Lead in Uruguay:
A Multidisciplinary Approach

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Medical Geology in Uruguay

“Lead contamination in Uruguay has been taken into account as a Medical Geology issue”

Dr. J. Centeno Round Table comments in Montevideo, 2005
Background

- Lead is ubiquitous in the environment as a result of mining and industrialization.
- This metal has no known physiologic value and children are the most sensitive population with high health risks.
- **Blood lead level (BBL, B-Pb)** is a recommended biological marker to environmental lead exposure.
- Our group at the Dept. of Toxicology and Environmental Hygiene has a 15-year-research-experience on lead monitoring on different Uruguayan populations.
- Other University Research Teams have also been studying metals from different points of view.
Background

– In 2001 lead pollution first received official attention in Uruguay, with the episode of “La Teja” with high B-Pb in children

– Health and Environmental authorities had our toxicology studies as the only background scientific available data from Uruguay.
Lead contamination sources

- Industries (metallurgies, manufacture of batteries, wires, pipes, etc)
- Recycling (foundries)
- TEL additive to gasoline up to Dec. 2003
- Lead pipes for water supply in old houses
- Solid wastes (smelters scaps)
- Others

Source: Cátedra de Toxicología e Higiene Ambiental- Facultad de Química
Toxicology & Environmental Hygiene Dept: Faculty of Chemistry

This Toxicology Team has been studying metals exposure in uruguayan populations being lead, its main research line since 1986 with QA/QC analytical results.

Source: Cátedra de Toxicologia e Higiene Ambiental
Studied Populations: WORKERS

Source: Cátedra de Toxicología e Higiene Ambiental- Facultad de Química
Studied Populations
ADULTS & CHILDREN

Source: Cátedra de Toxicologia e Higiene Ambiental- Facultad de Química
Studied Populations
DOGS & BOVINES

Source: Cátedra de Toxicologia e Higiene Ambiental- Facultad de Química
## Results

### B-Pb µg/dL

<table>
<thead>
<tr>
<th>Human Population</th>
<th>n</th>
<th>B-Pb</th>
<th>Year</th>
<th>Publication</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>adults</td>
<td>23</td>
<td>9,8</td>
<td>1987</td>
<td>Mañay et al., 1987</td>
<td>young adults 20-30 yrs</td>
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<tr>
<td>adults</td>
<td>29</td>
<td>9,1</td>
<td>1992</td>
<td>Schutz et al, 1994</td>
<td>teachers/civil servants</td>
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<tr>
<td>workers</td>
<td>47</td>
<td>54,1</td>
<td>1987-8</td>
<td>Mañay et al., 1989</td>
<td>Several Industries</td>
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<tr>
<td>workers</td>
<td>31</td>
<td>49,7</td>
<td>1992</td>
<td>Pereira et al., 1996</td>
<td>Several Industries</td>
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<tr>
<td>workers</td>
<td>60</td>
<td>48,2</td>
<td>1997</td>
<td>Pereira et al., 1998</td>
<td>Batteries Industry</td>
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<td>children&lt;14 yrs</td>
<td>34</td>
<td>10,0</td>
<td>1992</td>
<td>Schutz et al., 1994</td>
<td>urban area</td>
</tr>
<tr>
<td>children&lt;14 yrs</td>
<td>49</td>
<td>11,8</td>
<td>1995</td>
<td>Cousillas et al., 1997</td>
<td>industrial area</td>
</tr>
<tr>
<td>children&lt;14 yrs</td>
<td>2251</td>
<td>14,5</td>
<td>2001</td>
<td>Mañay et al., 2001</td>
<td>Polluted area</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>45</td>
<td>9,1</td>
<td>2001</td>
<td>Mañay et al., 2001</td>
<td>Polluted area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Animal Population</th>
<th>n</th>
<th>B-Pb</th>
<th>Year</th>
<th>Publication</th>
<th>Observations</th>
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</thead>
<tbody>
<tr>
<td>domestic dogs</td>
<td>151</td>
<td>12,1</td>
<td>1994</td>
<td>Mañay et al, 1998</td>
<td>Veterinary Facult</td>
</tr>
<tr>
<td>bovines</td>
<td>55</td>
<td>4,1</td>
<td>1999</td>
<td>Mañay et al, 1998</td>
<td>Rural Area</td>
</tr>
</tbody>
</table>

