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A diatribe on fluoride
The Lords of the Highly Reactive Ion Disposal Scheme
Once upon a time in a land far, far away

The children in had ugly teeth
The Brothers Grimm suspected witches evil water spirits called *fluorides* were casting ugly spells on teeth.

But a potion master found it was evil water spirits called *fluorides* were casting ugly spells on teeth.
An evil wizard of Isengard heard tell of this, and thought of his problem with toxic fluoride waste disposal.
So he seized control of the water gods and added his fluorides to the streams of the unwary.
And cavities were reduced with no side effects at all. Trust me!
The inheritors of this power fought to ensure his legacy at all costs.

Look at this data.

Your time here is over!
Fortunately for the hapless scientist, a good wizard restored his life.

You must give him back his job!
But in the land of US
the fluorides
were still put in the water of the unwary

Hopefully not THE END
<table>
<thead>
<tr>
<th>The land far, far away</th>
<th>Colorado Springs</th>
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<tbody>
<tr>
<td>Brothers Grimm</td>
<td>McKay and Black - fluorosis = less caries</td>
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<tr>
<td>Potion master</td>
<td>ALCOA scientists find fluoride = fluorosis</td>
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<td>The evil wizard</td>
<td>Andrew Mellon - founder of ALCOA and Secretary of Treasury that included USPHS</td>
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<td>Isengard</td>
<td>ALCOA and Florida fertilizer industry</td>
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<td>The water gods</td>
<td>USPHS</td>
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<td>The minions</td>
<td>EPA, ADA etc.</td>
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<tr>
<td>Frodo</td>
<td>EPA scientist</td>
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<tr>
<td>The spider</td>
<td>EPA minions</td>
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<tr>
<td>Good wizard</td>
<td>Robert Reich, Secretary of Labor</td>
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</table>
Does fluoride in drinking water reduce tooth decay?
WHO map on caries incidence in children
Global % population with fluoridated water
2009
Cochrane metaanalysis - June 2015

14% increase in children with no decay in their permanent teeth.
No evidence for a benefit in adults

However, they and others have concluded that studies had a:
“virtual absence of quantitative, statistical methods”
“nonrandom methods of selecting data”
“high sensitivity of the results to the way in which the study populations were grouped”
Reviewers state their confidence is limited by: the observational nature of the study designs and the high risk of bias within (all of) the studies.

Critically they also find that any evidence is not applicable to current lifestyles (Data is pre 1975).

Most obviously, the adoption of topical fluoride use (toothpaste) has superseded any benefit of fluoridation.
Global reaction these reviews

OK, so not enough evidence for strong conclusions

Stu interpretation = water fluoridation is not evidence based medicine.

USA reaction to review

We only care/know about teeth

We have ignored the evidence for so long that changing our stance will make us look bad
Other evidence

Water fluoridation does not correlate with reduction in caries
bad science observation by Stu

No fluoridation in Northern Ireland

Compulsory fluoridation in Ireland
Data

Water fluoridation does not correlate with reduction in caries (DMFT = decay, missing, filled)
Data (from WHO)
Dental decay in Western Europe (very little fluoridation) has declined at the same rate as in the United States over the past half century.

For the seven countries with the lowest tooth decay rates, six have no water fluoridation programs, and England has 10% fluoridation.
Tooth Decay Trends in Fluoridated and Non-Fluoridated Countries

WHO data on DMFT in 12 year olds*

- Decayed, Missing or Filled Teeth (DMFT)

<table>
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<th>Years 1970 through 2010</th>
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</tbody>
</table>

- New Zealand
- Italy
- Iceland
- Japan
- Australia
- Belgium
- United States
- Ireland

- Non-Fluoridated
- Fluoridated


** No water or salt fluoridation.
So why the reduction in caries

Use of fluoridated toothpaste is >95% in the OECD countries

CDC since 1999

“Fluoride prevents dental caries predominately after eruption of the tooth into the mouth, and its actions primarily are topical for both adults and children.”

The National Research Council since 2006

“The major anticaries benefit of fluoride is topical and not systemic.”
Does fluoride in drinking water reduce tooth decay?

Probably, but only when there is no toothpaste.
Does fluoride in drinking water have negative health effects?
Fluorine is the most electronegative and reactive element on Earth.

It is useful to human health in small/trace amounts but **toxic at >1.5 mg/L** (WHO, 2011).

“Airborne fluorides have caused more worldwide damage to domestic animals than any other air pollutant.”

USDA
WHO guideline <1.5 mg/L

The effect depends on intake, concentration, exposure duration, absorption capacity (nutritional status) and age.

So the standard is supposed to be modified by region/age.

