

Pivoting during a crisis: lessons for Emergency Medical Services (EMS) and everyday health systems resilience from the Vaxi Taxi in South Africa

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Abstract

Covid-19 demanded new ways of working. In this paper, we present the experience of the Vaxi Taxi, a community-orientated model of care developed when Emergency Medical Services (EMS) pivoted in response to the Covid-19 pandemic, converting its ambulances into mobile vaccination units in the Western Cape, South Africa. Using a five-year long embedded research approach, we drew on traditions of organizational ethnography and critical action research. Data collection included documenting observations and reflections in a research diary during implementation. In addition, in-depth conversational interviews, group discussions and a series of sensemaking discussions with academic research team members were done. Our analysis draws on the Everyday Health Systems Resilience framework (EHSR) which understands resilience as an emergent process underpinned by system capacities (cognitive, behavioral and contextual) that can be nurtured through response to stress and shock. Responses take the form of absorptive, adaptive or transformative strategies. We consider the Vaxi Taxi as adaptive resilience strategy that nurtured system capacities which may have transformative potential in future. For health practitioners, it highlights the value of creative problem-solving to generate 'slack in the system' and creating 'spaces of unlearning' in supporting adaptive strategies. However, the experience also highlighted that the relational work to support meaningful community relationships that enable trust take time. Routine EMS operations don't support this trust building, and this requires alternative approaches. Finally, the paper represents a rare empirical example of an adaptive response to crisis tracked over time, and thus offers globally relevant lessons to the still-small EHSR literature.

Background

Addressing the COVID-19 pandemic demanded new ways of working.(1) Beyond vaccine and diagnostic developments, the groundbreaking health system interventions developed during this time included technological innovations,(2) such as telemedicine,(3–6) new early detection systems, such as wastewater surveillance,(6, 7) and a proliferation of public dashboards to track new infections, testing, recovery and mortality rates.(8) Amidst the largely technical and hospital-based innovations there was also some focus on social and behavioral change or risk communication (9) and a few examples of novel community-orientated models of care. These models included an expanded role for community pharmacists, (10) community health workers,(11) and self-organized COVID care networks.(12) The importance of putting communities at the center of a pandemic response is also more widely recognized as important because meaningful integration of community perspectives into health policy is critical to more accurate assessment of complex issues, and more appropriate and equitable design of interventions.(1, 9, 12, 13) However, there is limited research that seeks to understand what enabled or limited these new community-orientated ways of working during the COVID-19 pandemic.

In South Africa, the Western Cape (WC) province's public ambulance service responded to the COVID-19 pandemic through a community-orientated model of vaccination known as the 'Vaxi Taxi' (see Box 1). The vaccination programme began at the end of February 2021 as a fixed-site model, but in order to build trust, and reach folks struggling to access vaccines, a mobile unit was launched in October 2021. The

Vaxi Taxi was recognized by the Premier of the Western Cape Province and received a Public Service Excellence Award in 2023.(14)

This paper presents an analysis of the Vaxi Taxi experience. Given the limited empirical research about community-orientated models of care initiated in response to COVID-19, the paper adds to the existing literature both by presenting the model, and by analysing how and why it emerged and was sustained over time. As the Vaxi Taxi was itself an adaptive resilience strategy in a time of crisis, (15) this analysis applies the conceptual lens of everyday health system resilience (EHSR) (15, 16) and addresses the question: what system capacities a) underpinned EMS' ability to pivot in a time of crisis and b) supported the implementation of the Vaxi Taxi for 18 months during the pandemic?

Methods

Embedded researcher role

Embedded research is increasingly recognized as an innovative approach research approach within health systems. Drawing from organizational ethnography (17) and critical action research (18), such an approach understands knowledge construction not as the work of researchers alone, but instead as 'co-constructed by researchers working with participants in shared webs of significance and action'.(18) Critical action researchers 'refuse to separate thought from action, laying claim to the view that in such research, knowing is inseparable from doing'.(18) As others have noted (19), the blurring of positionality in embedded research can raise ethical and methodological challenges, as the researcher inevitably becomes an actor in the system, although the extent of such involvement may vary.

The lead author (LB) was formally employed as an 'embedded researcher' in the WC EMS over a five-year period. Her appointment, in 2019, arose out of previous engagements with EMS as a documentary filmmaker. Her role initially involved supporting the development of a 'learning system' (19) in EMS through processes of action and reflection with health care workers and managers (20, 21). This included supporting the senior leadership team with decision making processes (drawing on lessons from international evidence, for example) and working with EMS managers and health care workers to develop new community models of emergency care (including initiatives such as a community-based ambulance and a community first aid responder program). Over time, she became increasingly embedded in organizational life, and when the COVID-19 pandemic intensified in 2020, the urgency of the moment led her to take on more active community engagement roles from her EMS base. She played a critical role in organizing city-wide community action networks (CANs) in response to the pandemic in March 2020. (22) Then from October 2021 – March 2022 she was tasked by EMS to lead Vaxi Taxi community mobilization efforts, including linking EMS to the CANs. Over time, then, her embedded researcher role shifted from being primarily a 'participant observer' to playing an active role as an 'observing participant'(18) including supporting and documenting the Vaxi Taxi experience as it unfolded. In supporting the Vaxi Taxi LB drew on her wider existing experience, including insights about EMS gained as an embedded researcher.

Conceptual framing

To support its analysis, the paper draws on – and extends – the EHSR framework.(16, 23) The framework recognises both the everyday chronic stress and acute shocks to which health systems respond. It describes responses to shock and stress as resilience strategies, seeing them as the collective actions of individuals and teams working within systems, and, sometimes, across organisational boundaries.(24) The framework outlines three sets of system capacities as underpinning such responses.(25)

Drawing from this framework, our paper considers the Vaxi Taxi experience as an adaptive resilience strategy that also nurtured system capacities, which might themselves have transformative potential over time. We specifically seek to understand whether and how the system resilience capacities identified in the EHSR framework help understand this experience. These three capacities are fully outlined in our other published work (25) and can be summarised as:

- Cognitive – the mental models, skills and use of language that support collective problem diagnosis and development of solutions.(26–28)
- Behavioural - a toolbox of possible actions that can be collectively drawn upon in emerging situations – for example, to support an initial response to challenge that creates options rather than constrains future actions.(27)
- Contextual - ‘the network of interactions and resources that provide the backdrop for an organization’s response to disruptive conditions’(27) and that are enabled through a foundation of interpersonal relationships.

Data collection

In selecting the Vaxi Taxi as a case study, we used an approach that others have called ‘at-home ethnography’ – an emergent process in which cases are selected when they present themselves: “the researcher doesn’t find the empirical matter, it finds her”.(18) Drawing also on best practice from organizational ethnography(18) data collection as an embedded researcher included documentation of observations and reflections in a research diary.(17, 29) While care was taken to distinguish between empirical observations and own interpretations, this can be hard to do as an embedded researcher as the distinction becomes less clear over time.(17) In addition, in-depth conversational interviews, a group discussion, observations, and a series of sensemaking discussions with academic research team members (LG and AG) were also conducted to understand the Vaxi Taxi experience (see Table 1). Against the backdrop of five years of experience as an embedded researcher in EMS, the data gathered reflected on 18 months of experience (see Fig. 2) including transitioning from the fixed-vaccination site while piloting the Vaxi Taxi (September 2021), establishing the model across the province (October 2021 – March 2022) and finally, seven months of a two year implementation experience (December 2021 – June 2022) in the Cape Winelands district. This district’s experience was selected for analysis because

is the longest experience of the Vaxi Taxi among the province’s nine districts, and was one of the few Vaxi Taxis that had a dedicated team.

