SSPH+ SWISS SCHOOL OF PUBLIC HEALTH
15 YEARS
A FOUNDATION OF SWISS UNIVERSITIES

Swiss TPH
Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut
Institut Tropical et de Santé Publique Suisse
Associated Institute of the University of Basel

ETH zürich

Clean Air for Health – Using Science to stop "Fake news"

1st lecture in the SSPH+/ETH Jubilee Series **"This Is Public Health"**
Wed 19.2.2020 – 17:15h (CET) @ ETH Zurich HG D16.2 and
live-streamed online https://ethz.zoom.us/j/253320154?status=success

Prof. Nino Künzli, MD PhD

Swiss Tropical and Public Health Institute (Swiss TPH) Basel and University of Basel, Switzerland
Dean Swiss School of Public Health (SSPH+)

… be prepared for a QUIZ… soon open: PollEv.com/ninokuenzli573

Engines of a highly successful Swiss air pollution & health research agenda launched in 1989

Prof. Hans-Urs Wanner, ETHZ († 2019)

Prof. Ursula Ackermann-Liebrich
Prof. Charlotte Braun-Fahrländer
1989 @ former Institute of Public Health Uni Basel

Dr. Gianfranco Domenighetti († 2017)

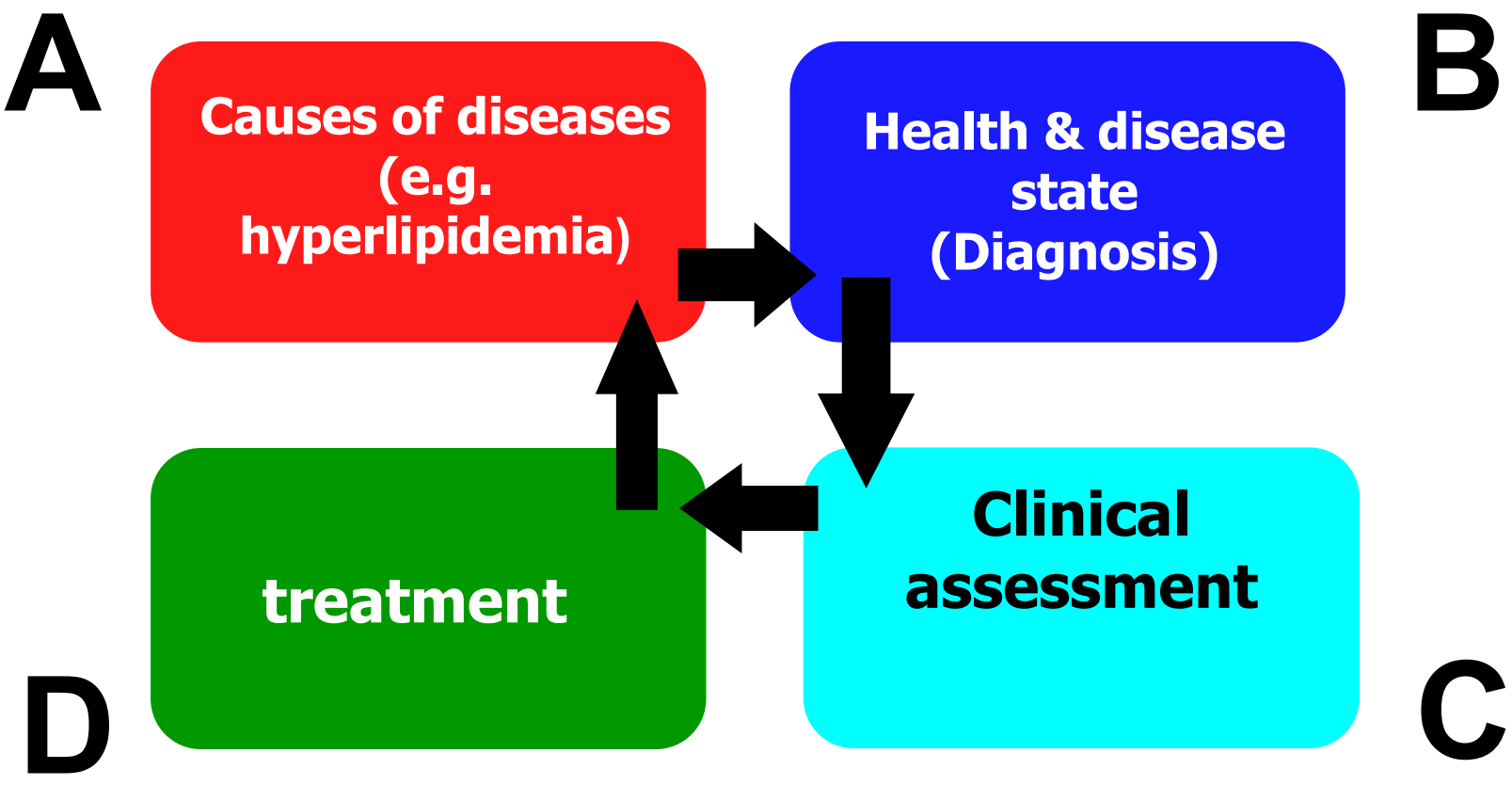
SSPH+ Honorary Fellows

… QUIZ soon open: PollEv.com/ninokuenzli573

… "the science and art of preventing disease, prolonging life and improving quality of life through organized efforts … of society…"

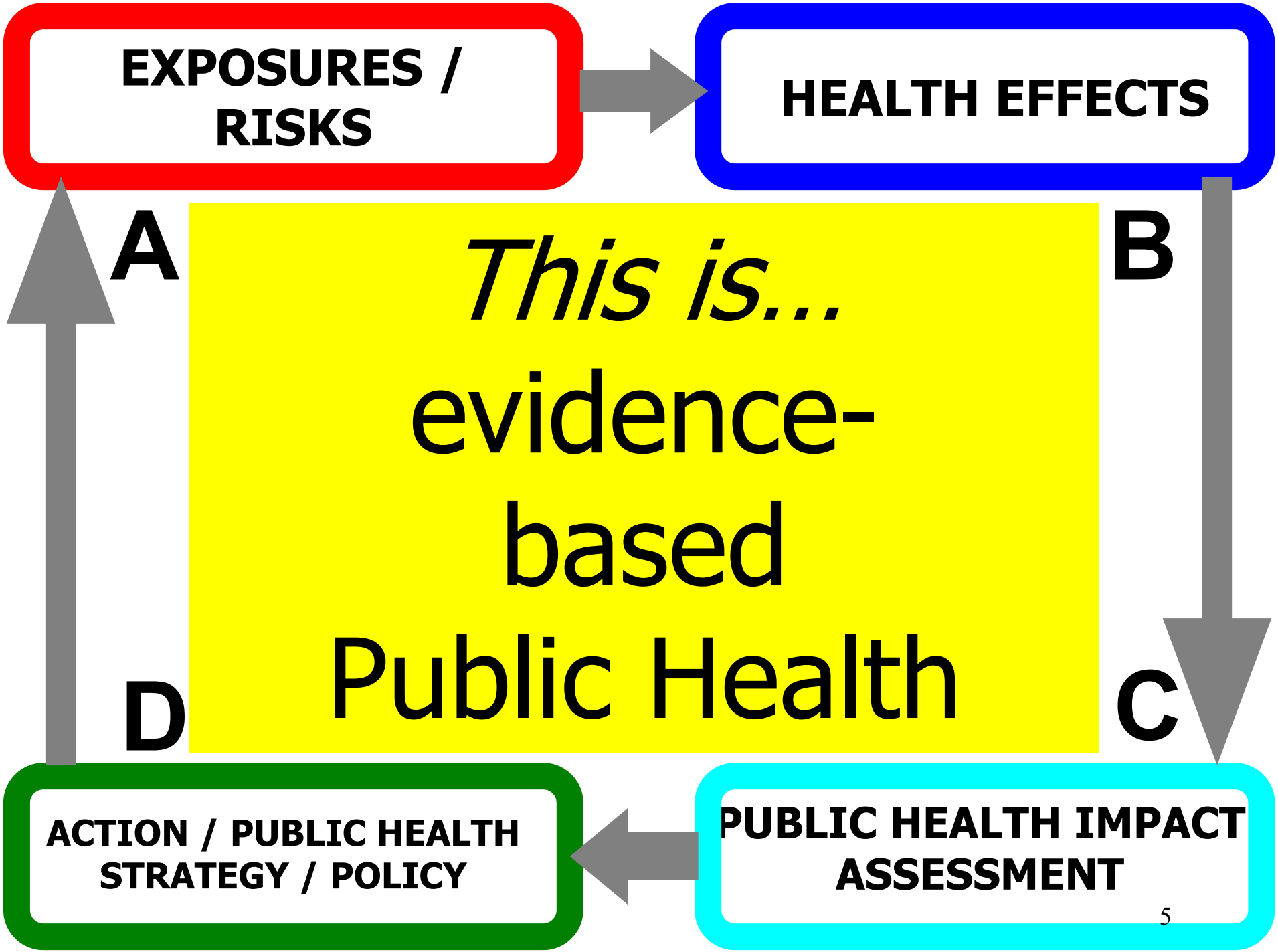
… QUIZ soon open: **PollEv.com/ninokuenzli573**

Evidence-based medicine



Künzli & Perez, Swiss Med Weekly 2009 – free on line

… QUIZ soon open: PollEv.com/ninokuenzli573


EXPOSURES / RISKS
HEALTH EFFECTS
A
B
This is...
evidence-based
Public Health
D
C
ACTION / PUBLIC HEALTH STRATEGY / POLICY
PUBLIC HEALTH IMPACT ASSESSMENT

A QUIZ to start with… go on-line /smart phone at:

PollEv.com/ninokuenzli573

or text-message **NINOKUENZLI573** to **22333** to join session.

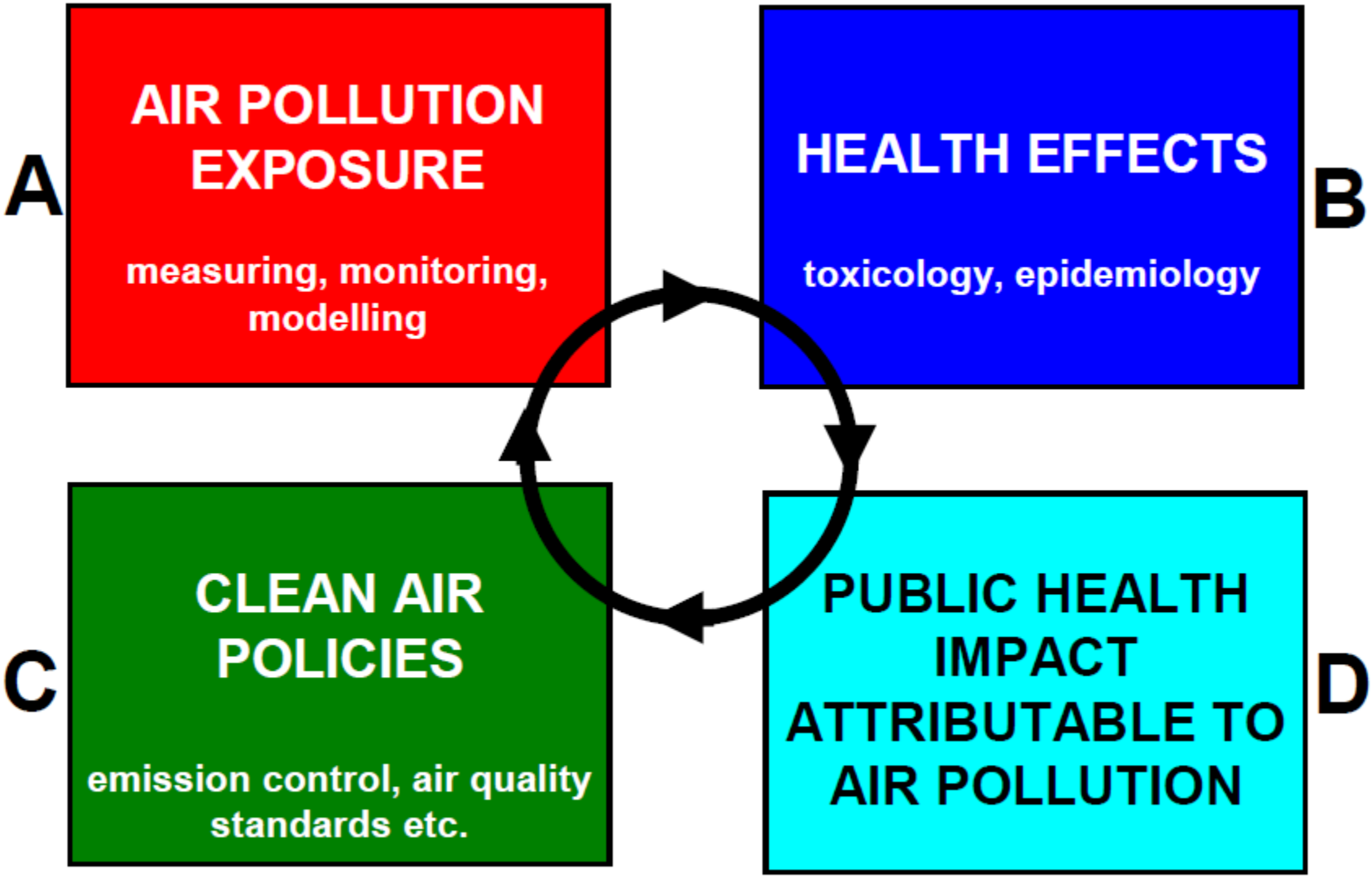
QUESTION:

What risk factor or disease is the LARGEST cause of premature death, globally? (choose only ONE)

A) HIV/AIDS + Tuberculosis+Malaria
B) Alcohol
C) Environmental Pollution
D) Malnutrition
E) Tobacco

Science Based Clean Air Policy Making

The Environmental Health Policy Cycle



Künzli & Perez Swiss Med Wkly 2009

Sources

… and related pollutants

Gases - e.g.

