Road Transport Health risk assessment – as a tool for Public Health Protection

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Aims

- Do health risk assessment and HIA for road transport system in Ostrava City in the target years 2010 and 2020 with D47 and without D47
- Comparison health risks coming from road transport and risk coming from another anthropogenic sources in region
- Decision making position for public health protection.

Method

HEALTH RISK ASSESSMENT

- Identification of hazards from transport
- Dose –response assessment
- Exposure assessment
- Risk characterisation

Hazards identification I (cemical factors)

- Car exhaust a lot of substances in the air - (CO), (NOX), dust particles (PM10, PM 2,5), havy metals, soot, organic compounds (PAU, Benzene, Nitro-pyren, 1.3-butadien etc.).
- **HRA our case was based on the model – trace compounds:**
  - **one threshold *NO2* and**
  - **one stochastic - *benzene.***
- **Risk studies were based on conclusions from WHO, US EPA epidemiologic studies and TNO 1994 methodology respectively.**

Hazard identification II

- Emise NO_2 and theirs impact on health
- Emise VOC (benzene and it’s impact)
- Noise from traffic
- Fine bust particles - PM 2,5

Dose - response assessment

- Dose response assessments were done for:
- Possible acute risk - short term exposure higher concentrations and noise levels
- Possible chronic risk - long term daily average concentration exposure, noise levels respectively.

Toxicology data from literature - NO_2

- http://www.epa.gov/iaq/no2.html#Health%20Effects%20Associated%20with%20Nitrogen%20Dioxide
- http://ec.europa.eu/environment/air/pdf/pp_no2.pdf „Position paper on Air Quality: nitrogen dioxide“

NO_2 (Nitrogen oxides)

- LOAEL (Lowest Observed Adverse Effect Level) cca 400 - 600 $ug.m^{-3}$
- IH_d 100 $ug.m^{-3}$ IH_k 200 $ug.m^{-3}$ IH_r 80 $ug.m^{-3}$
- WHO daily average concentration 150 $ug.m^{-3}$ recommended year average concentrations 40 - 50 $ug.m^{-3}$, hour limit 200 $ug.m^{-3}$
- EU 98 -hour limit 200 $ug.m^{-3}$

NO_2 (oxidy dusíku)

- For quantification has been Aunan's predictive formulas used. This formulas are based on met analysis of epidemiologic date and published in NILU (1995)

NO_2 Acute respiratory syndromes – adults

- Daily concentration NO_2 are in relation with increasing acute respiratory syndromes.

- The **odds ratio (OR)** is a measure of effect size particularly important in Bayesian statistics and logistic regression.

  It is defined as the ratio of the odds of an event occurring in one group to the odds of it occurring in another group, or to a sample-based estimate of that ratio. These groups might be men and women, an experimental group and a control group, or any other dichotomous classification. If the probabilities of the event in each of the groups are *p* (first group) and *q* (second group), then the odds ratio is:

$$\frac{p/(1-p)}{q/(1-q)} = \frac{p(1-q)}{q(1-p)}.$$

- **OR = exp (β..C), where β - regression coefficient 0,0014 (95%CI 0,0010-0,0017) and C is daily concentration NO_2 v $\mu g.m^{-3}$. (Aunan 1995)**
- **The limit is** 4,6 %.

NO_2 *Acute respiratory symptoms - children*

- **OR = exp (β..C), where β - regression coefficient 0,0055 (95%CI 0,0026-0,0088) a C annual concentration NO_2 v μg.m^{-3}.** (Aunan 1995)
- Is possible to use it for prevalence increasing more than 2% - limit

NO_2 Incidence of asthma atacs within children

- **OR = exp (β..C), where β - regression coefficient 0,016 (95%CI 0,002-0,0308) and C annual concenration NO_2 v μg.m^{-3}**. (Aunan 1995)
- Limit is 6,0 %.

NO_2 acute effects

1 hour conc.	Health adverse effects
200 - 400 $\mu g.m^{-3}$	S.P. within people with asthama and bronchitis
401 - 900 $\mu g.m^{-3}$	Light spastic manifestation within sensitive population.
901 - 1600 $\mu g.m^{-3}$	More serious health adverse affects within sensitive population together with others determinants – physical activity, could, humidity etc. Low probability of asthma attack.
1 601 - 1 800 $\mu g.m^{-3}$	Higher probability of asthma attack.

Benzene toxicology

- Common known
- Man –made sources
- Smoking

Benzene exposure in Ostrava 1998

- Clean area 24 hours from 0,014 μg.m-3 /d.l./ till 0,92 μg.m-3 (95 percentile),
- Industrial area 24 hours 0,014 μg.m-3 till 9,15 μg.m-3 (95 percentile).
- Transport influenced areas cca 12,8 do 15,6 μg.m-3 benzenee,
- Heavy influenced area (coke oven + transport) 53,6 μg.m-3 (personal information fy. ELCOM Ostrava s.r.o. in cooperation with NILU Oslo).

