



<b>Case study title:</b>	<b>Outdoor air pollution (Clinical case)</b>
<b>Target group:</b>	<b>Paediatricians, General practitioners, Public health professionals</b>
<b>Linked to modules:</b>	<b>Indoor air pollution, Outdoor air pollution, Second-hand tobacco smoke, Allergies</b>
<b>Source of case study:</b>	<b>Environmental Health in Family Medicine – original author Alan Abelsohn MD, CCFP, FCFP Lecturer Dept. of Family Medicine, University of Toronto</b>
<b>Case handling:</b>	<b>Use powerpoint presentation and/or handouts based on the case description. Stepwise approach. Includes a post test.</b>

### **Asthma and Air Pollution**

A 16 year old girl is seen in the office in mid July. She is accompanied by her mother. She is short of breath, and presents cough and tightness in chest. This started when she woke up that morning at 6am. She used Ventolin soon after the onset, with some relief, but she still symptoms.

Physical examination reveals some wheezing with respirations. She shows no cyanosis, no anaemia.

Oral temperature is 37 C. A respiratory rate of 18. A heart rate of 88. Blood pressure 105/65. Head, neck and throat look normal.

CVS: normal. Respiratory tract: wheeze throughout. Trachea central. No focal changes.

Abdominal examination: normal

Additional examination: calves. No tenderness. No ankle oedema.

PEF: 240 (expected for height=400 ). Spirometry is not available. 15 minutes after 2 puffs of Ventolin, her PEF has increased to 320.

Question 1: What is your diagnosis?
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**ANSWER TO QUESTION 1: asthma**

**Question 2: What are the possible triggers for this episode of asthma?**

What else do you want to know about the medical or family history, or personal exposure history, to investigate this?

Make sure you include environmental exposures that might be triggers, using the paediatric environmental history from this training module.

Consider items on:

- Community,
- Housing/Hobbies,
- Occupation,
- Personal exposure

**ANSWER TO QUESTION 2: discuss what might be important triggers**

Additional information on the patient.

1. History of present illness.

Any preceding symptoms? Any Upper respiratory infections? **Nil**

Any associated symptoms? Specifically, any fever, cough, chest pain, swelling or pain in the legs/ calves? **Nil**

2. Past Medical history.

including asthma, allergy, respiratory or cardiac problems?

She had a few episodes of wheezing last summer. They were treated with Ventolin puffer, and settled quickly, lasting a few days each. She was also successfully treated with Ventolin for a cough that persisted for 2 weeks after an upper respiratory infection in the winter. No allergies or hay fever. No other respiratory problems. No other medical history.

3. Medications ? **Nil, besides Ventolin described above.**

4. Allergies? **Nil, not to any medications, and no history of hay fever or rhinorrhea.**

5. Family history of asthma , allergy, hay fever? **Nil**

6. Personal: smoker? **Nil**

7. What other triggers, especially environmental exposures? Answers grouped according to community, housing, hobbies, occupation and personal exposure.

**Community**

**The status of the outdoor air in the community**

A Smog Advisory had been in effect for the previous 3 days.

In some countries the Ministry of Environment measures and reports on the status of air quality. In some countries there might be an AQI (Air Quality Index) as a source of information. The Air Quality Index (AQI) is an index synthesizing the six most commonly measured air pollutants; Carbon Monoxide, Nitrogen Dioxide, Sulphur Dioxide, Suspended Particles, Total Reduced Sulphur, and Ozone, reported as Very



Good, Good, Moderate, Poor, and Very Poor. In summer, a Poor AQI is usually related to an increase in Ozone, and this in turn is usually associated with an increase in fine particles in the air.

A Smog Advisory had been issued. This is issued when average regional levels of ozone are forecast to reach 80ppb with local peaks anticipated at 120ppb or greater. In some countries different values may be selected. Check with your own national authorities about these values. The levels of ozone, in this case, are associated with health effects, and can exacerbate asthma, chronic respiratory disease, and cardiac conditions. On average about 5 such episodes, each a few days in duration, are likely to occur in the course of the summer. Elevated levels of fine particulates are usually found at the same time.

With the smog advisory, there had been warnings in the media as follows: During the episode individuals may experience eye irritation. Heavy outdoor exercise during the episode may cause respiratory symptoms. People with heart or lung disease (including asthma) may experience worsening of their condition. Outdoor activity should be reduced.

### Housing

Have they moved to a new house? **No**

A new community? **No**

Any renovations? **No**

Any new furniture, or bedding? **No**

What is the state of the basement? Any moisture problems? **Yes, it is a bit damp after heavy rains.**

How do they heat the house? **Gas, with forced air.**

How do they cook? **Gas range.**

Pets, or birds, in the home, or contact with other pets, and animals? **Yes, they have had a cat for the past 5 years.**

### Hobbies

Any hobbies that involve use of solvents? glues? **No.**

### Occupation

Does she work? **She has started working as a waitress in a restaurant.**

What do her parents do? **Both have office jobs.**

### Personal

Does she smoke? **No.**

Does anyone at home smoke? **Yes, mom smokes 5 per day. Mostly smokes outdoors.**

**Does not smoke in the car.**

Activities? What outdoor activities has she done in the past few days?

