AN ENHANCED MODEL FOR ASSESSING CHOKING RISK IN CHILDREN FOR CONSUMER PRODUCTS

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Clinical & Epidemiological Features

• Description of the main characteristics of the FB
• Help in management of the FB

Risk assessment

• Main goal is to estimate risks posed by objects: target of the SS project

Prevention

• Some risks are unavoidable: need for prevention
The Susy Safe DataBase

At 2019 29440 injuries

+ about 13000 from the Italian Ministry of Health
+ 366 MagDb data
Prospective cases (via WEB interface)

Retrospective data series incorporation

Single case indications

SS-DBMS
Surveillance: Object characteristics
Regulation: Brand identification

<table>
<thead>
<tr>
<th></th>
<th>Size &lt;3mm</th>
<th>Size &gt;3mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conforming</td>
<td>90</td>
<td>77</td>
</tr>
<tr>
<td>Rigid</td>
<td>23</td>
<td>0</td>
</tr>
</tbody>
</table>

Technical LEGO from the right lung
Desperate need for details

<table>
<thead>
<tr>
<th>fbTypeSpecific</th>
<th>fbTypeSpecific</th>
<th>fbBrand</th>
<th>shape</th>
<th>size1</th>
<th>size2</th>
<th>size3</th>
<th>consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>ruota</td>
<td>giocattoli lego</td>
<td>3D</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
<tr>
<td>pallina</td>
<td>geomag</td>
<td>Spherical</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
<tr>
<td>pallina</td>
<td>geomag</td>
<td>Spherical</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
<tr>
<td>pallina</td>
<td>geomag</td>
<td>Spherical</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
<tr>
<td>pallina</td>
<td>geomag</td>
<td>Spherical</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
<tr>
<td>pallina</td>
<td>geomag</td>
<td>Spherical</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
<tr>
<td>pallina</td>
<td>geomag</td>
<td>Spherical</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Rigid</td>
</tr>
</tbody>
</table>

Precision + Reliability + Liability issues
## Issues with SS-BDMS

<table>
<thead>
<tr>
<th>Facts</th>
<th>Consequences</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary collection of data, no random sample</td>
<td>Difficulties in estimating incidence/prevalence</td>
<td>IDB-like estimator based on area coverage</td>
</tr>
<tr>
<td>Non-emergency MDs cooperating</td>
<td>Difficulties in estimating mortality</td>
<td>Integration with newspapers clippings information</td>
</tr>
<tr>
<td>Difficulties in data coding (ICD9-CM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete object measurements</td>
<td>Geometric solid approximation in risk assessment</td>
<td>Data enhancement for known objects (e.g.: coins)</td>
</tr>
<tr>
<td>Unknown object shapes</td>
<td>Missing information block in risk assessment</td>
<td>Stochastic data augmentation</td>
</tr>
<tr>
<td>Brand identification</td>
<td>Reliability of indications</td>
<td>Reformulate the question</td>
</tr>
</tbody>
</table>

**SS Enhanced Data Model Structure (SS-EDMS)**

Targeted at risk assessment
## SS-EDMS Setup

<table>
<thead>
<tr>
<th>Core Data</th>
<th>Object Specific data</th>
<th>Data Enhancement</th>
<th>Stochastic Data augmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data as coming form the clinical records by physicians</td>
<td>Data characteristics expressed in their own language / with reference to the local situation</td>
<td>Data on shape, dimensions, ... as recalled by literature / internet search</td>
<td>Reconstruction of the probability distribution of basic objects characteristics</td>
</tr>
<tr>
<td>Derived by SS data collection system</td>
<td></td>
<td></td>
<td><strong>SS labs @UniPD</strong></td>
</tr>
</tbody>
</table>

**SS record structure**
Data enhancement

Clinically collected information

“1 centavo en la laringe de una chica”

Mexico

Measurements and composition

Click to [hide]

- Mass
  - 8 g (1863)\(^1\)
  - 9.5 g (1864)\(^2,3\)
  - 8.9 g (1869-1897)\(^4\)
  - 2 g (1882-1883, 1950-1969)\(^5\)
  - 2.61 g (1899-1905)\(^6\)
  - 3 g (1905-1949)\(^7\)
  - 1.5 g (1970-1973)\(^8\)

- Diameter
  - 26.5 mm (1863)\(^9\)
  - 25 mm (1864, 1869-1897)\(^5,9\)
  - 16 mm (1882-1883)\(^5\)
  - 19.5 mm (1899-1949)\(^7\)
  - 16 mm (1950-1969)\(^8\)
  - 13 mm (1970-1973)\(^9\)

