Neurotoxicity of Mercury:
Two Fish Tales

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New York University School of Medicine
Disclosure

• I have no financial or academic conflicts to disclose
Objectives

• Describe the classic findings of acute neurotoxicity from mercury
• Describe the classic findings of *in-utero* neurotoxicity from mercury
• Discuss the evidence related to neurotoxicity from mercury in fish
• Describe the events leading to the false association between mercury in vaccines and autism
Road Map

• A few words about Louis Roche and the Award
• A few words about me
• Mercury poisoning
  • Background
  • Fish
• Autism
### Previous Louis Roche Awardees

<table>
<thead>
<tr>
<th>Alex Proudfoot</th>
<th>Donna Seger</th>
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<tbody>
<tr>
<td>Edward Krenzelok</td>
<td>Nick Bateman</td>
</tr>
<tr>
<td>Allister Vale</td>
<td>Andrew Dawson</td>
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<tr>
<td>Hans Persson</td>
<td>Philippe Hantson</td>
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<tr>
<td>Milton Tennebein</td>
<td>Randy Bond</td>
</tr>
<tr>
<td>Albert Jaeger</td>
<td>Hugo Kupferschmidt</td>
</tr>
<tr>
<td>Jeff Brent</td>
<td>Michael Greenberg</td>
</tr>
<tr>
<td>Jan Meulenbelt</td>
<td>Simon Thomas</td>
</tr>
<tr>
<td>Thomas Zilker</td>
<td>Me?</td>
</tr>
</tbody>
</table>
The Imposter Syndrome

• Term coined in 1978 by clinical psychologists Clance and Imes referring to high-achieving individuals marked by an inability to internalize their accomplishments and a persistent fear of being exposed as a "fraud".
Louis Roche

- Dominant
- Pioneering
- Fiery spirits
- Emphasized studying all aspects of poisoning
- Recognized that International collaboration was vital

? -1998
Louis Roche

✔ Dominant
  • Pioneering
  • Fiery spirits
  • Emphasized studying all aspects of poisoning
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✖ Pioneering
✔ Fiery spirits
✔ Emphasized studying all aspects of poisoning
✔ Recognized that International collaboration was vital

-1998
Me
Mercury is Cool
It is Wonderfully Radiopaque
It Can Be Very Toxic
Neurotoxicity
Union Records of Tremor in a Hg Worker
Chemist dies after toxin penetrates gloves

Associated Press

HANOVER, N.H. — A Dartmouth College scientist whose specialty was the dangers of heavy metals died of mercury poisoning this week, 10 months after as little as a drop of a rare toxic compound apparently seeped through her rubber gloves.

Karen Wetterhahn, 48, had been hospitalized since January, when tests showed 80 times the lethal dose of mercury in her blood, a college investigation showed.

After she was diagnosed on Jan. 28, Wetterhahn told investigators she remembered spilling one to several drops of dimethylmercury in August, Chemistry Department Chairman John S. Winn said yesterday.

After the diagnosis, Winn said Wetterhahn's attitude seemed to be:

“I know what it is, I know what to do about it. I'm in a good place. I'm getting good care. Let's get on with it.”

Three weeks after she was diagnosed, she went into a coma that lasted until her death Sunday at Dartmouth-Hitchcock Medical Center in Lebanon.

“Whether she knew the peril she was in at that time, I don't think we will ever know,” Winn said.

Wetterhahn, a cancer researcher, was using the compound to examine the effects of toxic metals on human cells. At the time of the accident, she was studying how mercury prevents cells from repairing themselves, much like cancer does.

Wetterhahn had two episodes of nausea and vomiting about three months after the spill, but Winn said no one will ever know if the mercury caused them.

Mercury attacks the central nervous system well before the victim shows symptoms, and Wetterhahn began losing her balance and having trouble speaking and hearing in January.

