DETECTING AND CONFIRMING PUBLIC HEALTH IMPACTS IN AREAS OF THE ENVIRONMENT THAT ARE UNACCEPTABLY HAZARDOUS

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Article 42 of the Russian Federal Constitution guarantees the right of everyone:

to a healthy environment

to having full access to reliable information on the current state of the environment

to compensation for damages caused either to health or to property from violations of environmental laws

«… **DAMAGES (or IMPACTS)** on public health can be construed as any harm done to the anatomical integrity or physiological function of human organs or tissues as a result of exposure to any physical, chemical, biological, psychogenic, or other environmental factors …»

Resolution of the Russian Federal Government dated 17 August, 2007 N522, entitled: "On the approval of rules for determining the severity of public health impacts"

The criteria for measuring the severity of impact

Light	Moderate	Severe
This includes: any temporary impairment of the functions of either body organs or body systems that persists up to 3 weeks in time, or any general disability that can be considered as less than 10% of impairment.	This includes: any temporary impairment of the functions of either body organs or body systems that persists more than 3 weeks, or any general disability that falls between an impairment level of 10% to 30%.	This includes: any acute cardiac and/or vascular failure that is severe in nature; or any severe degree of blood flow restriction to the brain; or any acute or severe respiratory failure; or any acute restriction of blood flow to any part of the body or internal organs; or any acute instances of poisoning.

- **Cited from Articles 11.5, 12.2 and other sections within the Russian Federal Code of Administrative Laws and Violations…**

- **and from orders issued by the Ministry of Public Health, April 24, 2008 N 194n**

- **and from Articles 111, 112, 113, etc. of the Russian Federal Criminal Code**

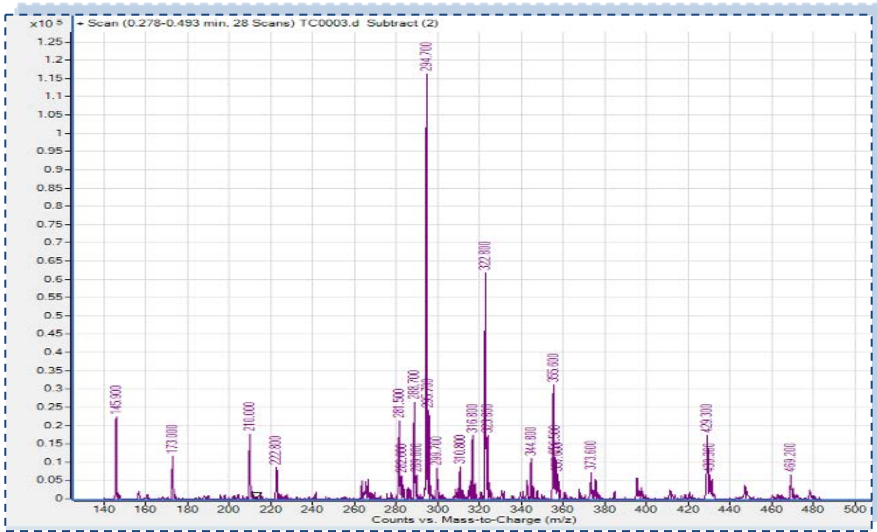
Russian Federal legislation that deals with establishing and proving public health impacts include:

- The Russian Federal Civil Code (part II) dated Jan. 26, 1996, N14-F3 (art. 1064);
- Russian Federal Code of Administrative Laws and Violations, dated Dec. 30, 2001 N 195-F3 (6.17, 14.43, 14.44, 14.46);
- Russian Federal Criminal Code, dated June 13, 1996 N 63-F3 (Articles 236, 238, chapter 26);
- Russian Federal Law dated Feb 7, 1992 N 2300-1 entitled: “On the Protection of Consumer Rights” (Art. 14)
- Russian Federal Law dated Mar 30, 1999 N 52-F3 entitled «On the Sanitary and Epidemiological Welfare of Human Populations» (Art. 57);
- Russian Federal Law dated May 4, 1999 N96-F3 entitled: “On the Protection of Air and Atmospheric Resources” (Art. 32);
- Russian Federal Law dated Jan 10, 2002 N 7-F3 entitled: «On Protecting the Environment» (Art. 79);
- Russian Federal Law dated Dec 27, 2002 N184-F3 entitled: «On the Regulation of Technologies» (Art. 36).