**She has been involved in a baseball tournament the previous two days.**

**QUESTION 3:** What is the status of the outdoor air in your community?  
How would you find this out?



Answer to question 3: see above under community

**Question 4 :** What was her exposure to outdoor air pollutants?

**Answer 4:** A Smog Advisory had been in effect for the previous 3 days. A Smog Advisory indicates elevated Ozone levels, and this is almost always accompanied in Ontario by elevated levels of fine particulates (PM10 and PM2.5) She has been involved in a baseball tournament the previous two days. Being outdoors increased her time of exposure, and physical activity , by increasing the respiratory rate and volume, increases exposure to pollutants in the air.

**Question 5:** How would you counsel the patient and family about how to deal with these trigger factors?



**Answer 5:**

The patient and family should be made aware of the **connection** between elevated levels of ozone and particulates ie smog, and exacerbations of asthma. It appears that smog is a trigger for her asthma. As such they should:

1. be aware of **smog advisories** in their area when they are issued via the media, and can also call the MOE Air Quality line.
2. attempt to reduce exposure to smog. They should understand that **outdoor activity** during smog advisories increases exposure, so that she should be careful with outdoor activities. She might need to stay indoors during smog advisories to reduce exposure if her asthma worsens significantly.
3. Increase monitoring of her Peak Flow during Smog Advisories, and follow her action plan by increasing her inhaled steroids and Ventolin if her Peak Flow drops.
4. It is also appropriate to give them information about the larger picture of how smog is formed, and what the individual can do **personally** and in an **advocacy role** to reduce the problem.

**Question 6:** What where possible triggers from Indoor air pollution?



### **Answer 6:**

These will not be discussed in detail here. See module on indoor air pollution for more detail. The factors relevant in this case are:

1. Environmental Tobacco Smoke, at home and at work (occupational exposure)
2. A damp basement, with possible exposure to mould or House Dust Mites.
3. A cat with allergens.
4. A gas range can emit Oxides of Nitrogen.

### **Additional information on ozone:**

#### **Ozone**

Ground level ozone, as opposed to stratospheric ozone (the ozone layer), is a colourless gas that is formed when its precursors, oxides of nitrogen and hydrocarbons, interact in the atmosphere in the presence of high temperatures and sunlight (photochemical reactions). Nitrogen oxide precursors (NO<sub>x</sub>) are emitted from the combustion of fossil fuels, mainly from motor vehicles exhausts, but also from power plants and industrial processes. The hydrocarbon precursors, also called volatile organic compounds or VOC's, are also produced by motor vehicle exhausts, industrial processes and by evaporation of gasoline from gas pumps, of surface coatings such as oil-based paints, and of solvents such as cleaners and barbecue starter fluid. Another major source of VOC's can be natural vegetation.

#### **Health Effects of Ozone**

Levels of ozone and particulates measured, especially during smog advisories, overlap with levels shown to have adverse effects on human health. Inhaled ozone causes an inflammatory response, manifested by increased airway permeability and bronchial hyperreactivity. Increased ozone exposure has been linked to reduced measures of pulmonary function, increased cough and chest tightness, exacerbations of asthma, and increased hospital admissions for respiratory diseases, including asthma. It is very likely that in this case, the asthmatic exacerbation was triggered by exposure while outdoors playing baseball to the elevated ozone levels. Recent studies have clearly linked ozone and particulates to increased mortality. The evidence for chronic effects of ozone is unclear, although there is concern that children living in more polluted areas have reduced pulmonary function indices compared to children in less polluted areas. There is a marked individual variability in sensitivity to ozone, which cannot be predicted.

#### **How should the physician counsel this patient in terms of asthma and air pollution?**

1. Awareness: The patient and family should be made aware of the connection between elevated levels of ozone and particulates, and exacerbations of asthma. They should be aware of smog advisories in their area when they are



issued via the media.

2. Reduce Exposure: They should also understand that outdoor physical activity during smog advisories increases exposure, so that she should be careful with outdoor activities especially during the afternoon and early evening when ozone levels are at their highest, and stay indoors to reduce exposure if her asthma worsens significantly. Patients with asthma, chronic respiratory or cardiac disease, children and the elderly are more sensitive to the effects of smog, and all these groups should be counselled to reduce exposure in a similar way.

3. She should also be advised to be more careful in monitoring her peak flow during the smog advisory, and to increase her medication according to her action plan if necessary.

4. It might also be appropriate to give them information about the larger picture of how smog is formed, and what the individual can do personally and in an advocacy role to reduce the problem.

It must be emphasized that short term behaviour change (during smog episodes) will not produce immediate environmental improvement, and it is not wise to walk or cycle, thereby increasing personal exposure, in order to help reduce smog during smog episodes.

### **Primary Prevention**

In the long term, primary prevention includes empowering patients to become part of the solution, by reducing emissions as follows:

- \*Reduce car use by using public transportation and car pooling whenever possible.
  - \*Walk or ride your bicycle (wearing a helmet) when the smog levels are not high.
  - \*Keep your car well tuned, and check the emission control system.
  - \*Avoid idling for long periods, and turn off your engine while waiting.
  - \*Driving at moderate speeds uses less fuel. Buy a fuel efficient vehicle.
  - \*Use alternatives to other gasoline-powered vehicles and machines, such as motorbikes, motorboats and gas lawnmowers.
  - \*At home, think about Reducing, by considering energy efficiency.
  - \*Solvents in household cleaners and in surface coatings like oil-based paints are a major source of VOC's. Choose alternatives such as water-based paints, and if it is necessary to use solvent-based products, handle and dispose with care.
- Primary prevention also certainly involves advocacy and political action regarding motor vehicle emission standards, urban planning and public transportation issues.

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