

## How are COVID-19 and routine childhood vaccines distributed to people in Rwanda?

Vaccines are among the most successful public health interventions against infectious diseases [1]. However, the challenges posed by vaccine delivery are often overlooked. For many resource-limited countries, gaps in cold chain infrastructure result in ineffective immunisation programmes [2]. In Africa, only 12.8% of the eligible population was fully vaccinated against COVID-19 by March 2022 [3], and routine childhood immunisation rates often fall below World Health Organisation (WHO) targets [4].

However, Rwanda has achieved over 95% coverage for childhood vaccinations [5]. It also met the WHO target of 40% COVID-19 vaccination coverage by the end of 2021 [6]. I spent my elective in Rwanda, at the African Centre of Excellence for Sustainable Cooling and Cold Chain (ACES). I aimed to map the nodes in the Rwandan vaccine cold chain. I visited healthcare sites across Rwanda, observing vaccine distribution from their arrival in Kigali to administration in local communities (Figure 1).

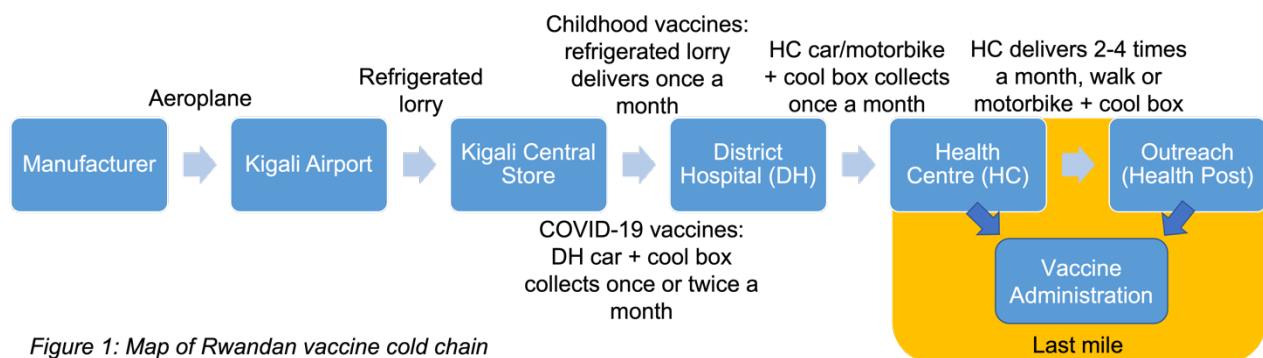
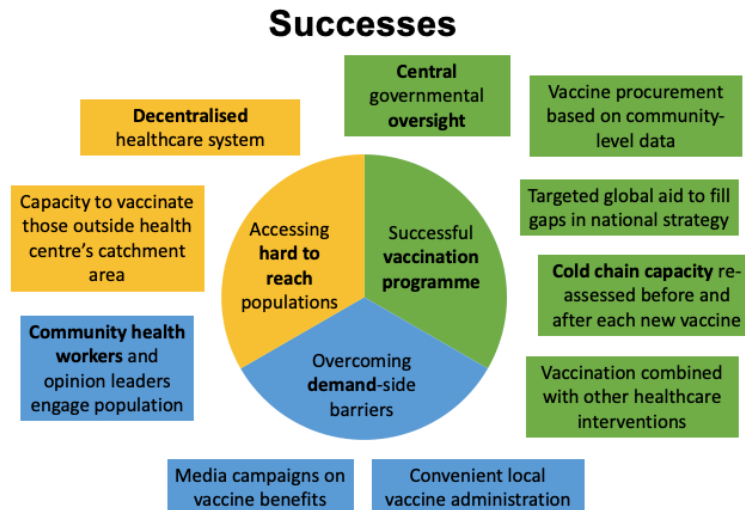


Figure 1: Map of Rwandan vaccine cold chain

I also aimed to critically appraise Rwanda's current vaccine delivery infrastructure. I developed a standardised quantitative data collection template, to assess cold chain equipment capacity, age and electricity supply at 14 healthcare sites. I used snowball sampling to recruit 19 vaccine delivery stakeholders, including healthcare workers, public health officials and cold chain technicians. I collected qualitative interview data, to gain an in-depth understanding of Rwanda's vaccine distribution successes and ongoing challenges.