CHEMIST KAREN E. WETTERHAHN was accidentally poisoned in her own lab.
Figure 3. Cerebellar Hemispheric Sections from the Patient (Left) and from a Woman of Approximately the Same Age without Neurologic Disease (Right). Widespread shrinkage of the folia and diminution of the cerebellar cortical thickness are evident in the section from the patient.
Methylmercury induces oxidative injury, alterations in permeability and glutamine transport in cultured astrocytes

Zhaobao Yin¹, Dejan Milatovic¹, Judy L. Aschner¹, Tore Syversen², Joao B.T. Rocha³, Diogo O. Souza⁴, Marta Sidoryk⁵, Jan Albrecht⁵, and Michael Aschner¹

- Astrocytes were cultured with various concentrations of methyl Hg.

- MeHg induced a concentration-dependent reduction in the inner mitochondrial membrane potential ($\Delta \Psi_m$), as assessed by the potentiometric dye, tetramethylrhodamine ethyl ester (TMRE).
The maintenance of adequate intracellular glutathione (GSH) concentrations is dependent on the availability and transport of the rate-limiting substrate, cysteine.
Astrocyte cysteine uptake as a function of [MeHg]
Why I had my Amalgam Fillings REMOVED

Chilling FACTS About The Silent KILLER in Your MOUTH

Mercury Poisoning & Alzheimer’s Disease IT ISN’T A COINCIDENCE

SYMPTOMS OF MERCURY POISONING
- Irritability
- Anxiety
- Depression
- Memory loss
- Agitation
- Physical or verbal outbursts
- Emotional distress
- Restlessness
- Sleep disturbances
- Delusions

SYMPTOMS OF ALZHEIMER’S DISEASE
- Irritability
- Anxiety
- Depression
- Memory loss
- Agitation
- Physical or verbal outbursts
- Emotional distress
- Restlessness
- Sleep disturbances
- Delusions

www.realfoodrn.com

rawforbeauty.com

NYU School of Medicine
NYU Langone Medical Center
Slight Renal Effect of Mercury from Amalgam Fillings

Serife Eti¹, Richard Weisman², Robert Hoffman² and M. M. Reidenberg¹

¹Departments of Pharmacology and Medicine, Cornell University Medical College, New York, NY, and, ²New York City Poison Center, NYC Dept. Health, New York, NY, U.S.A.

BCPT 1995;76:47-49

- 100 healthy adults (18-44)
- Health questionnaire
- Urine Hg and N-acetyl-beta-glucosaminidase
- Those with amalgam fillings (N = 66) compared with those without (N = 34)
Results

The graph shows the relationship between Urine Mercury Level (ng/ml) and Total Amalgam Number. The data points indicate a trend where higher Total Amalgam Numbers correspond to higher Urine Mercury Levels.
## Results

<table>
<thead>
<tr>
<th>Groups</th>
<th>Urine Hg Median (95% CI) ng/mL</th>
<th>Urine NAG Median (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Dental amalgams</td>
<td>1 (1-2)</td>
<td>23 (18-27)</td>
</tr>
<tr>
<td>- Dental amalgams</td>
<td>0 (0-0.6)</td>
<td>16 (11-18)</td>
</tr>
<tr>
<td>p value</td>
<td>&lt; 0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

While both differences are statistically significant they are clinically irrelevant.
Figure Preoperative images from the left forearm (A) Photograph of keloid following polar biopsy (before radical excision).
Fish Tale 1: Mercury And Fish
GOT

This Toxic Heavy Metal is in TUNA and SWORDFISH, VACCINES, DENTAL FILLINGS, and in our AIR and WATER.

MERCURY?

It’s Time We Got It Out.

www.emagazine.com
Hg Concentrations Associated With Toxicity

- Fish in Minimata bay 10-30 PPM – 1950s
- Grain in Iraq 710-5700 PPM – 1971
  - Maternal hair - 18-598 PPM
- US FDA dietary limit for fish 1.0 PPM
- US Women consuming 3 fish meals/month
  - Maternal hair - 0.34-2.75 PPM
Mercury Dose Response Curve?

