No, combination vaccines don't overwhelm kids' immune systems

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No parent likes seeing their child have injections. Yet, around 93% of parents across Australia protect their children against 15 serious diseases by giving them all the recommended vaccines on the National

Immunisation Program Schedule. This success is due in part to the value of combination vaccines, which protect against two or more diseases in one go.

Combination vaccines mean kids need fewer injections overall. By adding several antigens (the part of the germ that stimulates the immune system) together in one vaccine, we can protect kids against up to six diseases in a few shots. These shots are typically given in a series of two or three injections over time.

Our new study released today in JAMA Pediatrics, backs the safety of a four-in-one combination vaccine – designed to protect against measles, mumps, rubella and varicella (chickenpox) and known as the MMRV vaccine. We also show its added benefits in protecting kids by the time they reach pre-school.

Making a combination vaccine typically involves decades of research to ensure the precise balance of "active" components is included, the immune response to each component is effective, and even the slightest change in a vaccine doesn't change its safety profile.

This is stringently regulated across the world, by groups such as the Therapeutic Goods Administration in Australia and Food and Drug Administration in the USA, before a vaccine is even trialled in humans, or indeed ultimately licensed for use.

Once these combination vaccines are used, their safety (as well as the safety of other vaccines) is also actively monitored. One new way we do this in Australia is by monitoring any side-effects in real time. Parents respond to an SMS survey about their child's recent vaccination, the results of which are collated and posted online.

Too much to handle?

However, some parents question if giving an injection that protects against multiple diseases will overwhelm the immune system or be too much to handle. The answer is "no" for many reasons.

A review into parental concerns about combination vaccinations confirms the moment babies enter the world they are covered in millions of foreign germs. The infant immune system is no longer considered "immature" but is finely tuned to respond to the incredible number of viruses, bacteria and other things it meets early in life. Vaccines contain just a few antigens compared to what babies meet every day.

The researchers estimate that even if 11 vaccines were given to infants at one time, only about 0.1% of the immune system would be "used up".

Rather than weaken the immune system, or putting it under strain, vaccines train the infant immune system to respond, without causing the terrible consequences of the disease itself. Combination vaccines do the same.

The design of vaccines has been increasingly tailored to leverage this unique biology, including the development of new combination vaccines.

For instance, in 2013, two new combination vaccines – the MMRV vaccine and a combination vaccine against the *Haemophilus influenzae type b* and meningococcus type c bacteria (Hib-MenC) – were added to Australia's immunisation schedule, reducing the number of injections babies needed.

Tackling four diseases at once, and measles

Our new study evaluated the impact of one these – the MMRV vaccine – since it was added to the schedule.

Before the MMRV vaccine was introduced, kids were protected against varicella (or chickenpox) with a separate vaccine. And they received their second dose of measles-mumps-rubella (MMR) vaccine at age four years, quite a big gap after their first-birthday dose of MMR.

By introducing this combination MMRV vaccine earlier (at 18 months), our study showed the second dose of vaccine against measles provided early comprehensive protection against this deadly disease.

While the first vaccine dose (given at 12 months) only gives a full immune response in about 90% of children, giving a second dose boosts immunity to more than 95% and also helps to provide longer lasting protection.

Our study showed not only that the percentage of children fully protected against all four diseases is now greater compared with when MMR was separated from the varicella vaccine, it is also occurring at a much earlier age.

"On time" vaccination (within 30 days of the recommended age) has now improved by 13.5% (from 58.9% to 72.4% of children). This means many more children are protected against measles, chickenpox, mumps and rubella (German measles) before entering pre-school.

Tackling four diseases at once, and safety

Another important part of our evaluation was to ensure that introducing this vaccine was safe. If the combination MMRV vaccine is given as the very *first dose* of measles-containing vaccine in very young children, it causes more cases of fever and a small increase in febrile seizures (a common, usually benign, but frightening convulsion in children) compared with giving the vaccines separately.

Our study examined if using the MMRV shot in the Australian program as the *second dose* would be linked to an increase in febrile seizures. When we examined all children who came to paediatric hospitals across the country with a febrile convulsion, then looked at what vaccines they had received, we found no increase in febrile seizures associated with this second dose given at 18 months.

So introducing this combination vaccine in 2013, which has taken decades to develop, has:

- reduced the number of injections children need
- helped improve the total number of children vaccinated on time, and
- has been safe.

In a nutshell

Combination vaccines not only mean fewer visits to the doctor or nurse for injections, they can have other benefits, as well as being safe.

Our study highlights how much information is considered before making any change to the immunisation schedule to introduce combination vaccines, and importantly, how carefully changes to the schedule are monitored and evaluated.

While combination vaccines might introduce extra antigens to a child's immune system in one go, they are a tiny, tiny proportion of what children meet as they grow. Being vaccinated trains a child's immune system to withstand some of the biggest and baddest germs they will encounter.

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