



REPORT ON VIRTUAL HEALTH REPOSITORY

Version 3
12.2018





Summary

Indoor air quality (IAQ) can be characterised by physical parameters (e.g., temperature, relative humidity, air exchange rate), chemical air pollutants (e.g., carbon dioxide, nitrogen dioxide, particulate matter, ozone, benzene, etc.) and biological agents (e.g., pollen, fungi). During the monitoring campaign 64 primary school buildings were investigated in Central Europe (Czech Republic, Hungary, Italy, Poland and Slovenia) where the concentration of the most important air pollutants as well as the physical parameters were monitored. Due to the complexity of this issue, a simple Indoor Health Index has been developed (i) to disseminate the results of the project among the public and stakeholders and (ii) to provide health relevant information about the IAQ.

The indoor health index applies benzene, formaldehyde and fine particulate matter (PM) as indoor pollutants; because for other pollutants there is not enough scientific based evidence available on how to develop categorization. In case the three main compounds the comfort and optimum ("healthy" and "moderate" category in IAQ) thresholds are set as follows:

benzene: 0-4.99 $\mu\text{g}/\text{m}^3$

formaldehyde: 0-19.9 $\mu\text{g}/\text{m}^3$

PM_{2.5}: 0-24.9 $\mu\text{g}/\text{m}^3$

An online platform called Virtual Health Repository is used for these purposes and it is available at <https://www.oki.hu/virtual-health-repository-vhr-general-overview>. Methodological related studies and the recent factsheet are available at <https://www.interreg-central.eu/Content.Node/InAirQ/InAirQ.html>. For more technical and methodological information please contact dr Tamás Szigeti at the National Public Health Center, Budapest.



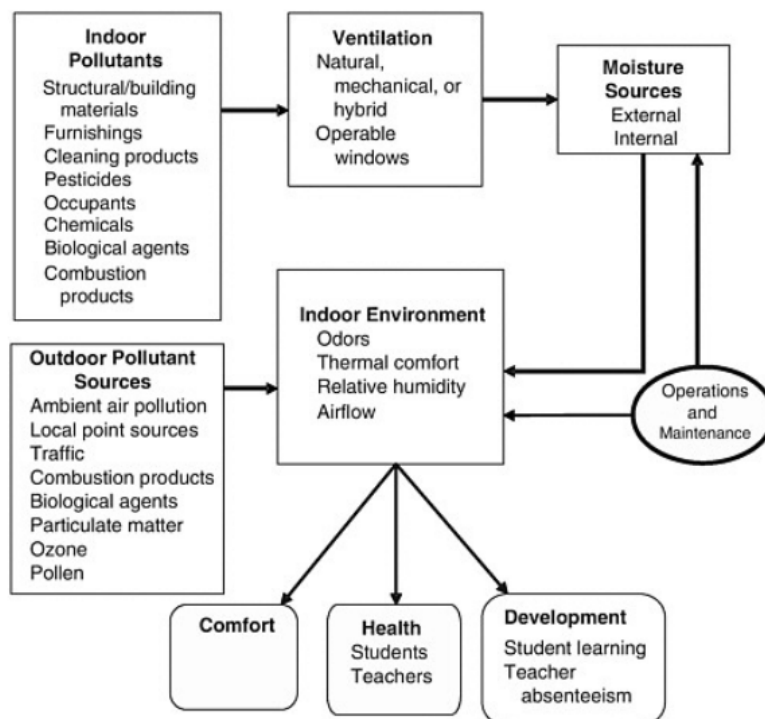
Indoor Health Index

Indoor air quality, which is a function of outdoor and indoor air pollutants, thermal comfort, and sensory loads (odors, “freshness”), can affect the health of children and adults and may affect student learning and teacher productivity.

Pollutants are generated from many sources. Outdoor pollutants include ozone, which has been associated with absenteeism among students. Pollutants and allergens in indoor air—mold, dust, pet dander, bacterial and fungal products, volatile organic compounds, and particulate matter—are associated with asthma and other respiratory symptoms and with a set of building-related symptoms (eye, nose, and throat irritations; headaches; fatigue; difficulty breathing; itching; and dry, irritated skin). In some cases, outdoor pollutants react with indoor chemicals to create new irritants.

