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Social Studies of Science
42(2) 237–261
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DOI: 10.1177/0306312711435832
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Credibility battles in the autism litigation

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Abstract

That vaccines do not cause autism is now a widely accepted proposition, though a few dissenters remain. An 8-year court process in the US federal vaccine injury compensation court ended in 2010 with rulings that autism was not an adverse reaction to vaccination. There were two sets of trials: one against the measles–mumps–rubella (MMR) vaccine and one against the mercury-based preservative thimerosal. The MMR story is more widely known because of publicity surrounding the main proponent of an MMR–autism link, British doctor Andrew Wakefield, but the story of thimerosal in court is largely untold. This study examines the credibility battles and boundary work in the two cases, illuminating the sustaining world of alternative science that supported the parents, lawyers, researchers, and expert witnesses against vaccines. After the loss in court, the families and their advocates transformed their scientific arguments into an indictment of procedural injustice in the vaccine court. I argue that the very efforts designed to produce legitimacy in this type of lopsided dispute will be counter-mobilized as evidence of injustice, helping us understand why settling a scientific controversy in court does not necessarily mean changing anyone's mind.

Keywords

credibility, expert testimony, MMR–autism hypothesis, thimerosal–autism controversy, vaccines, vaccine injury compensation court

We know the story and we know how it ends. Vaccines were tried for causing autism in a special vaccine injury tribunal in the USA and were vindicated. There was an 8-year legal process investigating the putative link, and in all six test cases the special masters (as the attorneys who act as judges in vaccine cases are called) found that there was not sufficient evidence that autism is linked to vaccination. But how exactly were vaccines

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vindicated? Even after all the attention a possible vaccine–autism link has received, the details of how these court cases played out have not been fully explored. Prior to these prominent court decisions in 2009 and 2010, few people were even aware that the US legal system includes a special no-fault compensation program designed for families whose children suffer adverse events after getting required childhood vaccinations. Set up by the National Childhood Vaccine Injury Act of 1986, this special tribunal shields vaccine manufacturers from liability out of a concern that big verdicts in civil suits would disrupt the national vaccine supply. The US Department of Health and Human Services (HHS) steps in as the respondent, defended by attorneys from the Department of Justice (DOJ). The eight special masters typically process a few hundred cases per year, and many families whose claims would not have been able to meet tougher evidentiary hurdles in regular civil court have been compensated for adverse events. Awards and petitioners' attorney fees and costs are paid from a .75 excise tax on each dose of vaccines routinely recommended for children.[1]

The autism controversy was tried in this vaccine court after more than 5600 families claimed autism as a side effect of the childhood vaccine schedule. More than 100 lawsuits had been filed in regular civil courts alleging injuries from thimerosal (a vaccine preservative, about half mercury by weight), potentially involving millions of people if certified as class actions. But because the vaccine court is the exclusive forum for bringing claims about vaccine injuries under the 1986 act, the plaintiffs could not proceed in regular civil court. Because holding so many hearings was untenable, the cases were consolidated into the Omnibus Autism Proceeding (OAP) so that the causation issues could be tried in six test cases.[2] The court uses a Vaccine Injury Table to expedite claims for which there is a known relationship between a vaccine and an adverse event.[3] However, with claimed adverse events such as autism that are so-called off-Table claims, petitioners have to prove causation-in-fact by the preponderance of the evidence standard. The autism claims indicted both the measles–mumps–rubella (MMR) vaccine and the thimerosal preservative. The petitioners in the first set of test cases argued that thimerosal-containing vaccinations had disrupted the children's immune systems via mercury toxicity. Even though the MMR vaccine never contained thimerosal, the plaintiffs alleged that that when their children were vaccinated with it, the vaccine-strain measles virus was able to persist in their guts and cause inflammation. This was called theory one. According to this theory, the virus then traveled to and affected their brains, causing autism (*Cedillo v. Secretary of HHS*: 20).[4] In the next three test cases, the plaintiffs alleged their second theory, which was that thimerosal-containing vaccines alone caused autism by provoking neuroinflammation in the brain, which in turn led to the behavioral expressions labeled autism (*Dwyer v. Secretary of HHS; King v. Secretary of HHS*: 17; *Mead v. Secretary of HHS*: 24–25).

The OAP departed dramatically from the usual business of the vaccine court in scale, effort, publicity, cost, and implications. The vaccine court was still using a paper-based filing system when claims first started to flood in, and there was not even enough space to house the paper files that would result from so many claims.[5] The stakes were very high. Linking vaccines and autism could cause widespread vaccine refusals and imperil public health's greatest achievement in the developed world: the banishment of many infectious childhood diseases. Verdicts in favor of the thousands of

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families would bankrupt the compensation fund. Verdicts against the families would leave them uncompensated during a lifetime of expensive care for their children in a society with a meager safety net. Used to processing cases in almost total obscurity, the special masters of the vaccine court found themselves adjudicating the most volatile public health question of our day. The court's business is normally closed to the public because of the private medical issues involved, but the Petitioners' Steering Committee (PSC) and the Justice Department agreed to allow for the test case hearings to be open to the public and for nearly all the documents filed in the case to be put online.

Off-Table claims do not get the presumption of causation that the Vaccine Injury Table provides, but they are regularly compensated with only indeterminate scientific evidence. Typically cases settle before reaching a hearing, but when there is a hearing, it usually takes only a day or two and involves one or two expert witnesses. Autism was different. The first MMR–thimerosal test case to go to hearing, *Cedillo v. Secretary of HHS,* took 12 days of testimony from 17 experts (six for the family of Michelle Cedillo, and 11 from the government). The lead case for the second thimerosal-only theory, a combined hearing for *Mead v. Secretary of HHS* and *King v. Secretary of HHS* took 14 days with 16 experts (five for the families and 11 for the government). Originally slated to go to hearing in 2004, the autism cases were not heard until 2007 and 2008 because the petitioners asked for delays in order to wait for new studies to be completed and attempted a full-scale discovery process not normally seen in vaccine cases. What was originally designed as a quick, generous, and cooperative program had become a very close relative of the protracted and adversarial products liability cases it was supposed to replace.

The two theories actually had fascinatingly different careers in the OAP, despite both being found implausible in the end. The MMR theory and its most famous proponent, British gastroenterologist Dr Andrew Wakefield, lost scientific legitimacy due to suspicions of fraud and the association of scientific interest with litigation-driven profit motives (Deer, 2011a,b; General Medical Council, 2010). Even though it received more publicity, the MMR theory was always less important in the USA, and had a much shorter lifespan of credibility and more abrupt closure in the OAP. The case against thimerosal, by contrast, had a more ambiguous beginning, but gained more support through a broader anti-mercury campaign and had somewhat more credible researchers working to buttress it.

There are many fascinating questions for both socio-legal research and science studies in the vaccine cases. My analysis will operate on two levels to focus on just a few of these questions. The first level is the discrete credibility battles of the OAP. How exactly did the mainstream view that vaccines do not cause autism come to be accepted? There has been much promotion of the epidemiological studies that failed to show links between autism and both thimerosal and the MMR. While these were important in the cases, much of the actual credibility-wrangling involved technical disputes about biopsied children, polymerase chain reaction (PCR**)** tests, autopsied brains, lab mice, and baby monkeys.

These battles took place within a particular institutional and cultural context. The second level of analysis here focuses on the contests over the portrayal of the OAP and its translation to the broader public. Once the cases were lost, another battle over legitimacy began which is still going on. Was the OAP a grand effort to give the most detailed

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and transparent hearing possible to this contentious issue, or did the scale and effort itself help solidify the impression of injustice on the part of the federal government? The puzzle this raises for studies of credibility is how, by ruling against a relatively weak opponent, a vast and powerful entity such as the US federal government may end up producing both greater and weaker credibility. This bi-directional co-production occurs because multiple credibility zones pre-exist the conflict and persist after the attempt at closure (Jasanoff, 2004). Credibility zones are spaces of knowledge production for communities that have their own sources and forms of sustenance: communities such as the network of parents organized around autism as vaccine injury, for example, or the network of scientists who have rejected that theory. While we often see different social worlds coming together through the mobilization and use of boundary objects (Star et al., 1989), little such convergence occurred in the OAP.

In the sections that follow, I describe the disputes in the test cases, discussing the thimerosal-only theory test cases first followed by the MMR–thimerosal cases. Moving to the level of institutional legitimacy, I explain how the production of scientific credibility in the litigation came to be used as a critical tool by disappointed activists after the court ruled against them. I conclude by examining how the legitimacy of the decisions came to be seen so differently from opposing perspectives, and suggest broader implications for asymmetrical struggles over scientific legitimacy in a democracy.

Credibility and legitimacy in STS and sociolegal studies

Looking back on the event, the vindication of childhood vaccines in the OAP seems foreordained. One way to think of it is as a case in which the overwhelming weight of good science bested the efforts of confused parents and their charlatan doctors to discredit lifesaving vaccines. But another view would insist that, regardless of the lopsidedness of the outcome, how it happened, by what means, in what context, with what techniques, infused with which values, and with what after-effects are critical questions that a conclusory nod to good science cannot answer. As Steven Shapin (1995: 257) puts it, 'All propositions have to win credibility, and credibility is the outcome of contingent social and cultural practice.' Moreover, as Gary Edmond (2001: 192) notes, 'law–science knowledge … is a contingent artifact of specific law–science interactions drawing on and reinforcing a range of normative behaviors, commitments, and relations'. He adds that we should extend our attention 'beyond contests around expert opinions and include the role played by (and recourse to) legal rules, procedures, and traditions as well as the invocation and influence of social and moral values' (Edmond, 2001: 193). The OAP decisions represent not only the culmination of an overwhelmingly detailed process, but also a bid for procedural justice. We should therefore understand the OAP as a contest in which all sides knew perfectly well that the winner would need to be seen as having been fair, polite, transparent, and sympathetic as well as scientifically rigorous throughout the process.

