

## The Art of PCB Reverse Engineering (Standard Edition): Unravelling the Beauty of the Original Design

In early 2020, as Covid-19 ripped across the planet and humanity braced for the unknown, doctors in Italy began noticing a disturbing phenomenon. A surge of young girls, all under the age of eight, began to grow breasts or menstruate – separate medical conditions known as precocious puberty and precocious menarche. Now, nearly three years into the pandemic, new research is exploring various mysterious impacts on the reproductive cycles of female, trans and non-binary individuals across the globe, from girls experiencing their first menstrual cycles years before they’ve even finished primary school, to missed periods, other menstrual cycle disturbances and menopause. (Unfortunately, an initial delay by the medical community in recognising some of these impacts plays directly into the hand of anti-vaccine groups, keen to push falsehoods, most prominently that Covid-19 vaccines may be dangerous, or cause infertility – claims that are not backed up by credible research. In fact, scientists exploring the impacts of Covid-19 on reproductive health stress that the emerging studies in this area do not question the efficacy of Covid-19 vaccines, nor discourage their uptake.)

In the early days of the pandemic, the northern city of Bergamo anchored Italy as the second epicentre of Covid-19 outside China. Demoralised and exhausted doctors struggled to keep Covid-19 patients alive as hospital intensive care units were stretched beyond capacity. To cope, Italy was the first country to implement a restrictive, nationwide lockdown. Shortly thereafter, researchers from the Meyer Children’s Hospital in Florence, one of the oldest paediatric hospitals in the country, began tracking young girls being referred for precocious puberty, or early-onset puberty. Prevalence of the condition has risen in recent decades owing to a host of poorly understood and complex factors. Still, the rate of referrals was high enough to draw their attention.

After conducting a retrospective study, comparing rates of diagnosis in the five years preceding the pandemic, they published their scientific research in the Italian Journal Of Pediatrics in November 2020. The study confirmed an increased incidence of precocious puberty in girls during – and after – Italy’s 2020 lockdown. Between March and July 2020, 49 young girls experienced either the onset of precocious puberty or rapid progression of the condition – meaning that for those already experiencing the symptoms associated with early onset puberty, those symptoms progressed more quickly than expected – compared to a total of 89 such girls combined in the five years prior. The legitimacy of this study was reaffirmed in Italy in February 2022 by additional research published in Endocrine Connections. Further, this trend was marked globally. Similar studies followed in China, Turkey and India, as reported by The Washington Post and The Fuller Project this past spring.

One study flagged the apparent link between the pandemic and quickening rates of early-onset puberty as a –potential emergency–. But finding a single, or primary cause for this phenomenon is difficult, given that the onset of puberty is influenced by a combination of genetic, psychological, environmental, and metabolic factors. The pandemic further complicates the picture. Researchers speculate that stress, lack of physical activity, diet, hand sanitiser use, and increased exposure to electronic devices may be potential causes. Ultimately,

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each study stresses the need for additional research involving bigger populations, according to Dr Katie Larson Ode, a paediatric endocrinologist and clinical associate professor of paediatrics at University of Iowa Stead Family Children's Hospital, who said the medical community needs to determine whether these surges are happening and, if so, what the causes may be.

As the pandemic rolled into 2021 and beyond, it became clear that young girls weren't alone in experiencing pandemic-related impacts on their reproductive health. On the heels of the Covid-19 vaccine rollout, whispers of post-vaccination menstrual cycle disruptions began to emerge. They percolated in tweets and among friends who began gathering more freely after social distancing requirements were relaxed. These early reports drew the interest of Meghna Roy, a medical anthropologist at Jawaharlal Nehru University in New Delhi, India. Roy spent time throughout 2022 interviewing a small group of women, mostly between the ages of 20 and 30, who were willing to discuss their experiences of what they suspected was the Covid-19 vaccine's impact on their menstrual cycles. The women, who received vaccines (including Covaxin, Pfizer, Covishield, and Sputnik) administered across India, Kuwait, Germany and the United Kingdom, have experienced an array of symptoms. "Some subjects report a lengthening of time between the menstrual cycle, others speak of a shorter cycle with little to no bleeding at all, and still others report increased menstrual pain and heavy bleeding," says Roy.

Ultimately, Covid-19 vaccine menstrual side effects were self-reported to the medical community and scientific regulators. By 23 October 2022, more than 51,000 people reported suspected Covid-related menstrual disruptions via the Medicines and Healthcare products Regulatory Agency (MHRA) Coronavirus Yellow Card Reporting Scheme in the UK. The website is dedicated to capturing self-reported side effects from Covid-19 vaccines, which are then reviewed by the MHRA to ensure the vaccine's safe and effective use. The MHRA website states it is reviewing reports of suspected side effects of menstrual disorders and unexpected vaginal bleeding post-Covid-19 vaccination in the UK. Still, the MHRA response as of November 2022 is: "The rigorous evaluation completed to date does not support a link between Covid-19 vaccines and other changes to menstrual periods." It did not disclose its method and the position seemingly conflicts with the National Institutes of Health approach in the United States, which announced funding for a year-long study to look at the potential link. In late September 2022, the results of the NIH international study, which includes data from almost 20,000 people in the United States, the United Kingdom and Canada, confirmed a temporary increase in menstrual cycle length. Further, research out of the Imperial College London's Department of Metabolism, Digestion and Reproduction in November 2022, utilising data from menstrual tracking apps, also confirmed a

transient impact on women's menstrual cycles post-vaccination. Some researchers have described the findings overall as reassuring since the disruptions are generally short and reverse themselves over time and the research definitively shows that those who have had the vaccine are significantly less likely to be hospitalised for serious illness and/or die from Covid-19.

