How to Write a Really Bad Cancer Story

How to Write a Really Bad* Cancer Story

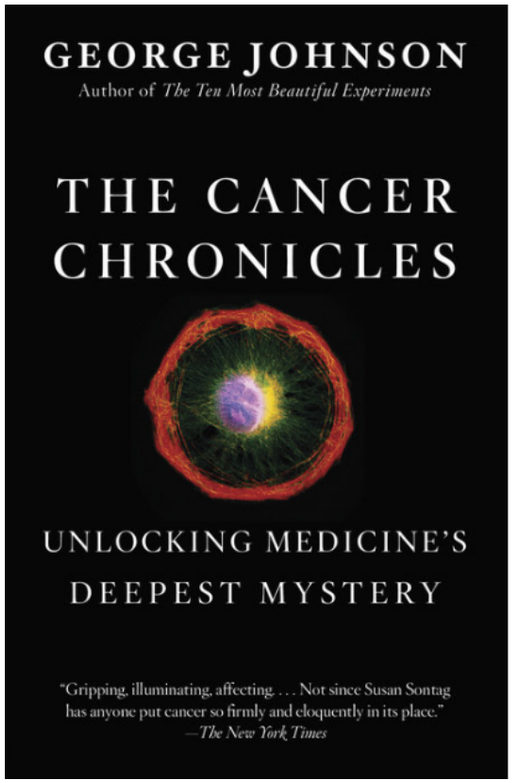
*as in misleading and uninformed

I’m speaking ironically

alternate title:

Myths to Avoid When Writing About Cancer

(and many other maddeningly complex things)



drawn from research for this book.
also many stories in the New York Times including in my column “Raw Data” which ran monthly for several years

“Several years ago, for reasons that will become clear in these pages, I was driven to learn everything I could about the science of cancer. How much could I as an outsider, a longtime science writer more comfortable with the sharp edges of cosmology and physics, grasp of this wet, amorphous, and ever-changing terrain? . . .

here is how the preface begins

. . . I imagined the expanse before me as a boundless rain forest whose breadth and diversity could never be captured within a single book or even a single mind. I would find an opening at one of the borders and enter, cutting my own path, exploring where my curiosity led—until I emerged years later at the other side, with a better understanding of what we know and don't know about cancer. I was in for some remarkable surprises."

So much of what I had thought was true about cancer turned out to be very uncertain or even flat-out wrong.

And for all of its unique horror, cancer turns out to be a fascinating intellectual puzzle.

the biggest surprise
too often though, we as journalists get it wrong

I wonder now, though, if the steady presence of music around me didn't contribute importantly to my sense of the cancer as a thing with its own rights. Now it sounds a little cracked to describe, but then I often felt that the tumor was as much a part of me as my liver or lungs and could call for its needs of space and food. I only hoped that it wouldn't need all of me.

—Reynolds Price, *A Whole New Life*

Tuberculosis used to be called "consumption" because it consumes. It dissolved a lung or bone. But cancer produces. It is a monster of productivity.

—John Gunther, *Death Be Not Proud*

two epigraphs from the book that I think capture cancer's eerie essence
Price: astrocytoma wrapped itself around his spinal column just below the neck
he called it "the gray eel"
 left him paralyzed from the waist down.
found solace in music

Contents

briefly scan through the contents to give you a birds eye view

Cancer cluster

"a greater-than-expected number of cancer cases that occurs within a group of people in a defined geographic area over a specific period of time" – U.S. Centers for Disease Control

A good place to start is with cancer clusters.

a concerned citizen suspects that there are an abnormal number of cancer cases in the town and that a nearby factory, waste dump, or other industrial site is to blame

> “Lay a chessboard on a table. Then grab a handful of rice and let the grains fall and scatter where they may. They won’t spread out uniformly with the same number occupying each square. Instead there will be clusters. Now suppose that the chessboard is a map of the United States and the grains are cases of cancer.
>
> “Each year about 1.6 million cases of cancer are diagnosed in the United States, and epidemiologists regularly hear from people worried that their town has been plagued with an unusually large visitation. Time after time, the clusters have turned out to be statistical illusions —artifacts of chance.”

Before we dive in, I’d like to get this image in your head. From a piece I wrote for Slate.

A disclaimer:

I'm not saying that toxic waste isn't an important issue. Or that discharges from various industrial processes are not harming streams, lakes, and the air and can make people sick.

I'm not saying that polluters shouldn't be tracked down and held to account.

What I want to show you is that despite the common wisdom, clusters of cancer caused by environmental carcinogens are so rare that . . .

having been berated more than once on social media or in emails by angry readers, let me start with a disclaimer.

, . . well consider this report:

Journal List › Taylor & Francis Open Select › PMC3408895

CRITICAL REVIEWS IN TOXICOLOGY

Taylor & Francis

Crit Rev Toxicol. 2012 Jul; 42(6): 474–490.
Published online 2012 Apr 21. doi: 10.3109/10408444.2012.675315

PMCID: PMC3408895

Cancer clusters in the USA: What do the last twenty years of state and federal investigations tell us?

Michael Goodman,[1] Joshua S. Naiman,[2,3] Dina Goodman,[4] and Judy S. LaKind[2,5,6]

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Out of 428 investigations only three "indicated that at least some evidence was found of an association between the cancer(s) of concern and hypothesized exposures, although the level of certainty of these findings differed."
-- Goodman, et al *Cancer clusters in the USA: What do the last twenty years of state and federal investigations tell us?*

Since the study was published this has remained the consensus view
three with "at least some evidence"

Woburn, Mass and Toms River, NJ (the third was not really a community cluster but involved workers exposed to asbestos
Charleston Navy Shipyard) an occupational cancer cluster.

But first . . .

pleural cancer, mesothelioma
19 people and 12 worked at shipyards
so this is what is called an occupational cancer cluster

Here’s maybe the most famous. Hinkley Calif. cancer cluster
hexavalent chromium. compressor station for natural gas. Pacific Gas & Electric
Erin Brockovich. You saw the movie but you probably didn’t see the epidemiological study that came out 11 years later

Preliminary Assessment of Cancer Occurrence in the Hinkley Census Tract, 1996-2008
John W. Morgan, DrPH, CPH Epidemiologist, DSCSP January 10, 2011

Conclusions: These findings identify cancer occurrence in the Hinkley Census Tract that is slightly, but not significantly *below* the number of new cases expected for an average risk population having the same demographic characteristics as the Hinkley Census Tract population. Similar to the previous two cancer assessments that evaluate cancer occurrence in 1988-1993 and 1988- 1998 (1), these 1996-2008 preliminary findings do not identify a generalized cancer excess in the Census Tract encompassing Hinkley, San Bernardino County. Staff in the DSCSP will continue to monitor cancer occurrence in the Hinkley Census Tract and elsewhere in the DSCSP.

so the rate was slightly less than general population. but long before this study came out the lawsuit was settled out of court for $333 million. lawyers not scientists negotiated a mutually agreeable reality — according to case law, not biology and geology — and then movie producers spread the myth

ENVIRONMENT JUNE 3, 2013

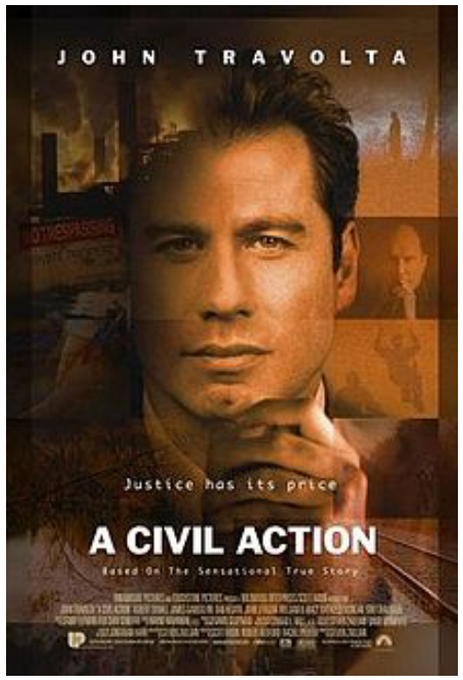
Erin Brockovich's Biggest Debunker, Debunked

MIND

Debunking the Debunker's Debunker

Fire in the Mind | By George Johnson | Jun 19, 2013 5:27 AM

push back against the study. Mother Jones: writer worked for an advocacy group that was starting with the foregone conclusion that hexavalent chromium caused the cancers in Hinkley. The group also fired up Miles O'Brian who did a very misleading report on PBS Newshour. I wrote my own piece debunking the debunker's debunker. Years later there remains little reason to believe that Hinkley was a bonafide cancer cluster



Here’s another famous case.

