Inleiding

ZonMw programma EMV en Gezondheid

Een update

Hans Kromhout

Institute for Risk Assessment Sciences (IRAS)
Universiteit Utrecht
NVvA-symposium 13 april 2011

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ZonMw EMV en Gezondheid

http://www.zonmw.nl/nl/onderwerpen/alle-programma-s/elektromagnetische-velden-en-gezondheid/gehonoreerde-projecten/

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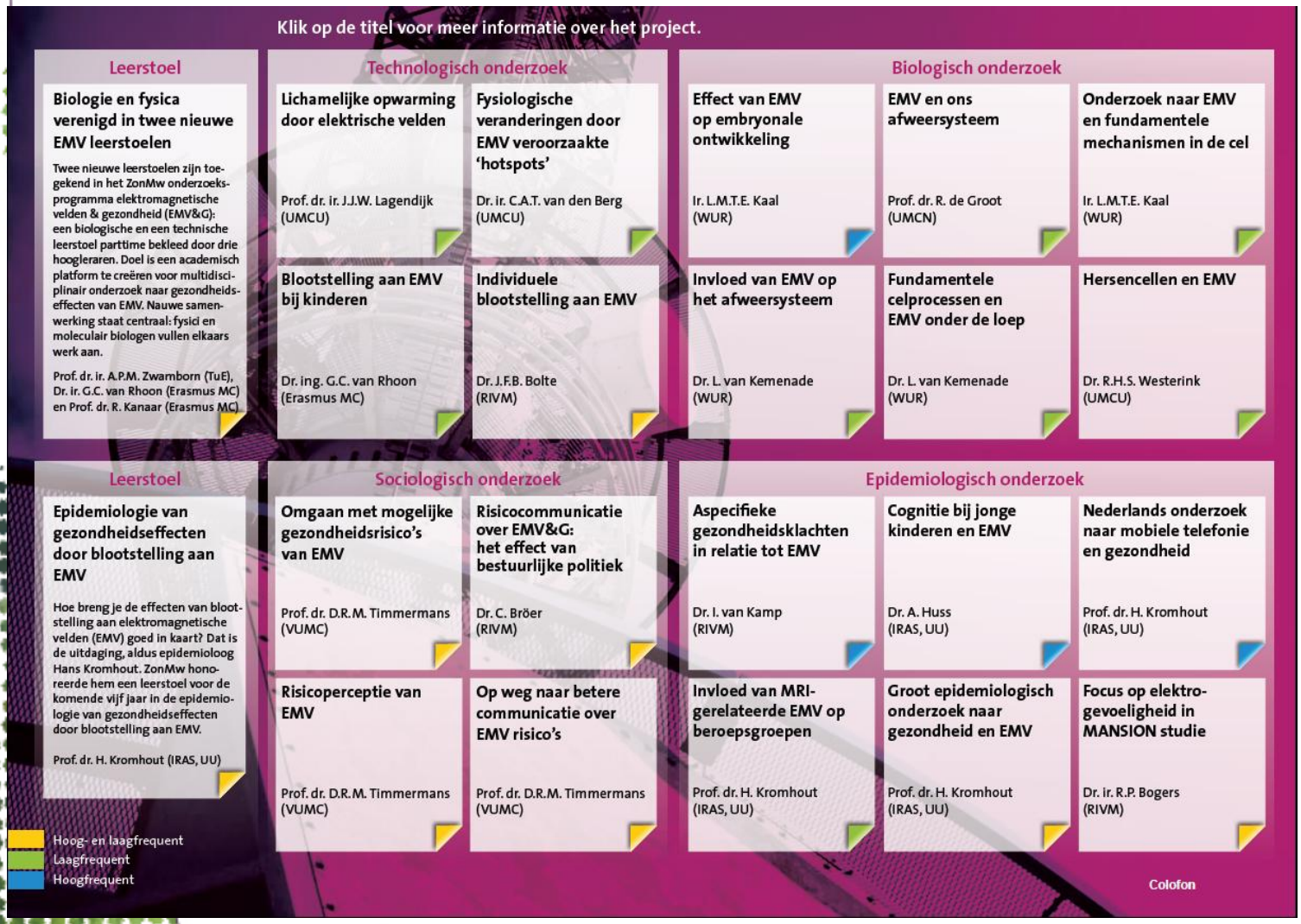
ZonMw EMV en Gezondheid



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Inhoud onderzoeksprogramma

- Blootstelling
  - Algemeen milieu
  - Woonomgeving
  - **Werkomgeving**
  - Verkeer
- Effecten
  - In vivo
  - In vitro
  - **Humaan**
    - Harde eindpunten (kanker, neurodegeneratieve aandoeningen als ALS, Parkinson's)
    - Zachte eindpunten (elektronsensitiviteit, slaap en concentratie stoornissen, etc.)

