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The Influence of COVID-19 on Standard Child Immunisation Practices in South Africa

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Abstract

The COVID-19 pandemic interrupted immunisation programs globally, undoing previous progress that had brought vaccine-preventable diseases under significant control. This research investigated how the pandemic influenced the uptake of routine child immunisation services in South Africa. A qualitative study was carried out through in-depth interviews with 51 parents or caregivers of children under five who had missed or postponed one or more scheduled immunisation doses between 2020 and 2022. Additionally, 12 healthcare providers who administered public immunisation services during this period were interviewed. During lockdown periods, most caregivers viewed the threat of their child contracting COVID-19 at a health facility as more immediate than the dangers of missing immunisation. Caregivers noted limited access to routine immunisation information and reported vaccine shortages at public clinics. Healthcare providers also experienced stress and exhaustion. Following the pandemic, many caregivers began making more deliberate choices about immunisation, a departure from the previously habitual acceptance of RI. Some delayed vaccinating their children due to increased caution. There were also instances of caregivers associating negative perceptions from COVID-19 vaccines with routine childhood vaccinations, fostering concerns about vaccine safety. This movement from default to deliberate immunisation decisions raises concerns that RI uptake could decline in future pandemics. Strengthening health system resilience and ensuring consistent, transparent messaging about routine immunisation and vaccine safety are essential, along with addressing supply challenges. In South Africa, routine immunisation is broadly supported due to generational practices and health provider guidance. However, during the COVID-19 crisis, many caregivers faced the difficult choice between avoiding virus exposure and protecting children from vaccine-preventable diseases, which led to missed immunisation appointments. The shift toward active decision-making suggests potential risks in future pandemics. Governments must prioritize resilient health systems and address the needs of hesitant or delaying caregivers. Effective communication on the benefits of routine immunisation and vaccine safety is vital to counter misinformation and prevent erosion of public trust.

Keywords: South Africa, Behavioural science, Routine immunisation, Pandemic preparedness, Vaccine-preventable disease

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Introduction

Even before the onset of the COVID-19 pandemic, African nations were already falling short of meeting the United Nations Sustainable Development Goals aimed at lowering child mortality and eliminating preventable child deaths [1]. The continent recorded the highest mortality rates from vaccine-preventable diseases (VPDs) among children under five globally [2]. The pandemic further hindered progress, as strategies to control COVID-19 disrupted maternal and child health services across Africa [2, 3], and concerns about virus transmission led to reluctance in visiting health facilities.

In 2020, an estimated 23 million children worldwide missed immunisation doses—an increase of 3.7 million from 2019 and the highest figure recorded since 2009 [4]. The most notable drop in routine child immunisation occurred in April 2020, with a global 33% decrease in the administration of the third dose of the diphtheria–pertussis–tetanus-containing vaccine compared to 2019. This reduction varied by region, from 9% in the WHO African region to 57% in Southeast Asia [5]. According to the World Health Organisation (WHO), by April 2022, there were 21 major and disruptive measles outbreaks worldwide, with Africa and the Eastern Mediterranean reporting the highest numbers [4]. Actual figures are likely underestimated due to weakened global surveillance systems during the pandemic.

In South Africa, there was a drop in the number of children who were fully immunised from 2019 to 2020 [6]. Specifically, full immunisation coverage by age one declined by 4.3% in that period [6]. The sharpest decreases occurred in April, July, and August 2020 compared to the same months in 2019 [6], coinciding with national lockdowns. Most provinces experienced reductions, with Northern Cape, Eastern Cape, and Mpumalanga seeing the largest declines at 11.8%, 9.9%, and 8% respectively. North West province was the exception, showing a 7.1% increase [6].

This article offers a brief overview of earlier studies on both supply- and demand-side factors [7] that affected routine immunisation (RI) services for children during the COVID-19 pandemic. It then presents a qualitative study that investigates caregiver and healthcare worker (HCW) perspectives and behaviours concerning RI in three South African provinces.