Table 1
Data collection summary table

Data collection method	Quantity	Primary focus (why it was done)	Details of data collected (what was done)
In-depth conversational interviews	4	To capture experiences of those involved in the Vaxi Taxi Program focusing on key reflections from the implementation process. Any critical insights were explored and used to guide further discussion. In addition, some question prompts developed from the conceptual framework were used as a guide to further explore the role of the capacities (Supplementary file A)	Transcripts of interviews of project managers for Provincial program, Cape Winelands Taxi, and non-core members of Cape Winelands Vaxi Taxi
Group discussion (GD) with Vaxi Taxi teams	9	To better understand collective perceptions of the program and gain deeper insights into team dynamics. In addition, some question prompts developed from the conceptual framework were used as a guide to further explore the role of the capacities. (Supplementary file A)	Transcripts of GD with all Vaxi Taxi teams (1–9) Sessions were on average two-hours. For the Cape Winelands Vaxi Taxi, the GD included all six team members, and program manager
Observation of Cape Winelands vaccination events	3	To support a deeper exploration of the capacities and supplement the narratives from the GD and interview data	Notes from observations of one school vaccination event, and two 'slaap dorpie' ¹ events (one at a church hall and one in an informal settlement)
Friday reflection sessions (Cape Winelands Vaxi Taxi team)	4	To observe team dynamics, and understand the role sensemaking sessions play to support action	Notes from observations of four 90-minute online Friday reflection sessions
Vaxi Taxi Statistics	1	To capture performance of the provincial Vaxi Taxi program	Relevant data extracted from routine data
Research team discussions (University colleagues LG and AG)	8	Sensemaking sessions to draw in broader health systems experiences and literature	Notes from discussions on research process and findings discussed prompting thoughts to deepen insights
Research diary	1	To document observations, wider reflections, and assist with deeper	Reflections captured throughout the

Data collection method	Quantity	Primary focus (why it was done)	Details of data collected (what was done)
		understanding of positionality	research process. Specifically, detailed notes of the observations, and reflections on the following were made: a) Weekly Tuesday Check-in sessions with all Vaxi Taxi teams (15) b) Meeting with EMS district managers (1)

Data analysis

In line with the embedded research approach, our analytic process sought to support the co-production of knowledge through regular engagement (20) with key EMS colleagues involved in conceptualizing and implementing the Vaxi Taxi. As depicted in Fig. 1 below, there were three iterative phases of analysis.

In the first phase, as part of the longer-lasting embedded research process and before the Vaxi Taxi was initiated LB considered the EHSR capacities as potential factors influencing the emergence of other community-orientated projects through regular reflective sessions with EMS colleagues. Observations and reflections were recorded in a research diary.(29) This analysis helped to further refine understandings of the system capacities, testing ideas through action and validate their resonance within EMS.

The second phase focused specifically on the Vaxi Taxi experience and entailed, as is best practice for qualitative research,(17) familiarization with the data, thematic analysis (using the system capacities as a guide), and triangulation across the qualitative data sets summarized in Table 1. Next, a visual synthesis was developed to compare and contrast themes and identify similarities and differences between the two different elements of the Vaxi Taxi experience considered (transitioning from the fixed vaccination site to the provincial Vaxi Taxi, and then a specific focus on Cape Winelands experience). This visual synthesis, along with a timeline of events extracted from the research dairy, was used to create a narrative of key themes for both elements of the experience.

The third phase entailed validation of the emerging analysis among EMS and among research team colleagues. Reflective, collective discussion sessions allowed all to interrogate findings and refine interpretations and all involved also commented on initial, written analyses.

Reflexivity

Clinical hierarchy carries significant power in the health system, and LB thus benefitted both from her unearned professional power as one of three medical doctors in EMS. Although she did not serve as a medical doctor, her role as documentary filmmaker, embedded researcher, and later community organizer was enabled by colleagues in EMS perceiving her a 'welcomed partial insider'(18). This gave her a 'passport of legitimacy' (30) which aided her in earning trust and supported her implementation role.

As mentioned, the blurring of positionality between role of researcher, and role of practitioner is a complex challenge for embedded researchers (19). The researcher cannot be separated from the research process and instead 'is part of a field of asymmetric relations of power' (18). This position requires constant reflexivity to interrogate researcher positionality and the influence it may have on the research (21). We sought to work with this complexity through regular sensemaking sessions with university colleagues (LG and AG) who were independent to the experience and helped to interrogate reflections of the influence of positionality on the research in the data collection and analysis stage. For example, concerns regarding 'romantic bias' in retrospective interviews where LB was part of the implementation team, and lead researcher was mitigated through contrasting interview data with reflections in the researcher diary, and a validation meeting.

However, while reflecting on the influence of this power on the research is critical, as is common practice within the HPSR field (31, 32) overall we consider this relationship as one that can make a meaningful contribution to the research. (33, 34)

Results

Context

In South Africa, the Covid-19 vaccination program began somewhat unexpectedly. Although low-and middle income countries were predicted only to get vaccines in 2022–2023,(35) in February 2021 the Sisonke healthcare worker COVID-19 vaccination program was announced (36) and the health system jumped into action to support the vaccine rollout. Within a few days vaccines became available to health care workers across the country.

Figure 2 and Table 2 summarise the activities undertaken by the Western Cape EMS to support the vaccination programme, and how they evolved over time. They were initiated in response to an early (February 2021) survey that found that 41% of provincial health care workers were vaccine hesitant (37) and would likely not get vaccinated. However, the activities subsequently implemented to address this hesitancy (Table 2) led EMS staff to become invested in finding a way to ensure access to the life-saving vaccines.

Table 2
EMS Covid-19 vaccination activities

Activity	Purpose	Adaptive response
Group discussions (GD)	Understand EMS staff perceptions of the Covid-19 vaccine	Embedded researcher seconded to support the vaccine program
EMS Covid-19 vaccine hotline	All EMS staff received a friendly phone call from a trained EMS vaccine ambassador to address any concerns and book appointment	Repurposed a standby call center set up earlier in the pandemic
Short films	Storytelling to support vaccine rollout: reduce fear and stigma, and build confidence in the vaccine	Embedded researcher seconded to develop films
Mass vaccination center	Provide Covid-19 to other frontline workers (such as teachers, police etc.)	Repurposed ambulance workshop (usually responsible for vehicle maintenance) and re-deployed staff requiring alternative placement.
Vaxi Taxi	Mobile vaccination unit to improve access to vaccines in low-income neighborhoods and build trust	Converted ambulances into mobile vaccination clinics

By May 2021, planning for a mass vaccination center at the main Cape Town (Pinelands) ambulance base was underway. The ambulance maintenance workshop was converted into a vaccination center within a few weeks and the Vaccine Project Office (VPO), responsible for coordinating vaccination efforts province-wide, trained EMS staff as vaccinators and established vaccine procurement processes. 36 242 people were vaccinated at this former ambulance workshop over five months, and EMS also adapted its model at critical moments. For example, after a decision to re-open schools in July 2021, the center vaccinated 14 000 teachers (41% of all teachers in the province) in the few weeks before the third wave (Fig. 3). Then, as the third wave began to subside (see Fig. 3) and fewer people were coming to get vaccinated, the model was adapted once again in September 2021, and the main Vaccine Center became the base for the EMS Vaxi Taxi model.

The story of the EMS Vaxi Taxi

As the fourth COVID-19 wave approached (Fig. 3), EMS again demonstrated its ability to pivot its operations by establishing the Vaxi Taxi as a community-based vaccination programme (Box 1). Because EMS had never been involved in vaccination programmes, the stakes were high. It had been widely praised by the provincial government for its initial vaccination efforts, but the EMS vaccine cold-chain technical team were concerned that this reputation might be jeopardized by weaknesses in an ambulance-based service, such as failing to maintain the proper temperature of the vaccines in a portable fridge or cooler box. However, experience at the Pinelands fixed site Vaccine Center provided the platform for successfully implementing the Vaxi Taxi across all EMS districts.

