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OUTCOME EVALUATION OF THE HIV CARE CASCADE IN THE ABIDJAN HEALTH REGION IN CÔTE D'IVOIRE

BY

ANNITA EMELINE HOUNSA EPOUSE ALLA

(10803312)

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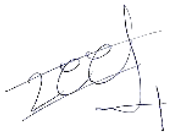
DECLARATION

I, Annita Emeline Hounsa épouse Alla, hereby declare that to the exclusion of specific references that have been duly acknowledged, this submission is my own work for my MSc Degree and does not contain any material published in the past by some other individual or material that has been approved for the presentation of some other Degree from the University or somewhere else.

Candidate's Signature :  **Date : 9-11-2021**

Annita Emeline HOUNSA épouse ALLA

Supervisor's Signature :  **Date : 9-11-2021**

Dr. Patricia AKWEONGO

DEDICATION

I dedicate this dissertation to :

- GOD, who makes everything possible.
- My wonderful husband ALLA K. Florent who has been an unfailing support to me for 24 years.
- My lovely children KILLIAN, MAELYS and AUREANE who are the perpetual source of motivation.
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ABSTRACT

Background

Around 80 to 90% of new HIV infections are due to PLHIV undiagnosed or diagnosed and yet not retained in care. There are few findings on the evaluation of the HIV Care Cascade in Western African countries. The objective of this study was to evaluate the HIV Care Cascade in the Abidjan Health Region in Côte d'Ivoire and the achievement of the 90 90 90 targets in 2018.

Methods

The study location was the Abidjan Health Region. I used data from the SIGDEP2, French acronym for an Electronic Patient Record Management Information System. A cross-sectional and longitudinal cascade analysis were used. Factors associated with Viral Suppression analysed by a logistic regression model. MS Excel 2016 and Stata version 15 were used for the analysis.

Results

In the HIV Care Cascade, there were 31,182 PLHIV, 23,895 (76.6%) were women and 22,314 (71.6%) were between 25 and 49 years old. Considering the number of PLHIV in the HIV Care Cascade, 24,247 (83 %) were linked to care, 22,280 (92%) of those linked to care started ART, 20,708 (93 %) of those on ART were retained in care and 11,944 (58%) of those on ART achieved Viral Suppression. Considering the number of PLHIV newly diagnosed from 2014 to 2018 which is 17,294, 15,839 (92%) were linked to care, 12,931 (75%) started ART, 12,207 (71%) were retained in care and 5,932 (34%) achieved Viral Suppression.

The ages between 20 and 24 years old (AOR= 0.63 ; 95% CI [0.43 - 0.94]), between 25 and 49 years old (AOR= 0.71 ; 95% CI [0.60 - 0.84]), over 50 years old (AOR= 0.71 ; 95% CI [0.60 - 0.84]), the marital status single (AOR= 0.84 ; 95% CI [0.72- 0.98]) and married (AOR= 0.84 ; 95% CI [0.71 - 0.99]), tertiary school education (AOR= 1.50 ; 95% CI [1.15 - 1.95]) were more likely to have Viral Suppression.

Conclusion

Among PLHIV diagnosed, linkage and Retention in Care are effective. Gaps observed in the cascade is with ART coverage and Viral Suppression which should be intensified.

Keywords : Abidjan Health Region, Côte d'Ivoire, HIV Care Cascade, 90-90-90 targets

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
CD4	Cluster of Differentiation 4
CDC	Centers for Disease Control and Prevention
CNLS	National Aids Control Council - French acronym for Conseil National de Lutte contre le Sida
DIIS	Directorate of Information Technology and Health Information - French acronym for Direction de l'Informatique et de l'Information Sanitaire
DU	Drug User
EMTCT	Elimination of Mother To-Child Transmission
GMT initiative	Gay men, Men who have sex with men, Transgender individuals
HIV	Human Immunodeficiency Virus
HTS	HIV Testing Services
IDU	Injection Drug User
LMIC	Low and Middle Income Countries
LTC	Linkage To Care
MSHP	Ministry Of Health and Public Hygiene - French acronym for Ministère de la Santé et de l'Hygiène Publique