Supply-side issues impacting routine immunisation

RI services across all WHO regions experienced disruptions during the pandemic, with varying impacts on service sessions, staff availability, and vaccine supply chains [5]. In many areas, RI service delivery was affected by the redeployment of HCWs to other departments, absenteeism due to illness or COVID-19 exposure, and fatalities among healthcare staff caused by the virus [8].

An analysis of WHO data from 170 countries covering 2019 and 2020 identified the main causes of RI service interruptions as a lack of personal protective equipment (PPE) for HCWs, reduced staffing, mobility limitations due to travel restrictions, and shortages of vaccines and related supplies [5]. Service disruptions were further exacerbated when HCWs who depended on public transportation encountered difficulties getting to work, including service withdrawals, fare hikes, and operational breakdowns [9].

In the WHO African region, 30 out of 47 member countries provided data. Among these, 17 countries (57%) reported disruptions to RI sessions. Two countries had partial suspensions of fixed-post RI services, while 17 experienced partial or full suspensions of outreach services. Additionally, seven countries (23%) reported vaccine supply challenges [5].

Demand-side issues impacting RI

In April 2020, all WHO regions experienced interruptions in the demand for immunisation services. Within the African region, 11 out of 30 countries (37%) reported difficulties related to vaccine demand due to fear of exposure to COVID-19, obstacles in transportation, and misinformation [5]. Parents were hesitant to take their children to vaccination centres because of concerns about infection, and some mothers chose to deliver their babies at home, resulting in missed opportunities for the first vaccine doses [10]. Anxiety about infection, combined with either a lack of information or misleading content related to both COVID-19 and immunisation, further contributed to vaccine hesitancy [10, 11]. This reluctance to visit health facilities for routine childhood measles vaccines may have led to a rise in unvaccinated children, potentially causing an increase in measles cases [12].

A risk–benefit evaluation regarding the reopening of immunisation clinics during the pandemic indicated that for every COVID-19-related death potentially linked to visiting such clinics in Africa, 84 deaths from vaccine-preventable diseases (VPDs) could be prevented [13]. These findings highlight the much greater threat posed by VPDs to children and the broader healthcare system compared to the risk of COVID-19 transmission in immunisation settings.

Lessons from the Ebola outbreak

Experiences from earlier epidemics, such as the 2014–2015 Ebola outbreak in West Africa, offer valuable insight into the importance of maintaining vaccinations during major public health crises. The suspension of immunisation programmes and the resulting drop in vaccination coverage led to more deaths from measles than

from Ebola itself. Additionally, some parents avoided using healthcare services due to the belief that visiting clinics increased the risk of contracting Ebola [14]. The Ebola outbreak weakened an already under-resourced national immunisation programme, and recovery after the crisis took considerable time—both of which likely contributed to the rise in measles cases [14]. This example underscores the importance of continuing routine immunisation (RI) efforts during a pandemic to prevent serious consequences for both communities and health systems as a whole.

Materials and Methods

In September 2022, we carried out a qualitative exploratory study across urban, peri-urban, and rural settings in the Gauteng, KwaZulu-Natal, and Mpumalanga provinces of South Africa. We conducted detailed interviews with fifty one parents or caregivers of children under five years old who had missed or delayed one or more scheduled immunisation appointments between 2020 and 2022. Using South African Demographic and Health Survey data, we identified communities within these provinces that had high populations of children under five. Recruitment was conducted door-to-door, employing a screening tool to locate parents or caregivers who consented and regularly used public health routine immunisation (RI) services for their children under five. Those caregivers who did not routinely immunise their children were excluded from the study. Additionally, we recruited 12 healthcare workers (HCWs) who provided immunisation services in the public sector during the pandemic, sourcing them from online platforms for interviews. Trained interviewers carried out telephone interviews guided by a validated discussion protocol, which explored obstacles to RI uptake during and after the COVID-19 lockdowns in South Africa.

The survey collected participants' demographic profiles and explored their attitudes and practices around RI for their children prior to, during, and following the COVID-19 pandemic. Participants were asked if they had attended health facilities for RI during the pandemic, reasons for not attending when applicable, or why those who attempted were unsuccessful in obtaining immunisations for their children. Additional questions covered perceptions of healthcare workers' and community attitudes toward RI, understanding of government communication about RI during the pandemic, and personal beliefs about the importance of RI. Participants were also asked about their confidence in the effectiveness of routine immunisations and COVID-19 vaccines.