Benzene

- **IARC human carcinogen group. 1**
- **US EPA human carcinogen group A**
- **NIOSH humánn carcinogen**
- **CZE standard (ambient air) 15,0 $\mu g.m^{-3}$**
- **dle**
- **WHO 4,0 E-06 ($\mu g.m^{-3}$) - 1,0 $\mu g.m^{-3}$**
- **RBC US EPA 0,22 $\mu g.m^{-3}$ - risk E-06**

Noise

- ***Noise and Health, TNO Institute of Preventive Health Care, The Hague: Health Council of the Netherlands, publ. No A93/02E, 1994***

Noise - L_{Aeq}

- Hypertension
- Ischemic CVD
- IM
- Quality of sleeping
- performance next day
- Mood next day

- LAeq 6-22 70 dB(A)
- LAeq 6-22 70 dB(A)
- LAeg 6-22 70 dB(A)
- LAeg noc   40 dB(A)
- LAeg noc < 60 dB(A)
- LAeg noc < 60 dB(A)

Exposure assessment

- **Rout transport system – selection based on capacity of routs (cca 400 km Ostrava)**
- **Exposed person is anyone living in the belt 30 m from side of routs**
- **Ambient air concentrations NO_2 and benzene were model in Car International (TNO) and ISCT ST(EPA)**
- **Noise was model in CZE modele Koláře a Liberka**

Car Interantional Model

- **Simple parametric model**
- **Takes in calculation geometry of routs**
- **Model concentrations in 5 – 30 m distance from axis of route**
- **Model annual concentration or percentiles**
- **Model was recommended for using in EC**

Car International Model

- **Model is able to give (calculate):**
- **City background concentration level**
- **Rout emission**
- **Proportion of local transport**
- **Annual averadge concentration**

Car International Model

- **Emision variable „ Specific emissions for basic car categories and given running mode ÚVMV Praha 1995 „**
- **S 1 – average speed 13 km/h, lane with traffic jam**
- **S 2 - average speed 22 km/h, street with speed limit 50 km/h**
- **S 3 - average speed 44 km/h, street with speed limit 70 km/h**
- **S 4 - average speed 100 km/h – highway**

Car International Model

- **Streets and lane were diveded into 807 segments in Ostrava city:**
- **Intensity of transport**
- **Proportion of heavy transport**
- **Speed**
- **Geometry of street or lane**
- **Inputdata into model were from City Ostrava developmnet plan „Zpracování modelového zatížení výhledové komunikační sítě města Ostravy objemy dopravy roku 2010 a 2020„(UDIMO s.r.o. arch.č: II-1.3/180/96)**

Case of Ostrava city

- EIA (legal obligation)
- Exposure of citizens – distance < 200 m, total length D 47 - 10 km
- No. of inhabitants several thousands

- HRA (PH wish)
- Exposure of citizens residential suburbs< 30 m resp.60, length 440 km
- No. of inhabitants 38 000, including age stratification
- Identification of high exposed buildings (hot spots)

GIS aplication (MIC)

- **No. of inhabitants living in the distance 30 and/or 60 m from axis or side of the street**
- **Identification of health care facilities, school, kindergartens, houses for aldery etc..**

Charakteristika rizika

- **HRA NO_2 1 h. and 24 h. exposition with D 47 and without D 47,**
- **HR for benzene was assessed in Lifetime Individual Cancer Risk**

Risk characterisation noise I

- **Schulze (1983) predict (within 2 500 exposed adults) increasing of hypertension**

  is about 2% and ICVD about 4% Babische (1992,1993) and Manikowského (1995) can be increasing of IM from 1.2 to 1.7 x.
- **We did not possibility of noise exposure prevention measurements.**

Risk characterisation for noise

- **HRA was done as No. of exposed inhabitants and IM predication.**

General results

- Situation with and without D47 will be in the health risk level NO2, benzene the same in 2010
- In 2020 is the same (little be better for D47)
- In noise exposure were three hot spot identified with D47 scenario.
- The HR coming from traffic in Ostrava city is comparable with another industrial cities.

HRA uncertainties I

- **Using of the dispersin models (Car International, ISC ST)**
- **Using emissions data from sources REZZO I,II**
- **Quality of predicted data about traffic density**
- **Quality of the car emissions data**
- **Quality of the dose – response data**

HRA uncertainties

- **Demografic data about inhabitans (MIS) Ostrava**
- **Health status data – routine statistcs společnosti**
- **Epidemiology studies resuls**

Discussion

- HRA as a HIA tools for decision
- D 47 is build, we will see
- In the late 90ties it was nice case study for municipality management of HR

Conclusions and recommendations

- **Comparison of the HR from traffic needs very broad concept of HRA or HIA**
- **In our case the highway doesn’t bring any increasing health risk**
- **Realisation of the highway D47 doesn't bring decreasing risk in the existing downtown**