As shown in Figure 1 the complex interactions between indoor and outdoor pollutants, moisture/humidity, HVAC systems, operations and maintenance practices can affect occupants’ health, comfort, and productivity.

Figure 1: Relationships between pollutants, moisture, and ventilation and human comfort, health, and development





The review of the methodologies to determine indoor air quality indices has been completed within the InAirQ project. In order to elaborate a simple, easily applicable method, we developed an Indoor Health Index.

The calculation of the Indoor Health Index is based on different threshold values determined by the health effects of the air pollutants/physical parameters (recommendations of the WHO and/or EC and/or scientific papers).

We applied a five scale categorization of the most important and frequent chemical air pollutants using for the cut off points. Based on the guidelines provided by the World Health Organization for indoor air pollutants, only benzene, formaldehyde and fine particulate matter were used. In other cases, there is not enough scientific based evidence available on how to develop categorization. The five-scale categorization is very common in the case of air quality indices developed for the communication of both indoor and outdoor air quality.

Table 1. The calculation of Indoor Health Index.

category	benzene ($\mu\text{g}/\text{m}^3$)	formaldehyde ($\mu\text{g}/\text{m}^3$)	PM _{2.5} ($\mu\text{g}/\text{m}^3$)
Healthy	<1.7	<10	<10
Moderate	1.7-4.99	10-19.9	10-24.9
Unhealthy	5-7.5	20-50	25-49.9
Very unhealthy	7.51-10	51-100	50-75
Dangerous	>10	>100	>75

When applying the index in practice we characterize the actual air quality according to the worst category, indicating the pollutant.

The database in which the Indoor Health Index has been calculated is available upon request.

To characterize the thermal comfort, different cut-off points for two physical parameters, temperature and relative humidity, as well as for the concentration of carbon dioxide have been set (Table 2).



Table 2: Categories based on the measured temperature, relative humidity and carbon dioxide concentration values

Category	RH (%)	T (°C)	CO ₂ (ppm)
Healthy	43<RH<67	18.5<T<25.5	<1200
Moderate	37<RH<43; 67<RH<73	17.5<T<18.5	1200-1800
Unhealthy	RH<37 RH>73	T<17.5 T>25.5	>1800

Virtual Health Repository

The Virtual Health Repository is an online platform which consists of two items: (i) the description of the method for the calculation of the Indoor Health Index based on the IAQ data as well as (ii) the description of the IAQ results for all primary school buildings participated in the monitoring campaign. Only the building IDs are listed in the VHR, thus it is not possible to identify the schools by the readers. Besides the Index calculated for the school, some IAQ-relevant properties of the school environment (e.g., location, traffic density, renovation works) are listed. Furthermore, it is noted that the inappropriate indoor air quality is caused by either the outdoor air pollution or the indoor sources of air pollutants are responsible for the problem. The measured values are also listed in summary tables for all schools.

The National Public Health Center (NPHC) calculated the Indoor Health Index values and prepared the online platform. All project partners provided input to the description of the school environment. Examples are provided in Figure 2. The VHR can be updated by the NPHC once new IAQ data are collected.



InAirQ – Virtual Health Repository (VHR)

[About us](#)

[Virtual Health Repository - general overview](#)

[VHR](#)

[VHR - Czech Republic](#)

[VHR - Hungary](#)

[VHR - Italy](#)

[VHR - Poland](#)

[VHR - Slovenia](#)

[Transnational Environment Quality Forum](#)

VHR - Czech Republic

Number of school buildings investigated: 12

CZ01

is located in the residential area of the northwest quadrant of the city center of Prague. The road is characterized by moderate traffic density close to the school. The school building type is panel and it was built in the middle of the 20th century. The building's electrical wirings, lightings and windows have been reconstructed in the past five years. The capacity of the school is 660 pupils. The indoor air quality was in the unhealthy category based on the indoor health index. The main air pollutant was the particulate matter (PM_{2.5}). It should be noted that the outdoor value for the PM_{2.5} mass concentration was also high, thus the inappropriate indoor air quality was mainly caused by the outdoor air pollution. Furthermore, one of the comfort parameters was in the moderate range, the carbon dioxide concentration was relatively high in the classroom.

