An Equitable Framework for Antiretroviral Therapy and COVID-19 Vaccine Allocation Strategies in Botswana

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Abstract

The HIV/AIDS epidemic and the COVID-19 pandemic have ruined many people's lives. Antiretroviral therapy (ART) has controlled the HIV/AIDS epidemic and COVID-19 vaccine is expected to ease confusion caused by the pandemic. However, the supply of health-resource falls far short of the demand in resource-constrained countries; thus, decision-making about resource allocation should be discussed. Botswana, as a resource-constrained country with a high prevalence of HIV, needs to construct its own framework for ART allocation. We propose an equitable framework for ART and COVID-19 vaccine allocation in Botswana based upon the egalitarian principle, which provides each individual has an equal chance of receiving them. We use a spatial mathematical model of treatment accessibility with an equity objective function, and sequential quadratic programming is used to address the nonlinear programming model. Considering Botswana's current health infrastructure, our strategy brings the most equal health outcomes. However, the disparity of accessibility still exists between rural and urban areas even from our equitable strategy. We present proposals that can increase the accessibility of rural areas using sensitivity analysis. Our work can be applied to different contexts, especially in sub-Saharan Africa.

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Contents

Chapter 1

Introduction

Human immunodeficiency virus (HIV) is a retrovirus that weakens the immune system as the disease progresses. Once HIV enters a human body, it finds the T cells responsible for one's immune system and attacks them. It continuously destroys the immune system, which eventually leads to death. This virus passes from person to person through body fluids, such as sexual contact, maternal-infant exposure or sharing needles [1]. HIV is classified into HIV-1 and HIV-2, and most cases are HIV-1 (95%). HIV-2 is relatively slower to develop and less infectious than HIV-1, and it is mainly distributed in a few parts of Africa. HIV infection can be divided into three stages: (i) acute HIV infection, (ii) chronic HIV infection and (iii) acquired immunodeficiency syndrome (AIDS). AIDS is the final stage of HIV infection and is considered when a person has the number of $CD4^+$ T cells count (the level of the virus in the body) less than 200 cells/mm^3 (there are 500 to 1,600 $CD4^+$ T cells count in a human body with a healthy immune system). It is important to diagnose people living with HIV early after being infected with the virus and treat them early since they can spread the virus to others without knowing their infection status. The epidemic of HIV/AIDS is considered one of the most severe global epidemics that has devastated lives and economies in several parts of the world.

According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), as of 2019, 75.7 million people have become infected with HIV, and 32.7 million people have died from AIDS-related illness since the first case of HIV reported in 1981. The severity of the HIV/AIDS epidemic varies from region to region and is greatest in Africa. Among African countries, sub-Saharan African countries have been more severely affected by HIV than West and Central Africa [2]. Sub-Saharan

Africa accounts for 61% of all new HIV infections according to the UNAIDS; thus, it is not surprising that AIDS is a major cause of mortality in the region. The most crucial reason for the high prevalence of HIV in the region lies in sexual behavior patterns influenced by cultural and socioeconomic factors; low power of women, poverty, rapid urbanization and frequent wars and conflicts within the continent [2]. Since HIV weakens patients' immune system and makes them vulnerable to other infections and diseases, treating HIV-infected patients and preventing people from getting newly infected by HIV has become one of the most important public-health tasks in the world.

Antiretroviral therapy (ART) has begun since the mid-1990s to treat HIV infection. It can suppress HIV and increase $CD4^+$ T cells count in a human body. There is no viable vaccine or cure for HIV, but it is possible to maintain the immune system when people living with HIV are on ART. ART has been used to control the HIV/AIDS epidemic, which has greatly reduced the mortality of AIDS-related illnesses. It has not only decreased overall mortality but also had a crucial role in life-saving treatment, allowing people living with HIV survive longer and to return to healthier lives. However, in resource-constrained countries, particularly in sub-Saharan Africa, demand for ART continues to be greater than supply, due to an insufficient amount of ART, and it has led to new HIV infections exceeding the amount of those added onto ART in the continent [3]. Accordingly, the importance of the fair and rational distribution of limited ART between and within resource-limited settings has begun to be recognized.

Botswana has one of the highest per capita HIV prevalences in the world, with an estimated adult population (aged 15–49) HIV prevalence of 20.7% in 2019 [4]. Although Botswana has a relatively developed health infrastructure compared to other sub-Saharan African region, the HIV/AIDS epidemic has had a tremendous impact on all aspects of its society, not only the healthcare sector [5]. Since the 2000s, the government of Botswana has been actively responding to the national crisis of the epidemic. In 2000, Botswana established a public-private partnership with the African Comprehensive HIV/AIDS Partnerships (ACHAP), the Bill & Melinda Gates foundation and the Merck Company Foundation to make ART available throughout the country [6]. In 2002, Botswana launched Africa's first national ART program, "Masa" (meaning 'new dawn' in Setswana, implying hope), which provides universal free ART to all HIV-infected citizens using a criterion $CD4^+$ T cells count of 200 cells/mm^3 or less. The eligibility for the program has been revised over several stages; and now, under the "Treat All" strategy in effect in 2016, every HIV-positive citizen can get free treatment, regardless of their $CD4^+$ T cells count. The effect of the provision of free ART to the public has spread throughout Botswana; a high rate of ART uptake, decreased new infections and declined AIDS-related deaths [7]. However, despite the efforts of the government and the success of the national ART program, Botswana still has high HIV prevalence and has a high rate of new infections [8]. Moreover, the

sustainability of the nation's response to the HIV/AIDS epidemic remains an issue of great concern, since funding from external sources has been reduced in recent years. Thus, it is more important than ever to establish its own system of how to allocate the scarce amount of ART.

Resource-allocation policies are complex as they are determined by different epidemiological, ethical or preferential treatment-priority criteria [9]. The World Health Organization (WHO) and UNAIDS have suggested several ethical principles that should be considered when allocating ART fairly: (i) the formal principle of equity: non-discrimination in the right to health, (ii) the utilitarian principle: maximizing health benefits for the society as a whole, (iii) the egalitarian principle of equity: distributing resources equally among different groups and (iv) the Maximin principle: giving preference to those who are worst off in some relevant respect [10]. In this study, we suggest a new ART rollout plan in Botswana, and compare it with other plans that satisfy the egalitarian principle, assuring that all people living with HIV have equitable access to ART. Our work shows which of the plans brings equal utilization of healthcare services for different groups of people in Botswana. Policies based on the egalitarian principle make all people living with HIV have equitable access to ART-dispensing healthcare facilities (HCFs). The reason why it is important to make equitable treatment accessibility is that distance to HCFs acts as a significant factor in whether patients can be on the treatment or not [11,12,13]. Distance mostly causes poor ART-programme outcomes, such as HIV testing, timely ART initiation and consistent drug adherence [14, 15], and the same situation has been found in Botswana [16].

Along with the work on ART allocation, we extend our results in order to address a strategy for the allocation of vaccines for coronavirus disease 2019 (COVID-19). COVID-19, caused by the coronavirus disease (SARS-CoV-2), is a respiratory infection that first occurred at the end of 2019 in China and has spread worldwide. SARS-CoV-2 is an RNA virus that causes respiratory diseases and spreads between people. It is transmitted when droplets of an infected person pass to the respiratory tract of others. If infected, it can cause minor symptoms, some develop serious illness, and, in severe cases, death can occur. While the HIV/AIDS epidemic appears prominent in several areas, the COVID-19 pandemic has affected lives, social and national systems, with no exception in any part of the world.

Accordingly, research on the development of COVID-19 treatments and vaccines is actively underway and the distribution of vaccines is expected to put an end to the pandemic. Vaccines released so far (AstraZeneca, Janssen, Moderna, Pfizer etc.) are anticipated to be distributed during 2021 in most countries to make people become immune to the virus enough to develop herd immunity. However, the phenomenon that the supply of health-resource does not keep up with demand will occur in the distribution of COVID-19 vaccine. Furthermore, there is a "vaccine nationalism" phenomenon in which economically stable countries monopolize large quantities of

vaccines, causing other countries to lose the opportunity to receive them. Thus, securing vaccines with stable supply in economically vulnerable regions will be a challenge in the COVID-19 era.

In Botswana, the total number of COVID-19-confirmed cases and deaths is 18,630 and 88, respectively at the time of analysis (January 15, 2021), lower than in neighboring countries (South Africa, Namibia, Zambia, Zimbabwe) [17]. However, similar to other countries in the sub-Saharan African region, Botswana lacks sufficient medical resources, such as testing kits, personal-protective equipment, intensive-care beds, medicines, ventilators and trained medical staff who can respond to the outbreak of COVID-19 [18]. Moreover, the high prevalence of HIV and increasing rates of non-communicable diseases are adding more burden on the health system in Botswana. Given these conditions, the best possible way to safely resolve problems is to prepare the nation with a rapid and efficient vaccine-allocation plan.

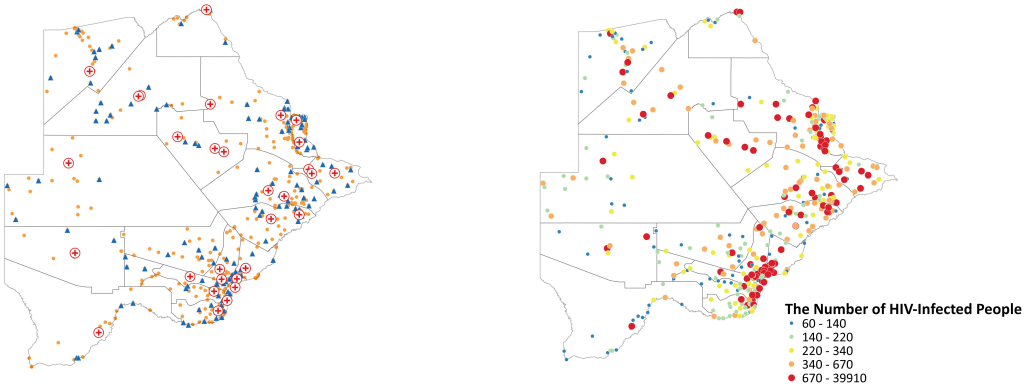
Since equity in access to health resources is often impractical and sometimes is even unreachable [19], we address a reachable goal: how to distribute ART and COVID-19 vaccines to minimize disparities in treatment accessibility. We propose an equitable framework for ART and COVID-19 vaccine allocation using a spatial mathematical model of treatment accessibility that applies an equity objective function. We suggest a strategy that gives each individual an equal chance of receiving treatment or vaccination according to the equitable framework. We also discuss a gap in treatment accessibility between regions, which is due to the impracticality of the perfect equity of accessibility, and solutions that could be utilized in other resource-limited settings.

Chapter 2

The Framework for ART Allocation in Botswana

2.1 The ART rollout plan

As a part of the Masa programme, a general plan for ART rollout in Botswana focusing on designated ART sites in the 26 health districts has been in place since the beginning of 2002. The purpose of the programme is to provide free ART to people living with HIV through government-run healthcare facilities. Free ART is provided by primary, district and referral hospitals, as well as satellite clinics that support the hospitals. Since only 6.4% of HIV-infected people are eligible for non-free ART provided by the private sector, with most living in urban areas [20], we exclude private facilities, even though they contribute to some extent to Botswana's healthcare services [21]. We thus focus on 30 public hospitals and 203 clinics where location information can be obtained. The hospital lists are drawn from the Ministry of Health and Wellness (MoHW) database [21] and shown in Table 2.1. We use data on the amount of ART obtained from the MoHW Monitoring and Evaluation Unit [21] and 73.7% of HIV-infected people were treated in 2017. Figure 2.1.(a) illustrates a map of Botswana, indicating health districts and the location of communities and HCFs.



(a) (b)

Figure 2.1. (a) The locations of community and public ART sites in Botswana are indicated with health districts. The red hospital mark and the blue triangle indicate public ART-dispensing hospitals and clinics, respectively. The communities are indicated with orange circle. (b) The number of HIV-infected people are indicated in both size and color in the map of Botswana.

2.2 People living with HIV and HIV prevalence

We use health districts as our baseline unit of analysis. HIV patterns vary from district to district, so the geographical research unit results in an effective treatment-allocation policy in a resource-limited setting [22, 23]. The difference between districts with the highest and lowest prevalence rate is 16.4% [24], suggesting that HIV-incidence patterns between districts are significantly different. To measure the demand for ART, we consider all 26 health districts with 419 communities (cities, towns, urban villages and rural districts) of more than 500 people across Botswana. According to the Statistics Botswana's functional definition, urban area is a locality with a minimum population of 5,000. We use data from the 2017 Botswana Demographic Survey [25], which was updated from the 2011 Population and Housing Census conducted by Statistics Botswana [21]. The 2017 census only provides district level information, unlike the 2011 census, which provides community level information, so we estimate the population of communities in 2017 by applying the change in population between 2011 and 2017 at the district level.

Statistics Botswana, National AIDS Coordinating Agency (NACA) and the Ministry of Health (MoH) jointly conducted the Botswana AIDS Impact Survey (BAIS), providing HIV/AIDS-related information at the national, district and sub-district levels. Four surveys have been carried out so far, and we use the HIV prevalence by district from the most recent survey, 2013 BAIS IV [24], to estimate the number of HIV-positive people living in Botswana in 2017. Even though the prevalence year

(2013) and the population year (2017) do not match, we use the 2013 prevalence since HIV prevalence in Botswana has remained relatively stable [21, 26]. Figure 2.1.(b) illustrates the estimated number of HIV-infected people in each community.

2.3 The mathematical model of treatment accessibility

To distribute treatment, a patient's effective demand for treatment, which also can be interpreted as one's treatment access to health services, should be prioritized. This is because not all HIV-infected people have demand for treatment, as spatial factors (e.g., geographic location, travel distance or time) and non-spatial factors (e.g., socioeconomic status, disease status, demographic factors) affect whether or not a patient has an willingness to get healthcare services. Since we consider geographical equitable treatment access to HCFs, we assume that only spatial factors have an impact on one's access. We determine treatment accessibility in terms of the number of HIV-infected people that live in the catchment area of the HCF and have access. Since the degree of accessibility depends on how well the medical and road infrastructure are expanded in the community where patients reside, it is presumed that people are heterogeneous in their spatial accessibility by which community they live.

We set a catchment area around each HCF accounting for how many of the HIV-infected people are willing to visit the facility and how much access will be provided. The 90-minute driving time catchment area is used, divided into 15, 30 and 60-minute sub-zones. The reason for doing so stems from the fact that 96% of Botswana communities have ART sites within 90 minutes. Figure 2.2 shows that about 37% and 87% of the communities have the closest HCF within 10 and 60minutes' drive, respectively. The division of the catchment area into the sub-zones reflects that each of them has a different level of spatial accessibility, while patients living outside a 90-minute catchment area are considered inaccessible and receive a zero weight. We assume that HIV-infected people in Botswana would only visit the one closest HCF.

Spatial access to healthcare is commonly referred to as potential spatial access, which depends on three key factors: supply of health services, a patient's demand for the services and a patient's travel cost [27]. In general, a patient's demand relative to supply in the treatment is called availability and the travel cost a patient has to the service is proximity [28, 29]. Specifying potential spatial accessibility have been developed in various ways. The provider-to-population ratio was used as the simplest way; however, it does not measure travel distance or time. The kernel density model and the gravity model have been put forward to compensate for its limitations and explain potential spatial access to medical services regarding travel cost. We use the gravity model, as the kernel density model does not fully account for the factors, availability and proximity, that influence potential spatial accessibility and the gravity

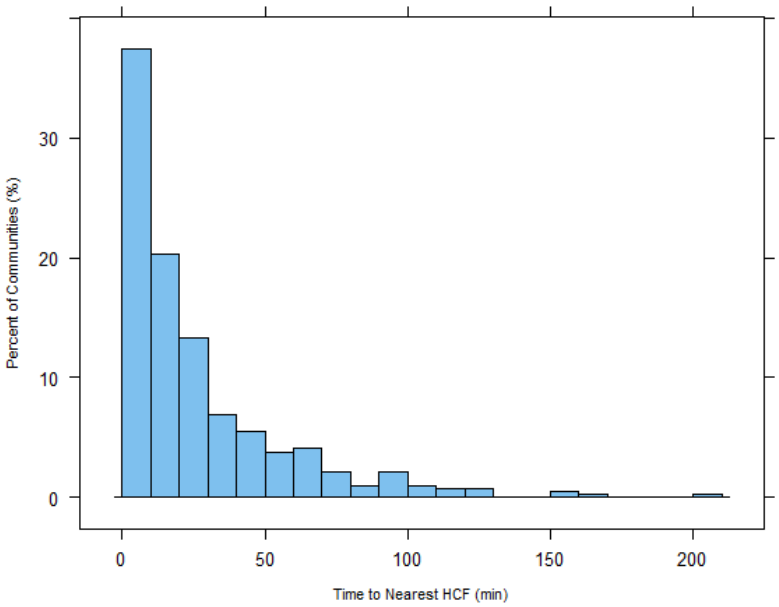


Figure 2.2. A histogram implies heterogeneity in access to the nearest ART sites (clinics are included) between each community in Botswana. Botswana has relatively high treatment accessibility in comparison to other sub-Saharan African countries; most communities have their nearest ART site within 100-minute driving time.

model is more reliable in this regard [30,31]. The gravity model is designed to calculate the spatial access based on Newton's Law of Gravitation [29]. The effective demand that community i ($i = 1, 2, \cdots, n$) has on HCF j ($j = 1, 2, \cdots, m$) in the gravity model is estimated as

$$D_{ij} = f(t_{ij})I_i, \tag{2.3.1}$$

where $f(t_{ij})$ is the treatment accessibility function and I_i is the number of infected people in community i. The treatment accessibility function, $f(t_{ij})$, is constructed in such a manner that a person's treatment accessibility to a facility is inversely proportional to the travel impedance (e.g., travel distance, travel time or transport cost) [32, 33]. The inverse power function, the negative exponential function and the Gaussian function are broadly used in determining treatment accessibility in the gravity model. We use the Gaussian function to indicate the travel impedance effect, since it tends not to decay as rapidly as other models toward zero at a great distance [34]. Treatment accessibility with the Gaussian function is modeled as

$$f(t_{ij}) = \exp\left(-\frac{1}{\beta}{t_{ij}}^2\right), \tag{2.3.2}$$

where t_{ij} is the driving time between community i and HCF j and β is the impedance coefficient implying the extent of travel time, which influences one's willingness to take ART. The value of β set so that the treatment accessibility of the last sub-zone of catchment area is 1% as proposed by Kwan [35]. In our analysis, the β value of 1,759 corresponds to the Gaussian value of 0.01 to the outermost sub-zone (i.e., 90 minutes driving time). The treatment accessibility from the innermost to outermost sub-zone is 0.8799, 0.5995, 0.1292 and 0.01.

The effective demand on HCF j is estimated as summing the inverse distance weighting function of all communities surrounding the facility,

$$D_j = \sum_{i=1}^{n} \exp\left(-\frac{1}{\beta}{t_{ij}}^2\right) I_i \tag{2.3.3}$$

We use travel time rather than distance as the travel cost, because it improves the accuracy by taking into account topographic features. According to the Botswana Department of Surveys and Mapping (2019), people in Botswana use road transportation as their primary means of travel [21]. Therefore, we assume that people living with HIV in Botswana use a car, taxi or public transportation to access medical facilities. Location data obtained from websites, including Google Maps, Medpages, Bing Maps and Maps.ie, were used to calculate the driving time between the community and the facility in QGIS software (version 3.10). The software calculates the shortest driving time between locations.

2.4 The mathematical model of ART allocation

We model the ART-allocation strategies at the hospital level. This is due to the fact that the current distribution of ART in Botswana takes place first at the hospital level and is subsequently distributed from each hospital to its supporting clinics. We determine how the total amount of ART should be given to each hospital and how the hospital distributes ART to the surrounding communities according to its effective demand. The ART allocation from HCF j to communities within the catchment area is determined by the ratio of the effective demand of those communities for HCF j as

$$\frac{f(t_{1j})I_1}{D_j} : \frac{f(t_{2j})I_2}{D_j} : \cdots : \frac{f(t_{nj})I_n}{D_j}, \tag{2.4.1}$$

and the treatment demand for a clinic is included in the demand for its parent hospital. Then the total number of treated people in community i is

$$T_i = S_j \frac{f(t_{ij})I_i}{D_j} = S_j R_{ij} \tag{2.4.2}$$

where S_j is the amount of ART allocated to HCF j.

It is practically impossible for all communities to have equitable treatment accessibility [19]. However, we can minimize the inequality of treatment by minimizing the following objective function suggested by Wilson and Blower [9]:

$$\min\ F(S_1, ..., S_m) = \sum_{i=1}^{n} \left(\frac{T_i}{I_i} - \frac{R}{\sum_{k=1}^{n} I_k} \right)^2, \tag{2.4.3}$$

where R is the total available ARV regimen and $\sum_{k=1}^{n} I_k$ is the total number of HIV-infected people in Botswana. The function is an expression of minimizing the variance of the accessibility index across all communities by redistributing ART among HCFs [19, 36, 37].

The constraints are similar in spirit to that presented by Wilson and Blower [9], but they are modified and extended to suit the circumstances in Botswana. There are three constraints on the function: (i) every HCF must have at least one ART, implying that no HCF is excluded from the distribution policies, (ii) the sum of supplies from each HCF must equal the total ART amount in Botswana, allowing the strategies to make maximum use of the given supply amount and (iii) the number of treated people in each community cannot be greater than the effective demand that

community has, suggesting that all strategies should have one-to-one allocation. If the ART amount exceeds the effective demand, it violates the purpose of finding an equitable distribution strategy in a resource-constrained country. All the constraints are as follows:

$$S_j \geq 0, \quad j = 1, \cdots, m, \tag{2.4.4}$$

$$\sum_{j=1}^{m} S_j = R, \tag{2.4.5}$$

$$T_i \leq D_{ij}, \quad i = 1, \cdots, n, \;\; j = 1, \cdots, m. \tag{2.4.6}$$

We suggest three strategies that minimize the objective function with nonlinear programming (NLP). NLP is a general optimization problem for a nonlinear objective with nonlinear constraints [38]. We compare these strategies with two other strategies: (a) the current rollout strategy by the government of Botswana in 2017 and (b) distributing an equal amount of ART to all hospitals. Our three strategies with NLP consist of (c) a general strategy with no guaranteed amount of ART in any community, (d) the city with the best healthcare infrastructure (Gaborone city) has ART equal to its effective demand and (e) two cities with the best healthcare infrastructure (Gaborone and Francistown city) are guaranteed ART equal to their effective demand. The sequential quadratic programming (SQP) method, an iterative method for constrained nonlinear optimization problems, is implemented to find the solution to our nonlinear optimization problem.

2.5 Sequential Quadratic Programming

In nonlinearly constrained optimization problems, SQP is one of the most successful methods, with high efficiency and accuracy. This section is a summary of papers and books [39,40,41], and we describe theoretical underpinnings of SQP and its algorithm.

2.5.1 The framework of SQP

Consider an NLP of the form

$$\min_{x} f(x) \tag{2.5.1}$$

$$\text{s.t.} \quad h(x) = 0 \tag{2.5.2}$$

$$g(x) \leq 0. \tag{2.5.3}$$

SQP models the NLP for a given iterate x^k using a Quadratic Programming (QP) subproblem. The solution of the QP subproblem is used to build a new iterate x^{k+1}.

This construction is performed in such a way that the sequence of approximation converges to a local minimum of NLP, x^*. In this manner, the method of SQP, with an appropriate choice of QP subproblem, can be regarded as the natural extension of Newton and quasi-Newton methods to the constrained optimization problems.

2.5.2 Assumptions and notation

We describe assumptions and notation that are essential to implementing SQP. The blanket assumption of the method is that the functions f, h and g are three times continuously differentiable. The Hessian of a scalar-valued function, denoted by $Hf(x)$, is given by

$$Hf(x)_{ij} = \frac{\partial^2 f(x)}{\partial x_i \partial x_j}, \quad 1 \leq i, j \leq n. \tag{2.5.4}$$

An essential function in constrained optimization settings is the Lagrangian function, defined as

$$\mathcal{L}(x, \lambda, \mu) = f(x) + \lambda^T h(x) + \mu^T g(x), \tag{2.5.5}$$

where λ and μ are Lagrangian multiplier vectors. For x, the index set

$$A(x) = \{i : g_i(x) = 0\}$$

is referred to as the set of active constraints at x consisting of the inequality constraints. $G(x)$, consisting of $\nabla h(x)$ along with the columns $\nabla g_i(x)$, is defined as

$$G(x) = (\nabla h_1(x), \nabla h_2(x), \cdots, \nabla h_m(x), \nabla g_{i1}(x), \nabla g_{i2}(x), \cdots, \nabla g_{iqx}(x)),$$

and it plays an important role in explaining the assumptions and the analyses of SQP. Assuming that $G(x)$ has full column rank, the null space of $G(x)^T$ defines the tangent space to the equality and has active inequality constraints at x. The projection onto this tangent space can be written as

$$\mathcal{P}(x) = I - G(x)\Big(G(x)^T G(x)\Big)^{-1} G(x)^T.$$

The corresponding projection onto the range space of $G(x)$ is writte-

$$\mathcal{Q}(x) = I - \mathcal{P}(x).$$

These projections evaluated at iterates x^k and at a solution x^* will be denoted by $\mathcal{P}^k$, $\mathcal{P}^*$, $\mathcal{Q}^k$ and $\mathcal{Q}^*$. Similarly, we will write

$$H\mathcal{L} = H\mathcal{L}(x^*, \lambda^*, \mu^*)$$

throughout the remainder of the section.

Let x^* be a local minimum of the NLP in this section. The following conditions are called the *strong second-order sufficient conditions*, which ensure that x^* is an isolated local minimum of NLP and that the optimal Lagrangian multipliers λ^* and μ^* are unique.

A1. The first-order necessary conditions hold; i.e., there exist Lagrange multipliers λ^* and μ^* such that

$$\nabla\mathcal{L}(x, \lambda^*, \mu^*) = \nabla f(x^*) + \nabla h(x^*)\lambda^* + \nabla g(x^*)\mu^* = 0. \tag{2.5.6}$$

A2. The columns of $G(x^*)$ are linearly independent.

A3. Strict complementary slackness holds at x^*; i.e.,

$$g_i(x^*)\mu_i^* = 0, \quad 1 \le i \le p, \tag{2.5.7}$$
$$\mu_i^* > 0, \quad i \in A(x^*). \tag{2.5.8}$$

A4. The Hessian of the Lagrangian with respect to x is positive definite on the null space of $G(x^*)^T$; i.e.,

$$d^T H\mathcal{L}^* d > 0$$

for all $d \neq 0$ such that $G(x^*)^T d = 0$.

Note that a feasible point x that satisfies (A1) is called a *critical point* of the NLP, and it may or may not be a local minimum.

2.5.3 Convergence of SQP

There are three standard measures of convergence rates in SQP algorithms.

Definition 2.5.1. Let x^k be a sequence of iterates converging to x^*. The sequence is said to converge

- *linearly* if there exists a positive constant $\xi < 1$ such that

$$\|x^{k+1} - x^*\| \le \xi\|x^k - x^*\| \tag{2.5.9}$$

for all k sufficiently large

- *superlinearly* if there exists a sequence of positive constants $\xi_k \to 0$ such that

$$\|x^{k+1} - x^*\| \leq \xi_k \|x^k - x^*\| \tag{2.5.10}$$

  for all k sufficiently large

- *quadratically* if there exists a positive constant ξ such that

$$\|x^{k+1} - x^*\| \leq \xi \|x^k - x^*\|^2 \tag{2.5.11}$$

  for all k sufficiently large.