Data analysis

All interviews were transcribed, translated where necessary, and coded in Excel. The data were analysed thematically, applying an iterative approach that involved repeatedly reviewing data and emerging themes to sharpen and deepen the analysis. This process revealed distinct themes and pathways related to RI. Descriptive demographic data were summarised using R software.

Results and Discussion

We first outline the demographic profile of respondents, followed by a thematic analysis of their replies. **Table 1** displays selected demographic characteristics of the caregiver participants. Equal proportions (33%, n = 17) were from each of the three provinces: Gauteng, KwaZulu-Natal, and Mpumalanga. Most respondents (75%, n = 38) were aged between twenty six and forty years. Household income varied across the group, with 22 percent (n = 11) earning below R3,000, 20 percent (n = 10) reporting incomes between R3,000 and R5,999, and 43 percent (n = 22) falling within the R6,000 to R9,999 range. **Table 2** summarises the reasons caregivers reported for either not visiting health facilities or leaving clinics without receiving RI doses, categorised by province, age group, and income bracket. The most common deterrent to seeking RI was fear of COVID-19 infection, whereas frequent causes for not receiving requested vaccines included shortages of immunisation staff and vaccine stock outs.

Table 1. Caregiver characteristics

	N (%)
Province	
Gauteng	17 (33.3%)
KwaZulu-Natal	17 (33.3%)
Mpumalanga	17 (33.3%)
Age	
18–25 years old	9 (17.6%)
26–40 years old	38 (74.5%)

41–60 years old	4 (7.8%)
Household income	
No income	5 (9.8%)
R1—R1 399	2 (3.9%)
R1 400—R1 999	2 (3.9%)
R2 000—R2 999	2 (3.9%)
R3 000—R5 999	10 (19.6%)
R6 000—R9 999	22 (43.1%)
R10 000—R19 999	6 (11.7%)
R20 000—R39 999	2 (3.9%)

Table 2. Reason for missed doses, per demographics against participant characteristics

Variables	Did not visit the facility, due to community announcement of COVID restrictions N = 4	Did not visit the facility, due to fear of contracting COVID-19 N = 18	Did not visit the facility, due to lack of time N = 1	Other personal reasons N = 2	Returned from clinic due to immunization stock shortage N = 20	Returned from clinic due to lack of immunisation staff N = 6
Province						
Gauteng	1 (25%)	6 (33.3%)	0 (0%)	1 (50%)	7 (35%)	2 (33.3%)
KwaZulu-Natal	2 (50%)	7 (38.9%)	0 (0%)	0 (0%)	6 (30%)	2(33.3%)
Mpumalanga	1 (25%)	5 (27.8%)	1 (100%)	1 (50%)	7 (35%)	2 (33.3%)
Age						
18–25 years old	0 (0%)	5 (27.8%)	1 (100%)	0 (0%)	1 (5%)	2 (33.3%)
26–40 years old	4(100%)	11 (61.1%)	0 (0%)	2 (100%)	18 (90%)	3 (50%)
41–60 years old	0 (0%)	2 (11.1%)	0 (0%)	0 (0%)	1 (5%)	1 (16.7%)
Income						
No income	0 (0%)	2 (11.1%)	0 (0%)	0 (0%)	3 (15%)	0 (0%)
R1—R1 399	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (10%)	0 (0%)
R1 400—R1 999	0 (0%)	1 (5.6%)	0 (0%)	0 (0%)	1 (5%)	0 (0%)
R10 000—R19 999	0 (0%)	3 (16.7%)	1 (100%)	0 (0%)	2 (10%)	0 (0%)
R2 000—R2 999	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5%)	1 (16.7%)
R20 000—R39 999	1 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (16.7%)
R3 000—R5 999	2 (50%)	5 (27.8%)	0 (0%)	1 (50%)	2 (10%)	0 (0%)
R6 000—R9 999	1 (25%)	7 (38.8%)	0 (0%)	1 (50%)	9 (45%)	4 (66.7%)

Thematic findings

Prepandemic immunisation behaviors

Routine immunisation (RI) was widely accepted and practiced among South Africans. Our findings indicate that vaccinating children was a default behavior rooted in longstanding social norms, supported by healthcare provider recommendations and facilitated by broad access to RI through comprehensive outreach efforts. As a result, parents and caregivers generally did not deliberate much over the decision to immunise their children. The immunisation program enjoyed strong community trust.