MSLS	Ministry of Health and Aids - French acronym for Ministère de la Santé et de la Lutte contre le Sida
MSM	Men having Sex with Men
MTCT	Mother To-Child Transmission
PATH	Progression and Transmission of HIV/AIDS
PCR	Polymerase Chain Reaction
PLHIV	People Living with HIV
PMTCT	Prevention of Mother To-Child Transmission
PNLHV	National Programme to fight against Viral Hepatitis - French acronym for Programme National de Lutte contre les Hépatites Virales
PNLS	National Aids Control Programme - French acronym for Programme National de Lutte contre le SIDA
PNLT	National Tuberculosis Control Programme - French acronym for Programme National de Lutte contre la Tuberculose
PNN	National Nutrition Programme - French acronym for Programme National de Nutrition
PNSME	National Mother and Child Health Programme - French acronym for Programme National de Santé de la Mère et de l'Enfant

PNPEC	National AIDS care Programme - French acronym for Programme National de Prise en Charge médicale des Personnes vivant avec le VIH
PNSSU	National School and University Health Programme - French acronym for Programme National de la Santé Scolaire et Universitaire
POC	Point-Of-Care
PrEP	Pre-Exposure Prophylaxis
SIGDEP2	Electronic Patient Record Management Information System - French acronym for Système d'Information et de Gestion du Dossier Electronique du Patient-version 2
STIs	Sexually Transmitted Infections
SW	Sex worker
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund - French acronym for Fonds des Nations Unies pour l'Enfance
VL	Viral Load
VLT	Viral Load Test
VMMC	Voluntary Medical Male Circumcision
VS	Viral Suppression
WHO	World Health Organization

CHAPTER ONE – INTRODUCTION

1.1. Introduction

The HIV pandemic remains a worlwide health issue. Many strategies are necessary to control the HIV pandemic such as the elimination of Mother-to-Child Transmission (EMTCT) ; Distribution of Condom ; Antiretroviral Pre-exposure Prophylaxis (PrEP) ; Voluntary Medical Male Circumcision (VMMC) in priority countries ; Harm Reduction Services for people who inject drugs and targeted prevention programmes for other key populations. Of the prevention interventions assessed in randomized controlled trials, to date, HIV treatment has, by a long shot, the greatest impact on HIV incidence (Baeten et al., 2012). Providing HIV treatment to all who need it is an essential strategy. As stated by the Joint United Nations Programme on HIV/AIDS (UNAIDS), the HIV pandemic could be interrupted by 2020 through the 90 90 90 targets. Achieving these objectives necessitate utilizing data to determine gaps in a HIV Care Cascade.

This chapter presents the objectives to evaluate the HIV Care Cascade in the Abidjan Health Region in Côte d'Ivoire and justifies its necessity.

1.2. Background

In 2018, there were 37.9 million People Living with HIV (PLHIV) and 1.7 million people were newly infected with HIV globally (UNAIDS, 2019c). In 2020, these numbers were 37.7 million PLHIV and 1.5 million people newly infected. In Western and Central Africa, out of the 37.9 million PLHIV globally, there were 5 million living with HIV and 280 000 newer infections in 2018 (UNAIDS, 2019c). In the same year, Côte d'Ivoire had 460,000 PLHIV, new infections were 17,000, and HIV prevalence was 2.6% among adults aged 15 to 49 years old (UNAIDS, 2019a).

ART treatment is by far the most effective intervention to prevent many deaths. However, it is not enough on its own, as it is important to consider the stage prior to treatment and also the steps that ensure the effectiveness of the treatment (UNAIDS, 2014). The HIV Care Cascade refers to the sequential steps of HIV Care to monitor the number of PLHIV who are receiving care and the treatment they need. It was developed to recognize the different steps needed to ensure that for everyone who needs HIV Care can continue to participate, from the initial phase of HIV testing, through treatment, to the removal of the virus (The GMT initiative, 2013; World Health Organization, 2015).