Source: Cátedra de Toxicologia e Higiene Ambiental- Facultad de Química
“Development of analytical methodologies for metals in biological matrices. Analysis of lead in blood and chromium in urine”

Source: Cátedra de Toxicologia e Higiene Ambiental- Facultad de Química
Montevideo: Environmental Contamination
Non occupational lead exposure is usually due to living in manufacturing areas or by inadequate handling of lead containing materials and solid wastes which represents an important health risk for children.
“La Teja” area Pb-Soil Contamination
Montevideo, 2001

Source: El Tejano
Lead Contamination
(La Teja, Canelones & other areas)

• A child from “La Teja” had a B-Pb > 20 ug/dL and other cases appeared afterwards.
• Health effects caused by the environmental ground polluting metallic agents exposure installs a debate in the society.
• Affected community began a broad mobilization demanding solutions from the Health and Environmental authorities.
• They claimed to know and to solve the situation of the contaminated sites in the whole country.
• The Health Ministry especially established a Interinstitutional and multidisciplinary committee, including delegates from health, environmental, labor, educational, social security institutions and community NGOs, among others.

• The University of the Republic was the main responsible for technical advice and support.
Multidisciplinary & Interinstitutional Committee

- MSP: Ministerio de Salud Pública (Health Ministry)
- MVOTMA: Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente (Environmental Ministry)
- MTSS: Ministerio de Trabajo y Seguridad Social (Work Ministry)
- MIEM_DINATEN/DINAMIGE: Ministerio de Industria, Energía y Minería; Dirección Nacional de Tecnología Nuclear/Dirección de Mineralogía y Geología (Industry, Energy & Mineralogy Ministry)
- IMM: Intendencia Municipal de Montevideo (Municipality of Montevideo)
- UNIVERSIDAD DE LA REPÚBLICA: Facultades de Química, Medicina; Ciencias & Agronomía. (Research University Delegates)
- ANCAP: Administración de Combustibles, Alcohol y Portland (Petrol Refinery)
- OSE: Obras Sanitarias del Estado. (Potable Water State Administration)
- BPS: Banco de Previsión Social. (Social Security & Health Care Center)
- BSE: Banco de Seguros del Estado (State workers Insurance)
- OPS/OMS: Organización Panamericana de la Salud (PAHO in Uruguay)
- CVSP: Comisión Vivir sin Plomo (“Lead Community” Committee)
Community Request for B-Pb analysis

- La TEJA & Other Populations, Montevideo URUGUAY, 2001
Reference Values used in Uruguay

- **Blood Lead Levels (B-Pb)**
  - Adults / exposed workers: < 30 ug/dl (ACGIH)
  - Adults/non exposed: < 25 ug/dL (ACGIH)
  - Children (<15ys): <15 ug/dL (WHO)
  - Children (<15 y): < 10 ug/dL (CDC)
  - Women (fertile age): < 10 ug/dL (ACGIH)

- **Lead in soil**
  - Residential, playing yards: < 140 mg/kg (CCME)
  - Residential, playing yards: < 400 mg/Kg (EPA)
  - Industrial areas: < 740 mg/kg (CCME)

Source: Dr. Ponzo, MSP 2002; IMM, 2003
Some Examples:
1) B-Pb Analytical Data in Uruguay (2001-2002)

- Studied population: 7786
- 6574 Children
- 1212 Adults (45 pregnant women included)
- 65% children with B-Pb > 10 µg/dL (CDC, 1991)
- 30% children with B-Pb > 15 µg/dL (OMS).
- Occupationally exposed Adults (B-Pb: 22.9 µg/dL)
- Without occupationally data Adult (B-Pb: 11.6 µg/dL)
- Pregnant women (B-Pb: 9.1 µg/dL)