Only a small number of participants expressed concerns regarding the vaccines' efficacy, effectiveness, or possible side effects. The "Road to Health" immunisation card

served as a practical tool for caregivers to monitor scheduled vaccination appointments. Before the onset of the COVID-19 pandemic, the system enabled reliable forecasting and efficient planning of supplies and staffing for healthcare workers.

"It was better because we weren't full because no one just came in randomly. Everyone knows their date; that today is this child's date. You can't wake up today and just decide to take the child for immunisation, or maybe after a month or after a year. You have to go according to your date." (HCW, Enrolled Nurse, KwaZulu Natal)

When immunisation doses were temporarily unavailable, caregivers were frequently given a new appointment date within a two-week period. Delays and missed doses were uncommon rather than typical. Those caregivers who chose not to immunise their children often faced negative perceptions from both the community and healthcare workers (HCWs).

Minor challenges with RI uptake existed before COVID-19 but were manageable

Issues such as long waiting times, vaccine stock shortages, insufficient education, negative attitudes from HCWs, and concerns about stigma and judgment influenced care-seeking behaviors both before and after the COVID-19 pandemic. Many participants expressed frustration over the lengthy wait times to receive clinic services, including routine immunisation. These challenges were worsened by stock shortages, which reduced motivation to maintain children's immunisation schedules. Mothers who were employed particularly found it difficult to attend multiple clinic visits when stock was unavailable, often resulting in missed vaccine doses.

"Previously, they would make sure that if they have a shortage of anything, that they would call around, they would communicate with you so that you are able to get it as soon as possible." (female, 26-40 years old, Gauteng)

Insufficient knowledge regarding the significance of RI overall, the rationale behind particular doses, and their potential side effects contributed to lower adherence to RI. Previous unfavorable interactions with HCWs and a general distrust in the public health system weakened trust in RI services both before and after the pandemic. Additionally, some young mothers were deterred from accessing postnatal care due to fear of judgment from HCWs and other women.

"I would not go to the clinic when I have a problem with a child. I'd rather go to the doctor. Nurses make it hard for us to want to learn, to want to know something, because they are rude." (female, 18-25 years, Mpumalanga)

Before the pandemic, RI uptake was strong; in 2019, 83.9 percent (95 percent CI: 82.9–84.9) of children received all the basic vaccinations by age 1 year, including measles 1. The proportion of children fully vaccinated—meaning they received all age-appropriate vaccines from birth to eighteen months—was 76.8 percent (95 percent CI: 75.4–78.2) [15].

Immunisation disruption during the pandemic

Caregivers faced a difficult choice between the risk of COVID-19 exposure and the risk of their child contracting a vaccine-preventable disease.

The immediate threat of COVID-19 was perceived as more significant than the risk of missing doses that prevent VPDs. During the peak lockdown periods, attendance at health facilities was low, as many caregivers avoided public health centers due to fears of COVID-19 infection. They questioned whether sufficient infection control measures were being implemented to protect themselves and their children. Participants described various instances of missed RI appointments, ranging from short delays of a few weeks to multiple missed visits extending over two years.

"it was truly scary because I was also scared, I was also afraid that she might even get COVID at the clinic" (female, 26-40 years, Mpumalanga)

Some participants remained unsure if immunisation services were operational during the lockdowns, as they did not receive clear communication from the South African president or through media channels. The widespread belief that the health system was focusing mainly on COVID-19 rather than RI and child health led some mothers to avoid taking their children to clinics, fearing they would be denied service, although this was not accurate.

