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**Workplace hospital:**

**Noise as a strain for the medical staff**

**- state of knowledge -**

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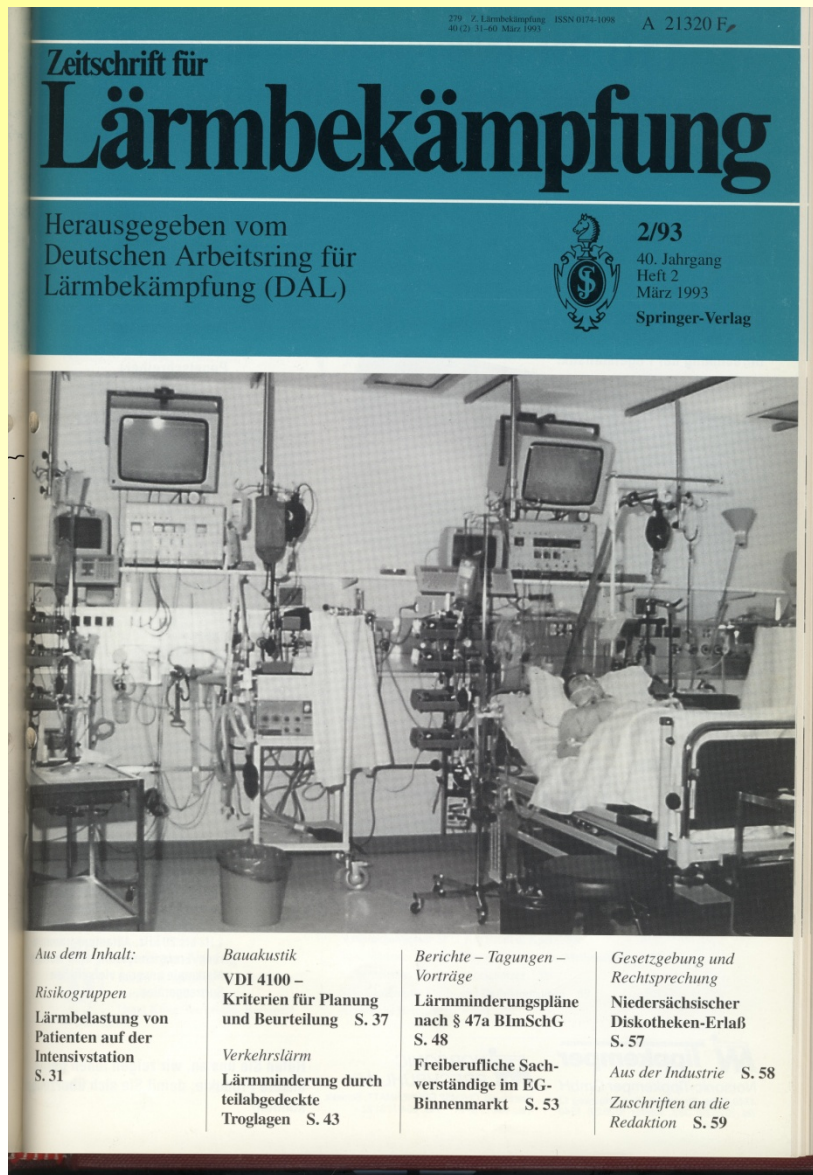
# Questions

**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:**  $L_{eq}$  /  $L_{max}$  /  $L_{min}$  /  $L_{AIm}$   
and third-octave-band analyses