Inhoud onderzoeksprogramma

- Leerstoelen
  - Leerstoel Epidemiologie van gezondheidseffecten door blootstelling aan EMV
  - Biologische Leerstoel
  - Technische Leerstoel

Two occupational projects

- Symptoms, acute effects and chronic health effects of occupational exposure to MRI-related electromagnetic fields (SMF, TVMF, RF)
- NIOSH intervention study (ELF)

Symptoms, acute effects and chronic health effects of occupational exposure to MRI-related electromagnetic fields

Suzan Bongers, Kristel Schaap, Lotte van Nierop, Pauline Slottje, Yvette Christopher, Frank de Vocht, Hans Kromhout

Financiering: ZonMW. project 8510001

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Associations and real safety risks

- Use of metal in a MRI environment

Case Report

Spontaneous Discharge of a Firearm in an MR Imaging Environment

Anton Oscar Beitia[1], Steven P. Meyers[1], Emanuel Kanal[2], William Bartell[3]

AJR:178, May 2002

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Associations and real safety risks

Boy,6,killed in MRI accident

By MELISSA KLEIN AND OLIVER W.PRICHARD

(Original publication:July 31,2001)

VALHALLA — A 6--year-old boy died two days after he was smashed in the head by a metal oxygen canister that was pulled by magnetic force into the MRI machine where he was being examined,Westchester Medical Center officials said yesterday. An unidentified hospital employee brought the oxygen tank within reach of the 10-ton magnet's field,and it shot through the air to the center of the machine, the hospital said.

....

Three sub-projects

1. Health complaints and neuropsychological effects after **long-term exposure** to MRI-related EMF Suzan Bongers (MRI Cohort study)

2. Symptoms and acute health effects of occupational exposure to MRI-related electro-magnetic fields in **hospital and research settings**

   Kristel Schaap (MRI Cross-sectional study)

3. **Experimental trials** on acute effects of occupational exposure to MRI-related electromagnetic fields

   Lotte van Nierop (MRI Experimental studies)

Background
Semi-acute effects

- One study assessed health complaints and neuropsychological effects among MR technicians.

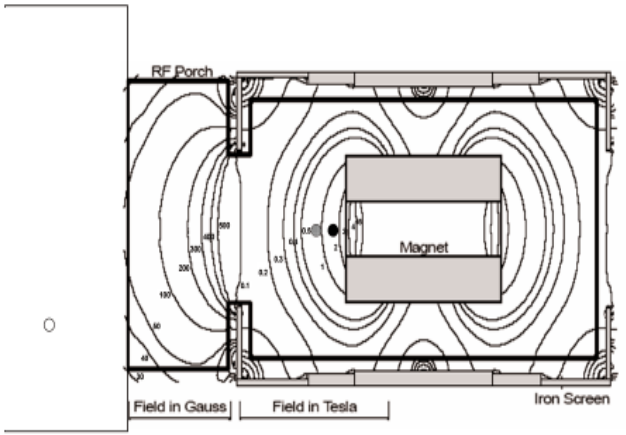
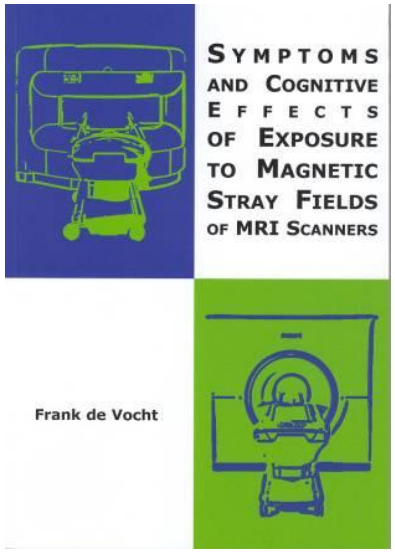


Figure 6.1. Overview of the magnetic stray field of the 7 Tesla magnet and approximate position of the volunteers* in all four sessions.
*: high exposure (~1600mT) in black, medium exposure (~800mT) in grey and un-exposed position outside the magnet room in white.



de Vocht et al. J Magn Reson Imaging 2006; 23(3): 197-204.