2.5.4 The QP subproblem

The SQP method is an iterative method that solves a QP subproblem in the current iteration x^k to obtain new information to the next iteration. The QP subproblem is a problem with a quadratic objective function and nonlinear constraints, which keeps the nonlinearities of the original problem but enables the problem to be solved relatively easily. The benefit of using the QP subproblem is that the resulting algorithm has good local convergence properties, as the objective function in the QP provides identical iterations to those provided by Newton's method. The idea of QP subproblem replaces the

- objective functional f by its local quadratic approximation

$$f(x) \approx f(x^k) + \nabla f(x^k)(x - x^k) + \tfrac{1}{2}(x - x^k)^T Hf(x^k)(x - x^k),$$

- constraint functions h and g by their local affine approximations

$$\begin{aligned} h(x) &\approx h(x) + \nabla h(x^k)(x - x^k) \\ g(x) &\approx g(x) + \nabla g(x^k)(x - x^k). \end{aligned}$$

Thus, the QP subproblem will have the form

$$\min_{d(x)} \nabla f(x^k)^T d(x) + \frac{1}{2} d(x)^T B_k d(x) \tag{2.5.12}$$

$$\text{s.t.} \quad \nabla h(x^k) + h(x^k)^T d(x) = 0 \tag{2.5.13}$$

$$\nabla g(x^k) + g(x^k)^T d(x) \leq 0, \tag{2.5.14}$$

where $d(x) = x - x^k$ and $B_k = Hf(x^k)$. Since the QP (2.5.12)–(2.5.14) is related to a local quadratic model of the Lagrangian as the objective functional, the quadratic Taylor series approximation in x for the Lagrangian is defined as

$$\mathcal{L}(x^k, \lambda^k, \mu^k) + \nabla\mathcal{L}(x^k, \lambda^k, \mu^k)^T d(x) + \frac{1}{2} d(x)^T H\mathcal{L}(x^k, \lambda^k, \mu^k) d(x).$$

Thus, the QP subproblem can be written as

$$\min_{d(x)} \nabla\mathcal{L}(x^k, \lambda^k, \mu^k)^T d(x) + \frac{1}{2} d(x)^T H\mathcal{L}(x^k, \lambda^k, \mu^k) d(x) \tag{2.5.15}$$

$$\text{s.t.} \quad \nabla h(x^k) + h(x^k)^T d(x) = 0 \tag{2.5.16}$$

$$\nabla g(x^k) + g(x^k)^T d(x) \leq 0. \tag{2.5.17}$$

When x^* is justified as a local minimum with the conditions (A1)–(A4), the QP subprolem can be defined as

$$\min_x \mathcal{L}(x, \lambda^*, \mu^*) \tag{2.5.18}$$

$$\text{s.t.} \quad h(x) = 0 \tag{2.5.19}$$

$$g(x) \leq 0. \tag{2.5.20}$$

Let B_k be an approximation of $H\mathcal{L}(x^k, \lambda^k, \mu^k)$. Then the QP subproblem will be

$$\min_{d(x)} \nabla\mathcal{L}(x^k, \lambda^k, \mu^k)^T d(x) + \frac{1}{2} d(x)^T B_k d(x) \tag{2.5.21}$$

$$\text{s.t.} \quad \nabla h(x^k) + h(x^k)^T d(x) = 0 \tag{2.5.22}$$

$$\nabla g(x^k) + g(x^k)^T d(x) \leq 0. \tag{2.5.23}$$

Taking a step from x^k in the direction of $d(x)$, the solution $d(x)$ of the QP subproblem can be used to produce a new iterate x^{k+1}. We need new estimates for the multipliers to proceed to the next iteration, and the optimal multipliers of the QP subproblem can be used as the new estimates. Let the optimal multipliers of the QP subproblem be denoted by λ_{qp} and μ_{qp}. Setting

$$d_\lambda = \lambda_{qp} - \lambda^k$$
$$d_\mu = \mu_{qp} - \mu^k$$

allows the updates of (x, λ, μ) to be written in the compact form

$$x^{k+1} = x^k + \alpha d_x$$
$$\lambda^{k+1} = \lambda^k + \alpha d_\lambda$$
$$\mu^{k+1} = \mu^k + \alpha d_\mu$$

for some selection of the *steplength parameter* α. When the new iterations are processed, the problem functions and derivatives are evaluated, and a choice of B_{k+1} is calculated.

2.5.5 The basic algorithm of SQP

In an SQP algorithm, the QP subproblem must have a solution in order to produce steps in the algorithm. Thus, the system of constraints of QP subproblem must have a nonempty feasible set, and the quadratic objective function should be bounded below on that set. If the QP subproblem is guaranteed to have a solution, then the sequences generated by the algorithm must converge. Convergence properties are classified as local and global. Local convergence theorems are based on Newton's method. The process starts from the assumption that the initial x-iterate is close to a solution x^* and the initial Hessian approximation is close to $H\mathcal{L}^*$. Global convergence begins from a remote starting point; its theorems are thus based on descent. A merit function ϕ — a measure of progress — whose reduction means progress towards a solution, must be included in the SQP algorihm to assure global convergence. Therefore, the basic SQP algorithm is as follows: given approximations (x^0, λ^0, μ^0), B_0 and a merit function ϕ, set $k = 0$.

1. Form and solve the QP subproblem to obtain (d_x, d_λ, d_μ).
2. Choose steplength α so that
$$\phi(x^k + \alpha d_x) < \phi(x^k).$$
3. Set
$$\begin{aligned} x^{k+1} &= x^k + \alpha d_x \\ \lambda^{k+1} &= \lambda^k + \alpha d_\lambda \\ \mu^{k+1} &= \mu^k + \alpha d_\mu. \end{aligned}$$
4. Stop if converged.
5. Compute B_{k+1}.
6. Set $k = k + 1$; go to 1.

Table 2.1. ART and COVID-19 vaccine-dispensing hospitals in Botswana

HCF no.	Hospital Name	District
HCF 01	Bamalete Lutheren	South East
HCF 02	Bobonong	Central-Bobonong
HCF 03	Deborah Retief Memorial	Kgatleng
HCF 04	Ghanzi	Ghanzi
HCF 05	Goodhope	Central-Barolong
HCF 06	Gumare	Ngamiland West
HCF 07	Gweta	Central-Tutume
HCF 08	Hukuntsi	Kgalagadi North
HCF 09	Jwaneng Mine	Jwaneng
HCF 10	Kasane	Chobe
HCF 11	Letlhakane	Central-Boteti
HCF 12	Letsholathebe II Memorial	Ngamiland East
HCF 13	Lobatse-Atholone	Lobatse
HCF 14	Mahalapye	Central-Mahalapye
HCF 15	Masunga	North East
HCF 16	Maun	Ngamiland East
HCF 17	Mmadinare	Central-Bobonong
HCF 18	Nyangabgwe Referral	Francistown
HCF 19	Orapa Mine	Orapa
HCF 20	Palapye	Serowe/Palapye
HCF 21	Princess Marina	Gaborone
HCF 22	Rakops	Centra -Boteti
HCF 23	Scottish Livingstone	Kweneng East/West
HCF 24	SDA Kanye	Ngwaketse
HCF 25	Sefhare	Central-Mahalapye
HCF 26	Sekgoma Memorial	Serowe/Palapye
HCF 27	Selebi-Phikwe Government	Selebi-Phikwe
HCF 28	Thamaga	Kweneng East
HCF 29	Tsabong	Kgalagadi South
HCF 30	Tutume	Central-Tutume

Chapter 3

The Framework for COVID-19 Vaccine Allocation in Botswana

3.1 The COVID-19 vaccine-rollout plan

Botswana, as a self-financing country (a nation that finances the vaccines from their budgets), has recently reached an agreement with COVID-19 Vaccine Global Access (COVAX) facility to obtain COVID-19 vaccines, securing vaccines for 20% of the nation's population. COVAX is co-led by Gavi, the Coalition for Epidemic Preparedness Innovations (CEPI) and the WHO. It aims to ensure equitable access to safe and effective vaccines for all nations as soon as the vaccines are available. The 20% figure is the initial floor allotment determined by the WHO [42], which is expected to be enough to cover the most medically vulnerable groups. Nothing has been decided yet regarding a plan for future COVID-19 vaccine rollout in Botswana. However, making an equitable framework for COVID-19 vaccine allocation before its rollout is urgently needed, as we only have a limited vaccine supply for 20% of the population at the first batch. To establish the COVID-19 vaccine-allocation plan, we identify which groups of people shoud get the first batch of vaccine given by COVAX and how to allocate the vaccine equitably in Botswana.

3.2 Vaccine priority groups

Distinguishing between groups at high risk of infection or severe symptoms from groups least at risk is challenging, because making decisions on the priorities of vaccination for a pandemic can cause controversial issues [43]. The WHO has suggested guidance on global COVID-19 vaccine allocation, "Fair Allocation Mechanism for COVID-19 Vaccine", specifying groups that should be prioritized. The guidance is a population-based distribution, consisting of two phases. In Phase I, countries will receive vaccines equivalent to 20% of their population and the first 3% of them will be given to healthcare workers. A population-proportional allocation is completed when 20% of population has vaccinated and additional volumes will be distributed to cover more of the population in Phase II [42]. The WHO states that Tier 1 vaccination in Phase I could include the following target groups to reduce mortality and protect healthcare system: i) frontline workers in healthcare settings, ii) people over the age of 65 and iii) people under the age of 65 who have underlying conditions that put them at risk of serious infection. To determine Botswana's COVID-19 vaccine-allocation target groups and strategy, we follow the guidance in the context of current circumstances in Botswana, since the size of the target groups across countries varies. The government of Botswana states that healthcare workers, people who have underlying conditions and those over 60 years old have a higher risk of developing severe disease and death from COVID-19 [17].

The WHO's guideline suggests the first 3% of vaccine shall be allocated to healthcare workers. However, healthcare workers in Botswana constitute only a small minority, accounting for roughly 1% of its population; three-quarters of them are in urban areas and a quarter are in rural areas [44]. When applied to the estimated population in Botswana in 2020, about 0.61% of the population are medical staff, far below the WHO recommendation [18]. Thus, the remainder of the vaccine (about 2.4%) can be allocated to the senior populations with underlying conditions. Individuals older than 65 years are defined as the elderly in our research, since the census provides information about people aged 65, not 60.

3.2.1 Co-morbidities affecting prognosis of COVID-19

Since relevant co-morbid conditions affecting high risk of severe disease or death from COVID-19 vary by country [45,46], which underlying conditions should constitute the next priority group after the elderly with underlying conditions, is bound to differ from country to country [47]. In general, cardiovascular diseases, chronic kidney diseases, chronic respiratory diseases and diabetes are considered to increase the risk of COVID-19 complications [45]. However, it is hard to affirm which diseases will worsen the prognosis of COVID-19 infection in sub-Saharan Africa because of the lack of information. According to the WHO, asthma, cardiovascular disease, diabetes

and hypertension are the most significant pre-existing diseases that can put people at a risk of more serious COVID-19 infection in the African region [48].

Diabetes, cardiovascular diseases and hypertension are known to make the prognosis of COVID-19 2–3 times worse and the mortality rate of COVID-19 patients with these co-morbidities is significantly higher than that of patients who do not have these diseases [49]. The relationship between SARS-CoV-2 and the underlying health issues in Botswana is yet to be known. However, as the prevalence of non-communicable diseases in Botswana has been increasing, we briefly examine whether they act as risk factors that might exacerbate the prognosis of COVID-19 patients.

Diabetes is linked to a higher risk of developing disease from COVID-19 worldwide [50, 51] and about 20% of COVID-19 deaths in Africa occurred among diabetic patients [52]. In Botswana, diabetes has also become one of the most serious public-health problems because of social and demographic changes [53]. However, the real concern is that uptake of statin (one of the treatments), which can decrease the incidence of heart disease and the corresponding mortality in patients with Type 2 diabetes [54], is low considering the burden of the disease.

Hypertension is a common pre-existing disease that COVID-19-infected patients have and it has a serious impact on patients' condition. Hypertension is one of the emerging non-communicable diseases in sub-Saharan Africa and low levels of hypertension control is an area of concern, as with diabetes [55]. In fact, 45% of people in Botswana who have been diagnosed with hypertension are not being treated [56].

Cardiovascular diseases are another cause for the extreme burden of COVID-19 [57, 58]. This may become more of an issue in Botswana, since cardiovascular diseases cause 18% of mortality, 1.8 times higher than that of other non-communicable diseases [59]. Furthermore, the death rate of cardiovascular diseases is the second highest after HIV/AIDS [59]. As high blood pressure and diabetes can produce some heart disorders, failure to properly treat them might put people at significant risk for severe illness and death from COVID-19.

We can expect that those diseases worsen the burden of COVID-19 in Botswana because of the increased risk of the diseases and the suboptimal control of them. Therefore, healthcare workers, the older with co-morbities and people with these underlying conditions should be vaccinated at the first batch of vaccine.

3.2.2 Asthma and HIV/AIDS as co-morbidities affecting prognosis of COVID-19

Studies in non-African countries have shown that asthma has no significant effect on COVID-19 patients [60]. However, according to the WHO, asthma has a negative impact on COVID-19 patients in Africa. There is still debate about how asthma affects the incidence and symptoms of COVID-19 and it is presumed that the reason for different patterns in different regions is due to genetic factors [61]. According to a

recent cohort study, conducted on COVID-19-infected patients in the United States, African Americans were disproportionately higher in the asthma group compared with the non-asthma group [62]. Other study shows that patients with non-Type 2 asthma (severe asthma can be divided into two main categories; Type 2 inflammation and non-Type 2 inflammation [63]) are at a higher risk for severe COVID-19 symptoms [64]. It has not been discussed whether non-Type 2 asthma has an impact on heightened risk of infection or prognosis of COVID-19 in the African region. However, we need to regard asthma as one of the underlying conditions in Botswana, since African Americans are more likely to have non-Type 2 asthma than other ethnic groups [65].

It remains unclear as to whether HIV/AIDS has an impact on severe prognosis on COVID-19, although it is assumed that people living with HIV may be at risk because of their weakened immune systems [45, 66, 67, 68]. Thus far, being infected with HIV does not have a significant impact on health outcomes from COVID-19 when compared with the outcomes of matched non-HIV-positive individuals [67, 69]. Even though HIV itself is not a significant risk factor for COVID-19 susceptibility, not receiving ART might put HIV-infected people at risk of more severe disease. Several studies show that HIV-infected people who have normal $CD4^+$ T cells counts and suppressed viral loads due to ART may not be at heightened risk of experiencing increased morbidity if infected with SARS-CoV-2 [68, 70, 71]. This is because ART helps persistent immune dysfunction, weakened by HIV infection, become reactive and normalizes CD4 ratio [72]. As the recovered immune system greatly lowers the incidence and severity of diseases and mortality [73], it is expected to decrease susceptibility to COVID-19. In contrast, a study shows a bad clinical course even though the HIV/SARS-CoV-2 co-infected patients were on ART and had low HIV viral loads [74].

In the absence of scientific evidence for this, whether HIV/AIDS will be included in consideration of factors that influence COVID-19 is an intricate matter. However, the majority of studies on the relationship between HIV/AIDS and COVID-19 provide evidence that co-infected patients show a positive response to ART, so people who do not have access to ART should not be left out of the discussion [71].

The percentage of people with asthma, cardiovascular diseases, diabetes and hypertension is 12.5%, 3.5%, 5.4% and 34.9%, respectively [25]. For the number of people living with HIV but not on the treatment, we use the number of people who would not receive the treatment from our ART allocation strategy (c) (a general optimal allocation plan without any conditions). From the results of the ART-allocation plan according to strategy (c), we can estimate how many people would be neglected from the treatment.

3.3 The mathematical model of COVID-19 vaccine allocation

Since the percentage of older people varies at the district level, we apply the different figures to estimate the number of them in each community. In our data, about 3% of the population are the elderly with at least one of the co-morbidities. Healthcare workers and the elderly with chronic health conditions make up about 3.7% of the population, which is slightly more than the vaccines given to healthcare workers (3%). For this reason, we set 4% of the vaccine to the amount that must be allocated to healthcare workers, who are the most exposed to infection, and the elderly with underlying conditions, who are at the greatest of serious COVID-19 infection. Hence, we investigate how the remaining 16% of the first batch vaccine should be allocated within the target group, which is people with co-morbidities (diabetes, cardiovascular diseases, hypertension, asthma, HIV-infected but not in ART), regardless of their age.

Identical communities are used in the COVID-19 vaccine-allocation analysis. We use data from the Botswana Population Projections (2011–2026) [75] to estimate the 2020 population for each community by applying the change in population between 2017 and 2020 at the district level. The population projections report provides four scenarios (high, medium, low, HIV/AIDS scenario) based on different assumptions about fertility and mortality. We apply the medium scenario, because fertility has not changed much (2011: 3%; 2020: 2.8% [76]) and mortality has decreased substantially for the period (2011: 8.4%; 2020: 5.7% [25]).

All the mathematical models used in the COVID-19 vaccine-allocation analysis are identical to those used in the ART-allocation analysis based upon the egalitarian principle. Here, I_i is the number of people with co-morbidities in community i and T_i is the number of vaccinated people in community i ($i = 1, 2, \cdots, n$). Since only 28% of HCFs can manage temperature-sensitive vaccines properly in sub-Saharan Africa [77], we assume that people receive vaccines only from hospitals. All 30 hospitals are expected to be outfitted with the necessary equipment required to store and distribute the vaccines by the time when vaccines are available. Unlike ART allocation, we consider a 180-minute driving time catchment area, consisting of 30, 60, 90 and 120-minute sub-zones, as a high number of people in African regions are willing to get the COVID-19 vaccine [78]. Vaccine-deliverable hospitals are widely distributed geographically, which makes them less accessible to the community, unlike clinics. About 85% and 93% of communities have the nearest hospital within 120- and 180-minute, respectively (see Figure 3.1). In this analysis, 7,036 is assigned as the β value to the Gaussian value of 0.01 to the outermost sub-zone. The treatment accessibility from the innermost to outermost sub-zone is 0.8799, 0.5995, 0.3163, 0.1292 and 0.01.

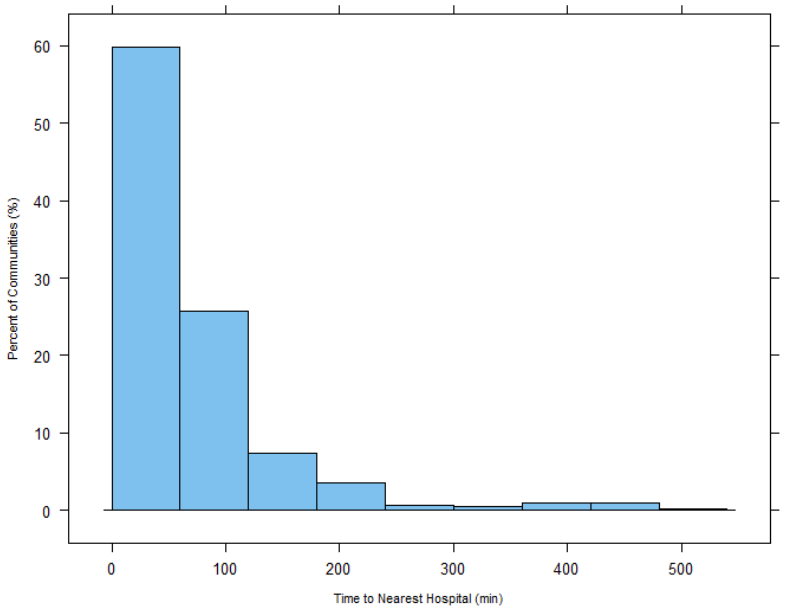


Figure 3.1. A histogram implies heterogeneity in access to the nearest vaccination centers between each community in Botswana. Here, the treatment accessibility to the nearest hospital in the community is lower than the accessibility in ART-allocation analysis. More than half communities have the nearest hospital within 60-minute driving time and most of them have the nearest site within 100-minute driving time.

Chapter 4

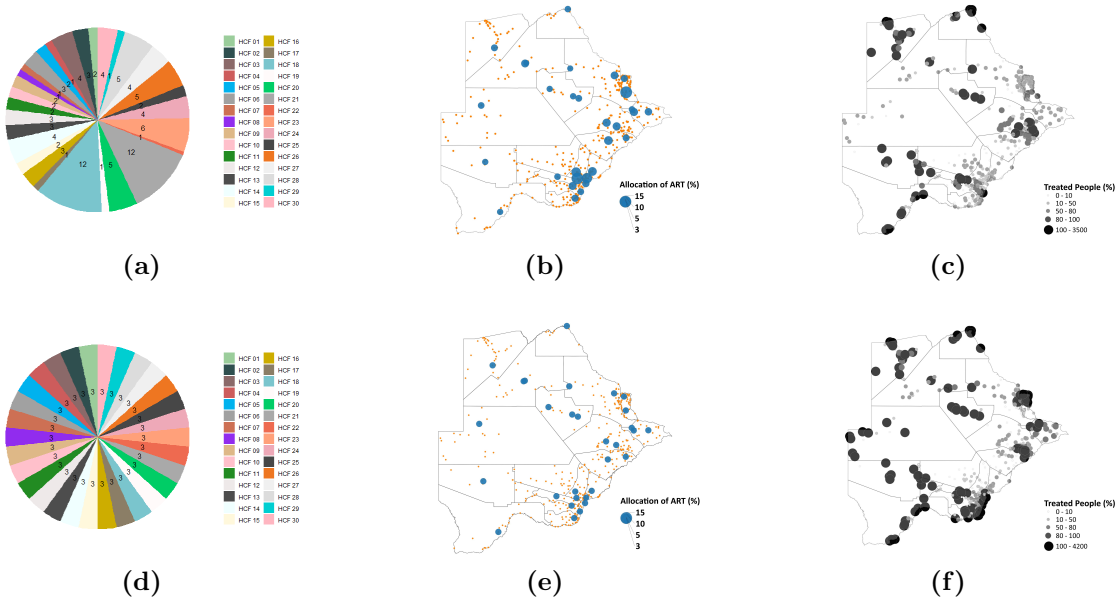
Results

4.1 The ART-allocation strategy

Our analysis shows that a significant portion of ART (34–44%) should be distributed to HCFs that have large populated surrounding communities: Gaborone city (HCF 21), Francistown city (HCF 18) and Kweneng district (HCF 23 and 28). The remaining ART should be allocated to the remaining 26 HCFs at a rate of 1–6% each throughout the communities (see Figure 4.1). The equity objective function estimates (a) F = 1205.4, (b) F = 1949.71, (c) F = 46.37, (d) F = 47.54 and (e) F = 46.67. None of the strategies provide perfect equality, but our optimal strategies provide substantially higher levels compared to the other two strategies: (a) the current allocation policy and (b) the equal amount of distribution throughout the HCFs. Among our optimal allocation strategies (c–e), strategy (c), the general plan without any conditions, has the highest equality over two other NLP allocation strategies. Different outcomes from each strategy are shown in Figure 4.1.

Our research is designed so that 30 hospitals share total ART; thus the percentage of total health resource that each hospital has does not vary appreciably between hospitals. We also illustrate the results for hospitals with more than 3% of the total ART in Figure 4.2.

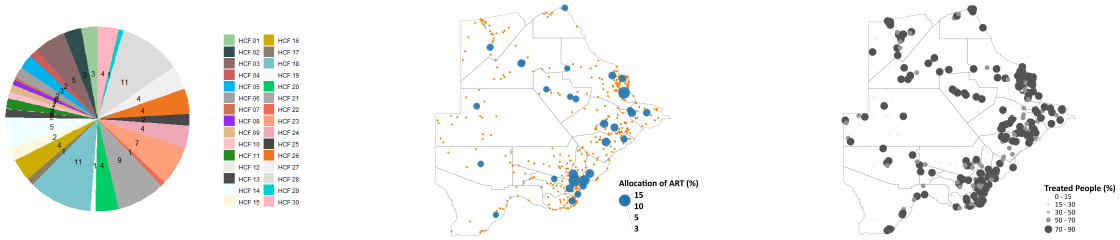
Figure 4.3 shows different percentage of treated people according to each strategy in all communities (Figure 4.3.(a)) and the marginalized districts (Figure 4.3.(b)). In all communities, the fraction of treated people per community is (a) 0.53–3451.54%, (b) 0.28–4155.3%, (c) 0.65–88.28%, (d) 0.69–88.57% and (e) 0.63–88.28%. Strategy (c) has significantly least interquartile range (34.2) compared with (a) 52.89, (b)



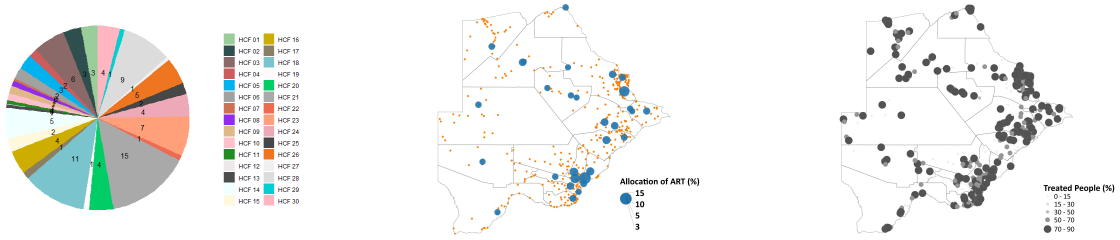
(a) (b) (c)

(d) (e) (f)

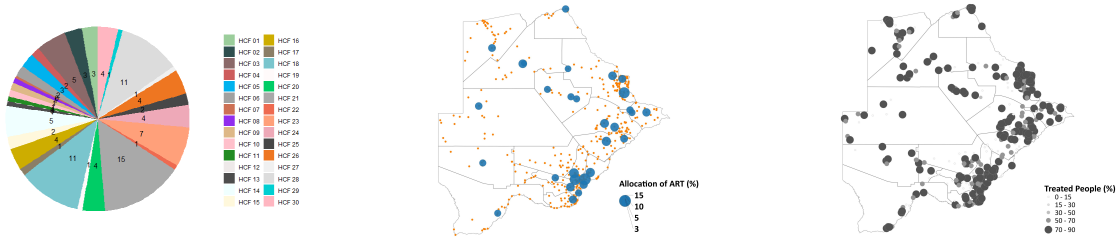
Figure 4.1. Results of five different ART-allocation strategies are indicated on the map of Botswana. The first row illustrates the results from the current ART-allocation plan by the government of Botswana. The second row shows the results from the strategy of equal amount of ART allocation to every HCFs. The third row shows the results from our optimal-allocation strategy without any conditions. The fourth row illustrates the results from our optimal-allocation strategy when the biggest community has ART equal to its effective demand. The fifth row shows the results from our optimal-allocation strategy when the biggest two cities have ART equal to their effective demand. Pie charts of the proportion of ART allocated to the hospitals are shown in (a), (d), (g), (j), (m) and the spatial images of them are shown in (b), (e), (h), (k), (n). The percentage of treated people in each community are shown in (c), (f), (i), (l), (o).



(g) (h) (i)



(j) (k) (l)



(m) (n) (o)

Figure 4.1. Continued.