Woburn, Mass. — one of the three out of >400 in that study that might be real
A very good nonfiction book by Jonathan Harr
and a movie that was not so good

Woburn, Massachusetts

21 childhood leukemia cases over a period of 17 years when 5.5 would be expected.

The suspect: Drinking water tainted with trichloroethylene (TCE) and perchloroethylene

Class-action lawsuit settled out of court

First of all these are not huge numbers. That surprised me at first. I had thought of cancer clusters as involving hundreds or thousands of people.
In fact you have to look at the numbers very closely to see something resembling a pattern, and it is easy to see pictures in the clouds

“a non-significant association between potential for exposure to contaminated water during maternal pregnancy and leukemia diagnosis, (odds ratio = 8.33, 95% CI 0.73-94.67). However, a significant dose-response relationship (P < 0.05) was identified for this exposure period. In contrast, the child's potential for exposure from birth to diagnosis showed no association with leukemia risk. Wide confidence intervals suggest cautious interpretation of association magnitudes.” -- *A case-control study of childhood leukemia in Woburn, Massachusetts: the relationship between leukemia incidence and exposure to public drinking water.* Costas K1, Knorr RS, Condon SK.

Found for boys but not girls -- no biological explanation for why that would be.

the lowdown on Woburn. And curiously, the excess cancers found in boys but not girls. No known biological reason for why that would be. Was it an environmental tragedy be only a statistical fluke?


TOMS RIVER, NEW JERSEY

Toms River, New Jersey

14 childhood cancers over a period of 13 years when between 9 and 10 cases was considered normal

Final conclusion:

Among 8 girls whose mothers had drunk most often from a contaminated well, 5 had leukemia, and 3 did not. “However, it is important to note that there is considerable uncertainty in the findings.” -- *Case-control Study of Childhood Cancers in Dover Township (Ocean County), New Jersey, January 2003*

Boys were not affected -- the opposite of Woburn and again no biological explanation. This case too was settled out of court for many millions

The second possible residential cluster was in Toms River, New Jersey. A mostly excellent book about this by a friend and colleague won a Pulitzer prize for nonfiction. You can read my review in Slate.

You have to wonder. If limiting the analysis to girls hadn’t uncovered an association, would the next step have been to distinguish between those with brown hair and blond?
Again was this a real cancer cluster or a statistical fluke? Whatever, Danny DeVito optioned the movie rights.

Erin Brockovich? Very probably not.

Woburn, Massachusetts? Maybe if you squint pretty hard.

Toms River? Keep squinting . . .

So, to summarize . . .

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Cancer clusters in the USA: What do the last twenty years of state and federal investigations tell us?

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return to this study, it's maybe less surprising now

So why do so many people continue to believe that cancer clusters are a major problem? Or that environmental toxins are driving a modern cancer epidemic?

Part of the problem is the way cancer — in genera — is often covered in the press

1. A resident of a town near a chemical factory, an abandoned waste dump, or some industrial plant becomes distraught that they or their child or a neighbor has been diagnosed with cancer.

2. They canvass the town and, sure enough, there are other cancer cases too.

They probably don't inquire whether any of the cancer victims smoke cigarettes, or whether they are obese, or drink excessive amounts of alcohol -- established risk factors for cancer.)

Or take into account the cancer victims' age. (60 percent of cancers diagnosed in people 65 or older -- the result of the load of cellular mutations that accumulates in all of us as we go through life.)

with all of these cases the stories flooded newspapers and magazines and TV news shows.
the familiar structure. contacted by worried resident.

The baked-in assumption is that, in the absence of some chemical contaminant, there would be no childhood cancer in the community.

Since there are several children with cancer there must be a common cause.

They demand an investigation, and they call the press.

Anne Anderson, whose child died of leukemia, stands by the map of Woburn, with pushpins indicating the sites of leukemia victims and toxic waste.

LEUKEMIA STRIKES A SMALL TOWN

In Woburn, Mass., a town with one of the 10 most hazardous waste sites in America, 16 children have died of the disease.

A STIFF MORNING breeze rolls a basketball from one yard to the next in a neighborhood of newly shingled homes with asphalt driveways just wide enough for one car. Inside a maroon ranch house, a bedroom door still bears the name "Jim" in black and gold metal letters. Anne Anderson, tall and blonde, with soft Norwegian features and smoky blue-gray eyes, sits in her son's room, reading in a deep velvet chair.

desk is a glossy street map spotted with blue plastic pushpins, 16 of them, each representing a child who has died of leukemia since 1969. One of those children was Jimmy Anderson.

According to the National Cancer Institute, the average incidence of leukemia is 3.74 cases per 100,000 children. In Woburn, a town of 36,000, in addition to the 16 blue pins on the map, there are eight red ones for children now ill with the disease. In Anne Anderson's neighborhood of East Woburn alone, there have been 12 cases, six within a few blocks of her home. The odds

and tanneries no longer operating in the area. The Environmental Protection Agency has listed this tract among the 10 most hazardous waste sites in the United States. And studies have shown that the children struck by leukemia in Woburn had only one relevant factor in common: They lived in a neighborhood that drew its water from two wells contaminated by toxic carcinogenic chemicals.

A clear case of cause and effect? A layman might assume so, but traditional medical epidemiology, the science of causes of epidemics, cannot prove what the

NYT Magazine on Woburn

“A STIFF MORNING breeze rolls a basketball from one yard to the next in a neighborhood of newly shingled homes with asphalt driveways just wide enough for one car. Inside a maroon ranch house, a bedroom door still bears the name "Jim" in black and gold metal letters. Anne Anderson, tall and blonde, with soft Norwegian features and smoky blue-gray eyes, sits in her son's room, reading in a deep velvet chair.

More often, though, she can be found downtown in Woburn, a commuter suburb 10 miles north of Boston, where she works in the storefront office of a volunteer organization called For A Cleaner Environment. Not far from her desk is a glossy street map spotted with blue plastic pushpins, 16 of them, each representing a child who has died of leukemia since 1969. One of those children was Jimmy Anderson.

now how are these stories generally written

The New York Times

What's Wrong in Toms River?

June 1, 1996

In Linda Gillick's living room is a large county map covered with red pushpins. One pin marks her house, and her son, Michael, who at 3 months was diagnosed with a rare cancer. Another highlights the house of Linda Pascarella, whose toddler daughter died a few years ago of another rare cancer. There is also a pin for Amber Dering, a tiny redhead who came down with childhood leukemia.

There are many more, all representing children under the age of 20 who have come down with all sorts of cancers, and Gillick and many others in this community are convinced that something in the air, or water, or soil of this seaside town is to blame.

Now, state and federal officials are starting to acknowledge that Gillick and the others may be right.

Ocean County, which includes Toms River, had a rate of childhood brain and central nervous system cancer nearly 70 percent above the state average for the years 1979 to 1991, according to a recent New Jersey Department of Health study. In Toms River alone, these two cancers were diagnosed at a rate three times higher than the state average in children under age 20, and seven times higher in children under age 5.

Washington Post on Tom's River.
Michael Gillick: neuroblastoma
(Remember that it was leukemia that the study found might be connected to the toxic waste. not neuroblastoma: cancer of the sympathetic nervous system. "The incidence of neuroblastoma is 10.2 cases per million children under 15 years of age" ~700-800 new cases are reported annually"

How good reporters can write bad cancer stories.

Your editor wants human interest. People in the story. So you lead with one of the victims. If you're not careful you may already be conveying them as victims even though that is far from having been established — and maybe never will be.

Because you are an empathetic human you lean toward giving each victim the benefit of the doubt. They are suffering, whether physically or psychologically, and deserve our sympathy. You feel compelled to honor their personal truth.