### Results:

#### - intensive station:

$L_{AIm}$  never < 60 dBA

$L_{max}$  of equipment: 66 – 80 dBA

#### - anaesthesia initiation room:

$L_{max}$  equipment: 65 – 80 dBA

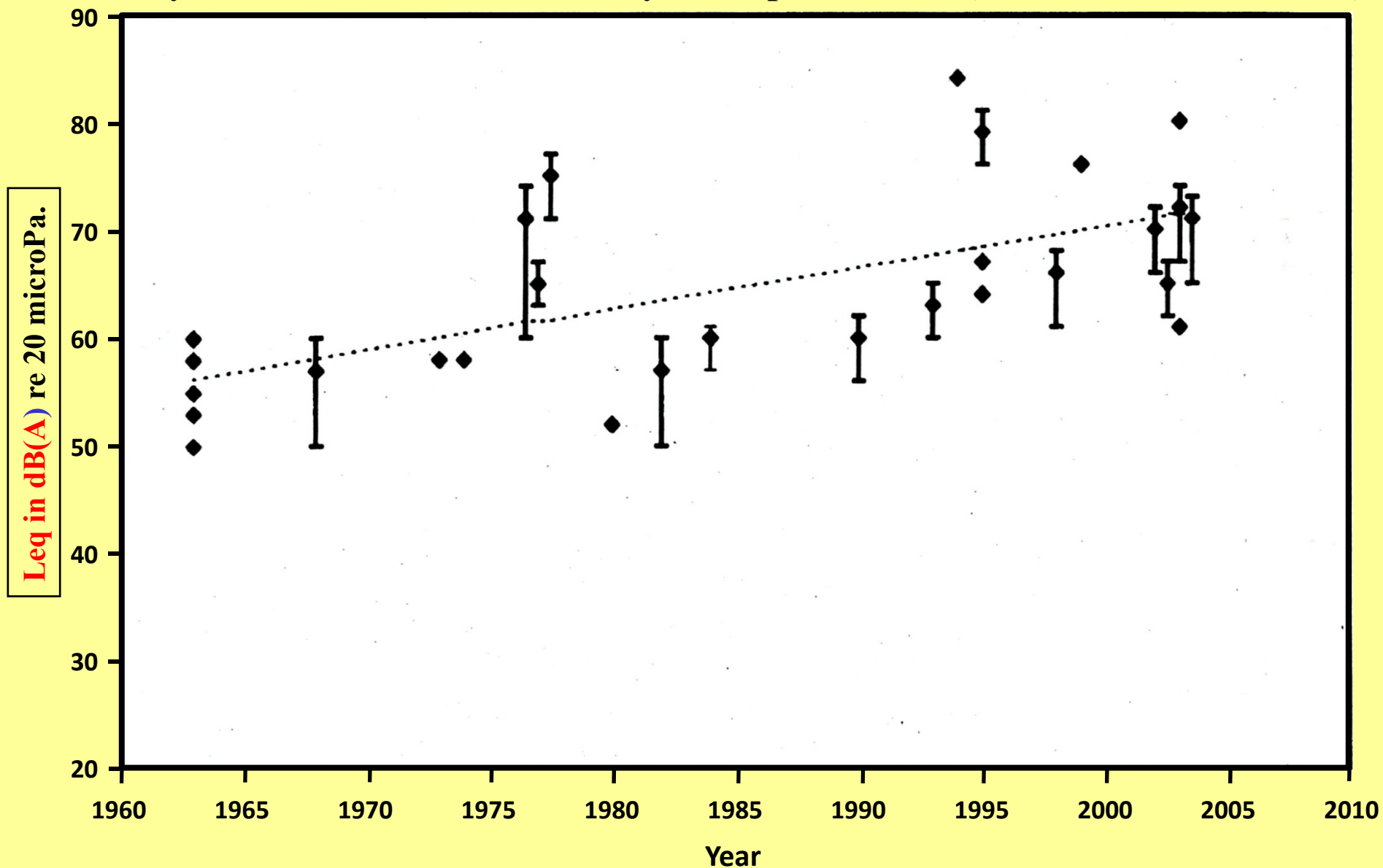
$L_{max}$  work noise: 79 – 95 dBA

#### - Wake-up room: $L_{eq}$ 60 – 65 dBA

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

## VDI 2058 „Evaluation of noise at the workplace 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 % wear 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 ( $L_{\max}$ ) 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 ( $L_{\max}$ ) 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