During its first 6 months, Vaxi Taxi teams visited over 180 neighborhoods, vaccinating 14 560 people (see Fig. 4). Working with local partners for each event (Box 1), they went to community kitchens, school halls, churches, cargo ships and many other local community structures, in areas with low vaccination coverage, both urban informal settlements and rural farmlands. The Vaxi Taxi also worked in high-risk areas known as 'red zones'(25) defined as neighbourhoods the Provincial government has declared as too dangerous for ambulance crews to enter without an armed police escort. However, the Vaxi Taxi worked in collaboration with trusted community partners (rather than with police escorts, as was usual practice in these areas). While the total number of vaccinations delivered was quite small compared to the four million delivered in the province as a whole by November 2021, the Vaxi Taxi reached people who would probably otherwise not have been vaccinated. It captured the hearts and minds of many – including Dr Tedros Ghebreyesus, the Director General of the World Health Organization(38) and was described as the 'outreach model with the greatest traction and appeal across the province'.(39)

No additional resources were made available for the Vaxi Taxi beyond vaccines and basic consumables. In terms of staffing it was, therefore, necessary to work creatively. Three groups of existing EMS staff were allocated to the Vaxi Taxi team closest to where they lived: staff who had been placed on incapacity leave either because they were declared too high risk to be patient-facing during the pandemic or because they had been previously assaulted on duty and were suffering from post-traumatic stress disorder; the Human Resource Development staff from the EMS College which closed during the pandemic; and people who had initially volunteered at the EMS fixed-site centre were appointed on an internship contract to work an additional 6-month period to support the Vaxi Taxi. Over time, competing operational demands for EMS staff and to get ambulances on the road generated tensions (*Researcher diary*). One manager noted that *"if these guys could have been used for operations, then we probably wouldn't have been able to pull this off"* (Validation meeting, November 2023).

The Cape Winelands Vaxi Taxi

Cape Winelands is a sparsely populated rural district, consisting mostly of informal settlements, farmlands, and small towns. The Vaxi Taxi for this area started a bit later than other teams but vaccinated consistently over 2 years, compared to the average of 6 months sustained by, and more sporadic operation of, other district teams (Fig. 4).

The core team, as elsewhere, were drawn from EMS staff unable to perform their routine operational duties, was comprised of six dedicated staff (one coordinator for each of the four sub-districts within the Cape Winelands, and two vaccinators) and a range of EMS volunteers from different bases who assisted at Vaxi Taxi events on their off-duty days. The team was recruited and actively supported by the sub-district manager (TK), who had been tasked by the district manager with coordinating the Cape Winelands Vaxi Taxi.

The team initially worked with community members to organize vaccination events in informal settlements, on farms, and even did late night events to improve access in 'slaap dorpie' (translated as 'sleeping towns' because they are small towns predominantly occupied by farmworkers and are thus

empty during the day as people are at work, and only come home at night to sleep). However, as with other Vaxi Taxi teams, over time they began to collaborate more often with more formal institutions such as schools, neighborhood markets, factories, and hotels.

How the Vaxi Taxi evolved over time: understanding the critical enablers

Tackling initial resistance

The Vaxi Taxi had dual goals. Not only was it a strategy *“to end the pandemic”* (Group discussion 1, Jan 2022) but it was also *“an opportunity to work with the community to save lives”* (Group discussion 8, March 2022). The idea was to *“build relationships with the community, so that when EMS staff go out there, they can have our backs, and protect us”* (Group discussion 1, Jan 2022). A policy document to senior provincial health department officials, thus, described it as *‘a trust building intervention that sought to use the COVID-19 vaccination programme as vehicle to build relationships and nurture community networks to improve the safety of ambulance crews’*. (40)

However, multiple concerns were raised by frontline staff and managers. Overall, initially, *“it was a really hard sell. The idea that we could use our ambulances for anything else other than transport and medical care was foreign”* (Validation meeting, June 2023). Frontline staff were primarily concerned with their safety, especially because many of those who worked with the Vaxi Taxi were only available because they had previously been assaulted on duty, were recovering from psychological trauma and required alternative placement. In addition, as already mentioned, for a small group of staff, concerns regarding a mobile model and potential difficulties in following proper cold-chain processes to ensure vaccine efficacy seemed insurmountable. For the EMS operational managers, meanwhile, the main concern was that vaccinating fell outside of the EMS mandate, and would require resources that should instead be used for its core duty of delivering emergency care. Beyond these initial concerns, a continuing context of uncertainty, resulting from EMS operational staff frequently being re-allocated back to their routine clinical duties, and a lack of clarity about when the project would end, remained distressing for the frontline staff driving the initiative and made planning ahead difficult.

However, overall, the Vaxi Taxi received high level support because through its dual goals it spoke to the broader strategic imperative of improving safety of ambulance crews. This strategic goal ultimately led to the support both of senior health officials and EMS managers: *“For a very long time, EMS has been seen in this negative light due to so many reasons beyond our control. But this project gives us an opportunity to restore that trust”* (District manager meeting 31st March 2022, researcher diary reflection).

‘Taking our show on the road’: critical capacities enabling the shift from a fixed vaccination site to the Vaxi Taxi.

Our analysis suggests a range of interacting factors enabled the shift from the fixed vaccination site to the Vaxi Taxi. As summarised in Fig. 5, these included the system capacities developed during earlier EMS vaccination efforts (boxes with dashed border), three additional critical drivers (boxes with solid

border) and some conditions created by the COVID-19 pandemic itself (dotted line mix border). In addition, although not explicitly investigated, the dotted background in this figure notes that these experiences developed against a background of power dynamics. For example, the experiences at the Pinelands Vaccination Centre created an environment that supported bottom-up problem solving that underpinned the can-do attitude of the Vaxi Taxi which overcame the traditional 'command and control' practices of leadership in EMS (*Validation meeting, June 2023*).

System capacities are built over time: from the fixed-vaccination site to the Vaxi Taxi

As already noted, the Vaxi Taxi built on the earlier EMS vaccination efforts. In this next section we describe specific examples of where system capacities were built over time.

For example, given that EMS had never been involved in any vaccination programme before, the legitimacy it earned from its successful fixed vaccination site (41) was critical: *"EMS earned its vaccination stripes at Pinelands"* (*Researcher diary*) thus building contextual capacity. In addition, the trust underpinning key relationships with colleagues in the broader health system (such as the pharmacist) supported Vaxi Taxi development (*Researcher diary*) as well as the technical muscle to vaccinate EMS developed. For example, practised routines of vaccine procurement and delivery were already well-rehearsed and could be drawn on by *"actually running a mock setup where we had members of the public coming to get their vaccinations in the back of the ambulance"* (*Interview 1, 20th Dec 2021*) at the main Vaccine Centre, thus building behavioural capacity over time. These processes could then be adapted for a mobile unit. The EMS vaccination hotline set up in February 2021 (see Table 1 and Fig. 2), meanwhile, nurtured the collective purpose (*Researcher diary*) a cognitive capacity that remained a driving force throughout vaccination efforts: *"We were part of history. We were part of the team that made it happen"* (*Group discussion 1, Jan 2022*).