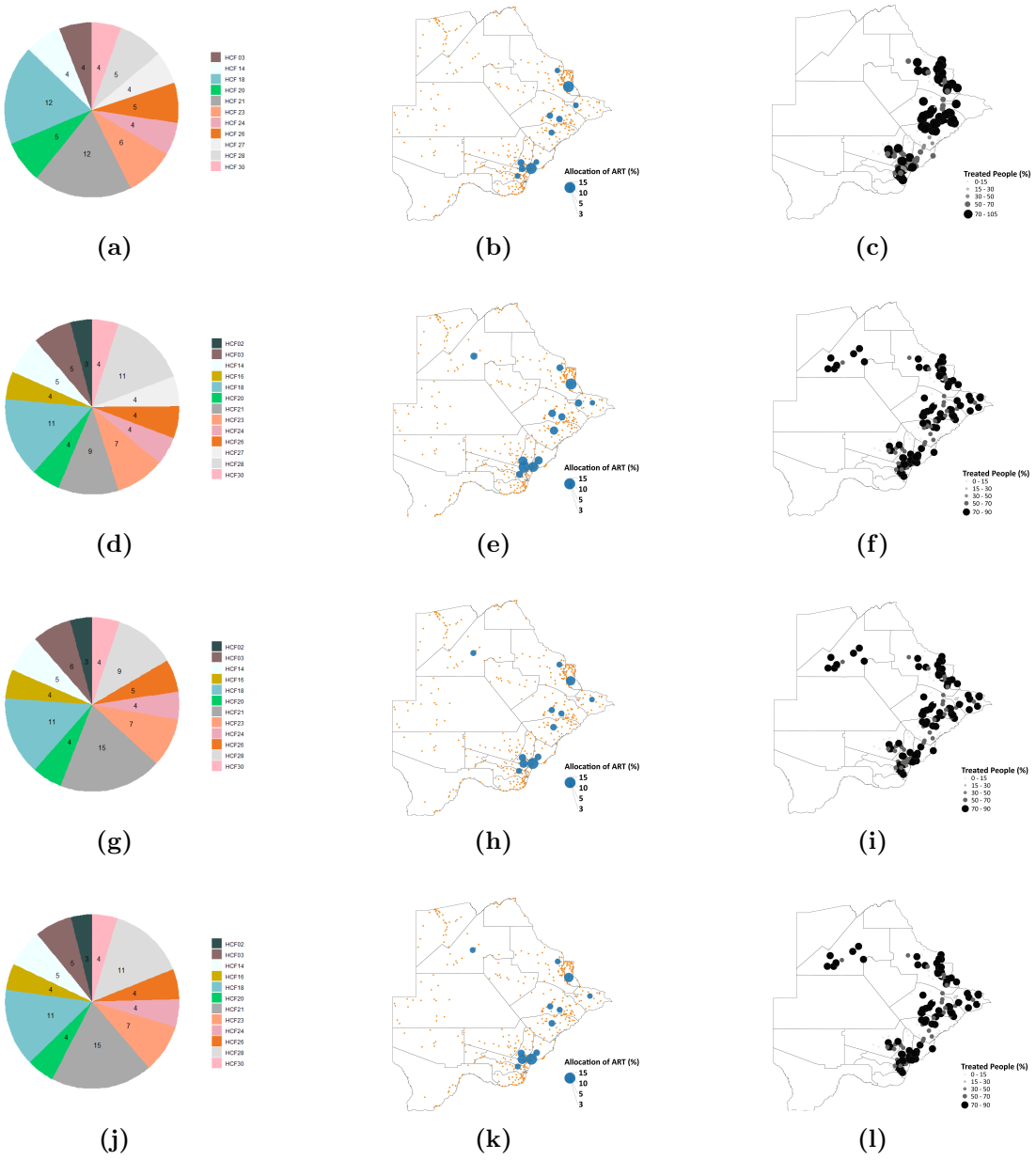
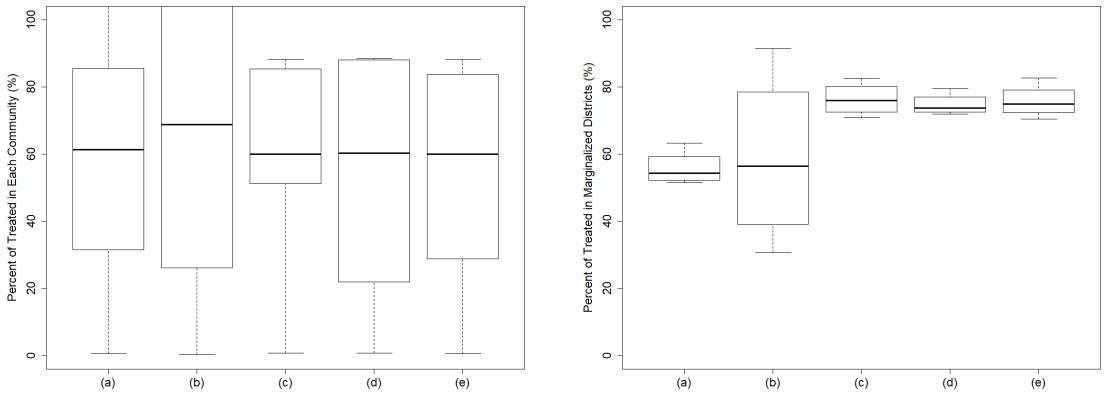


Figure 4.2. Results of different ART-allocation strategies for hospitals with more than 3% of the total ART. The order of rows of figures appearing for each plan is the same as that described in Figure 4.1. Results for strategy (b) are not included, since all results are the same as in Figure 4.1.

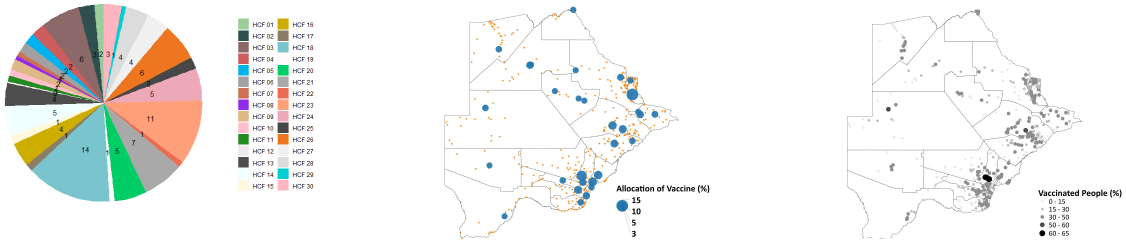


(a) **(b)**

Figure 4.3. (a) Box plots of the percentage of treated people in all communities. (b) Box plots of the percentage of treated people in the marginalized districts. As the current plan and the equal distribution to all HCFs violate the assumption of one-to-one allocation, the upper parts of the box plots exceed 100% in (a). The bold black line indicates the median percentage of treated people in each community.

84.37, (d) 61.68 and (e) 48.97. Furthermore, both strategy (a) and (b) violate the assumption of one-to-one allocation that should be guaranteed in the analysis. There are 140 and 115 communities where the assumption is violated, respectively with strategy (a) and (b).

We also compare how these different strategies appear in three marginalized districts; Mahalapye, Kweneng East and Goodhope, where high HIV prevalence and low ART uptake rates are occurred [21]. Figure 4.3.(b) shows which strategy can increase the ART uptake in the marginalized districts the most. Strategy (c) allows the median 76.03% of individuals with HIV in the three districts to take the therapy, which raises overall ART uptake in these areas the most. The median value of HIV-infected people would obtain ART by strategies (d) and (e) are 73.72% and 74.95%, respectively, which are slightly lower than that of strategy (c). The median value of treated people provided by strategies (a) and (b) are about 20% lower than strategy (c). Thus, our optimal plans driven by minimizing the objective function perform better than the current policy and the equal distribution in terms of the equal treatment accessibility in all communities and increasing the ART uptake in the marginalized districts. Tables of allocated amount of ART to each HCF and the percentage of treated people in each community according to each strategy are shown in Appendix A (Tables A.1–A.10).



(a) (b) (c)

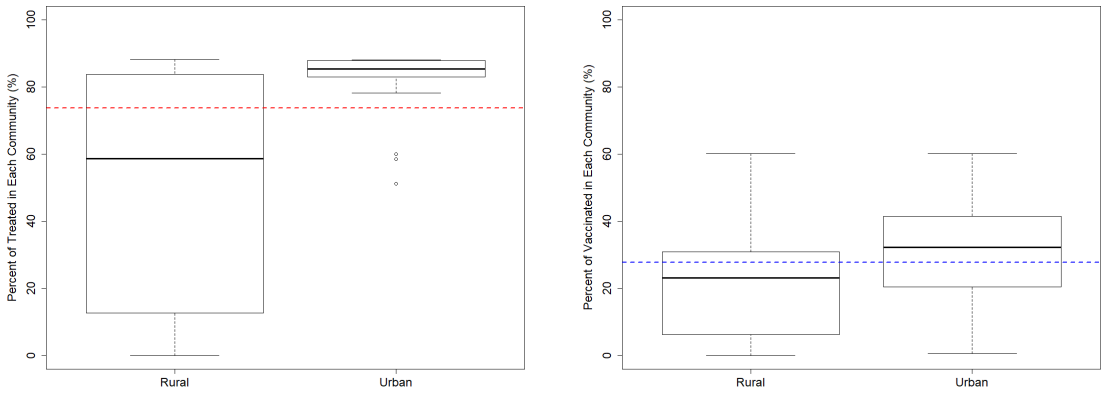
Figure 4.4. Results of COVID-19 vaccine-allocation strategy with minimizing the objective function. (a) Pie chart of the proportion of vaccine to the hospitals. (b) The spatial image of how much vaccine is distributed to each hospital. (c) The percentage of vaccinated people in each community.

4.2 The COVID-19 vaccine-allocation strategy

Our analysis for COVID-19 vaccine allocation demonstrates that a quarter of COVID-19 vaccines should be distributed to two large communities, Francistown city (HCF 18) and Kweneng district (HCF 23). The remaining vaccines are allocated to the remaining hospitals at a rate of 1–7% each throughout the communities. The proportion of vaccines to be allocated to each hospital and how many people are vaccinated in each community are displayed in Figure 4.4. The equity objective function for the COVID-19 vaccine-allocation analysis is 8.24 and our strategy allows the median 24.68% of people with co-morbidities to be vaccinated. The fraction of vaccinated people per community ranges from 0.36% to 60.2%, and the interquartile range of it is 25.42. Tables of allocated amount of COVID-19 vaccine to each HCF and the percentage of vaccinated people in each community are shown in Appendix A (Tables A.11–A.12).

4.3 The disparity in equality of treatment accessibility between rural and urban areas

Considering that all ART-providing HCFs and the most valid catchment area were applied in the analysis, strategy (c), the general optimal allocation strategy with nonlinear programming without any conditions, has the most chance of obtaining health resources in Botswana. However, there is a substantial difference in equality between urban and rural residents. Figure 4.5 shows the percentage of HIV-infected people/people with co-morbidities who obtain ART/COVID-19 vaccine per community according to strategy (c). In our analysis, the quantity of ART and COVID-19 vac-



(a) **(b)**

Figure 4.5. (a) Box plots of the percentage of treated people per community from strategy (c). (b) Box plots of the percentage of vaccinated people per community from strategy (c). The bold black line indicates the median percentage of treated/vaccinated people in each community. The dotted red/blue line indicates the ideal value of treated/vaccinated under the egalitarian principle.

cine available for distribution to the HCFs is sufficient to treat 73.71% and 27.81% of the total number of people who require them. Rural residents have both substantially low equality of access to health services and median percentage of treated/vaccinated people compared to that of urban residents.

4.4 Sensitivity analysis

We perform a sensitivity analysis to identify which input variables are important in contributing to an output variable [79]. Here, 'the number of treated/vaccinated people in each community' is used as the output variable. We assess which input variable has the most powerful effect on the output variable. Our input variables are 'population of the community' (P), 'the number of infected people/people with comorbidities in the community' (I_i), 'effective demand that the community has' (D_{ij}) and 'the ratio of the effective demand that the community has for HCF' (R_{ij}). The last input variable is used to assess how the proportion of the community's effective demand in the sum of all communities' effective demands for the HCF (total effective demands that HCF has) affects the number of treated/vaccinated people in that community.

We use Latin Hypercube Sampling (LHS), an efficient sampling design, in that each value of each variable is used only once in the analysis [79]. We calculate the

partial rank correlation coefficient (PRCC) of each input variable, since it is the most efficient and reliable among the sampling-based indice [80]. PRCC is powerful when there is a monotonic association between the input variable and the output variable [81]. The sign and value of the PRCC represent the sensitivity (degree of monotonicity between) of the output variable to the input variable. If the PRCC is > 0, then the number of people treated/vaccinated in the community increases as the input variable increases, whereas if the PRCC is < 0, the number of them decreases. The input variable has a significant effect on the sensitivity of the output variable when the $|\text{PRCC}| > 0.5$. The following is a summary of a paper on the steps when LHS is implemented [82].

1. Assume there are N times of simulations with K input parameters, u_i, $1 \leq i \leq K$. Then the parameter space for the uncertain parameters is defined by K dimensions, and the inequality of $N > (4/3)K$ has to be satisfied [79, 83].

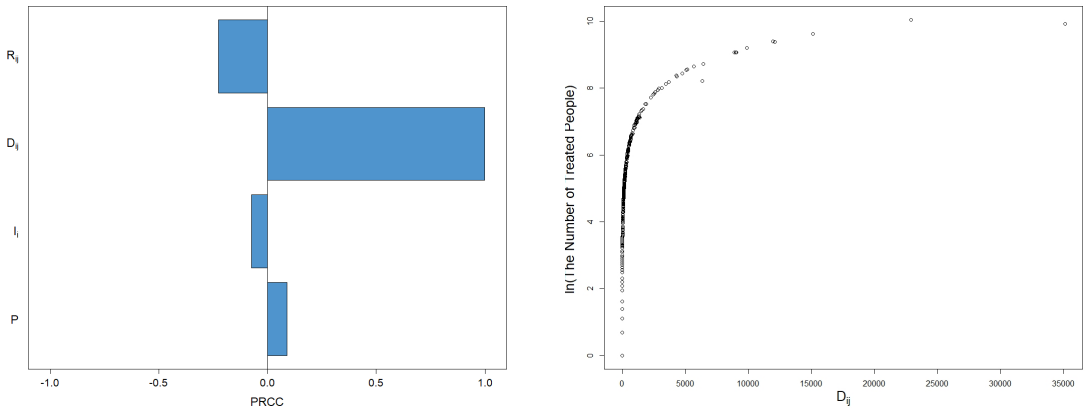
2. Each uncertain parameter is assigned with a probability density function (pdf), determined by an observed distribution of a plot of data. Then each pdf is divided into N non-overlapping equiprobable intervals, and the interval of each parameter is randomly sampled once. Thus, the sampling distribution of the values of each parameter reflects the shape of the particular pdf. After this step, each of the uncertain parameters will have N values.

3. The sampled values are stored in an $N \times K$ LHS matrix. The values for each column are random, and they are not arranged in any particular order according to magnitude. Note that, for this matrix, each column has entry, (r_j, u_i), or the jth sampled random values of the ith uncertain parameter, when $1 \leq i \leq K$, $1 \leq j \leq N$. Thus, each row in the matrix comprises K random values, each corresponding to a specific LHS parameter, respectively.

4. Investigate the level of monotonicity between outcome parameter and an LHS test parameter, u_i, using the PRCC analysis. For each of the N simulations, all the K values in each row in the LHS matrix are used as input variables. Note that truncating or excluding non-monotonic parameters are processed when monotonicity fails.

5. In the PRCC analysis, rank transformation procedures are done by arranging the values of the data in rank order. In other words, to perform PRCC, we will first rank the LHS matrix and the matrix for the outcome measure using a sort routine.

6. There are two linear regression models for each parameter and each outcome measure. The first model reflects that ranked parameter in terms of the other ranked parameter. The second model represents the ranked outcome measures

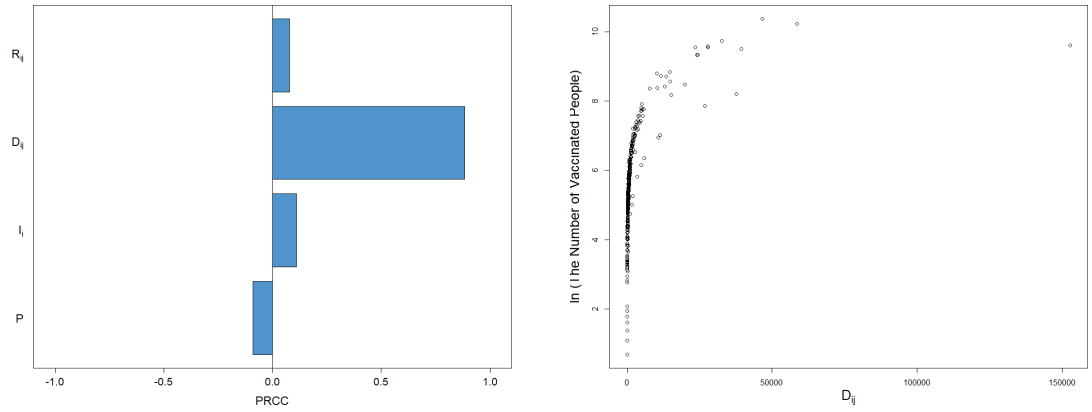


(a) **(b)**

Figure 4.6. Sensitivity analysis for the analysis of ART allocation. (a) Partial rank correlation coefficients on the number of treated people per community for four input parameters: population of the community (P), the number of HIV-infected people (I_i), the effective demand the community has (D_{ij}), and the ratio of community's effective demand to HCF's total effective demand (R_{ij}). (b) The effect of effective demand on the number of treated people.

in terms of the other ranked parameter values. The PRCC value for that specific parameter is provided by a Pearson correlation coefficient for the residuals from the two models.

Figures 4.6 and 4.7 show sensitivity analysis for ART allocation and COVID-19 vaccine allocation, respectively. In the ART-allocation analysis, the effective demand each community has on its HCF is most sensitive to the number of treated people, with a PRCC value of 0.99. In the vaccine-allocation analysis, the effective demand each community has the most effect on the number of vaccinated people with a PRCC value of 0.88. Scatter plots of the input variables that do not affect the increase or decrease of the outcome variable are shown in Figures 4.8 and 4.9.



(a) **(b)**

Figure 4.7. Sensitivity analysis for the analysis of COVID-19 vaccine allocation. (a) Partial rank correlation coefficients on the number of treated people per community for four input parameters: population of the community (P), the number of people with co-morbidities (I_i), the effective demand the community has (D_{ij}), and the ratio of community's effective demand to HCF's total effective demand (R_{ij}). (b) The effect of effective demand on the number of vaccinated people.

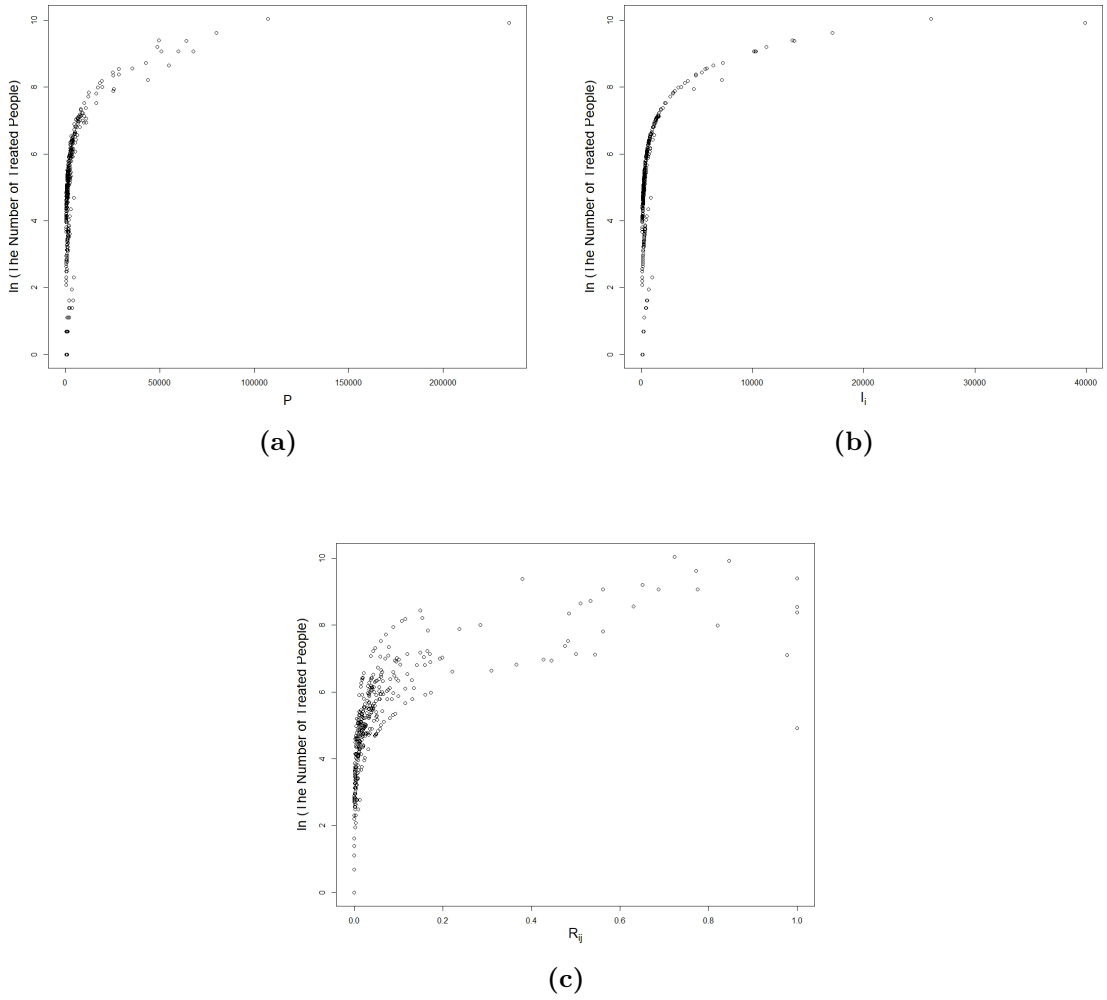


Figure 4.8. Scatter plots between the input variables and the output variable in the analysis of ART allocation. (a) A scatter plot between population in the community and the output variable in the analysis of ART. (b) A scatter plot between the number of HIV-infected people in the community and the output variable. (c) A scatter plot between the ratio of community's effective demand to HCF's total effective demand and the output variable.

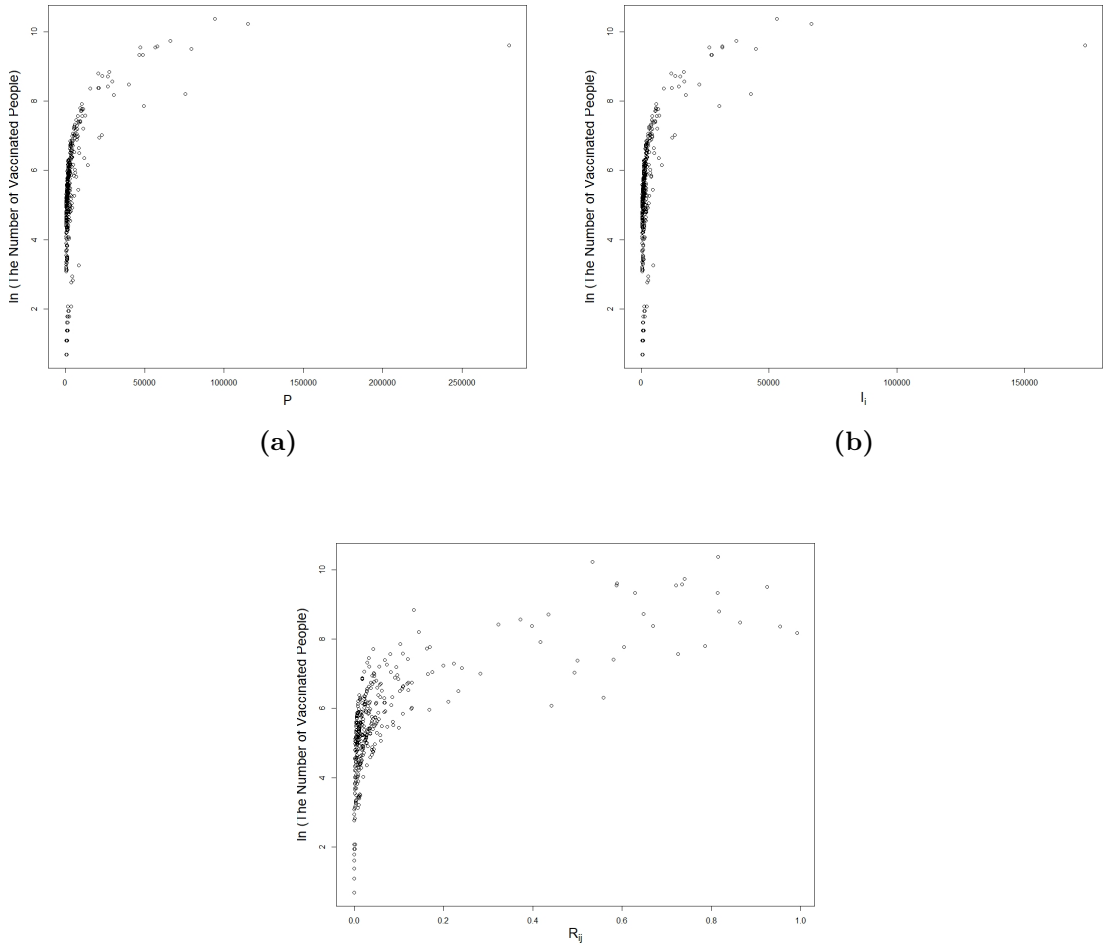


Figure 4.9. Scatter plots between the input variables and the output variable in the analysis of COVID-19 vaccine allocation. (a) A scatter plot between population in the community and the output variable. (b) A scatter plot between the number of people with co-morbidities in the community and the output variable. (c) A scatter plot between the ratio of community's effective demand to HCF's total effective demand and the output variable.

Chapter 5

Discussion

We have suggested a new framework for determining an equitable allocation of ART and COVID-19 vaccination to HCFs in Botswana. The motivation of our work stems from the fact that the decision on resource allocation should be discussed as one of the most important public-health issues, as the scarcity of health resources directly affects poor health outcomes. We have shown that different allocation strategies with the same amount of resources can have different equality of access to the resources.

Botswana has been actively trying to eradicate the burden of HIV in various ways, but equitable ART rollout interventions have not been discussed. With Botswana's current ART allocation intervention, it is not able to achieve equality of treatment accessibility, and about 5% of ART is wasted. Some communities are provided surplus ART (i.e., ART uptake is over 100%), while others are given far less than the number of infected people. No further information has been provided on the current plan, but it appears to be designed based on the population of each community, making it difficult for people who do not live in large communities to have access to treatment services equitably.

Under the circumstances Botswana currently has, our optimal strategy with minimizing the objective function ensures the best equality of access to resources in Botswana. It also brings better equality to the marginalized areas that have a deficit in ART uptake. Despite its high equality of accessibility, there still exists gap between regions. Weak health infrastructure due to the geographical characteristics in rural areas has forced their residents to have worse access compared to that of urban residents. The main reason for the equality disparity between the two regions is because the healthcare system is primarily limited to large communities and decentralized in

rural areas [14, 84]. A weak public-health system and poor road infrastructure have made rural residents get less willing to receive health resources, making them have a lower equal chance of obtaining treatment. Therefore, policymakers should consider interventions that increase access in rural areas while maintaining high equality in urban communities to reduce the access gap. It is not possible to increase the total number of treated/vaccinated people at the national level with a given amount of health resources. However, if the intervention is regarded with the aim of increasing the number of treated/vaccinated people in certain areas (e.g., rural, populated, the most infected or underprivileged area), then increasing them at the community level could be considered. Here, we consider which intervention can bring the increased number of treated/vaccinated in rural areas.