Regardless, these studies by NIH, Imperial College London and the MHRA were retrospective. Rather than reproductive health being monitored and tracked as part of vaccine development, this issue was researched by the medical and scientific community after vaccines were administered. This is baffling to some reproductive health advocates when one considers that over 50% of the global population experiences menstruation, and prospective studies " which would capture more data, and in real-time " could prove more beneficial. Unfortunately, most large-scale Covid-19 vaccine trials have excluded any questions about menstruation, so the opportunity to learn how these vaccines might impact menstruation beforehand was missed. This has created openings for anti-vaccine groups to fill in the blanks and push misleading theories unsupported by science.

The idea to include menstruation in medical research isn't novel. As far back as 2006, medical professional societies such as the American College of Obstetrics and Gynaecology have called for including menstruation as a fifth vital sign, alongside pulse, breathing rate, blood pressure and body temperature, given that periods are increasingly seen as a key indicator of health. If the menstrual cycle were considered a vital sign, then likely impacts on the cycle would be considered during medical research, including vaccine development.

A persistent roadblock to this issue being taken seriously post-vaccination is that reports tend to be based on individual experience, rather than quantitative, biomedical evidence. Scientists and clinicians, particularly in Western medicine and the global North, prefer the latter. The self-reporting aspect represents a dilemma, one that Roy seeks to address in her research in India. "At the moment, when some doctors are not aware of this issue, and there are scientists saying it is just stress impacting the menstrual cycle of these individuals, what does [the] evidence actually mean?" she said. "How is it not evidence when I have been through it myself and reported it?" she asks.

For medical professionals who have gone on the record to address the self-reported links between Covid-19 vaccines and menstrual disruption, the responses have been problematic. Typically, they emphasise the transient nature of the menstrual cycle disruption, noting that it will not affect one's fertility. Reducing reportees to a monolith solely interested in menstrual cycle disruption out of fertility concerns and anything that may impede the ability to achieve

pregnancy obscures the issue that the Covid-19 vaccines can have a hormonal impact, along with the virus itself. There are understandable reasons why medical professionals might want to downplay post-vaccine menstrual disruption to assuage Covid-19 vaccine hesitancy concerns and encourage their uptake. But one result of deemphasising the issue is that, in addition to invalidating the experience of temporary impact on menstrual cycles for individuals, it can add to the perception that the health of certain genders is secondary, or less important than the health of men.

This doesn't come as a surprise to Dr Sarah Glynne, a general practitioner and member of the British Menopause Society based in London. Dr Glynne has been working closely with fellow menopause specialist Dr Louise Newson to track and treat a third distinct impact on reproductive health during the pandemic – the link between long Covid and menopause. Dr Glynne reports a gender bias and willful ignorance among medical professionals managing patients with long Covid. "There seems to be a huge blind spot when it comes to considering the impact of the virus on women's hormones and the role of hormone replacement therapy," she said. Part of Dr Glynne's work is alerting people to this fact.

"Men and women are roughly equally likely to catch Covid-19. But men are more likely to have a severe, acute illness, whereas women are more likely to develop long Covid," she said. A 2021 study highlights the mean age of those impacted is 46 years of age and more than 80% of those diagnosed with long Covid are female. More than a third of those women, according to the study, experience menstrual cycle disturbance.

The symptoms of long Covid – which include fatigue, brain fog, chest pains, and muscle and joint pain that persist for more than three months after a Covid-19 infection – have many similarities with the symptoms of menopause.

While research clearly shows that Covid-19 vaccines may indeed minimise the likelihood that one develops long Covid, research on how long Covid and menopause interact is nascent. According to Dr Glynne and Dr Newson, Covid-19 is negatively impacting ovarian function, causing hormone deficiency and menopausal symptoms in many women with long Covid. "Research is urgently needed," says Dr Glynne. "Women presenting with long Covid should be asked about their menstrual cycles and history, but this isn't always happening." This, explains Dr Glynne, can lead to prolonged suffering that goes beyond the individual. "By June 2022, 2 million people in the UK had been diagnosed with long Covid. [As] women between the ages of 40 and 60 are the group most likely to get long Covid, this is significantly hampering women's ability to work and care for their children and families, meaning not just negative consequences for families [but also for] society and the economy," notes Dr Glynne.

For the first three years of the Covid-19 pandemic, media coverage has been extensive to say the least. Why, then, is the apparently unique impact that Covid-19 has had on females, non-binary and trans individuals across the span of their reproductive health stages at best a footnote, and at worst an afterthought? Perhaps the stigma associated with these naturally occurring health transitions may hinder societal engagement on the topic, but there are likely structural issues at play too. It is clear that additional funding for further research and attention to these areas is necessary. So too is a courageous and introspective reflection from the scientific community on what qualifies as medical evidence so that the concerns of some genders aren't overlooked. Assessing menstrual cycles and puberty is difficult given the wide variations in the population, but it is possible. Proactive research on the role between sex hormones and Covid-19 and other viruses is not only worthy of our collective attention, it is absolutely necessary.

Jamie Brooks Robertson is a London-based writer, independent scholar, and emerging essayist focusing on health and culture

\*Please note that the information in this article is no substitute for medical diagnosis, guidance or advice. If you are experiencing any impacts on your reproductive health during the Covid-19 pandemic or otherwise, please seek input from a trusted medical professional.

## Reference

[Learning Engineering Toolkit](#)

[Water Resources Engineering](#)