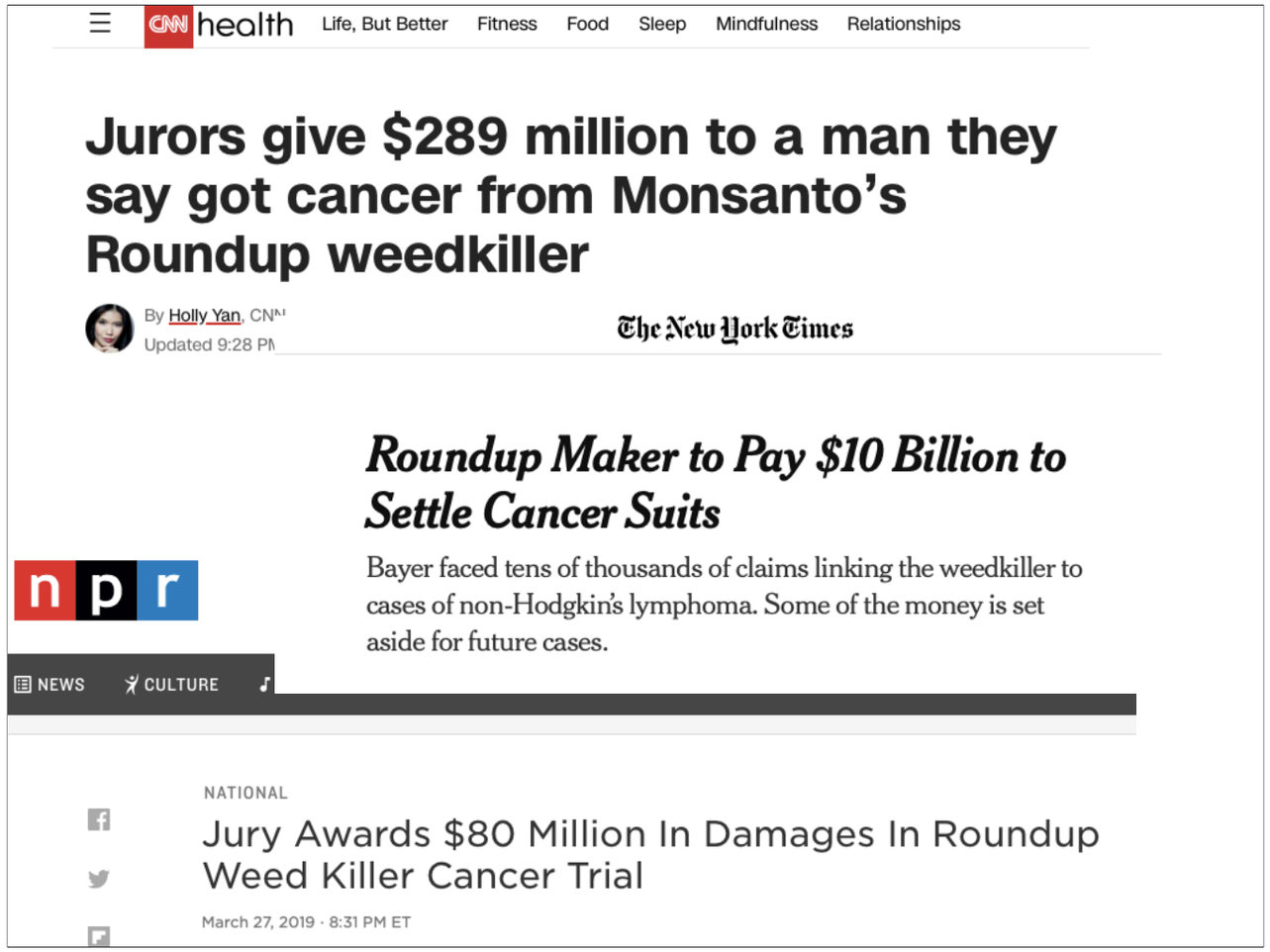
As a reporter you also want to tell a compelling story. We journalists often think of ourselves as rebels. ("All the President's Men"). One of the great mythological archetypes is David vs Goliath. The people fighting the chemical company.

how does this happen?

We also pride ourselves as skeptics, who question — as well we should — the self-serving pronouncements of corporations and politicians. Too often we don't bring the same skepticism to the victims and their advocates.

Naomi Oreskes and Erik Conway's book *Merchants of Doubt*. How corporations like tobacco companies try to breed uncertainty about the science — for their own benefit.

But so do personal injury and mass-tort lawyers looking for the deepest pockets when they represent plaintiffs with cancer. So do advocacy organizations that have their own agendas. The hard part of journalism is closing in on something resembling truth — one that lies between the extremes.



moving on. cancer clusters are not necessarily geographical
Roundup. nonhodgkin lymphoma

Mutation Research/Reviews in Mutation Research
Volume 781, July–September 2019, Pages 186-206

Review

Exposure to glyphosate-based herbicides and risk for non-Hodgkin lymphoma: A meta-analysis and supporting evidence

Luoping Zhang [a], Iemaan Rana [a], Rachel M. Shaffer [b], Emanuela Taioli [c], Lianne Sheppard [b, d]

the evidence is sketchy at best. 2019 study

9. Conclusions and Future Directions

The rise of glyphosate as the most widely used herbicide raises serious health concerns, given its potential links with NHL. Using our high-exposure *a priori* hypothesis and including the recently updated AHS cohort in a meta-analysis for the first time, *we report that exposure [to glyphosate-based herbicides] is associated with increased risk of [nonHodgkin lymphoma] in humans. . . . However, given the heterogeneity between the studies included, the numerical risk estimates should be interpreted with caution*.

this was an outlier

The International Agency for Research on Cancer , World Health Organization of the United Nations.

Group 2A: "Probably carcinogenic to humans" There is strong evidence that it can cause cancer in humans, but at present it is not conclusive.

reasons to be dubious

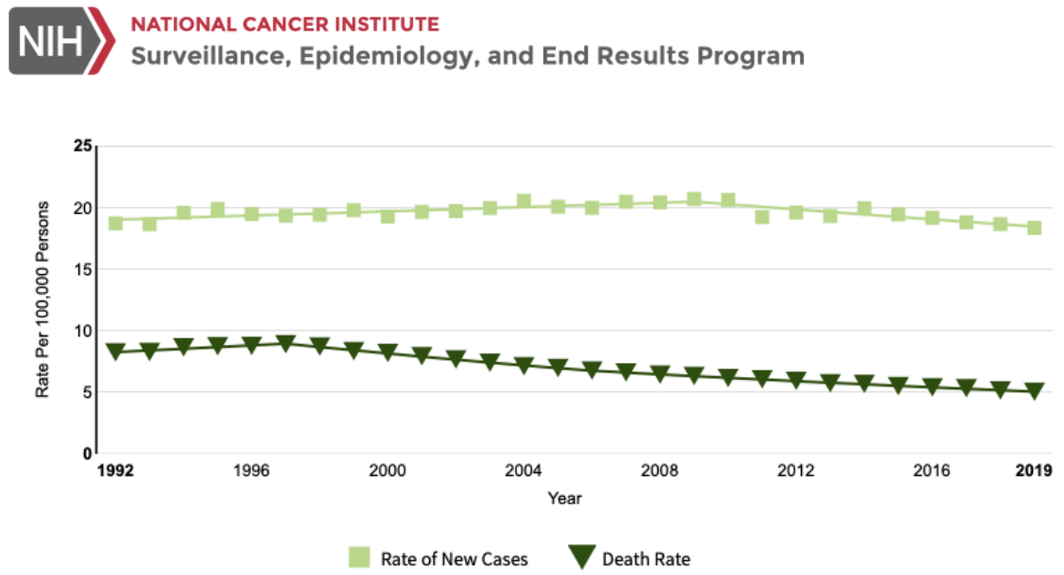
The EPA

- **No risks of concern to human health from current uses of glyphosate. Glyphosate products used according to label directions do not result in risks to children or adults. . . .**

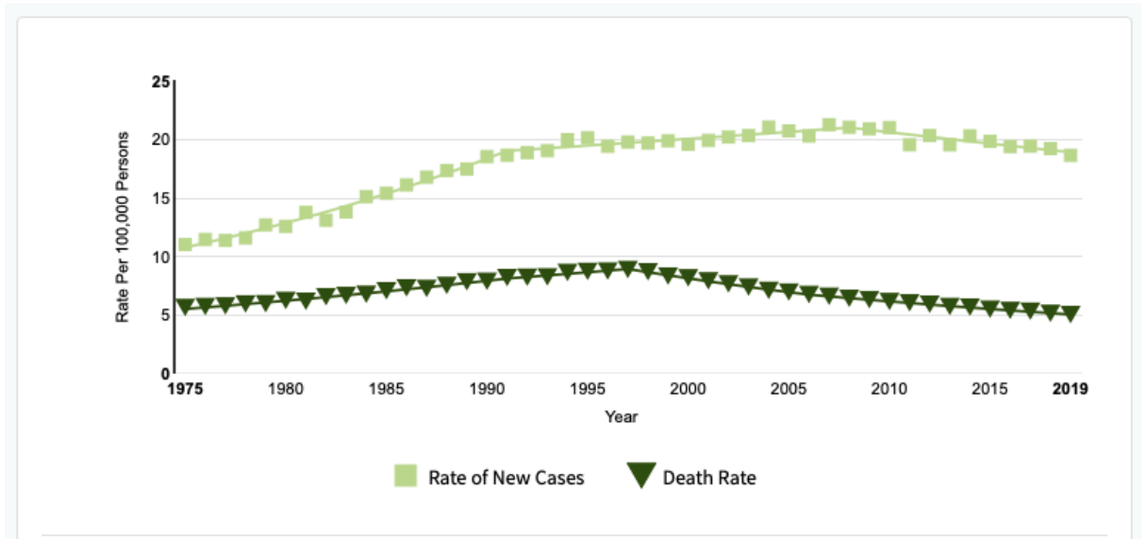
- **No evidence that glyphosate causes cancer in humans. The Agency concluded that glyphosate is not likely to be carcinogenic to humans. *EPA considered a significantly more extensive and relevant dataset than the International Agency on the Research for Cancer (IARC)*.**

EPA went on to do a more extensive study. General consensus is that there may be a small risk in occupational settings — workers spraying glyphosate day after day in large volumes. But no evidence that there is any risk to home gardeners. But again it is the lawyers settling cases for reasons only tangentially related to the science.