(Semi)-quantitative estimates of exposure

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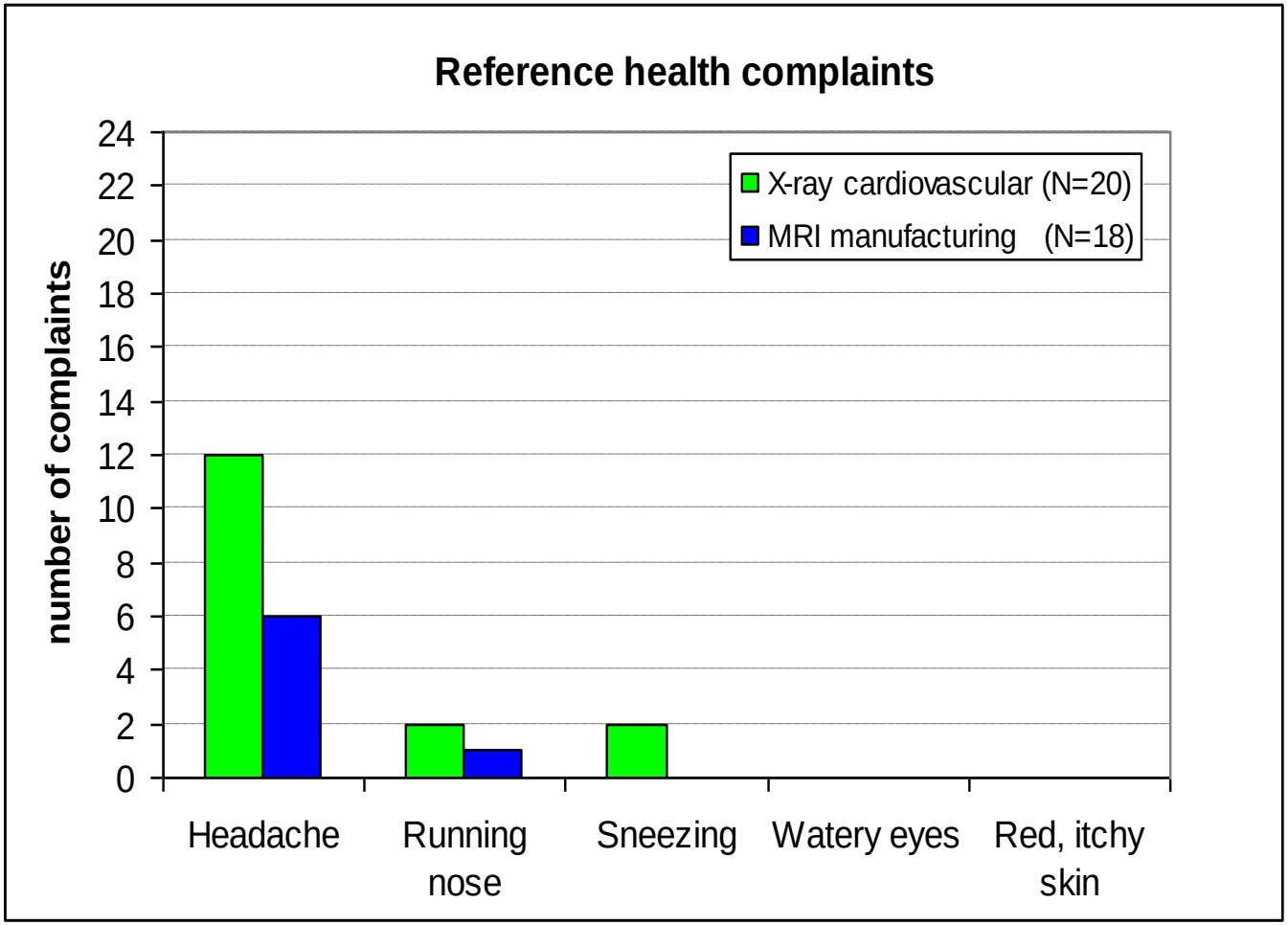
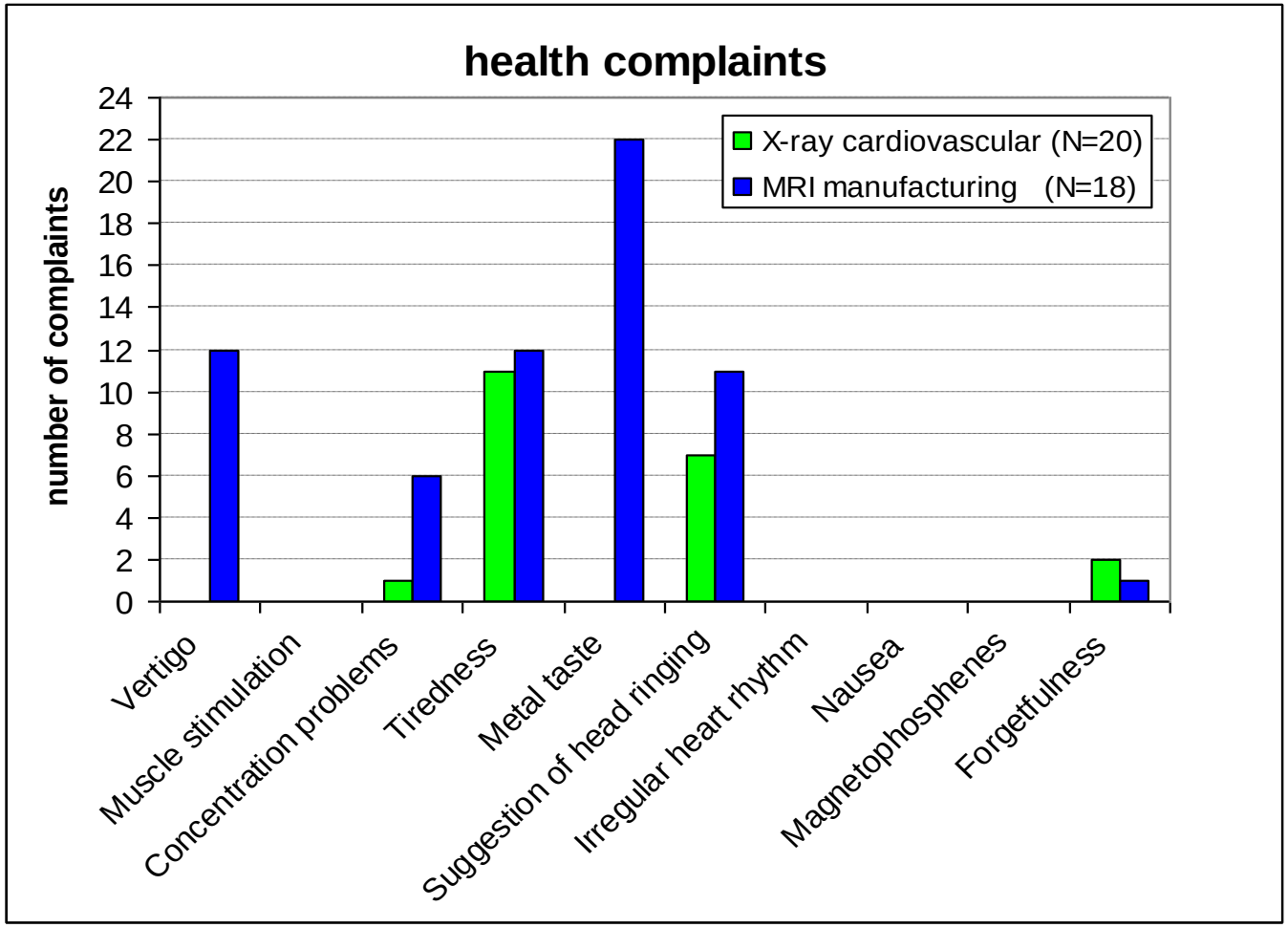
Results