I identified multiple factors contributing to Rwanda's successful vaccine delivery infrastructure. Its healthcare system is decentralised, with a focus on providing preventative interventions at community health centres. This gives autonomy to health centres to engage, vaccinate and track their local population. Central to this are community health workers, volunteers from the community who extend healthcare to remote populations. Simultaneous governmental oversight allows for cohesive national vaccination campaigns, targeted use of aid and accurate national vaccine stock and cold chain capacity estimates. This combination, along with other factors (Figure 2), could form the blueprint for next-generation vaccine cold chains across Africa.



*Figure 2: Successes of Rwanda's vaccine delivery infrastructure*

I also identified gaps in Rwanda's vaccine delivery network and proposed solutions, which I presented to ACES and key stakeholders in Rwanda and the UK. Vaccine vial temperature is not monitored during transit in cool boxes to health centres and outreach posts, potentially jeopardising vaccine viability. ACES could assist with thermometer and data logger procurement, or introduce drone vaccine delivery to eliminate fragile last mile logistics. Additionally, the frequency of outreach vaccination visits and cold chain equipment maintenance is limited by the numbers of specialised staff. Through its links with University of Rwanda, ACES could be involved in additional training programmes. Finally, high numbers of doses per vaccine vial mean that people are turned away unvaccinated to avoid open vial wastage. ACES could advocate to manufacturers for smaller vials. I will continue to be involved with ACES moving forward, to enact these changes and make a meaningful difference to the health of local populations.

Working with ACES on cold chain solutions provided valuable public health experience. In comparison to individual-level healthcare, where patient benefits are immediately apparent, I initially found it challenging to conceptualise the big-picture benefit of the networking, talks and meetings. However, I learnt that both approaches must work in tandem. Bringing together clinicians, scientists, government officials and industry members is required to address the complex social, environmental and biological factors that contribute to health and disease [7]. I was able to appreciate how the resultant large-scale interventions and policies can have population-wide impacts. This real-life public health experience confirmed that this is an area in which I would like to specialise.



Simultaneously, I was immersed into an entirely new culture. Rwanda was the first country I had been to where a major tragedy has occurred in living memory. The Rwandan Genocide of 1994 led to the deaths of over one million people. Nearly everyone we met had been impacted by it in some way. Though I could conceptually understand this, learning that my supervisor was the only survivor out of his ten siblings was almost incomprehensible. This reinforced how, in my career, I must be aware that patients may be dealing with incredible challenges. I also appreciated how resilient people can be in the face of trauma, which was genuinely inspiring.

At times, I did experience the challenges of culture shock. Having the income to study at university and travel abroad set me apart from a lot of people I talked to. I was conscious of my position of privilege and felt guilty when people would sometimes assume I could help them financially. Though uncomfortable, I learnt to establish protective boundaries and to appreciate that crossing these, even with the intention of helping someone, will inevitably complicate a relationship and worsen outcomes [8]. This skill will be useful when maintaining professional boundaries with patients, to safeguard my mental health and wellbeing.

Eliciting discussions with healthcare staff about vaccine-related issues also developed key communication skills. I quickly realised that people were much less likely to speak openly if they felt uncomfortable or if differences in our sociodemographic backgrounds were highlighted [9]. Though it was possible to have discussions in English, people were more animated and engaged when speaking Kinyarwanda, the country's main language. Equally, I learnt the value of building rapport before attempting to gather any opinions. Staff were much more forthcoming if I took the time to reassure them that we were looking generally into the cold chain, rather than auditing individuals' performance. I will use this understanding in my future conversations with patients, especially when trying to encourage discussions about sensitive topics, like drug use or sexual activity.

I am very grateful for the support of the Rhino Award in making my elective possible. I visited healthcare sites across Rwanda, collecting data that will underpin future cold chain projects in Rwanda and beyond. Constant trial-and-error learning made me more comfortable with situations I cannot completely control. I gained many transferrable skills, including communication, adaptability and resilience, which I will utilise as a doctor. I was even able to see white rhinos, which completed an elective that has both guided my career and allowed me to make a meaningful contribution to the local community.

#### *Bibliography:*

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