From the sensitivity analysis, we have shown that increasing the effective demand for HCFs would increase the number of treated/vaccinated people in the region. There are two ways that we can increase the effective demand: increasing the number of HCFs or the size of their catchment region. Since it is hard to expand the size of the catchment region in remote areas and it does not significantly improve the equality of access to HCFs because of the large distances between rural areas [9, 84], increasing the number of HCFs is more practical. The most realistic way to scale-up health services in rural communities in Botswana is to utilize existing health posts and mobile clinics. Health posts were not considered as ART-dispensing facilities in our analysis, since they were not providing free public ART in 2017. However, it has been an ongoing effort to reach all health posts to provide free ART; thus, it may be economically effective to increase the number of HCFs in this manner. In remote communities with relatively smaller populations, mobile clinics can visit regularly for monitoring and follow-up care, reducing the travel cost for residents. Enhancing health-resource access in rural areas with a given amount of resources means some access could be sacrificed in urban areas. Thus, to maintain high ART access in urban areas, policymakers can consider a way of providing ART from the private sector to urban residents who have high treatment accessibility and can afford it. In other words, economically and geographically vulnerable groups of people should be the priority group to be treated with free public ART. However, we have not been able to do determine whether this option would actually bring higher quality of treatment accessibility to rural residents, due to the lack of reliable information on health posts, mobile clinics and ART from private sector hospitals because MoHW does not provide any information on them. Therefore, future research could extend our work by considering health posts, mobile clinics and private HCFs as ART-dispensing facilities.

The implication of our work is that it can be applied to different contexts. For example, tuberculosis (TB), along with HIV/AIDS, is one of the top ten causes of death in Botswana [85]. However, the supply of TB drugs is unstable and it has caused huge drug resistance in Botswana [86]. Also, we have identified how to

distribute the amount of COVID-19 vaccine equivalent to 20% of the population provided by COVAX and have not discussed it after that. Future research on the equitable distribution of TB drugs and vaccine allocation thereafter in Botswana can be guided by our mathemathical framework.

Our work can also be applied to other country settings, since geographical barriers are linked to outcomes of nations' ART programme in sub-Saharan Africa [87]. For example, Namibia, one of Botswana's neighboring countries, has the highest HIV prevalence in the world, and HIV/AIDS has been the leading cause of death [88]. Namibia has similar healthcare system and patterns of the HIV epidemic as Botswana. About 76% of the population have HCFs within a 10km radius [89], and most ART is provided by the public sector free of charge [90]. The problem of ART programme in Namibia is that poor geographical treatment accessibility hinders people living with HIV to physically get to health services, since Namibia is one of the most sparsely populated countries [91]. Thus, identifying the heterogeneity in the HIV epidemic and treatment accessibility between regions to expand the treatment programme has become one of the urgent national tasks in Namibia. Our optimal allocation strategy could suggest policies that can increase equality of accessibility to ART, using the existing HCFs in Namibia.

Our work has been based on the egalitarian principle, guaranteeing geographic equality. However, decision-making about resource-allocation policy can be made based upon various ethical principles depending on the target group. We have set people with underlying conditions as a top priority vaccination group in the work of COVID-19 vaccine allocation. However, the priority group may vary depending on the aim of interventions of policymakers. For example, it is believed that when 70% of the total population is immune to the coronavirus, then herd immunity will be obtained. If policymakers wish to distribute more vaccines to densely populated areas to secure herd immunity first, then the vaccine-allocation strategies according to the utilitarian principle, which gives health maximization over health equity by treating the greatest number of people, could be studied. Also, vaccination priorities can be given to older people regardless of their health status to reduce serious cases and overall mortality. On the contrary, some argue that vaccination should be made first for relatively younger people who still have longer life expectancy [43].

One of the limitations of our research is that we did not take into account all the effects of migrants living with HIV, since they are not provided free ART from public HCFs, and BAIS IV does not provide any information on them. Botswana has about 30,000 non-citizens living with HIV, and only 29% of them are enrolled in ART [92], since they cannot afford treatment from private HCFs. The lack of free treatment for non-citizens contributes to an increase in new infections [93]. Furthermore, non-citizens are significantly less likely to be aware of their positive HIV status, even though they can access free HIV testing [94]. The constant influx of migrant workers has become one of the fundamental causes of Botswana's difficulty

in tackling the HIV/AIDS epidemic [95]. To resolve the problem, the government of Botswana has recently announced that the eligibility of the Masa programme will be extended for non-citizens. Therefore, future research with an analysis of migrants could be conducted with more information, considering how migrants who are not able to access treatment affect the HIV/AIDS epidemic in Botswana.

Another limitation of our research is that we assumed the COVID-19 vaccine centers are all public hospitals. At the time of our study, there was no information about where vaccination sites would be, so hospitals with proper equipment and ability to dispense vaccines were regarded as vaccination centers. However, by the time the vaccine is distributed in large quantities, small clinics, schools or any other public places may be able to dispense the vaccine. As with the ART allocation, the more facilities available, the higher equality of access to the vaccine will be achieved, and it may be carried out in Gaborone city (the largest community). The results from our analysis, only 8% of people in Gaborone city would be vaccinated with our suggested plan because of its high effective demand on the nearest hospital (HCF 21, Princess Marina hospital). The effective demand for the hospital is as twice much as the second highest demanded hospital. Thus, installing more vaccination sites within or around the city could be one of the feasible options to disperse people who need vaccine and eventually produce more vaccinated people in the city.

We have shown that mathematical solutions to distribute limited health resources equally exist. Most importantly, every intervention should be guaranteed with long-term sustainability as its sustainability affects health outcomes. For example, even short ART nonadherence can bring treatment failure in the form of drug resistance [28], and the long-distance and travel costs have been linked to its nonadherence [15, 96] in sub-Saharan Africa. We can expect a policy to be implemented by our suggestions to be sustainable in the long term in that it provides geographical equality of treatment, which will soon lead to the success of Botswana's ART programme. In this sense, our work would become an exemplar for resource-limited countries, especially in sub-Saharan Africa, which suffers from infectious diseases with limited resources more than any other part of the world.

Appendix A

Appendix

Table A.1. Allocated ART amount to each HCF according to strategy (a)

HCF no.	HCF name	ART	ART (%)
HCF 01	Bamalete Lutheren	4659	1.65
HCF 02	Bobonong	7975	2.82
HCF 03	Deborah Retief Memorial	11028	3.90
HCF 04	Ghanzi	3782	1.34
HCF 05	Goodhope	5456	1.93
HCF 06	Gumare	8357	2.95
HCF 07	Gweta	3340	1.18
HCF 08	Hukuntsi	3329	1.18
HCF 09	Jwaneng mine	6015	2.13
HCF 10	Kasane	5460	1.93
HCF 11	Letlhakane	6131	2.17
HCF 12	Letsholathebe II Memorial	7835	2.77
HCF 13	Lobatse-Atholone	7163	2.53
HCF 14	Mahalapye	12301	4.35
HCF 15	Masunga	6002	2.12
HCF 16	Maun	7835	2.77
HCF 17	Mmadinare	3174	1.12
HCF 18	Nyangabgwe Referral	33707	11.91
HCF 19	Orapa mine	3748	1.32
HCF 20	Palapye	14134	4.99
HCF 21	Princess Marina	33332	11.78
HCF 22	Rakops	1659	0.59
HCF 23	Scottish Livingstone	16666	5.89
HCF 24	SDA Kanye	10989	3.88
HCF 25	Sefhare	5532	1.95

Table A.1. Allocated ART amount to each HCF according to strategy (a)

HCF no.	HCF name	ART	ART (%)
HCF 26	Sekgoma Memorial	13589	4.80
HCF 27	Selebi Phikwe gvnt	10867	3.84
HCF 28	Thamaga	15373	5.43
HCF 29	Tsabong	3559	1.26
HCF 30	Tutume	9978	3.53

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Artisia	Deborah Retief Memorial	708	61.27
Beetsha	Gumare	223	127.99
Bere		135	0.00
Boatlaname	Scottish Livingstone	419	0.81
Bobonong	Bobonong	4917	78.68
Bodibeng	Maun	122	58.76
Bokaa	Deborah Retief Memorial	1391	61.27
Bokspits		84	0.00
Bonwapitse	Mahalapye	167	48.39
Borolong	Nyangabgwe Referral	1034	63.74
Borotsi 1	Mahalapye	228	71.24
Borotsi 2	Nyangabgwe Referral	375	13.61
Botlhapatlou	Scottish Livingstone	268	51.09
Botlhatlogo	Maun	111	40.44
Bray	Tsabong	135	1.08
Butale	Masunga	105	54.23
Chadibe 1	Sefhare	778	85.66
Chadibe 2	Nyangabgwe Referral	1024	63.74
Changate	Tutume	232	79.18
Charles Hill	Ghanzi	659	75.05
Chobokwane	Ghanzi	196	10.88
Dekar (D'kar)	Ghanzi	290	10.88
Dibete Station	Deborah Retief Memorial	345	41.78
Digawana	Goodhope	697	63.81
Dikgonnye	Deborah Retief Memorial	119	8.78
Diloro	Palapye	96	102.50
Dimajwe	Sekgoma Memorial	281	1.11
Dinatshana	SDA Kanye	127	12.41
Diphuduhudu	Scottish Livingstone	71	10.78
Ditladi	Nyangabgwe Referral	298	13.56
Ditlharapa	Goodhope	138	9.46
Ditshegwane	Scottish Livingstone	337	50.97
Dovedale	Mahalapye	235	0.69
Dukwi	Tutume	1277	79.26
Dutlwe		194	0.00
East Hanahai		97	0.00
Eretsha	Gumare	129	86.92

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Etsha 1	Gumare	180	18.61
Etsha 13	Gumare	380	127.99
Etsha 6	Gumare	738	87.21
Francistown	Nyangabgwe Referral	26056	93.54
Gabane	Thamaga	3919	42.41
Gaborone	Princess Marina	39912	70.68
Gachibana	Tsabong	128	129.03
Gakgatla	Thamaga	171	29.04
Gakutlo	Thamaga	430	42.38
Gamabuo	Sekgoma Memorial	135	91.37
Gamodubu	Thamaga	154	28.80
Gani	Gumare	102	18.56
Gasita	Jwaneng mine	262	1.79
Gathwane	Goodhope	221	43.33
Ghanzi	Ghanzi	2830	75.03
Gojwane	Sekgoma Memorial	267	62.11
Gonutsuga	Gumare	134	128.23
Good Hope	Goodhope	1348	63.83
Goo-Sekgweng	Sefhare	104	58.00
Gootau	Sefhare	254	58.22
Goshwe	Tutume	347	11.68
Groote Laagte		178	0.00
Gudingwa	Gumare	102	18.56
Gulubane	Tutume	163	54.14
Gumare	Gumare	1265	128.12
Gungwe	Masunga	103	54.40
Gweta	Gweta	1377	237.08
Habu	Maun	84	8.77
Hatsalatladi	Scottish Livingstone	373	51.07
Hebron	Goodhope	201	43.68
Hukuntsi	Hukuntsi	945	109.04
Hunhukwe	Hukuntsi	185	109.12
Ikoga	Gumare	172	127.84
Ikongwe	Mahalapye	129	48.23
Inalegolo	Jwaneng mine	129	93.43
Itholoke		121	0.00
Jackalas 1	Mmadinare	242	11.42

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Jackalas 2	Masunga	231	53.99
Jamataka	Nyangabgwe Referral	128	14.12
Jwaneng	Jwaneng mine	2108	137.73
K(G)obojango	Bobonong	491	53.53
Kacgae		110	0.00
Kachikau	Kasane	311	91.98
Kalakamati	Masunga	162	79.78
Kalamare	Mahalapye	662	71.16
Kang	Hukuntsi	1307	108.97
Kanye	SDA Kanye	6488	86.65
Karako(u)bis	Ghanzi	202	51.08
Kareng	Maun	307	58.93
Kasane	Kasane	1919	135.37
Kaudwane		145	0.00
Kauxwhi	Gumare	315	87.37
Kavimba	Kasane	135	135.57
Kazungula	Kasane	897	135.28
Kedia	Rakops	271	56.89
Keng	Jwaneng mine	234	20.07
Kgagodi	Palapye	337	103.24
Kgari	Masunga	101	79.64
Kgomodiatshaba	Deborah Retief Memorial	133	0.52
Kgomokasitwa	Bamalete Lutheren	181	7.20
Kgoro	Goodhope	150	43.53
Khakhea	Tsabong	669	1.53
Khisa		60	0.00
Khonkhwa	Jwaneng mine	108	20.29
Khudumelapye	Scottish Livingstone	420	74.92
Khuis	Tsabong	136	128.96
Khwawa		109	0.00
Khwee		262	0.00
Kodibeleng	Mahalapye	436	10.38
Kokong	Jwaneng mine	220	138.02
Kokotsha	Tsabong	193	87.85
Kolonkwane	Tsabong	92	87.38
Kopong	Thamaga	2609	42.42
Kotolana	Scottish Livingstone	80	10.63

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Kubung	SDA Kanye	255	59.09
Kudumatse	Mahalapye	521	0.78
Kule	Ghanzi	183	51.26
Kumakwane	Thamaga	1387	42.40
Kutamogree	Masunga	209	54.05
Kweneng	Deborah Retief Memorial	156	0.89
Lecheng	Palapye	672	103.02
Lefoko	Jwaneng mine	70	138.63
Lehututu	Hukuntsi	403	109.10
Lejwana	Goodhope	131	43.75
Lekgolobotlo	Bamalete Lutheren	149	7.22
Lentsweletau	Scottish Livingstone	1755	74.82
Leologane		194	0.00
Lepashe	Tutume	113	11.95
Lephephe	Mahalapye	267	0.91
Lepokole	Bobonong	216	78.64
Leporung	Goodhope	140	43.53
Lerala	Palapye	1327	103.10
Lesenepole	Palapye	557	103.05
Leshibitse	Deborah Retief Memorial	173	41.86
Lesoma	Kasane	162	135.76
Letlhakane	Letlhakane	5776	106.15
Letlhakeng	Scottish Livingstone	1316	74.83
Letsholathebe	Masunga	116	54.54
Lobatse	Lobatse-Atholone	4901	146.15
Lokgwabe	Hukuntsi	298	74.39
Lorolwana		223	0.00
Lorwana	Goodhope	249	63.81
Lotlhakane	SDA Kanye	647	86.60
Lotlhakane West	SDA Kanye	203	86.83
Maape	Sefhare	324	58.25
Mabalane	Deborah Retief Memorial	182	9.18
Mabeleapudi	Sekgoma Memorial	457	91.18
Mabesekwa		475	0.00
Maboane	Scottish Livingstone	283	11.12
Mabolwe	Bobonong	173	78.55
Mabudzane	Masunga	106	54.57

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Mabule	Goodhope	483	63.84
Mabutsane	Jwaneng mine	506	137.65
Machaneng	Sefhare	644	85.66
Mafongo/Hobona	Tutume	234	53.87
Magoriapitse	Goodhope	215	43.53
Magotlhwane	Bamalete Lutheren	179	33.86
Mahalapye	Mahalapye	11262	71.10
Mahetlwe	Scottish Livingstone	249	10.93
Mahotshwane	SDA Kanye	254	12.79
Maitengwe	Tutume	1202	79.26
Majwanaadipitse	Sekgoma Memorial	120	13.82
Majwaneng	Palapye	361	70.09
Makalamabedi	Maun	459	58.97
Makaleng	Masunga	237	79.70
Makobo	Nyangabgwe Referral	294	13.74
Makopong	Tsabong	241	128.57
Makunda	Ghanzi	197	51.08
Makuta	Tutume	199	79.19
Makwate	Mahalapye	437	0.74
Malaka	Palapye	190	70.28
Malatswai	Sekgoma Memorial	269	13.49
Maleshe	Tsabong	69	86.85
Malolwane	Deborah Retief Memorial	613	8.97
Malotwana Siding	Deborah Retief Memorial	186	61.39
Malwelwe	Scottish Livingstone	158	51.13
Mambo	Masunga	107	79.40
Mandunyane	Nyangabgwe Referral	839	13.68
Mantshwabisi	Scottish Livingstone	143	10.70
Manyana	SDA Kanye	483	86.65
Maokane	Jwaneng mine	330	93.91
Mapoka	Masunga	338	79.41
Maralaleng	Tsabong	79	18.50
Marapong	Tutume	523	79.20
Marobela	Tutume	374	79.21
Masingwaneng	Masunga	128	54.37
Masukwane	Masunga	119	53.92
Masunga	Masunga	1071	79.49

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Matebeleng	Deborah Retief Memorial	556	61.24
Mathangwane	Nyangabgwe Referral	1174	63.75
Mathathane	Bobonong	652	78.71
Matlapana	Letsholathebe II Memorial	227	3451.54
Matlhako	Sefhare	182	58.27
Matlhakola	Sefhare	177	12.64
Matobo	Tutume	289	53.90
Matshelagabedi	Nyangabgwe Referral	659	93.56
Matsiloje	Nyangabgwe Referral	595	93.62
Matsitama	Nyangabgwe Referral	431	0.99
Maubelo	Tsabong	67	128.71
Maun	Maun	10311	58.96
Maunatlala	Palapye	881	103.05
Mbalambi	Masunga	196	54.41
Metlobo	Goodhope	233	9.34
Metlojane	Goodhope	164	63.71
Metsimotlhabe	Thamaga	2179	42.41
Mhalapitsa	Sefhare	251	85.66
Middlepits	Tsabong	148	128.38
Mmadikola	Rakops	234	57.03
Mmadinare	Mmadinare	3319	78.44
Mmakgori	Goodhope	165	9.23
Mmankgodi	Thamaga	1753	42.43
Mmanoko	Scottish Livingstone	262	50.96
Mmanxotae	Tutume	142	11.41
Mmaphashalala	Mahalapye	295	48.48
Mmashoro	Sekgoma Memorial	541	91.20
Mmathethe	Goodhope	1464	63.83
Mmathubudukwane	Deborah Retief Memorial	488	8.99
Mmatseta	Thamaga	121	42.23
Mmatshumo	Orapa mine	361	17.69
Mmeya	Nyangabgwe Referral	155	1.37
Mmopane	Thamaga	4194	42.41
Mmutlana	Mahalapye	230	48.48
Mochudi	Deborah Retief Memorial	10116	61.26
Modipane	Deborah Retief Memorial	710	61.29
Moeng	Sefhare	271	12.57

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Mogapi	Bobonong	430	53.64
Mogapinyana	Palapye	307	103.02
Mogobane	Bamalete Lutheren	527	49.87
Mogoditshane	Thamaga	13782	42.42
Mogojogojo	Goodhope	414	43.46
Mogome	Palapye	107	70.06
Mogomotho	Gumare	126	1.16
Mogonye	Thamaga	72	28.79
Mogorosi	Sekgoma Memorial	513	91.13
Mohembo East	Gumare	77	86.99
Mohembo West	Gumare	280	127.94
Moiyabana	Sekgoma Memorial	918	91.23
Mokatako	Goodhope	321	43.40
Mokgenene	Deborah Retief Memorial	208	0.67
Mokgomane	Goodhope	244	9.52
Mokhomba	Jwaneng mine	136	94.37
Mokobeng	Sefhare	627	58.34
Mokoboxane	Orapa mine	364	119.47
Mokolodi	Bamalete Lutheren	147	49.70
Mokoswane	Mahalapye	135	10.18
Mokubilo		468	0.00
Molalatau	Bobonong	680	53.64
Molapowabojang	SDA Kanye	1172	86.63
Molepolole	Scottish Livingstone	17183	74.83
Moletemane	Bobonong	364	11.54
Monwane	Scottish Livingstone	68	11.26
Mookane	Mahalapye	801	48.42
Mopipi	Orapa mine	1148	119.56
Moralane	Sekgoma Memorial	235	13.23
Moremi	Palapye	114	15.41
Moreomabele	Sekgoma Memorial	107	62.00
Moreomaoto	Rakops	146	56.79
Moroka	Masunga	320	79.65
Morwa	Deborah Retief Memorial	784	61.28
Morwamosu	Jwaneng mine	155	137.33
Mosetse	Tutume	447	53.99
Moshaneng	SDA Kanye	205	59.09

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Moshaweng		396	0.00
Moshopha	Sefhare	392	58.33
Moshupa	SDA Kanye	3011	86.64
Mosojane	Masunga	229	54.07
Mosolotshane	Mahalapye	602	71.14
Mosu		590	0.00
Motlhabaneng	Bobonong	330	11.65
Motokwe	Jwaneng mine	285	93.91
Motshegaletau	Sekgoma Memorial	170	91.46
Mowana	Bobonong	91	54.04
Muchinje/Mabele	Kasane	209	91.99
Mulambakwena	Masunga	184	79.57
Nata	Tutume	1517	79.24
Natale	Nyangabgwe Referral	270	13.78
Ncojane	Ghanzi	447	74.97
New Xade	Ghanzi	255	74.91
New Xanagas	Ghanzi	177	0.96
Ngarange	Gumare	204	18.56
Ngwapa	Sefhare	122	58.22
Ngware	Scottish Livingstone	200	74.83
Nkange	Tutume	716	79.23
Nlakhwane	Masunga	299	79.50
Nokaneng	Gumare	480	128.02
Nshakashokwe	Masunga	482	79.50
Nswazwi	Tutume	429	79.13
Ntlhantlhe	Bamalete Lutheren	308	34.02
Nxamasere	Gumare	223	18.94
Nxaunxau		95	0.00
Oliphants Drift	Deborah Retief Memorial	270	61.37
Omaweneno	Tsabong	129	19.26
Oodi	Deborah Retief Memorial	1264	61.25
Orapa	Orapa mine	1570	119.54
Otse 1	Bamalete Lutheren	1547	49.83
Otse 2	Mahalapye	488	0.83
Paje	Sekgoma Memorial	510	91.26
Palapye	Palapye	7314	103.08

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Palla Road/Dinokwe	Mahalapye	368	48.53
Pandamatenga	Kasane	546	135.21
Papatlo	Goodhope	108	63.82
Parakarungu	Kasane	225	1.37
Phepheng	Tsabong	129	87.24
Phihitshwane	SDA Kanye	144	12.99
Phuduhudu 1	Gweta	94	34.39
Phuduhudu 2	Jwaneng mine	131	94.39
Pilane (Station)	Deborah Retief Memorial	386	61.33
Pilikwe	Sefhare	371	85.49
Pitsana-Potokwe	Goodhope	173	63.75
Pitsane Siding	Goodhope	772	63.81
Pitseng	Jwaneng mine	133	137.69
Pitshane Molopo	Goodhope	429	63.76
Poloka	Deborah Retief Memorial	206	9.13
Qabo		133	0.00
Qangwa	Gumare	166	128.07
Radisele	Palapye	555	103.00
Rakhuna	Goodhope	286	63.93
Ramaphatle	Thamaga	169	42.50
Ramatlabama	Goodhope	311	63.92
Ramokgonami	Sefhare	1115	85.60
Ramokgwebana	Masunga	293	79.58
Ramonaka	Deborah Retief Memorial	123	9.06
Ramotlabaki	Deborah Retief Memorial	123	0.57
Ramotswa station	Bamalete Lutheren	825	49.84
Ramotswa	Bamalete Lutheren	5894	49.83
Ranaka	SDA Kanye	344	58.97
Rasesa	Deborah Retief Memorial	967	61.27
Ratholo	Sefhare	449	58.29
Robelela	Mmadinare	229	11.68
Salajwe	Scottish Livingstone	433	0.79
Samochema	Gumare	163	87.55
Satau	Kasane	129	20.27
Sebina	Masunga	723	79.50
Sechele	Masunga	100	54.23

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Sedibeng	Goodhope	154	43.34
Sefhare	Sefhare	1285	85.63
Sefophe	Bobonong	1517	78.68
Segwagwa	Goodhope	172	0.84
Seherelela	Scottish Livingstone	91	74.76
Sehithwa	Maun	807	58.95
Sehunou	Sekgoma Memorial	187	91.46
Sekakangwe	Masunga	179	79.77
Sekhutlane	Goodhope	218	9.32
Sekoma	Jwaneng mine	305	20.01
Sekondomboro	Gumare	89	86.72
Selebi-Phikwe	Selebi Phikwe gvnt	13602	79.89
Seleka	Sefhare	281	85.52
Selokolela	SDA Kanye	265	12.63
Semane	Jwaneng mine	96	19.56
Semitwe	Tutume	154	79.52
Semolale	Bobonong	346	78.55
Senete	Tutume	559	79.25
Senyawe	Masunga	255	54.23
Seolwane	Palapye	269	103.20
Sepako	Tutume	145	0.62
Sepopa	Gumare	398	87.44
Serinane	Scottish Livingstone	105	51.02
Seronga	Gumare	524	128.11
Serowe urban	Sekgoma Memorial	10247	91.21
Serule	Palapye	648	103.04
Sese	Jwaneng mine	370	137.91
Sesung 1	SDA Kanye	98	13.06
Sesung 2	Scottish Livingstone	198	51.11
Shadishadi		351	0.00
Shakawe	Gumare	1046	128.08
Shakwe	Mahalapye	301	10.47
Shashe Bridge	Nyangabgwe Referral	207	93.47
Shashe	Nyangabgwe Referral	687	93.62
Shashe-Mooke	Nyangabgwe Referral	790	63.78
Shorobe	Maun	443	58.98
Shoshong	Mahalapye	2883	71.11

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Sikwane	Deborah Retief Memorial	315	9.06
Siviya	Masunga	244	54.08
Sojwe	Mahalapye	989	0.82
Sorilatholo	Scottish Livingstone	120	0.71
Sowa	Tutume	769	79.27
Struizendam		67	0.00
Takatokwane	Scottish Livingstone	497	0.86
Tamasane	Palapye	262	70.19
Tati Siding	Nyangabgwe Referral	1549	93.54
Taupye	Mahalapye	145	71.33
Tewane	Palapye	156	70.58
Thabala	Sekgoma Memorial	577	91.26
Thamaga	Thamaga	5429	42.42
Themashanga	Masunga	322	79.43
Tlhankane	Jwaneng mine	90	1.74
Tlhareseleele	Goodhope	150	63.85
Tloaneng	Bamalete Lutheren	204	7.22
Tlokweng	Princess Marina	7249	70.68
Tobane	Mmadinare	591	53.40
Tonota	Nyangabgwe Referral	4711	63.73
Topisi	Sekgoma Memorial	358	62.25
Toromoja	Rakops	253	38.92
Toteng	Maun	402	40.17
Tsabong	Tsabong	1234	128.63
Tsamaya	Masunga	452	79.58
Tsao(u)	Maun	478	59.01
Tsetsebjwe	Bobonong	1060	78.69
Tsetseng	Hukuntsi	68	16.39
Tshesebe	Masunga	450	79.53
Tshidilamolomo	Goodhope	161	43.71
Tshimoyapula	Sekgoma Memorial	326	13.35
Tshokatshaa	Gweta	124	34.76
Tshokwe	Mmadinare	256	78.36
Tsienyane/Rakops	Rakops	1584	57.01
Tsonyane	Jwaneng mine	93	1.68
Tsootsha	Ghanzi	378	75.12
Tswaane	Jwaneng mine	84	1.86

Table A.2. The percentage of treated people in each community according to strategy (a)