Creating spaces for unlearning

Although the Vaxi Taxi ultimately became a celebrated model of community engagement, as already noted, it *"almost didn't happen"* (*Validation meeting, June 2023*) due to the concerns of managers and some front-line staff. Even after senior EMS management had given overall approval, a critical obstacle remained: frontline staff fear and mistrust. Our analysis suggests that three critical drivers helped to overcome these initial concerns (Fig. 5) and that it was less about learning new skills, and more about unlearning prior ways of thinking and doing.

The first driver was a broad resource network of trusting relationships. This network was wide, including not only the health system actors already mentioned but also relationships with the community action networks (CANs) established during an earlier phase of LB's work during the pandemic.(22) This trusted network initially created a platform for the Vaxi Taxi, as the teams drew on these connections to safely

experiment with vaccination events at CAN community kitchens *“Knowing that the CANs were there. Once they promised we would be safe, then we knew we would be safe” (Validation meeting, June 2023).*

These events then gave rise to the second driver, spaces for unlearning, creating opportunities for meaningful collaboration between EMS and community members which in turn, supported the third driver, a mindset shift from fear and mistrust, to safety and connectedness. This new mindset meant that rather than spending as little time as possible (and often with a police escort) in communities, the Vaxi Taxi teams took time to connect with community members: *“So, for me that was definitely a paradigm shift. To be able to get out and walk there, and to be on the main road, and to walk into that shebeen and to stop someone and just speak to them because you are immersing yourself in that community. You’re in their space... for me that was a changing moment” (Interview 1, 20th Dec 2021).*

These spaces for unlearning set in motion a critical catalysing loop. With each vaccination event, from the door-to-door mobilising done ahead of time (see Box 1) to the event itself, there were multiple trust-building moments between EMS staff and community members that continued to support a positive mindset shift *“so I think, yeah, changing perception, in terms of our staff not having a perception that the community is totally against us, because when we are out there, that is when we connect” (Interview 2, 22nd June 2022).* The new mindset led to a spontaneous new routine of sharing positive messages and photos within the Vaxi Taxi team on a WhatsApp group (a routine first developed at the Pinelands site) which in turn, led to a buzz of excitement and re-activated the “can-do-attitude” that had infused the establishment of the fixed vaccination centre (*Researcher diary*). Ultimately, EMS was galvanised into action, and the Vaxi Taxi was officially underway.

Lessons on sustaining the model: insights from Cape Winelands Vaxi Taxi

Our analysis (summarized in Fig. 6) also identified three key drivers that sustained the Cape Winelands Vaxi Taxi model over the period of study (7 months of a 2-year implementation experience). These three drivers are: enabling leadership, helpful routines (including a weekly ‘touch-base’ sensemaking space) and nurturing team dynamics. Again, background power dynamics, whilst not explicitly investigated, were revealed in this experience. For example, a key manager buffered the Vaxi Taxi against organizational hierarchies and flat hierarchies within the team helped create an environment of psychological safety which enabled creative problem-solving.

Enabling leadership: a delicate balance of freedom and support

A dedicated manager played a supportive role in relation to the Cape Winelands team, while giving them the mandate to make key decisions regarding the project. The manager both acted as a buffer against disempowering organizational dynamics, such as instructive and authoritative management styles, and

deliberately encouraged the team's relative autonomy *"Own it. Grab it. It's yours"* (Group discussion 2, 2nd March 2021). He assisted with some of the logistics (such as getting approval for a travel allowance for accommodation after the late events), chaired weekly touch-base sessions, and made sure the team was *"not being micro-managed, and having the autonomy to make decisions"* (Interview 2, 22nd March 2021).

The team's relative autonomy, and sense of psychological safety, created a platform for the pre-existing MacGyver spirit to come alive *"we have always been MacGyvers out here, but the difference now, is that we have actually been given the freedom to do it"* (Group discussion 2, 2nd March 2021). The phrase MacGyverism was inspired by the 1985 TV action-series about secret agent Angus MacGyver, but is also used in everyday resilience theory and refers to the characters resourcefulness and creative problem solving ability – specifically because he was able to find solutions for 'seemingly insoluble problems and situations'(26) with minimal resources. This creative problem-solving ability was seen multiple times in the Vaxi Taxi experience. For example, because they initially had no chairs, they pragmatically collaborated with groups who could provide them, such as a church, a funeral parlor and a shebeen (defined as an informal alcohol outlet or bar, often run out the back of someone's house). They are social spaces where many people gather, and are most commonly found in townships or farm areas in South Africa) (Researcher diary). And when they realized that people in the 'slaap dorpiers' could not access vaccines they adapted their hours to do late night vaccination events, so that farmworkers could get vaccinated after their work shift (Researcher diary).

Establishing helpful routines that included a regular sensemaking space

The team set up a weekly structure to support their work. Mondays were for planning, Tuesday–Thursday for vaccination events, and on Fridays they held a touch-base session. This structure became a useful rhythm that enabled a weekly line-up of events; but they also remained flexible and adapted it as needed from week to week. For example, they adjusted their schedule to accommodate requests to host vaccination events on specific days (Researcher diary).

The Friday touch-base sessions also created a dedicated space for learning and reflection, and, our analysis suggests, was key to sustaining the Vaxi Taxi. Although unusual in EMS, which usually focuses on operational meetings to discuss logistics, the team found value in these sessions: *"funnily enough, this is one of the meetings I really enjoy. I don't want it to end"* (Group discussion 2, 2nd March 2021). The sessions allowed the constructive sensemaking, enabled by a purposeful reframing of challenges, that nurtured collective purpose. Reflecting back, one member of the team remarked, for example: *"We kind of moved away from the word 'challenges', you know? The Vaxi Taxi has taught me one thing you always said, there is no problem we cannot solve. We are just, we are just meant for that"* (Interview 2, 22nd June 2022).

Nurturing team dynamics and collective purpose

As with other Vaxi Taxi teams, there were initially no additional resources and pulling together a dedicated team required the creative re-allocation of staff. In some ways, the pandemic created conditions that enabled 'slack' in the system as several frontline workers could not fulfill their usual duties. As TK notes, *"In our district we took the approach of using our incapacities and our high risks, on this project, as opposed to letting them sit at the station"* (Interview, 22nd June 2022). Although this meant creating a team of people from different ambulance bases who had never worked together before, they quickly became a great team – *"like a family"* (Group discussion 2, 2nd March 2022). This itself seemed to be a driving force *"this has been one of the best rides of my life...and it's because of the team"* (Group discussion 2, 2nd March 2022).

It was this team dynamic alongside their passion for community-orientated work, itself re-ignited by their involvement in the vaccination program, that fueled collective purpose amongst the group. *"I mean, honestly, before Vaxi Taxi, some of these guys were so demotivated...But this is has just given another sense [of purpose], and I can really see that it is honestly because of their passion."* (Interview 2, 22nd June 2022) *"What I see in the team, is dedication. What I see in our staff is that it has given them the opportunity to transform"* (District manager meeting 31st March 2022, researcher diary reflection).

Overall, then, as Fig. 6 demonstrates, in Cape Winelands, it was the interconnection of a supportive manager, the weekly touch-base routine, and the team dynamics that supported collective action over time. For example, the weekly constructive sensemaking sessions were also referred to as *"family time"* (Group discussion 2, 2nd March 2021), and this enabled a sense of psychological safety within the team that encouraged them to continue problem solving, and thinking out of the box. The playful phrase *"don't come with a problem, come with a solution"* was frequently used. (Group discussion 2, 2nd March 2021)

Beyond Cape Winelands, many of those involved in the Vaxi Taxi also had a positive experience, and for some it was even seen as a 'place of healing' (Researcher diary). One person remarked *"my psychiatrist says this is the best they have ever seen me, and they hope I stay on this project for as long as possible"* (Group discussion 6, 25th March 2022). And another: *"I thought I would try it out, and I loved it! I don't even need my hypertensive medication anymore with this family"* (Group discussion 2, 2nd March 2022).