The HIV care cascade can be used as an individual-level tool to assess care outcomes as well as a population-level framework to study the proportion of HIV-positive people in a specific community who are engaged in each successive step (The GMT initiative, 2013). It can be used by country health systems to follow patients' progress after receiving a positive diagnosis and throughout their lives. It includes 3 steps of 90-90-90 targets introduced by The UNAIDS which are : the knowledge of the HIV status, the PLHIV initiated ART and the Viral Suppression and two more steps that are the Linkage to Care and the Retention in Care (World Health Organization, 2015).

By 2020, 90% of PLHIV will know their HIV status, 90% of PLHIV with diagnosed HIV infection will be on ART and 90% of those on ART will have Viral Suppression according to 90 90 90 targets (UNAIDS, 2014). The 90-90-90 targets aim to provide HIV testing and treatment to the vast majority of PLHIV by the end of 2020 and to reduce HIV levels in their bodies to undetectable levels so they can live healthy lives without spreading the virus (UNAIDS, 2014).

1.3. Problem Statement

Globally in 2018, 79% of PLHIV were aware of their HIV status, 62% of PLHIV were on ART and 53% of PLHIV on ART had Viral Suppression (UNAIDS, 2019c).

In Western and Central Africa in 2018, 64% of PLHIV were diagnosed, 51% of PLHIV were on ART, 39% of PLHIV on ART had Viral Suppression (UNAIDS, 2019c).

According to UNAIDS, progress in this Region is low compared to the global progress (UNAIDS, 2019c). In sub-Saharan Africa and other places, important gaps remain along the HIV Care Cascade (Sharma et al., 2015).

Around 80 to 90% of new HIV infections were due to PLHIV undiagnosed or diagnosed yet not retained in care (Li et al., 2019; Skarbinski et al., 2015).

The consequences are the increased risk of unknowingly transmitting HIV from PLHIV to others and increased HIV morbidity and mortality due to late diagnosis. Implications for Public Health are that HIV infections must be tested early and people with HIV infection must be rapidly involved in long-term care and treatment.

An important strategy to end AIDS is to provide HIV treatment to PLHIV through the HIV Care Cascade (UNAIDS, 2014).

Some factors such as the availability of HIV Testing Services, risk groups, young age and HIV treatment literacy affect the HIV Care Cascade.

This study seeks to evaluate the HIV programme performance in the HIV Care Cascade in reaching people about knowledge of their HIV status, ART coverage and the treatment success in the Abidjan Health Region.

1.4. Justification

There are different types of HIV Care Cascades :

- Cascades for HIV Care and Treatment
- Cascades for HIV prevention. A subset of prevention cascades is PMTCT
- Cascades for key populations
- Cascades for care and treatment of HIV co-morbidities

The cascade for HIV Care and Treatment is an important tool in the AIDS response, to prevent new infections, illness, and deaths (World Health Organization, 2015).

Viral Suppression is the foremost pertinent endpoint for individual and Public Health benefits. Each 1% augmentation in the number of individuals with Viral Suppression was associated with an estimated 1% decline in HIV incidence (Montaner et al., 2014). Viral Suppression can be sustainably achieved through the HIV Care Cascade (Cohen et al., 2014).

However, there is a dearth of accurate data on the HIV Care Cascade in Western African countries (H. Ali et al., 2019).

An HIV Care Cascade can measure indicators at specific or multiple points in time (World Health Organization, 2018). By evaluating different steps of the HIV Care Cascade, gaps that may exist in linking PLHIV to quality and sustainable care can be identified.

It may help policymakers, national, regional and local service providers to ameliorate systems and services to better support individuals as they progress from one step of the HIV Care Cascade to the next (Nosyk et al., 2014; The GMT initiative, 2013). In the HIV Care Cascade, data on PLHIV newly diagnosed are rarely documented (World Health Organization, 2018).

1.5. Study Objectives

Study Objectives are composed by General objective and Specific objectives.

1.5.1. General objective

To evaluate HIV Care Cascade in the Abidjan Health Region in Côte d'Ivoire.

1.5.2. Specific objectives

- To determine the proportion of PLHIV with knowledge on their HIV status
- To estimate the proportion of PLHIV linked to care
- To determine the proportion of PLHIV on ART
- To estimate the proportion of PLHIV retained in care
- To examine the proportion of PLHIV on ART with Viral Suppression
- To determine socio-demographic and Health System factors associated with Viral Suppression

CHAPTER TWO – LITERATURE REVIEW

2.1. The burden of HIV/AIDS

In this section, the burden of HIV/AIDS globally, in Africa and in Côte d'Ivoire are presented.