Community	HCF	HIV-infected	Treated(%)
Tswaaneng	Goodhope	183	63.83
Tswanyaneng	Goodhope	145	64.05
Tubu	Gumare	88	87.70
Tutume	Tutume	3590	79.24
Ukwi	Ghanzi	104	0.82
Werda	Tsabong	444	128.71
West Hanahai	Ghanzi	136	0.63
Xakao	Gumare	251	128.21
Xaxa		83	0.00
Xhauga	Gumare	124	128.00
Xhumo	Rakops	504	56.94
Zoroga	Tutume	278	54.09
Zutswa		113	0.00
Zwenshambe	Masunga	367	79.54

Table A.3. Allocated ART amount to each HCF according to strategy (a)

HCF no.	HCF name	ART	ART (%)
HCF 01	Bamalete Lutheren	9433	3.33
HCF 02	Bobonong	9433	3.33
HCF 03	Deborah Retief Memorial	9433	3.33
HCF 04	Ghanzi	9433	3.33
HCF 05	Goodhope	9433	3.33
HCF 06	Gumare	9433	3.33
HCF 07	Gweta	9433	3.33
HCF 08	Hukuntsi	9433	3.33
HCF 09	Jwaneng mine	9433	3.33
HCF 10	Kasane	9433	3.33
HCF 11	Letlhakane	9433	3.33
HCF 12	Letsholathebe II Memorial	9433	3.33
HCF 13	Lobatse-Atholone	9433	3.33
HCF 14	Mahalapye	9433	3.33
HCF 15	Masunga	9433	3.33
HCF 16	Maun	9433	3.33
HCF 17	Mmadinare	9433	3.33
HCF 18	Nyangabgwe Referral	9433	3.33
HCF 19	Orapa mine	9433	3.33
HCF 20	Palapye	9433	3.33
HCF 21	Princess Marina	9433	3.33
HCF 22	Rakops	9433	3.33
HCF 23	Scottish Livingstone	9433	3.33
HCF 24	SDA Kanye	9433	3.33
HCF 25	Sefhare	9433	3.33
HCF 26	Sekgoma Memorial	9433	3.33
HCF 27	Selebi Phikwe gvnt	9433	3.33
HCF 28	Thamaga	9433	3.33
HCF 29	Tsabong	9433	3.33
HCF 30	Tutume	9433	3.33

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Artisia	Deborah Retief Memorial	708	52.40
Beetsha	Gumare	223	144.46
Bere		135	0.00
Boatlaname	Scottish Livingstone	419	0.46
Bobonong	Bobonong	4917	93.06
Bodibeng	Maun	122	70.74
Bokaa	Deborah Retief Memorial	1391	52.40
Bokspits		84	0.00
Bonwapitse	Mahalapye	167	37.10
Borolong	Nyangabgwe Referral	1034	17.84
Borotsi 1	Mahalapye	228	54.62
Borotsi 2	Nyangabgwe Referral	375	3.81
Botlhapatlou	Scottish Livingstone	268	28.91
Botlhatlogo	Maun	111	48.69
Bray	Tsabong	135	2.87
Butale	Masunga	105	85.22
Chadibe 1	Sefhare	778	146.06
Chadibe 2	Nyangabgwe Referral	1024	17.84
Changate	Tutume	232	74.85
Charles Hill	Ghanzi	659	187.19
Chobokwane	Ghanzi	196	27.13
Dekar (D'kar)	Ghanzi	290	27.14
Dibete Station	Deborah Retief Memorial	345	35.73
Digawana	Goodhope	697	110.32
Dikgonnye	Deborah Retief Memorial	119	7.51
Diloro	Palapye	96	68.40
Dimajwe	Sekgoma Memorial	281	0.77
Dinatshana	SDA Kanye	127	10.65
Diphuduhudu	Scottish Livingstone	71	6.10
Ditladi	Nyangabgwe Referral	298	3.79
Ditlharapa	Goodhope	138	16.36
Ditshegwane	Scottish Livingstone	337	28.85
Dovedale	Mahalapye	235	0.53
Dukwi	Tutume	1277	74.92
Dutlwe		194	0.00
East Hanahai		97	0.00
Eretsha	Gumare	129	98.11

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Etsha 1	Gumare	180	21.00
Etsha 13	Gumare	380	144.46
Etsha 6	Gumare	738	98.44
Francistown	Nyangabgwe Referral	26056	26.18
Gabane	Thamaga	3919	26.02
Gaborone	Princess Marina	39912	20.00
Gachibana	Tsabong	128	341.98
Gakgatla	Thamaga	171	17.82
Gakutlo	Thamaga	430	26.00
Gamabuo	Sekgoma Memorial	135	63.42
Gamodubu	Thamaga	154	17.67
Gani	Gumare	102	20.95
Gasita	Jwaneng mine	262	2.81
Gathwane	Goodhope	221	74.92
Ghanzi	Ghanzi	2830	187.13
Gojwane	Sekgoma Memorial	267	43.12
Gonutsuga	Gumare	134	144.73
Good Hope	Goodhope	1348	110.36
Goo-Sekgweng	Sefhare	104	98.90
Gootau	Sefhare	254	99.27
Goshwe	Tutume	347	11.04
Groote Laagte		178	0.00
Gudingwa	Gumare	102	20.95
Gulubane	Tutume	163	51.18
Gumare	Gumare	1265	144.61
Gungwe	Masunga	103	85.50
Gweta	Gweta	1377	669.54
Habu	Maun	84	10.56
Hatsalatladi	Scottish Livingstone	373	28.90
Hebron	Goodhope	201	75.51
Hukuntsi	Hukuntsi	945	308.95
Hunhukwe	Hukuntsi	185	309.18
Ikoga	Gumare	172	144.29
Ikongwe	Mahalapye	129	36.99
Inalegolo	Jwaneng mine	129	146.51
Itholoke		121	0.00
Jackalas 1	Mmadinare	242	33.94

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Jackalas 2	Masunga	231	84.85
Jamataka	Nyangabgwe Referral	128	3.95
Jwaneng	Jwaneng mine	2108	215.99
K(G)obojango	Bobonong	491	63.32
Kacgae		110	0.00
Kachikau	Kasane	311	158.91
Kalakamati	Masunga	162	125.38
Kalamare	Mahalapye	662	54.57
Kang	Hukuntsi	1307	308.76
Kanye	SDA Kanye	6488	74.38
Karako(u)bis	Ghanzi	202	127.40
Kareng	Maun	307	70.94
Kasane	Kasane	1919	233.86
Kaudwane		145	0.00
Kauxwhi	Gumare	315	98.62
Kavimba	Kasane	135	234.21
Kazungula	Kasane	897	233.71
Kedia	Rakops	271	323.46
Keng	Jwaneng mine	234	31.47
Kgagodi	Palapye	337	68.90
Kgari	Masunga	101	125.16
Kgomodiatshaba	Deborah Retief Memorial	133	0.45
Kgomokasitwa	Bamalete Lutheren	181	14.57
Kgoro	Goodhope	150	75.26
Khakhea	Tsabong	669	4.05
Khisa		60	0.00
Khonkhwa	Jwaneng mine	108	31.82
Khudumelapye	Scottish Livingstone	420	42.40
Khuis	Tsabong	136	341.80
Khwawa		109	0.00
Khwee		262	0.00
Kodibeleng	Mahalapye	436	7.96
Kokong	Jwaneng mine	220	216.44
Kokotsha	Tsabong	193	232.83
Kolonkwane	Tsabong	92	231.58
Kopong	Thamaga	2609	26.03
Kotolana	Scottish Livingstone	80	6.02

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Kubung	SDA Kanye	255	50.72
Kudumatse	Mahalapye	521	0.59
Kule	Ghanzi	183	127.84
Kumakwane	Thamaga	1387	26.02
Kutamogree	Masunga	209	84.95
Kweneng	Deborah Retief Memorial	156	0.76
Lecheng	Palapye	672	68.75
Lefoko	Jwaneng mine	70	217.40
Lehututu	Hukuntsi	403	309.12
Lejwana	Goodhope	131	75.64
Lekgolobotlo	Bamalete Lutheren	149	14.62
Lentsweletau	Scottish Livingstone	1755	42.34
Leologane		194	0.00
Lepashe	Tutume	113	11.30
Lephephe	Mahalapye	267	0.70
Lepokole	Bobonong	216	93.02
Leporung	Goodhope	140	75.26
Lerala	Palapye	1327	68.81
Lesenepole	Palapye	557	68.77
Leshibitse	Deborah Retief Memorial	173	35.80
Lesoma	Kasane	162	234.54
Letlhakane	Letlhakane	5776	163.31
Letlhakeng	Scottish Livingstone	1316	42.35
Letsholathebe	Masunga	116	85.71
Lobatse	Lobatse-Atholone	4901	192.46
Lokgwabe	Hukuntsi	298	210.78
Lorolwana		223	0.00
Lorwana	Goodhope	249	110.32
Lotlhakane	SDA Kanye	647	74.34
Lotlhakane West	SDA Kanye	203	74.53
Maape	Sefhare	324	99.33
Mabalane	Deborah Retief Memorial	182	7.85
Mabeleapudi	Sekgoma Memorial	457	63.29
Mabesekwa		475	0.00
Maboane	Scottish Livingstone	283	6.29
Mabolwe	Bobonong	173	92.91
Mabudzane	Masunga	106	85.76

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Mabule	Goodhope	483	110.37
Mabutsane	Jwaneng mine	506	215.86
Machaneng	Sefhare	644	146.06
Mafongo/Hobona	Tutume	234	50.93
Magoriapitse	Goodhope	215	75.26
Magotlhwane	Bamalete Lutheren	179	68.54
Mahalapye	Mahalapye	11262	54.52
Mahetlwe	Scottish Livingstone	249	6.19
Mahotshwane	SDA Kanye	254	10.98
Maitengwe	Tutume	1202	74.93
Majwanaadipitse	Sekgoma Memorial	120	9.59
Majwaneng	Palapye	361	46.77
Makalamabedi	Maun	459	71.00
Makaleng	Masunga	237	125.25
Makobo	Nyangabgwe Referral	294	3.85
Makopong	Tsabong	241	340.76
Makunda	Ghanzi	197	127.39
Makuta	Tutume	199	74.86
Makwate	Mahalapye	437	0.57
Malaka	Palapye	190	46.90
Malatswai	Sekgoma Memorial	269	9.36
Maleshe	Tsabong	69	230.18
Malolwane	Deborah Retief Memorial	613	7.67
Malotwana Siding	Deborah Retief Memorial	186	52.51
Malwelwe	Scottish Livingstone	158	28.94
Mambo	Masunga	107	124.78
Mandunyane	Nyangabgwe Referral	839	3.83
Mantshwabisi	Scottish Livingstone	143	6.06
Manyana	SDA Kanye	483	74.38
Maokane	Jwaneng mine	330	147.27
Mapoka	Masunga	338	124.81
Maralaleng	Tsabong	79	49.03
Marapong	Tutume	523	74.87
Marobela	Tutume	374	74.88
Masingwaneng	Masunga	128	85.44
Masukwane	Masunga	119	84.74
Masunga	Masunga	1071	124.93

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Matebeleng	Deborah Retief Memorial	556	52.38
Mathangwane	Nyangabgwe Referral	1174	17.84
Mathathane	Bobonong	652	93.10
Matlapana	Letsholathebe II Memorial	227	4155.30
Matlhako	Sefhare	182	99.35
Matlhakola	Sefhare	177	21.56
Matobo	Tutume	289	50.96
Matshelagabedi	Nyangabgwe Referral	659	26.18
Matsiloje	Nyangabgwe Referral	595	26.20
Matsitama	Nyangabgwe Referral	431	0.28
Maubelo	Tsabong	67	341.12
Maun	Maun	10311	70.98
Maunatlala	Palapye	881	68.77
Mbalambi	Masunga	196	85.51
Metlobo	Goodhope	233	16.15
Metlojane	Goodhope	164	110.14
Metsimotlhabe	Thamaga	2179	26.02
Mhalapitsa	Sefhare	251	146.06
Middlepits	Tsabong	148	340.26
Mmadikola	Rakops	234	324.24
Mmadinare	Mmadinare	3319	233.11
Mmakgori	Goodhope	165	15.96
Mmankgodi	Thamaga	1753	26.04
Mmanoko	Scottish Livingstone	262	28.84
Mmanxotae	Tutume	142	10.79
Mmaphashalala	Mahalapye	295	37.18
Mmashoro	Sekgoma Memorial	541	63.30
Mmathethe	Goodhope	1464	110.35
Mmathubudukwane	Deborah Retief Memorial	488	7.69
Mmatseta	Thamaga	121	25.91
Mmatshumo	Orapa mine	361	44.53
Mmeya	Nyangabgwe Referral	155	0.38
Mmopane	Thamaga	4194	26.02
Mmutlana	Mahalapye	230	37.18
Mochudi	Deborah Retief Memorial	10116	52.40
Modipane	Deborah Retief Memorial	710	52.42
Moeng	Sefhare	271	21.42

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Mogapi	Bobonong	430	63.45
Mogapinyana	Palapye	307	68.75
Mogobane	Bamalete Lutheren	527	100.96
Mogoditshane	Thamaga	13782	26.03
Mogojogojo	Goodhope	414	75.14
Mogome	Palapye	107	46.76
Mogomotho	Gumare	126	1.30
Mogonye	Thamaga	72	17.67
Mogorosi	Sekgoma Memorial	513	63.25
Mohembo East	Gumare	77	98.19
Mohembo West	Gumare	280	144.40
Moiyabana	Sekgoma Memorial	918	63.33
Mokatako	Goodhope	321	75.03
Mokgenene	Deborah Retief Memorial	208	0.57
Mokgomane	Goodhope	244	16.45
Mokhomba	Jwaneng mine	136	147.99
Mokobeng	Sefhare	627	99.48
Mokoboxane	Orapa mine	364	300.66
Mokolodi	Bamalete Lutheren	147	100.63
Mokoswane	Mahalapye	135	7.80
Mokubilo		468	0.00
Molalatau	Bobonong	680	63.45
Molapowabojang	SDA Kanye	1172	74.36
Molepolole	Scottish Livingstone	17183	42.35
Moletemane	Bobonong	364	13.65
Monwane	Scottish Livingstone	68	6.37
Mookane	Mahalapye	801	37.13
Mopipi	Orapa mine	1148	300.89
Moralane	Sekgoma Memorial	235	9.18
Moremi	Palapye	114	10.29
Moreomabele	Sekgoma Memorial	107	43.04
Moreomaoto	Rakops	146	322.91
Moroka	Masunga	320	125.17
Morwa	Deborah Retief Memorial	784	52.41
Morwamosu	Jwaneng mine	155	215.36
Mosetse	Tutume	447	51.04
Moshaneng	SDA Kanye	205	50.72

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Moshaweng		396	0.00
Moshopha	Sefhare	392	99.45
Moshupa	SDA Kanye	3011	74.37
Mosojane	Masunga	229	84.97
Mosolotshane	Mahalapye	602	54.55
Mosu		590	0.00
Motlhabaneng	Bobonong	330	13.78
Motokwe	Jwaneng mine	285	147.27
Motshegaletau	Sekgoma Memorial	170	63.48
Mowana	Bobonong	91	63.91
Muchinje/Mabele	Kasane	209	158.91
Mulambakwena	Masunga	184	125.05
Nata	Tutume	1517	74.91
Natale	Nyangabgwe Referral	270	3.86
Ncojane	Ghanzi	447	186.99
New Xade	Ghanzi	255	186.83
New Xanagas	Ghanzi	177	2.40
Ngarange	Gumare	204	20.95
Ngwapa	Sefhare	122	99.26
Ngware	Scottish Livingstone	200	42.35
Nkange	Tutume	716	74.90
Nlakhwane	Masunga	299	124.93
Nokaneng	Gumare	480	144.50
Nshakashokwe	Masunga	482	124.94
Nswazwi	Tutume	429	74.81
Ntlhantlhe	Bamalete Lutheren	308	68.87
Nxamasere	Gumare	223	21.37
Nxaunxau		95	0.00
Oliphants Drift	Deborah Retief Memorial	270	52.49
Omaweneno	Tsabong	129	51.05
Oodi	Deborah Retief Memorial	1264	52.39
Orapa	Orapa mine	1570	300.83
Otse 1	Bamalete Lutheren	1547	100.88
Otse 2	Mahalapye	488	0.63
Paje	Sekgoma Memorial	510	63.34
Palapye	Palapye	7314	68.79

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Palla Road/Dinokwe	Mahalapye	368	37.21
Pandamatenga	Kasane	546	233.59
Papatlo	Goodhope	108	110.33
Parakarungu	Kasane	225	2.36
Phepheng	Tsabong	129	231.22
Phihitshwane	SDA Kanye	144	11.15
Phuduhudu 1	Gweta	94	97.11
Phuduhudu 2	Jwaneng mine	131	148.02
Pilane (Station)	Deborah Retief Memorial	386	52.46
Pilikwe	Sefhare	371	145.77
Pitsana-Potokwe	Goodhope	173	110.21
Pitsane Siding	Goodhope	772	110.32
Pitseng	Jwaneng mine	133	215.92
Pitshane Molopo	Goodhope	429	110.23
Poloka	Deborah Retief Memorial	206	7.81
Qabo		133	0.00
Qangwa	Gumare	166	144.56
Radisele	Palapye	555	68.74
Rakhuna	Goodhope	286	110.52
Ramaphatle	Thamaga	169	26.08
Ramatlabama	Goodhope	311	110.51
Ramokgonami	Sefhare	1115	145.95
Ramokgwebana	Masunga	293	125.07
Ramonaka	Deborah Retief Memorial	123	7.75
Ramotlabaki	Deborah Retief Memorial	123	0.48
Ramotswa station	Bamalete Lutheren	825	100.91
Ramotswa	Bamalete Lutheren	5894	100.89
Ranaka	SDA Kanye	344	50.62
Rasesa	Deborah Retief Memorial	967	52.41
Ratholo	Sefhare	449	99.39
Robelela	Mmadinare	229	34.71
Salajwe	Scottish Livingstone	433	0.44
Samochema	Gumare	163	98.82
Satau	Kasane	129	35.02
Sebina	Masunga	723	124.94
Sechele	Masunga	100	85.22

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Sedibeng	Goodhope	154	74.93
Sefhare	Sefhare	1285	146.01
Sefophe	Bobonong	1517	93.06
Segwagwa	Goodhope	172	1.46
Seherelela	Scottish Livingstone	91	42.31
Sehithwa	Maun	807	70.97
Sehunou	Sekgoma Memorial	187	63.48
Sekakangwe	Masunga	179	125.37
Sekhutlane	Goodhope	218	16.11
Sekoma	Jwaneng mine	305	31.39
Sekondomboro	Gumare	89	97.88
Selebi-Phikwe	Selebi Phikwe gvnt	13602	69.35
Seleka	Sefhare	281	145.82
Selokolela	SDA Kanye	265	10.85
Semane	Jwaneng mine	96	30.68
Semitwe	Tutume	154	75.17
Semolale	Bobonong	346	92.91
Senete	Tutume	559	74.92
Senyawe	Masunga	255	85.22
Seolwane	Palapye	269	68.87
Sepako	Tutume	145	0.59
Sepopa	Gumare	398	98.70
Serinane	Scottish Livingstone	105	28.88
Seronga	Gumare	524	144.60
Serowe urban	Sekgoma Memorial	10247	63.31
Serule	Palapye	648	68.76
Sese	Jwaneng mine	370	216.26
Sesung 1	SDA Kanye	98	11.21
Sesung 2	Scottish Livingstone	198	28.93
Shadishadi		351	0.00
Shakawe	Gumare	1046	144.56
Shakwe	Mahalapye	301	8.03
Shashe Bridge	Nyangabgwe Referral	207	26.16
Shashe	Nyangabgwe Referral	687	26.20
Shashe-Mooke	Nyangabgwe Referral	790	17.85
Shorobe	Maun	443	71.01
Shoshong	Mahalapye	2883	54.53

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Sikwane	Deborah Retief Memorial	315	7.75
Siviya	Masunga	244	84.99
Sojwe	Mahalapye	989	0.63
Sorilatholo	Scottish Livingstone	120	0.40
Sowa	Tutume	769	74.94
Struizendam		67	0.00
Takatokwane	Scottish Livingstone	497	0.48
Tamasane	Palapye	262	46.85
Tati Siding	Nyangabgwe Referral	1549	26.18
Taupye	Mahalapye	145	54.70
Tewane	Palapye	156	47.11
Thabala	Sekgoma Memorial	577	63.35
Thamaga	Thamaga	5429	26.03
Themashanga	Masunga	322	124.83
Tlhankane	Jwaneng mine	90	2.73
Tlhareseleele	Goodhope	150	110.38
Tloaneng	Bamalete Lutheren	204	14.61
Tlokweng	Princess Marina	7249	20.00
Tobane	Mmadinare	591	158.71
Tonota	Nyangabgwe Referral	4711	17.83
Topisi	Sekgoma Memorial	358	43.21
Toromoja	Rakops	253	221.28
Toteng	Maun	402	48.36
Tsabong	Tsabong	1234	340.91
Tsamaya	Masunga	452	125.07
Tsao(u)	Maun	478	71.04
Tsetsebjwe	Bobonong	1060	93.08
Tsetseng	Hukuntsi	68	46.44
Tshesebe	Masunga	450	124.99
Tshidilamolomo	Goodhope	161	75.57
Tshimoyapula	Sekgoma Memorial	326	9.27
Tshokatshaa	Gweta	124	98.15
Tshokwe	Mmadinare	256	232.87
Tsienyane/Rakops	Rakops	1584	324.14
Tsonyane	Jwaneng mine	93	2.64
Tsootsha	Ghanzi	378	187.36
Tswaane	Jwaneng mine	84	2.92

Table A.4. The percentage of treated people in each community according to strategy (b)

Community	HCF	HIV-infected	Treated(%)
Tswaaneng	Goodhope	183	110.35
Tswanyaneng	Goodhope	145	110.73
Tubu	Gumare	88	98.99
Tutume	Tutume	3590	74.90
Ukwi	Ghanzi	104	2.05
Werda	Tsabong	444	341.13
West Hanahai	Ghanzi	136	1.56
Xakao	Gumare	251	144.71
Xaxa		83	0.00
Xhauga	Gumare	124	144.48
Xhumo	Rakops	504	323.74
Zoroga	Tutume	278	51.14
Zutswa		113	0.00
Zwenshambe	Masunga	367	125.01

Table A.5. Allocated ART amount to each HCF according to strategy (c)

HCF no.	HCF name	ART	ART (%)
HCF 01	Bamalete Lutheren	8212	2.90
HCF 02	Bobonong	8722	3.08
HCF 03	Deborah Retief Memorial	15468	5.47
HCF 04	Ghanzi	4359	1.54
HCF 05	Goodhope	7295	2.58
HCF 06	Gumare	5603	1.98
HCF 07	Gweta	1240	0.44
HCF 08	Hukuntsi	2479	0.88
HCF 09	Jwaneng mine	3828	1.35
HCF 10	Kasane	3331	1.18
HCF 11	Letlhakane	5082	1.80
HCF 12	Letsholathebe II Memorial	136	0.05
HCF 13	Lobatse-Atholone	4313	1.52
HCF 14	Mahalapye	15223	5.38
HCF 15	Masunga	6307	2.23
HCF 16	Maun	11082	3.92
HCF 17	Mmadinare	3560	1.26
HCF 18	Nyangabgwe Referral	31696	11.20
HCF 19	Orapa mine	2495	0.88
HCF 20	Palapye	11408	4.03
HCF 21	Princess Marina	24118	8.52
HCF 22	Rakops	2275	0.80
HCF 23	Scottish Livingstone	19598	6.93
HCF 24	SDA Kanye	11159	3.94
HCF 25	Sefhare	5686	2.01
HCF 26	Sekgoma Memorial	12608	4.46
HCF 27	Selebi Phikwe gvnt	11969	4.23
HCF 28	Thamaga	30955	10.94
HCF 29	Tsabong	2323	0.82
HCF 30	Tutume	10445	3.69

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Artisia	Deborah Retief Memorial	708	85.93
Beetsha	Gumare	223	85.81
Bere		135	0.00
Boatlaname	Scottish Livingstone	419	0.95
Bobonong	Bobonong	4917	86.05
Bodibeng	Maun	122	83.11
Bokaa	Deborah Retief Memorial	1391	85.93
Bokspits		84	0.00
Bonwapitse	Mahalapye	167	59.88
Borolong	Nyangabgwe Referral	1034	59.94
Borotsi 1	Mahalapye	228	88.16
Borotsi 2	Nyangabgwe Referral	375	12.80
Botlhapatlou	Scottish Livingstone	268	60.07
Botlhatlogo	Maun	111	57.20
Bray	Tsabong	135	0.71
Butale	Masunga	105	56.98
Chadibe 1	Sefhare	778	88.05
Chadibe 2	Nyangabgwe Referral	1024	59.94
Changate	Tutume	232	82.88
Charles Hill	Ghanzi	659	86.51
Chobokwane	Ghanzi	196	12.54
Dekar (D'kar)	Ghanzi	290	12.54
Dibete Station	Deborah Retief Memorial	345	58.60
Digawana	Goodhope	697	85.31
Dikgonnye	Deborah Retief Memorial	119	12.31
Diloro	Palapye	96	82.73
Dimajwe	Sekgoma Memorial	281	1.03
Dinatshana	SDA Kanye	127	12.60
Diphuduhudu	Scottish Livingstone	71	12.68
Ditladi	Nyangabgwe Referral	298	12.75
Ditlharapa	Goodhope	138	12.65
Ditshegwane	Scottish Livingstone	337	59.94
Dovedale	Mahalapye	235	0.85
Dukwi	Tutume	1277	82.97
Dutlwe		194	0.00
East Hanahai		97	0.00
Eretsha	Gumare	129	58.27

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Etsha 1	Gumare	180	12.47
Etsha 13	Gumare	380	85.81
Etsha 6	Gumare	738	58.47
Francistown	Nyangabgwe Referral	26056	87.96
Gabane	Thamaga	3919	85.41
Gaborone	Princess Marina	39912	51.14
Gachibana	Tsabong	128	84.23
Gakgatla	Thamaga	171	58.47
Gakutlo	Thamaga	430	85.33
Gamabuo	Sekgoma Memorial	135	84.77
Gamodubu	Thamaga	154	57.99
Gani	Gumare	102	12.44
Gasita	Jwaneng mine	262	1.14
Gathwane	Goodhope	221	57.94
Ghanzi	Ghanzi	2830	86.48
Gojwane	Sekgoma Memorial	267	57.63
Gonutsuga	Gumare	134	85.97
Good Hope	Goodhope	1348	85.35
Goo-Sekgweng	Sefhare	104	59.62
Gootau	Sefhare	254	59.84
Goshwe	Tutume	347	12.22
Groote Laagte		178	0.00
Gudingwa	Gumare	102	12.44
Gulubane	Tutume	163	56.67
Gumare	Gumare	1265	85.90
Gungwe	Masunga	103	57.17
Gweta	Gweta	1377	88.02
Habu	Maun	84	12.41
Hatsalatladi	Scottish Livingstone	373	60.05
Hebron	Goodhope	201	58.39
Hukuntsi	Hukuntsi	945	81.19
Hunhukwe	Hukuntsi	185	81.25
Ikoga	Gumare	172	85.71
Ikongwe	Mahalapye	129	59.69
Inalegolo	Jwaneng mine	129	59.46
Itholoke		121	0.00
Jackalas 1	Mmadinare	242	12.81