comparison with "non-exposed" population



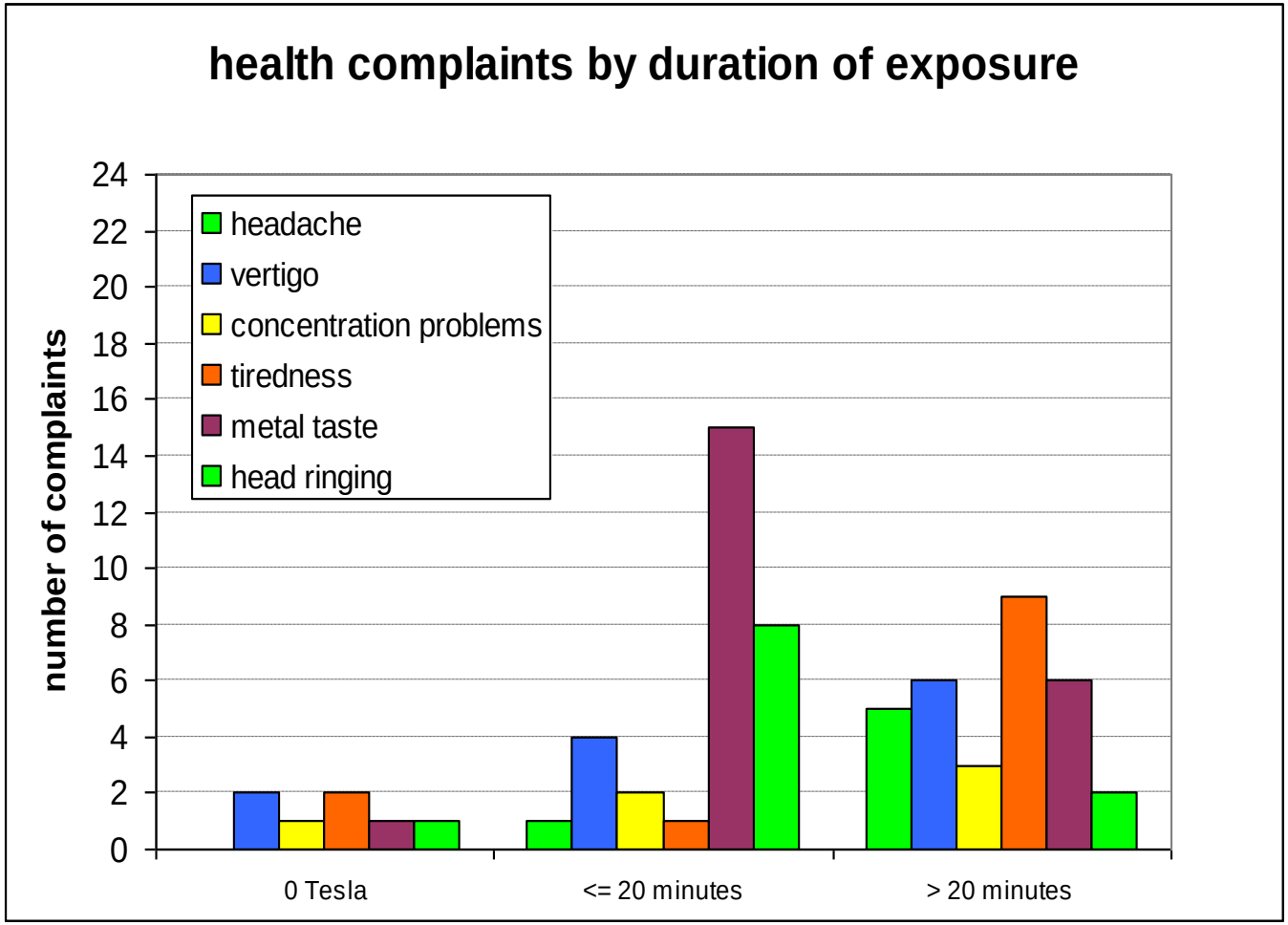
Results

comparison with "non-exposed" population



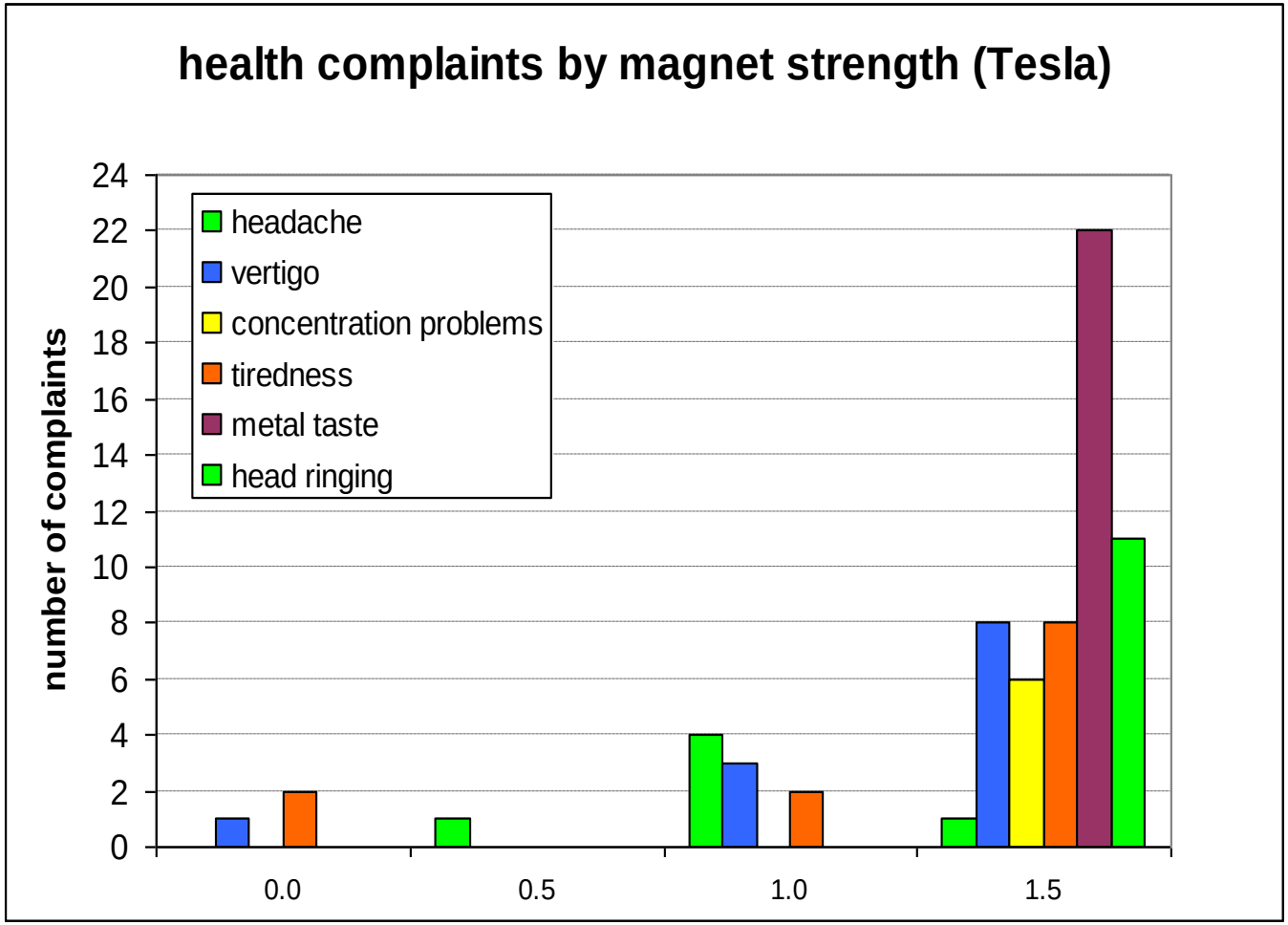
Results

stratified by duration of exposure



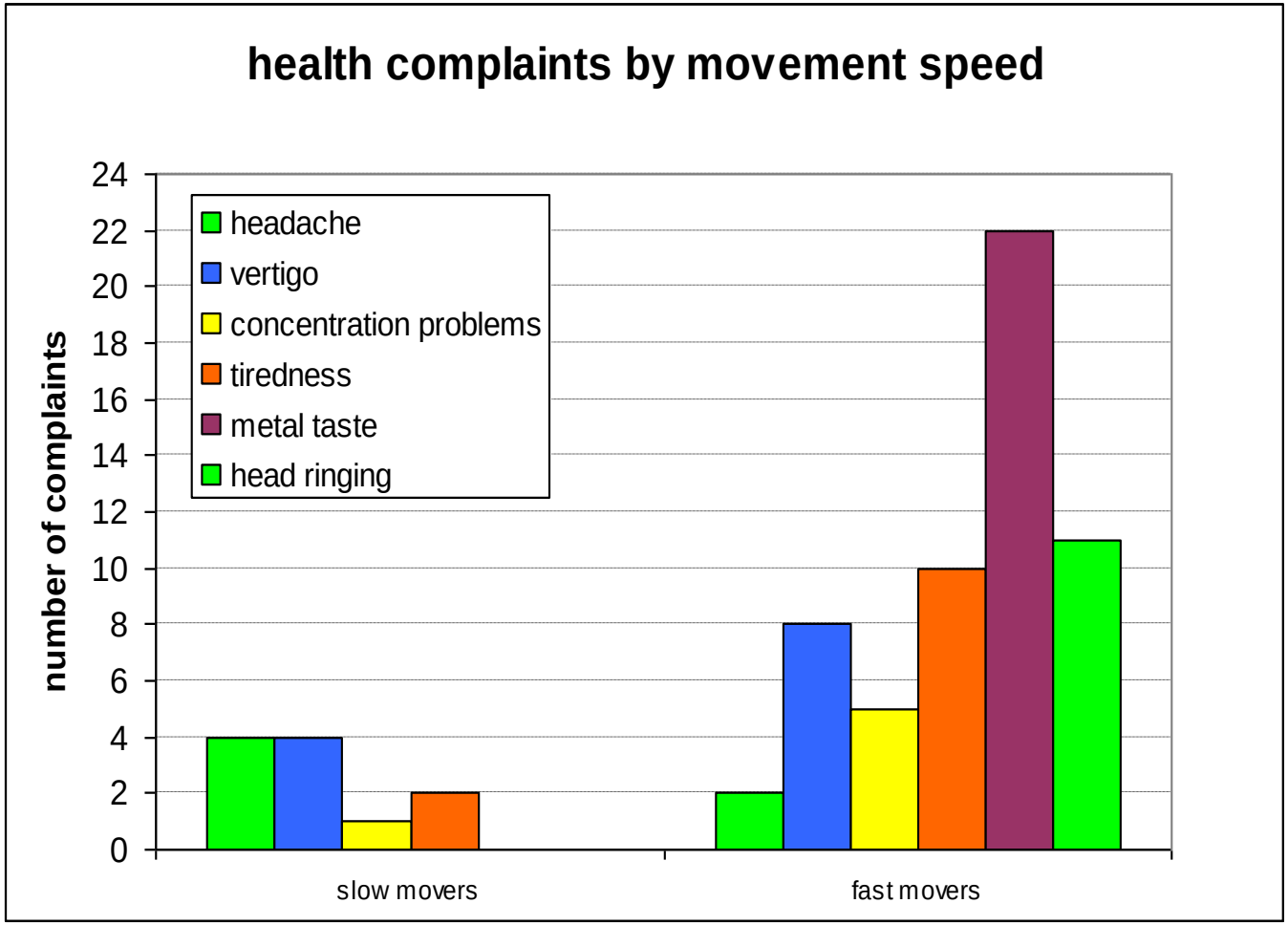
Results

stratified by intensity of exposure



Results

magnitude of dB/dt-exposure



Semi-acute effects

- no neuropsychological effects at the end of the working day compared to pre-work shift measurements
- self-reported vertigo, metallic taste, and concentration problems higher than in reference department
- prevalence of health complaints associated with duration and intensity of exposure (0.5-3 Tesla)

study strength

- same MR technicians worked at multiple field strengths

de Vocht et al. J Magn Reson Imaging 2006; 23(3): 197-204.

New data on exposure assessment

Following European Union Directive 2004/40/EC, most work has been done on measuring or estimating levels of B_0, switched gradients, dB/dt, or E exposure

- Measured surveys in occupational settings
  Fuentes et al., 2007; Bradley et al., 2007; Karpowicz and Gryz, 2006; EU report VT/2007/017, 2008
- Measured surveys in experimental set-ups
  HSE RR570, 2007; Riches et al., 2007; Riches et al., 2007b; Bradley et al., 2007; Glover and Bowtell, 2007, 2008
