Week 14: Vaccines

Going with the herd

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When it comes to public health, how far should governments compel people to do what is good for others?

MASS vaccination is without a doubt the greatest public-health triumph of the century. It has saved millions of lives, and prevented the crippling of countless others. As a result childhood diseases are, in the West, a rapidly fading memory. Even in poor countries, where they still persist, mass vaccination is among the cheapest and most effective ways to improve public health.

Vaccines are also very safe. They are dispensed by the million, so side-effects would be easy to see if they existed. But no medicine can be entirely without risk. In a large population, a few people will have a rare, strong reaction to even the safest substance. Moreover, as a disease becomes vanishingly rare—as diseases like measles and whooping cough have in the West—it follows that adverse reactions to the vaccine, however rare they in turn may be, will become more common than the disease itself.

Dealing with defectors

This presents a curious moral hazard, for the benefits of vaccination are twofold. Besides directly protecting individuals from infection, a campaign of mass vaccination provides so-called “herd immunity”. This is the level of immunity in the population above which an epidemic cannot start—a kind of firebreak for disease. Once that threshold is reached, the possibility that people will “free-ride” becomes real. The unvaccinated acquire the benefits of everyone else’s immunity without taking even a minuscule risk. Indeed, when a disease is rare, the best (albeit unethical) strategy for parents is probably to campaign vigorously for the vaccination of other people’s children, but not to vaccinate their own.

This raises a serious problem for those interested in public health. The more distant the memories of the ravages of disease (and who now remembers the creeping terror of paralysis from polio, or the deafness imposed by measles?) the more likely it is that even the whisper of a problem with a vaccine will scare people off (see article). Yet unless a disease has been eradicated from the world—and only one, smallpox, has so far gone—the risk of an epidemic can rise rapidly if the fraction of the unvaccinated falls even a little.

To see the potential for harm, one need only look at Russia since the collapse of the Soviet Union. With the end of compulsory vaccination and the collapse of the health system, hundreds have died from diseases that were on the point of extinction there a decade ago. Given all this, and given that people who refuse vaccination put not just themselves at risk should they encounter infection, but others too, what are governments to do? Many, and not just totalitarian ones, make vaccination compulsory for at least some diseases. In several American states, for instance, parents must obtain special permission for their children to be exempted from vaccination; otherwise the children are forbidden to attend school.

There is a better way. Voluntary vaccination can be as effective as compulsory vaccination at reducing the incidence of disease, as experience in Britain and Canada has shown. It has the added benefit of giving anti-vaccine campaigners less to latch on to. But one point is crucial. The continued success of voluntary mass vaccination depends on governments’ providing accurate information about the risks and benefits. Above all, this means resisting the temptation to pretend that a vaccination is perfectly safe, when it is only extremely safe.

Accurate information and peer pressure should do the trick. But if governments, bending the truth in a good cause, were to gain a reputation for dissembling on such matters, the prospects for successful voluntary vaccination would be damaged severely. And once that has happened, you can have public health or freedom, but not both.
A dose of dissent

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Doubt has been cast on the paper that started the MMR-and-autism scare

A FEW years ago Richard Dawkins, an evolutionary biologist at Oxford University, came up with the idea of the “meme”. He was trying to make the slippery problem of the evolution of human culture as tractable as that of biological evolution, and he thought that if cultural information could somehow be divided into separately transmissible elements, in the way that biologically heritable information is divided into genes, the rest might follow. A successful meme, he speculated, might pass from person to person like a virus.

Few recent memes have been more successful than the one which causes many people, particularly in Britain, to believe that the combined measles, mumps and rubella (MMR) vaccine can cause autism in children. That meme has been responsible for a fall in vaccination rates in Britain from more than 90% to less than 80% over the past six years (see chart). The consequence has been a rise in the incidence of measles and mumps, as the so-called “herd immunity” which mass vaccination brings has broken down. As the meme has spread, so have the viruses.

The MMR-causes-autism meme originated in the early 1990s, in the wake of suggestions that measles itself is a cause of autism. But it really started spreading in 1998, after the publication in the Lancet of a paper by Andrew Wakefield, of the Royal Free Hospital in London, and his colleagues. The paper examined the cases of 12 children who had two things badly wrong with them, a conjunction that the authors considered was a new syndrome (the fancy name for a set of symptoms that reflect a single underlying disease). The children in question had chronic intestinal disease, and they also had a history of normal behavioural development followed by a loss of behavioural skills that had already been acquired. In the majority of cases, the behavioural problems had been diagnosed as autism. And in eight of the 12 cases, the onset of the behavioural problems was associated by the child's parents with MMR vaccination.