- Nitrogen oxides (NO2, NO, NOx etc.)
- Sulfates
- Carbon monoxide (CO)
- Ozone (O3)

Volatiles - e.g.

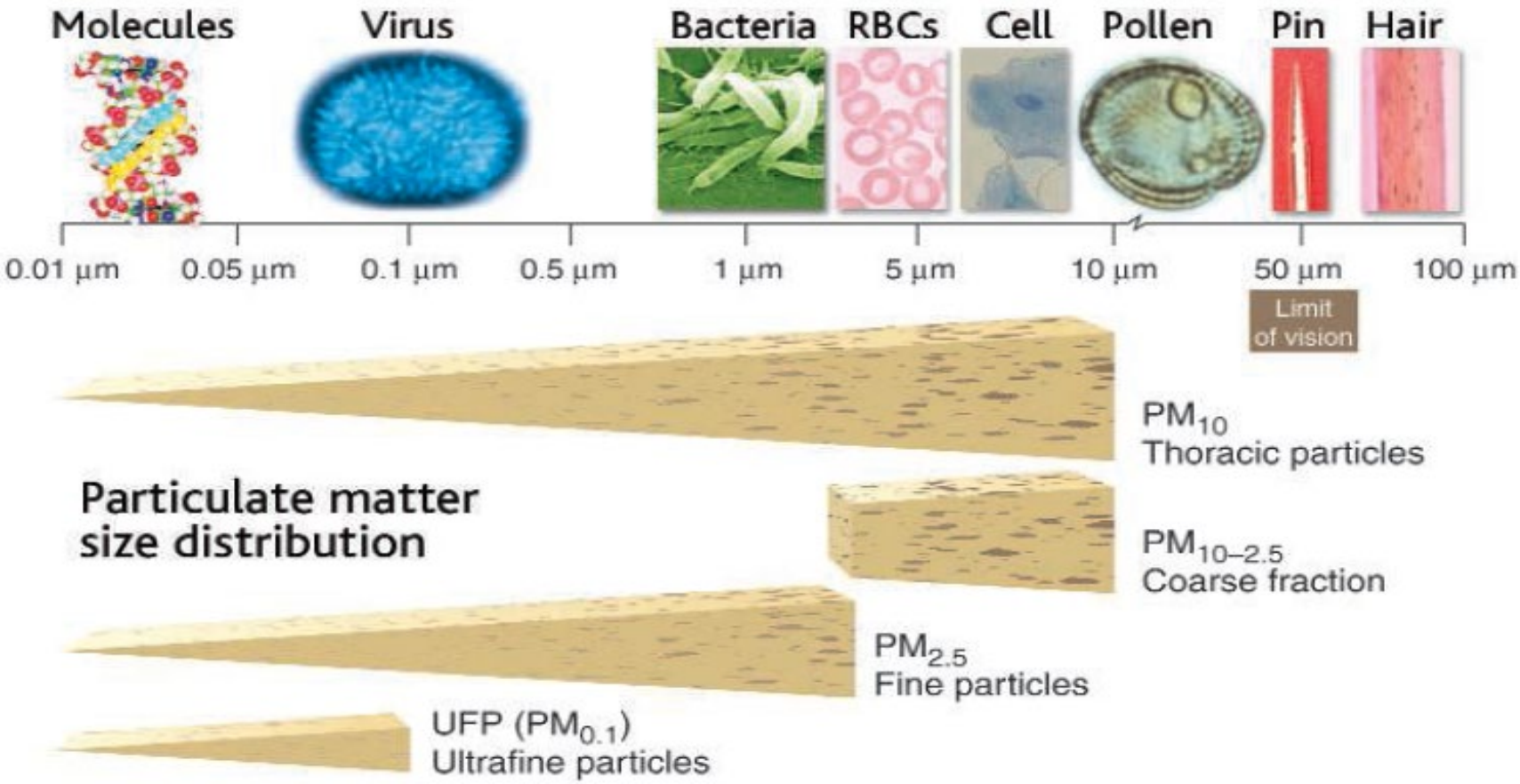
- Volatile Organic Compounds (VOC)

Particulate matter (PM) - e.g.

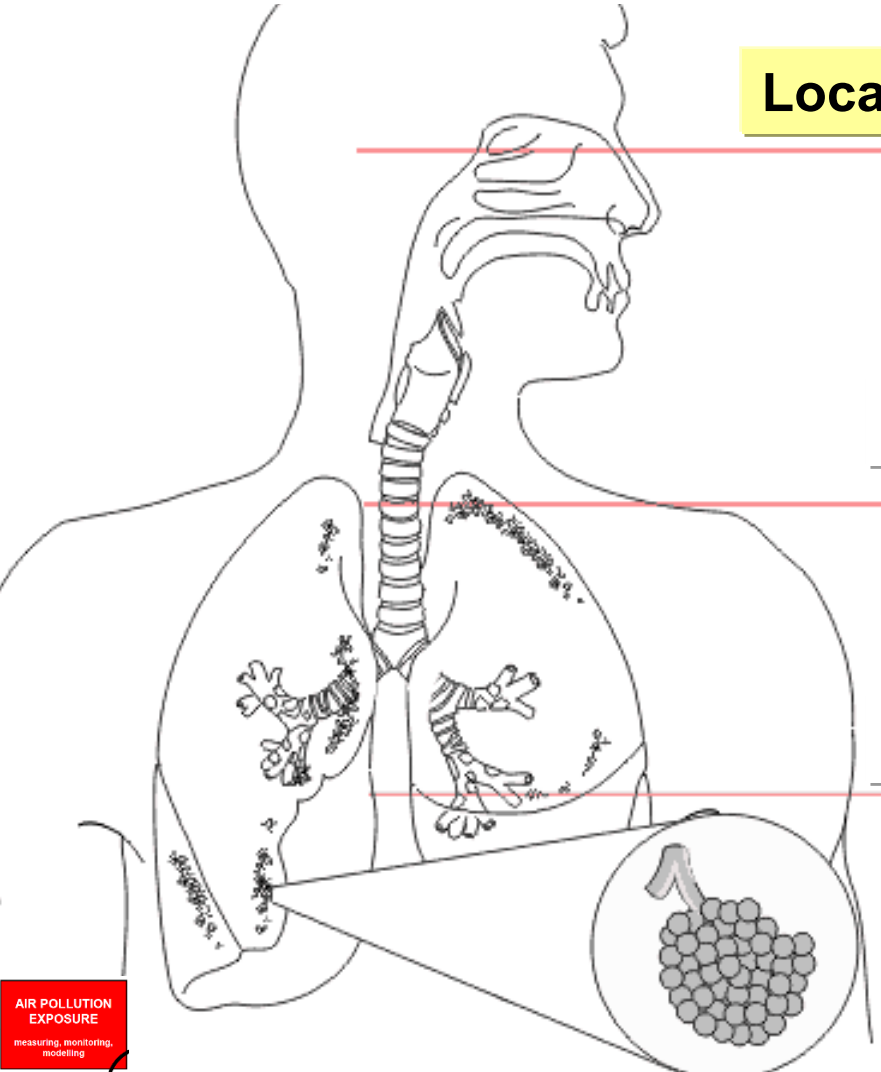
- Total suspended particles (TSP)
- Particles up to 10 micrometer in diameter (PM_{10})
- Fine Particles up to 2.5 microm. - $PM_{2.5}$
- Nano-Particles = Ultrafines / $PM_{0.1}$
- Black smoke / elemental carbon / soot / diesel particles

Particulate Matter (PM) by size (diameter, in micrometers)

Nel et al, Science, 2005; 307:1858



Deposition of fine particles in the respiratory tract



Location of action	Relevant particles
Nose / Throat	5-10 µm
Airways	3-5 µm
Bronchia	2-3 µm
Bronchioli	1-2 µm
Alveoli	0.1-1 µm

broncho-inhalers to treat asthma

see LECTURE ON 08 April 2020

SAPALDIA Director Prof. Nicole Probst-Hensch Swiss TPH

The Swiss Study on Air Pollution and Lung & Heart Disease in Adults

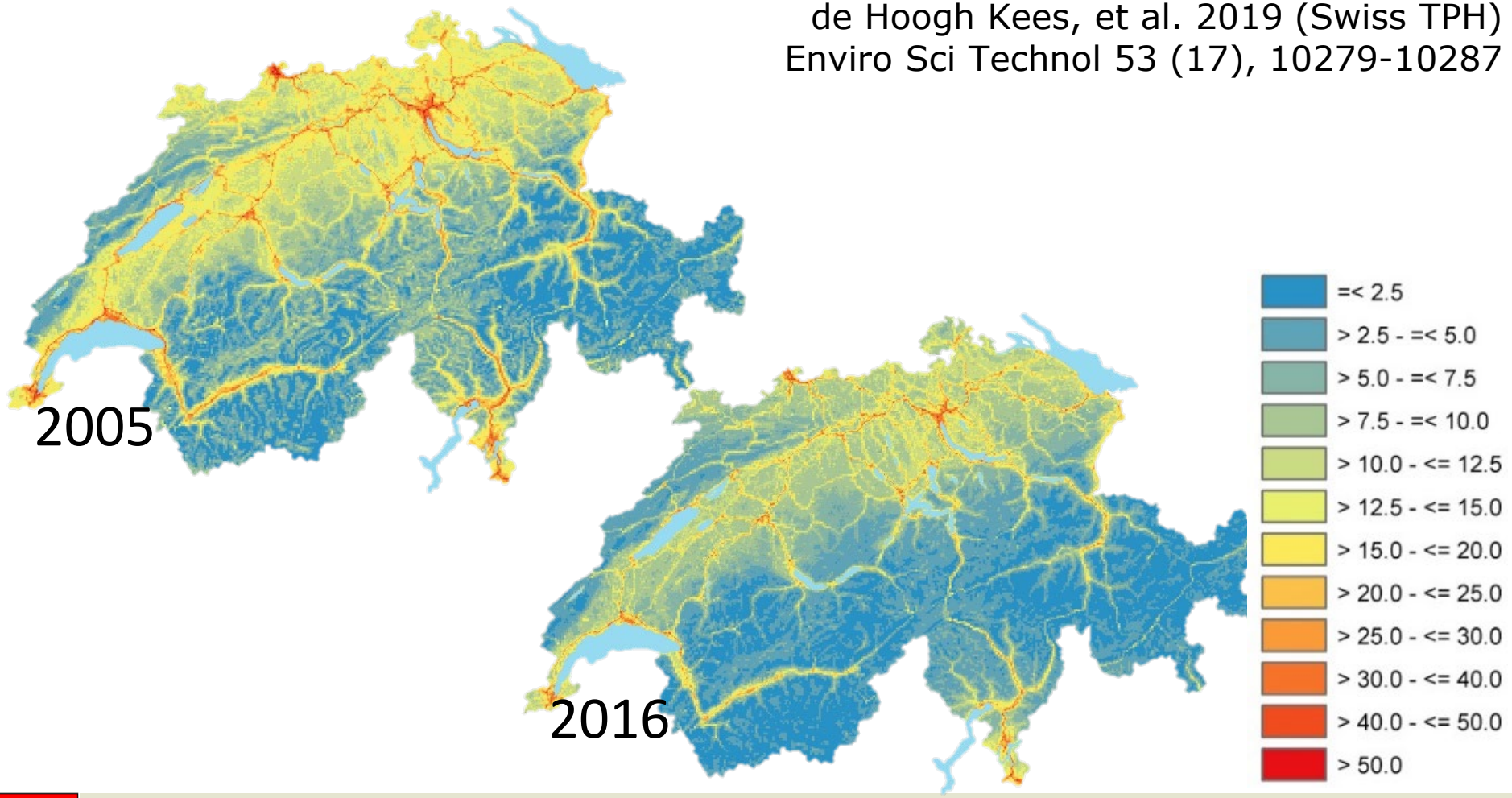
SAPALDIA

Initiated 1991 (~10'000 subjects) – and still running

Spatial map of annual mean NO_2 concentrations ($\mu g/m^3$)