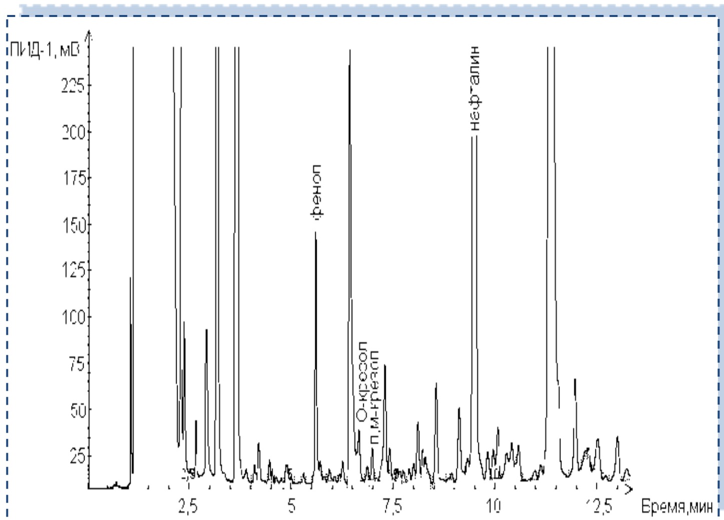
Note: The collection of evidence that confirms injury or harm due to exposure to any environmental factors is to be performed through various expert ecological and public health or epidemiological investigations and studies.

Systems of Biological Monitoring can help detect human contact with hazardous materials

Modern methods of gas and liquid chromatography, atomic-absorption spectrophotometry, and chromato-mass spectrometry make it possible to identify and quantify specific particulates in blood, urine, breast milk, hair, and bile for **more than 150 chemical substances,** as well as many of their metabolites **(this includes heavy metals, aromatic and aliphatic hydrocarbons, alcohol compounds, aldehydes, ketones, pesticides, dioxins, etc.)**



Mass spectrum of a group of aliphatic hydrocarbons and their derivatives in blood



Chromatogram of a sample of blood, comprised of phenols, o-cresols, p- and m- cresols, with an internal standard measurement of naphthalene

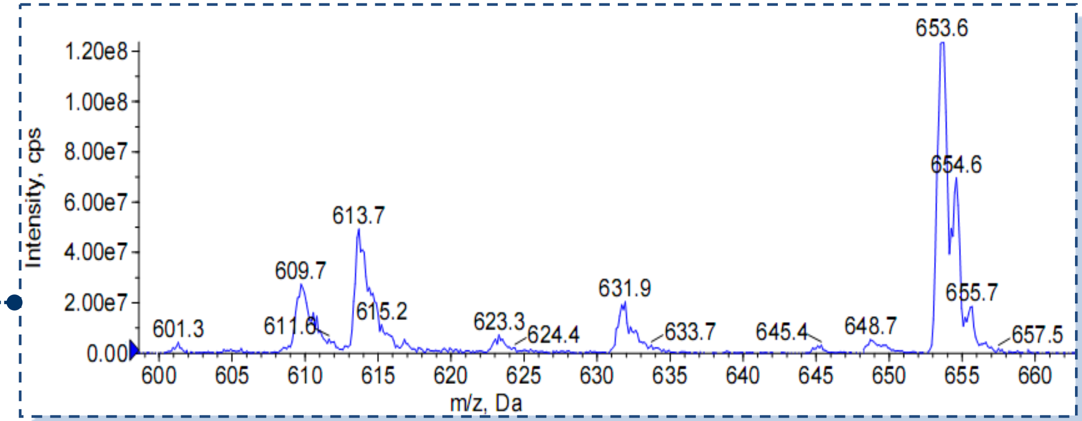
Many markers that show possible exposure can be based on normal background levels as a criterion for proving health impacts.

