The Viability of a Loaning-Based Delivery Model to Tackle Healthcare's Last-Mile Challenge in South Africa

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Abstract

Healthcare access in developing countries is a severe problem due to insufficient healthcare providers and non-existent supply chain infrastructure. This problem is particularly evident in South Africa due to the disparity between urban and rural regions along with an overcrowded public healthcare system. The result is that patients in rural regions who live many kilometers away from their nearest healthcare facility are unable to access essential medicines. This paper seeks to investigate the medical last-mile challenge in South Africa as well as test the viability of a potential solution. *Mobility* is a platform that seeks to mobilize the large population of unemployed youth in South Africa to complete deliveries of chronic medicines from pharmacies to individual households. It seeks to do this through the facilitation of loans that are repaid gradually through service-based contracts. By speaking with numerous stakeholders within the South African medical supply chain including pharmaceutical companies, healthcare providers, government officials along with potential partners, we sought out to determine the potential for *Mobility* to revolutionize healthcare access in South Africa. Stakeholder analysis proved the validity of *Mobility* as a concept and clarified the specific value propositions for pharmaceutical companies, healthcare providers, the government as well as patients. In addition, key next steps were identified in order to implement *Mobility* in South Africa.

1. Background

1.1 Last-Mile Challenge in Healthcare

The rising cost of healthcare combined with the increased demand for services has become a fundamental global dilemma. Despite the severity of this issue, current solutions overlook many intricacies of this convoluted problem. The lack of access to health services and improper infrastructure in many countries barricades most from achieving positive health outcomes (Ward et. al, 2014). Globally, over one billion people go their entire lives without ever seeing a healthcare worker. Further, a staggering four billion people lack access to essential medicines on a daily basis (Zarocostas, 2007). The problem lies in a misallocation of resources and a lack of recognition of those living in the outskirts of society. Whether it is due to distance or poverty, people living in rural communities do not receive nearly the same level of care as their urban counterparts (Ward et. al, 2014). This issue is particularly evident in the developing world. Here, governments have a limited set of resources. It is more efficient for the government to focus their efforts on urban regions given that the majority of the population resides there and that the infrastructure for healthcare and transportation is already established. Yet, this is exactly why 80% of sub-Saharan Africa will never receive even a single drug (Kharsany and Karim, 2016).

The problem lies in healthcare distribution. For those living in isolated locations, there are no healthcare providers nearby (Yadav et. al, 2018). Furthermore, given the typical economic conditions of these regions, patients simply do not have access to transportation. Even if they could find a way to a pharmacy or clinic, the cost of treatment would likely be too large for most patients to afford (Goudge et. al, 2009). For the government and private industry, the economics do not line-up for them to build more facilities and arrange for more deliveries in these regions. The cost of establishing the infrastructure would largely outweigh the marginal revenue generated from a small set of patients who do not have the means to pay for extensive service (Goudge et. al, 2009). This disconnect between the end-customer and the closest point of service is an issue that extends beyond healthcare and into nearly any industry (Gevaers et. al, 2011). The dilemma, termed the "last-mile challenge", describes the large costs associated with the distribution of a service or product to locations that are hard-to-reach and cannot be provided through bulk delivery. While this challenge is universal, the consequences in healthcare are particularly large given the millions of lives at stake (Goga et al., 2017).

1.2 General Sub-Saharan African Healthcare Supply Chain

Medicine distribution is a vital component of the healthcare ecosystem, serving as a bridge between creating medical innovations and providing them to those in need. However, this process is not as simple as pharmaceutical companies delivering their creations to pharmacies and healthcare clinics. This environment also consists of a complex combination of wholesalers,

distributors, government organizations, NGOs, and other retailers who all play a role in the medical supply chain (Yadav and Kraiselburd, 2013). Adding even more complexity to the matter, the method through which drugs are transported in the public sector is drastically different from private sector distribution (Figure 1).

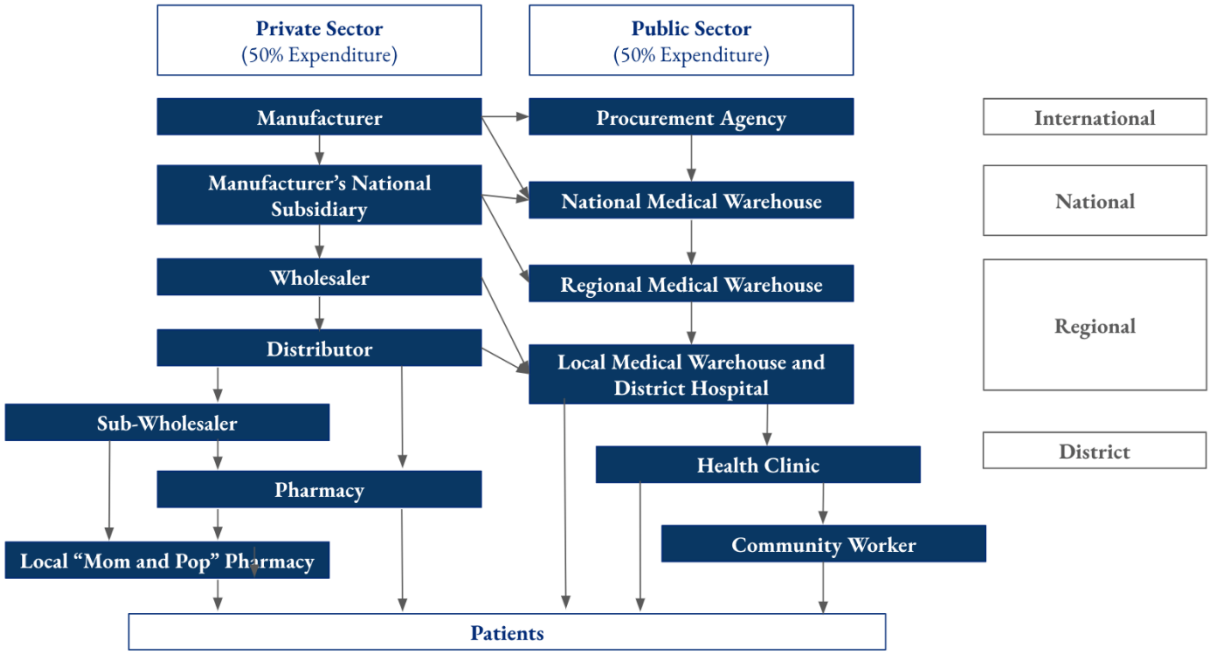

Figure 1: Current Medical Supply Chain in South Africa

For many countries in Sub-Saharan Africa including South Africa, the majority of manufacturing occurs overseas by multinational pharmaceutical companies. These drugs must then be imported and transferred either to the manufacturer's national subsidiary or to procurement agents that largely function through funding from the government. This transfer of medicines from international locations to domestic warehouses accounts for the majority of the costs in the current supply chain (Ganslandt et al., 2005). However, it is one that is inevitable unless domestic manufacturers can scale up to compete with their larger counterparts.

Once drugs arrive in-country, they are stored in the manufacturer's warehouse. These drugs can then be sold to wholesalers who buy medicines in bulk at low prices in order to make a profit by placing a significant mark-up on the drugs (Yadav and Kraiselburd, 2013). They can also be sold to the government who then store the stock in their central medical stores, large scale pharmacies or clinics mostly present in urban centers. In the private sector, wholesalers then utilize distributors, either through contracting, or in-house distribution channels to sell their product to sub-wholesalers and large-scale pharmacies. These agents then sell their products further down the supply chain to regional pharmacies and clinics, after which the products are delivered to the patients (Yadav and Kraiselburd, 2013). In the public sector, medicines are typically distributed

from central medical stores to smaller regional locations, hospitals and centers from where patients can then purchase the product (Yadav a d Kraiselburd, 2013).

1.3 The South African Healthcare Landscape

1.3.1 Public vs. Private Healthcare Sectors

South Africa has a two-tiered healthcare system separated into the public and private sectors. The differences between the two are drastic. All South Africans are guaranteed public health insurance and may visit a government healthcare facility whenever they choose free of charge. However, if they deem the system insufficient, they may also purchase private health insurance termed 'medical aid'. Currently, more than 80% of South Africans--over 40 million people-- rely on the government, even though the public sector accounts for less than half of total healthcare expenditure (Mayosi et al., 2009). This is despite the fact that healthcare spending is equivalent to about 10% of the national GDP, a statistic that surpasses many countries with significantly better healthcare outcomes (Ataguba and Alaba, 2012). The public sector covers 68% of people who do not use any private care at all, spending about 1900 rand per person.(Mayosi et al., 2009) In addition, another 16% of the population rely on the public sector for urgent hospital care however they opt for the private sector with respect to primary care, choosing to pay out of pocket in these instances (Benatar, 2004). The remaining populace uses private doctors and hospitals which are covered by their health insurance, often with a contribution from their employers. Their payments and premiums to health providers--one-third of which are not reimbursed-- costs approximately 11,000 rand per year (Benatar, 2004). This means that a private sector patient receives nearly 6 times the resources as their public counterparts.

In addition to the clear disparity in funding between the two sectors, there is also a gap in healthcare providers. Around 70% of doctors and most specialists serve the private sector (Rothmann et. al, 2016). The tiny portion of professionals left work in a public sector that sees far more patients. The consequence of this resource imbalance is that the majority of South Africans are forced to stick with a public system that is underfunded and overcrowded. The select few who can afford to pay for their healthcare get access to a world-class system that rivals any developed country and offers unparalleled health outcomes.

Despite the struggles of the public sector, it is unfair and inaccurate to treat it as a singular entity. In reality, each province receives a certain allocation of funds and resources based on their own estimated needs and demographics as well as the National Department of Health's available capital limitations (Meyer et. al, 2017). Often times, poorer provinces miscalculate and underestimate their estimated needs because they have no existing data-collection systems in place to record how many medicines are consumed annually (Mcintyre, 2010). However, allocations of funds are another issue. Each region has autonomy in how they spend their funds, but due to factors such as

corruption, lack of infrastructure, and insufficient healthcare workers, the impact of these funds varies widely.

The District Health Barometer is an annual publication currently in its 13 rendition that keeps track of healthcare outcomes across the country (Massyn et al., 2019) . This paper showed that just over half (55.57%) of babies in the Sarah Baartman district in the Eastern Cape were fully immunized, whereas in the eThekwini district of KwaZulu-Natal, this number rose to a staggering 97.7% (Massyn et al., 2019). Even within provinces, the disparity is vast. For example, the maternal mortality rate in the OR Tambo district of the Eastern Cape was 198.7 per 100,000 births (Massyn et al., 2019). Whereas in the Joe Gqabi district, also in the Eastern Cape, this number was 20.3 per 100,000, a near 10-fold reduction.