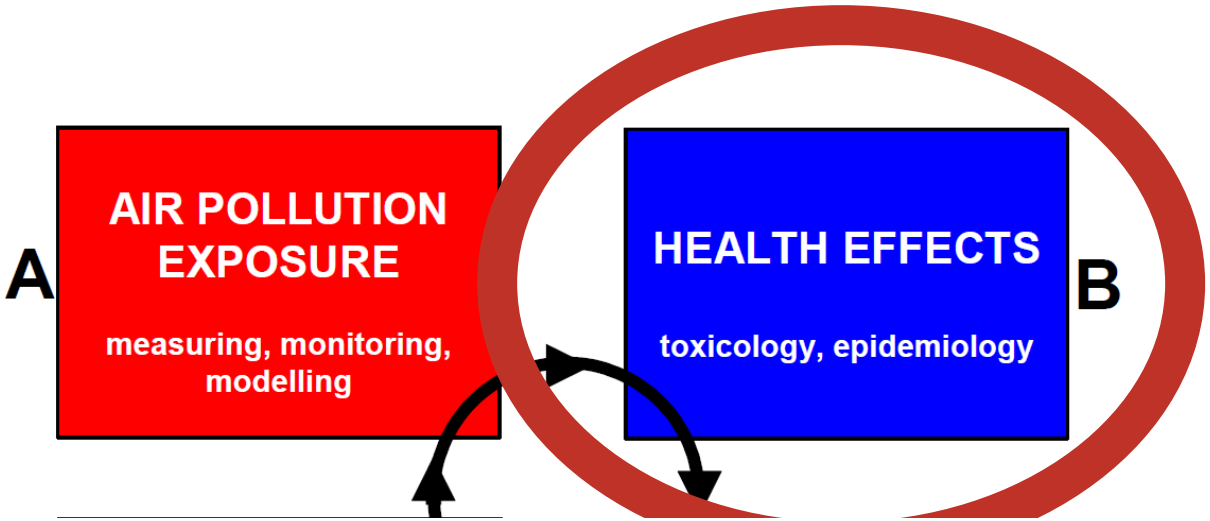
Switzerland 2005 and 2016

de Hoogh Kees, et al. 2019 (Swiss TPH)
Enviro Sci Technol 53 (17), 10279-10287



Science Based Clean Air Policy Making

The Environmental Health Policy Cycle

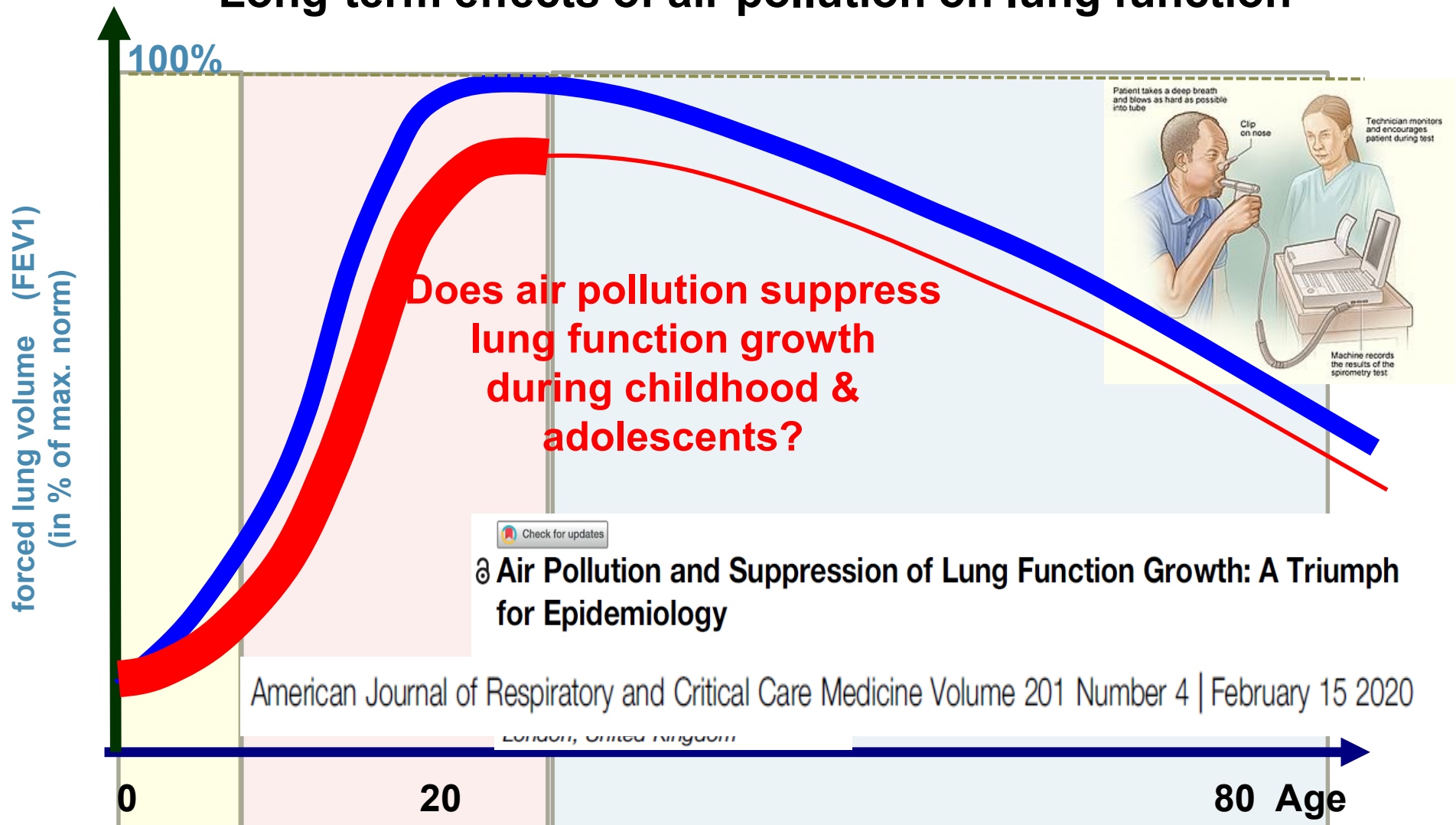


INTERNATIONAL SOCIETY FOR ENVIRONMENTAL EPIDEMIOLOGY

ISEE

STUDYING HUMAN HEALTH AND THE ENVIRONMENT

Long-term effects of air pollution on lung function

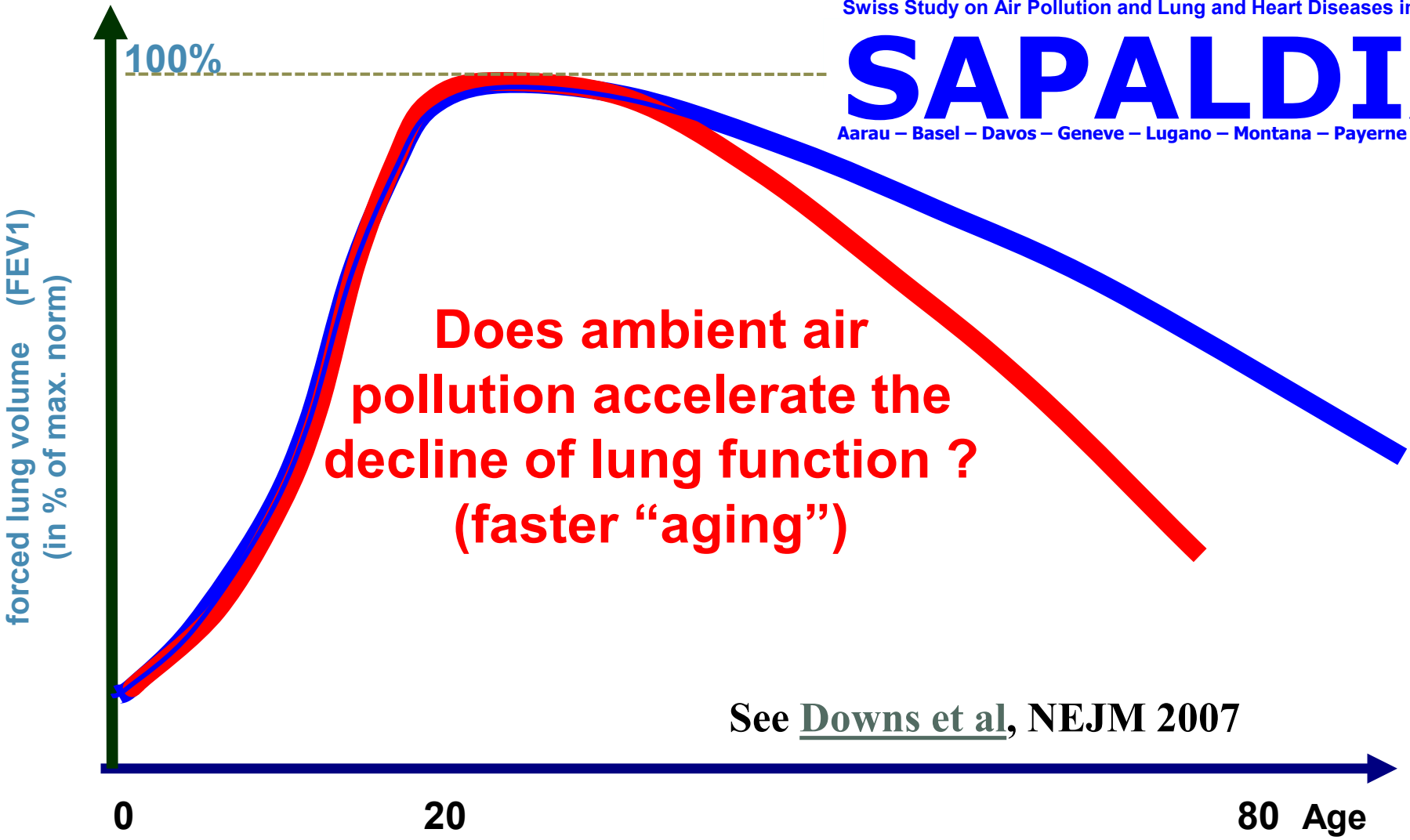


A primary 1991 hypothesis of

Swiss Study on Air Pollution and Lung and Heart Diseases in Adults

SAPALDIA

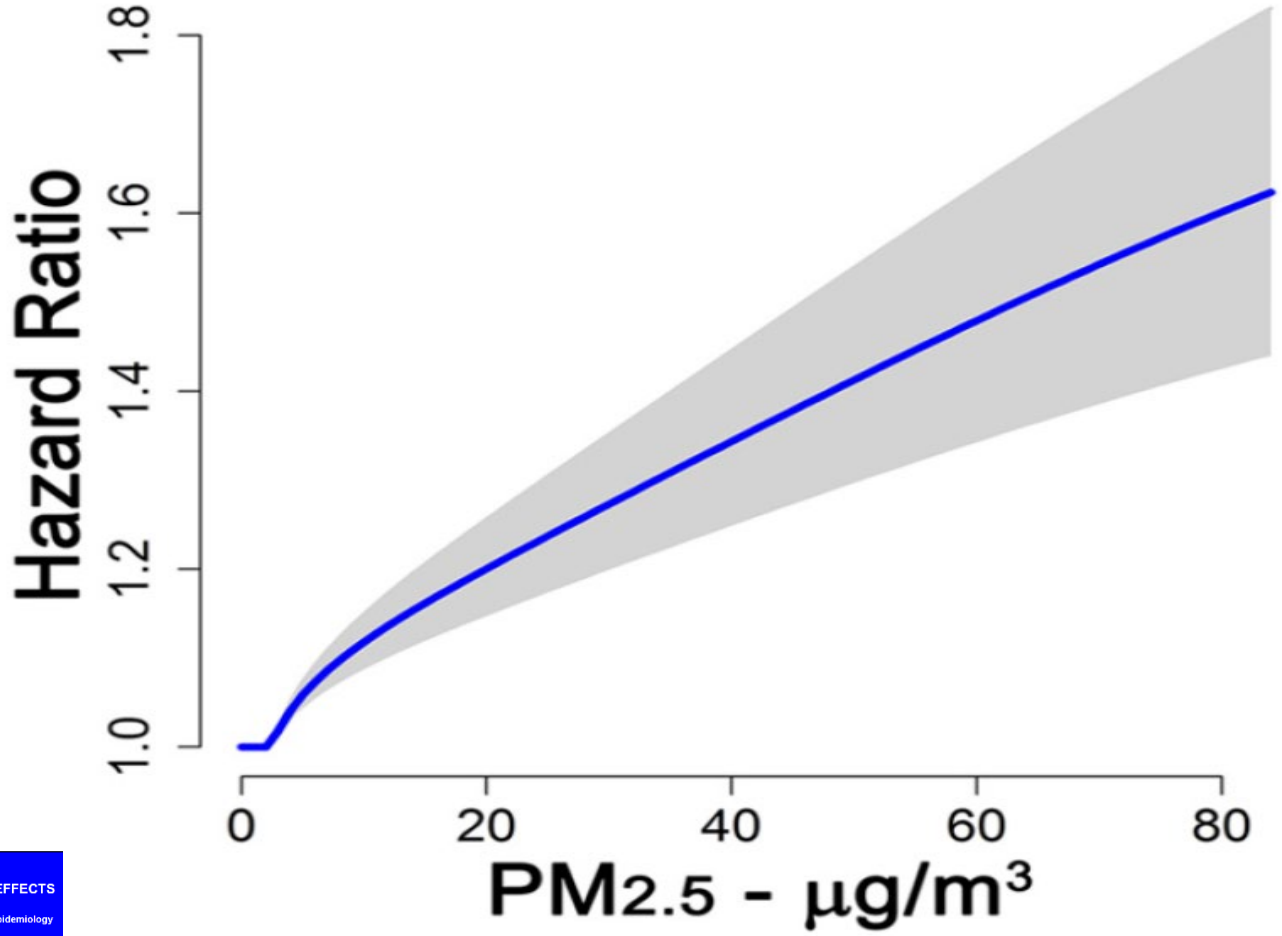
Aarau – Basel – Davos – Geneve – Lugano – Montana – Payerne – Wald



See Downs et al, NEJM 2007

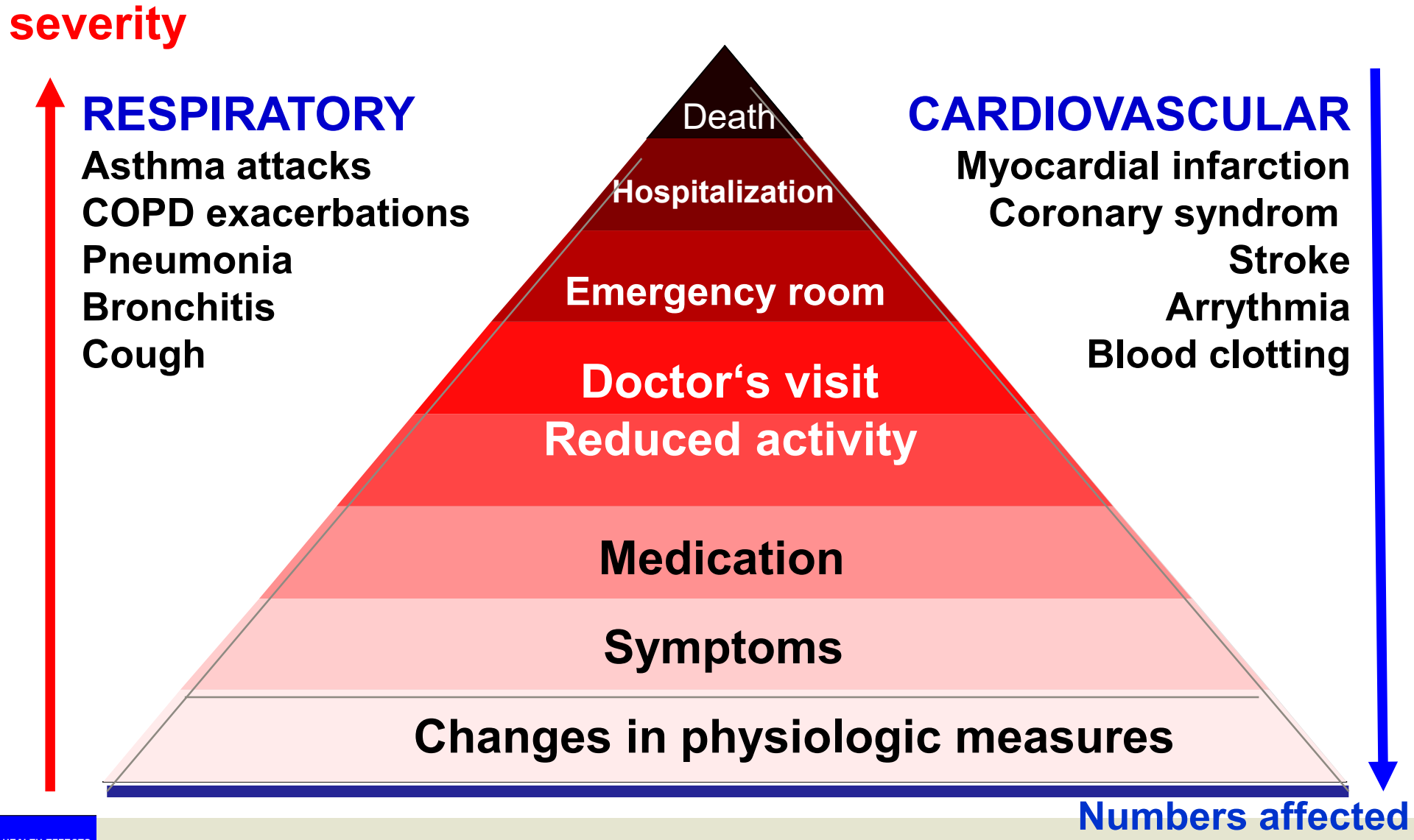
Association between home outdoor $PM_{2.5}$ long-term mean concentrations and mortality in 41 long-term studies from 16 countries (incl. Switzerland)

A «big data» meta-analysis by Burnett et al, PNAS 2018



Interrelated acute health effects of air pollution

Severity of effects depends also on susceptibilities

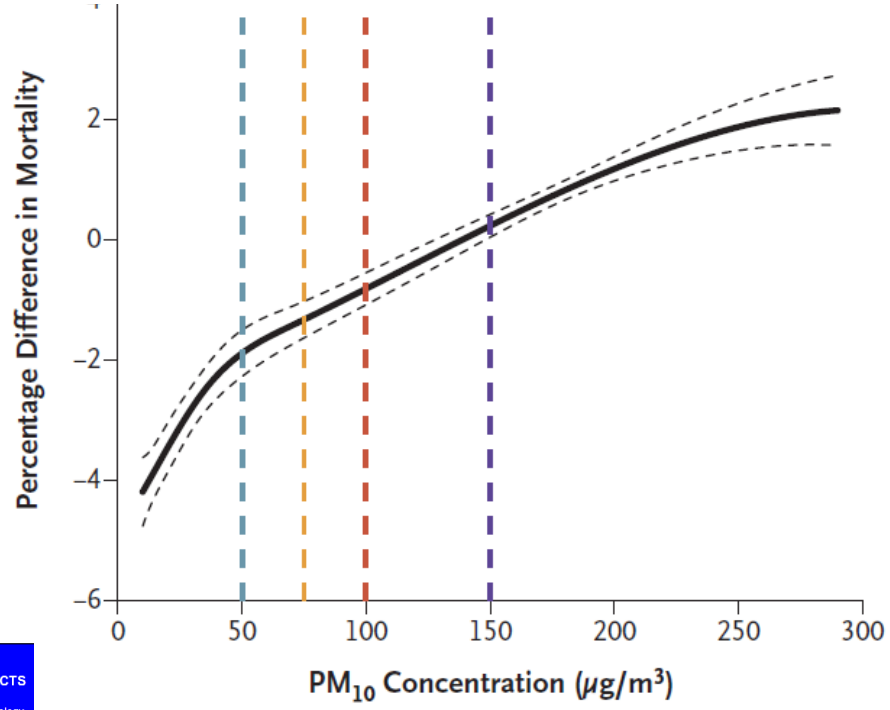


The NEW ENGLAND JOURNAL of MEDICINE

N ENGL J MED 381;8 NEJM.ORG AUGUST 22, 2019

Ambient Particulate Air Pollution and Daily Mortality in 652 Cities

