherd et al. 2008)
• **38 %** confirm that an intensive working day with many alarms might influence their sleep at night
• **49 %** admit to adjust the sound level of the alarms sometimes low enough not to hear them anymore
• **62 %** would prefer optical instead of visible alarms
Long-term effects

Nursing staff at ICUs

special strains: operation assistance, (rotating) shiftwork, involving high responsibility, often pressure of time

▶ NEXT-Study: Nurses’ Early Exit Study (Simon et al. 2005) European study on reasons for untimely exit from nursery – based on 3,565 questionnaires from Germany:

to be "very" or "moderately" annoyed by noise confirm
- 60.5 % working at intensive care units
- 39.9 % working at psychiatric units
- 33.7 % working at normal units
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Programs against noise in hospitals

Acoustical situation in each hospital / unit is different!
„Self-made“ programs for noise reduction including
- analysis of the specific problems together with staff
- team work on a program including constructural, technical, and/or organizational measures
- activities to change behavior of the staff
- evaluation of the changes and positive results
- establishing new standards of noise control

Staff is most important for implementing noise reduction programs!
Conclusions

- Strong evidence from international studies that still today the noise load in some areas of hospitals clearly exceeds recommendations for hospitals such as WHO guidelines for community noise.

- Some critical areas can be named: ICUs and operation theatre seem to be most important with regard to high noise load. But hospitals differ regarding size, specialization, equipment, regional and national aspects…

- Difficult to assess the impact of noise load in hospitals in general and to draw general conclusions.

- To analyze the situation in Germany, our institute has started own measurements and interviews in different stations of the Klinikum Westfalen ➔ results are coming soon (DAGA 2016)
Statements

Noise is a strain for the medical staff in specific units.

Noise might enhance stress at work for hospital staff resulting in lack of concentration, errors at work and adverse health effects.

Long-term effects on health or working ability of the hospital staff are not studied systematically yet.

It seems recommendable to develop a set of specific measures for the unit concerned and to involve the staff intensively in developing a noise reduction programme.