1.3.2 Government Tender Process

The South African pharmaceutical industry is heavily dependent on a tendering process, referring to the procedure whereby the government invites bids from manufacturers to compete for large projects (Pharasi and Miot., 2012). This process is an important way for pharmaceutical companies to play a role in the public sector, which caters to the vast majority of the population. The number of tenders in the pharmaceutical market is rapidly growing, as it offers benefits to both manufacturers and consumers. On the manufacturer's side, tendering allows companies to secure a strong demand for their products for generic and specialized drugs (Ambe and Badenhorst-Weiss, 2012). Governments usually award tender contracts for a large quantity of products, ensuring companies that there is a consistent and constant demand for their goods. On the consumer's side, tendering creates an artificial environment for competition among suppliers which both causes a drastic reduction in the price of medications and an increase in quality of service. Between 2003 and 2016, the prices of medicines in most tenders dropped on average of around 40% (Wouters et al., 2016). This decrease in price will allow the government to purchase a greater volume of medications, thus both decreasing the administrative inefficiencies associated with more a more disorganized system and increasing the accessibility of crucial medicines to patients (Wouters et al., 2019; Honda et al., 2016).

On the other hand, tendering presents many challenges to manufacturers to consumers. The increase in competition leads to price erosion, causing them to generate less revenue. This challenge is particularly prominent among domestic manufacturers, who have more difficulty reducing their prices to win tenders. Domestic companies incur many more production costs attributed to the fact that they do not have the same economies of scale as larger, international companies. Research shows that tenders can actually drive manufacturers out of business (Hollis and Grootendorst, 2012). Resultantly, losing out on a tender for these local companies generates many problems for not only the company itself but also for the domestic economy as a whole. Next, accurate forecasts of drug demand is difficult to estimate -- wrong estimates can result in

disruptions in the supply chain (Kanavos et al., 2009). In fact, government estimates were off by around 50% in most categories (Wouters et al., 2019).

1.3.3 Direct Delivery Voucher

A significant challenge for the South African government has been reducing lead times from when a medicine is requested by a particular government health facility to when it is ultimately delivered to that location (Meyer et. al, 2017). Initially, government tendering offers only stipulated requirements for pharmaceutical manufacturers to produce medicine and allowed them to choose how they would be distributed. Given the choice, manufacturers opted to deliver their medicines to centralized depots owned by wholesalers or distributors who would then deliver the medicines to facilities as needed. However, this process resulted in a lag where a particular healthcare facility would request specific medicines, and, if a depot did not have the requisite stock, they would then, in turn, have to request it from the supplier.

In December 2015, the South African Ministry of Health implement Direct Delivery Vouchers (DDVs) to alleviate this issue (Schneider et al., 2008). DDVs gave particular government healthcare facilities the capabilities to order directly to suppliers and mandated that these suppliers distribute directly to these facilities. While this system does reduce lead times and increase medical availabilities, it also forces pharmaceutical companies to bear a great burden in regards to distribution costs. Many of the major players within the public healthcare sector, such as Aspen, has had to create an entirely new distribution infrastructure to deal with this change in policy. DDVs have also shrunk profit margins in a sector where they are already incredibly tight due to government regulated prices. The end result has been a reduction in small-scale players being able to compete with industry giants who have the resources to either create new delivery channels or the money to outsource this task to larger third-party distributors.

1.3.4 National Health Insurance Program

The National Health Insurance (Republic of South Africa Department of Health, 2017) program is a newly introduced financing system by the government of South Africa aiming to provide better access to healthcare services to the entire population, regardless of their socioeconomic background. It aims to offer free services at the point of care in order to both improve both the affordability of healthcare and also address the burden of disease. This system will be characterized through its progressive universalism in which the right for healthcare will be determined based solely on need, its mandatory prepayment of health care by each individual to be pooled together for the general population, its single-payer structure to pay for all health care costs, and its single fund structure to create a unified pool to finance all relevant costs (Republic of South Africa Department of Health, 2017).

Several benefits and problems arise with the introduction of this program. These include financial risk protection for vulnerable populations through prepayment funding, the improved quality and access to care, the improved efficiency of procurement of medicines, and the increased accountability of the use of public funds (Republic of South Africa Department of Health, 2017). Such benefits will occur on the micro level through the increased quality and efficiency of care but also on the macro level through decreased costs for the individual. By slowing the growth of healthcare costs, the system deems to benefit the productivity of the labor force and ultimately contribute to the economy (Republic of South Africa Department of Health, 2017). However, it is still difficult to determine how exactly will the government sustainably fund the program solely through taxes. The government projects to spend a total of R256 billion on healthcare by 2025, of which R72 billion will be a deficit (Republic of South Africa Department of Health, 2017). The creation of a central body to manage resources and funds will also make it difficult for the different players in the healthcare system to channel resources, which may ultimately reduce both the efficiency and quality of care.

1.3.5 Single-Exit Pricing Model

In 2004, in order to combat rising pharmaceutical prices caused by significant mark-ups throughout the medicine supply chain, the South African government mandated a single-exit pricing (SEP) model. Single-exit pricing regulated the price at which all medicines and scheduled substances could be sold to any entity--consumers, distributors, or wholesalers--within the private-sector (Gray et al., 2015). The single-exit price includes a logistics fee for wholesalers and distributors for their service. It is deemed the fixed maximum selling price of the medicine, excluding a dispensing fee issued by pharmacies. The price is determined uniquely for each pharmaceutical and is calculated based on a number of factors such as the manufacturing costs and prices of the same drug in other countries, Along with this measure, the South African government also set a cap for how much the SEP for a particular medicine could increase every single year. The combination of the introduction of a SEP and capped annual price increases resulted in a 22% decrease in the prices of medicines after just one year (Flynn et al., 2009).

However, while the motive behind SEP is inspiring--allowing everyday people access to essential medicines at affordable prices-- in practice, there were some adverse consequences. Namely, while SEP does set an upper-limit for pricing it does not set a lower limit. Thus, many large insurance companies, such as *Discovery*, use the leverage they have due to their extensive market share to force pharmacies to lower their prices even beyond the mandated single-exit price in order to drive up the product's demand (Gray, 2009). This means that mom and pop pharmacies without the requisite economies of scale to survive on these narrow margins are driven out of business. It also means that those who can afford health coverage receive medicines at lower prices than those who cannot afford to pay for insurance.

1.3.6 Major Players Within the Supply Chain

The South African medical supply chain is characterized by the unique interactions between manufacturers, wholesalers, distributors, providers, and insurers (Gray et al., 2016). On top of all of this, these stakeholders play an important role in both the public and private sectors. Aspen Pharmacare and Adcock Ingram represent the largest domestic manufacturers, holding 17% and 9.5% of shares in the private pharmaceuticals sector, respectively (Gray et al., 2016) . To insert themselves in the public sector, they compete for government tenders -- namely for antiretroviral medicines. These manufacturers then sell their products in bulk to wholesalers and distributors in the private sector. United Pharmaceutical Distributors represents the largest wholesaler and distributor by volume in the private sector of the country, representing the link between manufacturers and providers (Gray et al., 2016). Finally, pharmacy chains such as Clicks and Dis-Chem manage the last official component of the supply chain. These two providers have major purchasing power over other smaller chains such as Medicare and often have competitive price wars to retain its consumer base. Finally, overlooking these players are private medical insurance companies such as Discovery that provide coverage to the population in the private sector (Ataguba and McIntyre, 2018).

1.3.7 Chronic Disease Burden

The South African population faces an increased burden of disease, which especially affects the poorest populations. HIV, AIDS, and tuberculosis are the biggest contributors to an increased death rate, with the national HIV prevalence estimated to be 17.3% since 2005 in adults aged 18 to 49 (Govuzela et al., 2018). In addition to these diseases, there has been an increased rate of non-communicable illnesses such as cardiovascular diseases, diabetes mellitus, respiratory illnesses, and obesity. The main factors affecting the increase of these diseases are poor diet, lack of physical activity, and drug consumption (Govuzela et al., 2018). It is estimated that increases in over 7% was observed in individuals suffering from multiple chronic diseases in 2016 (Govuzela et al., 2018). This increased burden of disease results in an enormous increased demand of chronic medicines on a regular basis.

1.3.8 Current Implemented Solutions to the Last-Mile Challenge

A. Chronic Medicine Dispensing Units (CMDU)

Chronic Medicine Dispensing Units are an out-sourced, public sector dispensing service that has been operational in the Western Cape since 2005 and has since expanded throughout South Africa (Magadzire et al., 2015). CMDUs are machines that provide patients with stable, chronic conditions the medicines they need without forcing them to travel all the way to a healthcare providers Described as medical ATMs or “Amazon

Lockers for Medicine", they aim to reduce pharmacists' workloads, patient waiting times and congestion at healthcare facilities (Magadzire et al., 2015). In addition, while many provinces do not have the funds to build an entirely new facility to serve as a pick-up point for medicines, these units are much more affordable, allowing them to be implemented in rural regions across South Africa. The results have been promising thus far, with nearly 300,000 parcels being dispensing from CMDUs every single month (Magadzire et al., 2015). However, one drawback of the innovation is that it eliminates the need for patients to follow-up with healthcare providers about their condition, causing new developments in their illness to be ignored and undiagnosed.

B. Community Health Workers

Another program established by the South African Ministry of Health to help resolve the medical last mile challenge and increase medical adherence is the deployment of Community Health Workers (Schneider et al., 2008). These workers were originally lay-people who were then recruited and trained to be able to provide basic medical services. These workers can then receive additional certifications to be able to handle more complicated situations and receive stipends funded by the governments while they train to serve their communities (Schneider et al., 2008). From here, these community health workers are employed by the government to either work in local healthcare facilities while others are assigned to particular communities where they distribute essential medical goods such as contraceptives and HIV medication and assist households in any medical situation they face. Today, nearly 90% of all Anti-retroviral (ARV) treatment is provided by community health workers, and locals particularly in rural regions rave about the instrumental role CHWs have played in ensuring they obtain the necessary medical attention and support without having to leave the comfort of their households (Busza et al., 2018). CHWs also assist in medical treatment adherence by encouraging, reminding, and oftentimes, even administering, chronic medicines to patients during their required intervals. While CHWs have been a resounding success, the programs only short-fall has been an inability to recruit and fund enough of these workers to serve every needy patient.