C. Liu, R. Chen, F. Sera, A.M. Vicedo-Cabrera, Y. Guo, S. Tong, M.S.Z.S. Coelho, P.H.N. Saldiva, E. Lavigne, P. Matus, N. Valdes Ortega, S. Osorio Garcia, M. Pascal, M. Stafoggia, M. Scortichini, M. Hashizume, Y. Honda, M. Hurtado-Díaz, J. Cruz, B. Nunes, J.P. Teixeira, H. Kim, A. Tobias, C. Íñiguez, B. Forsberg, C. Åström, M.S. Ragettli, Y.-L. Guo, B.-Y. Chen, M.L. Bell, C.Y. Wright, N. Scovronick, R.M. Garland, A. Milojevic, J. Kyselý, A. Urban, H. Orru, E. Indermitte, J.J.K. Jaakkola, N.R.I. Ryti, K. Katsouyanni, A. Analitis, A. Zanobetti, J. Schwartz, J. Chen, T. Wu, A. Cohen, A. Gasparrini, and H. Kan



per 10 µg/m³ increase in 2-day-mean PM_{10} …

natural mortality increases by 0.44% (95% CI: 0.39-0.50)

The Health Impact of Air Pollution

Swiss TPH

An expert report c
International Soci
and the European

Prof Dr Annette Peters, MSc, Helm
and Ludwig-Maximilian University
in 2012-2013, ISEE Policy Committ

Prof Dr Barbara Hoffmann, MD, MF
of the Environment and Health Con
Europe 2015-2017

Prof Dr Bert Brunekreef, Universit
ISEE President in 2000-2001, Chai
Committee of the ERS (2014-2017)

Prof Dr PhD Nino Künzli, MD, Swis
Institute (Swiss TPH), Basel, and U

Meltem Kutlar Joss, MSc ETH, MPH
Health Institute (Swiss TPH), Base

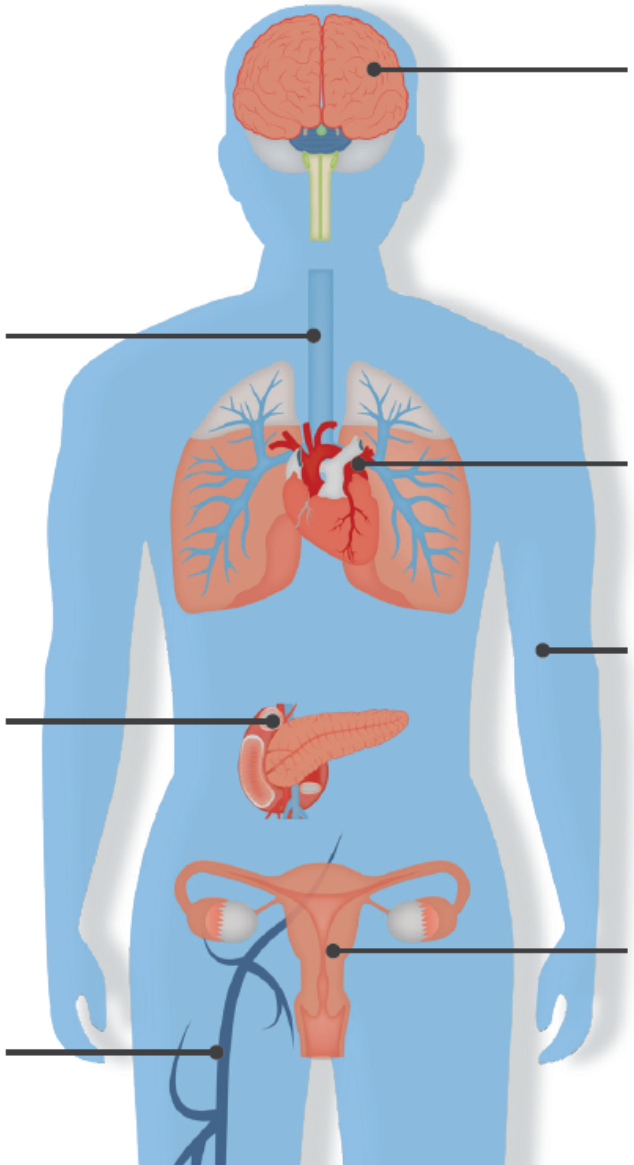
PProf Dr PhD Nicole Probst-Hensch
Health Institute (Swiss TPH), Basel,