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

(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?*

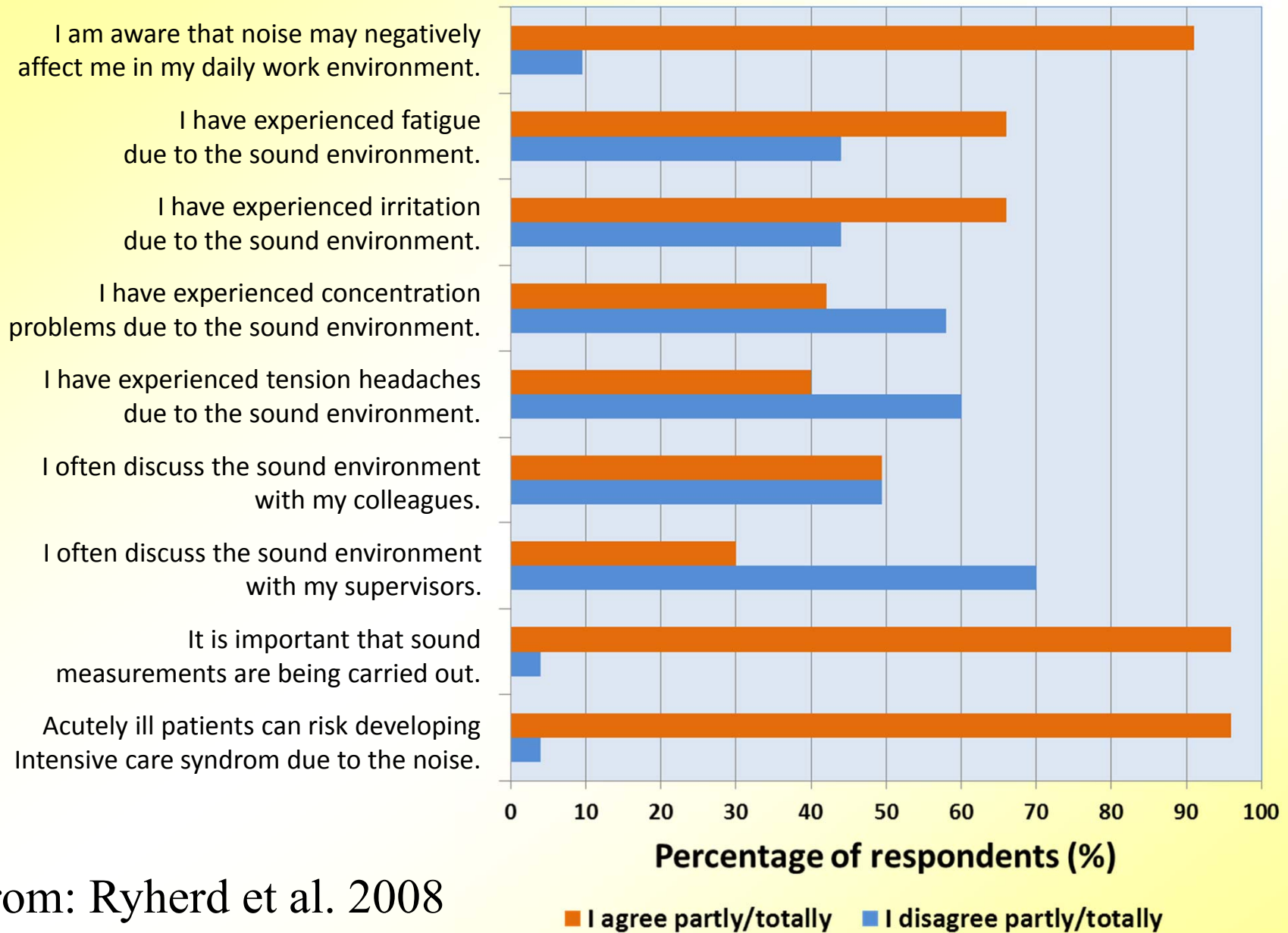
the high number of alarms: 55 %

the high sound level: 50 %

the high frequencies: 48 %

the tonal quality: 34 %

the kind of alarm: 28 %



from: Ryherd et al. 2008

## 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

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



## *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 structural, 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.