C. Mail-Order Pharmacies

Mail-order pharmacies are the primary means by which the private sector tries to tackle the medical last-mile challenge. Large players within the pharmacy industry in South Africa such as Clicks, Dis-Chem and Medicare Health have their own fleet of drivers housed at individual locations who complete deliveries of medicines for patients who request them at their homes (Gray et al., 2016) . While mail order pharmacies may seem like an adequate solution for patients who cannot make their way to a physical location, in reality, these services are too costly to make a real impact. Pharmacies are forced to purchase

transportation vehicles and hire drivers full-time even if the demand for deliveries are low or sporadic. In order to compensate for these high capital investments, pharmacies charge significant fees to customers for deliveries (Gray et al., 2016). This ultimately results in high-income customers located in urban regions being the primary users for these services, utilizing the delivery service for convenience rather than necessity.

D. Adherence Clubs

The Adherence Clubs model is an initiative started by Medecins Sans Frontieres (MSF) and piloted in the urban township of Khayelitsha in South Africa (Grimsurd et. al, 2015. The model seeks to provide a more sustainable solution to the last-mile challenge while at the same time increasing adherence to treatment regimens for chronic patients. Patients, often guided by a lay worker, gather once every month or few months at a health facility or community venue for chronic medicine distribution (typically ARVs). During this meeting, peers share their experiences and receive communal health education. The idea behind them is that patients should not have to travel all the way to a doctor to receive medical advice and support for their illness, but rather, can receive similar support from peers who have had similar experiences. Adherence Clubs have been incredibly successful and have been rolled out independently of MSF throughout the Western Cape, Gauteng and Free State Provinces (Luque-Fernandez et al., 2013). The primary issues with the model are related to distribution of medicines from healthcare facilities to these communal, local centers and the recruitment of healthcare professionals to provide patients with correct medical advice on their conditions.

2. Our Solution

A potential social venture was devised to tackle the medical last-mile challenge in South Africa. The project -- termed *Mobility* -- seeks to improve medical access to rural communities in a sustainable and scalable manner.

2.1 Problem Statement

Healthcare access in South Africa is difficult for many due to geography and distance. 40% of communities have to travel an average of 25 km to get access to healthcare. In addition, those who do make their way to a provider are typically met with long waiting times and no guarantee that their medication is available. 68% of patients spend between two to five hours waiting for a consultation with a doctor, depending on the facility. Both these factors deter patients from retrieving the medicines they desperately need.

2.2 The Idea

Mobility is a platform that seeks to mobilize the large population of unemployed youth in South Africa to complete deliveries of chronic medicines from pharmacies to individual households. It seeks to do this by facilitating the provision of loans for these individuals from scooter dealerships. However, rather than requiring these youth to repay these loans directly, the platform instead reallocates a proportion of the income they generate from their deliveries to the dealership. The rest is for drivers to keep. *Mobility* offers a solution to a distribution problem that necessitates thousands of small deliveries to be completed at once. It gives pharmacies a potential cost-effective way to gain access to a clientele that would otherwise be inaccessible. Additionally, it also aims to drastically increase medical adherence and outcomes by not requiring any additional commitment from the patient outside of picking up their medicines from their doorstep. Essentially, *Mobility* produces a self-sustaining healthcare supply chain in which patients do not even have to order their medications. The system understands when a new set of medicines is needed.

2.3 The Platform

The heart of *Mobility* lies within the software application that facilitates communication between the different players involved. The platform will consist of three distinct interfaces: pharmacy-facing, driver-facing, and patient-facing (Figure 2).

A. The pharmacy interface will allow pharmacists to receive notification of clients placing orders for prescribed medicines they would like delivered to them. From here, the pharmacist can request a delivery and notify the application when the package is ready to be picked up. Once the package has been retrieved by a driver, the pharmacist can track the progress of the delivery and will be notified once the package has been delivered to the patient's home.

B. The driver interface allows for drivers to notify the platform when they would like to complete a delivery and be notified when a delivery is available for them. Once a package has been retrieved, the driver receives directions to the customer's address. Once the driver arrives at the desired location with the package, they are then prompted to verify the patient's identity through a barcode system in which the driver scans a unique QR code present on the patient's phone. After each delivery, a driver's total income generated from *Mobility* is updated along with the progression of their scooter loan.

C. The patient interface allows for customers to either request for the delivery of a particular drug or set up an auto-delivery system that keeps track of when patients take their chronic medicines and when they will need a refill based on their treatment regimen. Once a

medicine is requested, patients can track the delivery's progress in real-time and will be notified when the driver has arrived. From here, the patient will be given a QR code on their phone that the driver will scan to validate the completion of the delivery. Once the patient has received the medication, they can keep track of the frequency of their medicine intake, their current medical state and any issues they have with their prescription. The platform will notify the patient when it is time for another dose as well as when it is time for them to check-in with a doctor in-person so that the chronic condition is adequately handled.

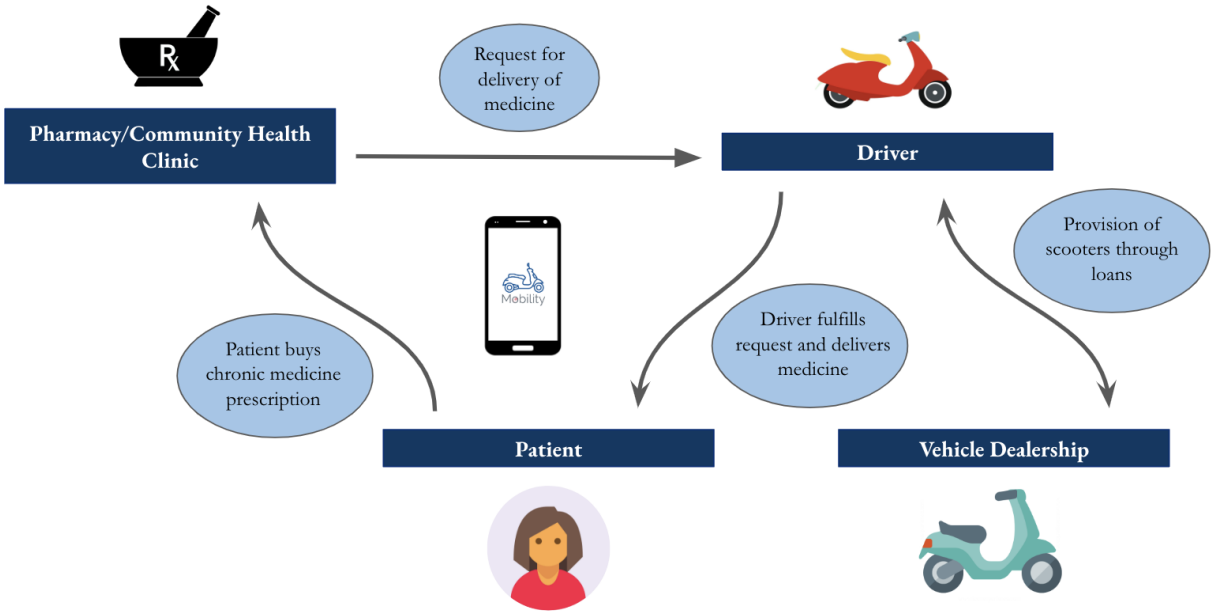

Figure 2: *Mobility* Business Model

2.4 General Loaning Model

In addition to the platform, another significant component of *Mobility* is how it attracts drivers to the venture. As opposed to traditional ride-sharing models that take pre-existing drivers who have the time and willingness to complete deliveries for money, *Mobility* seeks to create drivers and micro-entrepreneurs. *Mobility* hires unemployed youth aged from 18-34 and provides them with scooters without any initial capital needed on their part. It does this by facilitating the provision of loans for these individuals through partnerships with vehicle dealerships. Once the employee has a vehicle, they are free to use it however they would like asides from a certain number of required deliveries they must complete in order to make significant progress towards repaying their loan.

Once the loan has been paid off completely, they are now free to use the scooters in any way they choose and no longer have any financial commitment to *Mobility.*

In order to facilitate these loans, *Mobility* must acquire the funds to provide respective dealerships with a down-payment for the scooters they are providing individuals. In order to do this, *Mobility* seeks to partner with donor agencies such as USAID and the World Bank to provide upfront capital that will be repaid as drivers complete deliveries. In addition, it seeks to provide financial incentives for individuals to repay loans in a timely manner by utilizing the platform at a high rate. It will do this setting timelines for drivers to complete a certain number of deliveries, which, if they reach, will mean that the donor agency helps in repayment of a certain proportion of their loan.

The model is theoretically beneficial for all parties involved. Dealerships receive more customers and a guarantee that the vehicles they sell will be paid for. Unemployed individuals receive a vehicle and job without any initial capital on their part. Donor agencies further their goal of helping those in need by empowering youth and assisting in improving medical access while also receiving their investment back in a timely manner.

2.5 Revenue Generation

Mobility seeks to work with both the public and private sectors in South Africa. The public sector offers potential due to its higher chronic disease burden, particularly for HIV, and need to get patients their requisite medicine. In this case, the government would pay per delivery of medicines from public facilities to individual households based on distance. In the private sector, the customer would be individual pharmacies or pharmacy chains. In this case, there is a clear value proposition as *Mobility* expands the potential client base for a pharmacy by allowing them to sell to patient's who don't have the resources to travel to a physical location. In exchange for the increase in their customer base, pharmacies would pay a fee for each delivery that is completed.

Additionally, there is also room to create partnerships with pharmaceutical companies. There is a clear benefit for them through the creation of a platform like *Mobility.* The more sales that pharmacies make, the more drugs they order from pharmaceutical companies. In this case, *Mobility* could charge a fixed fee to pharmaceutical companies and, in exchange, patients who order medicines from that company receive free delivery. Thus, pharmaceutical companies sell more of their products to their customers without putting any additional burden on patients.

3. Methodology

In order to test the validity of *Mobility*, there needs to be a clear idea of its value proposition to individual stakeholders and role within the larger medicine supply chain. To achieve this, qualitative interviews were conducted with pharmaceutical companies, government officials, and healthcare providers. In addition, pharmacy consumers were asked a few quantitative questions to better understand medicine access in rural and urban regions. The goal of these qualitative questions is to extrapolate general themes about gaps in the supply chain as well as *Mobility*'s value add to the existing system. Each of these stakeholders play an integral part in whether *Mobility* could work as a venture and so understanding their motivations and willingness to collaborate is essential (Figure 3).