Prof Dr PhD Beate Ritz, MD, Unive
USA, ISEE President

Prof Dr Holger Schulz, MD, Helmh

PD Dr Kurt Straif, MD, MPH, PhD,

. Erich Wichmann, MD
Ludwig-Maximilian U



Death due to respiratory diseases
Disease due to respiratory diseases
Lung cancer/ Pneumonia
Respiratory symptoms
Inflammation of airways
Impaired lung function
Impaired pulmonary growth

Insulin resistance
Type- 2 Diabetes
Type-1 Diabetes
Bone metabolism

High blood pressure
Endothelial dysfunction
Increased blood clotting
Systemic inflammation
Venal thrombosis

Strokes
Neurological development
Mental health
Neurodegenerative disorders

Death due to cardiorespiratory disorders
Disease due to cardiorespiratory disorder
Myocardial infarction
Cardiac arrhythmia
Cardiac insufficiency

Aging of skin

Preterm birth
Lower weight at birth
Reduced foetal growth
Delayed foetal growth
Lower quality sperm
Preeclampsia

HEALTH EFFECTS
toxicology, epidemiology

Established «causality» (ISA, US EPA)

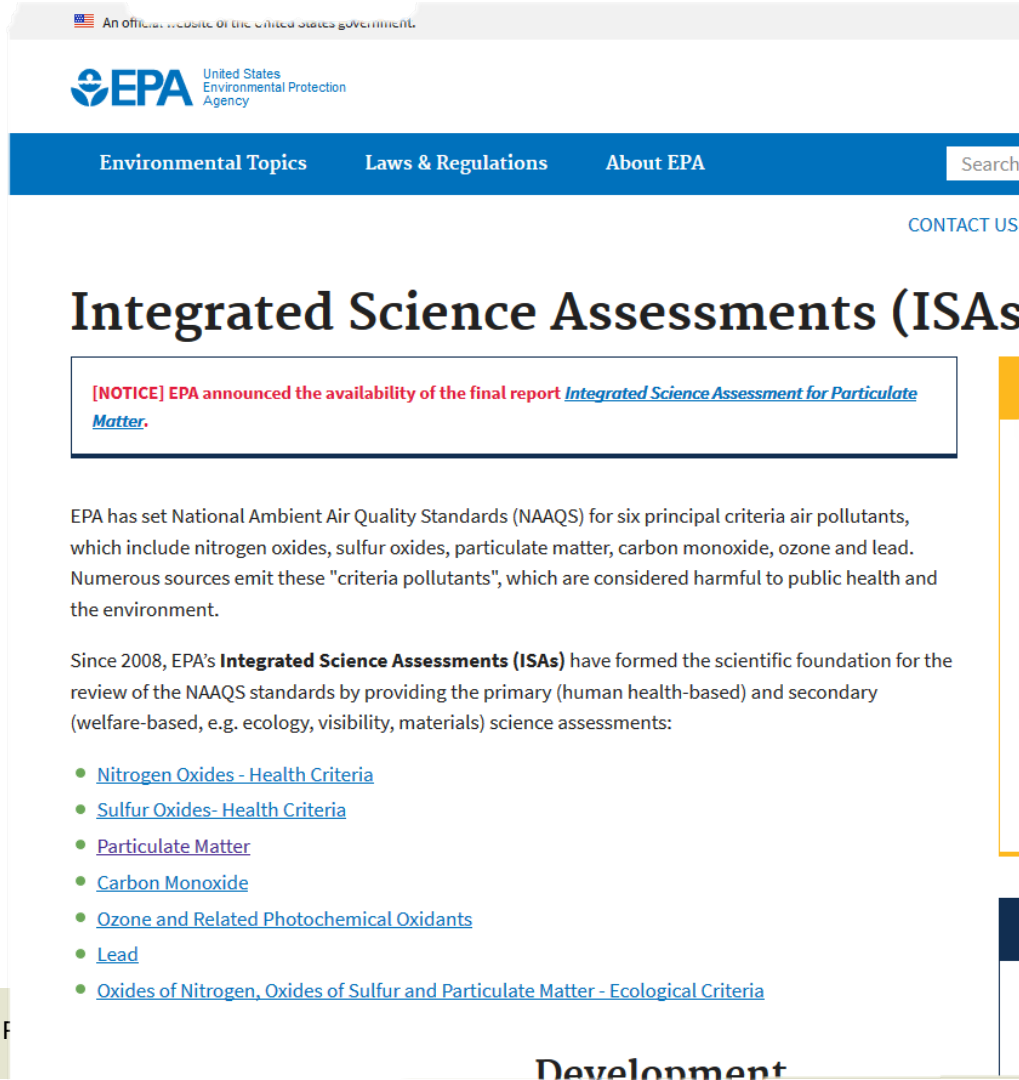
PM10 and PM2.5:

- total mortality
- cardiovascular mortality
- respiratory mortality

NO2:

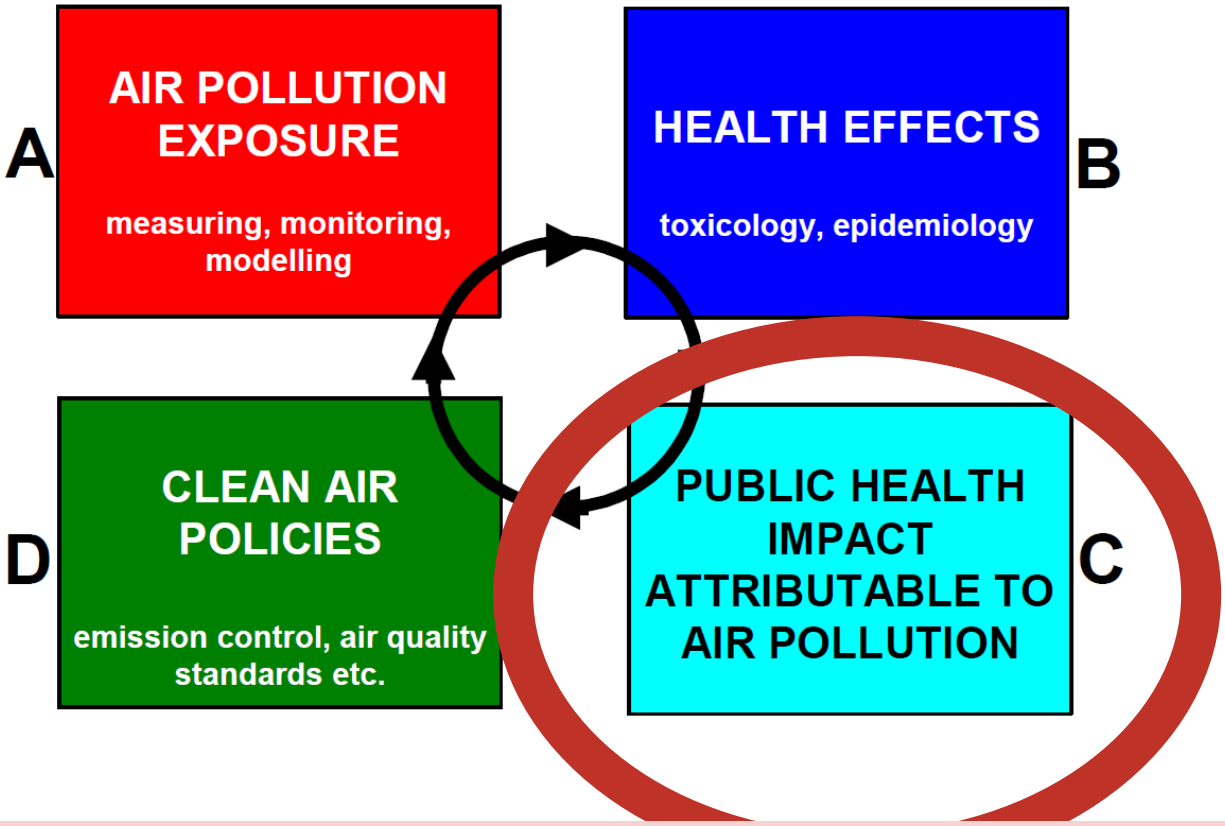
- bronchial hyperreactivity
- respiratory health problems among asthmatics

- … and PM2.5 is classified as CARCINOGEN (IARC)



Science Based Clean Air Policy Making

The Environmental Health Policy Cycle



Explore the Global Burden of Disease web tools ! http://www.healthdata.org/gbd

Air pollution is the 'new tobacco', warns WHO head

Exclusive: Simple act of breathing is killing 7 million people a year and harming billions more, but 'a smog of complacency pervades the planet', says Dr Tedros Adhanom

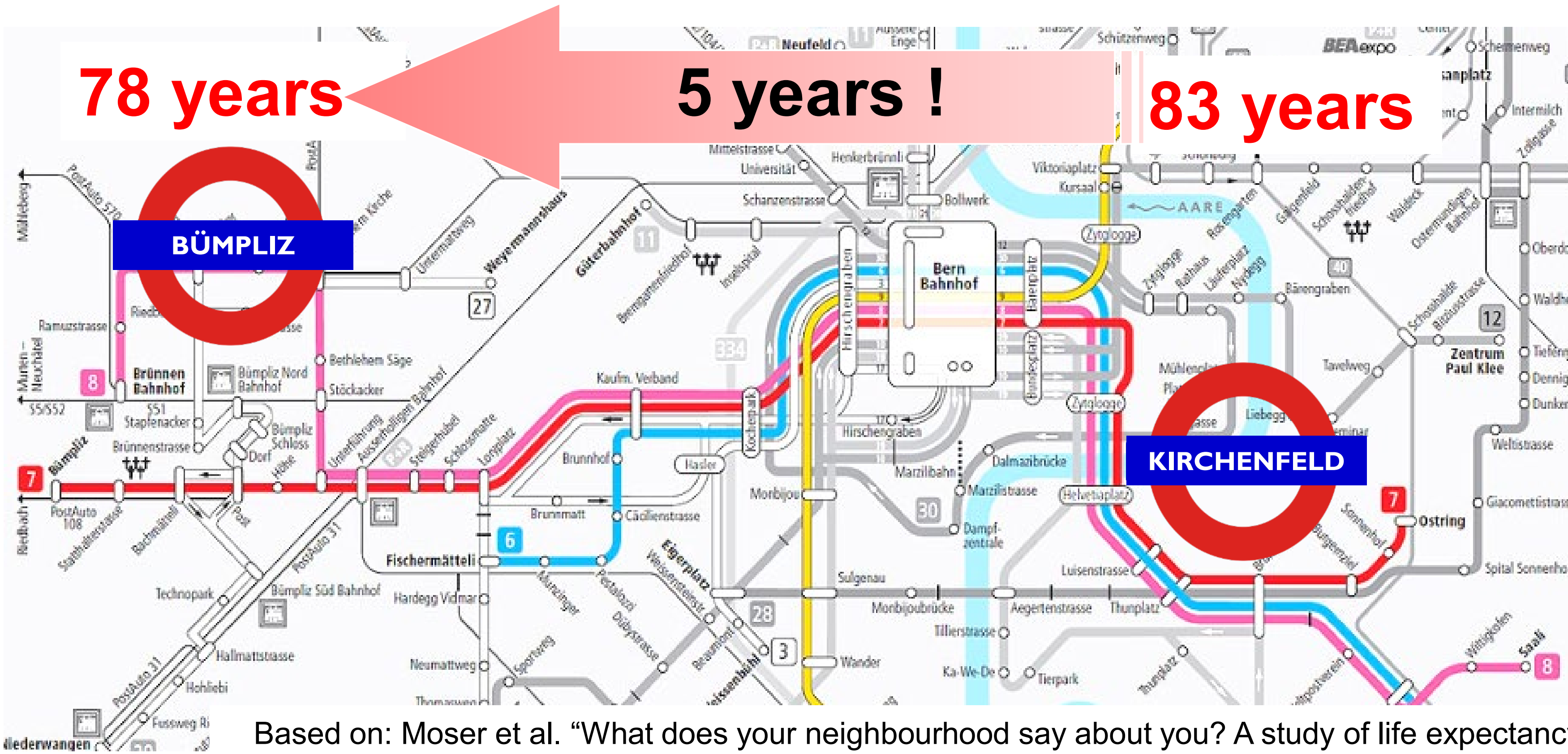
● **Dr Tedros Adhanom Ghebreyesus: Air pollution is the new tobacco. Time to tackle this epidemic**

also see: First WHO Conference on Air Pollution and Health – Oct 2018 in Geneva
http://www.who.int/airpollution/events/conference/en/