- Therapeutic effect
- Toxic effect
- Therapeutic index
- ED$_{50}$
- TD$_{50}$
Clarification

• No biological role for Hg in the body!!!

• No normal person preferentially ingests mercury

• Do the benefits of fish outweigh the risks of Hg??
Mercury Dose Response Curve?
Fish consumption has clear health benefits, and the risk posed by exposure to mercury is currently speculative.
Prenatal methylmercury exposure from ocean fish consumption in the Seychelles child development study

Lancet 2003;361:1686

Gary J Myers, Philip W Davidson, Christopher Cox, Conrad F Shalmye, Donna Palumbo, Elsa Cernichiari, Jean Sloane-Reeves, Gregory E Wilding, James Kost, Li-Shan Huang, Thomas W Clarkson

• 779 mother-infant pairs
• Mothers consumed fish 12/week
• 21 behavioral endpoints
• No support for a neurodevelopmental risk from prenatal Me-Hg exposure resulting solely from ocean fish consumption.
Associations between Prenatal and Recent Postnatal Methylmercury Exposure and Auditory Function at age 19 years in the Seychelles Child Development Study

Mark S. Orlando\textsuperscript{a}, Adam C. Dziorny\textsuperscript{b}, Donald Harrington\textsuperscript{c}, Tanzy Love\textsuperscript{c}, Conrad F. Shamlaye\textsuperscript{d}, Gene E. Watson\textsuperscript{e,f,g}, Edwin van Wijngaarden\textsuperscript{f,h}, Philip W. Davidson\textsuperscript{f,i,j}, and Gary J. Myers\textsuperscript{f,i,k}

Prenatal exposure to methyl mercury from fish consumption and polyunsaturated fatty acids: associations with child development at 20 mo of age in an observational study in the Republic of Seychelles\textsuperscript{1-4}

JJ Strain, Alison J Yeates, Edwin van Wijngaarden, Sally W Thurston, Maria S Mulhern, Emeir M McSorley, Gene E Watson, Tanzy M Love, Tristram H Smith, Kelley Yost, Donald Harrington, Conrad F Shamlaye, Juliette Henderson, Gary J Myers, and Philip W Davidson

- No association with prenatal exposure
- Some risk of postnatal exposure
Impact of prenatal methylmercury exposure on neurobehavioral function at age 14 years

Frodi Debes a, Esben Budtz-Jørgensen b,c, Pal Weihe a,c, Roberta F. White d, Philippe Grandjean c,e,*

Neurotoxicology and Teratology 28 (2006) 536–547

• 1022 consecutive singleton births
• Exposures levels defined
  • Cord blood and maternal hair
• Neuropsychological testing at 7 and 14 years
• Abnormalities correlated with exposure
Faeroes Vs Seychelles
Fish Intake, Contaminants, and Human Health
Evaluating the Risks and the Benefits  JAMA. 2006;296:1885-1899

Dariush Mozaffarian, MD, DrPH
Eric B. Rimm, ScD

Figure 2. Relationship Between Intake of Fish or Fish Oil and Relative Risks of CHD Death in Prospective Cohort Studies and Randomized Clinical Trials

eicosapentaenoic acid [EPA]
docosahexaenoic acid [DHA])
“For women of childbearing age, benefits of modest fish intake, excepting a few selected species, also outweigh risks.”