2.1.1. Globally

In 2018, 37.9 million [32.7 million–44.0 million] people were living with HIV comprising 36.2 million adults and 1.7 million children (<15 years) (UNAIDS, 2019c). About 79% of all PLHIV knew their HIV status and approximately 8.1 million people did not know they were living with HIV (UNAIDS, 2019c).

Since the peak in 2004, deaths associated with AIDS have declined by more than 56% (UNAIDS, 2019c). In 2018, approximately 770 000 individuals deceased from AIDS-related illnesses around the world, compared to 1.7 million in 2004 and 1.2 million in 2010 (UNAIDS, 2019c).

Since the peak in 1997, new HIV infections have diminished by 40% (UNAIDS, 2019c). Around 1.7 million new HIV infections were identified in 2018, compared to 2.9 million in 1997. Since 2010, new HIV infections have decreased by about 16%, from 2.1 million to 1.7 million in 2018. Since 2010, among children, new HIV infections have decreased by 41%, from 280 000 to 160 000 in 2018 (UNAIDS, 2019c).

Approximately 6000 young women per week between 15 to 24 years are infected with HIV (UNAIDS, 2019c).

Key populations and their sexual partners represent 54% of new HIV infections worldwide (UNAIDS, 2019c). Tuberculosis (TB) continues to be the leading cause of death among PLHIV, accounting for approximately 1 in 3 AIDS-related deaths and it is estimated that 49% of PLHIV and tuberculosis are unaware of their co-infection (UNAIDS, 2019c).

2.1.2. HIV burden in Africa

Although important progress has been made in reducing HIV-related mortality worldwide, in 2018, HIV continues to represent an immense health burden in Sub-Saharan Africa. According to the UNAIDS regional division of different regions in the world, Eastern and Southern Africa is the most affected by HIV and home to the largest number of PLHIV (UNAIDS, 2019c). The following data are for 2018. In Eastern and Southern Africa, there were 20.6 million PLHIV. New infections were 800 000 including 84 000 under 15 years of age. AIDS-related deaths were 310 000 (UNAIDS, 2019c). In Western and Central Africa, there were 5 million PLHIV. New infections were 280 000 including 58 000 under 15 years of age. AIDS-related deaths were 160 000 (UNAIDS, 2019c).

In sub-Saharan Africa, girls are affected by 4 out of 5 new infections among teenagers between 15 to 19 years. Young women between 15 to 24 years are twice as likely to live with HIV as men (UNAIDS, 2019c). In Western and Central Africa , key populations and their sexual partners account for 64% of new HIV infections compared to 25% of new HIV infections in Eastern and Southern Africa (UNAIDS, 2019c).

2.1.3. HIV burden in Côte d'Ivoire

One of the countries most affected by HIV in the Western and Central Africa region, after Nigeria, Cameroon and the Democratic Republic of Congo is Côte d'Ivoire, with an estimated 460 000 PLHIV [360,000 – 580,000] in 2018 (UNAIDS, 2019b).

In 2018, HIV prevalence among adults (15–49 years) was 2.6% [2.0-3.3]. There were about 17,000 people newly infected with HIV. Since 2010, the number of new HIV infections has decreased, from 25 000 to 17 000 (UNAIDS, 2019b). Côte d'Ivoire, with a population of more than 40% young people, is experiencing a mixed epidemic situation : generalized in the entire population and also with high prevalence among key populations (UNAIDS, 2019b).

The number of deaths due to HIV/AIDS in Côte d'Ivoire is about 16 000 [11 000-30,000].

Since 2010, the number of deaths associated with AIDS has diminished, with a 34 percent decline from 24,000 to 16,000 deaths (UNAIDS, 2019b).

Women are the foremost HIV- affected in Côte d'Ivoire : of the 430 000 HIV-positive adults, 260 000 (60.47%) were women. Among young women between 15 to 24 years, new HIV infections were more than three times higher than among young men: among young women, 3100 new infections, compared to less than 1000 among young men (UNAIDS, 2019b).