CZ02

is located in the residential area of the northwest quadrant of the city center of Prague, close to a relatively high traffic road. The school building was built from brick at the beginning of the 20th century. The whole building was reconstructed in 2000. The building's insulations, windows and water mains have been reconstructed in the past five years. The capacity of the school is 450 pupils. The indoor air quality was in the moderate category based on the indoor health index. The main air pollutant was the particulate matter (PM_{2.5}). Furthermore, one of the comfort parameters was in the unhealthy range; the relative humidity was low in the classroom.

CZ03

is located in the residential area of the northwest quadrant of the city center of Prague, close to a relatively high traffic road. The school building type is panel and it was built in the middle of the 20th

InAirQ – Virtual Health Repository (VHR)

[About us](#)

[Virtual Health Repository - general overview](#)

[VHR](#)

[VHR - Czech Republic](#)

[VHR - Hungary](#)

[VHR - Italy](#)

[VHR - Poland](#)

[VHR - Slovenia](#)

[Transnational Environment Quality Forum](#)

VHR - Hungary

Number of school buildings investigated: 16

HU01

is located in the city centre of Várpalota, close to a relatively high traffic road. The school building was built from brick at the beginning of the 18th century. The indoor air quality was in the unhealthy category based on the indoor health index. The main air pollutants were benzene and particulate matter (PM_{2.5}). It should be noted that the outdoor value for the PM_{2.5} and benzene mass concentrations were also high, thus the inappropriate indoor air quality was mainly caused by the outdoor air pollution. Furthermore, one of the comfort parameters was also in the unhealthy range; the relative humidity was low in the classroom and the carbon dioxide concentration was in the moderate range.

HU04

is a provincial school in Péteri, close to a relatively high traffic road. The school building was built from brick at the end of the 20th century. The indoor air quality was in the unhealthy category based on the indoor health index. The main air pollutant was particulate matter (PM_{2.5}). It should be noted that the outdoor value for the PM_{2.5} mass concentration was also high, thus the inappropriate indoor air quality was mainly caused by the outdoor air pollution. Furthermore, one of the comfort parameters was in the moderate range; the relative humidity was low in the classroom.

HU05

is located in the residential area of Várpalota, far away from high traffic roads. The school building was built from brick in the middle of the 20th century. The indoor air quality was in the moderate category based on the indoor health index. The main air pollutants were benzene and particulate matter (PM_{2.5}). It should be noted that the outdoor value for the PM_{2.5} and benzene mass concentrations were also high, thus the inappropriate indoor air quality was mainly caused by the outdoor air pollution. Furthermore, one of the comfort parameters was also in the moderate range and the carbon dioxide concentration was

InAirQ – Virtual Health Repository (VHR)

[About us](#)

[Virtual Health Repository - general overview](#)

[VHR](#)

[VHR - Czech Republic](#)

[VHR - Hungary](#)

[VHR - Italy](#)

[VHR - Poland](#)

[VHR - Slovenia](#)

[Transnational Environment Quality Forum](#)

VHR - Italy

Number of school buildings investigated: 12

IT01

is located in the southern suburbs of Turin city. The building, consisting of 3 floors above ground, was built in 1966 and is made of concrete. It also has lead pipes, very harmful to health, but no component in asbestos. The school is located along a street with moderate traffic, and with moderate traffic and urban-type driving speed (speed limit 50 km / h or less). It is, however, close to high traffic and high traffic arterial roads: the south ring road of Turin and the Orbassano course. As a result, the school building, despite being immersed in a relatively green neighbourhood, thanks to its proximity to an urban park, is exposed to the air pollution generated by heavy traffic that develops nearby. Consequently, the main indoor air pollutant was benzene originated by vehicular traffic, and the IAQ is in the very unhealthy category based on the indoor health index.

IT02

is located in the southern suburbs of Turin city. The building, consisting of 3 floors, is made of concrete, with no asbestos or lead components. It is heated by central heating (district heating with cast iron radiators). The school is located in a mainly residential area, with a moderate traffic and urban-type driving speed (speed limit 50 km / h or less). It is, however, not far from high-speed and high-traffic arterial roads: Corso Traiano and Corso Unione Sovietica, i.e. the main routes to take the southern ring road of Turin. As a result, the school building is exposed to the air pollution generated by heavy traffic flowing nearby and the IAQ is strongly influenced by outdoor pollution, particularly for what concerns the benzene levels, so high that they put the school IAQ in the dangerous category based on the indoor health index.