Continuing impacts on relationships: how the Vaxi Taxi built contextual capacity

Due to the nature of EMS, staff are located at ambulance bases spread widely across the province and have few opportunities to come together. The Vaxi Taxi provided opportunities for colleagues, who would usually not have contact, to work together and so begin to understand some of the nuances of their communication: *"when you hear someone on the radio you can immediately relate to that person, and understand what the tone of their voice means"* (Group discussion 5, 16th March 2022). There was also widespread acknowledgement of improved relationships between EMS and actors in other parts of the health system, such as pharmacy, and hospital staff. This was significant because EMS has often felt like a marginalized part of the health system, excluded from decision making; but *"EMS is now*

considered as part of a bigger team” (Group discussion 3, 9th March 2022) and “the gap between EMS and the hospital is closing because of the Vaxi Taxi” (Group discussion 5, 16th March 2022). In some districts, these improved relationships were drawn, and EMS was brought into decision making spaces at hospitals they had previously been excluded from (Interview 2, 22nd March 2021, Group discussion 3, 9th March 2022)

However, improving community level relationships remained difficult. While there were some examples of community mobilization activities initially, over time, including in Cape Winelands, many teams began to focus on more well-established institutions such as schools or factories, or drew on existing networks with securitized community networks or other uniformed services (*Researcher diary*). This limited opportunities to build meaningful community-level relationships which can be enabled by more grassroots organizing processes. Our analysis suggests this was largely due to a combination of existing contextual capacity gaps *“community engagement usually only happens when there is a complaint” (Group discussion 5, 16th March 2022)* and the nature of routine EMS work *“we just load and go and there is no time to build a relationship (Group discussion 1, 12th Jan 2022).*

Discussion

This paper shares the experience of the Vaxi Taxi, a community-orientated vaccination model of care implemented as an adaptive response to the COVID-19 pandemic. Although there are a few other, global examples of Emergency Medical Services (EMS) participating in COVID-19 vaccination programs,(42–44) there are very few examples seeking to understand why and how the models were implemented. It is thus, a rare empirical example of such a response. Despite various challenges, EMS was able to pivot its operations in a time of crisis. It converted ambulances into mobile vaccination clinics and, by collaborating with a range of community groups, was able to reach a large number of people who would probably otherwise not have been vaccinated. The Vaxi Taxi also sought to respond to the pandemic in ways that could build community networks and trust, addressing concerns that existed before Covid-19. Thus, EMS sought to use the crisis strategically, as a window of opportunity for transformative adaptation.(45)

The analysis presented offers insights both about how EMS was able to overcome barriers to getting the Vaxi Taxi up and running, and then how to sustain the model over time. Although the initiative was never itself intended to become a long-term project, it also appeared to have nurtured key system capacities that might offer lasting benefits to EMS.

One enabling factor was that the Vaxi Taxi was able to draw on the slack in the system created in part, by the pandemic. As noted, there were initially no additional resources for this initiative, and it was supported through a creative reallocation of existing human resources. This ‘slack’ was important in the shift from the fixed-vaccination site to the Vaxi Taxi, as well as in sustaining the model. Using the language of the EHSR framework, such ‘slack’ is generally understood as generated through networks (a contextual capacity). However, applied elsewhere to understand hospital responsiveness to COVID-19,

the concept of 'organizational slack' suggests an alternative pathway. Defined as "that cushion of actual or potential resources which allows an organization to adapt successfully",⁽⁴⁶⁾ the hospital experience affirms, as with the Vaxi Taxi, the importance of having the flexibility to redeploy staff to where they are needed most. Similarly, the adaptive governance literature refers to 'slack' as 'flexible capacity'.⁽⁴⁷⁾ Our analysis suggests then that resource slack is not necessarily about having more resources than needed, but rather can result from creative problem-solving within the available resource envelope. The Vaxi Taxi was never intended as a long-term initiative, and EMS staff returned to their routine duties when the Vaxi Taxi program ended, but this capacity for creative reallocation of existing human resources is an important lesson for inevitable future shocks.

The experiences examined also suggest that creating spaces of unlearning (a behavioral capacity) can be critical in enabling adaptive responses to crisis. For EMS, overcoming the inherent path-dependence⁽⁴⁸⁾ of complex health systems required demonstrating new ways of working that broke away from prior, often more limited forms of community engagement. As already discussed, vaccination events at CAN community kitchens became spaces of unlearning, opening-up new avenues for developing trusting relationships, and demonstrating new ways of doing. Our analysis suggests such experiences enabled a mindset shift among EMS staff (a cognitive capacity) from fear and mistrust, to safety and connectedness, catalysing them into collective action. These findings are echoed by pedagogy scholars^(49, 50) who argue that the unlearning (a behavioural capacity) required to shift mindsets (a cognitive capacity) to support action is embodied, relational and place-based, as was observed in the Vaxi Taxi.

Further, developing spaces of unlearning within the Vaxi Taxi programme drew on trusting relationships within a broad resource network (contextual capacity), developed earlier in the pandemic. Others have also recognized that a 'diversity of perspectives formed through fluid and plural networks' are key to enabling transformative change in response to a crisis.⁽⁴⁵⁾ The importance of networks, as described in the EHSR literature⁽²³⁾ was demonstrated in the case of the Vaxi Taxi and enabled spaces in multiple neighborhoods across Cape Town, allowing EMS to work in high-risk red zone neighborhoods with trusted community partners. Nonetheless, as others have noted, it is important to recognize spaces of unlearning as 'non-linear, relational, and inherently political'.⁽⁵¹⁾ While for some in EMS, such spaces created the necessary conditions for the 'paradigm shift' required for the Vaxi Taxi, an adaptive response to the pandemic, long-term change in practise will require ongoing connection to such networks to enable regular spaces of unlearning.

Our analysis, which, unusually, tracked experience over time, suggests that the capacities developed during earlier vaccination efforts ultimately contributed to the realization of the Vaxi Taxi. For example, it drew on the broad resource network (a contextual capacity) of CAN community kitchens, and benefitted from the legitimacy and prior relationships (also contextual capacities) developed at the Pinelands fixed-vaccination site. Well-rehearsed vaccine routines (a behavioural capacity) were also important, energized by the collective purpose and 'can-do' attitude (cognitive capacities) developed during earlier vaccination efforts. In addition, the Vaxi Taxi generated some positive unexpected consequences that may offer long term benefit for EMS. For example, relationships with other actors in the health system (a contextual

capacity) were strengthened as involvement in the vaccination program gave EMS legitimacy as part of the broader health care team. The development of system capacities through the Vaxi Taxi activities could, then, have created the platform for future responses to new crises, as has also been identified in other empirical EHSR studies. (15, 52)

Finally, however, although initially partly proposed as a community trust building initiative, in practice the Vaxi Taxi appeared to have limited impact in terms of improving community relationships (a contextual capacity). The initial energy for community mobilizing and a commitment to nurture community relationships waned over time, with a growing focus on organizing events where it was easier to gather more people to be vaccinated (such as in factories, or schools). Increasing the number of vaccinations through such events came at the expense of dedicating time to nurture community relationships. Other research reflecting on the Western Cape health system response to the Covid-19 pandemic also notes limited community engagement, and highlights the 'existing fault lines' of the system with the absence of critical community relationships prior to the pandemic.(53) There is also little evidence from other settings about initiatives that have sought to integrate communities into decision-making and multi-sectoral action in response to COVID-19 (54) whilst wider experience suggests that, as in the Vaxi Taxi experience, the forms of community participation that nurture networks and build relationships are generally very complex and difficult. (55)

Study limitations

The analysis reported is based on detailed, longitudinal data collection through LB's role as an embedded researcher, triangulation across multiple data sources and purposeful processes of validation with EMS colleagues and academic colleagues outside EMS. We were not able to track the initiative beyond the study period; for example, we could not consider if 'spaces of healing' had more long-term implications for EMS staff.