The authors clearly state in the paper's discussion that “We did not prove an association between measles, mumps and rubella vaccine and the syndrome described.” Nevertheless, the suggestion was there, and that was enough. No amount of official reassurance could persuade the sceptics. Nor did the results of other studies, including one carried out in Finland, which looked at all the children vaccinated with MMR in that country over a 14-year period and failed to find any association. Then a larger study in which Dr Wakefield was involved produced evidence that children with the new syndrome had measles viruses in their guts more often than healthy children did.

The measles component of MMR consists of living, though “attenuated”, viruses—so the implication was that this was the source of the viruses in the children's guts. However, the presence of the virus does not indicate that it caused the disease. Indeed, there is reason to suspect that having this syndrome might make it harder for someone's immune system to get rid of the virus once it was introduced. In that case, the cause would be the other way around. Meanwhile, in America, a completely different meme is circulating. This also blames MMR for causing cases of autism, but the guilty component is alleged to be a mercury-containing compound called thimerosal, which is used as a preservative.

Now there is a new twist in the tale. On February 20th, the Lancet issued a carefully worded statement (in other words, one that looked as though it had been thoroughly examined by the publication's lawyers). It said that certain allegations about Dr Wakefield's paper had been brought to its attention (by a journalist on the Sunday Times, as it turned out). It rejected some of these allegations after investigating them. But some it accepted. In particular, it seemed as though Dr Wakefield had had an undeclared conflict of interest. In the light of this Richard Horton, the Lancet's editor, said that if he had known then what he knew now, the paper would have been significantly modified before publication.

Correlation or causation?

Dr Wakefield's conflict of interest was that he had received £55,000 ($90,000) from England's legal-aid board to carry out a second study on the relationship (if any) between MMR and autism. This board was the body responsible for giving financial support to people involved in legal action who were too poor to pay for it. The board wanted to know if claims by parents that their children had suffered because of an MMR vaccination had any scientific validity. Not making this clear at the time was,
perhaps, a little foolish. Nor was Dr Wakefield the only common factor between the two studies. Several children participated in both as well, though Dr Wakefield says he was not responsible for this.

In one sense, parental response to the scare has been rational. The real benefit of vaccination against the three diseases involved is that it denies the viruses a place to hide in the population. This is the phenomenon referred to as herd immunity. But if everyone else's child is immunized, there is no need to immunize your own. So even a small risk is not worth taking, until herd immunity falls so far that the threat of infection (and measles is a disease that can cause serious brain damage) outweighs the risk of vaccine damage.

The actual pattern of response, however, does not suggest such a cool and Machiavellian assessment of risk. That is because the reaction of many parents has been to have (or want to have) their children vaccinated one disease at a time. Indeed, such a course of action was recommended by Dr Wakefield at a press conference held at the time the *Lancet* paper was published.

But besides leaving those children at risk of infection longer, this course of action does not seem to square with the idea that the risk factor for the alleged new syndrome is measles. There is no obvious reason to believe that a shot of pure live-virus measles vaccine would be less risky than MMR. (Killed-virus vaccines exist, but give less protection.) Although there have been claims that multi-disease vaccines somehow put more pressure on the immune system than single-disease ones, there is no actual evidence to support this.

So what is going on? One problem with the first study, apart from its tiny sample size, was that the original association between the administration of the vaccine and the onset of symptoms was, in most cases, made by a child's parents. In these circumstances, a parent is unlikely to be a rational observer. Indeed, he or she may be actively looking for something to blame for what in earlier times might simply have been regarded as an act of God.

The age at which the symptoms of autism generally manifest themselves is similar to the age at which MMR is first administered (14 months; a second dose comes later). Given that the MMR-causes-autism meme already existed, the link would be easy to make retrospectively. But correlation is not causation. At least, not always.

Dr Wakefield seems unrepentant. He points out (correctly) that his undeclared conflict of interest does not automatically discredit the original paper's science. And he says that he welcomes the inquiry into his research that has now been set in motion by the General Medical Council, the governing body of Britain's doctors. Whether the incident will serve as an effective pro-vaccine meme remains to be seen. If it does, it might yield an interesting result in cultural epidemiology, as well as casting light on the more traditional sort.

Questions.

#1. About how many cases of measles were reported in the U.S. in 1941 (before vaccination)? How many in 1997?

#2. What is the most rational (but unethical) strategy for parents to pursue regarding vaccination?

#3. There is currently a popular misconception that the MMR vaccine causes what disease?

#4. In Britain, people blame the attenuated measles virus vaccine for #3. In the U.S., the blame is placed on what component of MMR?