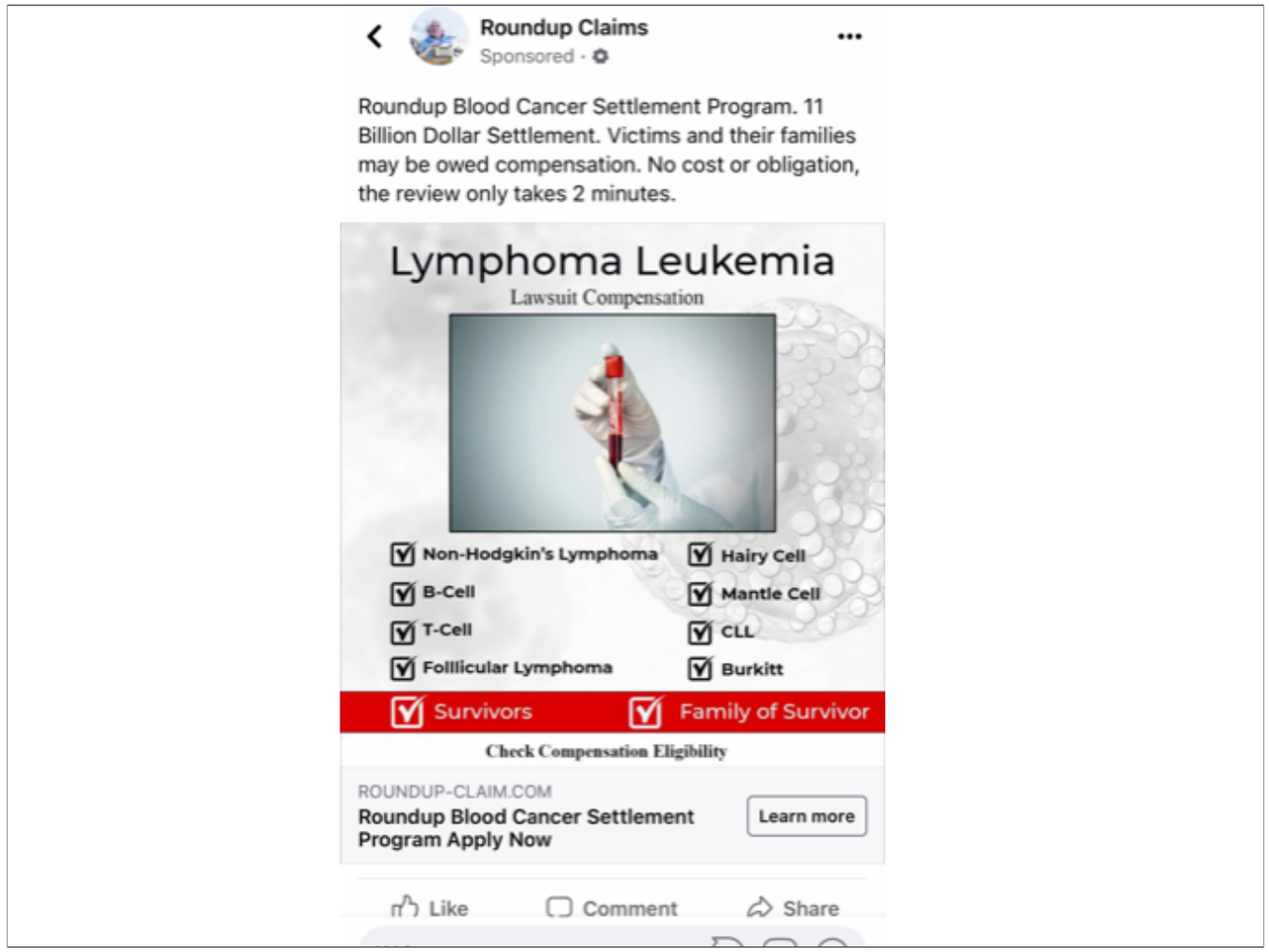
SEER stats on nonHodgkin lymphoma



Look at the stats from SEER on Hodgkin lymphoma —



going back further it looks more alarming.
tracks with increase in HIV, and one of the big risk factors is immunocompromised
and as RoundUp use increases the NHL cases level off and start to fall



A sidenote. I went on Facebook shortly after I pulled up these studies on Google. This is what appeared in my timeline.

Select-Justice
Sponsored ·

Those affected by Non-Hodgkin's Lymphoma or Chronic Lymphocytic Leukemia (CLL) after spraying Roundup may be entitled to compensation.

selectjustice.com
Take This Free Evaluation Apply now
It just takes a few minutes.

Like Comment Share

52

7 Shares

Most relevant

3:05

Roundup Injuries Settlement
Sponsored ·

Individuals Diagnosed With Non-Hodgkin's Lymphoma, B or T Cell, Chronic Lymphocytic Leukemia, Mantle Cell, and Hairy Cell A... See More

roseninjurylawyers.lpages.co
Get Compensation Now - Time Limited 👉
Learn more

2K 670 Comments 830 Shares

Like Comment Share

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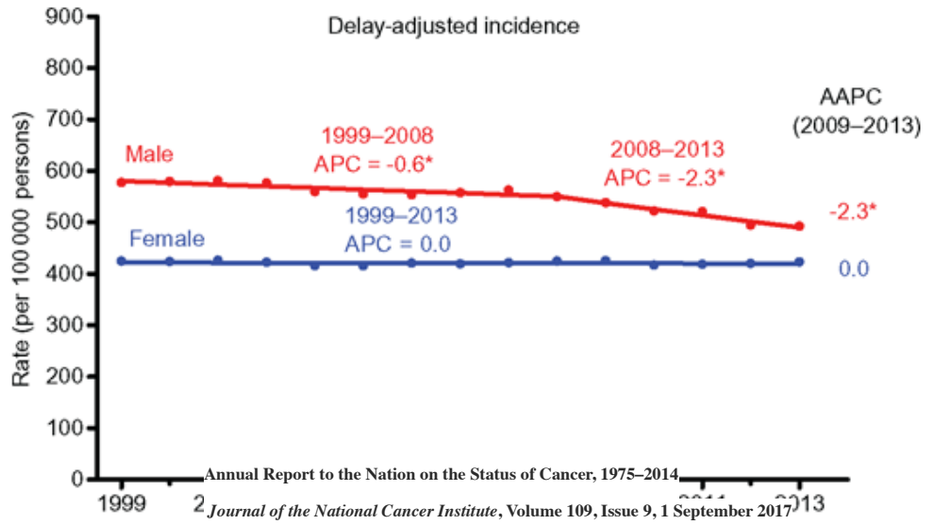
So often with cancer causation what initially seems like a great story so often fizzles in the end. Yet the overwhelming view of the public is that environmental contaminants are a primary cause of what seems like an epidemic of cancer.

So why are our instincts so wrong?

to summarize . . .

Cancer Incidence Rates for the Most Common Cancers

All cancers



Annual Report to the Nation on the Status of Cancer, 1975–2014

Journal of the National Cancer Institute, Volume 109, Issue 9, 1 September 2017

First of all, there isn't a cancer epidemic. cancer is not rising out of control

measured in raw numbers there are far more cases of cancer than there were 50, 100 and presumably 10,000 years ago.