PUBLIC HEALTH IMPACT ATTRIBUTABLE TO AIR POLLUTION

also see LECTURE ON 22 April 2020 Silvia Stringhini

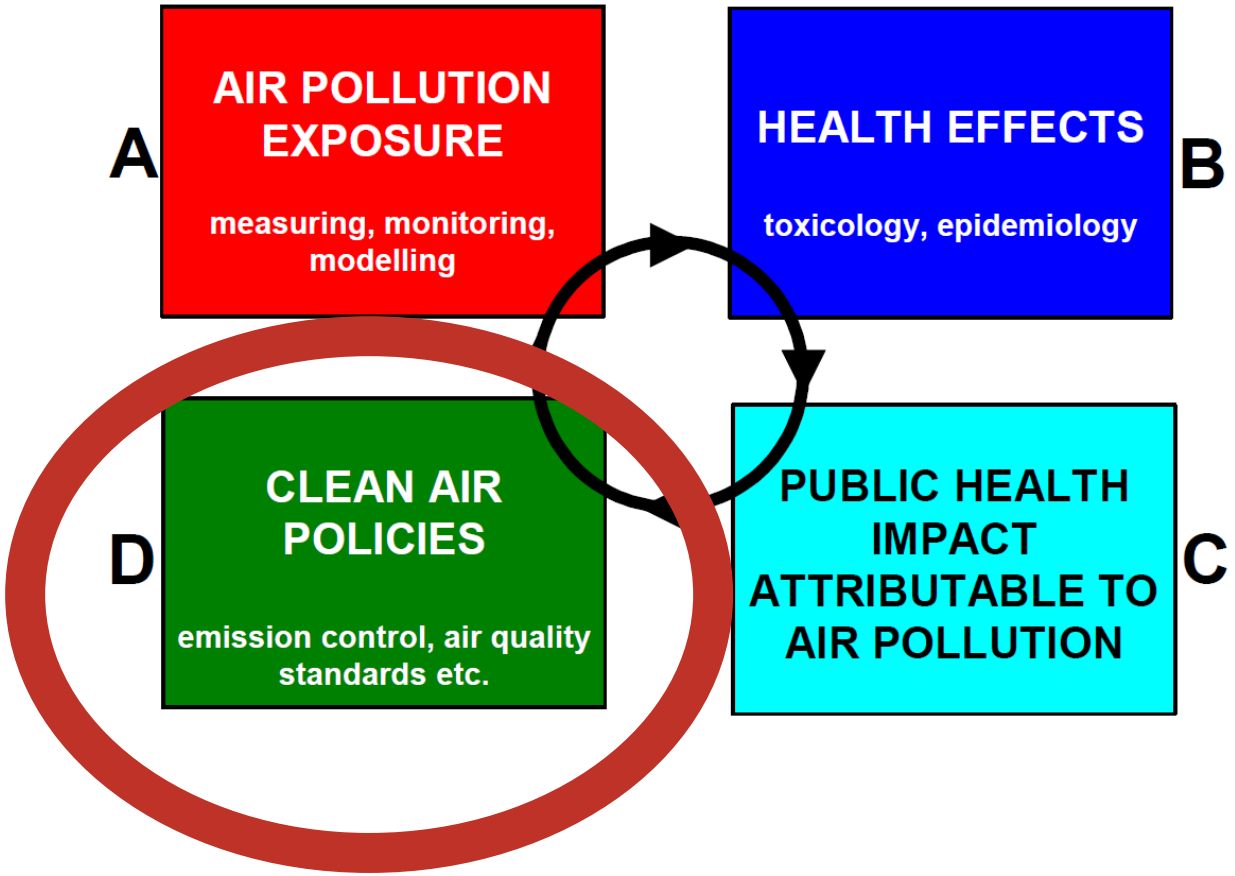
In Switzerland…
Life expectancy varies more strongly across socio-economic gradients than across contrasts in air pollution exposure



Based on: Moser et al. "What does your neighbourhood say about you? A study of life expectancy in 1.3 million Swiss Neighbourhoods». J Epidemiol Community Health 2014;68

Science Based Clean Air Policy Making

The Environmental Health Policy Cycle



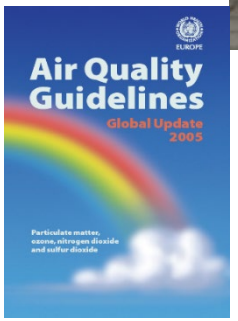
Künzli & Perez Swiss Med Wkly 2009

4 relevant pillars of Clean Air Policy Making

1. Fuel quality standards

2. EMISSION standards
   (= regulation of SOURCES)

3. AMBIENT AIR QUALITY STANDARDS



4. Clean Air Management Plans and controls / monitoring

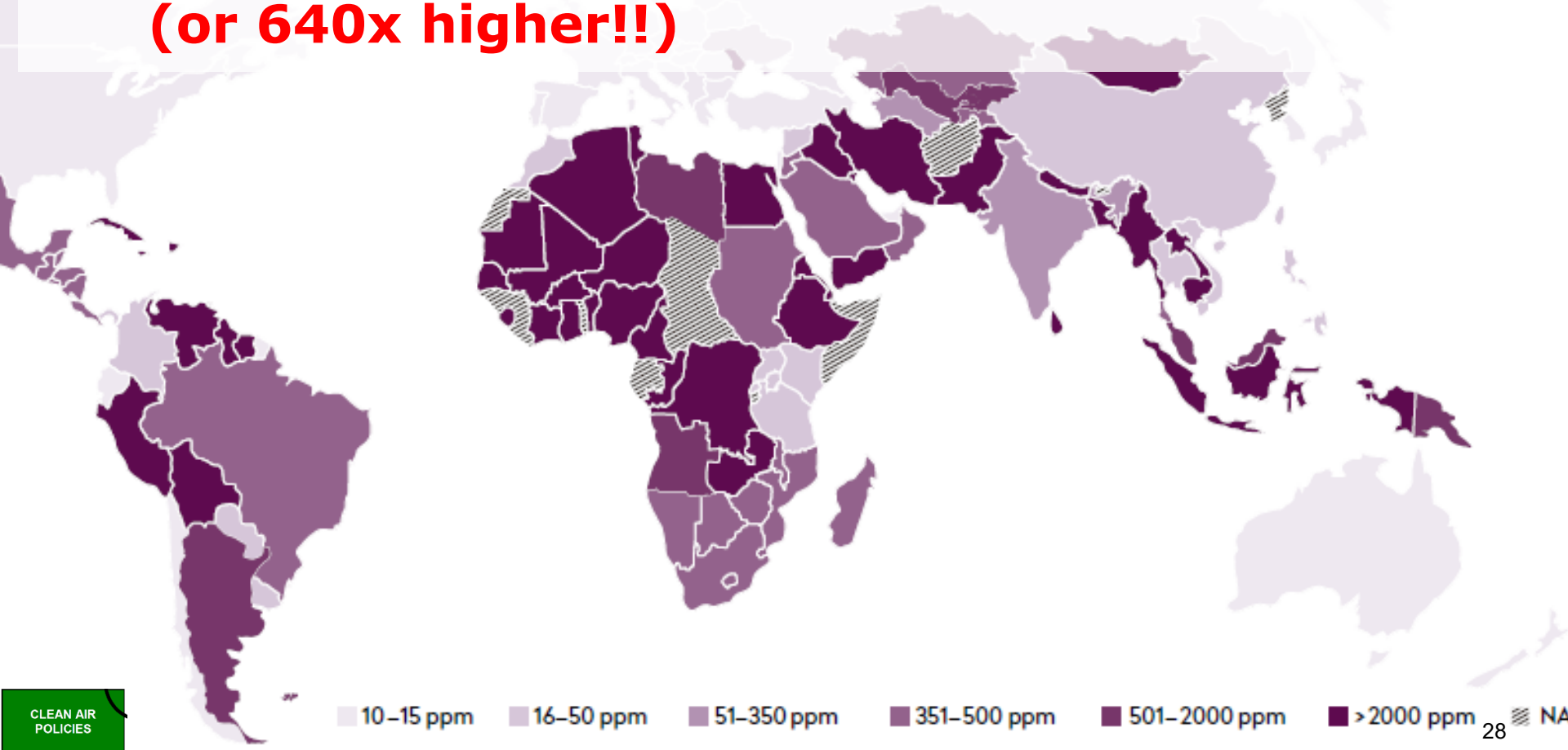
Unequal sulfur standards have devastating effects in Africa

An investigation of PublicEye (Swiss NGO)

Sulfur content in DIESEL:

- **Switzerland: 5 ppm**
- **«African quality», up to 3'800 ppm – delivered by Swiss traders**

(or 640x higher!!)



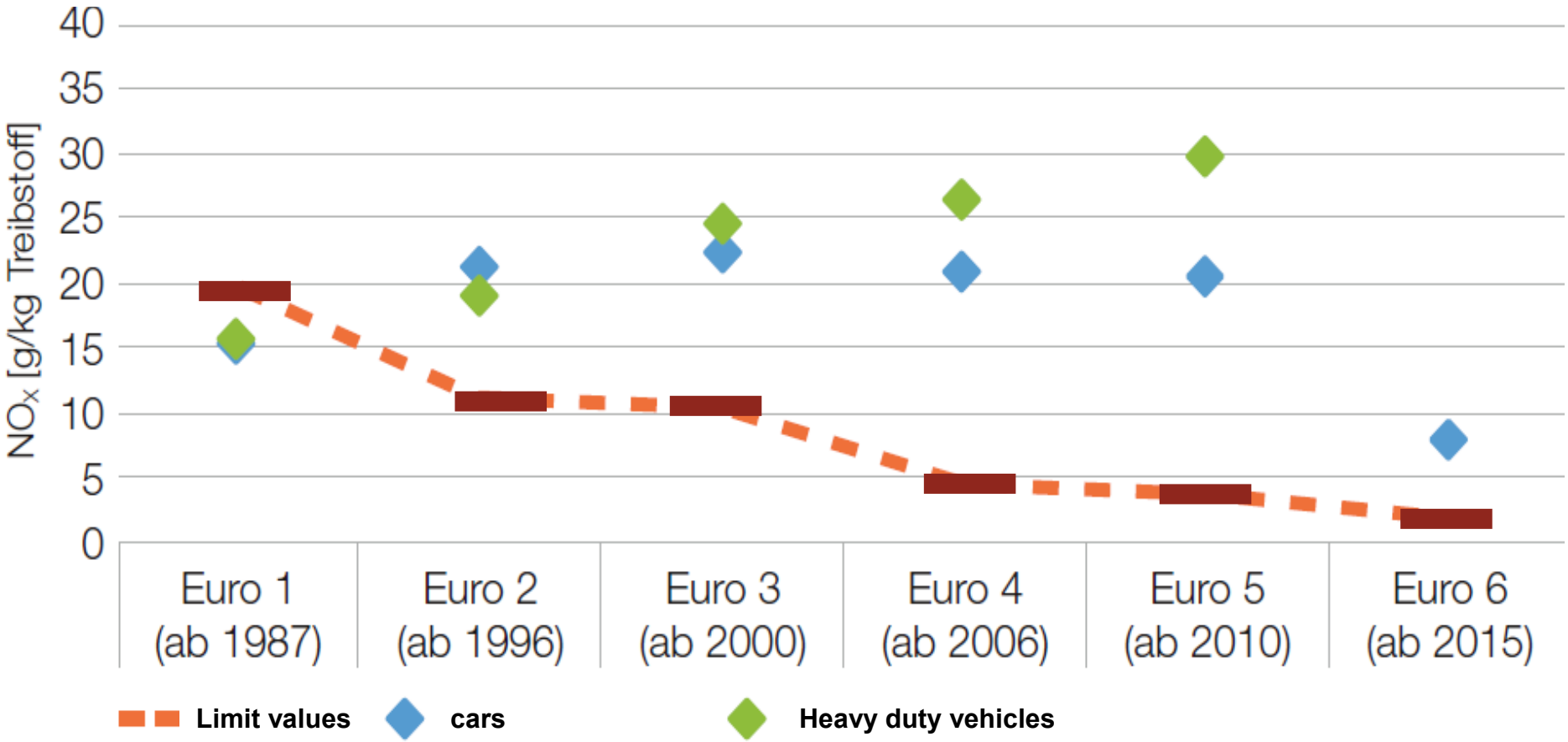
CLEAN AIR POLICIES

emission control, air quality standards etc.