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Jackalas 2	Masunga	231	56.74
Jamataka	Nyangabgwe Referral	128	13.28
Jwaneng	Jwaneng mine	2108	87.65
K(G)obojango	Bobonong	491	58.55
Kacgae		110	0.00
Kachikau	Kasane	311	56.12
Kalakamati	Masunga	162	83.83
Kalamare	Mahalapye	662	88.07
Kang	Hukuntsi	1307	81.14
Kanye	SDA Kanye	6488	87.99
Karako(u)bis	Ghanzi	202	58.88
Kareng	Maun	307	83.35
Kasane	Kasane	1919	82.59
Kaudwane		145	0.00
Kauxwhi	Gumare	315	58.58
Kavimba	Kasane	135	82.72
Kazungula	Kasane	897	82.54
Kedia	Rakops	271	78.01
Keng	Jwaneng mine	234	12.77
Kgagodi	Palapye	337	83.32
Kgari	Masunga	101	83.69
Kgomodiatshaba	Deborah Retief Memorial	133	0.73
Kgomokasitwa	Bamalete Lutheren	181	12.69
Kgoro	Goodhope	150	58.20
Khakhea	Tsabong	669	1.00
Khisa		60	0.00
Khonkhwa	Jwaneng mine	108	12.91
Khudumelapye	Scottish Livingstone	420	88.10
Khuis	Tsabong	136	84.18
Khwawa		109	0.00
Khwee		262	0.00
Kodibeleng	Mahalapye	436	12.84
Kokong	Jwaneng mine	220	87.84
Kokotsha	Tsabong	193	57.34
Kolonkwane	Tsabong	92	57.04
Kopong	Thamaga	2609	85.43
Kotolana	Scottish Livingstone	80	12.50

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Kubung	SDA Kanye	255	60.00
Kudumatse	Mahalapye	521	0.96
Kule	Ghanzi	183	59.08
Kumakwane	Thamaga	1387	85.38
Kutamogree	Masunga	209	56.80
Kweneng	Deborah Retief Memorial	156	1.25
Lecheng	Palapye	672	83.15
Lefoko	Jwaneng mine	70	88.23
Lehututu	Hukuntsi	403	81.23
Lejwana	Goodhope	131	58.50
Lekgolobotlo	Bamalete Lutheren	149	12.73
Lentsweletau	Scottish Livingstone	1755	87.98
Leologane		194	0.00
Lepashe	Tutume	113	12.51
Lephephe	Mahalapye	267	1.12
Lepokole	Bobonong	216	86.01
Leporung	Goodhope	140	58.20
Lerala	Palapye	1327	83.22
Lesenepole	Palapye	557	83.17
Leshibitse	Deborah Retief Memorial	173	58.71
Lesoma	Kasane	162	82.83
Letlhakane	Letlhakane	5776	87.98
Letlhakeng	Scottish Livingstone	1316	87.99
Letsholathebe	Masunga	116	57.31
Lobatse	Lobatse-Atholone	4901	88.00
Lokgwabe	Hukuntsi	298	55.39
Lorolwana		223	0.00
Lorwana	Goodhope	249	85.32
Lotlhakane	SDA Kanye	647	87.94
Lotlhakane West	SDA Kanye	203	88.18
Maape	Sefhare	324	59.88
Mabalane	Deborah Retief Memorial	182	12.88
Mabeleapudi	Sekgoma Memorial	457	84.60
Mabesekwa		475	0.00
Maboane	Scottish Livingstone	283	13.07
Mabolwe	Bobonong	173	85.91
Mabudzane	Masunga	106	57.34

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Mabule	Goodhope	483	85.35
Mabutsane	Jwaneng mine	506	87.60
Machaneng	Sefhare	644	88.04
Mafongo/Hobona	Tutume	234	56.39
Magoriapitse	Goodhope	215	58.20
Magotlhwane	Bamalete Lutheren	179	59.68
Mahalapye	Mahalapye	11262	87.99
Mahetlwe	Scottish Livingstone	249	12.85
Mahotshwane	SDA Kanye	254	12.99
Maitengwe	Tutume	1202	82.97
Majwanaadipitse	Sekgoma Memorial	120	12.82
Majwaneng	Palapye	361	56.57
Makalamabedi	Maun	459	83.41
Makaleng	Masunga	237	83.75
Makobo	Nyangabgwe Referral	294	12.92
Makopong	Tsabong	241	83.93
Makunda	Ghanzi	197	58.88
Makuta	Tutume	199	82.89
Makwate	Mahalapye	437	0.92
Malaka	Palapye	190	56.73
Malatswai	Sekgoma Memorial	269	12.51
Maleshe	Tsabong	69	56.69
Malolwane	Deborah Retief Memorial	613	12.59
Malotwana Siding	Deborah Retief Memorial	186	86.11
Malwelwe	Scottish Livingstone	158	60.13
Mambo	Masunga	107	83.43
Mandunyane	Nyangabgwe Referral	839	12.87
Mantshwabisi	Scottish Livingstone	143	12.59
Manyana	SDA Kanye	483	87.99
Maokane	Jwaneng mine	330	59.77
Mapoka	Masunga	338	83.45
Maralaleng	Tsabong	79	12.08
Marapong	Tutume	523	82.90
Marobela	Tutume	374	82.92
Masingwaneng	Masunga	128	57.13
Masukwane	Masunga	119	56.66
Masunga	Masunga	1071	83.53

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Matebeleng	Deborah Retief Memorial	556	85.89
Mathangwane	Nyangabgwe Referral	1174	59.94
Mathathane	Bobonong	652	86.08
Matlapana	Letsholathebe II Memorial	227	59.91
Matlhako	Sefhare	182	59.89
Matlhakola	Sefhare	177	12.99
Matobo	Tutume	289	56.43
Matshelagabedi	Nyangabgwe Referral	659	87.98
Matsiloje	Nyangabgwe Referral	595	88.04
Matsitama	Nyangabgwe Referral	431	0.93
Maubelo	Tsabong	67	84.01
Maun	Maun	10311	83.39
Maunatlala	Palapye	881	83.17
Mbalambi	Masunga	196	57.18
Metlobo	Goodhope	233	12.49
Metlojane	Goodhope	164	85.17
Metsimotlhabe	Thamaga	2179	85.40
Mhalapitsa	Sefhare	251	88.05
Middlepits	Tsabong	148	83.80
Mmadikola	Rakops	234	78.20
Mmadinare	Mmadinare	3319	87.98
Mmakgori	Goodhope	165	12.35
Mmankgodi	Thamaga	1753	85.44
Mmanoko	Scottish Livingstone	262	59.92
Mmanxotae	Tutume	142	11.95
Mmaphashalala	Mahalapye	295	60.00
Mmashoro	Sekgoma Memorial	541	84.62
Mmathethe	Goodhope	1464	85.34
Mmathubudukwane	Deborah Retief Memorial	488	12.61
Mmatseta	Thamaga	121	85.04
Mmatshumo	Orapa mine	361	11.78
Mmeya	Nyangabgwe Referral	155	1.29
Mmopane	Thamaga	4194	85.41
Mmutlana	Mahalapye	230	60.00
Mochudi	Deborah Retief Memorial	10116	85.93
Modipane	Deborah Retief Memorial	710	85.97
Moeng	Sefhare	271	12.92

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Mogapi	Bobonong	430	58.67
Mogapinyana	Palapye	307	83.15
Mogobane	Bamalete Lutheren	527	87.90
Mogoditshane	Thamaga	13782	85.42
Mogojogojo	Goodhope	414	58.11
Mogome	Palapye	107	56.55
Mogomotho	Gumare	126	0.77
Mogonye	Thamaga	72	57.97
Mogorosi	Sekgoma Memorial	513	84.55
Mohembo East	Gumare	77	58.32
Mohembo West	Gumare	280	85.77
Moiyabana	Sekgoma Memorial	918	84.65
Mokatako	Goodhope	321	58.02
Mokgenene	Deborah Retief Memorial	208	0.94
Mokgomane	Goodhope	244	12.72
Mokhomba	Jwaneng mine	136	60.06
Mokobeng	Sefhare	627	59.97
Mokoboxane	Orapa mine	364	79.53
Mokolodi	Bamalete Lutheren	147	87.61
Mokoswane	Mahalapye	135	12.59
Mokubilo		468	0.00
Molalatau	Bobonong	680	58.67
Molapowabojang	SDA Kanye	1172	87.97
Molepolole	Scottish Livingstone	17183	87.99
Moletemane	Bobonong	364	12.63
Monwane	Scottish Livingstone	68	13.24
Mookane	Mahalapye	801	59.93
Mopipi	Orapa mine	1148	79.59
Moralane	Sekgoma Memorial	235	12.28
Moremi	Palapye	114	12.44
Moreomabele	Sekgoma Memorial	107	57.52
Moreomaoto	Rakops	146	77.87
Moroka	Masunga	320	83.69
Morwa	Deborah Retief Memorial	784	85.95
Morwamosu	Jwaneng mine	155	87.40
Mosetse	Tutume	447	56.51
Moshaneng	SDA Kanye	205	60.00

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Moshaweng		396	0.00
Moshopha	Sefhare	392	59.95
Moshupa	SDA Kanye	3011	87.98
Mosojane	Masunga	229	56.82
Mosolotshane	Mahalapye	602	88.04
Mosu		590	0.00
Motlhabaneng	Bobonong	330	12.74
Motokwe	Jwaneng mine	285	59.77
Motshegaletau	Sekgoma Memorial	170	84.86
Mowana	Bobonong	91	59.10
Muchinje/Mabele	Kasane	209	56.12
Mulambakwena	Masunga	184	83.62
Nata	Tutume	1517	82.95
Natale	Nyangabgwe Referral	270	12.96
Ncojane	Ghanzi	447	86.42
New Xade	Ghanzi	255	86.34
New Xanagas	Ghanzi	177	1.11
Ngarange	Gumare	204	12.44
Ngwapa	Sefhare	122	59.84
Ngware	Scottish Livingstone	200	88.00
Nkange	Tutume	716	82.94
Nlakhwane	Masunga	299	83.54
Nokaneng	Gumare	480	85.83
Nshakashokwe	Masunga	482	83.54
Nswazwi	Tutume	429	82.83
Ntlhantlhe	Bamalete Lutheren	308	59.97
Nxamasere	Gumare	223	12.70
Nxaunxau		95	0.00
Oliphants Drift	Deborah Retief Memorial	270	86.08
Omaweneno	Tsabong	129	12.57
Oodi	Deborah Retief Memorial	1264	85.92
Orapa	Orapa mine	1570	79.58
Otse 1	Bamalete Lutheren	1547	87.83
Otse 2	Mahalapye	488	1.02
Paje	Sekgoma Memorial	510	84.67
Palapye	Palapye	7314	83.20

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Palla Road/Dinokwe	Mahalapye	368	60.05
Pandamatenga	Kasane	546	82.50
Papatlo	Goodhope	108	85.33
Parakarungu	Kasane	225	0.83
Phepheng	Tsabong	129	56.95
Phihitshwane	SDA Kanye	144	13.19
Phuduhudu 1	Gweta	94	12.77
Phuduhudu 2	Jwaneng mine	131	60.07
Pilane (Station)	Deborah Retief Memorial	386	86.02
Pilikwe	Sefhare	371	87.87
Pitsana-Potokwe	Goodhope	173	85.23
Pitsane Siding	Goodhope	772	85.32
Pitseng	Jwaneng mine	133	87.63
Pitshane Molopo	Goodhope	429	85.25
Poloka	Deborah Retief Memorial	206	12.80
Qabo		133	0.00
Qangwa	Gumare	166	85.87
Radisele	Palapye	555	83.13
Rakhuna	Goodhope	286	85.47
Ramaphatle	Thamaga	169	85.58
Ramatlabama	Goodhope	311	85.46
Ramokgonami	Sefhare	1115	87.98
Ramokgwebana	Masunga	293	83.63
Ramonaka	Deborah Retief Memorial	123	12.70
Ramotlabaki	Deborah Retief Memorial	123	0.79
Ramotswa station	Bamalete Lutheren	825	87.86
Ramotswa	Bamalete Lutheren	5894	87.84
Ranaka	SDA Kanye	344	59.88
Rasesa	Deborah Retief Memorial	967	85.94
Ratholo	Sefhare	449	59.91
Robelela	Mmadinare	229	13.10
Salajwe	Scottish Livingstone	433	0.92
Samochema	Gumare	163	58.70
Satau	Kasane	129	12.37
Sebina	Masunga	723	83.54
Sechele	Masunga	100	56.98

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Sedibeng	Goodhope	154	57.95
Sefhare	Sefhare	1285	88.02
Sefophe	Bobonong	1517	86.05
Segwagwa	Goodhope	172	1.13
Seherelela	Scottish Livingstone	91	87.91
Sehithwa	Maun	807	83.38
Sehunou	Sekgoma Memorial	187	84.86
Sekakangwe	Masunga	179	83.83
Sekhutlane	Goodhope	218	12.46
Sekoma	Jwaneng mine	305	12.74
Sekondomboro	Gumare	89	58.14
Selebi-Phikwe	Selebi Phikwe gvnt	13602	87.99
Seleka	Sefhare	281	87.90
Selokolela	SDA Kanye	265	12.83
Semane	Jwaneng mine	96	12.45
Semitwe	Tutume	154	83.24
Semolale	Bobonong	346	85.91
Senete	Tutume	559	82.96
Senyawe	Masunga	255	56.98
Seolwane	Palapye	269	83.30
Sepako	Tutume	145	0.65
Sepopa	Gumare	398	58.63
Serinane	Scottish Livingstone	105	60.00
Seronga	Gumare	524	85.89
Serowe urban	Sekgoma Memorial	10247	84.63
Serule	Palapye	648	83.17
Sese	Jwaneng mine	370	87.76
Sesung 1	SDA Kanye	98	13.27
Sesung 2	Scottish Livingstone	198	60.10
Shadishadi		351	0.00
Shakawe	Gumare	1046	85.87
Shakwe	Mahalapye	301	12.96
Shashe Bridge	Nyangabgwe Referral	207	87.89
Shashe	Nyangabgwe Referral	687	88.03
Shashe-Mooke	Nyangabgwe Referral	790	59.98
Shorobe	Maun	443	83.43
Shoshong	Mahalapye	2883	88.00

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Sikwane	Deborah Retief Memorial	315	12.71
Siviya	Masunga	244	56.83
Sojwe	Mahalapye	989	1.01
Sorilatholo	Scottish Livingstone	120	0.83
Sowa	Tutume	769	82.98
Struizendam		67	0.00
Takatokwane	Scottish Livingstone	497	1.01
Tamasane	Palapye	262	56.66
Tati Siding	Nyangabgwe Referral	1549	87.96
Taupye	Mahalapye	145	88.28
Tewane	Palapye	156	56.97
Thabala	Sekgoma Memorial	577	84.67
Thamaga	Thamaga	5429	85.41
Themashanga	Masunga	322	83.47
Tlhankane	Jwaneng mine	90	1.11
Tlhareseleele	Goodhope	150	85.36
Tloaneng	Bamalete Lutheren	204	12.72
Tlokweng	Princess Marina	7249	51.14
Tobane	Mmadinare	591	59.90
Tonota	Nyangabgwe Referral	4711	59.92
Topisi	Sekgoma Memorial	358	57.76
Toromoja	Rakops	253	53.36
Toteng	Maun	402	56.81
Tsabong	Tsabong	1234	83.96
Tsamaya	Masunga	452	83.62
Tsao(u)	Maun	478	83.47
Tsetsebjwe	Bobonong	1060	86.06
Tsetseng	Hukuntsi	68	12.20
Tshesebe	Masunga	450	83.57
Tshidilamolomo	Goodhope	161	58.44
Tshimoyapula	Sekgoma Memorial	326	12.39
Tshokatshaa	Gweta	124	12.90
Tshokwe	Mmadinare	256	87.89
Tsienyane/Rakops	Rakops	1584	78.17
Tsonyane	Jwaneng mine	93	1.07
Tsootsha	Ghanzi	378	86.59
Tswaane	Jwaneng mine	84	1.19

Table A.6. The percentage of treated people in each community according to strategy (c)

Community	HCF	HIV-infected	Treated(%)
Tswaaneng	Goodhope	183	85.34
Tswanyaneng	Goodhope	145	85.63
Tubu	Gumare	88	58.80
Tutume	Tutume	3590	82.94
Ukwi	Ghanzi	104	0.95
Werda	Tsabong	444	84.02
West Hanahai	Ghanzi	136	0.72
Xakao	Gumare	251	85.96
Xaxa		83	0.00
Xhauga	Gumare	124	85.82
Xhumo	Rakops	504	78.07
Zoroga	Tutume	278	56.62
Zutswa		113	0.00
Zwenshambe	Masunga	367	83.58

Table A.7. Allocated ART amount to each HCF according to strategy (d)

HCF no.	HCF name	ART	ART (%)
HCF 01	Bamalete Lutheren	8226	2.91
HCF 02	Bobonong	8920	3.15
HCF 03	Deborah Retief Memorial	15839	5.60
HCF 04	Ghanzi	4435	1.57
HCF 05	Goodhope	7520	2.66
HCF 06	Gumare	5739	2.03
HCF 07	Gweta	1240	0.44
HCF 08	Hukuntsi	2688	0.95
HCF 09	Jwaneng mine	3843	1.36
HCF 10	Kasane	3550	1.25
HCF 11	Letlhakane	1769	0.63
HCF 12	Letsholathebe II Memorial	136	0.05
HCF 13	Lobatse-Atholone	1769	0.63
HCF 14	Mahalapye	15223	5.38
HCF 15	Masunga	6641	2.35
HCF 16	Maun	11693	4.13
HCF 17	Mmadinare	3560	1.26
HCF 18	Nyangabgwe Referral	31692	11.20
HCF 19	Orapa mine	2758	0.97
HCF 20	Palapye	12066	4.26
HCF 21	Princess Marina	41499	14.67
HCF 22	Rakops	2561	0.91
HCF 23	Scottish Livingstone	19597	6.93
HCF 24	SDA Kanye	11159	3.94
HCF 25	Sefhare	5686	2.01
HCF 26	Sekgoma Memorial	13110	4.63
HCF 27	Selebi Phikwe gvnt	1769	0.63
HCF 28	Thamaga	24772	8.75
HCF 29	Tsabong	2435	0.86
HCF 30	Tutume	11081	3.92

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Artisia	Deborah Retief Memorial	708	87.99
Beetsha	Gumare	223	87.89
Bere		135	0.00
Boatlaname	Scottish Livingstone	419	0.95
Bobonong	Bobonong	4917	88.00
Bodibeng	Maun	122	87.70
Bokaa	Deborah Retief Memorial	1391	87.99
Bokspits		84	0.00
Bonwapitse	Mahalapye	167	59.88
Borolong	Nyangabgwe Referral	1034	59.93
Borotsi 1	Mahalapye	228	88.16
Borotsi 2	Nyangabgwe Referral	375	12.79
Botlhapatlou	Scottish Livingstone	268	60.07
Botlhatlogo	Maun	111	60.36
Bray	Tsabong	135	0.74
Butale	Masunga	105	60.00
Chadibe 1	Sefhare	778	88.05
Chadibe 2	Nyangabgwe Referral	1024	59.93
Changate	Tutume	232	87.93
Charles Hill	Ghanzi	659	88.01
Chobokwane	Ghanzi	196	12.76
Dekar (D'kar)	Ghanzi	290	12.76
Dibete Station	Deborah Retief Memorial	345	60.00
Digawana	Goodhope	697	87.95
Dikgonnye	Deborah Retief Memorial	119	12.60
Diloro	Palapye	96	87.50
Dimajwe	Sekgoma Memorial	281	1.07
Dinatshana	SDA Kanye	127	12.60
Diphuduhudu	Scottish Livingstone	71	12.68
Ditladi	Nyangabgwe Referral	298	12.75
Ditlharapa	Goodhope	138	13.04
Ditshegwane	Scottish Livingstone	337	59.94
Dovedale	Mahalapye	235	0.85
Dukwi	Tutume	1277	88.02
Dutlwe		194	0.00
East Hanahai		97	0.00
Eretsha	Gumare	129	59.69

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Etsha 1	Gumare	180	12.78
Etsha 13	Gumare	380	87.89
Etsha 6	Gumare	738	59.89
Francistown	Nyangabgwe Referral	26056	87.95
Gabane	Thamaga	3919	68.35
Gaborone	Princess Marina	39912	87.99
Gachibana	Tsabong	128	88.28
Gakgatla	Thamaga	171	46.79
Gakutlo	Thamaga	430	68.29
Gamabuo	Sekgoma Memorial	135	88.15
Gamodubu	Thamaga	154	46.41
Gani	Gumare	102	12.75
Gasita	Jwaneng mine	262	1.15
Gathwane	Goodhope	221	59.73
Ghanzi	Ghanzi	2830	87.99
Gojwane	Sekgoma Memorial	267	59.92
Gonutsuga	Gumare	134	88.06
Good Hope	Goodhope	1348	87.98
Goo-Sekgweng	Sefhare	104	59.62
Gootau	Sefhare	254	59.84
Goshwe	Tutume	347	12.97
Groote Laagte		178	0.00
Gudingwa	Gumare	102	12.75
Gulubane	Tutume	163	60.12
Gumare	Gumare	1265	87.98
Gungwe	Masunga	103	60.19
Gweta	Gweta	1377	88.02
Habu	Maun	84	13.09
Hatsalatladi	Scottish Livingstone	373	60.05
Hebron	Goodhope	201	60.20
Hukuntsi	Hukuntsi	945	88.04
Hunhukwe	Hukuntsi	185	88.11
Ikoga	Gumare	172	87.79
Ikongwe	Mahalapye	129	59.69
Inalegolo	Jwaneng mine	129	59.69
Itholoke		121	0.00
Jackalas 1	Mmadinare	242	12.81

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Jackalas 2	Masunga	231	59.74
Jamataka	Nyangabgwe Referral	128	13.27
Jwaneng	Jwaneng mine	2108	88.00
K(G)obojango	Bobonong	491	59.88
Kacgae		110	0.00
Kachikau	Kasane	311	59.81
Kalakamati	Masunga	162	88.27
Kalamare	Mahalapye	662	88.07
Kang	Hukuntsi	1307	87.99
Kanye	SDA Kanye	6488	87.99
Karako(u)bis	Ghanzi	202	59.90
Kareng	Maun	307	87.94
Kasane	Kasane	1919	88.01
Kaudwane		145	0.00
Kauxwhi	Gumare	315	60.00
Kavimba	Kasane	135	88.15
Kazungula	Kasane	897	87.96
Kedia	Rakops	271	87.82
Keng	Jwaneng mine	234	12.82
Kgagodi	Palapye	337	88.13
Kgari	Masunga	101	88.12
Kgomodiatshaba	Deborah Retief Memorial	133	0.75
Kgomokasitwa	Bamalete Lutheren	181	12.71
Kgoro	Goodhope	150	60.00
Khakhea	Tsabong	669	1.05
Khisa		60	0.00
Khonkhwa	Jwaneng mine	108	12.96
Khudumelapye	Scottish Livingstone	420	88.09
Khuis	Tsabong	136	88.24
Khwawa		109	0.00
Khwee		262	0.00
Kodibeleng	Mahalapye	436	12.84
Kokong	Jwaneng mine	220	88.18
Kokotsha	Tsabong	193	60.10
Kolonkwane	Tsabong	92	59.78
Kopong	Thamaga	2609	68.36
Kotolana	Scottish Livingstone	80	12.50

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Kubung	SDA Kanye	255	60.00
Kudumatse	Mahalapye	521	0.96
Kule	Ghanzi	183	60.11
Kumakwane	Thamaga	1387	68.33
Kutamogree	Masunga	209	59.81
Kweneng	Deborah Retief Memorial	156	1.28
Lecheng	Palapye	672	87.95
Lefoko	Jwaneng mine	70	88.57
Lehututu	Hukuntsi	403	88.09
Lejwana	Goodhope	131	60.31
Lekgolobotlo	Bamalete Lutheren	149	12.75
Lentsweletau	Scottish Livingstone	1755	87.97
Leologane		194	0.00
Lepashe	Tutume	113	13.27
Lephephe	Mahalapye	267	1.12
Lepokole	Bobonong	216	87.96
Leporung	Goodhope	140	60.00
Lerala	Palapye	1327	88.02
Lesenepole	Palapye	557	87.97
Leshibitse	Deborah Retief Memorial	173	60.11
Lesoma	Kasane	162	88.27
Letlhakane	Letlhakane	5776	30.63
Letlhakeng	Scottish Livingstone	1316	87.99
Letsholathebe	Masunga	116	60.34
Lobatse	Lobatse-Atholone	4901	36.10
Lokgwabe	Hukuntsi	298	60.07
Lorolwana		223	0.00
Lorwana	Goodhope	249	87.95
Lotlhakane	SDA Kanye	647	87.94
Lotlhakane West	SDA Kanye	203	88.18
Maape	Sefhare	324	59.88
Mabalane	Deborah Retief Memorial	182	13.19
Mabeleapudi	Sekgoma Memorial	457	87.96
Mabesekwa		475	0.00
Maboane	Scottish Livingstone	283	13.07
Mabolwe	Bobonong	173	87.86
Mabudzane	Masunga	106	60.38

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Mabule	Goodhope	483	87.99
Mabutsane	Jwaneng mine	506	87.94
Machaneng	Sefhare	644	88.04
Mafongo/Hobona	Tutume	234	59.83
Magoriapitse	Goodhope	215	60.00
Magotlhwane	Bamalete Lutheren	179	59.78
Mahalapye	Mahalapye	11262	87.99
Mahetlwe	Scottish Livingstone	249	12.85
Mahotshwane	SDA Kanye	254	12.99
Maitengwe	Tutume	1202	88.02
Majwanaadipitse	Sekgoma Memorial	120	13.33
Majwaneng	Palapye	361	59.83
Makalamabedi	Maun	459	88.01
Makaleng	Masunga	237	88.19
Makobo	Nyangabgwe Referral	294	12.92
Makopong	Tsabong	241	87.97
Makunda	Ghanzi	197	59.90
Makuta	Tutume	199	87.94
Makwate	Mahalapye	437	0.92
Malaka	Palapye	190	60.00
Malatswai	Sekgoma Memorial	269	13.01
Maleshe	Tsabong	69	59.42
Malolwane	Deborah Retief Memorial	613	12.89
Malotwana Siding	Deborah Retief Memorial	186	88.17
Malwelwe	Scottish Livingstone	158	60.12
Mambo	Masunga	107	87.85
Mandunyane	Nyangabgwe Referral	839	12.87
Mantshwabisi	Scottish Livingstone	143	12.59
Manyana	SDA Kanye	483	87.99
Maokane	Jwaneng mine	330	60.00
Mapoka	Masunga	338	87.87
Maralaleng	Tsabong	79	12.66
Marapong	Tutume	523	87.95
Marobela	Tutume	374	87.97
Masingwaneng	Masunga	128	60.16
Masukwane	Masunga	119	59.66
Masunga	Masunga	1071	87.96