In hot dry climates, the standard should be much lower

EPA drinking water standard for fluoride pre 2015

Enforceable < 4.0 mg/L
Non-enforceable secondary standard < 2.0 mg/L
Groundwater fluoride above 1.5mg/L is considered a major health risk by the WHO.
Fluoride in things requires a poison control warning even in the USA
Excessive fluoride intake can cause

Acute toxic hazard, such as to people with impaired kidney function,

Chronic toxic hazards of gene mutations, cancer, reproductive effects, neurotoxicity, bone pathology and dental fluorosis.
Neurotoxin
More than 400 peer reviewed studies find that fluoride is a neurotoxin

Anatomical effects
Neurodegeneration and neurotransmitter deficiency

200+ animal studies
Prolonged exposure is bad
especially with iodine deficiency or aluminum excess

3 human studies
Gestational exposure impairs fetal brain development

Functional deficits

**Reduced intelligence** - 53 studies in human populations
Moderately high fluoride reduces IQ by ~10 points
Fetal exposure seems to be a major factor
FDA banned fluoride supplements for expecting mothers in the 60’s

**Impaired learning and memory** - >40 studies in animals
Rodents ingesting fluoride have impaired learning and memory

**Neurobehavioral deficits** - 7 human and 5 animal studies
>fluoride correlates to impaired visual-spatial organization
IQ effects

Anna L. Choi (2012)
Developmental Fluoride Neurotoxicity: A Systematic Review and Meta-Analysis. Environmental Health Perspectives

Average loss in IQ was equivalent to seven IQ points.

Same finding in a Lancet meta-analysis in 2014
Fetal development seems to be a major risk window

Barshash et al 2017

Increase in maternal urine fluoride of 0.5mg/L predicted 2.5 point lower IQ

In Bashash et al. (2017) and Thomas et al. (2017) the fluoride levels in the urine of the pregnant women were similar to adults living in fluoridated communities in the U.S.

Valdez Jiménez et al. (2017)

Tested effect at higher exposures (most still <4mg/L) IQ <90 points was 25% in control group (F urine 1.5 mg/g creatinine) and 58% of children in the exposed group (F urine >5 mg/g creatinine)
Systemic effects


Looked at ultrastructural changes of epithelial cells of liver, adrenal glands, and thyroid glands of human fetuses from a fluorosis-endemic area

Fluoride damage to cell structures was multifaceted.

Deficits in microvilli

Swollen mitochondria with absent or reduced cristae

Reduced nucleoproteins on ER

Damaged and dilated nuclei
Spleen/Immune function

Sodium fluoride impairs splenic innate immunity via inactivation of TLR2/MyD88 signaling pathway in mice.

Sodium fluoride induces splenocyte autophagy via the mammalian targets of rapamycin (mTOR) signaling pathway in growing mice.

Sodium fluoride (NaF) causes toxic effects on splenic development in mice.
Negative effects on Kidney Function


Sodium fluoride induces renal inflammatory responses by activating NF-κB signaling pathway and reducing anti-inflammatory cytokine expression in mice.
Negative effects on **Thyroid Function**

Fluoride is an effective reducer of thyroid function in people with hyperthyroidism.

Potential for fluoride to contribute to hypothyroidism: fluoride can

1. exacerbate the anti-thyroid effect of iodine deficiency
2. cause goiter in some individuals
3. alter thyroid hormone consistent with a general thyroid suppressant
Cancer Incidence

The source of fluoride (SFA) contains arsenic, which is a demonstrated carcinogen.

In addition, the National Toxicology Program (NTP), in “the preponderance of evidence” from laboratory studies indicates that fluoride is a mutagen.

Some evidence for osteosarcoma in males not females (human and rat) (Bassin 2006)

Some evidence for bladder and lung cancer in humans (Grandjean 2004)
Does fluoride in drinking water have negative health effects?

Yes, lots....
Is that going to change anything in the US?
By 2012

there were more people drinking
artificially fluoridated water
in the USA
than the rest of the World combined
After evidence of negative health effects became convincing, fluoridation actually increased in the USA.
And fluoridation is still extolled as awesome

Pew Center map from 2013
The EPA has reevaluated the current science on fluoride.

EPA will rely on these new assessments to review the existing maximum level of fluoride allowed in drinking water and determine whether drinking water regulations for fluoride should be revised.

EPA will review the drinking water standard to make sure that it continues to protect against unwanted effects of excessive exposure. We don’t want to admit cancer and neuro-effects exist because then we look incompetent and immoral for quashing data.

EPA’s examination of the fluoride drinking water public health goal and enforceable standard will be based on this new science, along with other information such as analytical methods and treatment feasibility.

