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THE LAC-MÉGANTIC TRAGEDY: THE PUBLIC HEALTH EMERGENCY RESPONSE

Dr. Mélissa Généreux (director) and her team
Eastern Townships Public Health Department (PHD)
September 8, 2015
OUTLINE

1. A Look Back
2. Crisis Management: The First Few Hours/Days
3. Risk Management: The First Few Weeks
4. Lessons and Conclusion
THE TOWN OF LAC-MÉGANTIC

Source: Town of Lac-Mégantic
JULY 6, 2013: THE FIRE AND A SERIES OF EXPLOSIONS
DEVASTATED NEIGHBOURHOODS
A CLOUD OF SMOKE
AN OIL SPILL

- 72 wagons with a capacity of 100,000 litres of light crude oil
- 6,000,000 litres of crude oil spilt:
  - Some of it burned
  - Some of it seeped into the soil
  - Some of it spilled into the lake and some of it into the river (100,000 L)
TRAGEDY = MULTIPLE EMERGENCIES

- Soil
- Surfaces
- Lake
- River

- Derailment
- Conflagration and explosions
- Oil spill
- Massive evacuation & prolonged power outage

- Cloud of smoke
- Buildings destroyed
- Deaths
- Extreme mid-July heat
• Major fire in downtown Lac-Mégantic around 1:15 a.m.
• CSSS du Granit notified Health Mission coordinator around 1:30 a.m.
• Physician on duty in environmental health called around 2 a.m.
• Public health director called around 5 a.m.
• The head of the public health component of the Health Mission on vacation
INITIAL CRISIS MANAGEMENT

• Presence at the emergency measures coordination centre around 6 a.m.
• Presence on site around 8 a.m.
• Team mobilized
• Work organized
• Support requested from the province
COMMUNICATION WITH THE NETWORK

• First actions taken before 9 a.m.:
  – memo for physicians and ambulance drivers
  – Info-Santé notification

• Information transmitted:
  – situation report
  – effects of acute exposure to oil
  – measures to be taken in the event of exposure

• Oil vapours may cause:
  – irritation of the eyes and respiratory tract
  – dizziness, confusion
  – loss of consciousness
• Initial evacuation around a large safety perimeter by firefighters
• First data gathered by TAGA around 8:30 a.m.
• First data transmitted to Public Health around 10 a.m.
• Evacuation of the Fatima sector as requested by Public Health around 11 a.m.

More than 2,000 persons were evacuated (1/3 of the population)
TAEA :

- 8h40
- 1h20
- 2h00
- 3h00
- 4h00

- 5 SO2
- 12 NO
- 100 HAP
- 97 PM2.5
- 93 PM10
- 920 NO2
- 530 Nbx
- 160 TSP

- 6h40
- 6h40
- 7h00
- 7h30

- Rue du Foyer
- Fatima

- Alzheimer
- Résidence Mobilité
- Morales

- Eaux - municipalité
- Air - service OC

Gmm 1sh30
<table>
<thead>
<tr>
<th>Heure</th>
<th>Station</th>
<th>HAP (ng/m³)</th>
<th>SO₂ (ppb)</th>
<th>CO (ppm)</th>
<th>NO (ppb)</th>
<th>NO₂ (ppb)</th>
<th>NOₓ (ppb)</th>
<th>TSP (µg/m³)</th>
<th>PM-10 (µg/m³)</th>
<th>PM-2.5 (µg/m³)</th>
<th>Benz (µg/m³)</th>
<th>Tolu (µg/m³)</th>
<th>Ethyl Xyl (µg/m³)</th>
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<td>11h00</td>
<td>Montcalm coin Salaberry</td>
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</tbody>
</table>

Tous les HAP sont détectés, donc des sommets 1000 = symptômes - HAP = Air contenant des petites molécules - BTEX = Benzène, Toluène, Éthylène, Xylène, Acétylène.
IMMEDIATE ISSUES - WORKERS

• Safety:
  – building collapse
  – electricity
  – explosions (accumulation of crude oil and VOC emissions)

• Health:
  – dust (asbestos, silica, debris from buildings, metals, etc.)
  – VOC
  – benzene (100 ppm measured on site during SAR operations)
IMMEDIATE ISSUES - WORKERS

• Risk management during the first hours/days:
  – visits to the site by the CSST and the PHD
  – safety guidelines transmitted to occupational health and safety managers
  – mandatory wearing of dust masks at all times
  – measurements taken by HAZMAT team (firefighters)
  – specialized patrol at the site with a detector
  – benzene measurements (instant readings)
    • work stopped if ≥ 5 ppm (maximum short-term exposure standard)
    • resumption after ventilation if deemed safe
  – work under thermal constraints
CASUALTY AND PATIENT MANAGEMENT