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Matebeleng	Deborah Retief Memorial	556	87.95
Mathangwane	Nyangabgwe Referral	1174	59.94
Mathathane	Bobonong	652	88.04
Matlapana	Letsholathebe II Memorial	227	59.91
Matlhako	Sefhare	182	59.89
Matlhakola	Sefhare	177	12.99
Matobo	Tutume	289	59.86
Matshelagabedi	Nyangabgwe Referral	659	87.97
Matsiloje	Nyangabgwe Referral	595	88.02
Matsitama	Nyangabgwe Referral	431	0.93
Maubelo	Tsabong	67	88.06
Maun	Maun	10311	87.99
Maunatlala	Palapye	881	87.97
Mbalambi	Masunga	196	60.20
Metlobo	Goodhope	233	12.88
Metlojane	Goodhope	164	87.80
Metsimotlhabe	Thamaga	2179	68.34
Mhalapitsa	Sefhare	251	88.05
Middlepits	Tsabong	148	87.84
Mmadikola	Rakops	234	88.03
Mmadinare	Mmadinare	3319	87.98
Mmakgori	Goodhope	165	12.73
Mmankgodi	Thamaga	1753	68.38
Mmanoko	Scottish Livingstone	262	59.92
Mmanxotae	Tutume	142	12.68
Mmaphashalala	Mahalapye	295	60.00
Mmashoro	Sekgoma Memorial	541	87.98
Mmathethe	Goodhope	1464	87.98
Mmathubudukwane	Deborah Retief Memorial	488	12.91
Mmatseta	Thamaga	121	68.05
Mmatshumo	Orapa mine	361	13.02
Mmeya	Nyangabgwe Referral	155	1.29
Mmopane	Thamaga	4194	68.35
Mmutlana	Mahalapye	230	60.00
Mochudi	Deborah Retief Memorial	10116	87.99
Modipane	Deborah Retief Memorial	710	88.03
Moeng	Sefhare	271	12.92

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Mogapi	Bobonong	430	60.00
Mogapinyana	Palapye	307	87.95
Mogobane	Bamalete Lutheren	527	88.05
Mogoditshane	Thamaga	13782	68.35
Mogojogojo	Goodhope	414	59.90
Mogome	Palapye	107	59.81
Mogomotho	Gumare	126	0.79
Mogonye	Thamaga	72	46.39
Mogorosi	Sekgoma Memorial	513	87.91
Mohembo East	Gumare	77	59.74
Mohembo West	Gumare	280	87.86
Moiyabana	Sekgoma Memorial	918	88.02
Mokatako	Goodhope	321	59.81
Mokgenene	Deborah Retief Memorial	208	0.96
Mokgomane	Goodhope	244	13.11
Mokhomba	Jwaneng mine	136	60.29
Mokobeng	Sefhare	627	59.97
Mokoboxane	Orapa mine	364	87.91
Mokolodi	Bamalete Lutheren	147	87.76
Mokoswane	Mahalapye	135	12.59
Mokubilo		468	0.00
Molalatau	Bobonong	680	60.00
Molapowabojang	SDA Kanye	1172	87.97
Molepolole	Scottish Livingstone	17183	87.99
Moletemane	Bobonong	364	12.91
Monwane	Scottish Livingstone	68	13.23
Mookane	Mahalapye	801	59.92
Mopipi	Orapa mine	1148	87.98
Moralane	Sekgoma Memorial	235	12.77
Moremi	Palapye	114	13.16
Moreomabele	Sekgoma Memorial	107	59.81
Moreomaoto	Rakops	146	87.67
Moroka	Masunga	320	88.12
Morwa	Deborah Retief Memorial	784	88.01
Morwamosu	Jwaneng mine	155	87.74
Mosetse	Tutume	447	59.96
Moshaneng	SDA Kanye	205	60.00

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Moshaweng		396	0.00
Moshopha	Sefhare	392	59.95
Moshupa	SDA Kanye	3011	87.98
Mosojane	Masunga	229	59.83
Mosolotshane	Mahalapye	602	88.04
Mosu		590	0.00
Motlhabaneng	Bobonong	330	13.03
Motokwe	Jwaneng mine	285	60.00
Motshegaletau	Sekgoma Memorial	170	88.23
Mowana	Bobonong	91	60.44
Muchinje/Mabele	Kasane	209	59.81
Mulambakwena	Masunga	184	88.04
Nata	Tutume	1517	88.00
Natale	Nyangabgwe Referral	270	12.96
Ncojane	Ghanzi	447	87.92
New Xade	Ghanzi	255	87.84
New Xanagas	Ghanzi	177	1.13
Ngarange	Gumare	204	12.75
Ngwapa	Sefhare	122	59.84
Ngware	Scottish Livingstone	200	88.00
Nkange	Tutume	716	87.99
Nlakhwane	Masunga	299	87.96
Nokaneng	Gumare	480	87.92
Nshakashokwe	Masunga	482	87.97
Nswazwi	Tutume	429	87.88
Ntlhantlhe	Bamalete Lutheren	308	60.06
Nxamasere	Gumare	223	13.00
Nxaunxau		95	0.00
Oliphants Drift	Deborah Retief Memorial	270	88.15
Omaweneno	Tsabong	129	13.18
Oodi	Deborah Retief Memorial	1264	87.97
Orapa	Orapa mine	1570	87.96
Otse 1	Bamalete Lutheren	1547	87.98
Otse 2	Mahalapye	488	1.02
Paje	Sekgoma Memorial	510	88.04
Palapye	Palapye	7314	87.99

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Palla Road/Dinokwe	Mahalapye	368	60.05
Pandamatenga	Kasane	546	87.91
Papatlo	Goodhope	108	87.96
Parakarungu	Kasane	225	0.89
Phepheng	Tsabong	129	59.69
Phihitshwane	SDA Kanye	144	13.19
Phuduhudu 1	Gweta	94	12.77
Phuduhudu 2	Jwaneng mine	131	60.31
Pilane (Station)	Deborah Retief Memorial	386	88.08
Pilikwe	Sefhare	371	87.87
Pitsana-Potokwe	Goodhope	173	87.86
Pitsane Siding	Goodhope	772	87.95
Pitseng	Jwaneng mine	133	87.97
Pitshane Molopo	Goodhope	429	87.88
Poloka	Deborah Retief Memorial	206	13.11
Qabo		133	0.00
Qangwa	Gumare	166	87.95
Radisele	Palapye	555	87.93
Rakhuna	Goodhope	286	88.11
Ramaphatle	Thamaga	169	68.49
Ramatlabama	Goodhope	311	88.10
Ramokgonami	Sefhare	1115	87.98
Ramokgwebana	Masunga	293	88.05
Ramonaka	Deborah Retief Memorial	123	13.01
Ramotlabaki	Deborah Retief Memorial	123	0.81
Ramotswa station	Bamalete Lutheren	825	88.00
Ramotswa	Bamalete Lutheren	5894	87.99
Ranaka	SDA Kanye	344	59.88
Rasesa	Deborah Retief Memorial	967	88.00
Ratholo	Sefhare	449	59.91
Robelela	Mmadinare	229	13.10
Salajwe	Scottish Livingstone	433	0.92
Samochema	Gumare	163	60.12
Satau	Kasane	129	13.18
Sebina	Masunga	723	87.97
Sechele	Masunga	100	60.00

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Sedibeng	Goodhope	154	59.74
Sefhare	Sefhare	1285	88.02
Sefophe	Bobonong	1517	88.00
Segwagwa	Goodhope	172	1.16
Seherelela	Scottish Livingstone	91	87.91
Sehithwa	Maun	807	87.97
Sehunou	Sekgoma Memorial	187	88.23
Sekakangwe	Masunga	179	88.27
Sekhutlane	Goodhope	218	12.84
Sekoma	Jwaneng mine	305	12.79
Sekondomboro	Gumare	89	59.55
Selebi-Phikwe	Selebi Phikwe gvnt	13602	13.01
Seleka	Sefhare	281	87.90
Selokolela	SDA Kanye	265	12.83
Semane	Jwaneng mine	96	12.50
Semitwe	Tutume	154	88.31
Semolale	Bobonong	346	87.86
Senete	Tutume	559	88.01
Senyawe	Masunga	255	60.00
Seolwane	Palapye	269	88.10
Sepako	Tutume	145	0.69
Sepopa	Gumare	398	60.05
Serinane	Scottish Livingstone	105	60.00
Seronga	Gumare	524	87.98
Serowe urban	Sekgoma Memorial	10247	88.00
Serule	Palapye	648	87.96
Sese	Jwaneng mine	370	88.11
Sesung 1	SDA Kanye	98	13.27
Sesung 2	Scottish Livingstone	198	60.10
Shadishadi		351	0.00
Shakawe	Gumare	1046	87.95
Shakwe	Mahalapye	301	12.96
Shashe Bridge	Nyangabgwe Referral	207	87.88
Shashe	Nyangabgwe Referral	687	88.02
Shashe-Mooke	Nyangabgwe Referral	790	59.97
Shorobe	Maun	443	88.03
Shoshong	Mahalapye	2883	88.00

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Sikwane	Deborah Retief Memorial	315	13.02
Siviya	Masunga	244	59.84
Sojwe	Mahalapye	989	1.01
Sorilatholo	Scottish Livingstone	120	0.83
Sowa	Tutume	769	88.04
Struizendam		67	0.00
Takatokwane	Scottish Livingstone	497	1.01
Tamasane	Palapye	262	59.92
Tati Siding	Nyangabgwe Referral	1549	87.95
Taupye	Mahalapye	145	88.27
Tewane	Palapye	156	60.26
Thabala	Sekgoma Memorial	577	88.04
Thamaga	Thamaga	5429	68.35
Themashanga	Masunga	322	87.89
Tlhankane	Jwaneng mine	90	1.11
Tlhareseleele	Goodhope	150	88.00
Tloaneng	Bamalete Lutheren	204	12.75
Tlokweng	Princess Marina	7249	88.00
Tobane	Mmadinare	591	59.90
Tonota	Nyangabgwe Referral	4711	59.92
Topisi	Sekgoma Memorial	358	60.05
Toromoja	Rakops	253	60.08
Toteng	Maun	402	59.95
Tsabong	Tsabong	1234	88.01
Tsamaya	Masunga	452	88.05
Tsao(u)	Maun	478	88.07
Tsetsebjwe	Bobonong	1060	88.02
Tsetseng	Hukuntsi	68	13.24
Tshesebe	Masunga	450	88.00
Tshidilamolomo	Goodhope	161	60.25
Tshimoyapula	Sekgoma Memorial	326	12.88
Tshokatshaa	Gweta	124	12.90
Tshokwe	Mmadinare	256	87.89
Tsienyane/Rakops	Rakops	1584	88.01
Tsonyane	Jwaneng mine	93	1.08
Tsootsha	Ghanzi	378	88.10
Tswaane	Jwaneng mine	84	1.19

Table A.8. The percentage of treated people in each community according to strategy (d)

Community	HCF	HIV-infected	Treated(%)
Tswaaneng	Goodhope	183	87.98
Tswanyaneng	Goodhope	145	88.28
Tubu	Gumare	88	60.23
Tutume	Tutume	3590	87.99
Ukwi	Ghanzi	104	0.96
Werda	Tsabong	444	88.06
West Hanahai	Ghanzi	136	0.74
Xakao	Gumare	251	88.05
Xaxa		83	0.00
Xhauga	Gumare	124	87.90
Xhumo	Rakops	504	87.90
Zoroga	Tutume	278	60.07
Zutswa		113	0.00
Zwenshambe	Masunga	367	88.01

Table A.9. Allocated ART amount to each HCF according to strategy (e)

HCF no.	HCF name	ART	ART (%)
HCF 01	Bamalete Lutheren	7908	2.79
HCF 02	Bobonong	8646	3.06
HCF 03	Deborah Retief Memorial	15047	5.32
HCF 04	Ghanzi	4324	1.53
HCF 05	Goodhope	7254	2.56
HCF 06	Gumare	5551	1.96
HCF 07	Gweta	1240	0.44
HCF 08	Hukuntsi	2434	0.86
HCF 09	Jwaneng mine	3783	1.34
HCF 10	Kasane	3286	1.16
HCF 11	Letlhakane	2355	0.83
HCF 12	Letsholathebe II Memorial	136	0.05
HCF 13	Lobatse-Atholone	2357	0.83
HCF 14	Mahalapye	15223	5.38
HCF 15	Masunga	6250	2.21
HCF 16	Maun	10732	3.79
HCF 17	Mmadinare	3560	1.26
HCF 18	Nyangabgwe Referral	31390	11.09
HCF 19	Orapa mine	2505	0.89
HCF 20	Palapye	11153	3.94
HCF 21	Princess Marina	41084	14.52
HCF 22	Rakops	2282	0.81
HCF 23	Scottish Livingstone	19598	6.93
HCF 24	SDA Kanye	11106	3.92
HCF 25	Sefhare	5686	2.01
HCF 26	Sekgoma Memorial	12306	4.35
HCF 27	Selebi Phikwe gvnt	2283	0.81
HCF 28	Thamaga	31021	10.96
HCF 29	Tsabong	2308	0.82
HCF 30	Tutume	10168	3.59

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Artisia	Deborah Retief Memorial	708	83.59
Beetsha	Gumare	223	85.02
Bere		135	0.00
Boatlaname	Scottish Livingstone	419	0.95
Bobonong	Bobonong	4917	85.30
Bodibeng	Maun	122	80.49
Bokaa	Deborah Retief Memorial	1391	83.59
Bokspits		84	0.00
Bonwapitse	Mahalapye	167	59.88
Borolong	Nyangabgwe Referral	1034	59.36
Borotsi 1	Mahalapye	228	88.16
Borotsi 2	Nyangabgwe Referral	375	12.67
Botlhapatlou	Scottish Livingstone	268	60.07
Botlhatlogo	Maun	111	55.40
Bray	Tsabong	135	0.70
Butale	Masunga	105	56.47
Chadibe 1	Sefhare	778	88.05
Chadibe 2	Nyangabgwe Referral	1024	59.36
Changate	Tutume	232	80.68
Charles Hill	Ghanzi	659	85.80
Chobokwane	Ghanzi	196	12.43
Dekar (D'kar)	Ghanzi	290	12.44
Dibete Station	Deborah Retief Memorial	345	57.00
Digawana	Goodhope	697	84.84
Dikgonnye	Deborah Retief Memorial	119	11.97
Diloro	Palapye	96	80.88
Dimajwe	Sekgoma Memorial	281	1.00
Dinatshana	SDA Kanye	127	12.54
Diphuduhudu	Scottish Livingstone	71	12.68
Ditladi	Nyangabgwe Referral	298	12.62
Ditlharapa	Goodhope	138	12.58
Ditshegwane	Scottish Livingstone	337	59.94
Dovedale	Mahalapye	235	0.85
Dukwi	Tutume	1277	80.77
Dutlwe		194	0.00
East Hanahai		97	0.00
Eretsha	Gumare	129	57.74

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Etsha 1	Gumare	180	12.36
Etsha 13	Gumare	380	85.02
Etsha 6	Gumare	738	57.93
Francistown	Nyangabgwe Referral	26056	87.11
Gabane	Thamaga	3919	85.59
Gaborone	Princess Marina	39912	87.11
Gachibana	Tsabong	128	83.69
Gakgatla	Thamaga	171	58.59
Gakutlo	Thamaga	430	85.51
Gamabuo	Sekgoma Memorial	135	82.74
Gamodubu	Thamaga	154	58.11
Gani	Gumare	102	12.33
Gasita	Jwaneng mine	262	1.13
Gathwane	Goodhope	221	57.62
Ghanzi town	Ghanzi	2830	85.78
Gojwane	Sekgoma Memorial	267	56.25
Gonutsuga	Gumare	134	85.18
Good Hope	Goodhope	1348	84.87
Goo-Sekgweng	Sefhare	104	59.62
Gootau	Sefhare	254	59.84
Goshwe	Tutume	347	11.90
Groote Laagte		178	0.00
Gudingwa	Gumare	102	12.33
Gulubane	Tutume	163	55.17
Gumare	Gumare	1265	85.11
Gungwe	Masunga	103	56.65
Gweta	Gweta	1377	88.02
Habu	Maun	84	12.02
Hatsalatladi	Scottish Livingstone	373	60.05
Hebron	Goodhope	201	58.07
Hukuntsi	Hukuntsi	945	79.71
Hunhukwe	Hukuntsi	185	79.77
Ikoga	Gumare	172	84.92
Ikongwe	Mahalapye	129	59.69
Inalegolo	Jwaneng mine	129	58.76
Itholoke		121	0.00
Jackalas 1	Mmadinare	242	12.81

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Jackalas 2	Masunga	231	56.22
Jamataka	Nyangabgwe Referral	128	13.15
Jwaneng town	Jwaneng mine	2108	86.63
K(G)obojango	Bobonong	491	58.04
Kacgae		110	0.00
Kachikau	Kasane	311	55.36
Kalakamati	Masunga	162	83.07
Kalamare	Mahalapye	662	88.07
Kang	Hukuntsi	1307	79.66
Kanye town	SDA Kanye	6488	87.58
Karako(u)bis	Ghanzi	202	58.40
Kareng	Maun	307	80.72
Kasane	Kasane	1919	81.46
Kaudwane		145	0.00
Kauxwhi	Gumare	315	58.04
Kavimba	Kasane	135	81.59
Kazungula	Kasane	897	81.41
Kedia	Rakops	271	78.24
Keng	Jwaneng mine	234	12.62
Kgagodi	Palapye	337	81.46
Kgari	Masunga	101	82.93
Kgomodiatshaba	Deborah Retief Memorial	133	0.71
Kgomokasitwa	Bamalete Lutheren	181	12.22
Kgoro	Goodhope	150	57.88
Khakhea	Tsabong	669	0.99
Khisa		60	0.00
Khonkhwa	Jwaneng mine	108	12.76
Khudumelapye	Scottish Livingstone	420	88.10
Khuis	Tsabong	136	83.65
Khwawa		109	0.00
Khwee		262	0.00
Kodibeleng	Mahalapye	436	12.84
Kokong	Jwaneng mine	220	86.81
Kokotsha	Tsabong	193	56.98
Kolonkwane (Kolonkwaneng)	Tsabong	92	56.67
Kopong	Thamaga	2609	85.61

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Kotolana	Scottish Livingstone	80	12.50
Kubung	SDA Kanye	255	59.72
Kudumatse	Mahalapye	521	0.96
Kule	Ghanzi	183	58.60
Kumakwane	Thamaga	1387	85.57
Kutamogree	Masunga	209	56.29
Kweneng	Deborah Retief Memorial	156	1.22
Lecheng	Palapye	672	81.29
Lefoko	Jwaneng mine	70	87.20
Lehututu	Hukuntsi	403	79.75
Lejwana	Goodhope	131	58.17
Lekgolobotlo	Bamalete Lutheren	149	12.26
Lentsweletau	Scottish Livingstone	1755	87.98
Leologane		194	0.00
Lepashe	Tutume	113	12.18
Lephephe	Mahalapye	267	1.12
Lepokole	Bobonong	216	85.26
Leporung	Goodhope	140	57.88
Lerala	Palapye	1327	81.36
Lesenepole/Matolwane	Palapye	557	81.31
Leshibitse	Deborah Retief Memorial	173	57.11
Lesoma	Kasane	162	81.70
Letlhakane	Letlhakane	5776	40.77
Letlhakeng	Scottish Livingstone	1316	87.99
Letsholathebe	Masunga	116	56.79
Lobatse town	Lobatse-Atholone	4901	48.09
Lokgwabe	Hukuntsi	298	54.38
Lorolwana		223	0.00
Lorwana	Goodhope	249	84.84
Lotlhakane	SDA Kanye	647	87.53
Lotlhakane West	SDA Kanye	203	87.76
Maape	Sefhare	324	59.88
Mabalane	Deborah Retief Memorial	182	12.53
Mabeleapudi	Sekgoma Memorial	457	82.57
Mabesekwa		475	0.00
Maboane	Scottish Livingstone	283	13.07
Mabolwe	Bobonong	173	85.16

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Mabudzane	Masunga	106	56.82
Mabule	Goodhope	483	84.88
Mabutsane	Jwaneng mine	506	86.58
Machaneng	Sefhare	644	88.04
Mafongo/Hobona	Tutume	234	54.90
Magoriapitse	Goodhope	215	57.88
Magotlhwane	Bamalete Lutheren	179	57.47
Mahalapye town	Mahalapye	11262	87.99
Mahetlwe	Scottish Livingstone	249	12.85
Mahotshwane	SDA Kanye	254	12.93
Maitengwe	Tutume	1202	80.77
Majwanaadipitse	Sekgoma Memorial	120	12.52
Majwaneng	Palapye	361	55.31
Makalamabedi	Maun	459	80.78
Makaleng	Masunga	237	82.99
Makobo	Nyangabgwe Referral	294	12.80
Makopong	Tsabong	241	83.39
Makunda	Ghanzi	197	58.39
Makuta	Tutume	199	80.69
Makwate	Mahalapye	437	0.92
Malaka	Palapye	190	55.46
Malatswai	Sekgoma Memorial	269	12.21
Maleshe	Tsabong	69	56.33
Malolwane	Deborah Retief Memorial	613	12.24
Malotwana Siding	Deborah Retief Memorial	186	83.76
Malwelwe	Scottish Livingstone	158	60.13
Mambo	Masunga	107	82.68
Mandunyane	Nyangabgwe Referral	839	12.74
Mantshwabisi	Scottish Livingstone	143	12.59
Manyana	SDA Kanye	483	87.58
Maokane	Jwaneng mine	330	59.07
Mapoka	Masunga	338	82.70
Maralaleng	Tsabong	79	12.00
Marapong	Tutume	523	80.71
Marobela	Tutume	374	80.72
Masingwaneng	Masunga	128	56.61
Masukwane	Masunga	119	56.15

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Masunga	Masunga	1071	82.78
Matebeleng	Deborah Retief Memorial	556	83.55
Mathangwane	Nyangabgwe Referral	1174	59.37
Mathathane	Bobonong	652	85.33
Matlapana	Letsholathebe II Memorial	227	59.91
Matlhako	Sefhare	182	59.89
Matlhakola	Sefhare	177	12.99
Matobo	Tutume	289	54.93
Matshelagabedi	Nyangabgwe Referral	659	87.13
Matsiloje	Nyangabgwe Referral	595	87.19
Matsitama	Nyangabgwe Referral	431	0.92
Maubelo	Tsabong	67	83.48
Maun town	Maun	10311	80.76
Maunatlala	Palapye	881	81.31
Mbalambi	Masunga	196	56.66
Metlobo	Goodhope	233	12.42
Metlojane	Goodhope	164	84.70
Metsimotlhabe	Thamaga	2179	85.58
Mhalapitsa	Sefhare	251	88.05
Middlepits	Tsabong	148	83.27
Mmadikola	Rakops	234	78.43
Mmadinare	Mmadinare	3319	87.98
Mmakgori	Goodhope	165	12.28
Mmankgodi	Thamaga	1753	85.63
Mmanoko	Scottish Livingstone	262	59.92
Mmanxotae	Tutume	142	11.63
Mmaphashalala	Mahalapye	295	60.00
Mmashoro	Sekgoma Memorial	541	82.59
Mmathethe	Goodhope	1464	84.87
Mmathubudukwane	Deborah Retief Memorial	488	12.26
Mmatseta	Thamaga	121	85.22
Mmatshumo	Orapa mine	361	11.82
Mmeya	Nyangabgwe Referral	155	1.28
Mmopane	Thamaga	4194	85.59
Mmutlana	Mahalapye	230	60.00
Mochudi	Deborah Retief Memorial	10116	83.59
Modipane	Deborah Retief Memorial	710	83.63

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Moeng	Sefhare	271	12.92
Mogapi	Bobonong	430	58.16
Mogapinyana	Palapye	307	81.29
Mogobane	Bamalete Lutheren	527	84.64
Mogoditshane	Thamaga	13782	85.60
Mogojogojo	Goodhope	414	57.79
Mogome	Palapye	107	55.29
Mogomotho	Gumare	126	0.77
Mogonye	Thamaga	72	58.10
Mogorosi	Sekgoma Memorial	513	82.52
Mohembo East	Gumare	77	57.79
Mohembo West	Gumare	280	84.99
Moiyabana	Sekgoma Memorial	918	82.62
Mokatako	Goodhope	321	57.70
Mokgenene	Deborah Retief Memorial	208	0.91
Mokgomane	Goodhope	244	12.65
Mokhomba	Jwaneng mine	136	59.36
Mokobeng	Sefhare	627	59.97
Mokoboxane	Orapa mine	364	79.84
Mokolodi	Bamalete Lutheren	147	84.37
Mokoswane	Mahalapye	135	12.59
Mokubilo		468	0.00
Molalatau	Bobonong	680	58.16
Molapowabojang	SDA Kanye	1172	87.56
Molepolole	Scottish Livingstone	17183	87.99
Moletemane	Bobonong	364	12.52
Monwane	Scottish Livingstone	68	13.24
Mookane	Mahalapye	801	59.93
Mopipi	Orapa mine	1148	79.90
Moralane	Sekgoma Memorial	235	11.98
Moremi	Palapye	114	12.16
Moreomabele	Sekgoma Memorial	107	56.15
Moreomaoto	Rakops	146	78.11
Moroka	Masunga	320	82.94
Morwa	Deborah Retief Memorial	784	83.61
Morwamosu	Jwaneng mine	155	86.38
Mosetse	Tutume	447	55.01

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Moshaneng	SDA Kanye	205	59.72
Moshaweng		396	0.00
Moshopha	Sefhare	392	59.95
Moshupa town	SDA Kanye	3011	87.56
Mosojane	Masunga	229	56.30
Mosolotshane	Mahalapye	602	88.04
Mosu		590	0.00
Motlhabaneng	Bobonong	330	12.63
Motokwe	Jwaneng mine	285	59.07
Motshegaletau	Sekgoma Memorial	170	82.83
Mowana	Bobonong	91	58.58
Muchinje/Mabele	Kasane	209	55.36
Mulambakwena	Masunga	184	82.86
Nata	Tutume	1517	80.75
Natale	Nyangabgwe Referral	270	12.83
Ncojane	Ghanzi	447	85.71
New Xade	Ghanzi	255	85.64
New Xanagas	Ghanzi	177	1.10
Ngarange	Gumare	204	12.33
Ngwapa	Sefhare	122	59.84
Ngware	Scottish Livingstone	200	88.00
Nkange	Tutume	716	80.74
Nlakhwane	Masunga	299	82.78
Nokaneng	Gumare	480	85.04
Nshakashokwe	Masunga	482	82.79
Nswazwi	Tutume	429	80.64
Ntlhantlhe	Bamalete Lutheren	308	57.74
Nxamasere	Gumare	223	12.58
Nxaunxau		95	0.00
Oliphants Drift	Deborah Retief Memorial	270	83.74
Omaweneno	Tsabong	129	12.49
Oodi	Deborah Retief Memorial	1264	83.58
Orapa town	Orapa mine	1570	79.89
Otse 1	Bamalete Lutheren	1547	84.58
Otse 2	Mahalapye	488	1.02
Paje	Sekgoma Memorial	510	82.64
Palapye town	Palapye	7314	81.34