New science = 1991
The EPA appears reluctant to use evidence to guide practice

**Why?** (Stu’s take)

Health policy is driven by commercial vested interests in the USA

In other developed countries it is driven by government trying to minimize the cost of universal healthcare
In 1985
William Marcus PhD, an EPA scientist
objected for being forced to write into regulations
that high levels of fluoride in water
were fine despite documented negative health effects

The EPA professionals union tried to settle
the ethics issue quietly in house
but the EPA caved to external political pressure
to set the fluoride level at 4mg/L

They then fired William Marcus
The Union fought for William Marcus

Investigation identified
highly improper communications
between chemical company attorneys and EPA managers,
explicit documentation that the companies orchestrated his removal

EPA violated the subpoena - shredded embarrassing notes

Trial found for Dr. Marcus on every count
He was reinstated, with full back pay and damages.

EPA continued to harass him and he won even more ‘damages’
Fluoride levels in the United States were lowered to recommended levels of 0.7ppm in 2015.
Is that going to change anything in the US?

Not soon....
Further reading

History of discovery that fluoride affects caries
nice who did what but propaganda


Why the Union for EPA scientists opposes fluoridation

https://fluoridealert.org/articles/epa-union/
https://www.whistleblowers.org/members/william-marcus/

An evidence based change of heart from the Dentist who led the drive for fluoridation in NZ

https://fluoridealert.org/articles/colquhoun/
Some other cool topics where evidence based medicine fails

**Reducing salt intake** - only the weakest evidence that it helps

**Vaccines** - some save lives, some are unhelpful
lack of logic in CDC policy provides ammunition to anti-vaxxers

**Fetal ultrasound** - it tracks with autism better than anything else

**Antioxidants** - supplements shorten lifespan

**Sterile hospitals and clinical care** - clean has better outcomes
Vaccines. Good, bad, or.... depends on the vaccine and the patient
Ignoring data is standard in the vaccine argument on both sides
United States Measles Mortality Rates


Measles Vaccine Introduced 1963
These lives matter
Infectious disease mortality 1900 to 1999
Mortality is not the total disease burden
Factors in mortality 1900 to 1999

- Flu pandemic
- Sulfonamides
- Penicillin
- Isoniazid
- HIV
Are there any useless or dangerous vaccines in use?
**Cochrane Collaboration review** of flu vaccines clinical evidence concerning flu vaccines is “rubbish” calls for placebo-controlled randomized clinical trials

**Center for Infectious Disease Research and Policy**

Recommends **at risk** people get the vaccine

Criticizes its over-promotion

"We have over-promoted and over-hyped this vaccine...

it does not protect as promoted.

It's all a sales job: it's all public relations".
Varicella-Zoster virus

Causes **Chickenpox** on first infection
It is the *chicken* of all ‘pox’ (symptoms are mild, weak)
Globally endemic with 140 million cases per year

Often asymptomatic
or
5 to 10 days of
small, itchy blisters
fever, fatigue, headache

Rarely pneumonia or encephalitis
Deaths ~1 in 60,000 documented cases
Undocumented cases not included in these stats
Deaths are almost all adult men

Other risk factors for complication are:
  Immune deficiency
  Non-immune pregnancy

**Treatment**

Calamine lotion for itching
Acetaminophen for pain/fever

For people at increased risk of complications (i.e.< immune) antiviral aciclovir is recommended

Most common complication is shingles
Shingles

Caused by reactivation of the virus decades after the initial infection

Small, itchy/painful blisters
fever, fatigue, headache

Usually in older adults
Rarely pneumonia or encephalitis

Thought to occur when specific cell mediated immunity declines

Usually only have 1 episode (episode is a booster)

Lifetime risk of shingles increases with age
~50% of people who live to 85 years have had shingles
The varicella vaccine has been used in the US since 1995

In many countries VZV vaccination is not given

Concerns are:

* It may not be enough to produce herd immunity
* It might increase age of infection for the non-immune
* The incidence of shingles may increase

Those countries have been waiting to see what happens in the vaccine crazy US
This is not enough to achieve herd immunity

Use has clearly decreased number of childhood presenting cases by 90%

Reduction in complications and possibly in infections

but VZV is still endemic

and 30% of vaccinated individuals don’t gain immunity
It might increase age of infection for the non-immune

Overall morbidity and mortality still seems to be reduced
but the first vaccinated kids are not that old yet

The vaccinated individuals that didn’t gain immunity (30%)
are likely to get infected at some point
(from grandma’s shingles)

Their outcomes are likely to be worse

Some of them might be pregnant (watch the next 10 years)
congenital and neonatal chickenpox will increase
The incidence of shingles may increase

Multiple studies have convincingly established that exposure to chickenpox temporarily boosts immunity