<table>
<thead>
<tr>
<th>High</th>
<th>Intermediate</th>
<th>Low</th>
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<tbody>
<tr>
<td>Mackerel (King)</td>
<td>Chilean bass</td>
<td>Anchovies</td>
</tr>
<tr>
<td>Shark</td>
<td>Grouper</td>
<td>Catfish</td>
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<tr>
<td>Swordfish</td>
<td>Halibut</td>
<td>Clams</td>
</tr>
<tr>
<td>Tilefish</td>
<td>Lobster (Northern/American)</td>
<td>Cod</td>
</tr>
<tr>
<td></td>
<td>Mackerel (Spanish)</td>
<td>Crab</td>
</tr>
<tr>
<td></td>
<td>Orange Roughy</td>
<td>Crawfish</td>
</tr>
<tr>
<td></td>
<td>Tuna (canned, Albacore)</td>
<td>Haddock</td>
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<td></td>
<td>Tuna (fresh/frozen)</td>
<td>Herring</td>
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<td></td>
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<td>Lobster (Spiny)</td>
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<td>Mackerel</td>
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<td>(Atlantic and Chub)</td>
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<td></td>
<td></td>
<td>Oysters</td>
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<td></td>
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<td>Perch (Ocean)</td>
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<td></td>
<td></td>
<td>Pollock</td>
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<td></td>
<td></td>
<td>Salmon</td>
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<td>Scallops</td>
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<td></td>
<td></td>
<td>Shrimp</td>
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<tr>
<td></td>
<td></td>
<td>Squid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tilapia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trout (fresh-water)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tuna (canned, light)</td>
</tr>
</tbody>
</table>

* Based on the FDA’s Food Monitoring Program (www.fda.gov). Seafood with the highest mercury content have mean concentrations of >0.7 parts per million (ppm). Those in the lowest category have mean mercury concentrations of ≤0.1 ppm.
Fish Intake in Pregnancy and Child Growth
A Pooled Analysis of 15 European and US Birth Cohorts

Figure 3. Body Mass Index (BMI) Percentile Trajectories From 3 Months to 6 Years According to Different Levels of Fish Intake in Pregnancy

Fish Conclusion

- There are small amounts of mercury in almost all fish
- The benefits of a reasonable diet that includes fish seem to outweigh the risk of mercury in the fish
- Too much of a good thing is rarely good.
Fish Tale 2: Mercury Autism
Thimerosal Does Not Equal Methyl Mercury

\[ \text{Thimerosal:} \quad \text{CH}_3\text{HgS} \quad \text{Hg}^2+ \]

\[ \text{Methyl Mercury:} \quad \text{CH}_3\text{Hg}^2+ \]
Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Summary

Background We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.

Methods 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.

Findings Onset of behavioural symptoms was associated by the parents, with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and otitis media in another. All 12 children had intestinal abnormalities ranging from ileal lymphoid nodular hyperplasia to aloid ulceration. Histology showed patchy chronic inflammation in 11 children and active ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible poststreptococcal or vaccine encephalitis (one). There were no focal neurological abnormalities and MRI and EEG tests were normal. Abnormal laboratory results were significantly raised urinary ethylmalonic acid compared with age-matched controls (p=0.03), low haemoglobin in four children, and low 51Cr-ethylenediaminetetraacetic acid in two children.

Introduction We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and vomiting, and in some cases, food intolerance. We describe the clinical findings, and gastrointestinal features, of these children.

Patients and methods

12 children, consecutively referred to the Department of Paediatric Gastroenterology, with a history of a pervasive developmental disorder with loss of acquired skills and intestinal symptoms, diarrhoea, abdominal pain, bloating, and food intolerance, were investigated. All children were admitted to the ward for a week, accompanied by their parents.

Clinical investigations

Gastrointestinal symptoms were examined, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases, the history was obtained by the senior clinician (J W S). Neurological and psychiatric assessments were done by consultant staff (P V, N M M) with HAM-A criteria. Developmental assessment included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, ileocolonoscopy was performed by SHM or MAH under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal findings in the terminal ileum. Barium follow-through radiography was possible in some cases.