• The CSSS du Granit prepared to receive a massive number of casualties as soon as it was notified (code orange).
  – In spite of that, the injured didn't arrive
  – And in spite of the conflagration, there were no mass consultations for respiratory problems

• Physical health issues related to needs arising from:
  – the evacuation of the seniors' residence
  – the loss of the local pharmacy
  – the loss of a medical clinic

all located downtown
REINTEGRATION

• Reintegration began as early as July 7
• Coordination of the decision to reintegrate:
  – huge challenge at first
  – consensus was required from all partners: municipality, environmental authorities, firefighters, police, public health
• Public health perspective:
  – Are there any residual risks?
  – How do you protect yourself from them?
  – How do you notify the public?
RESIDUAL RISK: SOOT FALLOUT

- A cloud of smoke up to 5 kilometres wide
- Soot fell back onto surfaces, the soil and surface water
- Risk of skin irritation (if there is direct contact)
- Potential of contaminating homes
- Residents had to clean up before reintegrating their homes
SOOT FALLOUT
PUBLIC NOTIFIED EVERY DAY AT 3:30 P.M.
Définition du problème et du contexte

Évaluation du processus et des interventions

Communication sur les risques

Mise en œuvre des interventions

Identification et examen des options

Choix de la stratégie

Adaptée de PCCRARM (1997a) et de Santé Canada (2000)
PRODUCTS INVOLVED

• Key component of our work
• Crude oil:
  – but great difficulty in obtaining copies of documents which would confirm its presence
  – constant allegations, notably in the media, that the train may have contained other products
POPULATIONS AFFECTED

• Evacuated and reintegrated population
• Disaster workers:
  – firefighters
  – police officers
  – entrepreneurs
  – decontamination teams
• Surrounding populations:
  – population affected by the cloud of smoke
  – populations of municipalities along the river
PARTNERS ON SITE

- Civil protection (coordination)
- Firefighters
- Sûreté du Québec (SQ)
- Coroner
- Municipality (mayor, councillors, and town employees)
- Ministry of environment
- CSSS du Granit (including clinical and psycho-social services)
HEALTH PROBLEMS OBSERVED

Epidemiological study

*Through the case declarations seen at the emergency rooms, at the local medical clinics, and of the occupational health teams for all regions (to get workers from other regions)*

- A dozen identified cases that could be linked to exposure to chemical contaminants (almost all workers)
- Various symptoms: headache, weakness, difficulty breathing, irritation of the eyes and face
- No severe cases
<table>
<thead>
<tr>
<th>Type of incident</th>
<th>Number of workers</th>
<th>Causal link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidental inhalation of oil vapour</td>
<td>5 cases</td>
<td>• 1 clearly linked</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 probable</td>
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<tr>
<td></td>
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<td>• 3 uncertain</td>
</tr>
<tr>
<td>Accidental projection of liquid</td>
<td>3 cases</td>
<td>• 2 cases clearly linked, including a CSST intervention to correct work methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 probable case</td>
</tr>
<tr>
<td>Exhaustion</td>
<td>4 cases</td>
<td>Unlikely link; non-specific symptomatology</td>
</tr>
<tr>
<td>Other</td>
<td>2 cases</td>
<td>Non-specific symptoms difficult to link to exposure</td>
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POTENTIAL SOURCES
OF EXPOSURE

• Recreational water
• Drinking water
• Soils contaminated at the site
• Air within proximity
• Air at the site
RECREATIONAL WATER

- Highly contaminated water and shoreline due to the direct spilling of petroleum products.
- Chaudières-Appalaches Region: some riverfront municipalities with water intakes directly along the river.
- Work effected to determine whether there were citizens who got their water from individual surface wells located near the river or under the cloud of smoke.
<table>
<thead>
<tr>
<th>Date</th>
<th>Analyses and results</th>
<th>Clarifications</th>
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<tbody>
<tr>
<td>July 6, 2013</td>
<td>Water main break</td>
<td>Preventive boil water advisories</td>
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<tr>
<td>July 10, 2013</td>
<td>Analysis of PH $C_{10}^{}$-$C_{50}^{}$, PAH and BTEX at various sites within the network</td>
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<tr>
<td>July 12, 2013</td>
<td>Receipt of test results:</td>
<td>The boil water advisory is lifted Request for raw water analyses</td>
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<tr>
<td></td>
<td>- PH $C_{10}^{}$-$C_{50}^{}$ detected in a 0.2 mg/L sample. Sampling site was near the devastated area</td>
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<td>- Toluene detected in a 0.3 µg/L sample</td>
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<td></td>
<td>- BTEX was not detected elsewhere in the network</td>
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<tr>
<td></td>
<td>- Bacteriological analyses were normal</td>
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<tr>
<td>July 18, 2013</td>
<td>Raw water analyses results were all normal</td>
<td>Recommendation of a weekly follow-up at various sampling points within the network and monthly analysis of raw water (wells)</td>
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</table>
## Monitoring of Drinking Water