Chemical substance	Blood levels, in mg/dm^3	Levels in urine samples, mg/dm^3
Phenol	0.057 ±0.017	0.280 ±0.146
Formaldehyde	0.005 ±0.0014	0.004 ±0.0009
Acetaldehyde	0.077 ±0.009	0.068 ±0.009
Butyraldehyde	0	0
Propionaldehyde	0	0
Methyl alcohol	0.369 ±0.117	1.251 ±0.294
Ethyl alcohol	0.605 ±0.103	0
Isopropyl alcohol	0.610 ±0.07	1.080 ±0.044
Manganese	0.0194 ±0.0015	0.0163 ±0.003
Copper	1.059 ±0.0332	0.038 ±0.0027
Magnesium	33.25 ±2.8656	35.75 ±15.082
Nickel	0.2299 ±0.0203	0.160 ±0.013
Lead	0.1326 ±0.0071	0.109 ±0.015

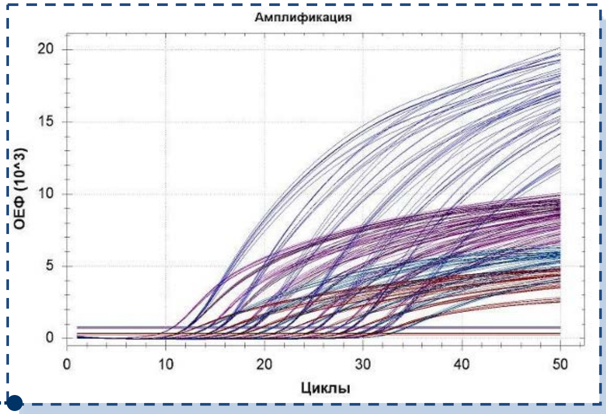
Samples taken in Perm and the Bashkiria Republic

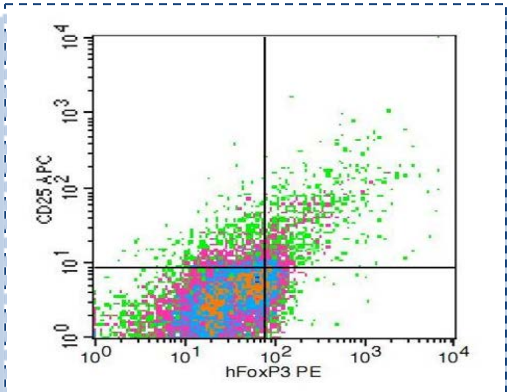
By identifying markers of response in proven association with markers of exposure, it is possible to detect the effects of various factors (this includes varied levels of proteomes, cell apoptosis, changes in metabolic processes, and other anomalies—all of which can predict somatic and/or reproductive pathologies).

Detailed mass-spectrum of peptides from a plasma sample taken from a child in our region, 58.1-58.7 min.



Phenotypes and genotypes with flow cytometry & polymerase chain reaction (PCR), as taken in real time