Winning in the OAP required summoning the legitimacy that science confers and constructing a boundary around that winning story of vaccines and autism, while excluding the losing story. Boundary work (Gieryn, 1999) is what the lawyers, special masters, parents, experts, and advocates did in the case to create credibility for their side

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and dismantle it for the other side: invoking and disparaging credentials and lab tests and pointing out interestedness and disinterestedness while policing the proper stance of the scientific expert toward uncertainty about evidence. Producing closure in a legal case is a dynamic and interested process for both sides (Edmond, 2001: 198). A courtroom in which federal government defends itself is a uniquely powerful authoritative context with a wide array of boundary-drawing techniques available (Jasanoff, 2005). Credibility is built up and torn down with specific techniques in specific contexts, and showing how exactly it helps to build consensus and draw boundaries can only be done through the details of a particular case (Gieryn, 1999; Hilgartner, 2000). For example, credibility unraveled for the scientists who claimed to have created cold fusion in 1989 when they used the press to prematurely trumpet their accomplishment and refused to share details of their experiments so they could be replicated (Gieryn, 1999: 217–229). Scientists testifying on behalf of evolution and against creationism discredited opposing expert witnesses by portraying them as ideologically driven, located outside the mainstream of academic publishing and research, dogmatic and undeterred by conflicting evidence, and highly motivated to do work that supports a specific creationist view (Gieryn et al., 1985). This research further confirms many of these same well documented credibility moves.

So while credibility is produced in the discrete and detailed moments of litigation, it is quite another question to ask how and whether that credibility can be broadened into institutional legitimacy for the court itself or the federal vaccine program more generally. Sociolegal scholars have shown that the legitimacy of legal institutions and legal actors is tied very closely to ordinary people's perceptions of procedural justice (Tyler, 1990; Tyler and Huo, 2002). When people feel they have been treated fairly, they are more likely to accept even adverse decisions from a legal authority. Much of this sociolegal scholarship focuses on more everyday police–court–citizen interactions, not dramatically contested cases. In the case of the vaccine court, many petitioners want a chance to tell their story, to testify in a legal proceeding about what happened to their child and how it affected their lives. Special masters and attorneys both described this process as very important, regardless of the outcome of the case. But the OAP petitioners were not ordinary vaccine court litigants asking for the usual brief, private hearing. They were part of a social movement organized around an answer to the causal question that the OAP was set up to resolve. Ideological disputes and popular misinformation often structure how people understand law (Haltom and McCann, 2004). Contentious causal questions are at the center of many public scientific debates (Brown et al., 2006; Jasanoff, 1995) and in such debates it may be difficult for procedural fairness to stand apart from the resolution to those causal questions as a soothing and legitimating feature. This research brings together sociolegal concerns with court legitimacy and science studies questions about how credibility battles matter for knowledge production.

Methodological approaches

This study of the credibility battles and boundary work in the autism litigation draws on the extensive public record including the rulings, briefs, transcripts, docket items, memos, and expert reports from the years of the OAP. The record begins with Autism General

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Order #1, setting up the omnibus process on 3 July 2002 and includes transcripts and rulings from the six trials held between June 2007 and July 2008, as well as nearly all the official documents passed between the opposing parties and the special masters. The most critical sources for my analysis are the transcripts of the trials (more than 5000 pages from all six test cases) and the six opinions themselves (about 150–300 pages each). Because of court-imposed format restrictions (each PDF was password-protected against any function beyond word-searching, screen-reading, and saving a copy), I was not able to use any coding software. Instead, I went back and forth between the opinions recording the special masters' credibility judgments and the transcripts after a full read of both. This reiterative reading allowed me to hone in on exactly which of the hundreds of studies put into evidence were the most pivotal and to re-create the boundaries of the disputes.

My data for the second-level observations about institutional legitimacy come from attendance at a major social movement event organized by vaccine critics,[6] and from participant observation at public vaccine court events, administrative agency meetings of the committees that advise on vaccine compensation policy, and critical events organized by parent groups after the court losses. I conducted a small number of interviews only when it was feasible and necessary to gather information beyond the extensive record already available. Many of these interviews were off the record and thus can inform my perspective but cannot be quoted or attributed. I was able to interview two attorneys who litigated the OAP on the petitioners' side; Department of Justice attorneys declined to be interviewed.

The case against thimerosal

Initial credibility and the construction of an alternate treatment community

The MMR theory has its roots in British doctor Andrew Wakefield's highly publicized idea that the combined MMR vaccine might cause autism (Wakefield et al., 1998), while anti-mercury activism in the USA gave rise to the second thimerosal-only theory at around the same time (Baker, 2008). Thimerosal had been added to some vaccines since the 1930s as a preservative to thwart the growth of bacteria in multi-dose vials, and it is about half ethyl mercury by weight. The childhood vaccine schedule from the 1990s contained more ethyl mercury than the Environmental Protection Agency (EPA) limit for methyl mercury (the type of mercury we normally hear about as the environmental contaminant in fish and the type for which there was a standard).[7] Researchers knew a lot about methyl mercury, but were not sure if ethyl mercury had the same effects.[8] In 1999, the American Academy of Pediatrics (AAP) and the US Public Health Service (USPHS) issued a joint statement recommending the removal of thimerosal from vaccines as a precaution, though some doses continued to be given until 2003 when supplies ran out (Allen, 2007: 375–383; American Academy of Pediatrics and US Public Health Service, 1999).

The decision to remove thimerosal happened very quickly, and was met with heated debate about whether it was a reasonable precaution or a rush to judgment that would only arm critics and scare parents (Allen, 2007: 380–83; Offit, 2008). In 2001, the

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Institute of Medicine (IOM) called the theory that thimerosal could cause autism 'biologically plausible' and urged more research (Institute of Medicine, 2001), but by 2004 the committee had concluded that evidence favored rejecting that hypothesis (Institute of Medicine, 2004). The fact that the government had not kept track of how much mercury was in vaccines until 1999, and the suggestion from the IOM that autism causation had some plausibility as of 2001, created some credibility for those expressing uncertainty, calling for more research, and even raising an alarm, at least until more reassuring studies appeared a few years later (Kirkland, 2012). Subsequent accounts of vaccine dangers by movement activists and journalists (such as Robert F. Kennedy, Jr's (2005) 'Deadly immunity' article and David Kirby's bestseller *Evidence of Harm* (2005)) used these and other missteps to sustain uncertainty about vaccine safety and to suggest a deliberate conspiracy to cover up problems in order to keep immunization rates high.

A founding paper of the lay anti-mercury movement in the USA put forth the idea that autism could be a new form of mercury poisoning (Bernard et al., 2001). Though this theory was not part of the petitioners' cases in the OAP, all the parents testified that their children had mercury toxicity confirmed by lab tests. One of the first treatment steps in the alternative protocol used by DAN! (Defeat Autism Now!) practitioners was to order extensive tests from certain labs. One mother testified that she first believed vaccines had caused her son's autism when she saw the lab report for mercury toxicity:

> And when we got those results back, we saw that he was in the 96th percentile for mercury, and that just – you know, even just visually on the page seeing that line go all the way over to the far right of the page is very upsetting to me, and I thought, oh, no, we're being exposed to something toxic, and that's what happened to Jordan. (*Mead* and *King* transcript: 1161)

Those urine test results were produced following chelation, a popular alternative treatment for autism based on this paradigm of mercury toxicity. A chelating agent is administered to draw out heavy metals from the body, so from the mainstream toxicology perspective, one would expect higher levels of mercury. The lab results that upset Jordan's mother were keyed to the normal range for an unprovoked sample, a diagnostic practice that the American College of Medical Toxicology calls invalid and harmful (American College of Medical Toxicology, 2010). Jordan had a blood test a month earlier that showed mercury levels in the reference range (*Mead* and *King* transcript: 1517–18). Another child in the first theory cases had five mercury level blood tests, all within the normal range despite being post-chelation (*Snyder v. Secretary of HHS*: 241–242). Still another child's mercury level test came back in the 'nondetectable' range (*Dwyer* transcript: 180). Despite these results, the children continued to be treated as if their autism was the result of mercury toxicity. One significant schism in credibility zones in the OAP, therefore, lay between the mainstream toxicology and medical communities and the alternative autism community, with different labs, tests, standards, practices, and foundational assumptions for each.