- Calculate/estimate exposure for given scenarios
  Collins, 2008; Bassen et al., 2005; Crozier et al., 2007; Stuchly et al., 2006, HSE RR570, 2007
- More data is needed on exposure levels during different procedures, but also on within- and between subject variability in occupational setting
  Karpowicz, 2006; Bailey et al., 2007

"Overall" conclusion studies so far

- In general, there is an absence of data on nearly all aspects needed to assess potential health effects associated with MRI
- New studies, especially cohort studies, should be conducted within the MRI community

HOWEVER

- Absence of an established exposure-disease metric
- Relatively small sample size, especially for high exposed individuals

Sub-project 1

Cohort study of health complaints and neuropsychological effects after long-term exposure to MRI-related EMF

Aim:

Analysis of **relation** between **long term occupational exposure** to electromagnetic fields (EMF) emitted by **MRI systems** during their development, projection and testing, and **acute, irreversible and/or delayed health effects**, including neuro-cognitive effects

Strategy Cohort Study

- Retrospective cohort study at Philips Healthcare in Best (PHC) (1984-2010)
  - Population:
    - Employees MR department
    - Employees XR department (comparison)
    - Volunteers (employees MRI scans: 'scan database')
  - Exposure assessment:
    - Historical exposure model: expert interviews, documents
    - Job history (from salary administration + questionnaire)
  - Health outcomes:
    - Longitudinal health examinations ('surveillance database')
    - Questionnaire, e.g. symptoms, chronic conditions, accidents
    - Subgroup study: long-term neurocognitive (tests without exposure)

Progress

- Started in Sep 2008
- PHC Management and OR (workers' council) agreed with the study (Sep 2009)
- Personal interviews of 16 long-term employees and managers to reconstruct MRI developments and occupational exposure for the period 1984-2009 (Oct–Dec 2009)
- Development of historical exposure model (Jan-Dec 2010)
- Updating and cleaning of health examinations and scanning databases (Sep 2010)
- Enumeration of MR cohort and XR comparison cohort has been finished in cooperation with HRM department and salary administration (Sep 2010)

Online questionnaire

- Questionnaire has been finalized and contains 21 sections with 104 questions
- Estimated time for completion 60 minutes.
- Procedures for approaching cohort have been formalized and full privacy guaranteed
- Launch online survey October 2010

NIOSH Intervention Study Occupational Exposure to Extremely Low Frequency Magnetic Fields