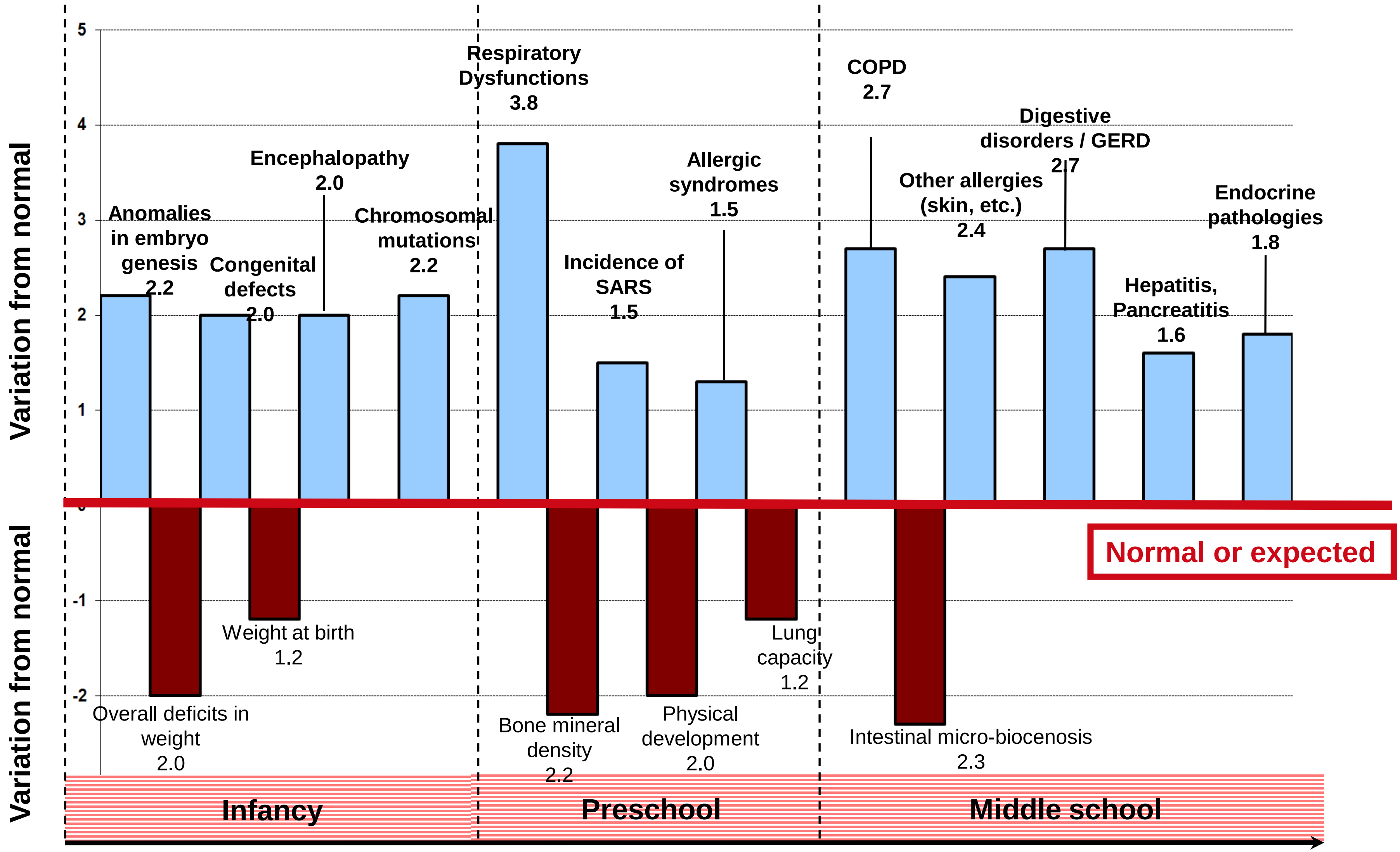




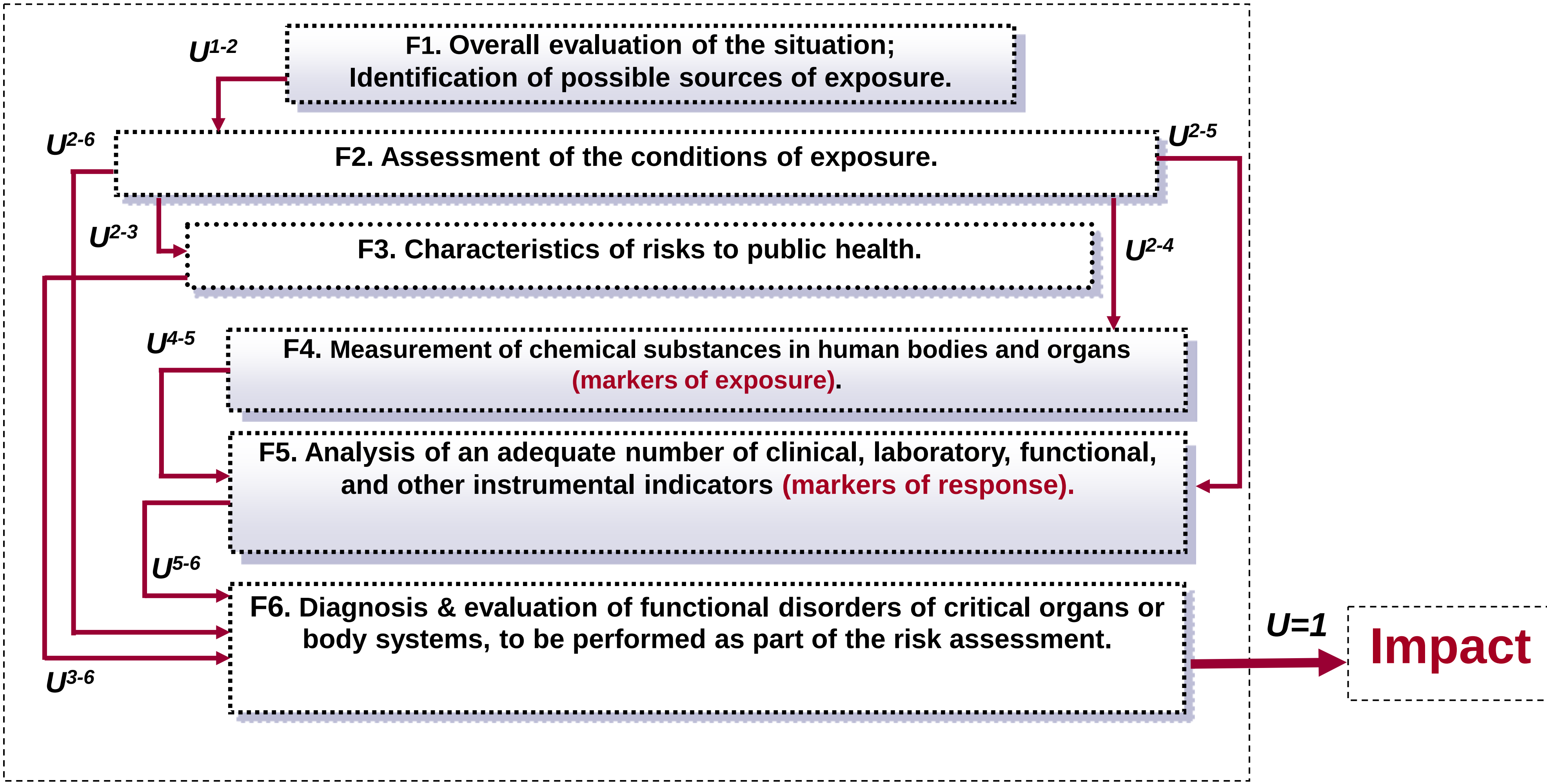
Markers of response may be bio-chemical, cytogenetic, immunological or molecular-genetic, amongst other types of markers:

Exposure	Markers of exposure (blood)	Markers of effect	
Manganese, Nickel, Chromium, Formaldehyde, Vanadium, Phenol, Chloroform	Mn in blood; Ni in blood; Cr in blood; Formaldehyde in blood; V in blood, etc.	Immunological	• Indicators of apoptotic variations (CD25+, CD95+, CD4+ etc.) • Markers of sensitization (CD4+, CD16+/56+, CD25+, Treg) • Cytokines (IL1-β, IL-6, IL-8, INF-γ etc.) • Specific levels of Immunoglobulin E or IgE • Leukotrienes LTC4/D4/E4
Formaldehyde, (Benzo)-pyrenes, Nickel, Styrols	Formaldehyde in blood; Ni in blood;	Genetic	• Disorder of enzymes & detoxification system • Genes involved in pathogenesis or techno-genic disorders in target organs • Condition of genes—components of immune response (CYP1A1, MTHFR, APO-E, etc.)
Phenol, Formaldehyde, Manganese, Copper, Lead, Chromium, Nickel	Phenol in blood; Formaldehyde in blood; Mn in blood; Cr in blood, etc.	Bio-chemical	• Indicators of poor oxidative metabolism • (MDA, AOA, Cu/Zn-SOD, etc.) • Changes in proteome profiles in plasma • Indicators of disorders in bone metabolism
Benzene, Toluene, Lead	Benzene in blood, Toluene in blood, Pb in blood.	Clinical-laboratory	Indicators of poor bone-marrow blood-cell formation (red blood cells, anisocytosis, anisochromia, reticulocytes)