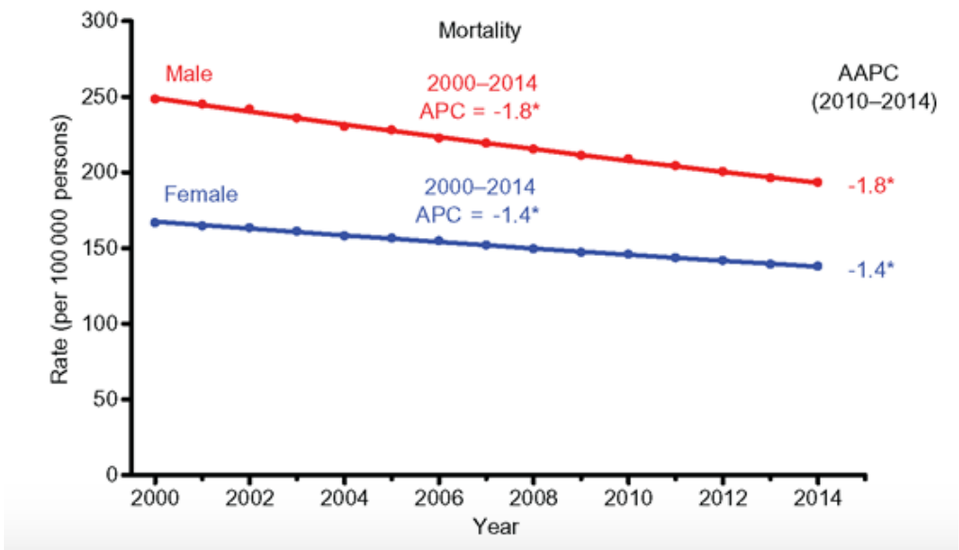
but of course that is because there are far more people. and we are living to a much longer age. They live long enough to get cancer.

this chart is the incidence of cancer. how often it occurs. adjusted for aging of the population

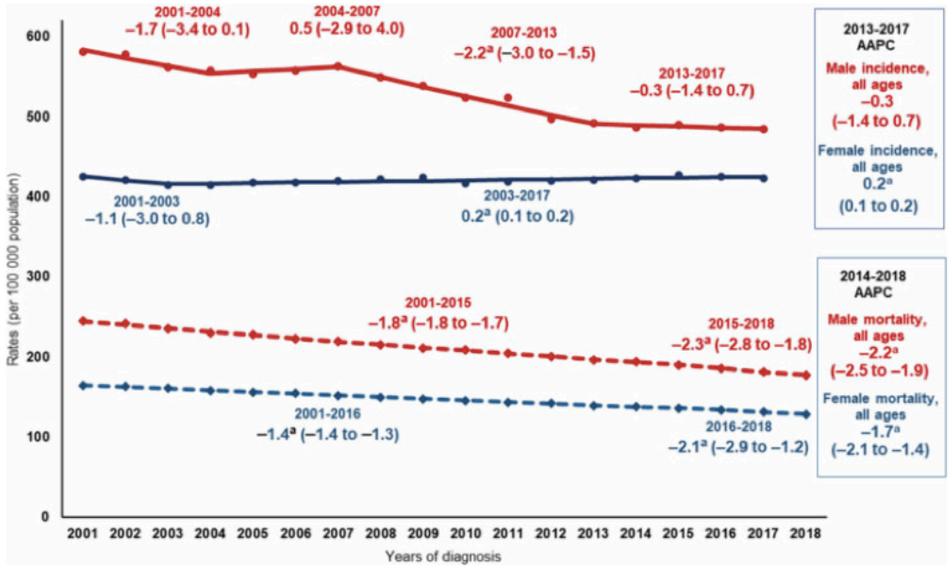
far less likely to die from bubonic plague, typhoid . . .

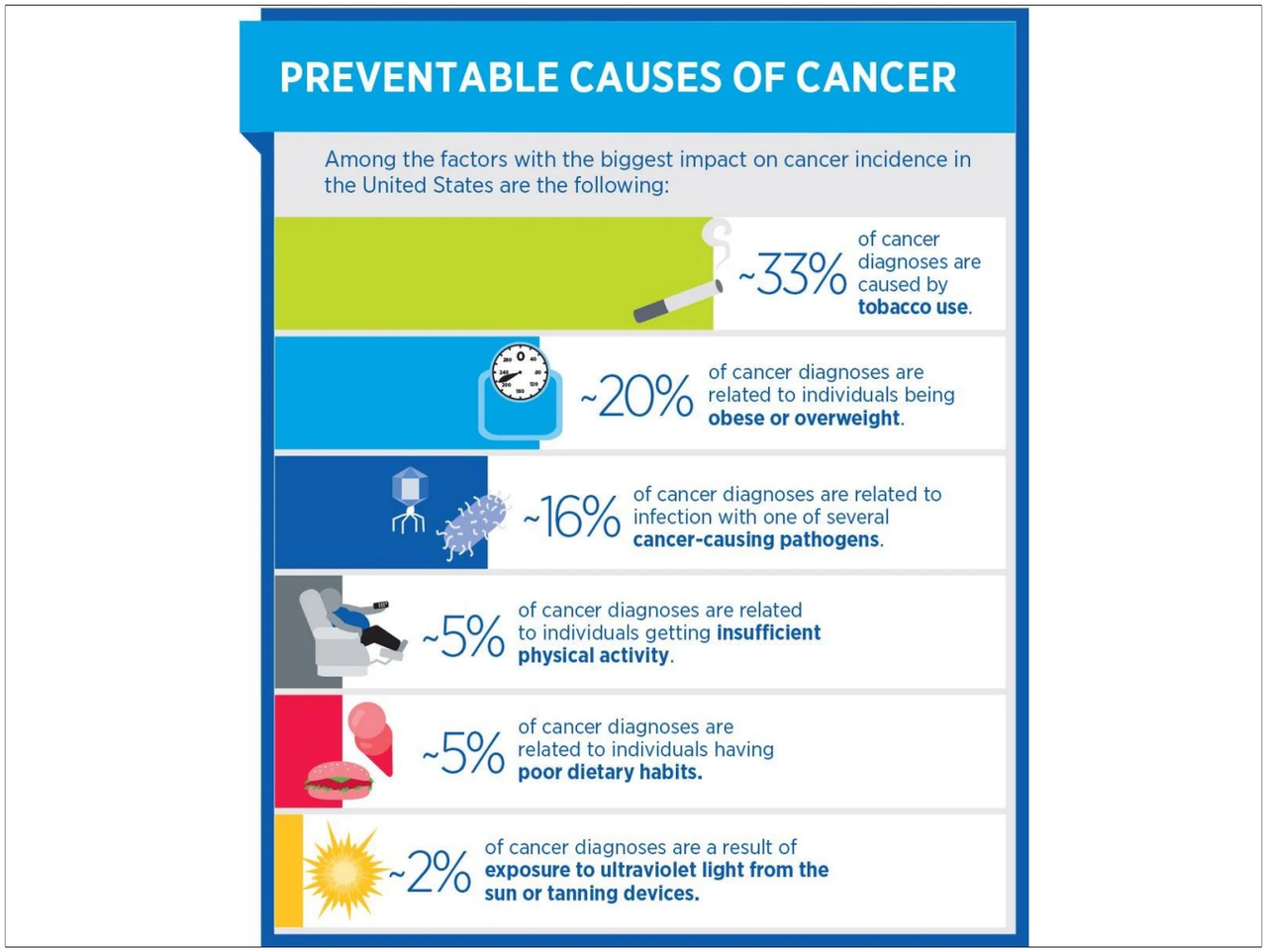
so we live long enough to get cancer.