Preliminary Results

NIOSH
Joseph Bowman

IRAS
Yvette Christopher
Anke Huss
Hans Kromhout

ArboUnie
Christan Schumacher
Henri Heussen

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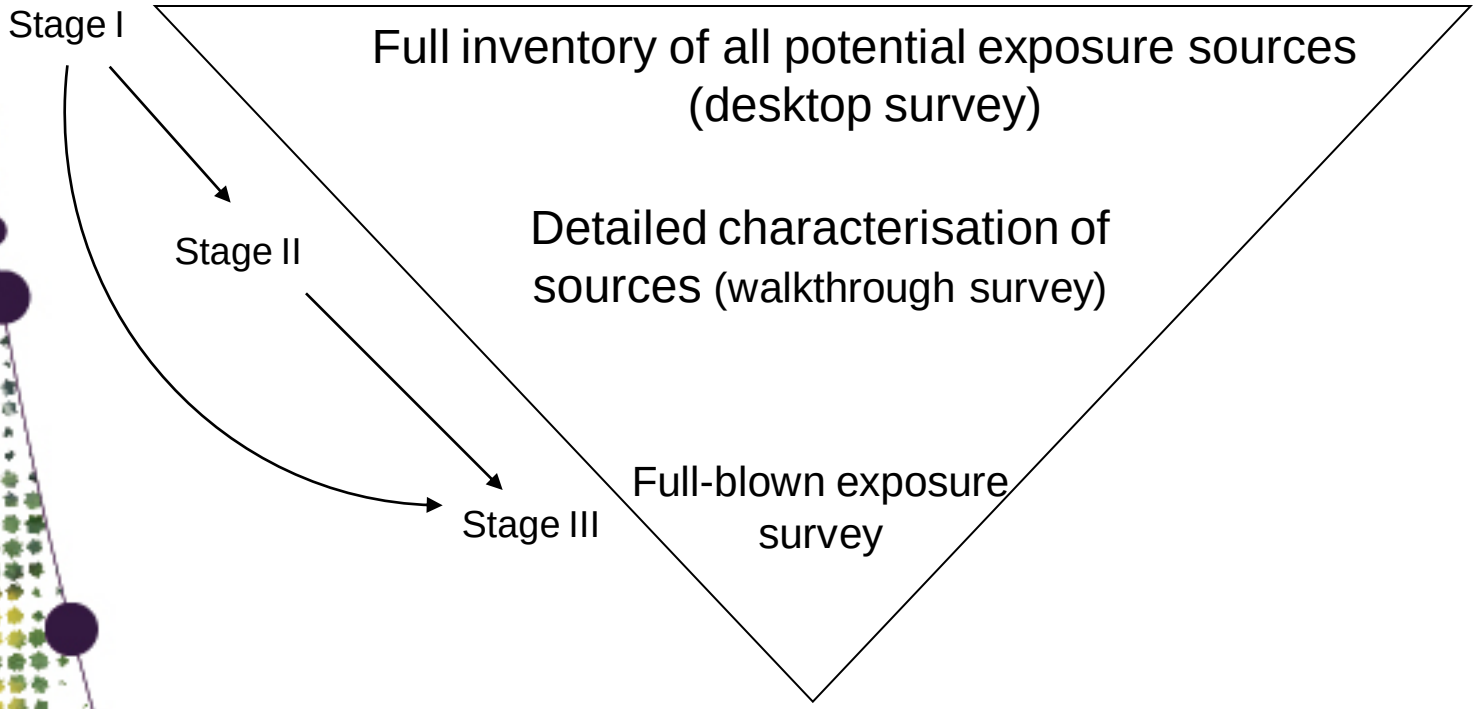
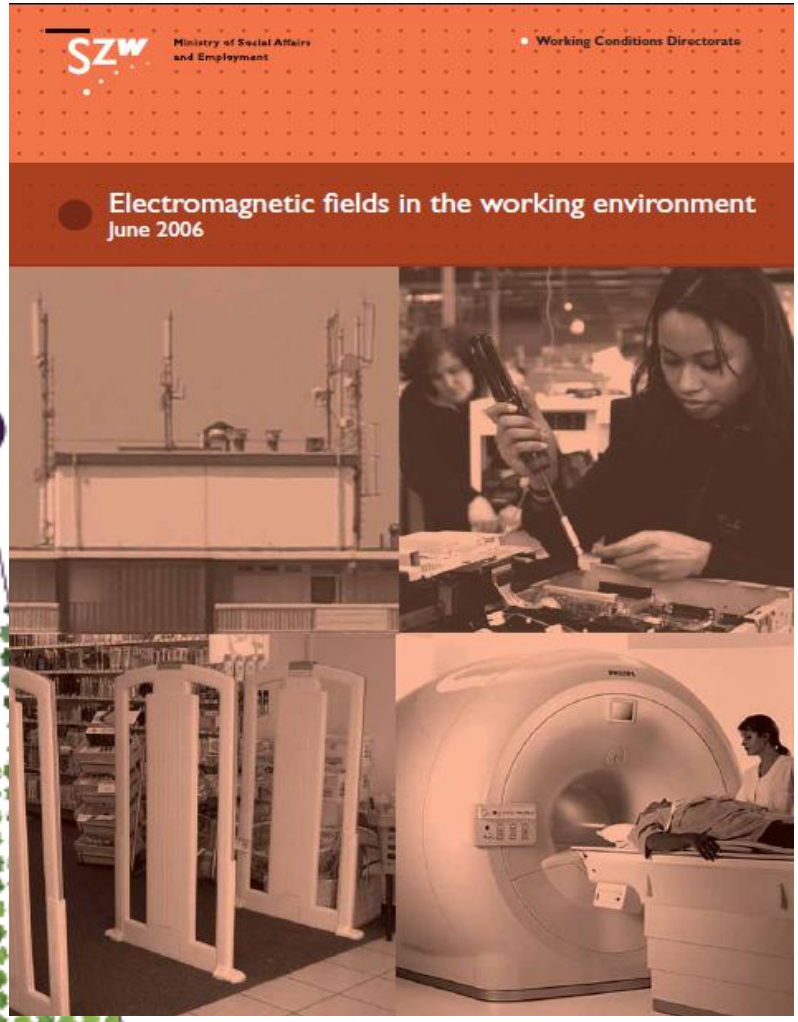
Staged approach for compliance monitoring