A full array of response markers, in combination with results from clinical studies, make it possible to verify that a certain disease or disorder may be connected to a specific exposure



Proving that there has been harm to public health from ambient contamination should involve a full battery of studies



M.U. Jan. 2, 2010 3165-14 "Procedures for implementing the results of bio-medical research in detecting damage to public health from the impacts of chemicals that are released into our environment"

Basic principles for providing evidence of damage to public health due to negative external factors

- Exposure must precede health impacts or effects;
- The effects should be evidenced in a group of several (or many) population members;
- The effects should also be dependent on degree of exposure;
- The effects are sustained or repeated;
- A plausible biological connection must be made between “exposure and effect”;
- There are no other possible explanations for the manifestation of the effects on health.

$$\mathbf{U} = \sum_{i=1}^{N_\phi} \mathbf{U}_i^{1-2} \cdot \left(\sum_{j=1}^{N_{\text{заб}}} \mathbf{U}_{ij}^{2-6} + \mathbf{U}_i^{2-3} \sum_{j=1}^{N_{\text{заб}}} \mathbf{U}_{ij}^{3-6} + \left(\sum_{k=1}^{N_{\text{кл}}} \mathbf{U}_{ik}^{2-5} + \mathbf{U}_i^{2-4} \sum_{k=1}^{N_{\text{кл}}} \mathbf{U}_{ik}^{4-5} \right) \sum_{j=1}^{N_{\text{заб}}} \mathbf{U}_{kj}^{5-6} \right)$$

***U* - connection between individual elements in the form of logical variables**
***U* = log. 1 «Correct»**
***U* = log. 0 «Incorrect»**

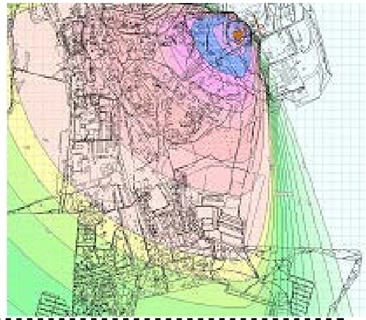
Any impact on public health that can be reliably connected to external factors should be considered fully proved only if the logical sequence of variables will lead to a “Correct” finding in which a continuous chain of cause and effect is established all the way from exposure to the evidence of an actual impact on public health.

How public health impacts were detected in the town of Kungur

Source of hazard– oil spills and other releases of oil products. Culprit – Oil Service Industry Inc.

U = 1

After these releases, atmospheric contaminants were found to exceed maximum allowable limits for: benzene, toluene, ethyl benzene, phenol, formaldehyde.



U=1

Unacceptable risks to the respiratory, nervous, immune, and cardio-vascular systems were fully verified (risks were found to be 25% to 375% higher);

U = 1

Regional tests of children's blood showed that many (40-85%) of them exhibited much higher levels of impurities than in other regions (benzene, toluene, ethyl benzene, and formaldehyde, V<0.05). Some 30% of the tested children showed heightened levels for at least *three* of these contaminants.

U = 1

For these children it was found that their systems of cellular immunity, phagocytosis, and anti-oxidation were all in a state of collapse—while at the same time there was a marked increase in their IgE (Immunoglobulin E) from formaldehyde.

U = 1

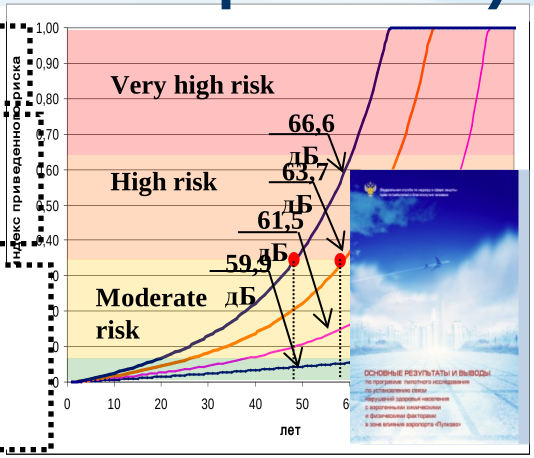
Exposed children also exhibited higher incidence of: 1) chronic pharyngitis and inflammation of the naso-pharanx, with hypertrophy of their lymph tissues; 2) allergic and chronic rhinitis (found in 40% of pre-schoolers and 21.7% grammar school students). There was also a prevalence of COPD and other breathing disorders (some 44% in all, 26% of which were found to be acute cases).