The proposed causal stories

The account of the causal mechanism in the second theory cases was that thimerosal exposure caused damage through its ability to impair sulfur metabolism at a sub-cellular

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level, disrupting metabolic pathways that regulate brain chemistry. (In the first theory, the role of mercury in previously administered vaccines was said to be weakening the immune system, thus allowing the measles virus to persist; in the second theory, it was the gradual buildup of mercury that caused brain damage. Recall that the MMR vaccine never contained thimerosal.) The petitioners' expert on this theory, Dr Richard Deth, a pharmacologist from Northeastern University in Boston, testified that this disruption would lead to impaired methylation and chronic oxidative stress in the brain (*Mead* and *King* transcript: 500–523). The idea was that mercury toxicity, produced by very low doses of mercury in thimerosal-containing vaccines (TCVs), would keep critical processes of cell regulation and amino acid production chronically off kilter, producing autistic symptoms. Dr Deth described this stressed state as neuroinflammation (*Mead* and *King* transcript: 513–14).

A second and closely related version of the thimerosal theory came from Dr Marcel Kinsbourne, a pediatric neurologist who had also testified in the first theory cases and submitted a report in the UK litigation over the MMR. Dr Kinsbourne testified that inorganic mercury in the brain from vaccines could cause neurons to release too much glutamate, an excitatory brain chemical. Astrocytes are immune cells in the brain that regulate and absorb excess glutamate, but Dr Kinsbourne argued that they would be damaged or killed by the inflammatory processes set off by the inorganic mercury. Methyl mercury at doses much higher than the ethyl mercury doses in vaccines had been shown to inhibit astrocytes' uptake of glutamate (Aschner et al., 2007). The excess glutamate would then cause excitotoxicity, Dr Kinsbourne proposed, a state in the brain characterized by too many neurons firing, which can bring on seizures and cell death. Dr Kinsbourne's 'overactivated brain' theory of autism proposed that the repetitive behaviors and agitation often seen in people with autism are expressions of this abnormal brain function. Both versions of the thimerosal injury theory postulated that the pathological processes would occur chronically rather than worsening to cause degeneration and cell death (because people with autism do not die from it and may improve over time, unlike people with neurodegenerative conditions such as Alzheimer's disease).

To account for why such small doses might have significant effects only for some children, the petitioners needed to provide a new interpretation of toxicology. Dr Vasken Aposhian, a PhD toxicologist from the University of Arizona, testified for the families that autism is a possible consequence of vaccination for individuals afflicted with a mercury efflux disorder (*Cedillo v. Secretary of HHS*: 92, 115, 129–131). Some people are genetically unable to excrete mercury properly, on this account, and it builds up and causes autism. He compared children with this postulated condition to people with Wilson's disease, a genetic condition in which the body cannot excrete copper (*Cedillo* transcript: 95). Wilson's disease is caused by a single gene mutation and can be treated by chelation therapy. Wilson's disease is an easy analogy to understand, but the special masters never accepted that it was more likely than not that a similarly vulnerable group existed for mercury excretion.[9]

'Well-established factual predicates'

Special master Denise Vowell explained that the thimerosal theory took hold because 'some of the factual predicates for the hypothesis are well established' (*Dwyer v.*

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Secretary of HHS: 257). 'Initially', she observed, 'to someone unacquainted with mercury's toxicology, [autism spectrum disorders], or biochemistry, Dr Deth's opinions on mercury, oxidative stress, and sulfur metabolism might appear to be solidly based and plausible' (p. 224). How did the special masters go from accepting some compelling 'factual predicates' to resoundingly rejecting the thimerosal theory? What were these factual predicates, and how did they fail to build a credible case?

First, everyone agreed that mercury generally is a dangerous neurotoxin. Its vapors made hatters mad. It is second only to lead as an element of public concern, and from the lead scares of previous decades we learned that even tiny amounts of a toxic substance can have ongoing subclinical effects (Warren, 2000). Despite general agreement that mercury is a known neurotoxin, the nature of its toxicity was highly contested throughout the autism proceedings. The petitioners' cases relied on an approach to mercury that resisted line-drawing and differentiation between types of mercury and different dosages. They emphasized mercury's well-known toxicity overall and extrapolated from studies that used much higher doses than the vaccine schedule or studies which got results indicating damage at the cellular or in vitro level. The special masters, however, accepted a perspective on mercury toxicity that the Department of Justice attorneys urged. That view paid close attention to the specific kind of mercury in question (methyl mercury, the much-studied kind found in fish, or ethyl mercury, the kind in thimerosal), the dose (similar to the vaccine schedule, or much higher); the exposed subject (a child, an adult, a mouse, a cell, an adult monkey, an infant monkey); and the clinical outcome (autism, nothing at all, or something else). The special masters carefully differentiated the properties and effects of mercury by type and granted less credibility to studies that did not specifically study the effects of ethyl mercury in humans (or at least primates).

The special masters refused to generalize from the small doses of ethyl mercury in vaccines to large-dose methyl mercury poisoning; instead, they constructed mercury as an element that can be benignly present in healthy bodies and which can behave very differently in the body in its different forms.[10] Everyday adult mercury exposure comes almost entirely from dental amalgams and fish consumption (of which canned tuna is the largest single source in the USA) and is almost entirely methyl mercury. The special masters understood mercury as functionally benign in the typical ranges found in human bodies, and noted that observable effects do not begin until brain concentrations reach 150 to 200 parts per billion (ppb) and perhaps higher (*King v. Secretary of HHS*: 36).[11] They saw human contact with mercury as a gradual, lifelong absorption process, beginning from gestation to normal adulthood, with adult brain mercury levels averaging 15 ppb.[12]

The special masters came to see the alternative mercury testing labs as unreliable sites for generating artificially alarming results that DAN! practitioners could use to undergird the notion that autism is caused by mercury toxicity. Special master Hastings noted that Dr Elizabeth Mumper, a DAN! pediatrician who testified about the lab results on behalf of the families, seemed able to get to a diagnosis of vaccine-induced autism no matter what the lab results looked like (*King v. Secretary of HHS*: 106–107). Under cross-examination, she admitted that some of the labs she relied on had significant reliability problems (*Mead* and *King* transcript: 1533; *Dwyer* transcript: 164–176). But this discrete credibility zone was a source of the parents' notions of the legally actionable

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harm done to their child. The lab test results were part of what tied them into the alternative autism community and gave them hope that their children could be cured. It was very unlikely that the OAP process would be able to convince them to change their minds.

A second factual predicate that nonetheless was taken up in divergent ways was that mercury from vaccines could cross the blood–brain barrier and persist in the brain. Some of the studies that demonstrated this fact functioned as rare boundary objects that could be invoked across credibility zones, but just being credible to everyone did not mean that these studies had enough epistemic force to prove the petitioners' cases. Studies from the 1990s in adult monkeys showed that when given very large doses of methyl mercury, the monkeys' brains showed neuroinflammation (though the monkeys remained behaviorally normal) (Vahter et al., 1994). The autism controversy then made it critical to extend that body of knowledge to baby monkeys and thimerosal. The Burbacher infant monkey study (Burbacher et al., 2005) (which the petitioners' lawyer identified as their most important study and which the special masters also accepted as credible) investigated how the different types of mercury behave in the developing brain.[13] Infant monkeys received dosages of both types of mercury and were killed to see what had happened in their brain tissue. The infant monkeys got thimerosal via vaccines administered at birth, and at 1, 2, and 3 weeks of age (about 2½ times the human infant amount and on a more frequent schedule to account for the monkeys' faster maturation rate). This study was perhaps the only boundary object in the OAP because it was important to both sides and 'satisf[ied] the informational requirements of each of them' (Star and Griesemer, 1989: 393).

The Burbacher infant monkey study showed that the two types of mercury were indeed different. Mercury from thimerosal injections (ethyl mercury) cleared the body faster than the mercury from the oral doses (methyl mercury), but a larger proportion of the inorganic mercury that was left in the monkeys' brains was from thimerosal. The petitioners relied on the Burbacher study to show that ethyl mercury crossed the blood–brain barrier and settled in infants' brains, and argued that the persisting inorganic mercury could trigger damaging subcellular processes. While everyone conceded the Burbacher study showed some persisting inorganic mercury from vaccines, the special masters were convinced by the government expert Dr Brent, who interpreted the study as implying that more *methyl* mercury would actually persist as inorganic mercury (because we are exposed to so much more methyl mercury). This interpretation made it hard to pin the blame for any damage (if there was any) on the vaccines (*King v. Secretary of HHS:* 65–66). The Burbacher study was thus a strong circumstantial piece of evidence for the petitioners, but once the special masters endorsed the dominant framework for understanding mercury (as different varieties, with methyl deposits vastly outnumbering ethyl deposits), it no longer seemed to provide clear support for the vaccine injury theory.

It was also accepted that damage to the immunological cells in the brain can cause neurological dysfunction (*Dwyer*, 68, 257). This takes us to the third factual predicate: it was not in dispute that in autopsy studies, the brains of autistic people showed neuroinflammation. The attorneys argued that inflammation meant that something was damaged. That brain damage could then cause susceptible children to regress to an autistic state. Two important research papers, the Vargas autopsy study and the Pardo neuroinflammation study from a well-regarded group at Johns Hopkins University, established that such inflammation occurred in autistic people's brains (Pardo et al. 2005; Vargas

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et al. 2005). In his opening statement in the second theory hearings of 12 May 2008, the petitioner's attorney noted that this work from Dr Pardo's neuropathology research group would be critical to proving their case. The Pardo group's work showed activated immune responses in the brains of autistic people, and it was the resulting neuroinflammation that the petitioners would claim was provoked by the ethyl mercury in thimerosal.