Not all regions are uniformly affected. The Region of Abidjan, in the South, presents the highest prevalence (3.4%), followed by the Belier and Sud-Comoe Regions respectively in the East-Central and the Southeast (3.3%), the Montagnes Region in the West (3.2%), and the Gontougou Region in the Northeast (3%) (Direction de l'Informatique et de l'Information sanitaire, 2019). HIV is more prevalent in urban (4.3%) than in rural (3.1%) areas (Direction de l'Informatique et de l'Information sanitaire, 2019).

In 2018, 63% of PLHIV knew their HIV status, 55% of PLHIV were on ART and 41% of PLHIV on ART had Viral Suppression (UNAIDS, 2019a).

2.2. Control and Treatment Interventions in HIV/AIDS

There are various strategies to stop HIV transmission worldwide, such as the EMTCT, Condom Distribution, PrEP, VMMC in first concerned countries, harm reduction services for people who inject drugs and HIV Care Cascade (UNAIDS, 2014).

2.2.1. Elimination of Mother-to-Child Transmission

During pregnancy, childbirth and breastfeeding, HIV can be passed from an HIV-positive woman to her child. Mother-To-Child Transmission (MTCT), also called 'vertical transmission' counts for the great part of infections in children (0-14 years) (World Health Organization, 2019a).

With no treatment, between 15% and 45% of children who are born to HIV-positive mothers are at risk of infection and half of all HIV-infected children are at risk of dying before their second birthday (World Health Organization, 2019a).

Several studies conducted since the 1990s have established that ART is effective in decreasing the risk of HIV transmission from mother to child (De Cock et al., 2000; World Health Organization, 2019a). The last decade has seen enormous progress in the Prevention of Mother-To-Child Transmission (PMTCT) (UNAIDS, 2014).

Interventions that reduce MTCT of HIV by more than 30% to 1% have been identified. Decentralized Point-Of-Care (POC) approaches for maternal HIV detection and immediate provision of comprehensive ART have turned out in a fast decline in the number of infants contaminated by HIV.

Indeed, PMTCT has been credited with leading to an overall decrease in HIV incidence (John-Stewart et al., 2017). The term Elimination of Mother-To-Child Transmission (EMTCT) has been used in 2010 to further stimulate global efforts to virtually eliminate paediatric HIV by 2015 (John-Stewart et al., 2017). However, in 2018, an estimated 1.3 million pregnant women worlwide were living with HIV. About 90% of these women live in sub-Saharan Africa (UNICEF, 2019).

In this same year, 82% of pregnant women living with HIV globally obtained effective ART medicines for prevention MTCT, up from 44% in 2010 (UNICEF, 2019). Nonetheless, there are regional variations in access to antiretroviral treatment for pregnant and breastfeeding women in sub-Saharan Africa (UNICEF, 2019). In 2018, access to antiretroviral medicines for pregnant women ranges from 92% in Eastern and Southern Africa to 59% in West and Centra Africa (UNICEF, 2019).

EMTCT necessitates a series of interventions, starting with voluntary and confidential counseling and testing for the virus.

This should be pursued by lifelong ART therapy for HIV-positive pregnant women and the dispensation of ART drugs as a preventive measure for their newborns, as well as harmeless delivery practices, and maintenance of the mother and child into long-term care and treatment (UNICEF, 2019; World Health Organization, 2019a).

2.2.2. Condom Distribution

Since the start of the pandemic, condoms have been regarded as one of the most effective biological mechanisms for turning down HIV transmission (Holmes et al., 2004).

Laboratory studies have demonstrated that latex condoms give an viable obstruction against indeed the smallest sexually transmitted infections (STIs) pathogens (Centers for Disease Control and Prevention, 2019; Weller & Davis, 2002).

Epidemiological studies have shown that condoms are effective against many STIs comprising HIV (Weller & Davis, 2002).