the red line starts higher because of lung cancer. women got a later start

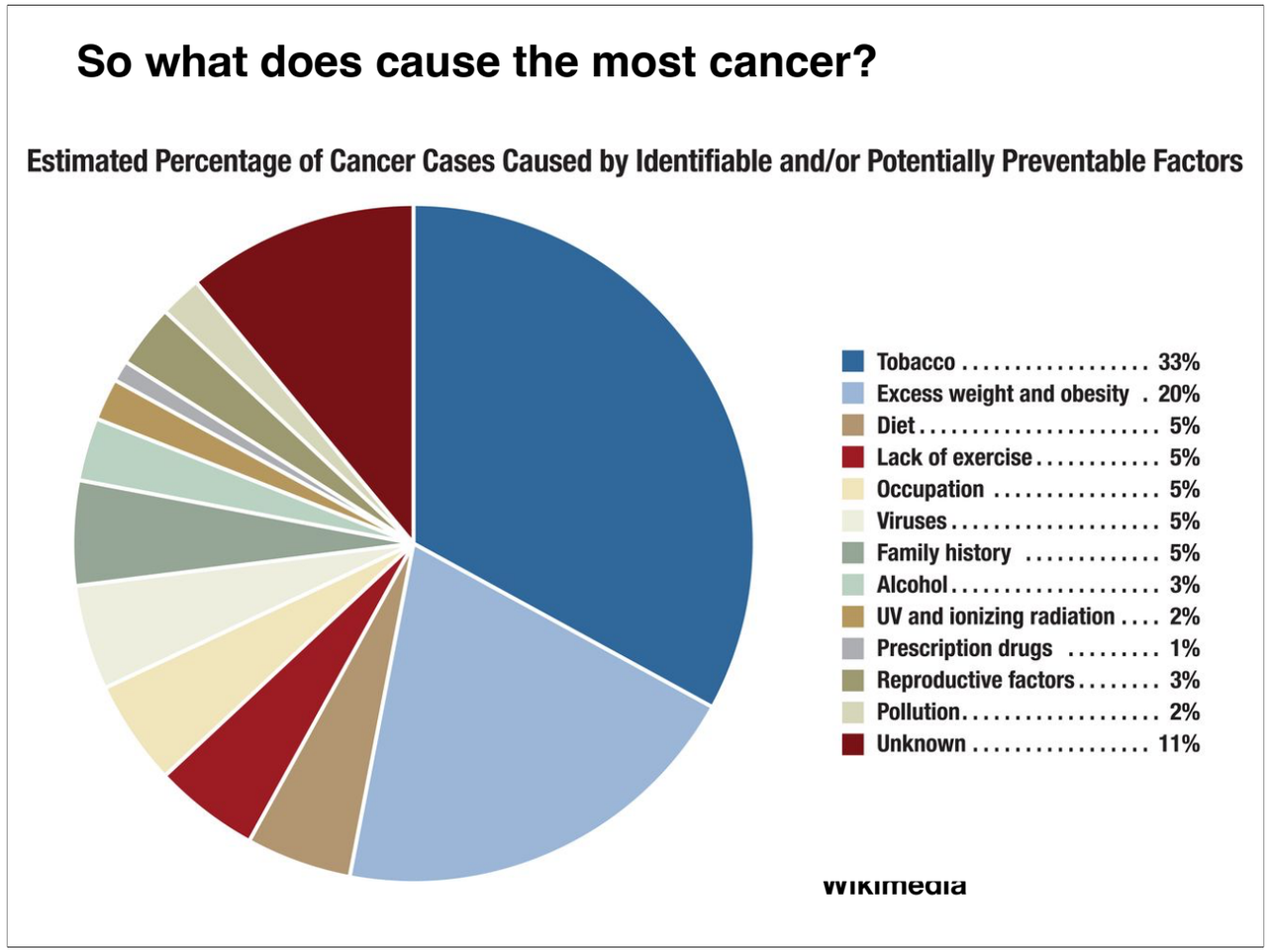


Mortality — number of deaths from cancer
again adjusted for the aging of the population


2001-2004
–1.7 (–3.4 to 0.1)
2004-2007
0.5 (–2.9 to 4.0)
2007-2013
–2.2[a] (–3.0 to –1.5)
2013-2017
–0.3 (–1.4 to 0.7)
2001-2003
–1.1 (–3.0 to 0.8)
2003-2017
0.2[a] (0.1 to 0.2)
2001-2015
–1.8[a] (–1.8 to –1.7)
2015-2018
–2.3[a] (–2.8 to –1.8)
2001-2016
–1.4[a] (–1.4 to –1.3)
2016-2018
–2.1[a] (–2.9 to –1.2)
2013-2017 AAPC
Male incidence, all ages
–0.3
(–1.4 to 0.7)
Female incidence, all ages
0.2[a]
(0.1 to 0.2)
2014-2018 AAPC
Male mortality, all ages
–2.2[a]
(–2.5 to –1.9)
Female mortality, all ages
–1.7[a]
(–2.1 to –1.4)
Rates (per 100 000 population)
600
500
400
300
200
100
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Years of diagnosis



meaning of “environmental” — everything that genetically inherited
and only a few percent of cancers are genetic



So what causes cancer?
 a small proportion of cancers are hereditary -- inherited genetic defects are linked to just a few percent of all cancers
and some cancers — another few percent— are caused by viruses or bacteria
the estimates vary. liver cancer by the hepatitis virus
stomach cancer by h pylori
cervical cancer by human papilloma virus. the HPV vaccine could nearly wipe out cervical cancer

inflammation
not specific foods but obesity — excess weight
lack of exercise, diet are related
hard to tease out all of the variables

and all of these factors overlap. one case of cancer can have multiple causes

>>how about toxic chemicals? in this chart occupation and pollution

Smoking increases the risk of lung cancer 23 times (2,300 percent!) for men and 13 times (1,300 percent!) for women.

-- The Health Consequences of Smoking: A Report of the U.S. Surgeon General, 2004

Here are more striking numbers. ^^^ As we look at the next few slides, keep those numbers in mind: 2300 percent 1300 percent
If we could go back in time and prevent the invention of cigarettes,
In terms of its power as a carcinogen, nothing else (except maybe a full blast of ionizing radiation) comes close.

Alcohol and breast cancer risk

Study	Study Population (number of participants)	Follow-up (years)	Relative Risk of Breast Cancer in Women who Drank Alcohol Compared to Women who Did Not RR (95% CI)		
			1-2 drinks/day*	2-4 drinks/day†	
Prospective cohort studies					
Million Women Study [2]	1,280,296 (28,380 cases)	7	1.13 (1.10-1.16)	1.29 (1.23-1.35)‡	**29 percent**
Nurses' Health Study [3]	105,986 (7,690 cases)	28	1.22 (1.13-1.32)§	1.20 (1.07-1.35)§	**20 percent**
NIH-AARP Diet and Health Study [4]	184,418 (5,461 cases)	7	1.13 (1.02-1.25)||	1.23 (1.08-1.41)||	**23 percent**
EPIC [5]	274,688 (4,285 cases)	6	1.07 (0.96-1.19)	1.13 (1.01-1.25)	**13 percent**

https://ww5.komen.org/BreastCancer/Table3Alcoholconsumptionandbreastcancerrisk.html

keeping those numbers in mind — 2300 percent and 1300 percent — let's look at some other carcinogens. drinking alcohol seems to marginally increase the likelihood of some cancers, like liver and colon. and breast cancer in women. but the effect is not nearly as strong as that of tobacco. not even close
look at these numbers in the chart. from various studies
cancer risk varies from 13 percent to 29 percent
compared with 1300 and 2300 percent for smoking

Warning: Your Cell Phone May Be Hazardous to Your Health

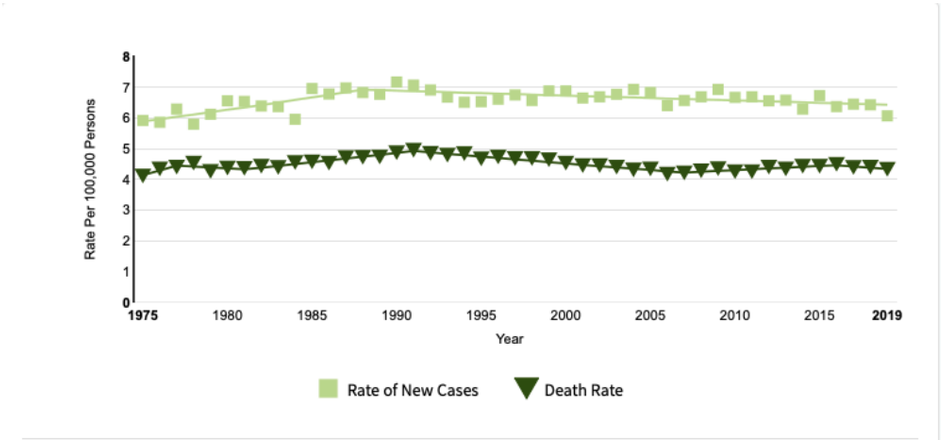
Ever worry that that gadget you spend hours holding next to your head might be damaging your brain? Well, the evidence is starting to pour in, and it's not pretty. So why isn't anyone in America doing anything about it?

By Christopher Ketcham • January 25, 2010

but even those numbers sounds worse than they are. relative vs absolute risk
GQ magazine.
relative risk vs absolute risk
cell phone example
For the last twenty years, while cell phone use has steadily increased, the age-adjusted incidence of malignant brain tumors has remained extremely low—6.1 cases per 100,000 people, or 0.006 percent— and for the last decade has been slightly but steadily decreasing.

or the 10 percent of people who reported the very highest use, the increased risk of glioma appeared to jump abruptly from 0 to 40 percent. A person's odds of being diagnosed with the cancer, the most common of all brain tumors, is about 0.0057 percent. A 40 percent increase would make that 0.008 percent.