Real NO_x-Emissions of diesel vehicles did not decline despite more restrictive policies...

Measurement data of Environmental agency AWEL, Zürich County

Diesel cars: NOx-Emissions, Euro 1 to Euro 6



CLEAN AIR POLICIES
emission control, air quality standards etc.

Air Quality Standards (annual means) for PM_{10} and $PM_{2.5}$ (in $\mu g/m^3$)

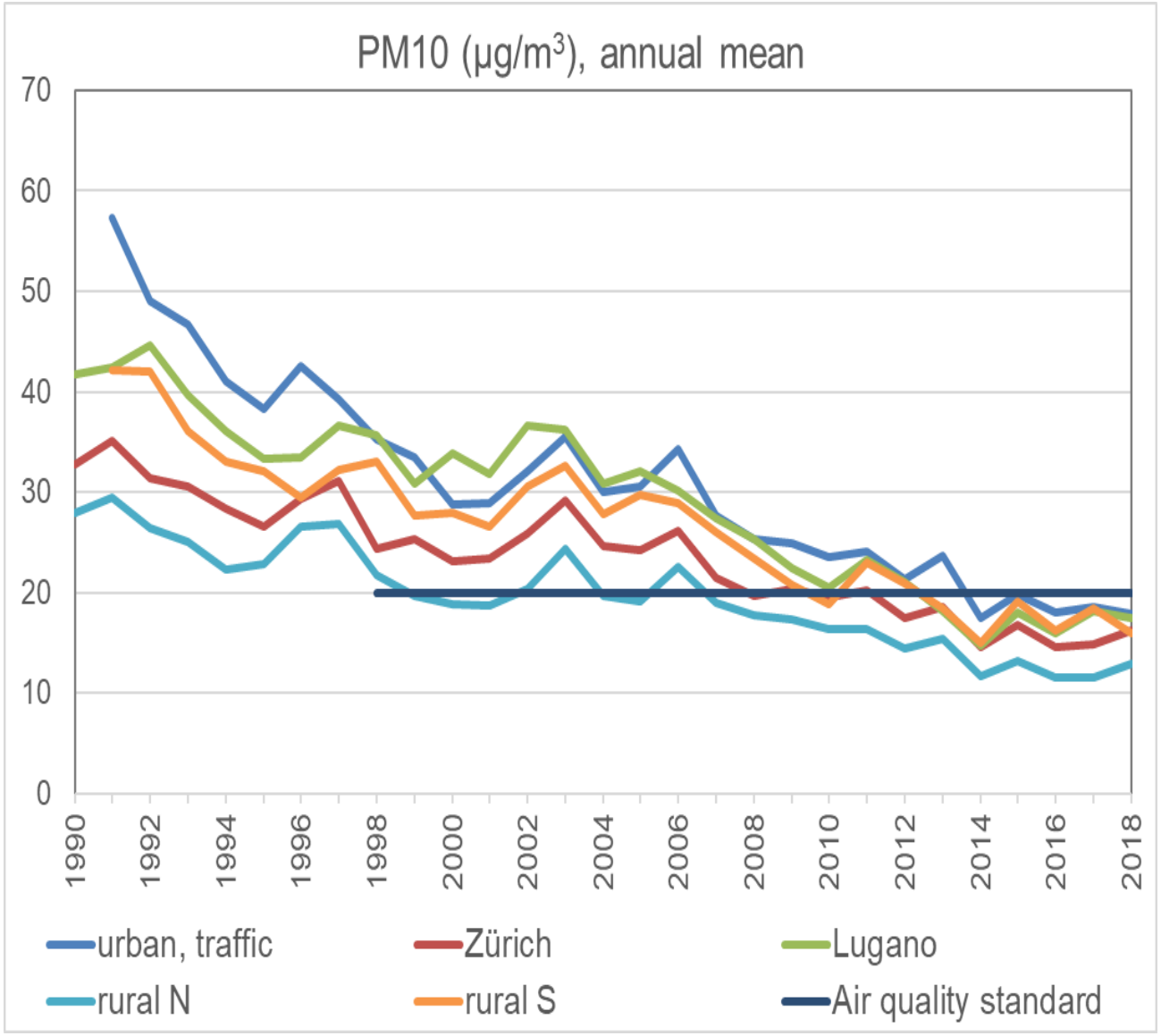
Science-based health oriented limit values

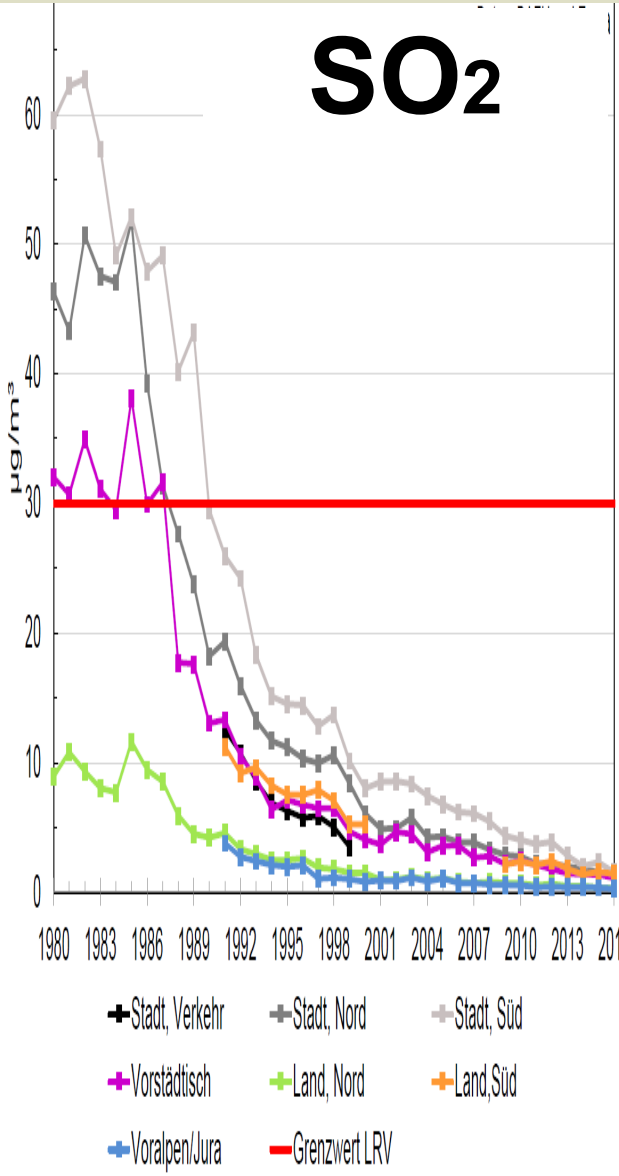
Politically defined values
No protection of public health

	WHO Guide-line Value	Afghanistan, Cameroon, Iceland, Iran, Australia Malawi, Switzerland, UK	State of California	U.S.A. Federal; Mexico	E.U.
PM_{10} Annual mean	**20**	**20**	**20**	**--**	**40**
$PM_{2.5}$ Annual mean	**10**	**10 (AUST: 8)**	**12**	**12**	**25**

Success of clean air policy making

Switzerland – 1990 – 2018



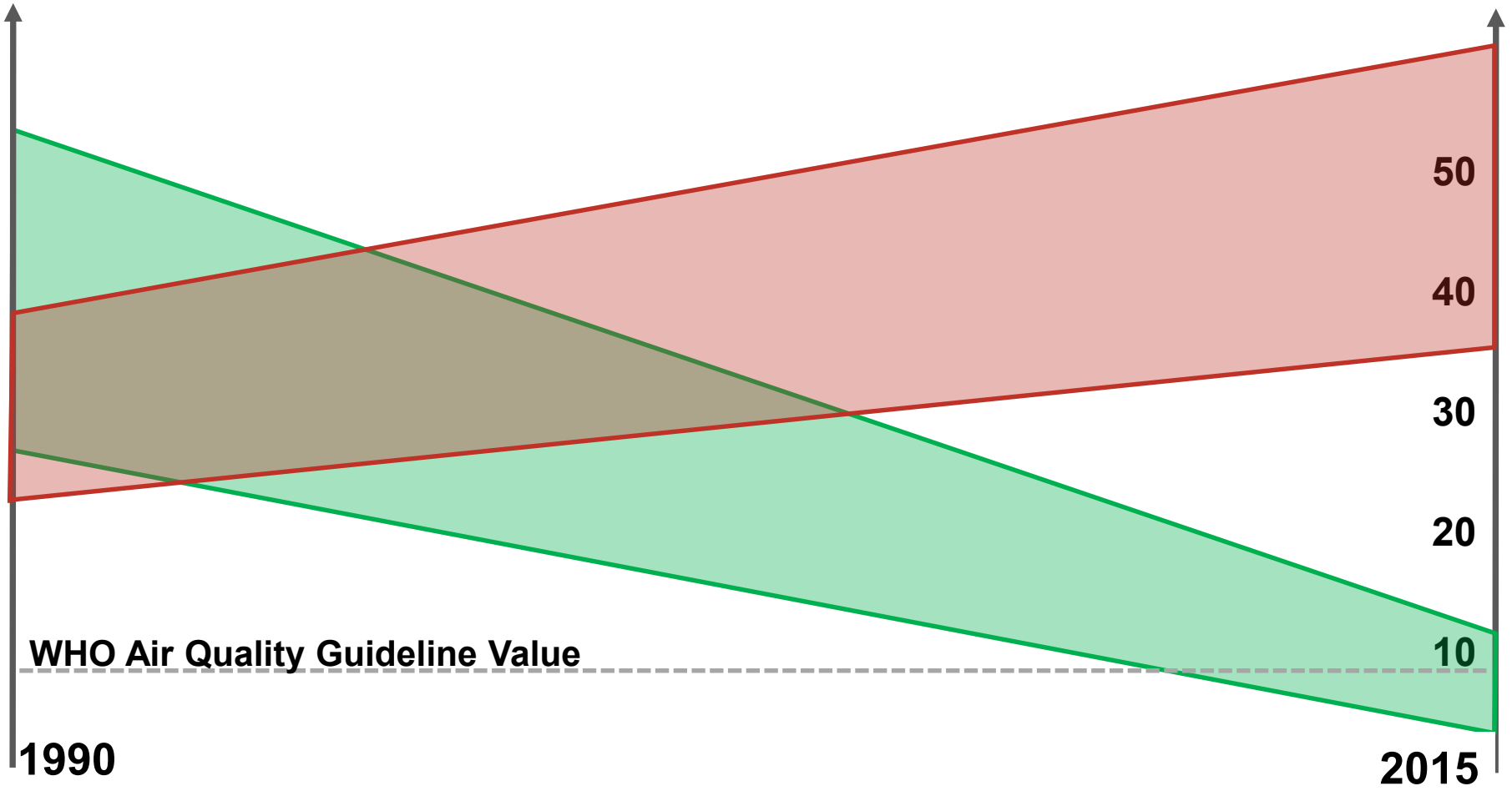


CLEAN AIR POLICIES

emission control, air quality standards etc.

Dissociated trends in air quality (annual means of $PM_{2.5}$) in the West and in Asia and Africa 1990 – 2015

Adapted from Brauer et al ES&T2016



CLEAN AIR POLICIES

emission control, air quality standards etc.