The retrospective interviews run the risk of romantic bias, and we cannot exclude that some challenges were not highlighted given the researcher and lead author of the paper was also part of the implementation team. However, a research diary that documented challenges was drawn on in interviews to remind participants of what had to be overcome, and this was discussed in detail during the validation sessions.

Lastly, although we considered organisational and clinical power dynamics in analysis, other societal power issues (such as race and gender) that may impact on organisations were not examined in detail. These could be examined in future research.

Conclusion

The Vaxi Taxi experience reported in this paper contributes to the EHSR literature by providing a rare empirical example of an adaptive response to crisis that was tracked over some time. Although this model is considered here as an adaptive response, capacities nurtured through action, for example,

improved relationships with other parts of the health system, may have transformative potential in future. For health system practitioners, it highlights the value of problem-solving to generate 'slack in the system' and of creating 'spaces of unlearning' in supporting adaptive strategies. However, it also demonstrates some structural features of EMS organisation that could not be overcome, despite improved capacities. Specifically, the relational work that supports meaningful community relationships that enable trust take time. They cannot easily be developed through routine EMS operations and thus require alternative approaches.

Abbreviations

CAN	Community Action Network (Cape Town Together)
EHSR	Everyday Health Systems Resilience
EMS	Emergency Medical Services
GD	Group Discussions
VPO	Vaccine Project Office
WC	Western Cape

Declarations

Ethics approval and consent to participate

In accordance with the National Health Act No 61.2003 ethical approval was granted by the University of Cape Town Health Sciences Faculty Human Research Ethics Committee (HREC: 847/2019) and the Western Cape Department of Health. The study was conducted in accordance with the principles of the Declaration of Helsinki. Formal written consent was obtained from all participants for interviews and observational work. As approved by the ethics committee, data collected as part of the embedded researcher role was recorded in a researcher diary, and drawn on in the analysis.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

LB, LG and AG were involved in the conception and design of the work; SDV, WP and TK gave regular input during the research. LB led the data collection. LB, LG and AG were involved in the data analysis, interpretation and drafting of the article. LB, LG, AG, SDV, WP and TK were involved in the critical revision of the article. All six authors gave final approval of the version to be submitted.

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Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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Footnotes

1. ‘Slaap dorpies’ or ‘sleeping towns’ are common in the Cape Winelands area. They are small towns predominantly occupied by farmworkers, are empty during the day, and places where people come home to sleep.