Brain and neurological cancers



brain and neurological

For the last twenty years, while cell phone use has steadily increased, the age-adjusted incidence of malignant brain tumors has remained extremely low—6.1 cases per 100,000 people, or 0.006 percent— and for the last decade has been slightly but steadily decreasing.

Multicenter Study > Int J Epidemiol. 2010 Jun;39(3):675-94. doi: 10.1093/ije/dyq079. Epub 2010 May 17.

Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case–control study

INTERPHONE Study Group

an outlier: the Interphone study

— No relationship between the amount of time talking on a cell phone and the incidence of gliomas and other brain tumors.

— A strangely negative correlation: Regular users appeared to have a *slightly lower risk* of getting brain tumors than people who didn't use cell phones at all.

— Stranger still, for the 10 percent of people who reported the very highest use —as much as twelve hours a day(!)—the increased risk of glioma appeared to jump abruptly from 0 to 40 percent.

Not gradually as one would expect. No dose-response relationship
But all at once.

Statistical noise
Probably a methodological flaw.
study since been surpassed by numerous others, none of which makes a persuasive case that exposure to cellular microwaves causes cancer

A person's odds of being diagnosed with glioma, the most common of all brain tumors, is about 0.0057 percent.

A 40 percent increase would make that 0.008 percent.

But even if the strangely anomalous result — an increase of 40 percent in glioma — were true there hardly seems to be much reason to worry
relative risks early reported in a single paper. as a reporter you often have to find them on your own. and too often this doesn't happen. time constraints, impatient editors

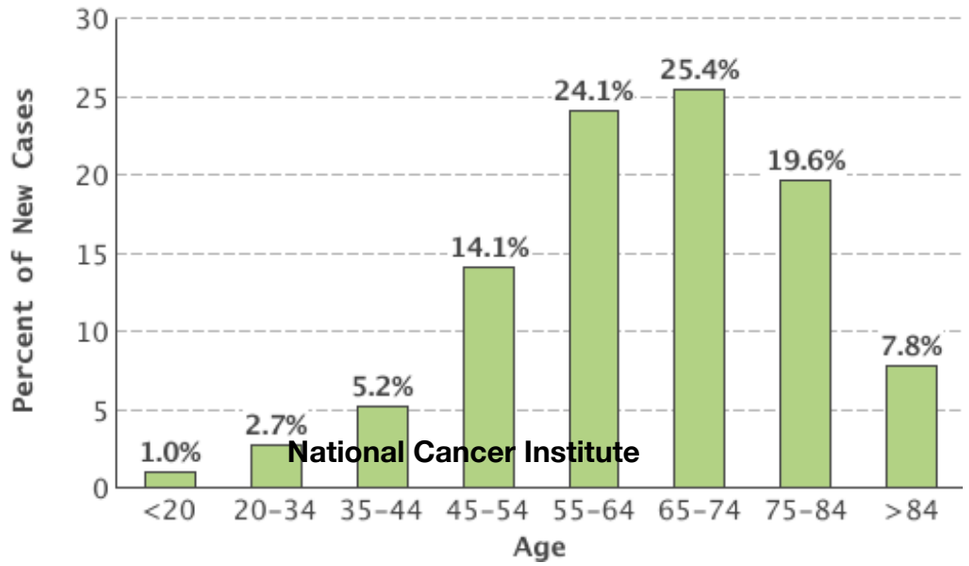
185 **odds of being diagnosed with the cancer:** This was a hard number to come up with. The statistics available online from SEER don't break down brain tumors by type, but the agency made the calculation at my request. (E-mail to author from Rick Borchelt, NCI Media Relations, July 12, 2012.) For a somewhat lower estimate, see table 1 of Judith A. Schwartzbaum et al., "Epidemiology and Molecular Pathology of Glioma," *Nature Clinical Practice Neurology* 2, no. 9 (2006): 494–503. Adding the incidence rates of the different kinds of glioma comes to .0049. The article also estimates that 77 percent of primary malignant brain tumors are gliomas. Multiplying SEER's incidence rate for all gliomas, 0.0061, by 0.77 yields a slightly different value, 0.0047.

The problem is that we can’t shake this idea that cancer is something inflicted on us from outside. By poisonous chemicals, invisible waves. When tragedy strikes out of the blue it’s human nature to seek a cause. To find a culprit — someone to blame. Maybe ourself ourselves. If only we hadn’t . . .

But much, maybe most cancer arises spontaneously from within.

We’re stuck with this mental model of infectious disease. Looking for a single causative factor.

60 percent of cancer cases are diagnosed in people 65 or older.



A hint in the statistics regarding age. There are about a trillion cells that make up the human body. As we age and these cells divide and divide, they accumulate an increasing load of mutations. Order gives way to entropy.

No wonder that 60 percent of cancer cases are diagnosed in people 65 or older.

“Cancer is an inevitability the moment you create complex multicellular organisms and give the individual cells the license to proliferate.

“It is simply a consequence of increasing entropy, increasing disorder.” -- *Robert Weinberg, the Whitehead Institute. MIT*

We shouldn’t be surprised

Early on in my research I interviewed Robert Weinberg at the Whitehead Institute at MIT — one of the two or three most prominent theorists about the nature of cancer

“If we lived long enough, sooner or later we all would get cancer.”

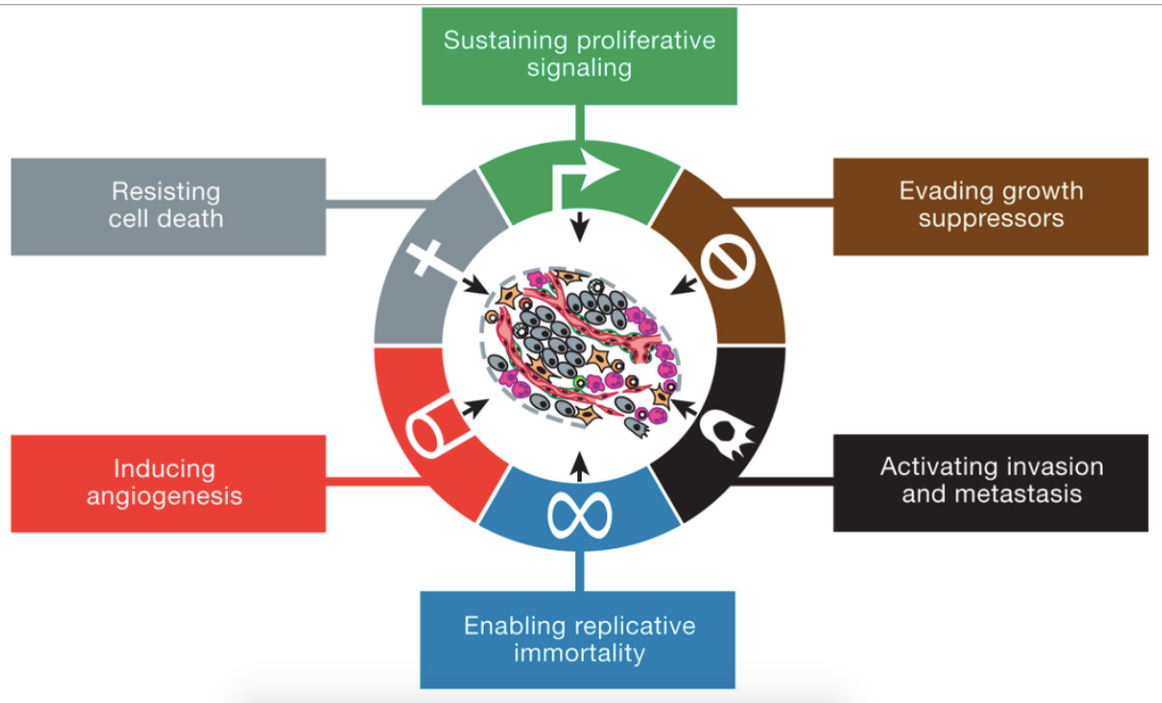
Every second 4 million cells in your body are dividing,
copying your entire genome.
Inevitably there will be mistakes -- mutations.

Some will caught and corrected by “proof-reading” enzymes. But this safeguard is imperfect.

Inevitably there will be mistakes -- mutations.

And certain combinations of mutations can tip a healthy cell into the wildfire growth we call cancer.

He did a back of the envelope calculation for me.