Communication from the government about routine immunisation was lacking

Public messaging on the continuation of RI services during lockdowns was minimal, which contributed to the common impression that RI was not urgent and was not prioritized by the government. While the Department of Health and associated institutions like the National Institute for Communicable Diseases recognized the necessity of sustaining RI services and issued protocols to safely deliver immunisations during the pandemic, this information did not adequately reach the public. Caregivers expected explicit guidance during the president's regular televised COVID-19 updates, but between March 2020 and March 2021, only one State of the Nation address specifically highlighted the importance of maintaining RI.

"I do not think that the government did anything. Rere was no communication whatsoever. Rey feel more that the pregnant ladies and the antenatal department has top priority." (female, 26-40 years, Gauteng)

Multiple addresses unintentionally suggested that individuals should avoid seeking routine health services during the lockdowns.

"Apart from people who need to travel to and from work or who need to seek urgent medical or other assistance during this time, everyone will be required to remain at home" (President Cyril Ramaphosa, 13 July 2020)

Consequently, numerous caregivers were unsure if they should pursue RI during the COVID-19 lockdowns, whether the services were accessible, and if it was safe to utilize RI services.

"When the president was talking on TV, he said, 'Re hospitals and clinics are only for emergencies.' So I did not go to the clinic. Rey did not turn me away— I did not go…. One should only go to the clinic for emergencies. So you wouldn't go to inject the baby, they would send you back [as the clinic only served] people who were very sick." (female, 26-40 years, KwaZulu-Natal)

Public health facilities experienced shortages of child immunisations during peak COVID

Children missed their scheduled vaccines because extended shortages at health facilities, driven by global supply chain issues, disrupted availability. Caregivers often lacked reliable updates on when vaccines would become accessible, complicating their ability to plan. Those strongly committed to RI made repeated trips or sought out alternative public health centres to locate the required doses. In contrast, caregivers who did not view RI as immediately essential chose to delay immunisation until a future scheduled visit or intended to catch up at a later stage, such as when their child entered school.

"I think I took him two times, but the first time I [only] managed to get some of the vaccines that I was due for, and then others I was told were out of stock. I had to turn back home. In addition, then, the second time, they told me they still had shortages. Rey told me to come back and try again, and they still had a shortage of that vaccine..." (female, 26-40 years old, Mpumalanga)

"You find that the clinics that are nearby also have nothing. You can refer them to a clinic. When you check with the clinics, they also say they don't have it. When they also check with the hospital we don't have it… Re next time their appointment is due, we might have it." (HCW, enrolled nurse, KwaZulu Natal)

Some caregivers were able to obtain RIs from private pharmacies. However, supply shortages posed a challenge for certain working caregivers who either could not take extra time off for repeated visits or were unwilling to pay for a service that was otherwise available at no cost.

HCWs experienced burnout and anxiety during the peak of the pandemic

During the pandemic's most intense periods, health providers faced numerous difficulties, including heavier workloads, understaffing, task reassignments, COVID-19 infections, mandatory isolation, and fear of spreading the virus to their families. These pressures negatively affected HCWs' motivation and led to burnout, which in turn influenced how they interacted with caregivers.

"Whoever is attending to you at the clinic does not want to spend too much time with you; Rey tend to do their job [more] haphazardly than what they did in the past obviously with the understanding that they have a fear of COVID… So I think then they just feel that the quicker that they are done with you, the better." (female, 26-40 years, Gauteng)

"I was at the point of finding another job because I was tired of being overworked; it was also emotion- ally draining." (HCW, enrolled nurse, Gauteng)

Many caregivers felt that children were overlooked as attention shifted primarily to addressing the COVID-19 crisis. They noticed that HCWs became more withdrawn and less attentive than before, with consultations often cut short to reduce in-person interactions. In some cases, caregivers were harshly judged by HCWs for missed doses, regardless of the reason, including concerns about COVID-19 exposure.

