Innovating Healthcare in Ribeirão Preto

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Executive Summary

Saúde Ribeirão 360 is a publicly funded clinic network of 454 clinics serving remote communities, but is struggling with staffing and medical supply issues. Widespread shortages have led to inaccessible healthcare and prolonged delays. A supply chain, inventory, and workforce optimization plan is needed to address this.

An online Inventory and Supply Chain Optimization System is recommended to manage supply across the primary care clinics and the central warehouse. By monitoring live supply and expiration dates combined with predictions regarding seasonal trends, regional outbreaks, and general usage from Artificial Intelligence, the system would minimize waste while ensuring that demand for medical supplies can be easily identified and addressed without delay. In coordination with Anvisa, the Brazilian Healthcare import agency, medical supplies will be imported from manufacturers and transported to a central warehouse where it will be stored in a temperature controlled setting. To supplement the existing transportation systems, medical drones capable of reaching speeds near 145 km/h would transport the medical goods from the central warehouse to the clinics. At the clinics, a salary increase to a competitive wage is recommended to increase retention and hiring of health care workers. Furthermore, collaboration with universities can attract health care volunteers to support existing staff. Finally, a pilot program is recommended to send mobile teams to communities to increase immunization rates, decreasing wait times at primary health care settings and preventing disease in local communities. Based on the outcomes, the pilot project can be scaled up.

For the cost-benefit analysis the solution would require an upfront investment in renting a warehouse, buying aid tents and salary increase of CHA stuff. But this will be outweighed by the benefits of increased patient satisfaction survey results.

1.0 Introduction

Saúde Ribeirão 360 operates a network of 454 primary care clinics delivering healthcare to remote communities in Brazil within the Ribeirão Preto region [1]. However, these clinics encounter major challenges with staffing and medical inventory. This report recommends new policies and systems to address these challenges.

2.0 Problem Analysis

Currently, numerous clinics are reporting medical supply and staffing shortages [1]. For example, 37.4% of clinics reported a shortage of antibiotics and 18.8% of clinics reported a shortage of Automated External Defibrillators (AEDs) [1]. 70% of respondents reported that they did not receive their desired vaccinations due to shortages. Prescription drugs were only available for 65% of respondents who required them [1]. Furthermore, 22.4% of clinics reported missing doctors [1] and 59% of clinics exceeded the recommended patient to clinic ratio, increasing wait times [1]. Therefore, there is a need for a supply chain and workforce optimization plan to address the medical supply and staffing shortages. This plan should be sustainable long-term. To comply with Brazilian laws, a minimum wage of $262 USD monthly must be paid to workers [2] and workers at clinics performing medical roles must be medically trained and licensed [3].

3.0 Proposed Solution

The following sections describe the recommendations for Saúde Ribeirão 360 to address their inventory and staffing challenges. Figure 1 demonstrates the solution overview.

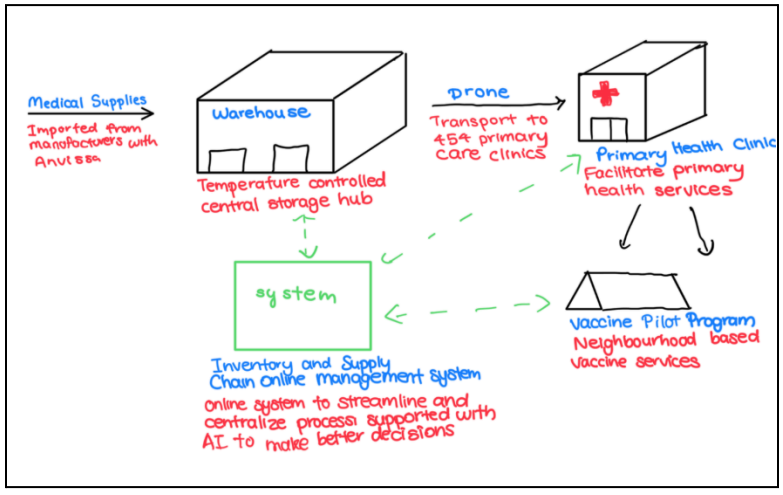

Figure 1. Overview highlighting solution components and system processes.

3.1 Inventory and Supply Chain Optimization System

An online inventory management supply chain optimization tool is recommended to manage medical supplies. A key feature includes modelling monthly data on patient demands and then giving out necessary supply for proper workflow and minimizing wastage. Several softwares already in existence include Ninsaúde [4] and Sortly [5]. By monitoring on-site supply and expiration dates on a database, delivery timeframes and purchase quantities will be adjusted to minimize waste while meeting demand. Artificial intelligence models will predict demand for essential vaccines using seasonal patterns, outbreak monitoring, and live demand usage rates [6].