As well as their successful in preventing HIV transmission, condoms are accessible, relatively cheap, safe, easy to use and can avoid unintended pregnancies (Centers for Disease Control and Prevention, 2019a). Due to these factors, distribution campaigns for condoms are approved as part of HIV prevention interventions (Centers for Disease Control and Prevention, 2020). However, distribution campaigns for condoms cope with carrying out and evaluation challenges, comprising (1) identifying and attaining people at risk for HIV; (2) make sure that condoms are dispensed to those who otherwise would not have access to condoms; and (3) ensuring that people at risk of contracting or transmitting HIV use condoms rightly and consistently (Shrestha et al., 2016).

Thus, when approaching condom use through structural interventions, there are 3 keys to take into account (Blankenship et al., 2000):

- availability, which depends on attitudes, materials, or settings that are necessary to decrease exposure to a specific health problem.
- acceptability, which aims to change the preconceptions in society, allowing people to examine and adopt new ideas.
- accessibility, which sets out to ameliorate access to health interventions, goods and services for those facing disadvantageous social or economic situations.

2.2.3. Pre-exposure Prophylaxis to Antiretrovirals

PrEP is an HIV prevention method in which individuals who do not have HIV but are at strong risk of getting HIV due to their behaviour or as a partner in a serodiscordant relationship, take HIV medicine daily to reduce their risk (World Health Organization et al., 2015a).

Over 15 oral PrEP trials performed have demonstrated that, when taken consistently and correctly, PrEP is highly effective and diminishes the risk of HIV infection to nearly zero (Desai et al., 2017; Fonner et al., 2016; Tetteh et al., 2017).

This risk of HIV infection during unprotected sex was over 90%, and over 70% when injecting drugs (Desai et al., 2017; Fonner et al., 2016; Tetteh et al., 2017).

There are many challenges associated with PrEP implementation, scale-up and access as well as issues related to individual adherence. PrEP's effectiveness decreases quickly if not taken frequently as prescribed, therefore dealing with the obstacles preventing adherence is key to success (Desai et al., 2017).

2.2.4. Voluntary Medical Male Circumcision

Male circumcision was in the mid-2000s, found out to decrease the female-to-male sexual transmission of HIV by 60% (Auvert et al., 2005). It is the only one-time intervention that decreases the risk of HIV infection and high cost-effectiveness. (World Health Organization, 2012).

Since 2007, in countries with high HIV prevalence and low levels of male circumcision, WHO and UNAIDS have supported VMMC as an essential component of combination HIV prevention (World Health Organization, 2012). Accordingly, 14 countries in Eastern and Southern Africa were distinguished as priority countries and started programmes to extend the availability of male circumcision (World Health Organization, 2014).

The male circumcision incompletely preserve men from HIV transmission, subsequently, it is proposed to incorporate VMMC as a feature of an overall HIV prevention strategy. This comprises condom promotion, HIV testing and counseling, risk reduction counseling, STI testing, PrEP and interventions that address harmful gender norms (World Health Organization, 2014).

2.2.5. Harm Reduction Services for people who inject drugs

Globally in 2018, around 13 million people inject drugs and 1.7 million of them are living with HIV (United Nations Office On Drugs and Crime, 2019).

Injection Drug Users (IDU) are among the key populations most at risk of HIV infection or transmission and 28 times more likely than the general population to live with HIV (UNAIDS, 2017). IDU counts for around 10% of HIV infections worlwide and 30% of those occuring outside of sub-Saharan Africa (UNAIDS, 2017).

However, as their drug use is often stigmatized and illegal, they are also among those with the lowest access to HIV prevention, care and treatment services (UNAIDS, 2017).

The tools and strategies needed to ameliorate the health and lives of drug users are well known and easily available (UNAIDS, 2017).

Needle-syringe programmes decrease the spread of HIV by up to 70%, hepatitis C and other blood-borne viruses by up to 43% (Wilson et al., 2015). Opioid substitution therapy and other forms of evidence-based drug treatment reduce infection disease vulnerability and improve the use of health and social services (Wilson et al., 2015).