Post-pandemic immunisation trends

A move toward more "active" decision-making about routine immunisation

Caregivers resumed visits to health facilities at varying rates. Unlike the pre-pandemic period—when routine immunisation was often a passive act shaped by social norms—COVID-19 led to more deliberate, "active" decision-making. This change was influenced by the clear threat of COVID-19 and a lack of awareness about the significance of child immunisation. Interestingly, the same reason—protecting children's health—drove both the decision to seek and to delay RI. Before COVID-19, immunisation was more automatic, involving minimal deliberation. But during the pandemic, widespread movement restrictions, fear of infection, and a belief that RI was not an urgent service shifted this pattern. As a result, some caregivers opted to miss or postpone doses. A new tendency to avoid what were seen as nonessential health visits began to take hold.

This shift toward active decision-making also exposed major information gaps—caregivers lacked awareness about the critical role of RI, the serious diseases it prevents, the long-term effects of vaccine-preventable diseases (VPDs), and the risks involved in not following through with RI.

"I just take my child to the clinic, they do whatever then I come back, but I don't know [what] the procedure [is], how it works, what is it for […] Rey [should] tell us that

[…] today your kids are going to get this injection, but they don't say that... It is just that there's no communication between nurses and mothers or patients." (female, 26-40 years, Kwa- Zulu-Natal)

"What will happen to a child that doesn't get immunised? Nothing. [...] Children that I have seen who don't get immunised but they are growing, they are alright. Rey have no problem." (female, 26-40 years old, Gauteng)

Emergence of a new "bad vaccine" mental model for some individuals

While vaccines—particularly those for children—were generally seen as "good" in the past, the COVID-19 pandemic gave rise to a new "bad vaccine" mental model, which reflects deeply held beliefs shaped by personal experiences. Participants began to differentiate between COVID-19 vaccines—frequently regarded as unfamiliar, rushed, ineffective, and linked to side effects or other adverse outcomes—and other vaccines, such as routine child immunisations, which were viewed as reliable, safe, effective, and well-established. Although this distinction was consciously made, growing adherence to the "bad vaccine" perception has begun to erode confidence in even long-trusted vaccines. As the line between these two mental models becomes less clear, overall faith in vaccine safety and effectiveness can weaken, potentially leading to increased vaccine hesitancy, mistrust, and refusal.

"We weren't sure of anything regarding COVID. Remember, on social media, Twitter, and Face- book, the messages they sent, I think, is what made us scared… We believe in media more than trying things out for ourselves… People say, 'Don't go get vaccinated; you will die; people are dying.' A lot of people listen to that. Rey did not want to get vaccinated. I didn't feel convinced about taking it. Re reasons behind taking it were not very valid for me…. [However, people] know that the child vaccine doesn't have anything wrong, it's made so that the child is fine. [Interviewer: Was the COVID one not made for people to be fine?] No ways—the COVID one is scary." (female, 18-25 years, KwaZulu-Natal)

This study affirms that the COVID-19 pandemic significantly disrupted routine immunisation services across South Africa through multiple pathways. In alignment with findings from other research, we observed that the primary reason for decreased RI uptake was parents' fear of contracting COVID-19, which led to the avoidance of health facilities [3, 16]. To promote vaccine uptake and recover missed immunisations, health systems must make substantial investments in behavioural research and prioritise both risk communication and community engagement strategies [16]. While pandemic preparedness studies tend to emphasise supply-side challenges, the demand side of RI is equally vulnerable during large-scale health crises.

The emergence of more "active" decision-making around child immunisation during the pandemic resulted in three distinct patterns of behaviour as lockdowns ended: the "path of procrastination," the "path of doubt," and the "path of persistence" **(Figure 1)**. Among these, only the "path of persistence" was associated with consistent RI uptake. The remaining two groups failed to vaccinate their children according to the recommended schedule. "Procrastinators" intended to vaccinate but postponed it—either intentionally or due to systemic and logistical barriers—despite a generally favourable view of RI. Those on the "path of doubt" questioned the importance and safety of RI due to concerns sparked or heightened by COVID-19 and its vaccines. These changing norms, prompted by uncertainty, underline the need for policymakers to anticipate such shifts and address the different paths caregivers may take toward vaccination.