3.2 Inventory Sourcing Process

Medical companies such as Merck, Pfizer, and Eli Lilly are examples of various manufacturers for vaccines, equipment and medication [7]. The import of medical supplies is regulated and managed by Anvisa, a Brazilian health regulatory agency [8]. The proposed central hub (Figure 1) will manage importing supplies with Anvisa. Using the inventory management system data, order quantities will be determined and sent to manufacturers. These imports will be transported to the central warehouse at the headquarters, which will store the supplies until they are sent to the primary care clinics (Figure 1). Certain medications must be stored at a certain temperature, so infrastructures such as refrigeration will be established at the warehouse to facilitate this [9].

3.3 Transporting Inventory to Primary Health Clinics

The next system component is transporting medical supplies from the centralized hub to the 454 Primary Health Clinics (Figure 1). A lack of developed transportation infrastructure makes it expensive to transport goods, including medical supplies, to remote communities with clinics [10]. To address this, a drone transportation system supplementing the existing model is recommended to transport the supplies from the centralized hub. Medical drones are currently used globally to transport medical equipment to remote locations [11]. These drones can transport supplies faster and avoid geographical obstacles on land, with existing medical drones reaching maximum speeds up to 145 km/h and a round trip range of 110 km [12]. In Rwanda, medical drones reduced blood delivery times from 4 hours to as low as 15 minutes [13]. Furthermore, these drones, such as the one seen in Figure 2, can transport 6 kilograms of supplies [12]. For example, considering a 500 mg dose mass for a sample of Amoxicillin to treat

pneumonia or bronchitis [14], up to 12,000 doses of Amoxicillin can be transported in a single shipment.

Figure 2. Image of existing medical drone with 6kg transport capability [12].

3.4 Incentivising and Retaining Health Care Workers

To address staffing shortages, increasing salaries will attract more healthcare workers and retain them. The low monthly salary of $228 [7] for CHA workers explains the low retention rate [1]. Considering average salaries, it is recommended to increase the monthly salary to $1488 for CHA and Nurse Technicians [15], $1634 for nurses [17], and $5002 for doctors [18], meeting local labour laws. Additionally, a volunteering program is recommended to be initiated to bring volunteers to support health care efforts.

3.5 Mobile Vaccinations Clinic Pilot Project

To reduce demand at primary clinics where patient demand is exceeding the recommended numbers [1], a mobile vaccination pilot project is recommended. Mobile staffed clinics will travel to neighbourhoods around the clinic, bringing healthcare closer to the people who need it. Using weather-resistant tents used in disaster relief [19], the tents will provide patients with essential vaccines, shortening the 1-3 hour triage waiting times at the primary care clinics [1]. The tent will be 15’ x 15’ x 8’ [19], and in the first phase of design, will be built for the 10% of clinics with the highest patient demand in the first phase of implementation. Based on the results of the pilot in reducing demand at primary clinics, it can be expanded to other primary clinics.

4.0 Implementation

4.1 Cost Benefit Analysis

Objectives of the design are to increase patient satisfaction with the healthcare system by increasing availability and quality of the treatments, as seen in Table 1. Furthermore, bringing certain treatments closer to patients through the mobile vaccination pilot program would be significantly convenient for local residents. By satisfying these objectives, patients would provide stronger satisfaction ratings with the treatment they receive.

Table 1. Tradeoff Table Between Cost and Benefits

Cost	**Benefit**
Salary	Improve staff retention
Software	Higher patient satisfaction due to material availability and preventing waste
Drone System	Rapid medical equipment and prescription delivery for shortages
Mobile Tents	Reduces congestion inside the clinic. Provide easier vaccination.
Warehouse	It will store all the medical inventory including vaccinations.

4.2 Implementation Costs for 10 Years

A budget of $4,693,470 is necessary to implement the solution over 10 years, as seen in Figure 3. More information can be found in Appendix A.