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Palla Road/Dinokwe	Mahalapye	368	60.05
Pandamatenga	Kasane	546	81.37
Papatlo	Goodhope	108	84.85
Parakarungu	Kasane	225	0.82
Phepheng/Draaihoek	Tsabong	129	56.59
Phihitshwane	SDA Kanye	144	13.13
Phuduhudu 1	Gweta	94	12.77
Phuduhudu 2	Jwaneng mine	131	59.37
Pilane (Station)	Deborah Retief Memorial	386	83.68
Pilikwe	Sefhare	371	87.87
Pitsana-Potokwe	Goodhope	173	84.76
Pitsane Siding	Goodhope	772	84.84
Pitseng	Jwaneng mine	133	86.61
Pitshane Molopo	Goodhope	429	84.77
Poloka	Deborah Retief Memorial	206	12.45
Qabo		133	0.00
Qangwa	Gumare	166	85.08
Radisele	Palapye	555	81.27
Rakhuna	Goodhope	286	85.00
Ramaphatle	Thamaga	169	85.77
Ramatlabama	Goodhope	311	84.99
Ramokgonami	Sefhare	1115	87.98
Ramokgwebana	Masunga	293	82.87
Ramonaka	Deborah Retief Memorial	123	12.36
Ramotlabaki	Deborah Retief Memorial	123	0.77
Ramotswa station/Taung	Bamalete Lutheren	825	84.60
Ramotswa	Bamalete Lutheren	5894	84.59
Ranaka	SDA Kanye	344	59.60
Rasesa	Deborah Retief Memorial	967	83.60
Ratholo	Sefhare	449	59.91
Robelela	Mmadinare	229	13.10
Salajwe	Scottish Livingstone	433	0.92
Samochema	Gumare	163	58.16
Satau	Kasane	129	12.20
Sebina	Masunga	723	82.79

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Sechele	Masunga	100	56.47
Sedibeng	Goodhope	154	57.63
Sefhare	Sefhare	1285	88.02
Sefophe	Bobonong	1517	85.30
Segwagwa	Goodhope	172	1.12
Seherelela	Scottish Livingstone	91	87.91
Sehithwa	Maun	807	80.75
Sehunou	Sekgoma Memorial	187	82.83
Sekakangwe	Masunga	179	83.07
Sekhutlane	Goodhope	218	12.39
Sekoma	Jwaneng mine	305	12.59
Sekondomboro	Gumare	89	57.60
Selebi-Phikwe town	Selebi Phikwe gvnt	13602	16.79
Seleka	Sefhare	281	87.90
Selokolela	SDA Kanye	265	12.77
Semane	Jwaneng mine	96	12.31
Semitwe	Tutume	154	81.03
Semolale	Bobonong	346	85.16
Senete	Tutume	559	80.76
Senyawe	Masunga	255	56.47
Seolwane	Palapye	269	81.44
Sepako	Tutume	145	0.63
Sepopa	Gumare	398	58.09
Serinane	Scottish Livingstone	105	60.00
Seronga	Gumare	524	85.10
Serowe urban	Sekgoma Memorial	10247	82.60
Serule	Palapye	648	81.31
Sese	Jwaneng mine	370	86.74
Sesung 1	SDA Kanye	98	13.20
Sesung 2	Scottish Livingstone	198	60.10
Shadishadi		351	0.00
Shakawe	Gumare	1046	85.08
Shakwe	Mahalapye	301	12.96
Shashe Bridge	Nyangabgwe Referral	207	87.04
Shashe/Semotswane	Nyangabgwe Referral	687	87.18
Shashe-Mooke	Nyangabgwe Referral	790	59.40
Shorobe	Maun	443	80.80

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Shoshong	Mahalapye	2883	88.00
Sikwane	Deborah Retief Memorial	315	12.36
Siviya	Masunga	244	56.31
Sojwe	Mahalapye	989	1.01
Sorilatholo	Scottish Livingstone	120	0.83
Sowa town	Tutume	769	80.78
Struizendam		67	0.00
Takatokwane	Scottish Livingstone	497	1.01
Tamasane	Palapye	262	55.39
Tati Siding	Nyangabgwe Referral	1549	87.11
Taupye	Mahalapye	145	88.28
Tewane	Palapye	156	55.70
Thabala	Sekgoma Memorial	577	82.64
Thamaga	Thamaga	5429	85.60
Themashanga	Masunga	322	82.71
Tlhankane	Jwaneng mine	90	1.09
Tlhareseleele	Goodhope	150	84.89
Tloaneng	Bamalete Lutheren	204	12.25
Tlokweng	Princess Marina	7249	87.12
Tobane	Mmadinare	591	59.90
Tonota	Nyangabgwe Referral	4711	59.35
Topisi	Sekgoma Memorial	358	56.37
Toromoja	Rakops	253	53.52
Toteng	Maun	402	55.02
Tsabong town	Tsabong	1234	83.43
Tsamaya	Masunga	452	82.87
Tsao(u)	Maun	478	80.83
Tsetsebjwe	Bobonong	1060	85.31
Tsetseng	Hukuntsi	68	11.98
Tshesebe	Masunga	450	82.82
Tshidilamolomo	Goodhope	161	58.12
Tshimoyapula	Sekgoma Memorial	326	12.09
Tshokatshaa	Gweta	124	12.90
Tshokwe	Mmadinare	256	87.89
Tsienyane/Rakops	Rakops	1584	78.40
Tsonyane	Jwaneng mine	93	1.06
Tsootsha(Kalkfontein)	Ghanzi	378	85.88

Table A.10. The percentage of treated people in each community according to strategy (e)

Community	HCF	HIV-infected	Treated(%)
Tswaane	Jwaneng mine	84	1.17
Tswaaneng	Goodhope	183	84.87
Tswanyaneng	Goodhope	145	85.16
Tubu	Gumare	88	58.26
Tutume	Tutume	3590	80.74
Ukwi	Ghanzi	104	0.94
Werda	Tsabong	444	83.48
West Hanahai	Ghanzi	136	0.72
Xakao	Gumare	251	85.17
Xaxa		83	0.00
Xhauga	Gumare	124	85.03
Xhumo	Rakops	504	78.31
Zoroga	Tutume	278	55.12
Zutswa		113	0.00
Zwenshambe	Masunga	367	82.83

Table A.11. Allocated COVID-19 vaccine amount to each HCF

HCF no.	HCF name	Vaccine	Vaccine (%)
HCF 01	Bamalete Lutheren	5602	1.52
HCF 02	Bobonong	9524	2.58
HCF 03	Deborah Retief Memorial	23843	6.46
HCF 04	Ghanzi	8092	2.19
HCF 05	Goodhope	6548	1.77
HCF 06	Gumare	6542	1.77
HCF 07	Gweta	2839	0.77
HCF 08	Hukuntsi	2302	0.62
HCF 09	Jwaneng mine	6445	1.75
HCF 10	Kasane	3921	1.06
HCF 11	Letlhakane	3576	0.97
HCF 12	Letsholathebe II Memorial	989	0.27
HCF 13	Lobatse-Atholone	13893	3.77
HCF 14	Mahalapye	17931	4.86
HCF 15	Masunga	5320	1.44
HCF 16	Maun	14449	3.92
HCF 17	Mmadinare	4475	1.21
HCF 18	Nyangabgwe Referral	51791	14.04
HCF 19	Orapa mine	3090	0.84
HCF 20	Palapye	19408	5.26
HCF 21	Princess Marina	25161	6.82
HCF 22	Rakops	3185	0.86
HCF 23	Scottish Livingstone	39166	10.62
HCF 24	SDA Kanye	19619	5.32
HCF 25	Sefhare	6975	1.89
HCF 26	Sekgoma Memorial	22804	6.18
HCF 27	Selebi Phikwe gvnt	13876	3.76
HCF 28	Thamaga	14004	3.80
HCF 29	Tsabong	2688	0.73
HCF 30	Tutume	10870	2.95

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Artisia	Deborah Retief Memorial	2230	30.11
Beetsha	Gumare	1027	0.00
Bere		676	0.67
Boatlaname	Scottish Livingstone	1658	21.59
Bobonong	Bobonong	13223	46.63
Bodibeng	Maun	534	4.37
Bokaa	Deborah Retief Memorial	4360	44.19
Bokspits		486	0.00
Bonwapitse	Mahalapye	458	40.73
Borolong	Nyangabgwe Referral	3672	41.49
Borotsi 1	Mahalapye	563	40.78
Borotsi 2	Nyangabgwe Referral	1513	28.26
Botlhapatlou	Scottish Livingstone	1351	40.96
Botlhatlogo	Maun	513	10.67
Bray	Tsabong	779	0.00
Butale	Masunga	401	12.22
Chadibe 1	Sefhare	1919	44.22
Chadibe 2	Nyangabgwe Referral	3637	41.49
Changate	Tutume	775	24.69
Charles Hill	Ghanzi	2738	0.63
Chobokwane	Ghanzi	955	20.32
Dekar (D'kar)	Ghanzi	1415	38.52
Dibete Station	Deborah Retief Memorial	952	27.74
Digawana	Goodhope	2086	39.51
Dikgonnye	Deborah Retief Memorial	460	30.10
Diloro	Palapye	353	18.92
Dimajwe	Sekgoma Memorial	1256	0.53
Dinatshana	SDA Kanye	472	30.94
Diphuduhudu	Scottish Livingstone	393	0.70
Ditladi	Nyangabgwe Referral	1266	28.27
Ditlharapa	Goodhope	512	5.34
Ditshegwane	Scottish Livingstone	1700	21.62
Dovedale	Mahalapye	782	5.98
Dukwi	Tutume	4247	24.67
Dutlwe		1093	0.69
East Hanahai		486	8.34
Eretsha	Gumare	626	0.00
Etsha 1	Gumare	959	32.15

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Etsha 13	Gumare	1746	32.14
Etsha 6	Gumare	3574	32.14
Francistown	Nyangabgwe Referral	66615	41.49
Gabane	Thamaga	12203	8.52
Gaborone	Princess Marina	173655	8.52
Gachibana	Tsabong	633	4.73
Gakgatla	Thamaga	579	30.81
Gakutlo	Thamaga	1347	8.53
Gamabuo	Sekgoma Memorial	491	30.92
Gamodubu	Thamaga	524	40.95
Gani	Gumare	544	0.00
Gasita	Jwaneng mine	1509	16.31
Gathwane	Goodhope	722	36.46
Ghanzi	Ghanzi	11695	56.56
Gojwane	Sekgoma Memorial	1046	14.93
Gonutsuga	Gumare	617	16.93
Good Hope	Goodhope	4014	36.46
Goo-Sekgweng	Sefhare	405	30.13
Gootau	Sefhare	989	30.14
Goshwe	Tutume	1399	24.68
Groote Laagte		892	8.29
Gudingwa	Gumare	543	0.00
Gulubane	Tutume	623	28.30
Gumare	Gumare	5784	47.17
Gungwe	Masunga	393	23.18
Gweta	Gweta	4510	36.56
Habu	Maun	424	6.95
Hatsalatladi	Scottish Livingstone	1261	40.96
Hebron	Goodhope	654	24.83
Hukuntsi	Hukuntsi	3260	34.82
Hunhukwe	Hukuntsi	642	5.12
Ikoga	Gumare	792	16.92
Ikongwe	Mahalapye	355	27.79
Inalegolo	Jwaneng mine	474	0.42
Itholoke		527	0.39
Jackalas 1	Mmadinare	1028	7.08
Jackalas 2	Masunga	882	28.28
Jamataka	Nyangabgwe Referral	514	28.25

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Jwaneng	Jwaneng mine	11866	36.36
K(G)obojango	Bobonong	1460	31.75
Kacgae		551	0.70
Kachikau	Kasane	1152	0.00
Kalakamati	Masunga	576	33.97
Kalamare	Mahalapye	1634	27.75
Kang	Hukuntsi	4509	5.11
Kanye	SDA Kanye	31688	45.43
Karako(u)bis	Ghanzi	894	8.27
Kareng	Maun	1342	4.36
Kasane	Kasane	6582	36.00
Kaudwane		815	0.00
Kauxwhi	Gumare	1532	0.00
Kavimba	Kasane	466	0.00
Kazungula	Kasane	3076	36.00
Kedia	Rakops	845	22.06
Keng	Jwaneng mine	992	13.07
Kgagodi	Palapye	1235	18.83
Kgari	Masunga	359	23.14
Kgomodiatshaba	Deborah Retief Memorial	531	6.53
Kgomokasitwa	Bamalete Lutheren	1022	26.93
Kgoro	Goodhope	490	36.48
Khakhea	Tsabong	2918	5.34
Khisa		344	0.00
Khonkhwa	Jwaneng mine	457	13.02
Khudumelapye	Scottish Livingstone	2002	8.84
Khuis	Tsabong	673	4.72
Khwawa		629	0.00
Khwee		1018	3.00
Kodibeleng	Mahalapye	1397	14.65
Kokong	Jwaneng mine	772	0.00
Kokotsha	Tsabong	1006	0.41
Kolonkwane	Tsabong	478	4.74
Kopong	Thamaga	8124	5.81
Kotolana	Scottish Livingstone	439	40.96
Kubung	SDA Kanye	862	21.01
Kudumatse	Mahalapye	1731	5.99
Kule	Ghanzi	811	0.00

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Kumakwane	Thamaga	4319	30.81
Kutamogree	Masunga	752	24.68
Kweneng	Deborah Retief Memorial	617	8.85
Lecheng	Palapye	2463	35.74
Lefoko	Jwaneng mine	342	24.75
Lehututu	Hukuntsi	1398	34.82
Lejwana	Goodhope	428	36.44
Lekgolobotlo	Bamalete Lutheren	842	30.95
Lentsweletau	Scottish Livingstone	5421	30.10
Leologane		768	8.80
Lepashe	Tutume	457	5.31
Lephephe	Mahalapye	1057	8.79
Lepokole	Bobonong	585	31.80
Leporung	Goodhope	456	13.09
Lerala	Palapye	4839	15.89
Lesenepole	Palapye	2042	6.05
Leshibitse	Deborah Retief Memorial	592	30.12
Lesoma	Kasane	559	36.02
Letlhakane	Letlhakane	17389	20.39
Letlhakeng	Scottish Livingstone	6246	21.60
Letsholathebe	Masunga	441	33.92
Lobatse	Lobatse-Atholone	15284	39.50
Lokgwabe	Hukuntsi	1110	34.83
Lorolwana		1288	0.52
Lorwana	Goodhope	745	39.52
Lotlhakane	SDA Kanye	3162	45.42
Lotlhakane West	SDA Kanye	998	45.40
Maape	Sefhare	890	35.71
Mabalane	Deborah Retief Memorial	705	30.13
Mabeleapudi	Sekgoma Memorial	1669	45.32
Mabesekwa		1976	6.09
Maboane	Scottish Livingstone	1559	8.81
Mabolwe	Bobonong	467	16.80
Mabudzane	Masunga	405	41.52
Mabule	Goodhope	1446	0.40
Mabutsane	Jwaneng mine	1776	5.33
Machaneng	Sefhare	1588	30.12
Mafongo/Hobona	Tutume	844	28.27

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Magoriapitse	Goodhope	701	36.45
Magotlhwane	Bamalete Lutheren	931	26.91
Mahalapye	Mahalapye	27649	40.75
Mahetlwe	Scottish Livingstone	957	40.97
Mahotshwane	SDA Kanye	1078	30.94
Maitengwe	Tutume	3998	24.67
Majwanaadipitse	Sekgoma Memorial	522	16.27
Majwaneng	Palapye	1417	15.89
Makalamabedi	Maun	1410	10.70
Makaleng	Masunga	843	23.15
Makobo	Nyangabgwe Referral	1183	28.25
Makopong	Tsabong	1190	4.72
Makunda	Ghanzi	872	0.66
Makuta	Tutume	665	36.20
Makwate	Mahalapye	1452	14.63
Malaka	Palapye	747	35.74
Malatswai	Sekgoma Memorial	1173	6.63
Maleshe	Tsabong	360	32.15
Malolwane	Deborah Retief Memorial	2372	30.11
Malotwana Siding	Deborah Retief Memorial	587	44.17
Malwelwe	Scottish Livingstone	796	21.64
Mambo	Masunga	382	23.13
Mandunyane	Nyangabgwe Referral	3383	28.27
Mantshwabisi	Scottish Livingstone	786	40.92
Manyana	SDA Kanye	2370	30.80
Maokane	Jwaneng mine	1712	13.08
Mapoka	Masunga	1202	23.14
Maralaleng	Tsabong	447	21.91
Marapong	Tutume	1749	28.28
Marobela	Tutume	1250	28.29
Masingwaneng	Masunga	488	23.16
Masukwane	Masunga	455	23.16
Masunga	Masunga	3788	33.96
Matebeleng	Deborah Retief Memorial	1753	8.52
Mathangwane	Nyangabgwe Referral	4170	41.49
Mathathane	Bobonong	1763	31.77
Matlapana	Letsholathebe II Memorial	1047	41.77
Matlhako	Sefhare	500	35.73

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Matlhakola	Sefhare	772	35.74
Matobo	Tutume	1040	36.20
Matshelagabedi	Nyangabgwe Referral	2315	41.50
Matsiloje	Nyangabgwe Referral	2090	28.27
Matsitama	Nyangabgwe Referral	1787	14.91
Maubelo	Tsabong	330	32.09
Maun	Maun	44892	29.76
Maunatlala	Palapye	3214	6.05
Mbalambi	Masunga	747	33.98
Metlobo	Goodhope	865	5.37
Metlojane	Goodhope	491	36.44
Metsimotlhabe	Thamaga	6785	8.52
Mhalapitsa	Sefhare	620	35.77
Middlepits	Tsabong	730	4.70
Mmadikola	Rakops	732	32.37
Mmadinare	Mmadinare	8864	48.13
Mmakgori	Goodhope	612	5.35
Mmankgodi	Thamaga	5459	30.81
Mmanoko	Scottish Livingstone	886	60.12
Mmanxotae	Tutume	575	5.35
Mmaphashalala	Mahalapye	809	14.65
Mmashoro	Sekgoma Memorial	1976	30.88
Mmathethe	Goodhope	4361	24.84
Mmathubudukwane	Deborah Retief Memorial	1890	30.10
Mmatseta	Thamaga	378	5.82
Mmatshumo	Orapa mine	1363	29.17
Mmeya	Nyangabgwe Referral	641	14.92
Mmopane	Thamaga	13062	8.52
Mmutlana	Mahalapye	631	27.79
Mochudi	Deborah Retief Memorial	31715	44.19
Modipane	Deborah Retief Memorial	2236	8.52
Moeng	Sefhare	1179	15.89
Mogapi	Bobonong	1681	28.08
Mogapinyana	Palapye	1126	18.84
Mogobane	Bamalete Lutheren	2039	39.50
Mogoditshane	Thamaga	42916	8.52
Mogojogojo	Goodhope	1350	26.91
Mogome	Palapye	419	35.69

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Mogomotho	Gumare	686	0.00
Mogonye	Thamaga	373	21.37
Mogorosi	Sekgoma Memorial	1873	45.33
Mohembo East	Gumare	377	0.57
Mohembo West	Gumare	1288	0.54
Moiyabana	Sekgoma Memorial	3336	30.87
Mokatako	Goodhope	1047	13.10
Mokgenene	Deborah Retief Memorial	691	5.96
Mokgomane	Goodhope	904	24.85
Mokhomba	Jwaneng mine	705	24.75
Mokobeng	Sefhare	1719	44.21
Mokoboxane	Orapa mine	1130	11.62
Mokolodi	Bamalete Lutheren	456	8.52
Mokoswane	Mahalapye	433	27.71
Mokubilo		1947	6.27
Molalatau	Bobonong	2020	46.62
Molapowabojang	SDA Kanye	5725	39.50
Molepolole	Scottish Livingstone	53072	60.11
Moletemane	Bobonong	1246	6.85
Monwane	Scottish Livingstone	376	41.03
Mookane	Mahalapye	2197	40.74
Mopipi	Orapa mine	3551	11.63
Moralane	Sekgoma Memorial	755	30.89
Moremi	Palapye	496	18.86
Moreomabele	Sekgoma Memorial	419	35.67
Moreomaoto	Rakops	455	10.70
Moroka	Masunga	1136	23.13
Morwa	Deborah Retief Memorial	2470	44.19
Morwamosu	Jwaneng mine	546	0.38
Mosetse	Tutume	1609	24.68
Moshaneng	SDA Kanye	1064	45.43
Moshaweng		2233	8.81
Moshopha	Sefhare	1076	44.22
Moshupa	SDA Kanye	14706	30.81
Mosojane	Masunga	873	33.94
Mosolotshane	Mahalapye	1484	27.76
Mosu		2293	6.28
Motlhabaneng	Bobonong	1130	16.75

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Motokwe	Jwaneng mine	1439	0.40
Motshegaletau	Sekgoma Memorial	622	30.88
Mowana	Bobonong	345	28.12
Muchinje/Mabele	Kasane	773	0.00
Mulambakwena	Masunga	654	33.97
Nata	Tutume	5046	13.14
Natale	Nyangabgwe Referral	1088	28.25
Ncojane	Ghanzi	1858	0.00
New Xade	Ghanzi	1058	0.00
New Xanagas	Ghanzi	885	0.65
Ngarange	Gumare	1085	0.00
Ngwapa	Sefhare	335	30.18
Ngware	Scottish Livingstone	954	21.63
Nkange	Tutume	2394	24.66
Nlakhwane	Masunga	1063	33.96
Nokaneng	Gumare	2204	32.15
Nshakashokwe	Masunga	1609	24.66
Nswazwi	Tutume	1434	24.68
Ntlhantlhe	Bamalete Lutheren	1596	26.92
Nxamasere	Gumare	1187	6.91
Nxaunxau		516	0.52
Oliphants Drift	Deborah Retief Memorial	850	0.53
Omaweneno	Tsabong	729	21.90
Oodi	Deborah Retief Memorial	3964	8.52
Orapa	Orapa mine	5668	42.81
Otse 1	Bamalete Lutheren	5954	39.50
Otse 2	Mahalapye	1621	5.97
Paje	Sekgoma Memorial	1862	45.31
Palapye	Palapye	26678	52.44
Palla Road/Dinokwe	Mahalapye	1008	40.73
Pandamatenga	Kasane	1880	12.95
Papatlo	Goodhope	323	24.87
Parakarungu	Kasane	958	0.00
Phepheng	Tsabong	672	11.57
Phihitshwane	SDA Kanye	533	30.97
Phuduhudu 1	Gweta	476	24.90
Phuduhudu 2	Jwaneng mine	480	0.41

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Pilane (Station)	Deborah Retief Memorial	1217	44.20
Pilikwe	Sefhare	917	35.75
Pitsana-Potokwe	Goodhope	517	36.49
Pitsane Siding	Goodhope	2312	36.47
Pitseng	Jwaneng mine	656	24.77
Pitshane Molopo	Goodhope	1284	13.10
Poloka	Deborah Retief Memorial	661	14.64
Qabo		663	8.33
Qangwa	Gumare	762	0.00
Radisele	Palapye	2036	35.74
Rakhuna	Goodhope	857	36.46
Ramaphatle	Thamaga	529	30.80
Ramatlabama	Goodhope	929	24.83
Ramokgonami	Sefhare	2751	30.12
Ramokgwebana	Masunga	1040	23.12
Ramonaka	Deborah Retief Memorial	477	30.10
Ramotlabaki	Deborah Retief Memorial	489	0.51
Ramotswa station	Bamalete Lutheren	3188	21.34
Ramotswa	Bamalete Lutheren	22680	21.35
Ranaka	SDA Kanye	1784	45.41
Rasesa	Deborah Retief Memorial	3046	44.19
Ratholo	Sefhare	1748	15.90
Robelela	Mmadinare	783	17.32
Salajwe	Scottish Livingstone	2435	0.67
Samochema	Gumare	792	0.54
Satau	Kasane	534	0.00
Sebina	Masunga	2414	24.67
Sechele	Masunga	382	23.12
Sedibeng	Goodhope	503	24.82
Sefhare	Sefhare	3153	44.22
Sefophe	Bobonong	4080	28.07
Segwagwa	Goodhope	989	16.34
Seherelela	Scottish Livingstone	445	60.18
Sehithwa	Maun	3514	10.69
Sehunou	Sekgoma Memorial	682	30.91
Sekakangwe	Masunga	635	23.15
Sekhutlane	Goodhope	809	0.41
Sekoma	Jwaneng mine	1295	13.08

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Sekondomboro	Gumare	432	0.00
Selebi-Phikwe	Selebi Phikwe gvnt	27410	41.20
Seleka	Sefhare	693	30.10
Selokolela	SDA Kanye	1498	30.94
Semane	Jwaneng mine	541	24.74
Semitwe	Tutume	513	14.89
Semolale	Bobonong	935	16.78
Senete	Tutume	1870	36.20
Senyawe	Masunga	973	28.25
Seolwane	Palapye	986	6.03
Sepako	Tutume	600	0.42
Sepopa	Gumare	1937	6.92
Serinane	Scottish Livingstone	529	40.93
Seronga	Gumare	2408	0.00
Serowe urban	Sekgoma Memorial	37235	45.32
Serule	Palapye	2374	18.85
Sese	Jwaneng mine	1817	36.36
Sesung 1	SDA Kanye	551	30.92
Sesung 2	Scottish Livingstone	996	21.60
Shadishadi		1394	8.82
Shakawe	Gumare	4785	0.54
Shakwe	Mahalapye	963	27.74
Shashe Bridge	Nyangabgwe Referral	727	41.52
Shashe	Nyangabgwe Referral	2261	41.50
Shashe-Mooke	Nyangabgwe Referral	2820	41.48
Shorobe	Maun	1938	28.48
Shoshong	Mahalapye	7079	27.76
Sikwane	Deborah Retief Memorial	1220	30.12
Siviya	Masunga	930	28.24
Sojwe	Mahalapye	3914	8.83
Sorilatholo	Scottish Livingstone	673	0.71
Sowa	Tutume	2575	5.32
Struizendam		388	0.00
Takatokwane	Scottish Livingstone	2795	0.68
Tamasane	Palapye	1030	35.71
Tati Siding	Nyangabgwe Referral	5411	41.49
Taupye	Mahalapye	358	40.80
Tewane	Palapye	433	27.78

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Thabala	Sekgoma Memorial	2106	30.89
Thamaga	Thamaga	16905	30.81
Themashanga	Masunga	1145	28.28
Tlhankane	Jwaneng mine	517	13.11
Tlhareseleele	Goodhope	450	36.50
Tloaneng	Bamalete Lutheren	784	5.81
Tlokweng	Princess Marina	30504	8.52
Tobane	Mmadinare	1750	28.07
Tonota	Nyangabgwe Referral	16733	41.49
Topisi	Sekgoma Memorial	1400	35.71
Toromoja	Rakops	852	32.39
Toteng	Maun	1863	20.28
Tsabong	Tsabong	6064	32.13
Tsamaya	Masunga	1607	28.28
Tsao(u)	Maun	2093	16.95
Tsetsebjwe	Bobonong	2851	16.76
Tsetseng	Hukuntsi	375	0.42
Tshesebe	Masunga	1598	23.13
Tshidilamolomo	Goodhope	524	5.37
Tshimoyapula	Sekgoma Memorial	1420	16.28
Tshokatshaa	Gweta	501	24.95
Tshokwe	Mmadinare	688	31.80
Tsienyane/Rakops	Rakops	4923	32.37
Tsonyane	Jwaneng mine	534	16.35
Tsootsha	Ghanzi	1568	20.34
Tswaane	Jwaneng mine	471	0.00
Tswaaneng	Goodhope	548	13.08
Tswanyaneng	Goodhope	432	13.13
Tubu	Gumare	429	47.21
Tutume	Tutume	11940	36.21
Ukwi	Ghanzi	443	0.00
Werda	Tsabong	2194	0.37
West Hanahai	Ghanzi	678	20.37
Xakao	Gumare	1153	0.00
Xaxa		451	0.00
Xhauga	Gumare	570	0.56
Xhumo	Rakops	1575	22.05
Zoroga	Tutume	1002	24.92

Table A.12. The percentage of vaccinated people in each community

Community	HCF	Co-morbidity	Vaccinated(%)
Zutswa		480	5.11
Zwenshambe	Masunga	1305	33.95

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