IT03

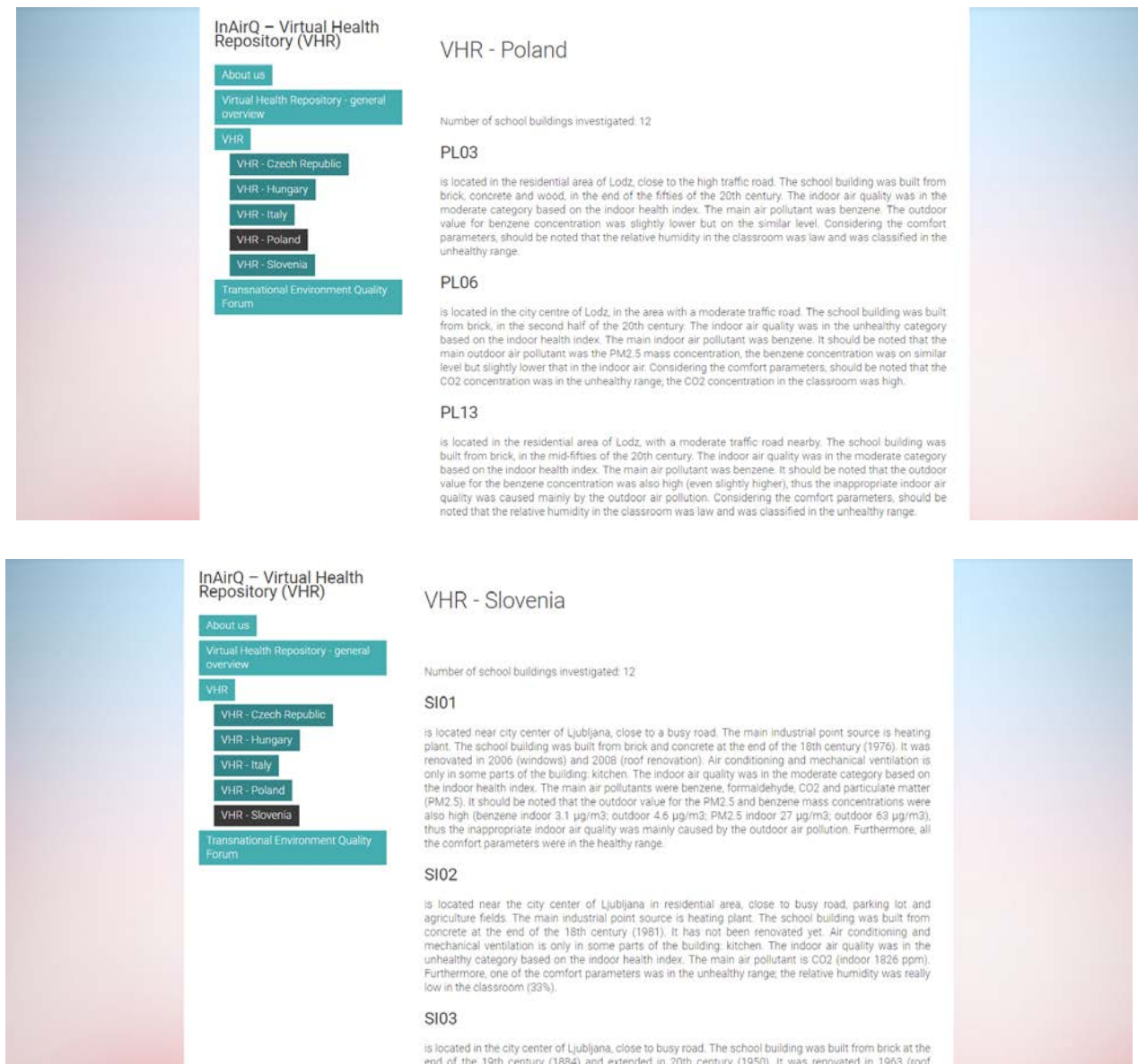


Figure 2: Examples for the description of the results of the InAirQ monitoring campaign

The Virtual Health Repository provide useful information to different target groups including the decision makers and also the people who are responsible for operating the schools daily.