Figure 3: Stakeholders interviewed and their respective connection to *Mobility*

3.1 Experimental Framework

Pharmaceutical Companies: Three companies were interviewed in different domains: the BioVac Institute, a domestic manufacturer of vaccines; Aspen Pharmaceuticals, a domestic manufacturer of all forms of pharmaceuticals; and GlaxoSmithKline (GSK) an international

manufacturer. Interviews were conducted with an entire team of pharmacists and supply-chain experts at BioVac, the Head of Supply Chain at Aspen and the Country Manager of South Africa at GSK. All interviews started with the same baseline questions about the medical supply chain, chronic disease burden in South Africa, and opinions on *Mobility* and then transitioned fluidly to the interviewees expertise.

Distributors: An interview was conducted with the Vice President of Healthcare at Imperial Logistics, one of sub-saharan Africa's largest distributors and logistics companies. The focus of this interview was primarily on the supply chain and the potential integration of *Mobility* into the existing infrastructure.

Government: An interview was conducted with the Pharmacies Manger of the Western Cape Ministry of Health. Here, questions were targeted at the public sector medical supply chain, chronic disease burden as well as regulatory issues for a platform like *Mobility.*

Providers: Three separate groups of healthcare providers were interviewed: pharmacy chains, 'mom and pop' pharmacies as well as local healthcare clinics. Interviews were conducted with the Global Digital Leader as well some of the lead pharmacists of Medicare Health, one of South Africa's largest pharmacy chains. In addition, interviews were conducted on site with a pharmacist at a Medicare pharmacy located in Secunda, a rural region in the Mpumalanga province of South Africa. On-site interviews were also conducted at Koeberg Pharmacy located on the outskirts of Cape Town along with Graceland pharmacy located in Khayelitsha, an urban, historically poor township in Cape Town, and First-Choice Pharmacies located in Johannesburg. Lastly, healthcare providers at SHAWCO, a student-run organization that facilitates healthcare clinics in economically disadvantaged parts of Cape Town, were also conducted. Interviewees were asked questions about their patient demographics, their process of medicine acquisition, and their chronic disease burden.

Potential Partners: In addition to those directly within the healthcare landscape, interviews were conducted with potential partners for *Mobility.* These ranged from discussions with 1. the owner of Big Boy Fourways, South Africa's largest bike dealership, 2. the CEO of Independent Community Pharmacy Association (ICPA), 3. the head of the Bertha Centre for Social Innovation and Entrepreneurship at the University of Cape Town, 4. a supply-chain expert at the African Resource Center, an NGO seeking to assist social ventures, and lastly, 5. the head of a YES (Youth Employment Services) Hub for unemployed youth. Discussions with each group consisted of finding common ground and the feasibility of a collaboration with *Mobility.*

Patients: Patients were interviewed on-site at the aforementioned pharmacies. These pharmacies ranged from locations located in urban, peri-urban and rural regions. Patients were asked a few

questions about the time it took for them to visit the pharmacy, their mode of transportation, the wait-time, and the frequency at which they visit pharmacies.

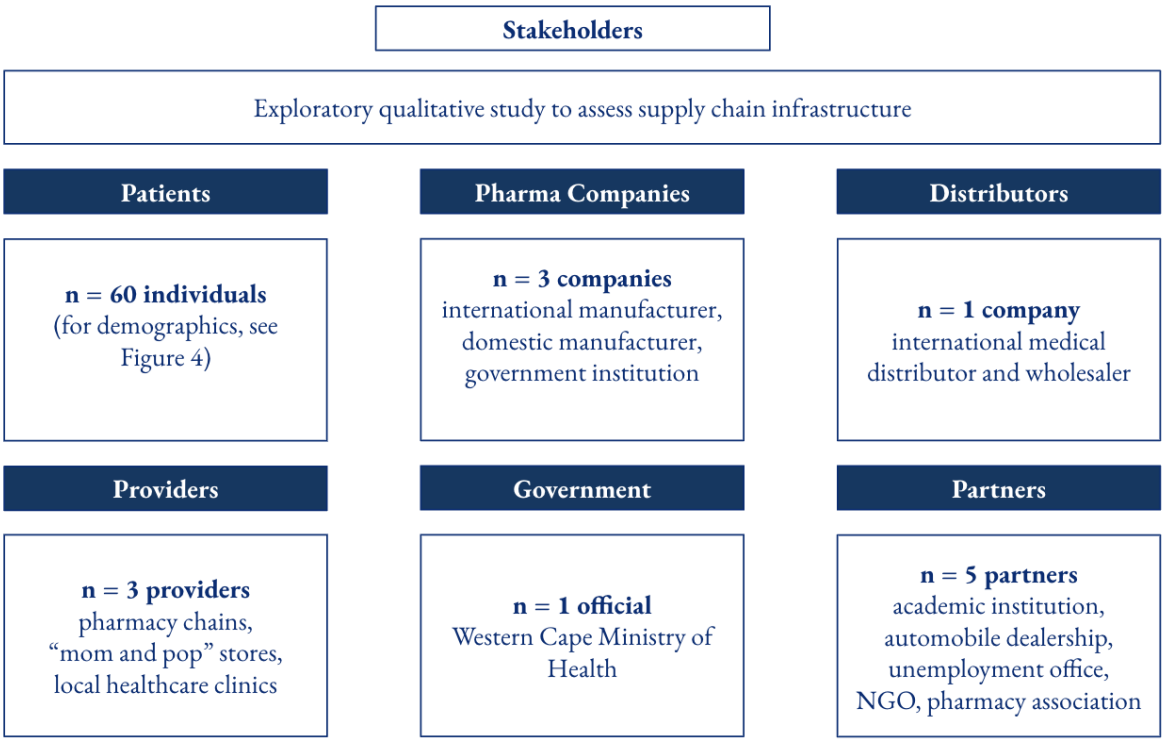

Figure 4: Experimental Framework

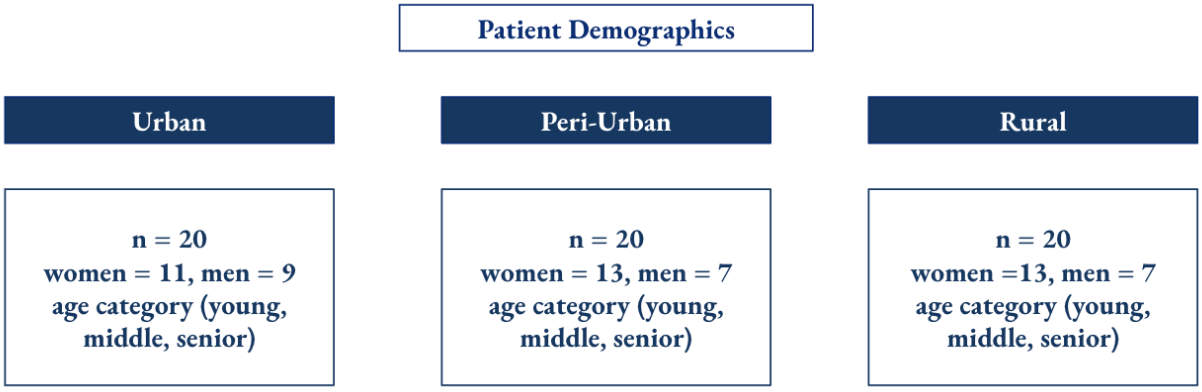

Figure 5: Summary of Patient Demographics

3.2 Set of Sample Questions

Figure 6 illustrates a few sample questions that helped direct the conversation with various supply chain stakeholders. Questions were split into three categories: general supply chain questions,

chronic disease questions, and questions about *Mobility*'s platform. The answers were recorded electronically in the conversations with partners, distributors, government, pharmaceutical companies, and providers. The answers were recorded manually in the surveys given to patients.