Figures

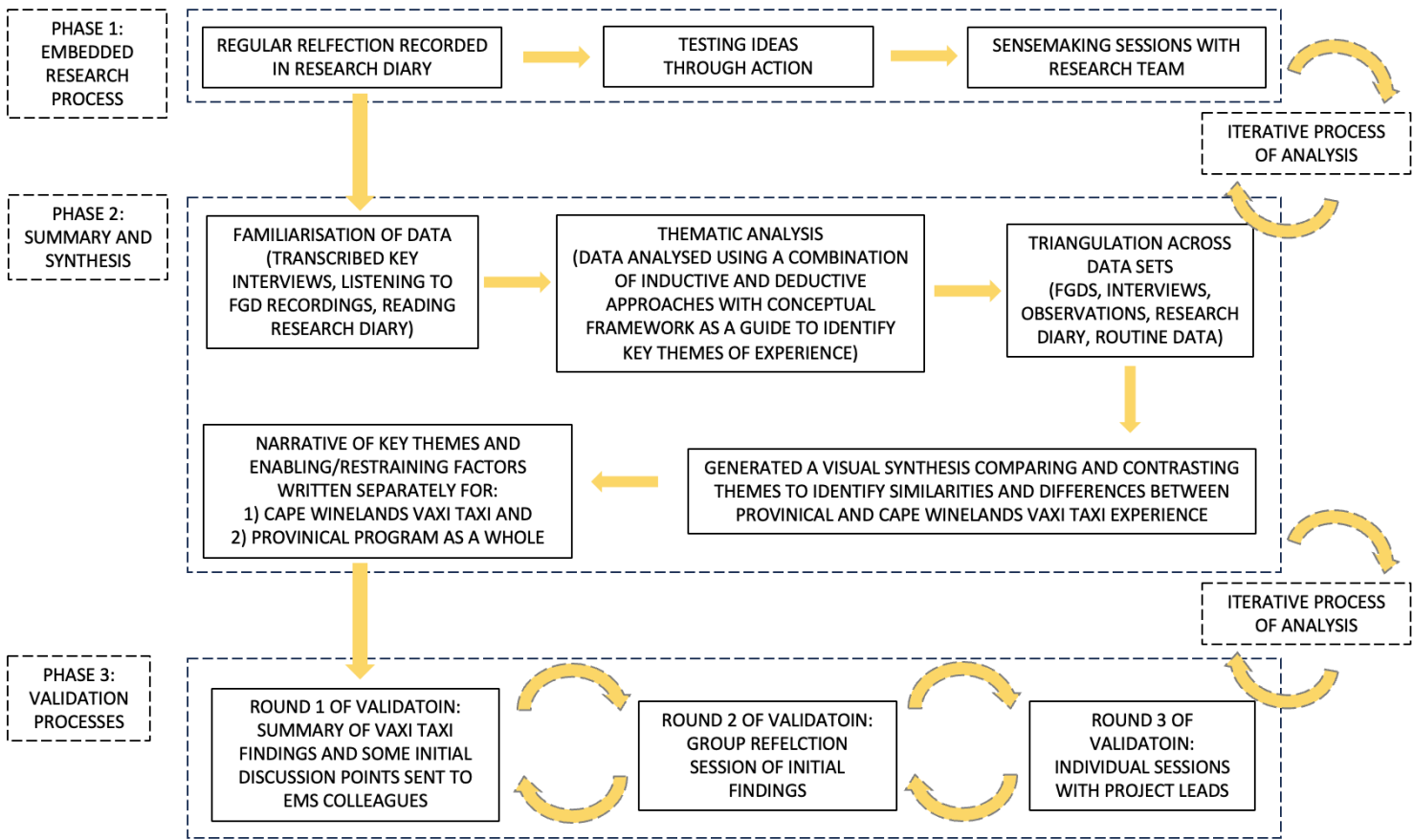


Figure 1

Summary of the three phases of iterative analysis

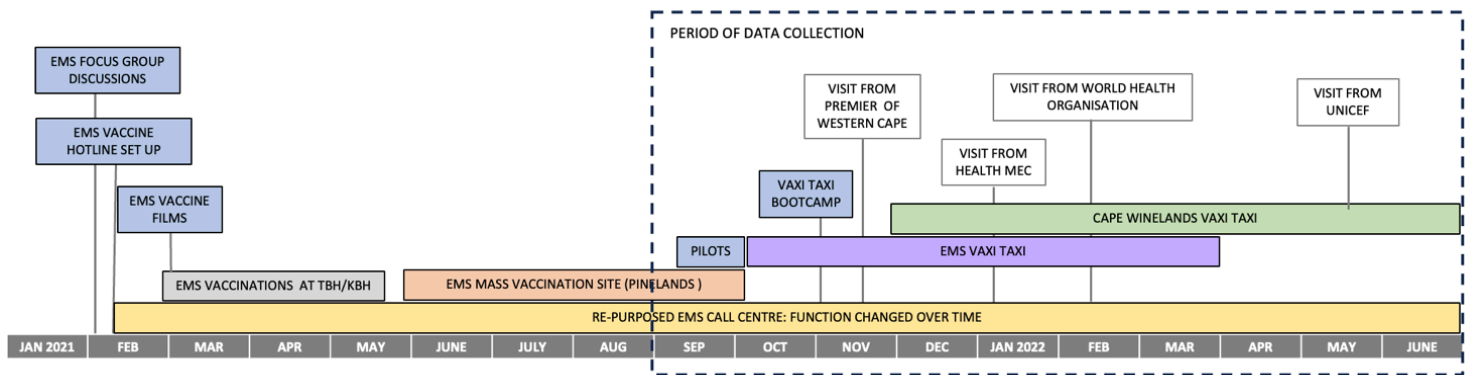


Figure 2

Timeline of EMS Covid-19 vaccination activities

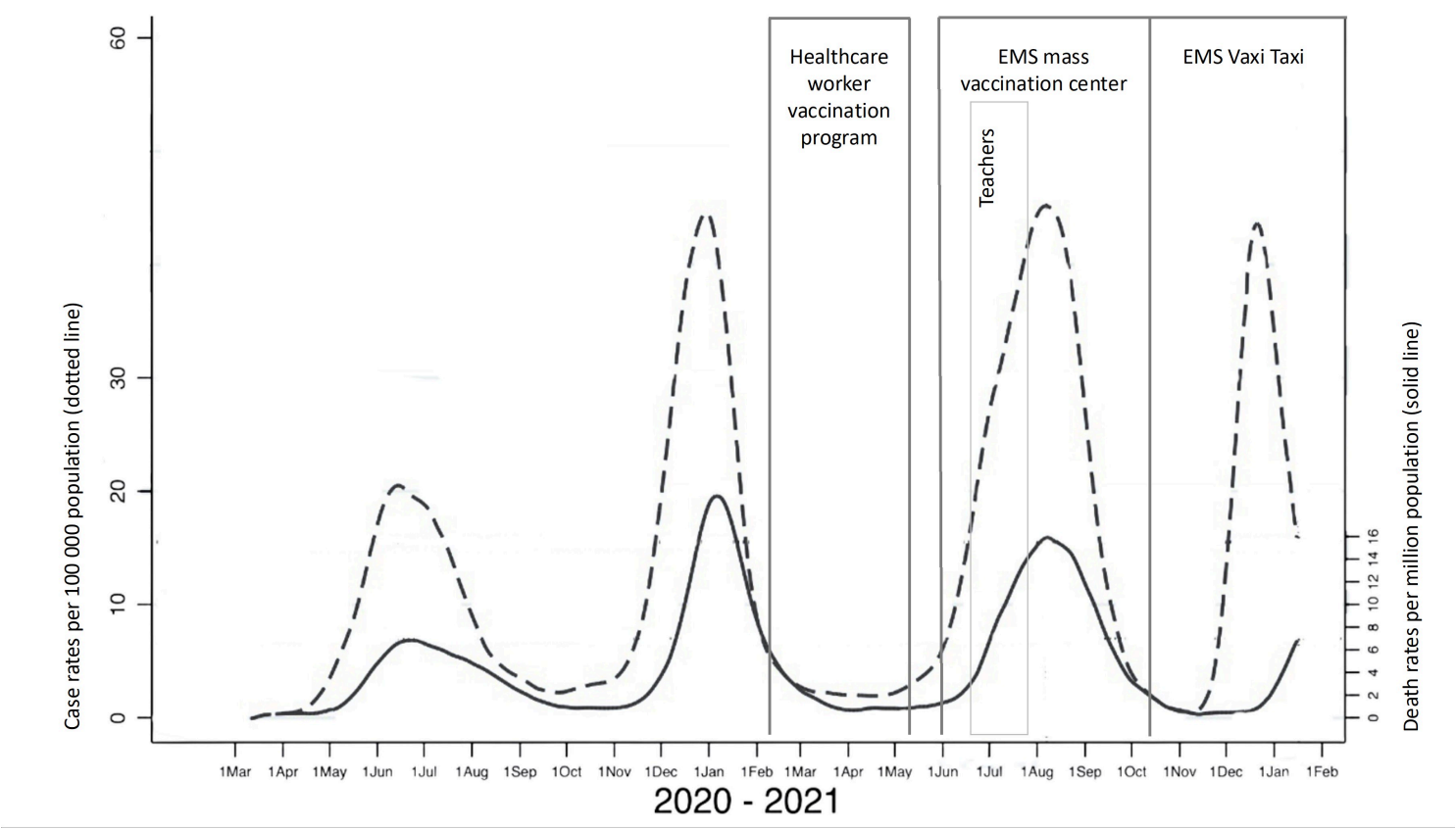


Figure 3

Timing of vaccination efforts and successive Covid-19 waves in the Western Cape.

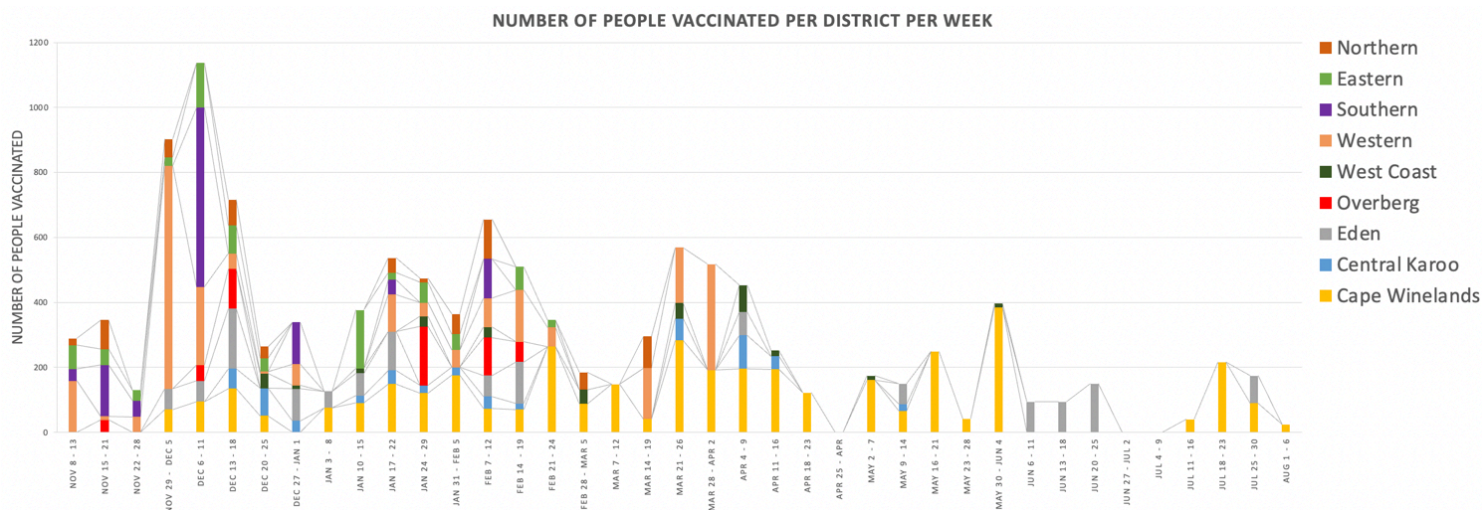


Figure 4

Number of people vaccinated by Vaxi Taxi in each EMS district per week (Source: routine Vaxi Taxi data, Western Cape Department of Health and Wellness)