The coverage of harm reduction programmes continues to be quite low throughout the world particularly in sub-Saharan Africa (UNAIDS, 2017). Of the 158 countries where injection drug use has been archived, only 80 have at least one site providing opioid substitution therapy, and only 43 have prison programmes (UNAIDS, 2017). In only 90 countries, needle-syringe programmes are available and only 12 countries have the recommended lower limit of 200 sterile needles per individual who injects drugs per year (UNAIDS, 2017).

2.3. HIV Care Cascade

The risk of high HIV transmission from PLHIV to other people and the urgency to diagnose early and treat quickly PLHIV are shown by these studies conducted in the United States (Li et al., 2019; Skarbinski et al., 2015).

Starbinsky et al (2015) used a multistep model that associated population denominator data from the National HIV Surveillance System with describe clinical and behavioral data from the National HIV Behavioral Surveillance System and the Medical Monitoring Project.

They found that people infected with HIV but not diagnosed and those diagnosed but not retained in medical care were responsible in the United States for 91.5% of the total HIV transmissions in 2009.

Li et al (2019) used the Progression and Transmission of HIV/AIDS (PATH 2.0) with behavioral data from National HIV Behavioral Surveillance and epidemiologic and clinical data from the National HIV Surveillance System.

Transmission rates by those who were 1) severely infected and unknowing of their infection, 2) not severely infected and unknowing, 3) Knowing HIV infection but untreated, 4) obtaining HIV Care but not virally suppressed, and 5) on ART and virally suppressed were 16.1, 8.4, 6.6, 6.1, and 0 per 100 person-years, respectively. About 80% of new HIV transmissions are from people who are not aware that they are infected with HIV or who do not receive standard care in 2016 in the United States.

Cascades for HIV Care and Treatment were used for the first time in 2005 (Giordano et al., 2005) and have since become widespread and pervasive in follow-up HIV Care and Treatment programs (Gardner et al., 2011).

There are 5 steps in the HIV Care Cascade namely knowledge of the HIV status, Linkage to Care, on ART, Retention in Care and Viral Suppression (Gueler et al., 2017; Kay et al., 2016; Vogler et al., 2018; World Health Organization, 2015).

2.3.1. Knowledge of the HIV status

The knowledge of the HIV status marks the first step of the HIV Care Cascade. People who know their HIV status have less risky behaviour than those who don't know their status (Mark et al, 2005). The Centers for Disease Control and Prevention (CDC) proposes that people between 13 and 64 years be tested for HIV (Branson et al., 2006). This can be done during visits to a health care provider or through community-based HIV testing centers. The knowledge of the HIV status can be done through the HIV testing services (HTS).

The HTS comprises pre-test information, HIV testing and diagnosis, post-test counseling when appropriate, referral and connection to prevention and care and treatment services. The WHO's 5Cs are principles that are applicable to all models to HIV testing in all areas : Consent, Confidentiality, Counselling, Correct test results and Connection (linkage to prevention, care and treatment) (World Health Organization, 2015).

Improving access to HIV testing through PMTCT services has allowed millions of children to be born HIV-negative through successful testing and care for them and their mothers (Haroz et al., 2017).

Rapid tests, also called as Point-Of-Care (POC), have radically changed the response by allowing HIV testing to be done by non-professional providers qualified in several areas, encompassing health ccenters, workplaces and homes (World Health Organization, 2015).

UNAIDS has put targets to diagnose 90% of all PLHIV by 2020 (UNAIDS, 2014). In 2018, it is estimated that 79% of PLHIV know their HIV status. Globally, in 2018, according to the regional division of the UNAIDS, levels of HIV testing are lowest in the Middle East and North Africa and in Western and Central Africa. In these two regions, respectively, 47% and 64% of PLHIV knew their status (UNAIDS, 2019c).

Western and Central Europe and North America are nearest to reaching 90% coverage for testing, with 88% of PLHIV knowing their status in 2018, followed by Eastern and Southern Africa (85% in 2018), Latin America (80% in 2018), the Caribbean (74% in 2018), Eastern Europe and Central Asia (72 % in 2018) and Asia and the Pacific (69% in 2018) (UNAIDS, 2019c).

Although the disparities, the universal scale-up of tests for HIV has been significant over the last decade. The proportion of PLHIV worldwide who were able to be tested increased from 12% to 60% between 2005 and 2015 (UNAIDS, 2019c).