Hallmarks of Cancer: The Next Generation
Douglas Hanahan, Robert A. Weinberg

cancer is caused by mutated genes. Robert Weinberg and Douglas Hanahan described how this happens in a famous paper called The Hallmarks of Cancer
This is a chart of all the things that can go wrong

one mutation might push a cell to divide more rapidly, to shift into overdrive
normally this would be noticed by the neighboring cells
they respond by sending out signals telling the over active cell to slow down
but a second mutation can knock out the cell's ability to receive and respond to these warning signals
and so it keeps dividing and dividing

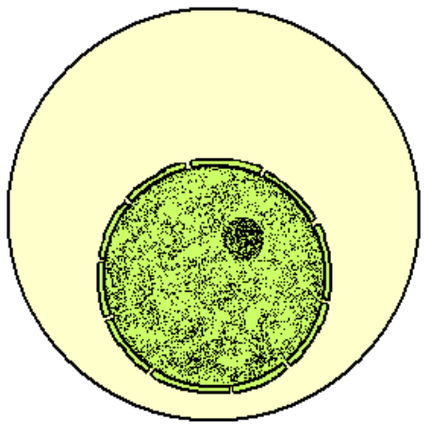
With the accelerator floored and the brake lines cut, the cell and its progeny multiply again and again. And so more mutations accumulate

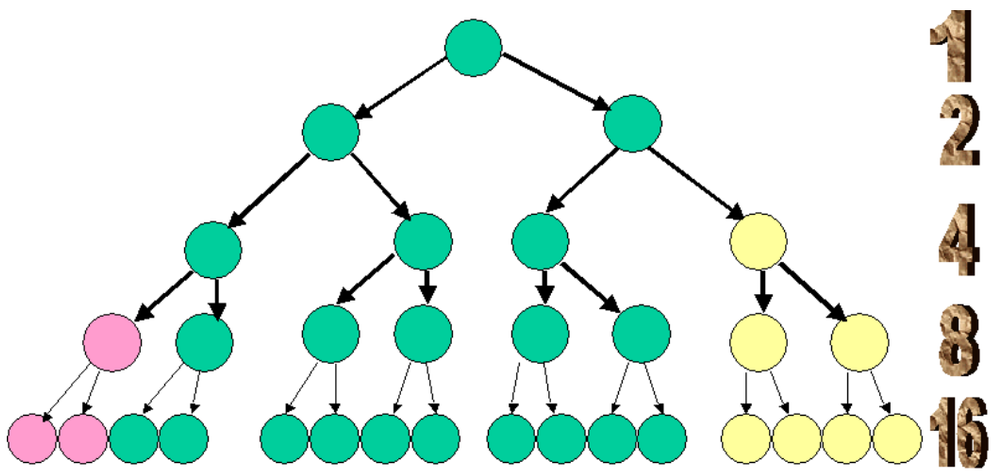
a new mutation might allow one of these outlaw cells to consume energy more efficiently, than its neighbors or to tolerate harsher environments or to suppress the immune system when it tries to put a halt to the crazy proliferation of cells

other mutations can defeat apoptosis: a mechanism through which cells can recognize they have become damaged and kill themselves

there is a safeguard called the cell cycle count -- telomeres — a cell can only divide a certain number of times before apoptosis kicks in and snuffs it out
but a mutation can reset the counter. so it keeps on dividing. it become immortal — at least as long as your body lives

mutations can even turn on angiogenesis, the ability of a cell to grow its own blood vessels.
so now the tumor can hook into the body's bloodstream like a vampire,
and cancer cells can travel though the circulatory system and metastasize





Cell Replication

Cell Replication

http://members.optusnet.com.au/exponentialist/Bacteria.htm

etc. etc.

As a cluster of cancer cells develops, mutation by mutation, it is like a creature trying to evolve inside the ecosystem of your body.

A final thought. Creepy. Makes you realize that as a cancer develops, mutation by mutation, it is like a creature trying to evolve inside the ecosystem of your body.

Random generator and selection. What to us are harmful mutations are from the perspective of the cancer cell, adaptive mutations. It becomes increasingly fit to thrive, driven by the Darwinian imperative.

Cancer is an unfortunate consequence of evolution -- of being multicellular creatures that evolved in a world ruled by the Second Law of Thermodynamics.

“Things fall apart.”

All systems move inevitably from a state of order to disorder.

The most powerful cause of cancer is entropy.

The bottom line.
Many, perhaps even most of these mutations are inevitable — the 2d law of thermodynamics — entropy! — guarantees that. These mutations would occur even in a world where there were no cancer-causing chemicals — no carcinogens.
Fortunately most mutations don’t harm us. Or are caught and corrected. Or lead the cell to quickly die, truncating the lineage.

The end

- leftovers

Camp Lejeune, North Carolina

42 deaths from kidney cancer when 36 was considered average.

For multiple myeloma: 17 deaths, when 16 would have been expected.

Actually there were fewer cancer cases than in the general population

“The healthy soldier effect”

One more I should mention

Love Canal

UPSTATE WASTE SITE MAY ENDANGER LIVES

Abandoned Dump in Niagara Falls Leaks Possible Carcinogens

By DONALD G. McNEIL Jr.
Special to The New York Times

NIAGARA FALLS, N.Y., Aug. 1 — Twenty-five years after the Hooker Chemical Company stopped using the Love Canal here as an industrial dump, 82 different compounds, 11 of them suspected carcinogens, have begun percolating upward through the soil, their drum containers rotting and leeching their contents into the backyards and basements of 100 homes and a public school built on the banks of the canal.

Children and dogs have received chemical burns playing on the canal site, and large numbers of miscarriages and birth defects have been found among residents of the homes along the site.

Tomorrow, the State Health Department is scheduled to recommend whether the Governor should declare a health emergency and evacuate the area's fami-

Published: August 2, 1978

in the years around World War II, the Hooker Electrochemical Company acquired an abandoned canal near Niagara Falls for use as a dump. Over the next decade, the company disposed of some 22,000 tons of toxic waste, including carcinogens like benzene and dioxin.

land was later sold and developed into a neighborhood complete with a school right by the old waste dump

"in the late 1970s, residents began to complain of a sickening smell. When an official from the Environmental Protection Agency came to inspect, he saw rusting barrels of waste that had found their way to the surface. Potholes were oozing waste into several backyards, and it had seeped into the basement of one home. “The odors penetrate your clothing and adhere to your footwear,” the official reported. Three days later his sweater still stank. The neighborhood was evacuated, a national emergency declared, and the investigations began."

Time Bomb in Love Canal

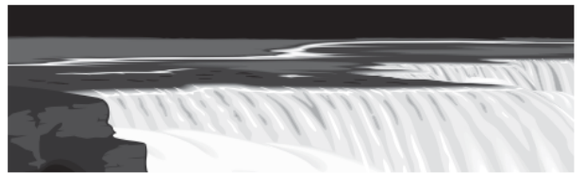
The New York State health commissioner is right to call the Love Canal area of Niagara Falls a "great and imminent peril." He is just 25 years too late. A "long-standing peril" would be more like it.

The bizarre troubles now surfacing at Love Canal originated decades ago in careless, virtually unregulated waste-disposal practices. The never-completed canal, a deep ditch, was once owned by Hooker Chemical Company, which used it as a sump for toxic chemical wastes. Then it was sold to the city of Niagara Falls, which dumped in municipal wastes. Other chemical companies and possibly the Army added their poisons. Eventually the ditch was covered over and a school and houses were built.

burying these things like ticking time bombs," one E.P.A. official warns. ". . . We're mortgaging our future if we don't control them more carefully."

New laws and regulations should do much to ease problems in the future. Two years ago Congress passed a Resource Conservation and Recovery Act which required a "cradle-to-grave" management system for hazardous wastes. The E.P.A. is now trying to define which wastes are hazardous and preparing regulations for managing and disposing of them. The regulations are expected to require that most disposal sites be made impermeable to leakage; that draining be engineered to keep surface water away; that very long-lasting and toxic materials be incinerated or neutral-

this was the first superfund site
So how many of the people who lived there got cancer?



Love Canal Follow-up Health Study

Prepared by the

Division of Environmental Health Assessment
Center for Environmental Health
New York State Department of Health
for the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

30 year follow-up, 2008

30-year retrospective

The overall cancer rate was actually a little lower than for the general population.

"For cancer incidence, the results of the external comparisons indicated that the total number of cancers observed among Love Canal residents was within the range expected for New York State and Niagara County. The respiratory and digestive systems were the only major organ systems to show any elevation, and some individual sites such as gall bladder, kidney, bladder, testis, liver and rectum also showed elevations. Due to small numbers, these elevations remained within the range of rates that would be expected by chance."