Figure 6: Sample Interview Questions for Three Categories

4. Results

4.1 Survey Data from Patients and Providers

4.1.1 Data Visualizations

A. Difference in Travel Times to Pharmacies

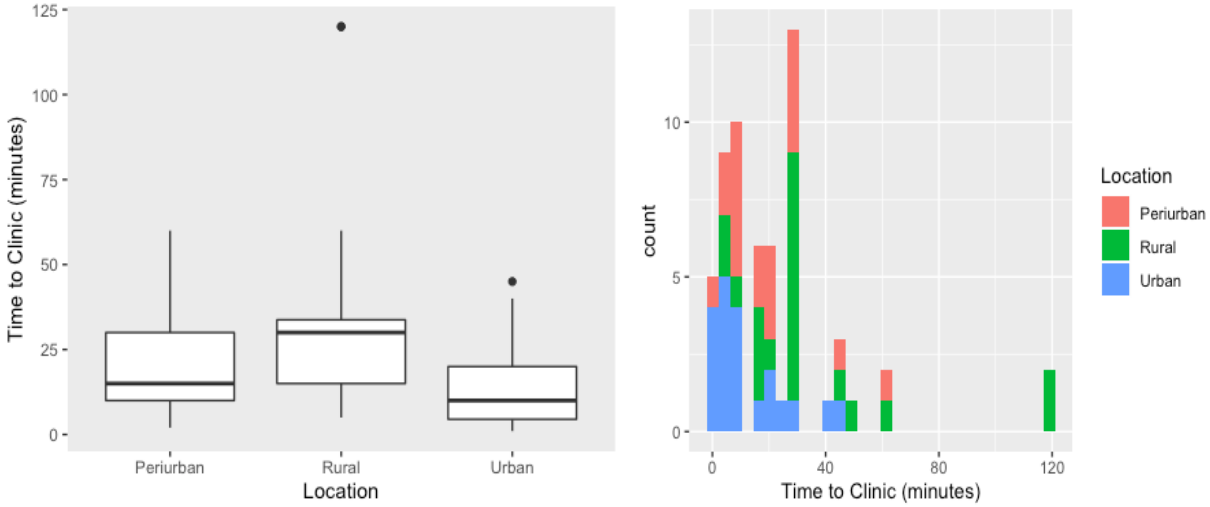

Figure 7: Travel Times to Pharmacies in Different Regions

B. Difference in Wait Times at Pharmacies

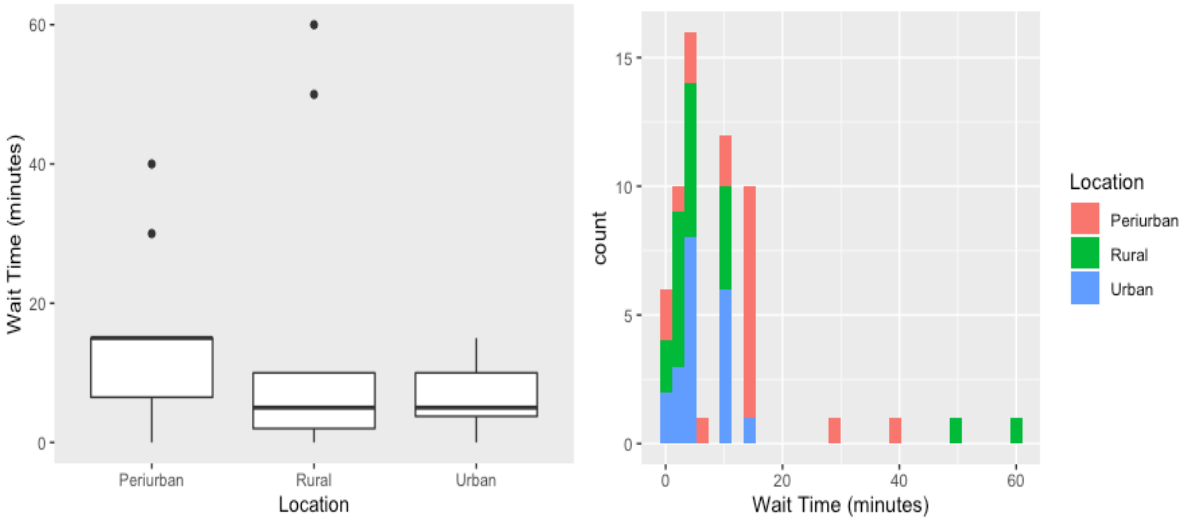

Figure 8: Wait Times at Pharmacies in Different Regions

C. Differences in Frequency of Visits to Pharmacies

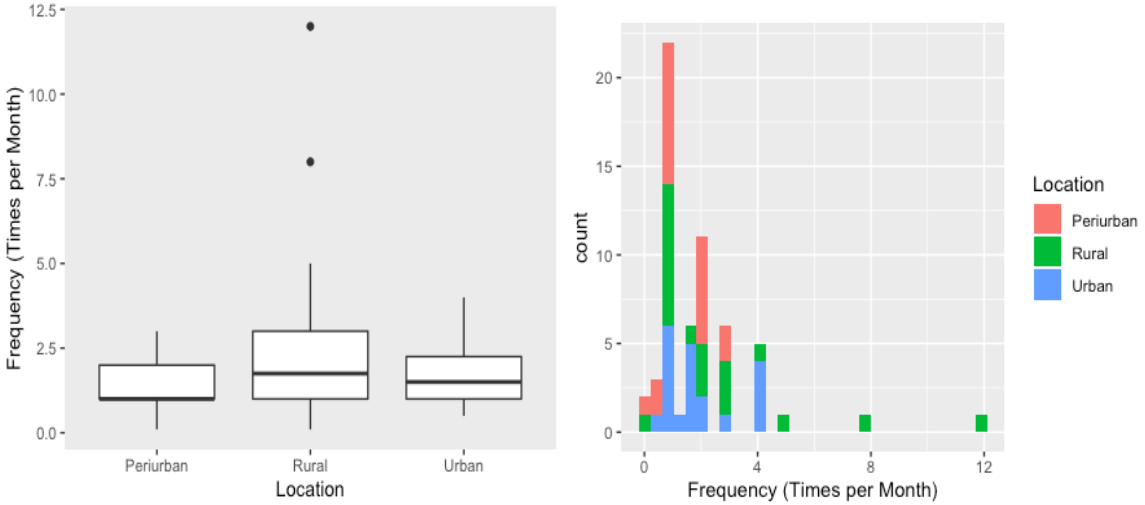

Figure 9: Frequency of Visits to Local Pharmacies in Different Regions

D. Modes of Transportation to Pharmacies

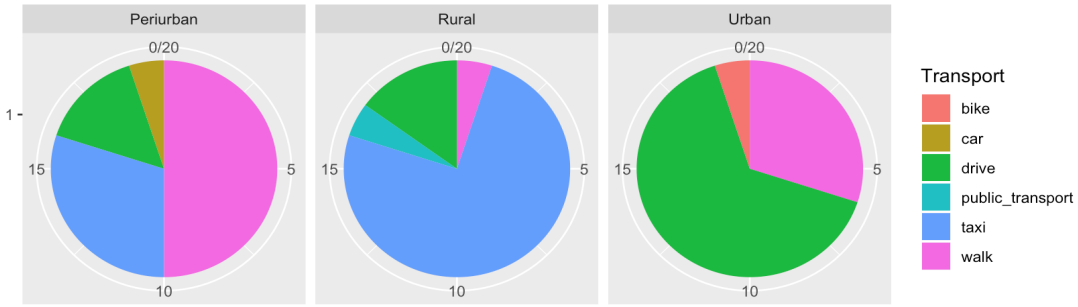

Figure 10: Modes of Transportation to Local Pharmacies in Different Regions

4.1.2 Significance Tests

Wait Time to Pharmacies		
Comparison	**P-value**	**95% CI**
Urban vs. Rural	0.3507	(-11.12,4.12)
Urban vs. Periurban	0.0080	(-11.73,-1.97)
Peri-urban vs. Rural	0.4299	(-11.88,5.186)

Figure 11: Wait Time to Pharmacies Two-Sample t-Test

Frequency of Visits		
Comparison	**T-test**	**95% CI**
Urban vs. Rural	0.2795	(-0.658, 2.185)
Urban vs. Peri-urban	0.1401	(-0.169,-1.150)
Peri-urban vs. Rural	0.0724	(-2.631,0.124)

Figure 12: Frequency of Visits to Pharmacies Two-Sample t-Test

Travel Time to Pharmacies		
Comparison	**T-test**	**95% CI**
Urban vs. Rural	0.0068	(-38.64,-6.863)
Urban vs. Peri-Urban	0.1485	(-15.64,2.460)
Peri-urban vs. Rural	0.051	(-32.40,0.080)

Figure 13: Travel Times to Pharmacies Two Sample t-Test

4.1.3 Interpretation

There is clear variance on the pharmacy experience for patients in South Africa based on the regions in which they live.

The main mode of transportation to the pharmacy shifted in each of the three demographic settings in which interviews were conducted (Figure 10). In urban areas, driving was the most common mode of transport, accounting for 65% of those surveyed. In peri-urban, this changed to walking, which accounted for 50% of survey participants. In rural regions, on the other hand, a staggering 80% chose to take a taxi. This variation is based on the geographical and socio-economic characteristics of the various regions. Both urban pharmacy locations were located in predominantly wealthy areas where owning a vehicle was universal. In peri-urban locations, the majority of those in the nearby vicinity had significantly lower annual incomes and did not have the means to own a vehicle. However, given that they still lived in a region where marketplaces were commonplace and located nearby, walking was still a convenient mode of transportation. In rural regions, the majority did not have the means to own a vehicle, however, walking was not practical given the distances many of these people have to travel to arrive at a pharmacy. Thus, the only feasible option left for these individuals to receive their medication is to pay for a taxi.

Regardless of where the pharmacies in the study were located, there was not a significant difference in wait-time for patients in general. The exception was that there did appear to be a difference between urban and peri-urban pharmacies (Figure 11). The majority of those interviewed mentioned that they had to wait no longer than 10 minutes to meet with a pharmacist and receive their prescription. However, all respondents who said they typically waited more than 20 minutes were all located in either peri-urban or rural regions. This shows that those in urban areas rarely, if ever, had long wait times, whereas those outside of these regions, could, on occasion, have to wait in long queues to receive their medication. Peri-urban pharmacies did also have the longest wait-times on average (Figure 8). This can be explained by the fact that peri-urban and rural pharmacies typically have similar number of pharmacists present, however given the larger accessibility of peri-urban pharmacies, there is a larger customer base to be served in these regions. Regardless, it is apparent that private sector pharmacies typically have enough pharmacists to serve their patient base, and the long wait-times discussed lie predominantly within the public sector.

There was no significant difference between any region for the average frequency of visits to the pharmacy by patients (Figure 12). This is logical as, given that all patients who visit a pharmacy have the means to do so, the number of visits they need to make is not contingent on their geographical location but rather their medical condition.

Lastly, there was a significant difference in travel times to pharmacies between urban and rural pharmacies (Figure 13). This makes sense based on preliminary research conducted as well as the qualitative interview data collected. Rural regions typically have much fewer pharmacies, and patients are located further apart meaning that they have to travel longer distances to get to a pharmacy. Additionally, given that people in rural regions typically do not have the means to own a vehicle, and must resort to taxis, the time to pharmacies is significant longer. This is because taxis in South Africa often pick up multiple riders and one trip may require multiple different drivers, given restrictions on the jurisdiction of each driver.

While the results show clear differences in pharmacy experiences based in the localities in which pharmacies are located, the study conducted also contains clear biases that must be addressed. Firstly, there is quite a large discrepancy in what is considered urban, peri-urban and rural areas, and not all pharmacies within each of these regions are the same. Only five pharmacy locations were surveyed and the results cannot be necessarily be applied to the entirety of South Africa. The urban pharmacies interviewed happened to be high income areas, and it is quite possible that our results would be different if this was not the case. Additionally, while the rural pharmacy at which interviews were conducted is categorized as 'rural', it was still only 2 hours away from the large metropolitan areas of Johannesburg. There are many areas in South Africa that are much further from a large city, and results in these locations may have been drastically different. In addition, all interviews were conducted in private pharmacies, and based on preliminary research, it seems the discrepancy between private and public is large and would affect our results.

In addition, it is important to note who exactly the surveyed population is. Firstly, many patients at the rural pharmacy did not speak English. On occasion, translation was provided from Zulu to English by pharmacists, but often, patients who could not speak English asked to not be interviewed. It is possible that those who do not speak English also have a harder time receiving healthcare access and so an inability to interview some of these individuals could clearly affect the results of the survey. In addition, patients were only interviewed at pharmacies, which presupposes that these patients had the means to make it to a pharmacy. The patients who the true targets of *Mobility* are those who cannot access pharmacies in the first place.