However, 10 days later the Department of Justice called Dr Thomas Kemper, a neuropathologist from Boston University. Dr Kemper told the special masters how he'd talked with his friend Dr Pardo about their research and its implications for autism. In perhaps the most dramatic example of boundary work in the whole OAP, Dr Kemper flatly contradicted the petitioners' construal of the Hopkins work on the stand (testimony of Dr Kemper, *King* and *Mead*: 2851–54). Dr Kemper introduced a letter he'd received from Dr Pardo dated 13 May 2008, just one day after the petitioners had announced their reliance on that group's work.[14] The vaccine court does not use the Federal Rules of Evidence, and anything that would help the special master decide the case is heard. The Pardo letter does not mention the court cases at all. Its tone is professionally closed in its technicality and direct address to a fellow scientist, but it clearly makes the case for another interpretation of the neuroinflammation.

On the first page of the letter, Dr Pardo explained his aim was to 'clarify some of the misconceptions' about his group's work on neuroinflammation and autism. He noted that the inflammatory response the petitioners were relying on is 'associated with the neuroinnate immune response rather than an adaptive immune response' and that the particular cells, astrocytes, that the petitioners claimed are affected do not actually decrease in number. He went on to say, 'These findings are inconsistent with the hypothesis of a potential toxic effect on astrocytes by neurotoxins or toxic material. … At present, we are not able to conclude that these neuroglial reactions are deleterious for the central nervous system.' The immune reaction might even be helpful or protective, his group speculated. Moreover, the activation of immune processes in autistic brains, he concluded, 'resulted likely from prenatal and early exposure rather than late exposure'. The special masters noted that neither the government experts on neuroinflammation nor the Pardo researchers were willing to infer a causal link, however, and they noted that experts believed that the inflammation was protective or an effect of the body's response to autism (*King v. Secretary of HHS*: 49). Special master Hastings made a special note of the Pardo letter on this point (50). To accept the petitioners' theory, the special masters would have had to embrace an interpretation of key evidence over the explicit written dissent of the scientist whose lab (in one of the most prestigious sites for medical research in the world) generated that evidence.

The petitioners still needed the final piece of the story: evidence showing that genetic vulnerability could predispose injuries from thimerosal for some subjects while others with a different genetic makeup would be unaffected. Studies by Jill James of the Arkansas Children's Hospital Research Institute and Mady Hornig of Columbia's School of Public Health were presented to fill in this gap. Hornig and James have been part of the inner circle of anti-mercury activists (Kirby, 2005: 346), and both were funded by the anti-mercury parents' group SafeMinds as well as by mainstream governmental sources. The petitioners had delayed the OAP proceedings numerous times, while awaiting the results of these and other studies. James aimed to find out if autistic children had

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different metabolic and genetic profiles than non-autistic children, which might show that they suffered from impaired methylation and oxidative stress. The James glutathione study (James et al., 2004) found that people with autistim had lower levels of glutathione, a crucial antioxidant, in their blood plasma than non-autistic controls. For Dr Deth (who testified about the James studies), this result indicated that autistic children are under chronic oxidative stress because they don't have enough glutathione. The James genetic polymorphism study (James et al., 2006) revealed differences between autistic and non-autistic children's genes that Dr Deth also argued showed their vulnerability to autism. Dr Deth also relied on the Hornig mouse study (Hornig et al., 2004), which compared the effects of thimerosal on two strains of lab mice, one with a pre-set vulnerability to autoimmune disorders. Mark Blaxill, a prominent activist with SafeMinds, trumpeted the Hornig study as showing 'clear evidence of developmental delay and altered brain development' in the genetically vulnerable mice (Blaxill, 2009). Unfortunately for the petitioners, these last pieces of the story were not understood as established factual predicates, but rather as discrete pieces of circumstantial evidence that were not scientifically compelling for reasons of study design and execution.

Credibility failures in the thimerosal theories

As special master Vowell put it, despite consensus on these factual predicates – that mercury could be toxic, that organic mercury would persist in the brain, and that autistic brains showed neuroinflammation – the petitioners' case nonetheless 'f[e]ll apart' (*Dwyer v. Secretary of HHS:* 224). The first credibility failure was a failure of implication: the special masters concluded that the studies the petitioners had waited for so hopefully did not provide enough evidence to link thimerosal and autism in susceptible children. This failure was not a negative judgment on the relevant experts' credibility, just a limit on their findings. As special master Campbell-Smith observed, James 'carefully avoided overstating the significance of the … findings' (*Mead v. Secretary of HHS:* 111). Even though she had been intimately involved in the development of the scientific case against thimerosal, Jill James seemed unwilling to cede the legitimacy of her papers (nor did she testify at the hearings). Her conclusions, though reputable, simply could not stretch far enough. The special masters adopted the opposing experts' position on her work that blood plasma levels of glutathione were so local as to hold no implications for brain levels (a point Dr Deth conceded), and that genetic differences were not surprising in a study comparing a group of children with a genetic condition to children without that condition (*Dwyer v. Secretary of HHS:* 225). Moreover, according to the special masters, the metabolic problems found in the autistic subjects were also commonly found in people with other diseases, and thus seemed more like effects of disease than a cause of autism. Even if someone did have a genuine problem with these cellular processes, the result would be continual deterioration and death, not a chronic damaged state like the petitioners described, and certainly not autism. The special masters were convinced that nothing that any kind of mercury poisoning does to humans seems to resemble autism at all.

The second credibility failure was descriptive. The petitioners described the body as highly vulnerable to tiny doses of mercury, at least in cases of pre-existing susceptibility.

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The prevailing account was of robust bodies that could commonly and easily excrete and manage small amounts of dangerous substances. According to this account, there was no credible evidence of a special subgroup that lacked such defenses. As noted above, the special masters considered the amount of mercury added by thimerosal-containing vaccines to the body's burden to be very tiny compared with the usual amounts any person, even a newborn, would be expected to carry without harm. They were also impressed by the government experts' alternative accounts of our bodies as being wholly resilient to all kinds of biochemical stresses, particularly the very tiny insult of a thimerosal-containing vaccine. On this account, our bodies handle oxidative stress constantly and easily (exercise, for example, causes it and may be one of the reasons why exercise is beneficial). We have so much glutathione in our cells that it would take less than 1 minute for an infant's body to replace the glutathione needed to process the first 6 months' worth of vaccines even if they were given all at once (*Mead v. Secretary of HHS*: 117). The descriptive scale just did not make sense, in other words.

The third type of credibility failure was reputational, both in absolute and relative terms. Similar reputational failings are identified in previous studies on credibility in the courtroom (Edmond, 2001; Gieryn, 1999; Jasanoff, 1995). The opinions portray the elderly Dr Aposhian as a bumbling and confused witness who took up the anti-vaccine cause after his scientific career was over. The opinions note his numerous calculation errors, how he could not remember many details in his testimony and simply read from his slides, and how he discounted the foundational dose theory of toxicology.[15] The opposing attorneys had cross-examined Dr Deth on how many rejections he had gotten on a key article (four) (*King* and *Mead* transcript: 3968), and on how his work had not been cited by other scientists even though he'd emailed them about it (3976). They intimated that he was much more circumspect when writing about autism causation for a peer audience than he was in his expert testimony in the OAP (591). The research he presented at the OAP had been almost entirely supported by parent advocacy organizations such as SafeMinds in the years leading up to the trials because he had trouble getting mainstream grant funding. Although Dr Deth's primary theory was that oxidative stress in the brain triggers autism, he had only published one review article on oxidative stress (cross-examination of Dr Deth, *King* and *Mead*, pp. 588–598). (By contrast, government expert Dr Jackson Roberts of Vanderbilt had researched oxidative stress for more than 20 years, with 180 original research publications and four patents related to it.) Dr Deth claimed he had detected cellular effects of mercury at levels 100–1000 times below what other researchers had found, but the work had not been published. The special masters entirely disregarded this evidence as simply not believable (*King v. Secretary of HHS:* 74). Dr Kinsbourne's credibility suffered because, though he is a pediatric neurologist, he had not seen patients in 18 years and was perceived as a 'frequent flyer', or professional expert witness (having appeared at the vaccine court, often before those same special masters, 185 previous times). He had also been an exponent of the measles causation theory in the first set of trials, and the government attorneys suggested in cross-examination that he had simply replaced the words 'measles virus' with 'thimerosal-containing vaccines' in his second expert report (transcript in *Mead* and *King*, 917). Finally, all the special masters emphasized that epidemiological studies across multiple countries had failed to find any association between thimerosal in

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vaccines and autism (for example, *King v. Secretary of HHS*, 79–85, discussing Andrews et al., 2004; Fombonne et al., 2006; Hviid et al., 2003; Madsen et al., 2003; Schechter et al., 2008; Stehr-Green et al., 2003; Verstraeten et al., 2003).[16]

The government's experts, on the other hand, successfully presented paradigmatic emblems of scientific credibility: publications in prestigious journals; results that had been replicated; long careers with many achievements; and highly professionalized testimony on the strengths and limits of their evidence without unseemly embellishment. The mainstream researchers' credibility did not entirely speak for itself, however, and there were skirmishes over whether the experts were engaged in advocacy: 'crossing the line from scientific testimony to public health advocacy' (Greenland, interview with author, 2011). The petitioners presented one witness with prestigious credentials and mainstream credibility, UCLA epidemiologist and statistician Sander Greenland. He testified that '[a]n association between TCVs [thimerosal-containing vaccines] and regressive autism, especially clearly regressive autism, would have been seriously diluted in all the available epidemiologic studies, if there were such an association' (*King* and *Mead* transcript: 76).[17] In other words, studies showing no association left open the possibility that the number of children affected by vaccines was so small that they did not show up. However, Dr Greenland testified that he did not think vaccines were causing an epidemic of autism (*King* and *Mead* transcript: 127). He was not eager at first to testify for the petitioners, but when he read Dr Steven Goodman's expert report for the government, he realized he 'had to go through with it' (Greenland, 2011). He read the Goodman report as a case of an 'expert witnesses interpret[ing] their role as a lawyer, like they're just sort of a lawyer with scientific credentials and they're there to create rhetoric to support the case, to persuade a jury and a judge' (Greenland, 2011). Science requires a special adherence to uncertainty about statistical estimates, in Greenland's view, and it is wrong to portray the evidence as positively establishing that there is no link between a small subset of autism cases and thimerosal when the mathematics just cannot rule it out.[18] So while the petitioners were able to bring along at least one prestigious outsider to push back against what he saw as a violation of scientific disinterestedness, his testimony was not able to establish the kind of fact that could change the outcome by positively meeting the petitioners' burden.