Reduced coverage in routine immunisation raised the likelihood of outbreaks of vaccine-preventable diseases (VPDs), such as measles, cholera, polio, and diphtheria. According to UNICEF, 20% of children in South Africa were underimmunised during a time of growing vaccine scepticism, while globally, 67 million children missed at least one vaccine between 2020 and 2023 [17]. Policymakers must reinforce public understanding of the risks posed by serious childhood illnesses and emphasise that vaccines are essential for protection. Government messaging should stress the critical need for vaccination, especially in the face of future pandemic disruptions.

At present, the "bad vaccine" mental model mainly pertains to COVID-19 vaccines, but it may eventually influence perceptions of other vaccines. Hard-earned progress in the fight against VPDs is now under threat due to widespread uncertainty, misinformation, and growing acceptance of negative vaccine narratives.

It is essential to maintain RI services during future pandemics through strong infection prevention and control practices to protect both healthcare workers and patients. Collaboration between governments and international partners is needed to preserve RI programs and ensure equitable vaccine distribution. Addressing supply-side issues requires preparedness plans that include sufficient buffer stock to manage potential shortages. Additionally, public-private partnerships should be explored to help mitigate supply disruptions.

Governments must also provide mental health support for HCWs, including training on coping with burnout. Access to mental health professionals during and after pandemics, routine psychological evaluations, and opportunities for recovery and self-care are important measures to reduce burnout and build resilience.

A comprehensive pandemic strategy must support the continuation of disease prevention efforts for endemic illnesses, maternal and child health services, and RI catch-

up campaigns. Recovery plans must also focus on long-term structural improvements within public health systems, ensuring both preparedness for future epidemics and uninterrupted delivery of essential health services [2]. Adamu *et al*. recommend adopting a systems-based approach that views all elements of the health system as interconnected [1]. Applying systems thinking and implementation science to public health planning and policy could enable African nations to better understand the pandemic's impact on services like childhood immunisation and promote the use of integrated, evidence-based strategies in complex real-world settings [1].

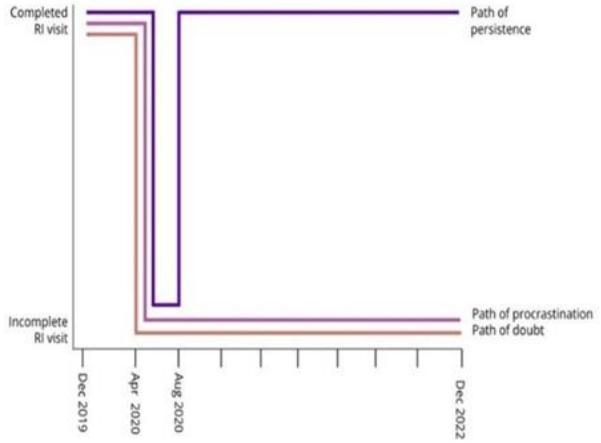

Figure 1. Pathways to routine immunisation during the post-COVID-19 pandemic in South Africa

Conclusion

In South Africa, routine immunisation remains a well-established and trusted public health measure, largely influenced by generational habits and guidance from healthcare providers. However, during the COVID-19 pandemic, caregivers were confronted with a difficult risk assessment—whether to risk exposure to COVID-19 or delay their child's protection against life-threatening VPDs. This tension led to significant disruptions in RI attendance for many children. The transition from habitual, default-based immunisation decisions to more deliberate and cautious decision-making presents a clear vulnerability that could re-emerge during future pandemics. To counter this, governments—especially in low- and middle-income settings—must prioritise the development of robust health systems spanning the community, primary healthcare, subnational, and national levels.

Our findings highlight three distinct behavioural patterns shaping post-pandemic RI uptake: the "path of procrastination," the "path of doubt," and the "path of persistence." While the latter group maintained consistent engagement with RI, the other two deviated from scheduled immunisation. These insights offer policymakers an opportunity to tailor interventions. Still, dedicated efforts must focus on caregivers who delay or question vaccination. As vaccine misinformation continues to circulate, there is a real possibility that new vaccines could become entangled in the spreading "bad vaccine" mental model. Preparedness planning must therefore give equal weight to public communication strategies that clarify the safety, value, and availability of RI, in addition to addressing supply-chain challenges.

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