CATEGORY	Item	Base Cost	Quantity	Estimated Cost	COST
	Drone	$81,000	46	$3,726,000	
	Annual Maintenance Cost (10 yrs)	$16,200	40	$648,000	
	Drone Landing Pad for Primary Clinic	$60	454	$27,240	
DRONE					$4,401,240
	Mobile Tent	$1,230	45	$55,350	
MOBILE PILOT PROJECT					$55,350
	Monthly Rental (10 yrs)	$1,825	120	$219,000	
WAREHOUSE					$219,000
	Monthly Cost (10 yrs)	$149	120	$17,880	
ONLINE SYSTEM					$17,880
	Doctor	$5,002	54480	$272,508,960	
	Nurse	$1,634	54480	$89,020,320	
	Nurse Technician	$1,488	54480	$81,066,240	
	Community Health Agents	$1,488	326880	$486,397,440	
CLINIC SALARIES (EXISTING)					$928,992,960
SYSTEM IMPLEMENTATION COST FOR 10 YEARS (SALARY COST IS AN EXISTING COST BUT IS PROVIDED TO THE CLIENT FOR FURTHER INFO)					$4,693,470

Figure 3. Cost of System Implementation for 10 years.

4.3 Long-Term Sustainability and Contingencies

There will be quarterly audits to check medical supply counts due to the high value and strict expiration dates [26], increasing accuracy in the Sortly database by keeping up-to-date records of available supplies. Additionally, there will be a training program set to teach volunteers how to assist staff in tents at primary care clinics, covering health education [27]. Drones will receive maintenance checks every six months, similar to other designs [28]. Drone routes will be designed to account for regional elevation data, as shown in Figure 4 below. Drone failure is plausible, as shown with 2,300 Amazon drone crashes in 2021 [29], which can be addressed by improving maintenance and decreasing load weight.

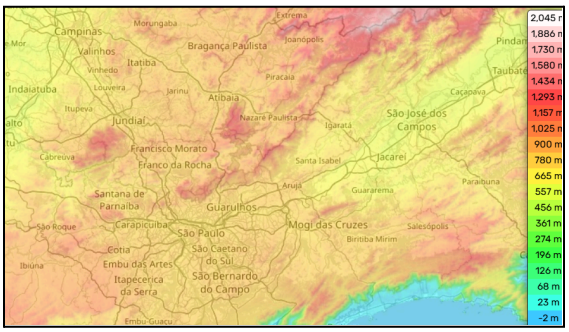

Figure 4. Elevation map of area serviced by organization.

4.4 Project Timeline

The Gantt chart in Figure 5 highlights the 1-year plan for implementing the fundamental systems of the design. More information can be found in Appendix B.

Gantt Chart

Task Name	Start Date	End Date	2026												2027
			1	2	3	4	5	6	7	8	9	10	11	12	1
Source Drones	1/10/2026	3/10/2026													
Deploy Drones	3/10/2026	5/10/2026													
Build Drone Facilities	5/10/2026	6/10/2026													
Warehouse Renting	1/10/2026	1/10/2027													
AI-Model Calibration	1/10/2026	3/10/2026													
Relief Tent Shipping	1/10/2026	2/10/2026													
Relief Tent Assembly/Implementation	2/10/2026	4/10/2026													
CHA Salary Increase	1/10/2026	1/10/2027													
Volunteering Program	1/10/2026	1/10/2027													

Figure 5. A Gantt chart highlighting the project's task timeline.

5.0 Conclusion

Implementation of the recommended plan will help Saúde Ribeirão 360 resolve staffing and supply issues. This will lead to better and more equitable health care for residents in the area.

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Appendix A: Implementation Budget for 10 Years

Existing salary payments are also provided to demonstrate the overall cost of managing the system. A medical drone suitable for the design costs $81,000 [19], and maintenance costs are 20% [20]. Drone landing pads would cost $60 per clinic [21]. A mobile tent would cost $1230 [18] and a warehouse rental costs $1825 monthly [22]. Deploying the online system would cost $149 a month [23]. Existing salary information is based on competitive salary rates identified in section 3.4, but is an existing cost and is not part of the system implementation price. As such, for 10 years, a budget of $4,693,470 is necessary.

Appendix B: Gantt Chart Plans

To address immediate accessibility, the design will implement AI inventory tracking and Medical Aid tents in a 2 month deployment process. Medical Aid tents would be shipped within a month, but assembling it and training staff to run mobile clinics will require an additional 2 months. 5 months is allocated to source, deploy, and establish necessary infrastructure to support drones. 2 months will be allocated to procure and obtain the necessary drones. Then, an additional 2 months is allocated for deploying and preparing the drone routes. Finally, establishing drone facilities such as launch pads would require an additional month. The drone, online mode, and relief tent process will run concurrently. Additionally, CHA salaries will be increased throughout the design to decrease turnover and a volunteering program will be established to help organize and maintain facilities and schedules. Long-term sustainability will be addressed with a 10-year plan to build on current designs through the increase of tents, drone services, and maintenance of current designs.