Also under sedation, cerebral magnetic-resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

Laboratory investigations

Thyroid function, serum long-chain fatty acids, and cerebrospinal-fluid lactate were measured to exclude known causes of childhood neurodegenerative disease. Urinary ethylmalonic acid was measured.
Commentary by Chen and DeStefano: Vaccine Adverse Events: Causal or Coincidental

• Without such a system, vaccine-safety concerns such as that reported by Wakefield and colleagues may snowball into societal tragedies when the media and the public confuse association with causality and shun immunization.
• This painful history was shared by the UK over pertussis in the 1970s after another similar case-series was widely publicized, and it is likely to be repeated all too easily over MMR.
• This would be tragic because passion would then conquer reason and the facts again in the UK.
Retraction of an interpretation

This statement refers to the Early Report “Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children”, published in The Lancet in 1998. It is made by 10 of the 12 original authors who could be contacted. It should be noted that this statement does not necessarily reflect the views of the other co-authors.

The main thrust of this paper was the first description of an unexpected intestinal lesion in the children reported. Further evidence has been forthcoming in studies from the Royal Free Centre for Paediatric Gastroenterology and other groups to support and extend these findings. While much uncertainty remains about the nature of these changes, we believe it important that such work continues, as autistic children can potentially be helped by recognition and treatment of gastrointestinal problems.

We wish to make it clear that in this paper no causal link was established between MMR vaccine and autism as the data were insufficient. However, the possibility of such a link was raised and consequent events have had major implications for public health. In view of this, we consider now is the appropriate time that we should together formally retract the interpretation placed upon these findings in the paper, according to precedent.

We were unable to contact John Linnell.

*Simon H Murch, Andrew Anthony, David H Casson, Mohsin Malik, Mark Berelowitz, Amar P Dhillon, Michael A Thomson, Alan Valentine, Susan E Davies, John A Walker-Smith

Centre for Paediatric Gastroenterology (SHM, MAT, JAW-S); and Departments of Histopathology (AA, APD), Child Psychiatry (MB), and Radiology (AV), Royal Free and University College Medical School, Royal Free Campus, London NW3 2PF, UK; Institute of Child Health, Royal Liverpool Children’s Hospital, Liverpool (DHC); Department of Paediatrics, Queen Elizabeth the Queen Mother Hospital, Margate, Kent (MM); and Department of Histopathology and Cytology, Addenbrooke’s Hospital, Cambridge, UK (SED)
(e-mail: s.murch@rfc.ucl.ac.uk)

Love them. Protect them. 

Never inject them.

There are NO safe vaccines!

Chronic Ear Infections
ADD
Allergies
Asthma
Autism
Death
Diabetes
Meningitis
Polio
Seizures
SBS
and SIDS are caused by adverse reactions to vaccine poisons.

VaccineTruth.com 1-888-249-1421

MERCURY POISONING AND AUTISM

It isn’t a coincidence.

SYMPTOMS OF MERCURY POISONING IN CHILDREN

- Loss of Speech
- Social Withdrawal
- Reduced Eye Contact
- Repetitive Behaviors
- Hand-flapping, Toe-walking
- Temper Tantrums
- Sleep Disturbances
- Seizures

SYMPTOMS OF AUTISM IN CHILDREN

- Loss of Speech
- Social Withdrawal
- Reduced Eye Contact
- Repetitive Behaviors
- Hand-flapping, Toe-walking
- Temper Tantrums
- Sleep Disturbances
- Seizures
Lancet retracts MMR paper after GMC finds Andrew Wakefield guilty of dishonesty

Clare Dyer BMJ

The Lancet has retracted the 12 year old paper that sparked an international crisis of confidence in the safety of the measles, mumps, and rubella (MMR) vaccine when its lead author suggested a link between the vaccine and autism.

Andrew Wakefield was found guilty by the UK General Medical Council last week of dishonesty and flouting ethics protocols.

The regulatory body held that Dr Wakefield abused his position, subjected children to intrusive procedures such as lumbar puncture and colonoscopy that were not clinically indicated, carried out research that breached the conditions of ethics committee approval, and brought the medical profession into disrepute.