Impact!

The guilty party has begun implementing measures to reduce emissions thanks to a pre-trial order

U = 1, if a definite tie has been established (variance<0.05)

Impact assessment project on the neighbourhood around Pulkovo Airport (an example of the effects of noise pollution):



Source of hazard – airplane take-offs and landings.

U = 1

Year-after-year high levels of noise, sometimes equivalent to 67 decibels—and in an area with **180 thousand local residents.**

U=1

For the last 47 years the noise pollution here has imposed an unacceptable level of risk, with impacts on the nervous systems and sensory organs of local inhabitants **(while there is no equivalent risk to people living outside this zone).**

U = 1

In-depth audiometric studies have found that in the area of the heaviest acoustic impact the local children have suffered from a marked **loss of hearing (where the noise commonly reaches 7db)**

U = 1

The final diagnoses on **«neurosensory hearing loss»** shows an impact amongst children in the area of highest sustained noise levels; and amongst adults who are 50 years are older, cases of severe loss of hearing have been shown to be some 100 times more common in this area than in areas further away from the airport.

U = 1

At the same time residents in the immediately affected area now exhibit a **much higher level of tolerance to aircraft noise**, thanks to the fact that they have lived in the area for such a long time.

Impact!

This situation requires a decision to clarify how far away residents should live from the airport

Experience shows us, that up **to 12% of all** those within groups that are tested for negative impacts actually suffer from a **whole series of problems.** This is one way in which results-driven medical testing can prove that various health impacts (and diseases) can be directly associated with concrete instances of environmental exposure.

Living in conditions of constant exposure → Exposure leads to risk (and manifestations of that risk become apparent) → There are markers of this exposure that are evident in local residents → And there are markers of response to this exposure

There are no other likely reasons for the resultant disorders in health → A diagnosis is delivered, saying that the evidence is adequate. **The impact is confirmed.**

Manner in which public health impacts can be revealed and confirmed for the inhabitants of Zakamensk (in the Buryat Republic)

Identifying the source of hazard (the waste piles from the Dzhidinski Tungsten-Molybdenum mine site and mill).

U = 1

Assessing public exposure to the specific source of the contaminants: Hg, Cd, Pb, Cr, Ni, Cu, Mn, Zn, As, Co, Mo, W, and other components of the mining waste site

U=1

Evaluating health risks to local habitants through possible manifestation of problems in the functions of critical body organs and other likely factors

U = 1

Identifying markers of exposure (through the careful study of the biological environment): Hg, Cd, Pb, Cr, Ni, Cu, Mn, Zn, As, Co, Mo, W (taking into account the criteria of regional comparisons)

U = 1

Identifying markers of response (through laboratory diagnostics): charting changes in hormonal profiles, or in the conditions allowing anti-oxidation, or in the patterns of phagocytosis, cellular immunities, and immuno-genetics, and the levels of IgE (immunoglobulin E) in relationship to heavy metals

U = 1

Mobile clinical research into the health status of children groups (including research into the somatic and embryo-formation systems, and into the physical development of each child; as well as evaluating the body functions and the levels of mental or emotional stress—all done with the participation of neurologists, endocrinologists, gastroenterologists, and other physicians). Research equipment to be used could include cardiographs, thyroid ultrasound, or instruments to test liver and kidney functions.

Impact?!

If it turns out that we can prove human health impacts in Zakamensk , then the local population must receive some form of compensation.

U = 1, if a definite tie has been established (variance<0.05)

Thank you for your time!