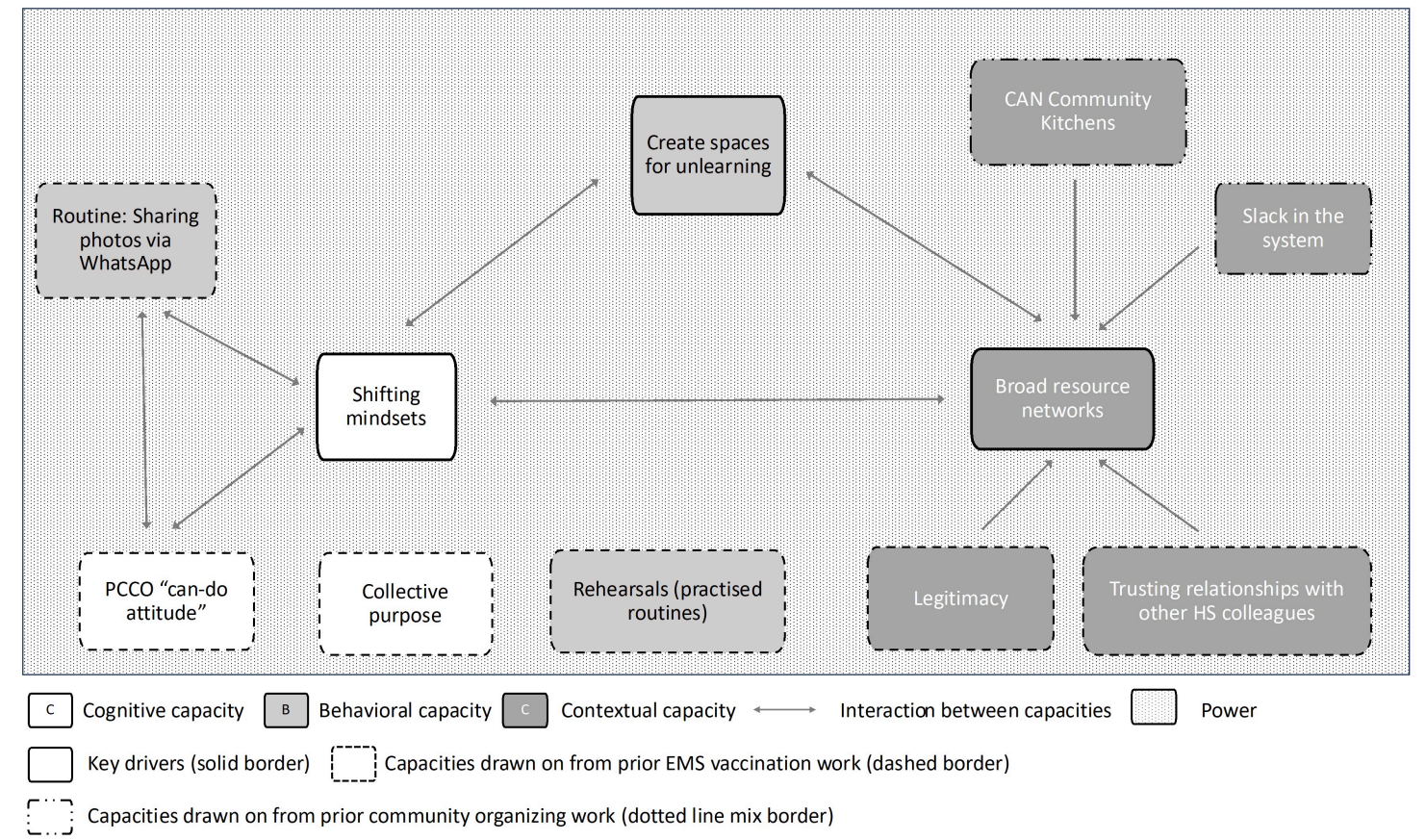


Figure 5

Transitioning from the Pinelands Vaccination site to the Vaxi Taxi

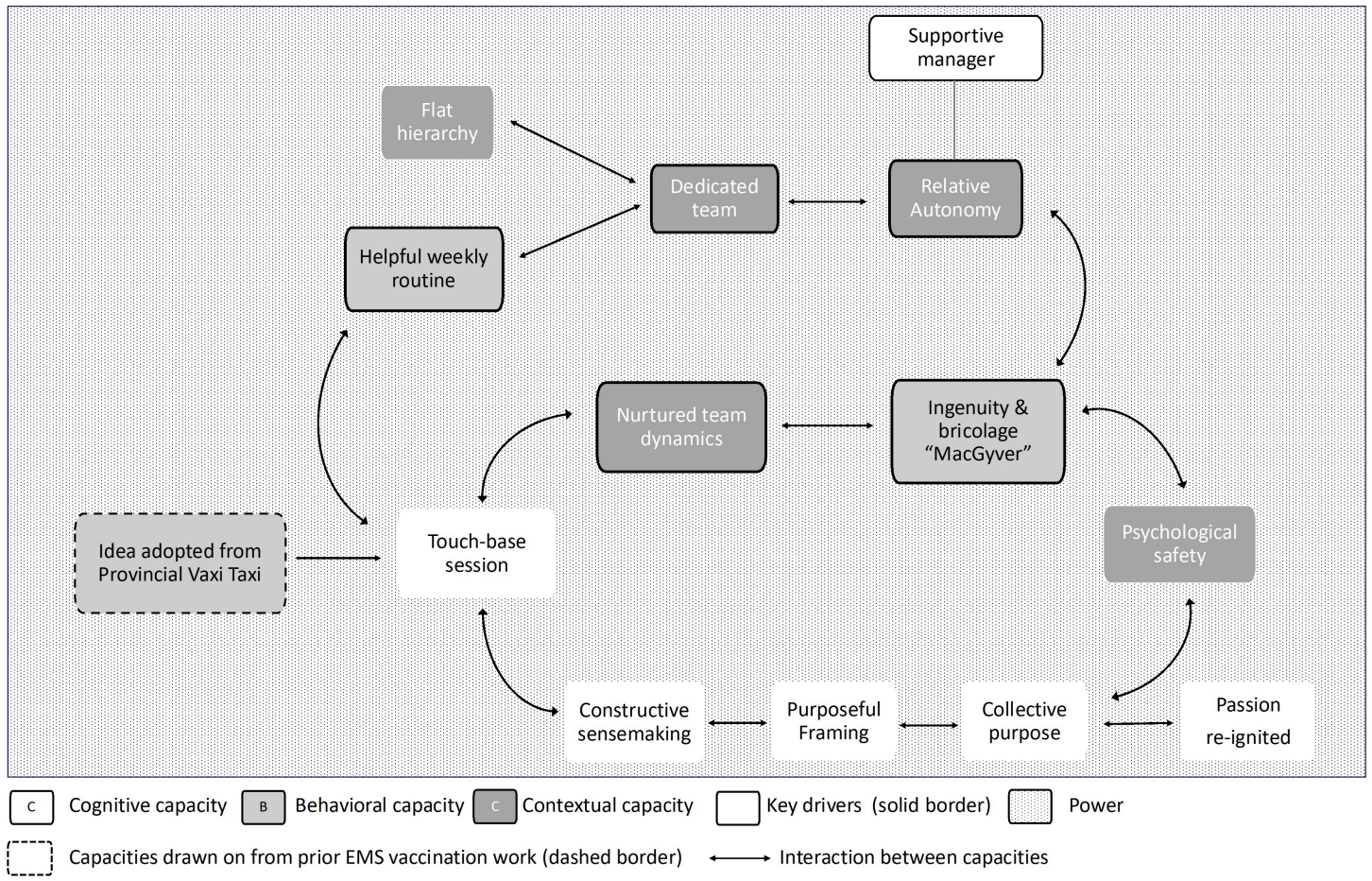


Figure 6

Capacities supporting collective action over time

Supplementary Files

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