- Composition
  - Copper (1863, 1864, 1869-1897)\(^1,2,3,4\)
  - Cupronickel (1882-1883)\(^2\)
  - Bronze (1905-1949)\(^7\)
  - Brass (1950-1973)\(^9\)
Data augmentation

“Semilla de girasol en el bronchio derecho”

Measurements taken on 20-200 semillas

Reconstruction of the Empirical Distribution Function of dimensions

Monte Carlo simulation

Generation of weighted dimensions of the semilla for inclusion in the risk analysis
The risk engine: Bayesian Model

\[ P(I|V, C) \approx P(V|I_{SS}, C) \times P(I_{SS}|I, C, M) \times P(I|C) \times P(V)^{-1} \]

\( V = \) object characteristics (volume, shape, …)

\( C, M = \) child characteristics (age, gender, …)

Susy Safe

Registration coverage

ICD records

...
Integration of medical competences

\[ P(I) = \int P(I|V, C) P(V,C) \]
Prior Elicitation process

- Participating MD from different specialties are involved
- About 15 MD are cooperating on a stable basis
The foreign bodies are coded using the Combined Nomenclature (CN) v. 8.

**Automatic re-coding into IDB-Eurostat and NEISS-CPSC standard**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000</td>
<td>Bead, pearl</td>
</tr>
<tr>
<td>25170000</td>
<td>Pebbles, gravel, broken or crushed stone, for concrete aggregates</td>
</tr>
<tr>
<td>36050000</td>
<td>Matches (excl. pyrotechnic articles of heading 3604)</td>
</tr>
<tr>
<td>40160000</td>
<td>Articles of vulcanized rubber (excl. hard rubber)</td>
</tr>
<tr>
<td>48180000</td>
<td>Toilet paper and similar paper, cellulose wadding or webs of cellulose fibers, of a kind used for household or sanitary purposes, in rolls of a width not exceeding 36 cm, or cut to size or shape</td>
</tr>
<tr>
<td>71130000</td>
<td>Articles of jewelry and parts thereof, of precious metal or of metal clad with precious metal</td>
</tr>
<tr>
<td>71180000</td>
<td>Coin, incl. legal tender (excl. medals, jewelry)</td>
</tr>
<tr>
<td>73180000</td>
<td>Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel</td>
</tr>
<tr>
<td>73190000</td>
<td>Sewing needles, knitting needles, bodkins, crochet hooks, embroidery stilettos and similar articles, for use in the hand, of iron or steel; safety pins and other pins of iron or steel, not elsewhere specified or included</td>
</tr>
<tr>
<td>85050000</td>
<td>Electromagnets (excl. magnets for medical use)</td>
</tr>
<tr>
<td>85230000</td>
<td>Discs, tapes, solid-state non-volatile storage devices, 'smart cards' and other media for the recording of sound or of other phenomena</td>
</tr>
<tr>
<td>93060000</td>
<td>Bombs, grenades, torpedoes, mines, missiles, Cartridge</td>
</tr>
<tr>
<td>95030000</td>
<td>Tricycles, scooters, pedal cars and similar wheeled toys; dolls’ carriages; dolls; other toys; reduced-size ('scale') models and similar recreational models, working or not; puzzles of all kinds</td>
</tr>
<tr>
<td>96000000</td>
<td>Buttons, press-fasteners, snap-fasteners and press studs, button molds and other parts of these articles</td>
</tr>
<tr>
<td>96080000</td>
<td>Ballpoint pens; felt-tipped and other porous-tipped pens and markers; fountain pens, stenograph pens and other pens; duplicating stylus; propelling or sliding pencils; pen-holders, pencil-holders and similar holders; parts (including caps and clips) of the foregoing articles, other than those of heading 9609</td>
</tr>
<tr>
<td>96090000</td>
<td>Pencils (other than pencils of heading 9608), crayons, pencil leads, pastels, drawing charcoal, writing or drawing chalks, and tailors' chalks</td>
</tr>
<tr>
<td>96150000</td>
<td>Combs, hair-slides and the like; hairpins, curling pins, curling grips, hair curlers and the like, other than those of heading 8516, and parts thereof</td>
</tr>
</tbody>
</table>
Enhanced Data Structure Model

**Bayesian Beta-Binomial model** has been implemented to compute the risk of a severe injury. Vague (Uniform distributions) and weakly informative (Beta distribution with parameters < 1) prior have been considered.

Conditional risk (median of the posterior distribution by FB type and age class of injured children) has been reported along with 95% credible interval.
A dynamic system for risk estimation

Epidemiological Evidence

Prior Information
Consumer Safety

Risk Models

Data

Clinics

Epidemiology

Prevention
THANKS!