The case against the MMR

A British medical researcher and gastroenterologist, Dr Andrew Wakefield, is credited with being the first to propose a connection between the MMR vaccine and autism in a now-famous *Lancet* paper (Wakefield et al., 1998) and in the press conference he gave about it. Dr Wakefield's rise and fall has been widely discussed (Deer, 2011a), and my emphasis here will be on the OAP process and its interaction with UK litigation that Dr Wakefield had been supporting against MMR manufacturers. (Such manufacturers can be sued directly in the UK, unlike in the USA.) Plaintiffs can get public funds to start litigation in the UK, and a team had set up a lab to test autistic children's gut samples for evidence of persisting vaccine-strain measles virus. The causal account was that the virus persisted in their guts, causing inflammation that traveled to the brain and caused autism. After the UK public funding authority for litigation reviewed 60 expert reports on the

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MMR–autism link, the case (*Sayers v. SmithKline Beecham*) was de-funded in 2003 on the grounds that it was not meritorious (Day and Kelleher, 2005). The PCR lab, called Unigenetics, which had been set up using those funds to find vaccine-strain measles virus in the guts of autistic children, closed in 2005. There was never a trial, and the records of the case remain sealed. The American OAP became the trial venue for the MMR theory instead. The OAP children introduced gut sample analyses from the Unigenetics lab as evidence. Michelle Cedillo's samples showed a positive PCR result for vaccine-strain measles RNA.

Some of the most dramatic testimony of the whole OAP came from British researchers who had been expert witnesses for the pharmaceutical companies in the first round of lawsuits in the UK over the MMR. A molecular biologist from the University of London, Dr Stephen Bustin, did the most to damage the credibility of the Unigenetics lab's PCR work. Allowing him to testify using his conclusions from the sealed British litigation reports was controversial because the underlying materials he had used were not available to the petitioners. The vaccine court's more permissive evidentiary rules permit any evidence that would be helpful, and generally nothing is kept out. From the petitioners' perspective, Dr Bustin had been paid by pharmaceutical companies to dig (for 1500 hours of work time) until he found some evidence of lab misconduct, which was then unfairly used to besmirch everything the lab touched, even though the sample from Michelle Cedillo did not show all of the same problems (Conway, interview with author, 2011). After examining the Unigenetics lab, Dr Bustin concluded that it was likely that the measles RNA was really a false positive due to contamination. Describing one practice that he called simply 'unacceptable', Dr Bustin found that when two samples from the same source tested differently (one negative and one positive, when the result should have been the same), it would be recorded as a positive result (*Cedillo*: 52). He also found that the lab's notebooks had been tampered with, perhaps fraudulently, to change results. The special masters were able to examine pages of the notebooks themselves and see the alterations. Testimony indicted both the Unigenetics lab work and Dr Wakefield's own lab work, which he used to develop the idea that autistic children with bowel symptoms suffered from 'autistic enterocolitis' caused by the MMR vaccine. Nicholas Chadwick, who had been a PhD student in Dr Wakefield's lab when he was testing for the measles virus, testified that he had personally done PCR testing on gut samples himself. In each case, either they were negative or the sequencing showed that an initial positive result was a false positive (testimony of Nicholas Chadwick, *Cedillo* transcript: 2284). (Sequencing is follow-up procedure in genetic testing, which is done as a check on a purportedly positive sample.) Dr Chadwick also testified that he told Dr Wakefield about the negative results and the false positives, and asked to have his name removed from any publications in which any of the PCR data appeared. Petitioners' expert Dr Krigsman testified that one of the published papers (Wakefield et al., 2000) that used those results sparked his initial interest in treating autistic children (though he referred to the article by a co-author's name rather than invoking Dr Wakefield). Dr Wakefield has continued to insist that he did find measles virus in the guts of autistic children, though his recent book does not mention or respond to Dr Chadwick's testimony (Wakefield, 2010).

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Credibility failures of the MMR case

All three special masters doubted that the PCR results really showed vaccine-strain measles virus persisting in the children. The experts and special masters came close to pronouncing the lab's work downright deceptive, and certainly understood its obscurantism to be a failure of professional scientific responsibility. '[T]he *most important* points in my rejection of the Unigenetics testing', special master Hastings explained in *Cedillo*, 'were (1) the fact that the laboratory failed to publish any sequencing data to confirm the validity of its testing, (2) the failure of other laboratories to replicate the Unigenetics testing, and (3) the demonstration by the D'Souza group that the Uhlmann primers were "nonspecific"' (85, emphasis in original). A nonspecific primer would amplify other materials in addition to the target material, thus giving a false positive result. Replication attempts found that at first the samples would appear to be positive, but follow-up tests of the RNA that had been amplified revealed it to be human genetic material (Afzal et al., 2006; D'Souza et al., 2006, 2007).

The government also pointed to epidemiological evidence from researchers in the US, Europe, and Japan showing no association between autism and the MMR vaccine. According to special master Hastings, 'the best form of evidence consists of epidemiologic studies' (Ruling Concerning Motion for Discovery from Merck re MMR Vaccine, 2004, 16).[19] Special master Hastings, writing in the *Cedillo* decision, concluded that '*all of those studies failed to find such an association*' (*Cedillo*, 112, emphasis in original). The families argued that the epidemiological evidence against them was irrelevant because it was about the link between vaccines and autism generally, while their claim was tailored to the small subset of regressive cases. The special masters responded that some of the studies had indeed looked at regressive cases, and MMR in particular, and found no association, and that the lack of broader associations did indeed render their subset association less likely (*Cedillo*, 119–120).

Special master Hastings concluded that the petitioners had 'failed to demonstrate that [Michelle Cedillo's] vaccinations played any role at all' in her medical problems (*Cedillo* 2009, 2). The evidence was 'overwhelmingly contrary' to the claims, Hastings wrote, and the expert witnesses for the government were 'far better qualified, far more experienced, and far more persuasive than the petitioners' experts concerning most of the key points' (Ibid.). The expert who represented Dr Wakefield's line of research for the families, Dr Krigsman, got a particularly critical appraisal. Not only had he listed items under the heading 'Publications' on his CV that turned out not to be real publications, but he had also been disciplined at a previous hospital position for doing unwarranted tests on autistic children, and in representing Michelle Cedillo's medical history, was 'grossly mistaken' about the timeline of her symptoms. It was as if he had not really even read her records, special master Hastings concluded, or at best badly misread them (*Cedillo*, 145–6).

The petitioners' attorney tried to show that the experts for the government, in their efforts to show that vaccines are safe, violated their own norms of scientific inquiry. One of the most emotional moments in all the test cases was when two psychiatrists testified about having watched the Cedillo family's home video-tapes of their daughter Michelle. The psychiatrists testified that they could detect early signs of autism in the tapes that

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predated the MMR vaccine and that Michelle's parents had missed. One of them, Dr Eric Fombonne, a leading figure in autism research, when asked in cross-examination about his prior 'beliefs' when viewing the tapes, parried: 'Actually, I have no beliefs in general.' Invoking classic Mertonian scientific norms, he continued: 'I'm a scientist. What I look at is the evidence, which I generate myself in studies, or when I review studies of others. So I have no particular set of beliefs which drive my opinion' (*Cedillo* transcript: 1416). But as the family's attorney pressed Dr Max Wiznitzer, the other diagnostic expert to view the tapes, 'You know the outcome and you're looking back and you're identifying things that support the outcome, correct?' (1716). Both experts replied that the purpose of the videotapes was only to pinpoint the time when early signs of autism appeared and that for that purpose not being blind to the eventual diagnosis was not a problem.