Swiss TPH

ARD Home Nachrichten Sport Börse Ratgeber Wissen Kultur Kinder Die ARD **Fernsehen** **Radio** **ARD Mediathek**

Das Erste

Suche im E

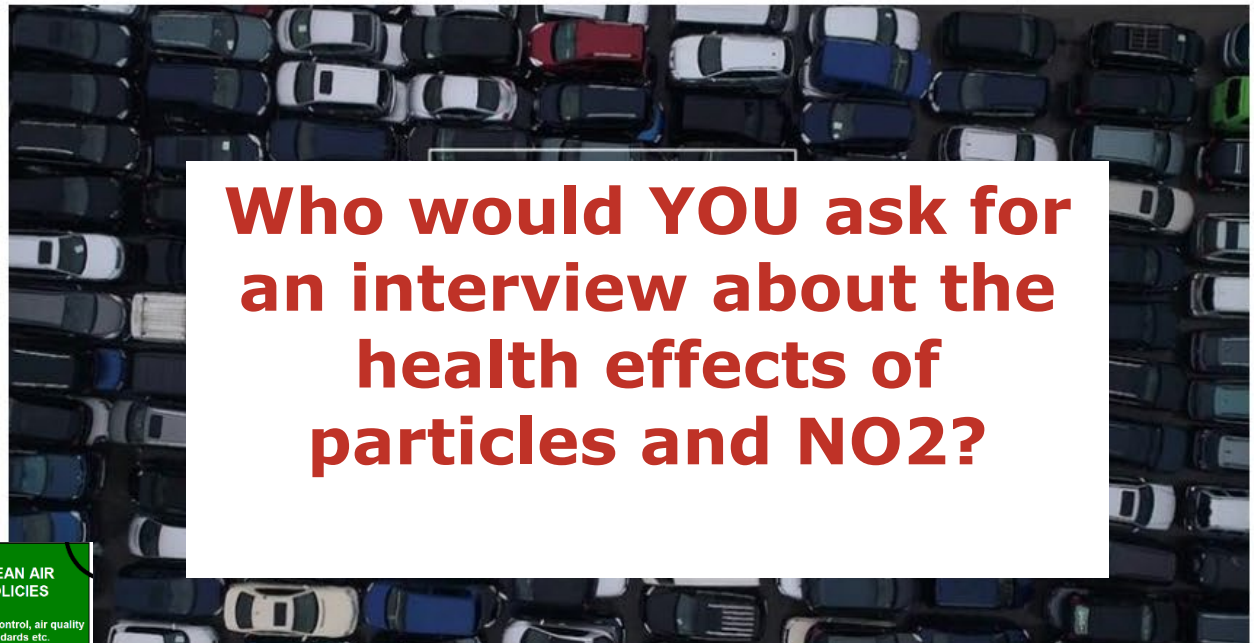
Startseite **Sendungen** TV-Programm Live Mediathek Teletext Service Über uns

Reportage & Dokumentation

Mo 7.1.2019 21:45

Startseite Sendungsübersicht Vorschau Videos Kontakt

Exclusiv im Ersten: Das Diesel-Desaster



Who would YOU ask for an interview about the health effects of particles and NO2?

Sendetermin

Mo, 07.01.19 | 21:45 Uhr
Das Erste

ANDERE SENDUNGEN

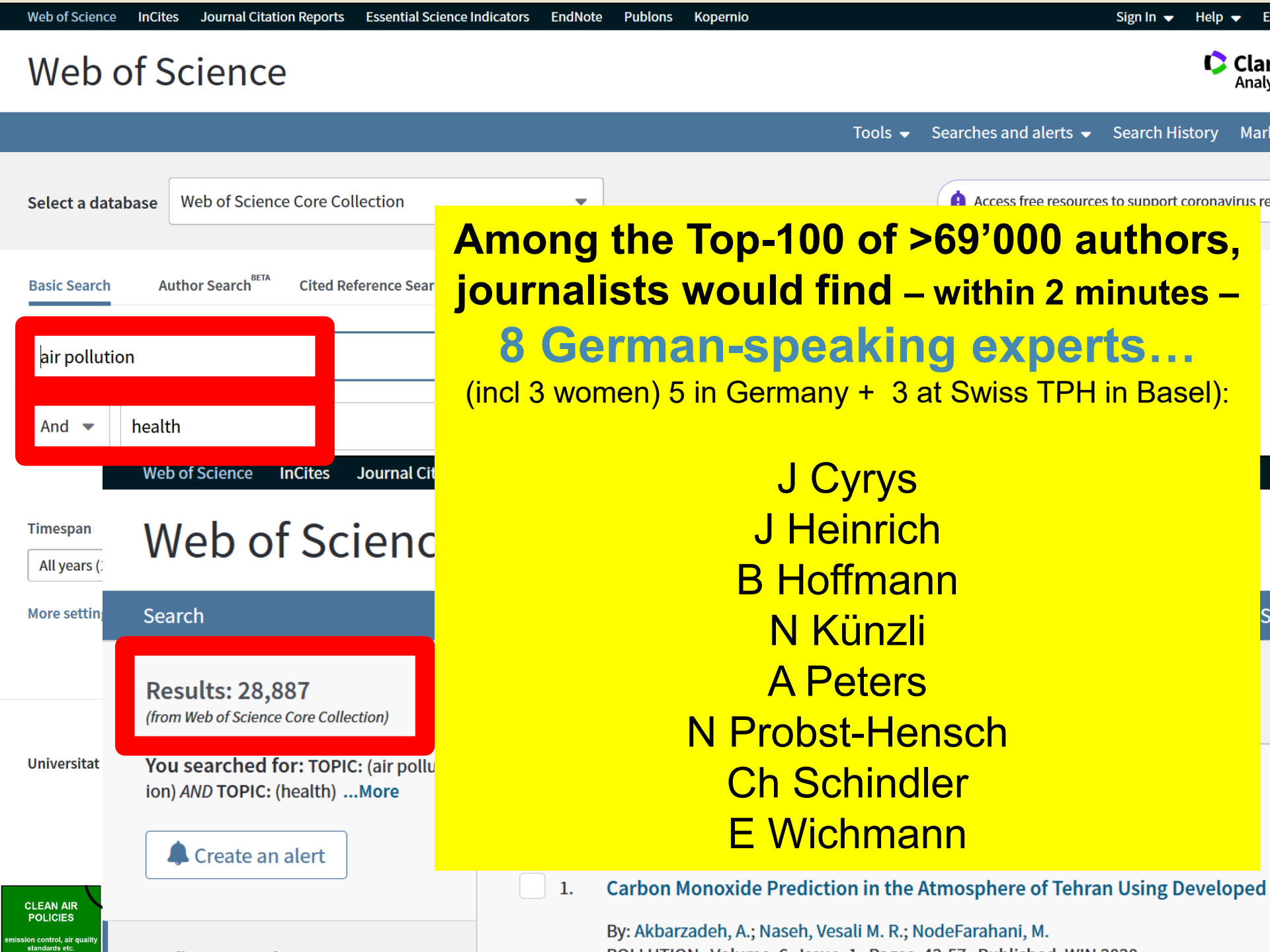
< VORHERIGE | NÄCHST

ALLE SENDUNGEN

MEHR ZUM THEMA

CLEAN AIR POLICIES

emission control, air quality standards etc.


Web of Science InCites Journal Citation Reports Essential Science Indicators EndNote Publons Kopernio
Sign In Help
Web of Science
Tools Searches and alerts Search History
Select a database
Web of Science Core Collection
Basic Search
Author Search BETA
air pollution
And
health
Timespan
Search
Results: 28,887
(from Web of Science Core Collection)
You searched for: TOPIC: (air pollu
ion) AND TOPIC: (health) ...More
Create an alert
Among the Top-100 of >69'000 authors,
journalists would find – within 2 minutes –
8 German-speaking experts…
(incl 3 women) 5 in Germany + 3 at Swiss TPH in Basel):
J Cyrys
J Heinrich
B Hoffmann
N Künzli
A Peters
N Probst-Hensch
Ch Schindler
E Wichmann
1. Carbon Monoxide Prediction in the Atmosphere of Tehran Using Developed
By: Akbarzadeh, A.; Naseh, Vesali M. R.; NodeFarahani, M.
CLEAN AIR POLICIES
emission control, air quality standards etc.

…but ARD features «Fake experts»

Leading journalists: Thomas Berbner & Torben Börgers

- demagogic populists
- no research record at all
- scientifically illiterate
- unethical call for lifting air quality standards

Prof. emeritus Dr. med. Dieter Köhler

Prof. Dr. med. Martin Hetzel

CLEAN AIR POLICIES

emission control, air quality standards etc.

U.S. Environmental Protection Agency (EPA) Acting Administrator Andrew Wheeler
Former pro-fossil-fuel & coal lobbiest

Swiss TPH

March 2020, Vol 110, No. 3 AJPH

Dockery and Pope **Editorial** 287

The Threat to Air Pollution Health Studies Behind the Environmental Protection Agency's Cloak of Science Transparency

Science

Cite as: H. H. Thorp, M. Skipper, V. Kiermer, M. Berenbaum, D. Sweet, R. Horton, *Science* 10.1126/science.aba3197 (2019).

Joint statement on EPA proposed rule and public availability of data (2019)

H. Holden Thorp[1]*, Magdalena Skipper[2], Veronique Kiermer[3], May Berenbaum[4], Deborah Sweet[5], Richard Horton

Don't abandon evidence and process on air pollution policy

Gretchen T. Goldman[1] *and* Francesca Dominici[2]

Science 10.1126/science.aaw9460 (2019)

CLEAN AIR POLICIES
emission control, air quality standards etc.

Nature, April 2019

POLICY

Pollution rules under siege at US environment agency

Adviser attacks EPA decision-making ahead of major review of air-pollution standards.

BY JEFF TOLLEFSON

research. The head of CASAC, Tony Cox, is towards the link between particulate poll

Lessons learned

- Air pollution is ubiquitous (although concentrations are very low in Switzerland).
- Air pollution affects peoples health in the short and long-term
- The air pollution related burden of disease and death is substantial and particularly large and costly in the global south.
- Solutions are available, effective, sustainable and should be enforced, globally
- Science-based public health policies are opposed by interest groups…
- The use of fake "experts" , (retired) demagogues and "pseudo-science" has become a more frequent phenomenon
  → be prepared !

Suggested readings I

REVIEWS

Thurston GD, Kipen H, Annesi-Maesano I, Balmes J, Brook RD, Cromar K, De Matteis S, Forastiere F, Forsberg B, Frampton M, Grigg J, Heederik A, Kelly FJ, **Künzli N**, Laumbach R, Peters A, Rajagopalan ST, Rich D, Ritz B, Samet JM, Sandstrom T, Sigsgaard T, Sunyer J, Brunekreef B. A joint ERS/ATS policy statement: what constitutes an adverse health effect of air pollution? An analytical framework. *Eur Respir J*. 2017;49:1600419. DOI: 10.1183/13993003.00419-2016

Ohlwein S, **Kappeler R**, **Kutlar Joss M**, **Künzli N**, Hoffmann B. Health effects of ultrafine particles: a systematic literature review update of epidemiological evidence. *Int J Public Health*. 2019;64(4):547-559. DOI: 10.1007/s00038-019-01202-7

Künzli N, **Perez L**. Evidence based public health - the example of air pollution. *Swiss Med Wkly*. 2009;139(17-18):242-250

Exposure modelling:

Eeftens M, **Meier R**, **Schindler C**, **Aguilera I**, **Phuleria H**, **Ineichen A**, **Davey M**, **Ducret-Stich R**, **Keidel D**, **Probst-Hensch N**, **Künzli N**, **Tsai MY**. Development of land use regression models for nitrogen dioxide, ultrafine particles, lung deposited surface area, and four other markers of particulate matter pollution in the Swiss SAPALDIA regions. *Environ Health*. 2016;15:53. DOI: 10.1186/s12940-016-0137-9

Chen J, **de Hoogh K**, Gulliver J, Hoffmann B, Hertel O, Ketzel M, Bauwelinck M, van Donkelaar A, Hvidtfeldt UA, Katsouyanni K, Janssen NAH, Martin RV, Samoli E, Schwartz PE, Stafoggia M, Bellander T, Strak M, Wolf K, **Vienneau D**, Vermeulen R, Brunekreef B, Hoek G. A comparison of linear regression, regularization, and machine learning algorithms to develop Europe-wide spatial models of fine particles and nitrogen dioxide. *Environ Int*. 2019;130:104934. DOI: 10.1016/j.envint.2019.104934

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AIR POLLUTION REALTED BURDEN OF DISEASE

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