A child in the house delays shingles for ~20 years

less chickenpox = more shingles

Shingles has doubled in the US since VZV vaccination

Costs for shingles complications have increased

>$700 per year per case
The most recent (eLife 2015) study shows that
1. Vaccinating kids doubles shingles
2. Shingles presents in younger adults when vaccine is used

We could vaccinate everyone at the same time
and boost everyone at 2 year intervals

My opinion
Only vaccinate the ‘at risk’ until the vaccine is more effective
How do we pick which vaccines to give?
<table>
<thead>
<tr>
<th>Disease</th>
<th>Prevalence</th>
<th>Morbidity</th>
<th>Efficacy</th>
<th>Side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles</td>
<td>200/yr</td>
<td>~0.1% fatal</td>
<td>&gt;96% Life</td>
<td>Moderate: Fever, fever seizures, rash, low platelets</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Severe: deafness, epilepsy, coma, CNS damage ~1 per million</td>
</tr>
<tr>
<td>Mumps</td>
<td>1700/yr</td>
<td>&lt;1% severe rarely fatal</td>
<td>90% &gt;10 years</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Severe:</td>
</tr>
<tr>
<td>Rubella</td>
<td>&lt;10/yr</td>
<td>0.05% severe fetal risk</td>
<td>&gt;90% &gt;15 years</td>
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<td></td>
<td></td>
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<tr>
<td>Diptheria</td>
<td>0.2/yr</td>
<td>&gt;5% fatal</td>
<td>85% ~10 years</td>
<td>Moderate: Fever, vomiting, diarrhea &gt;1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Severe: epilepsy, coma, CNS damage ~1 per million</td>
</tr>
<tr>
<td>Tetanus</td>
<td>30/yr</td>
<td>2 fatal/yr oldsters</td>
<td>95% 13 years</td>
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<tr>
<td>Pertussis</td>
<td>In kids 9200/yr</td>
<td>6 infant fatal/yr</td>
<td>80% ~5 years</td>
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<tr>
<td>Hep B</td>
<td>~40k/yr STD + IV</td>
<td>~2000/yr liver cancer</td>
<td>&gt;90%</td>
<td>fatal ~150/yr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;20 yrs</td>
<td></td>
</tr>
<tr>
<td>Polio</td>
<td>0</td>
<td>2 in 10k death</td>
<td>&gt;99%</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td>Last 1979</td>
<td></td>
<td>&gt;18 years</td>
<td>Old vaccine was risky</td>
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<tr>
<td>Rota</td>
<td>30 fatal/yr</td>
<td></td>
<td>90%</td>
<td></td>
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<td>?</td>
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<tr>
<td>Pneumococcal</td>
<td>120k 1.5k meningitis</td>
<td></td>
<td>~5 years</td>
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</table>
Most plausible ways vaccines can cause health issues

Uncontrolled fever in children

Syncope (fainting) and subsequent traumatic brain injury (TBI)
15% of HPV recipients report syncope

Causes actual disease

Increasing susceptibility to related disorders

Allergic reaction
Anthrax

1 case per year
cutaneous transmission (from animals)

Why not vaccinate?

Polio

0 cases per year
originating in the US
(for the last 40 years)

Why still vaccinate?
Multi-drug resistant tuberculosis
BCG in use since 1921
Reduces infection and inhibits disease progression
3 in 10k has swelling under the arm

Most widely used vaccine worldwide
WHO most essential and safe meds
$0.16 most of the World - $200 in the USA
Recently became voluntary because of reduced risk
UK in 1953 - 94 immunizations to prevent 1 case of TB
UK in 2005 - 12k immunizations to prevent 1 case of TB

US tests for and treats latent TB

Why not apply this approach to Polio?
At birth or not at birth

The immune system is immature (<5 months)
Maternal antibodies are present

T-cell populations take time to switch from suppression of maternal immune system (CD8 suppressor) to self defense (CD4 helper)

Takes 6 to 12 months

Vaccination during the neonatal period must overcome these barriers
At birth or not at birth
Some vaccines are usually safe and partially effective at birth.

**BCG - Tuberculosis**
Justification for use at birth is
\textit{need for immediate protection}
in parts of the World where TB is endemic.

**Hepatitis B**
Justification for use at birth is
\textit{they might not see a doctor before they become an intravenous drug user or sexually active}
At birth or not at birth

Other vaccines are ineffective and/or negatively affect the development of immunity

*Streptococcus pneumoniae* vaccine (PPV23)
Not immunogenic <2 years

Pertussis vaccine
Not immunogenic <3 months
Earlier vaccination reduces responses to boosters
(= decreased response to antigen)

A similar effect is seen for diphtheria and tetanus.
In development

Development of a vaccine against Alzheimer’s Disease was stopped at phase 1 clinical trial due to side effects in some participants.

Why might a vaccine not be a good idea for AD?