There was high drama around the most famous name of the whole vaccine scare –Dr Andrew Wakefield – and around the insinuation that real corruption, real manipulation of results, had occurred. The Unigenetics lab came to stand in for a credibility zone – both a real space and a trace of connected researchers – that loyal parents stood by but that the special masters found to be corrupted. Even leaving Wakefield aside (which the petitioners' lawyers were quite eager to do), the evidence upon which they relied came to be seen as scientifically suspect because it did not hold itself up to the kind of scrutiny that characterizes the most prestigious science: testing and re-testing, transparency, and replication. When other groups not affiliated with the litigation tried to replicate the PCR results, they could not. Contentment with false positives was the most damning implication for scientific credibility in the first theory cases. The fact that Dr Bustin's investigation was litigation-funded research and the fact that the diagnostic experts viewed Michelle Cedillo's tapes knowing her diagnosis were not understood as genuine credibility problems. Credibility in an adversarial contest is relational: Who is more credible than the other? Significant imbalance in the OAP meant that deviations from the model of scientific rationality (such as already knowing Michelle's diagnosis when viewing the tapes) did not weaken the government experts' scientific credibility.

The aftermath of the OAP: From scientific credibility to procedural justice

The vaccine court was supposed to provide an attractive alternative to tort litigation for families pursuing vaccine injury cases, but paradoxically, the flexibility of its procedures and the thoroughness of the government's defense in the OAP also helped produce confirmation for many families that the vaccine program was hopelessly corrupt. How could the same legal process look so different to different people? How can powerful institutions wage credibility battles with advocates for highly publicized causes that may not be well supported by mainstream authorities without incurring backlash for overreaching? The autism challenge to vaccines was particularly tricky: here was a childhood diagnosis that was rapidly growing and affecting a very large number of families, with no cure and an incomplete account of its origins. The paradox is that, even when the credibility struggles are otherwise wholly lopsided, when the Goliath of government pushes back strongly against a highly publicized and emotionally salient cause (vaccine-injured children), the pushback itself may reinforce the challenger's credibility in some ways and for some

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audiences. The autism–vaccine theory has been on the decline in the past few years, and groups and individuals who still insist on the connection have been relatively marginalized (Kirkland, 2012). The overall effect of the OAP outcome was to further diminish the respectability of the vaccine–autism link, but it nonetheless produced a new way of talking about the loss in vaccine court.

Instead of continuing to fight on the scientific merits of the theory, critics – the losing families and the vaccine critics who support them – pivoted instead to a procedural justice argument against the vaccine compensation program. Their continued belief in their own version of scientific truth continues to be bolstered within their credibility zone of alternative researchers, journals, labs, and activist community networks. But instead of continuing to stress the causal argument (although many still do), the petitioners and their advocates reframed their overwhelming loss on the credibility of the science into a case that demonstrated how the institutional power of government immunization programs was hopelessly stacked against them. It seems likely that court critics will not be able to separate their failed scientific arguments from their institutional criticisms because the relatively small number of advocates are very closely tied to discredited figures such as Wakefield. Yet, just as creationists argue for teaching 'both sides' and anti-climate change critics indict clannishness among scientists striving to close off questioning of their consensus, these vaccine critics have nonetheless managed to shift some of the debate from the merits of their scientific evidence to broader questions of procedural justice and governmental power.

From the petitioners' and advocates' perspectives, the large scale of the OAP and the harsh appraisals of experts were simply a matter of the federal government doing anything in its power to defeat the threat to national immunization coverage that a link between vaccines and autism represented. The attorneys for the families protested that the special masters had unfairly raised the burden of proof in the OAP. From their perspective, their clients had been injured shortly after receiving shots, and they articulated theories to explain why, provided a story of cause and effect, and thus were entitled to win at a fairly forgiving level of proof where close calls are supposed to go to the injured party. The attorneys had won many cases that way before. The families were not convinced by the evidence to change their minds about causation. Furious at the treatment of Dr Krigsman, Rebecca Estepp, an activist mother with a case in the OAP, told the special masters that in her house, he was a 'saint'.[20] She characterized the special masters' treatment of petitioners' witnesses as 'a public flogging' and complained that because of the outcome of the OAP, families could not find any experts willing to testify for them anymore. The root of her anger was the belief that vaccines really do cause autism and the OAP reached the wrong conclusion. But instead of continuing to insist on that belief, she reframed her complaint to the media in procedural terms: the vaccine court is a stacked deck in which '[g]overnment attorneys defend a government program, using government-funded science before government judges' (Pediatrics for Parents, 2010).

What the petitioners really wanted was a chance to sue pharmaceutical companies for punitive damages with the right to discovery in front of a jury. What they got instead was a hearing in a forum with sufficient institutional flexibility to expand into a full-scale, in-depth proceeding populated by a small group of actors who had been working together on vaccine cases for many years. Their claims were against the trust fund, not vaccine

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manufacturers, and since there is a presumption against outside discovery in vaccine court, the petitioners were not able to compel pharmaceutical companies to open their files to scrutiny. Especially after the Supreme Court's ruling in *Bruesewitz v. Wyeth* (2011) that design defect claims (claims that a vaccine could have been made with a safer formulation, say without thimerosal) are pre-empted by the Vaccine Act and must go to the vaccine court exclusively, families and vaccine critics feel forced into a hostile forum in which to air their grievances. As one critic charged in a press conference post-*Bruesewitz*, '[the vaccine court] is not remotely a court. There are no rules of evidence or procedure or discovery or juries of one's peers. It's a program that is stacked against families because let's face it, vaccine injuries make vaccines look bad' (Center for Personal Rights, 2011). Rolf Hazlehurst, the father of one of the OAP children and an attorney himself, holds the compensation court responsible for the rise in autism rates:

> In vaccine court, the rule of law in the American system has been replaced by what is known as a special master. A special master is nothing more than a politically appointed government attorney. The vaccine court is nothing more than a procedural hurdle that has kept the vaccine–autism issue out of court for twenty-five years. I truly believe that if it were not for the Vaccine Act of 1986, the autism epidemic would not be possible. (Center for Personal Rights, 2011)

For mainstream researchers and vaccine supporters throughout the federal government, however, the OAP had been an exhaustive effort to hear every bit of evidence, to give the families every delay they requested in order to build the best possible case, and to open their proceedings to public scrutiny in an unprecedented way. From their perspective, the OAP allowed the vaccine–autism theory a much more thorough hearing than it ever could have gotten in any other forum, in front of quasi-experts, where evidentiary rules might have barred some of the less reputable expert testimony and where the financial risk to the attorneys would have been greater. The unanimity of the rulings and the release of each set of decisions on the same day helped consolidate their bid for closure. Each opinion describes how vast the record was, details each special master's evaluation process for all the important pieces of evidence, and describes exactly how much weight was assigned to it. Though much of this explanation is for appellate review, the rhetorical effect of these accounts is to present the OAP as thorough, fair, open, and precise. Unlike in regular civil litigation where the contingency fee means a losing plaintiff's attorney collects nothing, the vaccine court pays attorney's fees and expenses whether or not petitioners prevail. The special masters consider themselves independent from the rest of the vaccine program because they are appointed by the judges on the US Court of Federal Claims and serve within the judicial branch, not at the whim of Congress (the source of the original statutory set-up) or the health bureaucracy of HHS (where the rest of the vaccine compensation program is housed). Special masters serve 4-year terms that are nearly always renewed. The more flexible rules of the vaccine court (those that permitted Dr Bustin's testimony from the UK litigation, for example) had previously garnered bipartisan praise for showcasing a workable alternative to unwieldy traditional products liability suits.

We cannot learn this lesson too many times: scientific evidence, no matter how clear it seems to be to the people who produce it and vouch for it, does not have magical

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power to change minds. It exists within interested communities and, in the law, enters into a charged adversarial context within which social norms and institutional values play an important role it what it is ultimately said to mean. The OAP was a tremendous effort to bring closure to one of the most controversial causal questions of our day, and legitimacy of the outcome was a crucial goal of its design and execution. Features of its overwhelming exactitude and procedural accommodations did not have fixed benevolent meanings, however, and could be transformed into critiques of the power imbalance between the parties. Just because a design meant to produce legitimacy ends up being used to upend legitimacy among dissatisfied citizens does not mean government and courts should not strive for the most thorough, transparent, and validated procedures possible. But we should not be surprised when the controversies they are meant to settle nonetheless stumble on.

Notes

I wish to thank Leslie Gerwin, Joel Howell, Peter Jacobson, Carla Keirns, Amy Lerman, Michael Lynch, Beth Mertz, Clark Miller, Jennifer Mnookin, Shobita Parthasarathy, Elizabeth Roberts, Abigail Saguy, Kim Lane Scheppele, Chloe Silverman, Sergio Sismundo, Alex Stern, Beth Tarini, Keith Wailoo, and Steven Wilf for their helpful comments on this work. I am grateful for feedback from participants in the Law and Public Affairs seminars at Princeton University, the UCLA law faculty seminar, and the University of Michigan STS seminar and from anonymous reviewers. This research (IRB #HUM00031641) was supported by a grant from the University of Michigan College of Literature, Science, and the Arts, by the Law and Public Affairs Program at Princeton University, and by research funds from the Women's Studies Department at the University of Michigan.