In a statement published online (www.thelancet.com) the editors of the Lancet said: “Following the judgment of the UK General Medical Council’s Fitness to Practise Panel on Jan 28, 2010, it has become clear that several elements of the 1998 paper by Wakefield et al

Dr Andrew Wakefield was found guilty of dishonesty, and research on developmentally disordered children without ethical approval and contrary to their clinical interests
Quotes

• Dr. Wakefield abused his position, subjected children to intrusive procedures such as lumbar puncture and colonoscopy that were not clinically indicated, carried out research that breached the conditions of ethics committee approval, and brought the medical profession into disrepute.

• Dr. Wakefield, failed to disclose that his research had received funding from the Legal Aid Board through a solicitor who hoped to mount a legal action against the manufacturer and that he had also filed a patent application for a new vaccine.
Early Thimerosal Exposure and Neuropsychological Outcomes at 7 to 10 Years

Association Between Thimerosal-Containing Vaccine and Autism

Anders Hviid, MSc
Michael Stellfeld, MD
Jan Wohlfahrt, MSc
Mads Melbye, MD, PhD

Context  Mercuric compounds are nephrotoxic and neurotoxic at high doses. Thimerosal, a preservative used widely in vaccine formulations, contains ethylmercury. Thus it has been suggested that childhood vaccination with thimerosal-containing vaccine could be causally related to neurodevelopmental disorders such as autism.

Objective  To determine whether vaccination with a thimerosal-containing vaccine is associated with development of autism.


Main Outcome Measures  Rate ratio (RR) for autism and other autistic-spectrum disorders, including trend with dose of ethylmercury.

Results  During 2,986,654 person-years, we identified 440 autism cases and 787 cases of other autistic-spectrum disorders. The risk of autism and other autistic-spectrum disorders did not differ significantly between children vaccinated with thimerosal-containing vaccine and children vaccinated with thimerosal-free vaccine (RR, 0.85 [95% confidence interval CI), 0.60-1.20] for autism; RR, 1.12 [95% CI, 0.88-1.43] for other autistic-spectrum disorders). Furthermore, we found no evidence of a dose-response association (increase in RR per 25 μg of ethylmercury, 0.98 [95% CI, 0.90-1.06] for autism and 1.03 [95% CI, 0.98-1.09] for other autistic-spectrum disorders).

Conclusion  The results do not support a causal relationship between childhood vaccination with thimerosal-containing vaccines and development of autistic-spectrum disorders.

JAMA. 2003;290:1763-1766

www.jama.com
Robert De Niro says he believes in link between vaccines and autism

Oscar-winner Robert De Niro is being honored for his pro-LGBT activism just as he’s confounded doctors and scientists for continuing to defend a discredited anti-vaccine film that his own film festival rejected.

Robert De Niro Suggests That His Wife Thinks Son's Autism Is Connected to Vaccines as He Defends Vaxxed
Autism Conclusion

• People would prefer to be poisoned over knowing and accepting uncertainty

• This gives them someone to blame AND

• Removes them of any guilt they may have over their children’s condition
Louis Roche

- Dominant
- Pioneering
- Fiery spirits
- Emphasized studying all aspects of poisoning
- Recognized that International collaboration was vital

? -1998
Secret to Success

• Think big, but start small
• Look for black swans
• Don’t let foolish events lead you astray
  • “Folly that succeeds is folly none the less”
  • “Study what you got” – Marty Smilkstein
• Finish what you start
• Work on projects that make a difference
• Collaborate with people who are far smarter than you, but often don’t know it yet!
International Collaboration
Other International Collaborations

- The Journal (Clinical Toxicology)
- Lipid Emulsion in Poisoning Workgroup
  - Charcoal, QT, others
- Joint Symposia at International meetings
Other People Who Have To Be Thanked

- Mary Ann Howland
- Maria Mercurio-Zappala
- Richard Weisman
- 30 years of Toxicology Fellows and visiting residents at the NYCPCC
- The Boards of AACT, ACMT, AAPCC
- EAPCCT