<table>
<thead>
<tr>
<th>Date</th>
<th>Parameters</th>
<th>Monitoring frequency Water supplied</th>
<th>Monitoring frequency Supply wells</th>
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<td>July 18, 2013</td>
<td>C&lt;sub&gt;10&lt;/sub&gt;-C&lt;sub&gt;50&lt;/sub&gt; PAH VOC Metals of the Regulation Respecting the Quality of Drinking Water (RQEP)</td>
<td>Weekly</td>
<td>Weekly</td>
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<td>September 6, 2013</td>
<td>C&lt;sub&gt;10&lt;/sub&gt;-C&lt;sub&gt;50&lt;/sub&gt; PAH BTEX Metals under the Regulation Respecting the Quality of Drinking Water (RQEP)</td>
<td>Weekly</td>
<td>Monthly</td>
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<td>December 10, 2013</td>
<td>C&lt;sub&gt;10&lt;/sub&gt;-C&lt;sub&gt;50&lt;/sub&gt; PAH BTEX Metals under the Regulation Respecting the Quality of Drinking Water (RQEP)</td>
<td>Monthly at 3 sampling points</td>
<td>Monthly</td>
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<tr>
<td>September 18, 2014</td>
<td>C&lt;sub&gt;10&lt;/sub&gt;-C&lt;sub&gt;50&lt;/sub&gt; PAH BTEX (cessation of metal analyses)</td>
<td>Monthly at 3 sampling points</td>
<td>Monthly</td>
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</table>

*From the end of March to the end of June 2014: monitoring frequency increased to twice monthly for a sampling point where 0.8 mg/L of C<sub>10</sub>-C<sub>50</sub> was measured.*
SUMMARY OF THE RESULTS

Samples taken along the network and at wells between July 10 and December 31, 2013

- 69 samplings (293 analysis results)

  - Traces of two phenolic compounds in a sample (July 2013): Concentrations very close to detection limits and contamination of field blanks
  - Traces of phthalates in 5 samples (July 2013)
  - Traces of VOC in 21 samples (July to September 2013): Detected VOCs are not linked to contamination by petroleum products
  - Detection of C10-C50 between 0.1 and 0.5 mg/L in 10 samples (July to December 2013): Samples occasionally taken from outside taps near sources of contamination.
  - Trace of PAH in 1 sample (November 2013): Benzo(a)pyrene (at detection threshold)
SOILS CONTAMINATED AT THE SITE

- Infiltration into nearby soil
- Spill followed existing water lines
- Initiation of decontamination work
AIR QUALITY NEAR THE SITE

• Measurements taken in evacuated homes
• Search for gas, especially in basements (e.g.: carbon monoxide, benzene)
• No anomalies detected
AIR QUALITY AT THE SITE

Exclusion Zone

• Many workers in the exclusion zone
• Search for specific contaminants (e.g.: benzene, VOCs)
• Potential for prolonged exposure
ENVIRONMENTAL MONITORING

• Daily measurements at the site during the work
• Direct reading instruments
• Gases evaluated:
  – Benzene
  – VOC
  – Toluene
  – Ethylbenzene
  – Xylene
  – Hexane
  – H₂S
  – SO₂
  – CO
• Suspended Dust Particles evaluated:
  – PM₁₀
  – Asbestos
• Lower Explosive Limit (LEL)
Measure of VOC after the derailment of Lac Megantic Tragedy

<table>
<thead>
<tr>
<th>Days</th>
<th>VOC Minimum</th>
<th>VOC Maximum</th>
<th>VOC Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 July 2013</td>
<td>0,2</td>
<td>0,5</td>
<td>0</td>
</tr>
<tr>
<td>15 July 2013</td>
<td>0,1</td>
<td>112</td>
<td>20,6</td>
</tr>
<tr>
<td>24 July</td>
<td>0,1</td>
<td>62,5</td>
<td>11,5</td>
</tr>
<tr>
<td>26 July to 28 July 2013</td>
<td>0,1</td>
<td>14,5</td>
<td>1,4</td>
</tr>
</tbody>
</table>
Measure of benzene after the derailment of Lac Megantic Tragedy

<table>
<thead>
<tr>
<th>Days</th>
<th>Contaminant (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 July 2013</td>
<td>Benzene Minimum: 0.15</td>
</tr>
<tr>
<td></td>
<td>Benzene Maximum: 1.5</td>
</tr>
<tr>
<td>15 July 2013</td>
<td>0.5</td>
</tr>
<tr>
<td>24 July</td>
<td>0.5</td>
</tr>
<tr>
<td>26 July to 28 July 2013</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>1.86</td>
</tr>
<tr>
<td></td>
<td>3.75</td>
</tr>
<tr>
<td></td>
<td>0.56</td>
</tr>
</tbody>
</table>
DOSE-RESPONSE RELATIONSHIP