1. Adults can file claims too. Now that the flu vaccine is recommended for everyone more than 6 months of age in the USA, a large and growing proportion of the court's cases are adult flu shot claims for Guillian–Barré syndrome, among other illnesses.
2. The Petitioners' Steering Committee (PSC) selected the test cases. There is no class action provision in the vaccine court rules. Though there were six test cases, I emphasize the three that established most complete factual record, *Cedillo v. Secretary of HHS*, *King v. Secretary of HHS*, and *Mead v. Secretary of HHS*. *King* and *Mead* were consolidated into one evidentiary hearing, so I refer to that transcript as the *King* and *Mead* transcript. All the opinions, transcripts, recordings, and many other documents are available at the court's website (www.uscfc.uscourts.gov/omnibus-autism-proceeding). The factual record established by the six test cases governs the disposition of the remaining OAP cases. The remaining autism cases are still being processed, but unless petitioners can produce new evidence showing causation it is unlikely any cases will result in compensation. The petitioners lost the cases they chose to appeal and so the special masters' original decisions stand.
3. For example, encephalitis, an inflammation of the brain, counts as a Table injury if it occurs within 72 hours of receiving any vaccine containing a pertussis (whooping cough) antigen (Health Resources and Services Administration, 2010).
4. The other two test cases for theory one were *Snyder v. Secretary of HHS* and *Hazlehurst v. Secretary of HHS.*
5. The autism petitions peaked in 2003 with 2437 filings. At the time, the court normally got about 200 claims per year (now up to about 400). Since it began ruling in 1989, the vaccine court has adjudicated 7281 non-autism claims, compensating 2749 or 38 percent. A total of 13,933 claims have been filed in the program from 1988 to August 2011 (Health Resources

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and Services Administration, 2011). Many claims are dismissed (more than 6700 so far) for reasons such as failure to meet the strict 3 year statute of limitations, failure to show that a covered vaccine was given, or as a result of the OAP rulings for the autism claims.

6. I describe this conference in detail elsewhere (Kirkland, 2012).
7. The hepatitis B vaccine, the DTaP (diphtheria, tetanus, and acellular pertussis) vaccine, and the Hib (*Haemophilus influenzae* type b) vaccine contained thimerosal, which could add up to 187.5 μg (micrograms) of ethyl mercury in the first 6 months of life. A microgram is one millionth of a gram or one thousandth of a milligram. Some flu vaccines still contain thimerosal (25 μg for some and 12.5 μg for the version administered to children under 3 years old).
8. There can be vast differences between different types of the same substance. Ethyl alcohol is the kind we like to drink, for example, while drinking methyl alcohol (wood alcohol) can cause blindness and death.
9. Dr Aposhian built his theory from a set of studies purporting to show that autistic children had very low mercury levels in their hair and teeth (Adams et al., 2007; Holmes et al., 2003; Hu et al., 2003), inferring that they were unable to excrete it normally. He also argued that chelation therapy helps cure autism (Bradstreet et al., 2003), and that must be because it removes the mercury. However, the special masters came to regard these studies as unreliable, low-quality litigation science. For example, the mercury level in hair from the autistic children in one study was actually within the normal range for children, while the control children's hair had 15 times the expected amount, and a replication study had failed to turn up any differences (*King v. Secretary of HHS*: 58).
10. Much of what we know about mercury poisoning comes from case studies of disasters, most notably a widespread poisoning in the 1970s in which farmers in Iraq ate seed contaminated with methyl mercury used as a fungicide, and the Minimata Bay industrial pollution case in Japan in the 1950s and 1960s, in which factory waste contaminated with methyl mercury was dumped into local fishing waters. The symptoms of methyl mercury poisoning documented in these cases are paresthesia (feeling 'pins and needles'), ataxia (uncoordinated movement), dysarthria (slurred speech), and loss of vision (*Mead*: 86). Ethyl mercury poisoning most frequently manifests with muscle weakness, loss of appetite, and dizziness (*Mead*: 86).
11. A can of tuna has about 0.17 parts per million of methyl mercury (or 170 parts per billion), though most of that amount would be excreted rather than remain in the body (Yess, 1993). One popular form of reassurance has thus been to point out that there is more mercury in a tuna sandwich than in a vaccine.
12. Babies are born with mercury in their bodies acquired from their mothers, and one study estimated that breast-fed infants get 290 μg in the first 180 days from mother's milk (Marques et al., 2007). The 1990s vaccine schedule delivered up to 187.5 μg. A government toxicologist estimated that the full course of TCVs would add 2 to 3 ppb to the brain burden of mercury (*King* and *Mead* transcript: 1810–11, 1818–19, 4335.)
13. Thomas Burbacher is a medical researcher at the University of Washington who received funding for his work from the National Autism Association, a group that supports the injury frame from autism, including vaccine-linked causation. Burbacher hinted at his sympathies in the closing paragraphs of his article, criticizing the IOM for its attempt at closure in 2004 with its finding that evidence did not support an association between thimerosal and autism. 'This approach is difficult to understand', he wrote, 'given our current limited knowledge of the toxicokinetics and developmental neurotoxicity of thimerosal, a compound that has been (and will continue to be) injected in millions of newborns and infants' (Burbacher et al., 2005: 1021).
14. The Pardo letter, along with all of the government's expert witnesses' reports, is available on the vaccine court website: www.uscfc.uscourts.gov/sites/default/files/autism/master%20

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autism.pdf (accessed 21 December 2011). The online docket of the OAP is also available there and contains links to the petitioners' exhibits as well.

15. When asked under cross-examination whether 'any substance is either toxic or non-toxic based upon the dose?', Dr Aposhian replied: 'No. This is an ancient form of quotation that until recently we taught in medical schools. ... We no longer believe that the dose determines the poison. That is an antiquated belief in this modern age because now we know about genetics and the hypersusceptibility of some people' (*Cedillo* transcript: 129).
16. There is some counter-epidemiology purporting to show connections between thimerosal and autism, but it was so discredited that the petitioners did not even cite it in their post-hearing briefs (*King v. Secretary of HHS:* 86).
17. Dr Greenland's point about vulnerable sub-populations was treated as a statistical truism that would apply to any study. He could not advance the affirmative case for vaccine-induced damage.
18. On the witness stand, Dr Goodman agreed with Dr Greenland on these points (*King* and *Mead* transcript: 3100).
19. This document is part of the online OAP docket available at the court's website (www.uscfc.uscourts.gov/omnibus-autism-proceeding; accessed 21 December 2011).
20. Rebecca Estepp, public comments at the question and answer session about the OAP held at the Court of Federal Claims on 26 October 2010. The quote comes from my notes from the event, which I attended.

References

Adams JB, Romdalvik J, Ramanujam V and Legator M (2007) Mercury, lead, and zinc in baby teeth of children with autism versus controls. *Journal of Toxicology and Environmental Health* 70(12): 1046–1051.

Afzal MA, Ozoemena LC, O'Hare A, Kidger KA, Bentley ML and Minor PD (2006) Absence of detectable measles virus genome sequence in blood of autistic children who have had their MMR vaccination during the routine childhood immunization schedule of UK. *Journal of Medical Virology* 78(5): 623–630.

Allen A (2007) *Vaccine: The Controversial Story of Medicine's Greatest Lifesaver*. New York: W.W. Norton.

American Academy of Pediatrics and United States Public Health Service (1999) Joint statement of the American Academy of Pediatrics (AAP) and the United States Public Health Service (USPHS). *Pediatrics* 104(3, Pt 1): 568–569.

American College of Medical Toxicology (2010) Position statement on post-chelator challenge urinary metal testing. *Journal of Medical Toxicology* 6(1): 74–75.

Andrews N, Miller E, Grant A, Stowe J, Osborne V and Taylor B (2004) Thimerosal exposure in infants and developmental disorders: A retrospective cohort study in the United Kingdom does not support a causal association. *Pediatrics* 114(3): 584–591.

Aschner M, Syversen T, Souza DO, Rocha JB and Farina M (2007) Involvement of glutamate and reactive oxygen species in methylmercury neurotoxicity. *Brazilian Journal of Medical and Biological Research* 40(3): 285–291.

Baker JP (2008) Mercury, vaccines, and autism: One controversy, three histories. *American Journal of Public Health* 98(2): 244–253.

Bernard S, Enayati A, Redwood L, Roger H and Binstock T (2001) Autism: A novel form of mercury poisoning. *Medical Hypotheses* 56(4): 462–471.

Blaxill M (2009) Rat on a hot tin plate: New evidence shows ethyl mercury from vaccines causes abnormal brain development in infants. *Age of Autism*, 3 November. Available at: http://www.ageofautism.com/2009/11/rat-on-a-hot-tin-plate.html (accessed 23 January 2012).

Downloaded from sss.sagepub.com at UNIV OF MICHIGAN on January 31, 2015

Bradstreet J, Geier D, Kartzinel JJ, Adams JB and Geier MA (2003) A case–control study of mercury burden in children with autistic spectrum disorders. *Journal of American Physicians and Surgeons* 8(3): 76–79.

Brown P, McCormick S, Mayer B, Zavestoski S, Morello-Frosch R, Altman RG and Senier L (2006) 'A lab of our own': Environmental causation of breast cancer and challenges to the dominant epidemiological paradigm. *Science, Technology, & Human Values* 31(5): 499–536.

Bruesewitz v. Wyeth (2011) 562 U.S._____.

Burbacher TM, Shen DD, Liberato N, Grant KS, Cernichiari E and Clarkson T (2005) Comparison of blood and brain mercury levels in infant monkeys exposed to methylmercury or vaccines containing thimerosal. *Environmental Health Perspectives* 113(8): 1015–1021.