Despite these biases, the results from the conducted survey show a clear discrepancy in healthcare access between urban and rural regions and thus, a clear need for a platform like *Mobility.*

4.2 Main Qualitative Themes

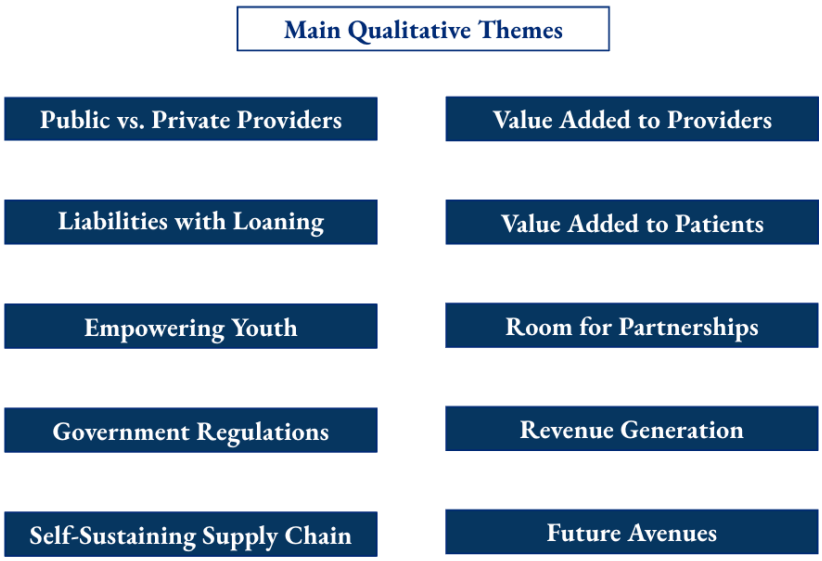

Figure 14: Identified Qualitative Themes

A. Differences in Serving Public vs. Private Providers

Mobility has the potential to operate within both the public and private sectors in South Africa, however, the differences between the two would mandate entirely discrete strategies for entry. This would include distinct customer bases, varying magnitudes of impact and separate competitors.

The severity of the last-mile challenge differs drastically between the two sectors. Those who have the means to pay for medical aids or out of their pocket typically live in urban areas and have access to the transportation needed to get to a pharmacy. As a pharmacist at BioVac mentioned, “If you go somewhere private, they’re gonna tell you, they have no problem accessing healthcare.” Additionally, those who would find a delivery service helpful may not have the means to even pay for the medication to begin with, making it difficult for private pharmacies to justify serving them. As an executive at Medicare Health said, “Making medicine cheaper and more accessible is our goal, but even then, it still remains outside of the means of those living in rural regions.” These costs include not only the price of medicine but also of transportation along with the opportunity cost associated with spending multiple hours travelling to and from the clinic. Mobility seeks to resolve this by removing transportation from the equation and allowing patients to pick up medicines from the comfort of their home or work. However, Medicare mentioned that they do in fact have a delivery service that they tried implementing in rural regions.

"In our pharmacies, we employ people as drivers who go and deliver. 95% of our pharmacies have delivery service. In areas where you think deliveries would be important, in rural places, you would think a delivery service would be essential. However, it doesn't work because those customers prefer to come to town and get all their jobs done at once. Their houses don't have house numbers, shacks, and so deliveries are difficult. Our deliveries end up primarily occurring in wealthier areas for convenience."

A large inhibitor to current delivery to rural villages lies in the cost that is incurred by the pharmacy, and in turn, passed on to patients through delivery fees. As pharmacies typically have to hire full-time drivers to complete deliveries, meaning these employees must be paid even when there are no deliveries to be completed. The only way to justify this cost is to charge a larger fee to the patient which makes it difficult for those with poorer socioeconomic conditions to afford. *Mobility* seeks to tackle this challenge by allowing pharmacies to pay for deliveries based on actual demand, decreasing their upfront costs. In other words, a single driver can now service multiple pharmacies. In addition, as mentioned by a GSK executive, "Medical Aids have a Corporate Social Responsibility so they may be able to contribute by subsidizing some of the delivery costs." Moving the burden from the patient to an alternative agent that has the means is essential because, as the same executive states, "You probably won't get too far with the patient paying."

The public sector is a different challenge. As a BioVac executive describes it, "The public sector, that's where we've got hospitals and clinics that are horribly oversubscribed. People getting there at 4 AM to get a space in the queue, they see 100 patients and then they go onto the next day. Patients are not getting the care they deserve." A partnership with the government could be promising in allowing medicines to be delivered from state-run healthcare facilities to individual houses. However, this operates under the assumption that these facilities have the required medicines to begin with. As a former state pharmacist now working at BioVac describes, "In rural regions there is a lack of accountability. No control for where funds are going. That's what it is, money has been allocated for drug, but then someone decides they want a new car and so drugs are not ordered." It is clear that *Mobility* may not resolve all of the public sector's woes, but it can at least help in ensuring that, when medicines are available, they are actually given to those in need.

B. Liabilities Associated with Loaning Scooters

A significant component of *Mobility's* business model is in providing scooters to those without the means to purchase one themselves. However, with the social impact of such an initiative comes significant liabilities that must be dealt with. As the aforementioned GSK executive stated, "the challenges are how do you manage if someone takes the scooter and

they don't come back? Debt collection, how do you deal with that?" The answer is not clear; however it is clear that incentivizing individuals to pay off their loans will be more effective than threatening repercussions if they do not. As the same executive mentions, ''There needs to be some carrot to incentivize people to pay off their loan. And carrot is better than stick especially for people who do not have that much to start with."

However, there is precedent for a loaning model where low-income individuals are provided vehicles in exchange for providing a service. As the owner of one of South Africa's largest bike dealerships mentions,

"People who buy scooters for Uber Eats and other delivery services are mostly all low-income. Typically, someone in the middle-class buys a scooter, gives it to an individual and, for every delivery they complete, they give them a certain proportion of their sales to the driver. The driver is making money for making trips but after he has paid the employer. 30% of those buying bikes are lower class and they then deliver for a bunch of services. It probably takes about 3 months of their yearly income which they can't afford. So this is a much more practical model."

When a loaning model was discussed with an executive at Imperial Logistics, a possibility for a partnership with a global donor agency was presented.

"I was thinking along the lines of a blending capital finance model. An end of period rebate that reduces their capital outstanding. You make it a performance-based finance contract. He has to pay an amount per month. If you pay 1000 rand per month on the bike. You pay 500 bucks a month and it's inclusive of your interest and goes down against your debt. After the six months, the donor will match your 500. Six months later it happens again. You will provide them with a credit history, teach him how to pay back loans sustainably and giving them a means to set up a business."

Such a partnership would be essentially especially considering the upfront capital that such a project would entail. As the dealership owner states,

"We can't register bikes unless the bike has been paid in total. Only once its paid for, can we set up the birth papers for the bike' 'Definitely these people won't have the money to pay 20K rand up front, you would have to find that capital."

Another larger concern is dealing with any damage that occurs to the scooter. As a BioVac executive mentions, 'Rural areas in South Africa are rocky, hilly and hard to access. Even with cars, certain routes are hard to travel. I do think that some of these people, where they are living, a scooter may not be entirely safe.' In order to deal with this concern, insurance

may be another cost that is added to the equation. As an expert from the African Resource Center mentions, 'There definitely needs to be insurance for the scooter. It's not safe for people and not it's not safe for *Mobility* if these assets aren't insured.'

The aforementioned bike expert and dealership owner assuages some of these concerns when he says,

"Bikes can ride on sand roads, if you're looking for really rural, the bikes we sell can basically get you anywhere around Africa. If bikes do get really badly damaged, we pay off with insurance. If it's not major, parts are usually cheap. 120-190 rand and we can do that right here. Companies like Uber typically has their own insurance that they require they're drivers to have and it hasn't really been a concern beyond that."

C. Importance of Empowering Youth

Unemployment stands as one of the main issues surrounding the country, with the unemployment rate nearly reaching 29%. Youth unemployment has risen to an all-time high of 56.4%. *Mobility*'s platform seeks to address this challenge by acting as a key facilitator providing youth with tools to succeed in the struggling South African economy. As mentioned by an executive from the BioVac Institute,

"I like [Mobility] *because you are providing jobs in a country where we need jobs so bad and trying to give a service to people who never get this time of service. You're looking at getting right to the person and I don't think anyone in rural regions has ever experienced this."*

The high unemployment rate is due to a variety of socioeconomic factors such as a lack of opportunity and a substandard education, as stated by a government official from the Western Cape Province. Medical students representing SHAWCO at the University of Cape Town reiterate this point by saying,

"A big thing is that education is difficult. Kids are caring for other kids and therefore cannot go to school. Households don't have enough money and need kids to work. Most youth will be working to survive. There's a lot of communal living so they are working not only for themselves but also for their families. Gangs and alcoholism are also huge problems, which results in children raising each other."

To combat this issue, SHAWCO mentions that the government is pushing to tackle this problem through entrepreneurship. There has been a lot of funding mechanisms in place

already to get individuals into the workplace. The government official states that NPOs should have a leading role in this mission by training community health workers.

"NPOs facilitate the process with a nurse to select and train community worker training. They provide the first point of contact between the health system and families. It's a deep-seated solution."

A meeting with the Youth Unemployment Services (YES4YOUTH) in Johannesburg proved that skills training provides unemployed individuals with a more diverse toolkit than just providing them with a job. YES4YOUTH organizes workshops to teach youth aged 18-34 a variety of skills from different industries ranging from agriculture to computer science. They also expressed an interest to collaborate with platforms like *Mobility* through the addition of community health worker training at their hubs. Resultantly, as a supply chain expert from the African Resource Centre mentions, this platform becomes more of a business opportunity for individuals in these communities. Furthermore, an executive from Imperial Logistics suggests that the ability to effect a delivery using a highly mobile person is great.

"You will provide them with a credit history, teach him how to pay back the loans sustainably, and give them a means to set up the business. The end process is an individual with an asset, a credit record, and a sustainable income."

D. Government Regulations/Liabilities for Medicine Handling

Transporting medicines from providers to individual households comes with many regulatory limitations and liabilities. The proper handling of the medications is pivotal. As one executive from the BioVac Institute, which produces vaccines, mentions, *"In South Africa, they are very strict on who can handle medications."* The same executive states that there may be several logistical and geographic limitations for *Mobility*'s model.

"*The model is more suited for pharmaceutical products. If you were to work with vaccines, your box would have to be insulated and consist of a cold chain. Furthermore, lots of vaccines are multi-dose. Once you open a vial, it has to be used on multiple people within eight or so hours. [...] Geographically, rural areas in South Africa are rocky, hilly, and hard to access. Even with cars, certain routes are hard to travel."*

A pharmacist from Medicare Health reiterates this point by mentioning that there's a need to ensure that the medications are delivered and that there are proper temperature controls for the medicine. She also states that there is a need to safeguard the drugs. Vaccines thus

require much more careful attention in terms of both delivery and administration, preventing it to work with *Mobility*'s current model.

Another important point is to determine which stakeholders will bear the liability for the handling of medicines. This issue was emphasized by an official from the Western Cape Government. As she states,

"The most important thing is the issue of accountability by the pharmacist for the safe delivery of medicines. You cannot hold the driver accountable. There has to be accountability by a non-profit organization through a nurse or through a pharmacist up until the parcels are delivered."

