Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Editorial

Vaccination against SARS-CoV-2 should be included in childhood vaccination programs

Nearly one and a half year into the SARS-CoV-2 pandemic it is clear that the pandemic will not disappear in a few months and indeed annual resurgence has been predicted in a modelling study (Kissler et al., 2020).

Therefore, we must expect that the pandemic will continue in non-immune groups and will possibly continue to evolve to create so called "variants of concern – VOCs" (de Oliveira et al., 2021; Di Caro et al., 2021; Karim and de Oliveira, 2021; Tchesnokova et al., 2021). Antigenic drift as we know it from influenza is a possibility and require continuous sequencing of a proportion of isolates as the key surveillance tool (Peacock et al., 2021). The phenotypic expression should also be monitored as we still ignore how some mutations translate into antigenic changes if we do not use neutralization tests, as we indeed do for influenza.

Emergence of VOCs is driven by circulation of viruses in non-immunes and the selection pressure from immunity in people with previous infections or vaccination. Therefore, reducing the viral reservoir will be key to reducing the virus's opportunity to mutate.

SARS-CoV-2 is a zoonotic virus and hosts also include animals as shown by the large and uncontrollable outbreak in mink farms in Europe and North America (Fenollar et al., 2021; Larsen et al., 2021). Sporadic infections have been reported in felines and dogs, and although the affinity of SARS-CoV-2 for its receptor varies across species, all mammals express this ACE2 receptor (Wardeh et al., 2021; Wei et al., 2021) and new unexpected animal reservoirs may emerge (Prince et al., 2021).

We know from other viruses that a high degree of immunity in the population is the best guarantee against resurgence, best exemplified by measles that has one of the highest R_0 among the current circulating virus and for which the heard immunity is reached when over 95% of the population is vaccinated (Gahr et al., 2014; Majumder et al., 2015). The R_0 for SARS-CoV-2 is estimated to be 2.5–3 which mean that circulation would be controlled when 60%–70% of the population is immune (Sridhar and Gurdasani, 2021). In Europe approximately 10% of the population is aged below 20 years and 2.7% below 4 years. In contrast, in Africa these two groups represent approximately 25% and 7% of the population, respectively (PopulationPyramid, 2021). Reaching the herd immunity threshold means that if we have to reach immunity in 60–70% of a population to slow down virus circulation, we have to successfully vaccinate 80–100% of all the African adults 20+ years with a vaccine with ~80% efficacy against any variant. This could be very difficult to achieve for a number of reasons including the logistics and vaccine hesitancy unless we also vaccinate children and adolescents. This group of mostly non-immune individuals (Ladhani et al., 2021) constitutes at present a potential SARS-CoV-2 reservoir and therefore studies of vaccine safety and efficacy should also focus on younger age groups in order to control the pandemic and limit the emergence of new VOCs (Monod et al., 2021).

Concern has been raised over the efficacy of the different vaccines against the VOCs. Most studies have used in vitro neutralisation assays to demonstrate reduced susceptibility of VOCs to immune sera (Cele et al., 2021; Wibmer et al., 2021; McCallum et al., 2021).

However, few studies have looked at clinical COVID-19 as the endpoint or added, beside neutralizing antibodies, a measurement of the cellular immune response against these VOCs. Recent studies found that T-cells should recognise newly emerged VOCs and provide some cross-protection (Redd et al., 2021; Woldemeskel et al., 2021). A press release from Pfizer/BioNTech indicate that their vaccine is protective against the South African variant, B.1.351 (Pfizer/Biontech, 2021; Businesswire, 2021). A recent review suggested that "... evidence is growing that these variants share similar combinations of mutations" (Cooper, 2021) meaning that the VOCs are converging i.e. that evolution will result in the same variants in different places.

The Pfizer/BioNTech coronavirus vaccine is effective in adolescents the companies reported on the 31st March [NY Times 31 March] and Pfizer, Moderna and Johnson & Johnson have all started trials in children planning immunisations down to the age of 6 months [NY Times 25 March].

We believe that it is key to controlling the pandemic including emergence of VOCs that children even down to 2 years of age are immunised.

For instance, in the United States, 24% of people are under 18 years old [2010 census data]. If most under-18s can not receive the vaccine, 100% of over-18s will have to be vaccinated to reach 76% immunity in the population (Aschwanden, 2021). A recent simulation study from the United States showed that immunising children is important to reduce disease burden overall in the community (Moghadas et al., 2021).

This means that if children are indeed a potential source of SARS-CoV-2 infections and vaccination can efficiently prevent transmission, every new birth cohort or approximately 140 million children worldwide needs to be immunised every year (Forbes et al., 2021; Jones et al., 2021). Since the direct benefits for the children are limited, this can only be envisaged with vaccines that

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demonstrate an excellent safety profile in this age group. At present it is not possible to predict if new VOCs will require booster vaccinations with second generation vaccines like we know it from influenza.

In conclusion: To control the pandemic children should be immunized against SARS-CoV-2 which require that the decision makers start planning how and when to include it in the childhood immunization program in every country.

Conflict of interests

Philippe Buchy is an employee of the GSK group of companies and hold shares in the GSK group of companies. This article represents the views of the authors only, and not the views of GSK.

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