Cedillo v. Secretary of HHS (2009) No. 98-916V (Fed. Cl. Spec. Mstr. 12 February).

Center for Personal Rights (2011) Vaccine justice press conference. Washington, DC, 3 March. Available at: www.ustream.tv/channel/vaccinejustice (accessed 27 July 2011).

D'Souza Y, Dionne S, Seidman EG, Bitton A and Ward BJ (2007) No evidence of persisting measles virus in the intestinal tissues of patients with inflammatory bowel disease. *Gut* 56(6): 886–888.

D'Souza Y, Fombonne E and Ward BJ (2006) No evidence of persisting measles virus in peripheral blood mononuclear cells from children with autism spectrum disorder. *Pediatrics* 118(4): 1664–1675.

Day M and Kelleher J (2005) Lessons from MMR and the future of group litigation funding. *Journal of Personal Injury Law* 1: 98–105.

Deer B (2011a) How the case against the MMR vaccine was fixed. *British Medical Journal* 342: c5347.

Deer B (2011b) How the vaccine crisis was meant to make money. *British Medical Journal* 342: c5258.

Dwyer v. Secretary of HHS (2010) No. 03–1202V (Fed. Cl. Spec. Mstr., 12 March).

Edmond G (2001) The law-set: The legal–scientific production of medical propriety. *Science, Technology, & Human Values* 26(2): 191–226.

Fombonne E, Zakarian R, Bennett A, Meng LY and McLean-Heywood D (2006) Pervasive developmental disorders in Montreal, Quebec, Canada: Prevalence and links with immunizations. *Pediatrics* 118(1): E139-E150.

General Medical Council (2010) Dr Andrew Jeremy Wakefield: Determination on serious professional misconduct (SPM) and sanction. General Medical Council, 24 May, London. Available at: www.gmc-uk.org/Wakefield_SPM_and_SANCTION.pdf_32595267.pdf (accessed 12 December 2011).

Gieryn TF (1999) *Cultural Boundaries of Science: Credibility on the Line*. Chicago: University of Chicago Press.

Gieryn TF, Bevins GM and Zehr SC (1985) Professionalization of American scientists: Public science in the creation/evolution trials. *American Sociological Review* 50(3): 392–409.

Haltom W and McCann M (2004) *Distorting the Law: Politics, Media, and the Litigation Crisis*. Chicago: University of Chicago Press.

Hazlehurst v. Secretary of Health & Human Services (2009) No. 03-654V (Fed. Cl. Spec. Mstr. 12 February).

Health Resources and Services Administration (2010) Vaccine injury table. Washington, DC: HRSA, US Department of Health and Human Services.

Health Resources and Services Administration (2011) VICP statistics reports. HRSA, US Department of Health and Human Services. Available at: www.hrsa.gov/vaccinecompensation/statisticsreports.html – Stats (accessed 15 September 2011).

Hilgartner S (2000) *Science on Stage: Expert Advice as Public Drama*. Stanford, CA: Stanford University Press.

Downloaded from sss.sagepub.com at UNIV OF MICHIGAN on January 31, 2015

Holmes A, Blaxill M and Haley B (2003) Reduced levels of mercury in first baby haircuts of autistic children. *International Journal of Toxicology* 22(4): 277–285.

Hornig M, Chian D and Lipkin W (2004) Neurotoxic effects of postnatal thimerosal are mouse strain dependent. *Molecular Psychiatry* 9(9): 833–845.

Hu L, Bernard J and Che J (2003) Neutron activation analysis of hair samples for the identification of autism. *Transactions of the American Nuclear Society* 89: 681–682.

Hviid A, Stellfeld M, Wohlfahrt J and Melbye M (2003) Association between thimerosal-containing vaccine and autism. *Journal of the American Medical Association* 290(13): 1763–1766.

Institute of Medicine (2001) *Thimerosal-containing Vaccines and Neurodevelopmental Disorders*. IOM. Washington, DC: National Academies Press.

Institute of Medicine (2004) *Immunization Safety Review: Vaccines and Autism*. IOM. Washington, DC: National Academies Press.

James SJ, Cutler P, Melnyk S, Jernigan S, Janak L, Gaylor DW and Neubrander JA (2004) Metabolic biomarkers of increased oxidative stress and impaired methylation capacity in children with autism. *American Journal of Clinical Nutrition* 80(6): 1611–1617.

James SJ, Melnyk S, Jernigan S, Cleves MA, Halsted CH, Wong DH, et al. (2006) Metabolic endophenotype and related genotypes are associated with oxidative stress in children with autism. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics* 141B(8): 947–956.

Jasanoff S (1995) *Science at the Bar: Law, Science, and Technology in America*. Cambridge, MA: Harvard University Press.

Jasanoff S (2004) *States of Knowledge: The Co-Production of Science and Social Order*. New York: Routledge.

Jasanoff S (2005) Law's knowledge: Science for justice in legal settings. *American Journal of Public Health* 95: S49-S58.

Kennedy RF, Jr (2005) Deadly immunity. *Rolling Stone*, 14 July, pp. 57–63.

King v. Secretary of HHS, No. 03-584V (Fed. Cl. Spec. Mstr. Mar. 12, 2010).

Kirby D (2005) *Evidence of Harm: Mercury in Vaccines and the Autism Epidemic*. New York: St. Martin's Press.

Kirkland A (2012) The legitimacy of vaccine critics: What's left after the autism hypothesis? *Journal of Health Politics Policy and Law* 37(1): 69–97.

Madsen KM, Lauritsen MB, Pedersen CB, Thorsen P, Plesner AM, Andersen PH and Mortensen PB (2003) Thimerosal and the occurrence of autism: Negative ecological evidence from danish population-based data. *Pediatrics* 112(3): 604–606.

Marques RC, Dorea JG, Fonseca MF, Bastos WR and Malm O (2007) Hair mercury in breastfed infants exposed to thimerosal-preserved vaccines. *European Journal of Pediatrics* 166(9): 935–941.

Mead v. Secretary of HHS (2010) No. 03-215V (Fed. Cl. Spec. Mstr. 12 March).

Offit PA (2008) *Autism's False Prophets: Bad Science, Risky Medicine, and the Search for a Cure*. New York: Columbia University Press.

Pardo, CA, Vargas DL and Zimmerman AW (2005) Immunity, neuroglia, and inflammation in autism. *International Review of Psychiatry* 17(6): 485–495.

Pediatrics for Parents (2010) Thimerosal not tied to autism. *Pediatrics for Parents* 3/4 (1 March): 9.

Sayers v. SmithKline Beecham Plc. (2004) WL 1640222 (Queen's Bench).

Schechter R and Grether JK (2008) Continuing increases in autism reported to California's developmental services system: Mercury in retrograde. *Archives of General Psychiatry* 65(1): 19–24.

Shapin S (1995) Cordelia's love: Credibility and the social studies of science. *Perspectives on Science* 3(3): 255–275.

Downloaded from sss.sagepub.com at UNIV OF MICHIGAN on January 31, 2015

Snyder v. Secretary of Health & Human Services (2009) No. 01-162V (Fed. Cl. Spec. Mstr. 12 February).
Star SL and Griesemer JR (1989) Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science* 19(3): 387–420.
Stehr-Green P, Tull P, Stellfeld M, Mortenson PB and Simpson D (2003) Autism and thimerosal-containing vaccines: Lack of consistent evidence for an association. *American Journal of Preventive Medicine* 25(2): 101–106.
Tyler TR (1990) *Why People Obey the Law*. New Haven: Yale University Press.
Tyler TR and Huo YJ (2002) *Trust in the Law: Encouraging Public Cooperation with the Police and Courts*. New York: Russell Sage Foundation.
Vahter M, Mottet NK, Friberg L, Lind B, Shen DD and Burbacher T (1994) Speciation of mercury in the primate blood and brain following long-term exposure to methyl mercury. *Toxicology and Applied Pharmacology* 124(2): 221–229.
Vargas DL, Nascimbene C, Krishnan C, Zimmerman AW and Pardo CA (2005) Neuroglial activation and neuroinflammation in the brain of patients with autism. *Annals of Neurology* 57: 67–81.
Verstraeten T, Davis RL, DeStefano F, Lieu TA, Rhodes PH, Black SB, et al. (2003) Safety of Thimerosal-Containing Vaccines: A Two-Phased Study of Computerized Health Maintenance Organization Databases. *Pediatrics* 112(5): 1039–1048.
Wakefield AJ (2010) *Callous Disregard: Autism and Vaccines: The Truth Behind a Tragedy*. New York: Skyhorse Publishers.
Wakefield A, Murch S, Anthony A, Linnell J, Casson D, Malik M, et al. (1998) Ileal–lymphoid–nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *Lancet* 351(9103): 637–641.
Wakefield AJ, Anthony A, Murch SH, Thomson M, Montgomery SM, Davies S, O'Leary JJ, Berelowitz M and Walker-Smith JA (2000) Enterocolitis in children with developmental disorders. *American Journal of Gastroenterology* 95(9): 2285–2295.
Warren C (2000) *Brush with Death: A Social History of Lead Poisoning*. Baltimore, MD: Johns Hopkins University Press.
Yess NJ (1993) US Food and Drug Administration survey of methyl mercury in canned tuna. *Journal of AOAC International* 76(1): 36–38.

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