This issue of accountability stems from the fear of improper handling of crucial medications, which will end up not only affecting the pharmacy but also the patient to which the medicine is being delivered. To prevent this, training programs must be instilled by *Mobility* to educate its drivers on the importance of medicine handling and the consequences associated with not complying with regulations. After a meeting with a chief pharmacist from the Independent Community Pharmacy Association, it was mentioned that,

"A lay person can handle medicine but cannot store medications. The person delivering medications has to be trained. This training can last one day and will consist of how to use Mobility's application, confidentiality training, and other logistical steps such as how to scan the medicine's barcode."

Here, the same chief pharmacist recommends that the parcel be barcoded and that the patient receiving the package should sign it. She additionally explains that these parcels must be transported in insulated boxes, that the driver should have the contact of the pharmacy from which they collect their packages, and that these packages should be delivered the day they are picked up. It is thus imperative that *Mobility* complies with these standards in order to operate in such a delicate landscape.

E. Building a Self-Sustaining Supply Chain

The true beauty in *Mobility'*s platform comes through the creation of a self-sustaining supply chain, where patients no longer have to request their medications, but rather, they are delivered to them based on their current treatment regimen. This means patients have to make no additional commitment outside of picking up their medicines from their door-step and taking them as needed. This feature seems especially necessary in the current

South African healthcare ecosystem as described by the Vice President of Healthcare at Imperial Logistics,

"If you live in huge sways of South Africa, you don't have access to any forms of healthcare service. You're multiple kilometers away from your nearest healthcare site. It's a complete dislocation of the demographic vs. the spread of services."

Through *Mobility,* people in rural places no longer have to worry about travelling to their local provider, outside of the occasional checkup, and can instead get the care they deserve at their home. As the aforementioned expert describes it, "Mobility is leap-frogging the need to develop distributed granular service points."

This is particularly important in South Africa, where, as the same Imperial Logistics executive says,

"The greatest challenge lies in access to registered points of availability. We have a pretty well enforced control around who can sell what medicines. The South African market 90% of dispensed medicines are associated with a prescription and 99% of dispensed medicines are dispensed at a registered dispensing point."

In addition, setting up additional pharmacies at points of care has been a struggle for South Africa as described by an executive at GSK,

"Having to have a pharmacy means you need a license, a pharmacist, plus people with enough funds to buy medicines. That's why you have a bunch of informal pharmacies that are established."

This is exactly why the same executive found *Mobility's* solution appealing,

"I've looked at these solutions before and when you try to set up more pharmacists, you fall short because you have to find pharmacists. The delivery person in your platform doesn't have to be a pharmacist which is huge."

However, providing patient's access to medicines cannot at the same time, inhibit these patients from coming in to check-in at their local provider to ensure their condition is being adequately handled. A Medicare Health pharmacist describes the current system to verify patient adherence,

"Prescriptions are only valid for 6 months. Then we can only encourage people to come back. Pharmacists phone but we can only hope.' 'It's good business, and it's good

healthcare. Unfortunately, it's rare to see drug adherence above 50% anywhere in the world. 55-60% is the actual refill adherence."

This is the value of the self-sustaining supply chain. It hopes to increase medical adherence by providing refills to patients and then notifies the patient when their prescription has expired, and it is time to visit the clinic once again. In essence, patients are more likely to pick up their medicines when it is more convenient for them to do so. An Aspen Pharmacare executive describes this very idea,

"You also want to convince the patient to come in for a check-up if the medication is not working effectively. When a driver delivers at the end of a regiment, there should be a system of them telling the patient to come in to the clinic for the next dose."

F. Value Added to Healthcare Providers

While the benefit of *Mobility's* platform is clear, in order for it to be implemented, it must also be accepted by healthcare providers. For this to happen, providers must believe that *Mobility* enhances their business and the services they are offering. The value proposition differs based on whether the service is being provider to public or private providers. In the public sector, the government is less worried about profits and more concerned about ensuring everyone gets the healthcare they need. In this case, enhancing the served population is the goal. In the private sector, pharmacies do care about their patients, but they also care about profit generations. Thus, the goal in this case is to enhance the served population while keeping delivery costs low in order to generate a decent profit margin.

Delivery of medicines has been something the private sector has been considering for a while based on this quote from a Medicare Pharmacist,

'We are looking for alternative delivery mechanisms. The pharmacy association has asked us to do this. It's really at the top of their mind. Access to healthcare is enshrined in our constitution and it's not being upheld. I think with technology a lot of this stuff is much more practical. It's a question of whether or not it's affordable. You just need to get some form of proof that its delivered and temperature control to ensure the medicine is safe. The need to safeguard the drugs is also really important'

Pharmacies have only delved into the delivery realm through their own courier services. However, as mentioned, these services have been hindered by high costs inhibiting those who actually need the service from receiving it. The key to a solution like *Mobility*, as described by an Imperial Logistics executive is, "If you can do this at a really low cost, then that could be a big differentiating factor. That's what's missing right now"

In addition, another major barrier to delivery services in rural communities has been trust between the driver and the target user. People did not trust strangers to deliver products to them and so they typically opted out of such services. *Mobility* seeks to tackle this by employing local drivers who are known to those in the community. The value of such an idea is described by the aforementioned Imperial executive,

"A network of guys on scooters that know everyone in the communities. You leverage the pharmacy as a counter to counter and add the deliveries for the scooter afterwards. These deliveries can be effective because the driver already knows everyone and where everyone lives. These are people from the community that you are hiring."

Another large part of the value proposition to healthcare providers comes from the impending NHI bill discussed previously. A hypothesized version of the bill seeks to allow all South Africans to use private healthcare facilities for certain services which will then be reimbursed by the government. Previously, private pharmacies had no reason to go into rural regions as many in these places could not afford to pay for health insurance or out of their pocket. However, if all individuals could use any provider, then private pharmacies can now make revenue from rural patients even if they cannot pay for their services. This means that delivery platforms like *Mobility* would allow these pharmacies to expand their range and serve rural populations without having to build capital-intensive pharmacies. This allows them to keep their costs low while gaining access to an entirely new customer base. This point was presented by an Aspen executive when he mentions,

"I think in terms of where we are and how it has evolved from the state perspective with DDV, we are getting closer to the customer. That final leg, your approach is certainly valid. In terms of opportunity for growth, your patient base is still what is, But with NHI, your patient base will grow and that's where being able to deliver to them becomes really important."

G. Value added to Patients

The main challenges facing patients in South Africa are the availability and accessibility of care. *Moblity*'s platform allows patients from various backgrounds to access points of service. In rural, less wealthy regions, the lack of funding and transparency in knowing what medications are available in addition to the logistical challenges in getting to clinics prevents individuals from accessing proper care. In urban, wealthier regions, delivery services such as *Mobility* convenience individuals by helping them obtain the medications that they need easily and with no hassle. In a conversation with a chief pharmacist from the BioVac Institute, she mentions,

"There is no point of service in rural regions. In every rural place, there lacks pharmacies, clinics, and hospitals. There is also a severe lack of funding and lack of healthcare professionals. There are a lot of places where people have to walk all day, taking a day's leave from work, to walk to a hospital or clinic really far just to be told 'sorry, we don't have that vaccine or blood-sugar tablet.'"

Executives at Medicare Health, a retail pharmacy chain, also remark that there is a financial aspect to be considered with going to visit clinics. Not only is there an opportunity cost of losing a day's work, of which most individuals would not be compensated for, there is also other additional costs associated with visiting pharmacies.

"The financial aspect is that you might be taking a whole lot of taxis. There are rules over which taxis can go. It's time consuming, it's costly, and there is no guarantee that the medicine you need is even there. From the public sector, that's why we've got hospitals and clinics that are horribly oversubscribed. People getting there at 4 AM to get a space in the queue."

Likewise, medical students at SHAWCO from the University of Cape Town mention that,

"Writing off a day of work once a month to stand in a queue becomes a lot for patients."

As a result, both the travel cost and the opportunity costs of time and money present huge barriers for these patients. *Mobility*'s platform helps to leapfrog the need to develop additional granular distribution points as mentioned by an executive from Imperial Logistics. Pharmacy chains have already realized this and have begun to implement smaller forms of delivery services, of which most have not been extremely successful in maintaining a larger patient base. The executive at Medicare Health mentions,

"Trying to expand to rural areas is not worthwhile and is not a justifiable pursuit. We have our own delivery service within a certain radius around each pharmacy."

The reason for this failure is due to the lack of a sufficient patient base. It is costly for pharmacies to utilize their own delivery services by employing their own drivers. *Mobility* overcomes this by having its drivers service multiple pharmacies in the region based on demand -- they would work not for individual pharmacies but rather for the platform, making money for themselves and to pay back their loans. Further, the impending introduction of the National Health Insurance Program allows private hospitals to serve more and more patients. During a conversation with an executive from Aspen Pharmacare, he mentions,

"National Health Insurance is proposing to allow private hospitals to serve more and more patients. Anyone can walk in to get primary healthcare and get reimbursement for that service. A patient comes for a check-in and the future demand for the patient is put in the system for when deliveries should be completed in the future. With NHI, we expect to see more volumes from the tender process. If it gets more affordable, more people will get prescription drugs which will drive volumes. I think in terms of where we are and how it has evolved from the state perspective with direct-distribution voucher, we are getting closer to the customer. With that final leg, your approach is certainly valid. In terms of opportunity for growth, your patient base is still what is. But with NHI, your patient base will grow and that's where being able to deliver to them becomes really important."

NHI hence benefits *Mobility*'s platform by providing a larger patient base, thus creating a more balanced demand among different regions in the country. They will be financially supported by the government to obtain critical prescriptions, increasing volumes and deliveries needed. Finally, *Mobility*'s platform also aims to convince the patient to come in for a check-up if the medications are not working effectively. As the same executive from Aspen Pharmacare states,

"When a driver delivers at the end of a regiment, there should be a system telling the patient to come in to the clinic for the next dose or check-up."

H. Room for Partnerships

Given that the challenge of delivering medicines to individual households is so multi-faceted and needs input from a variety of stakeholders, *Mobility* requires many partnerships for its platform to run smoothly. Such partnerships involve organizations such as scooter dealerships, the African Resource Centre, the Youth Employment Services (YES), and donor agencies.