Stage I tools

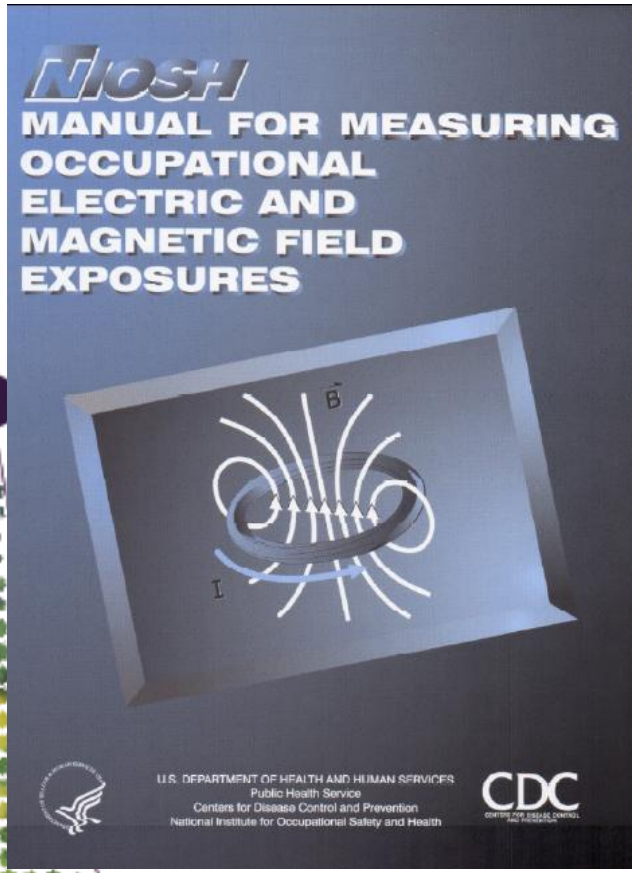


Stage I tools – identification of EMF sources

Work env.	Category I	Category II	Category III
1. Installation & maintenance	electrical hand-held tools (ex. welding equipment)	Equipment being installed/maintained …	Troubleshooting work
3. Dielectric heating	-	•Plastic sealers •Wood gluing equip.	-
4. Electricity production & distribution	Bus bars/conductor rails in substations ...	•Power stations •Air-cooled coils in capacitor banks	-
5. Electrochemical	-		rectifiers
6. Induction heating	Automated systems	•With open coils •Larger furnaces	Smaller smelting furnaces (alloying)
7. Welding	Automated systems	Arc welding (cable; electrode holder)	Spot and induction welding, (manual or semi-automated)
13. Other work environments	Induction hobs in hotel & catering industry (food preparation)	•Tape erasers •RF & microwave lighting •Non-destructive testing	

Adapted from: Bolte en Pruppers (2006). Elektromagnetishce velden in arbeidssituaties

Stage II/III tools



ELF-EMF meters

EMF meters	Range (μT)	Resolution (μT)	Frequency (Hz)	sample Rate (secs)
	standard: 0.01 – 70 High field 0.5 -7000	0.01 0.5	40 – 1000 40 - 1000	4.0 4.0
	Standard 0.01 – 300 High field 0.4 -12000	0.01 0.4	40 – 800 (Broadband) 100 – 800 (Harmonic) 40 – 800 (Broadband) 100 – 800 (Harmonic)	1.5 1.5

Exposure measurements at Stage II

Walkthrough survey

- Spot or short-term area measurements
- Hand-held EMF meter
- Measurement at known distances from sources e.g. 0.5 m;1.0 m

Exposure measurements at Stage III

- Sampling strategy
  - Personal monitoring
    - Task-based
    - Shift-based
- Meter location: waist, chest
- Work environments (identified in stage II)
- Job titles (identified in stage II)
- Repeat sampling
- Measurement equipment

Summary of personal exposure monitoring

Worker ID	task	N	Duration (mins)	Mean	range	SD
1	supervisory	4595	230	0.17	0.005 - 83.24	1.44
2	induction oven	3819	191	2.11	0.005 - 131.96	9.45
3	induction heater	4476	224	6.65	0.005 - 124.04	18.31
4	non-destructive testing	3739	187	1.68	0.005 - 132.2	12.19
	all			**2.7**	**0.005 - 132.2**	**12.29**

Devise control measures: some examples

Re-organisation:

- Locate heaters away from immediate vicinity of workers
- 1 heater per bench (to circumvent cumulative expo from several instruments
- Demarcation of area around heater where MF level has dropped off (based on measurements)

Possible procedural measures

- Turn off equipment when not in use
- Welding: never place cord over shoulder
- Reduce duration of time spent around induction heater

After control measures have been installed

- Re-sampling
  - Same measurement strategy as in Stage III
- Assess effectiveness of control measures

Any volunteers?

It’s almost free