• Standards or reference values different for workers than for the population for most potential contaminants identified
• Acute effects at very high doses
• Chronic effects following prolonged exposure
EXAMPLE OF BENZENE

- Acute effects: depression of the nervous system (starting at around 100 ppm)
- Chronic effects: cancer and hematopoietic system disorders
- Standard for benzene for 8 hours per day/40 hours per week for workers: 1 ppm
- Requires exposure to values greater than that reference value over many years
LEVELS OF EXPOSURE

• Very few people exposed to contaminant levels which could lead to acute health effects with the exception of a few workers who wore little or no protection
ESTIMATION OF RISKS

• Limited risks for:
  – the general population (evacuated or not)
  – workers in the exclusion zone
• Risks avoidable through simple protective measures
• Need to continue monitoring air, water and soil quality
PERCEPTION OF RISKS

EXPOSURE
- Involuntary
- Uncontrollable
- Man-made
- Unfamiliar
- Inequitable distribution of risks and benefits
- Suspicion of institutions
- Media attention

EFFECTS ON HEALTH
- Catastrophic
- Affecting youth
- Identifiable victims
- Immediate effects
- Irreversible effects
- Further uncertain, poorly known risks affecting future generations and invoking fear
IDENTIFICATION AND EXAMINATION OF OPTIONS

• Continuously evolving
• Adapting to new data:
  – analysis of the contents of the wagons
  – quality of air, soil and water
  – epidemiological study
• Sharing of information
• Broad context of uncertainty = CAUTION
RECOMMENDATIONS

For the workers:

• Respiratory and skin protection measures
• Reporting all occupational health and safety incidents
RECOMMENDATIONS

For the population:

• Reintegration of most evacuees, along with a variety of recommendations:
  – surface cleaning
  – drinking water
  – food, medications
  – swimming, fishing

• No reintegration for some 200 persons living in proximity to the disaster site
COORDINATION MECHANISMS

• Need for Public Health presence in the field and at the coordination centre
• Mobilization of various resources mostly in environmental and occupational health sectors
• Continuous sharing and management of information
• Daily meetings
• Coordination in line through the Health Mission
• Emergency measures coordination centre open until August 16, 2013
COORDINATION WITH THE PARTNERS

Need for more coordination

• 2 PHDs affected
• Coordination by the Civil protection
  – daily phone conferences at a predetermined time
  – plenty of interaction (ministries, SQ, CSST)
• Need for more direct contact between public health and Ministry of environment:
  – creation of a management committee for environmentally linked health risks
COMMUNICATION OF RISKS

Communication sur les risques

- Choix de la stratégie
- Identification et examen des options
- Mise en œuvre des interventions
- Évaluation du processus et des interventions
- Évaluation des risques
- Définition du problème et du contexte

(Adaptée de PCCRARM (1997a) et de Santé Canada (2000))
MEDIA INTERVIEWS

Priority given to local media to reach out to the local population
INFORMATION DOCUMENTS CONCERNING REINTEGRATION

Variety of information and recommendations:

• Cleaning oil droplets
• Can I drink water?
• Can I swim in Lake Megantic?

Distributed to each household before the reintegration and available online:

• The issue is that the document is relatively hard to read for the less-educated population.
DIRECT COMMUNICATION WITH THE LOCAL POPULATION
COMMUNICATION WITH WORKERS

- Meetings and visits to the site (PHD, CSST, occupational health and safety managers)
- Toxicological information sheet for physicians
- Information meetings for the workers
- Information sheet for the workers
TO SUMMARIZE

• A horrific tragedy:
  – Major impact on the community's population
  – Significant work for public health resources:
    • crisis management and risk management
  – Particularities of risk management in a disaster context:
    • speed
    • magnitude
    • coordination
FIVE LESSONS

1. Need for a national framework orienting public health actions before, during, and after a disaster
2. Agreement with respect to the timely sharing of sensitive information before a disaster
3. Understanding of respective roles and responsibilities of partners prior facing the challenges of a real tragedy
4. Interpretation guide for the mixture of compounds available at all time to physicians on duty
5. Local radio, direct local communication and door-to-door distribution of written communication most effective
CONCLUSION

• Public health issues:
  – Diverse:
    • Real and perceived risks
    • Chemical, physical and biological agents
    • Many potential sources of exposure
  – Concerning the workers and the public
  – In the short, medium and long term

• Importance of a joint, sustained, flexible and adaptable intervention

• Need for adequate public health emergency preparedness
The End

Thank You!