The partnerships will allow *Mobility* to most efficiently make an impact on the healthcare landscape in South Africa through the sharing of resources among the organizations. Scooter dealerships in South Africa will provide the bikes required by *Mobility*'s employees to deliver the medications. During a conversation with the owner of Big Boy Fourways, the largest dealership in the country, he mentions:

"66% of our sales are for delivery bikes. We are looking to implement a program with companies like Uber where either they come here and pay upfront for a bunch of scooters and then drivers pay them off when they work. If the bikes are badly damaged, we pay off

with insurance but those companies typically have their own insurance that they require their drivers to have."

However, he mentions that there is no way that the dealership can cover the upfront cost of the bikes without a guarantee that the bikes will be completely paid off. He states that:

"From our side, we can't supply 100 bikes and wait for payment months later. We can't register bikes unless the bike has been paid in total. Only once it's paid for can we set up the papers for the bike. These people definitely won't have the money to pay 20,000 rand up front so you would have to find that capital."

To resolve this, an executive from Imperial Logistics suggested that we look into establishing partnerships with donor organizations such as USAID Through a performance-based finance control, these donor agencies would match the paid loans every six months. He suggests that:

"There are immense quantities of available help. The capital they provide would also account for the risk of losing the bikes."

Finally, partnerships with organizations like YES and the African Resource Centre would allow *Mobility* to leverage their platforms to train community health workers and collaborate with companies with similar missions.

I. Revenue Generation

Mobility's platform contains three potential models to generate revenue streams. A for-profit model is preferable due to its capacity to incentivize different stakeholders as well as its ability to optimize efficiency in delivering chronic medications to households.

a. *Patient-Facing*

A patient-facing model targets chronic care patients as customers, charging them a small delivery fee for medications. According to an executive from the Independent Community Pharmacy Association,

"Patients cost on average 130 rand to acquire medicines due to travel costs and other costs. They are actually prepared to pay a small amount of fees."

These additional hidden costs for a patient to acquire medicines outweigh the fees they would incur for being medicines delivered to their homes, suggesting that *Mobility*'s platform can help them save money.

b. *Provider-Facing*

The provider-facing model targets pharmacies and clinics as customers. Clinics would be charged fees instead of incurring costs from a private delivery system. Pharmacies would either be charged a variable rate per delivery or a combination between fixed and variable rates. Pharmacies that have already implemented their private delivery systems have not experienced much success. According to an executive from Medicare Health,

"95% of our pharmacies have delivery service. It becomes a financial burden for these retailers because they hire private laypeople to deliver medications."

As a result, a centralized system partnering with multiple pharmacies allowing individuals to work with any provider in the region distributes resources evenly amongst different pharmacies, thereby reducing costs incurred by individual retailers significantly.

c. *Manufacturer-Facing*

The manufacturer-facing model allows pharmaceutical companies to pay for the services. As they face many regulatory restrictions such as the challenges of single-exit price, pharmaceutical companies can incur a small fee to compete in the industry. According to the same executive from the Independent Community Pharmacy Association,

"Manufacturers can also play an important role. By helping to fund and deliver products, they can help achieve better patient outcomes and overcome single-exit price by increasing their volume of sales."

While pharmaceutical companies cannot advertise for their products, this increase of volume of sales can be based off of recommendations by local pharmacists in the clinics, as stated by an executive of Aspen Pharmacare.

Mobility's platform would work best with a combination of all three revenue-generation models. The stakeholders in this complex supply chain are evidently willing to work together with both *Mobility* and each other to support its business model.

J. Future Avenues of Exploration

Mobility holds enormous promise in tackling the last mile challenge in South Africa. However, there is enormous room to grow in order for this idea to be implementable.

One issue that has arisen numerous times pertains to the verification that medication has been delivered safely to patients. A potential solution brought up by many has to with RFIDs or smart tags, given to the patient, physically or on their smartphone that is then scanned by the driver. Once the scanning has occurred, the pharmacy knows that the correct medication has been delivered to the correct patient. Here is an Aspen Pharmacare executive describing the idea,

'I was thinking along the lines of RFIDs and Smart Tech. How do you ensure that there is a proper handshake? Right now, patients coming into the clinic, now if you have an old lady who can't come in, and you want deliveries to households, how do you ensure there is a handshake between what is prescribed and what is given? An option is an RFID tag you can hook a metal thing or smart tag. With a scan now you can say okay, now you've received the medication. How do you get the reimbursement to the driver? Smartphones? Yes. But some places don't have smartphone signal. That's where the RFIDs come in. As long as there is a signed proof of delivery there is no dispute. The technology for this stuff is not far off. A patient comes in for a check-in and is given the RFID, and future demand for the patient is put in the system for when deliveries should be completed. You also need a mechanism to account for deliveries made. A lot of medicines are very regulated and very sought off. Pain medication or ARV can be intercepted. You want to make sure that the dispensed product is reaching your customer. There can't be any interference. You also want to convince the patient to come in for a check-up if the medication is not working effectively. When a driver delivers at the end of a regiment, there should be a system of them telling the patient to come in to the clinic for the next dose'

In addition to the medical adherence challenge faced globally, another large issue is the diagnosis of illnesses in the first place. This is particularly true for low-income individuals in rural regions who do not see it essential to get to a doctor as a precautionary measure when they have many other issues to deal with. This issue is confirmed by a Medicare pharmacist when she says, 'There is also a huge undiagnosed rate. A whole bunch of people who don't even know they have it.' In order to tackle this, the idea of a referral system was discussed where patient who refer their friends to a local clinic receive free deliveries of medicines for a certain time period. In this manner, patients benefit because they no longer have to pay anything for these deliveries. Pharmacies and clinics benefit because they are getting more customers and previously undiagnosed patients get their conditions treated.

Another issue discussed had to do with handling of medicines that require certain precautions such as vaccines. The director of the Bertha Centre for Social Innovation at the University of Cape Town says,

"Some challenges in the idea are the logistics of transporting the medicines such as the need for a cold-storage and other regulatory issues. There needs to be buy in from the government and you need to put time in to develop relationships with people. It's important to start reaching out to village heads and local NGOs to kickstart collaborations."

One of these collaborations discussed had to do with training community healthcare workers who could then become employees for *Mobility* and then deliver medicines and even administer certain products such as vaccines. When this idea was discussed with a local Youth incubator, the response was promising,

'Yes, that sounds great. Youth would receive immediate employment as community health workers after training and then through Mobility they could spread their skills to other regions and receive a scooter while doing so. This expands the impact Community Health Workers can have because they are no longer restricted to just their community.'

Another important consideration is how *Mobility's* efficacy is tracked. It is essential for there to be some sort of metrics of progress as confirmed by the African Resource Center,

'There needs to be some performance metrics in place to determine whether or not there is value added and how much value added. It is important to constantly improve and change your model if improvement is not happening.'
These metrics may include increases in revenue, additional patients added to the consumer base, customer satisfaction and retention, and geographic expansion.

Lastly, while *Mobility* began as a proof of concept of a solution to the last mile challenge in South Africa, it is certainly not limited to this context. A similar model is scalable to other countries, both developing and perhaps even developed. Whether or not such a model would actually be effective in a specific country would require an analysis of the socioeconomic, political and healthcare landscapes similar to the one being conducted here.

5. Conclusion

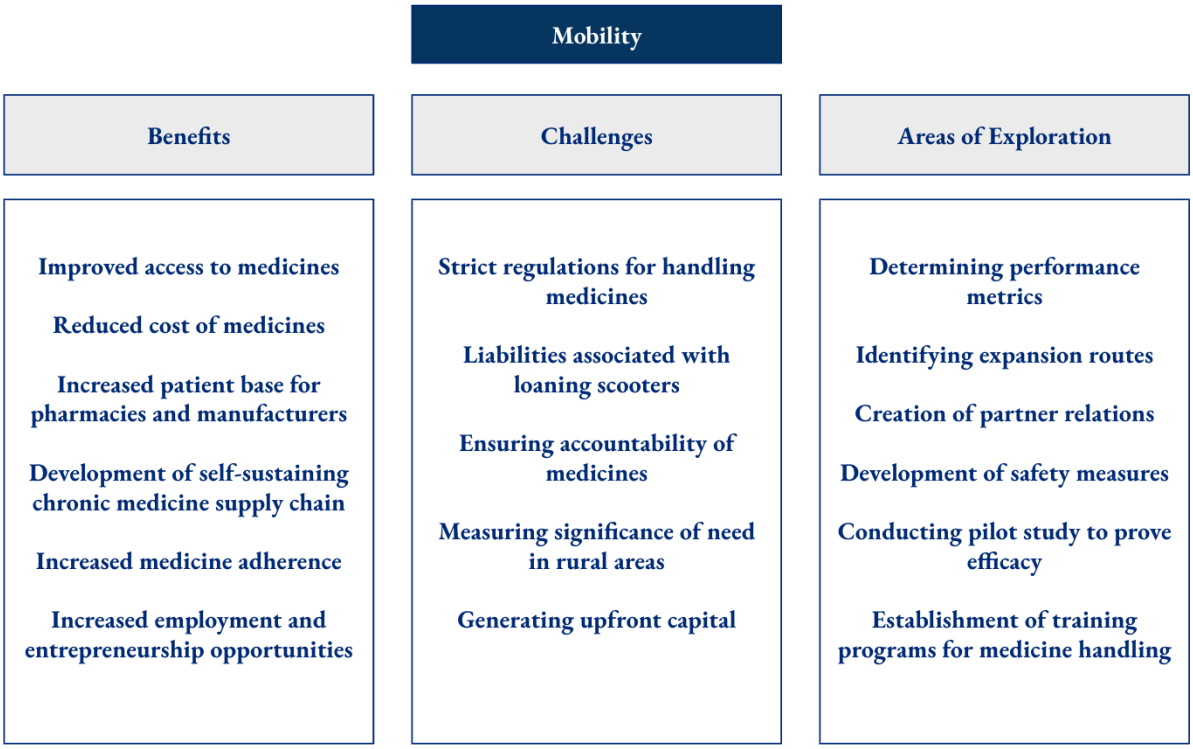

Figure 15: Summary of *Mobility*'s Benefits Challenges, and Future Areas of Exploration

This stakeholder analysis shows that *Mobility* does have promise in resolving South Africa's medical last-mile challenge. However, for it to be implemented successfully, there are many issues that need to be resolved. This includes regulatory hurdles regarding the handling of medicines, establishing a loaning model that mitigates risk, and ensuring a stable form of revenue generation. However, there is clear value added for the stakeholders involved including pharmaceutical companies and pharmacies who will see additional customers as well as patients who receive substantially easier access to their essential medicines. Further steps would involve partnering with donor agencies to generate the upfront capital for scooters, creating an easy-to-use interface and meeting government regulatory standards to ensure safety and credibility for the platform.

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