“Uruguay has to take actions to mitigate or eliminate lead contamination sources considering children as the most affected population”

Source: Cátedra de Toxicología e Higiene Ambiental, Alvarez et. al 2003
3) Soil samples from Settlement Areas (LHA-IMM)

- Studied Settlements
  n=57
- Soil samples Analised
  n=354
- Pb < 140 mg/kg
  n=209
- Pb 140 < Pb < 400 mg/kg
  n=80
- Pb > 400 mg/kg
  n=65
- Settlements with at least one sample Pb> 400 mg/Kg
  n=19

Source: IMM, 2003
4) Lead from traffic sources in Montevideo (2001-03) \( n=78 \)

Source: IMM, 2003
5) Pb-Soil Vs. B-Pb Children

$n=15$ settlements

Source: Dol, I et. al 2004
Lead in Uruguay: Current Situation

- TEL is not used any more as a gasoline additive
- Sanitary & Environmental Interinstitutional & Multidisciplinary joint actions.
- B-Pb > 15 µg/ dL must be always declared to the health risk surveillance authorities
- Many new laws, and laws projects debates
  - Ej. Pb-workers must be lead controlled, children might be lead controlled up to 4 ys, adults may have a pre-occupational lead control
- Many justice cases are in process
- Systematic surveillance B-Pb screening program in children will be done in the future
- New Research Studies developing
Lead Biomonitoring on Dogs as Sentinels for Environmental Risk Assessment

Aims:

- Demonstrate that dogs are more susceptible than children at similar conditions of lead exposure
- Assess the risk of environmental lead pollution by biological monitoring of \textit{B-Pb} on dogs.
- Work up a scientific basis for a B-Pb dog screening program as a lower cost methodology for lead pollution to prevent health effects in children.

Source: Cátedra de Toxicología e Higiene Ambiental: Manay N et al., 2003
Montevideo Studied Zones

Zonas:

a: 1, 2, 3, 4, 5
b: 9, 10
c: 11, 14, 15 y el este
d: 6, 7, 8, 12, 13, 19
e: 16, 17, 18, 20, 23, 24

Source: Mañay N. 2001
B-Pb Distribution
Dogs (200) vs. Children (134)

Source Mañay, N et al 2003
Dogs (n=200) vs. Children (n=134)

Source Mañay, N et. al 2003
Families living in a lead polluted area B-Pb (µg/dL)

(*)Source Mañay, N et al. 2003
Conclusions

- Dogs are very useful as sentinels for environmental lead pollution.
- They showed statistically significant higher B-Pb than children population and higher probability to develop early symptoms associated with lead intoxication with lower B-Pb than those observed from little children.
- Dogs may be used as a risk assessment tool as a first step in lead pollution diagnosis and control.
- It is a low cost and quickly way of establishing environmental screening programs with the advantage that dogs only “measure” biologically active lead.
- Finally, ethic aspects have been considered as another advantage of this proposal.

Source Mañay, N et. al 2003
B-Pb in uruguayan children 1994 Vs 2004

- Studied population and results ($\bar{X}$)

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>B-Pb (µg/dL)</th>
<th>% B-Pb &gt; 10µg/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>60</td>
<td>9.9</td>
<td>41.7</td>
</tr>
<tr>
<td>2004</td>
<td>180</td>
<td>5.7</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Source: Cátedra de Toxicología e Higiene Ambiental. Cousillas et. Al 2005
Considerations

• There is a lot of information from multidisciplinary approach.
• Medicine, Sociology, Chemistry, Geology, and other scientific disciplines worked together.
• Integration of the University activities with social and political actions has been very important for the management of health risk situation.
• Uruguay must develop Medical Geology as one of its aims to improve the knowledge and performance in environmental and health issues.
References

  http://www.montevideo.gub.uy/ambiente/documentos

Source: Cátedra de Toxicologia e Higiene Ambiental- Facultad de Química
Thank you !!