The challenge with HIV testing is to augment access to and uptake of HIV testing services for people who have never been tested and those most at risk of persistent HIV infection. Significantly increasing the number of PLHIV who are aware of their HIV status will necessitate going above a passive approach to testing.

More proactive, human rights-based programmes for testing will be required, comprising the promotion of testing in geographical hotspots and among key populations, investing in strategies to augment the need for testing services, and the use of a wide range of HIV testing and support approaches, comprising self-testing, counseling and testing initiated by providers and community-based approaches (UNAIDS, 2014).

2.3.2. Linkage to Care (LTC)

Linking HIV-positive to prevention, treatment and care is a decisive step in the HIV Care Cascade. It serves as the connection between testing and care. Diagnosis of HIV with no enrolment in care reveals a genuine patient and programme management issue (World Health Organization, 2015).

LTC is the time that begins with HIV diagnosis and ends with enrolment in HIV Care (World Health Organization, 2015).

Enrolment in HIV Care begins when a PLHIV goes to the facility where HIV Care is given and a patient record is opened. WHO suggests that after a positive HIV diagnosis, patients must be enrolled in HIV Care (that can occur on the same day as the diagnosis of HIV) (World Health Organization, 2015).

The CDC defines LTC as a time between diagnosis and initiation of HIV Care of 3 months or less (Kay et al., 2016). In 2015, the definition of a successul LTC was updated to an initial appointment with an HIV Care provider within a maximum of 30 days after HIV diagnosis (Centers for Disease Control and Prevention., 2019).

HIV LTC receives less attention than other steps of the HIV Care Cascade (World Health Organization, 2015).

In 2015, evidence-based guidelines to ameliorate the HIV Care Cascade were released by a group of experts from the International Association of Physicians in AIDS Care. The following is a summary of the panel's key recommendations for ameliorate LTC :

- Urgent referral to HIV Care taking after an HIV diagnosis to ameliorate linkage to ART therapy.
- Use of patient navigators and case managers to augment LTC.
- Proactive engagement and reengagement of patients who skip treatment appointments and/or are lost to follow-up, including intensive outreach within 1 month of a new HIV diagnosis for those not engaged in care.

This recommendation includes : (i) Case management to retain a person with HIV in care and to locate and reengage patients lost to follow-up and (ii) HIV-positive people's transportation assistance to attend their clinic visits.

2.3.3. Initiation of Antiretroviral Therapy (ART)

ART is a center component of the response of the national health sector to HIV. In response to new proof relating to the benefits of early start of ART for the clinical prognosis of patients and the reduction of HIV transmission (Cohen et al., 2011; Grinsztejn et al., 2014; Montaner et al., 2014), the WHO has revised its recommendations for initiation of ART treatment in 2013 and updated in 2015 (World Health Organization, 2016b). Under the latest guidelines, ART eligibility has been extended to adults and older children with a CD4 count of approximately 500 cells/mm^3 (The previous guideline was to start treatment with a CD4 count of approximately 350 cells/mm^3).

Other groups are eligible regardless of CD4 counts, including children under five years of age, sero-discordant couples, pregnant women and TB patients.

Using the new criteria , 23.3 million of PLHIV were accessing ART up from 7.7 million in 2010 (UNAIDS, 2019c). The use of fixed-dose combination therapy regimens and routine viral load monitoring as the essential marker of treatment success is also supported by new guidelines (World Health Organization, 2016b).

UNAIDS has set targets to 90% of PLHIV with diagnosed HIV infection will be on ART by 2020.

In 2018, 62% of all PLHIV were accessing treatment globally. In the same year, 82% of pregnant women living with HIV had access to ART medicines to prevent transmitting HIV to their child (UNAIDS, 2019c).

The proportion of PLHIV receiving ART varies considerably between regions. According to the regional division of the UNAIDS, in the Middle East and North Africa and Eastern Europe and Central Asia, PLHIV accessing ART were respectively, 32% and 38% (UNAIDS, 2019c). In Western and Central Africa, Asia and Pacific and Carribbean, PLHIV accessing ART were respectively 51%, 54% and 55% (UNAIDS, 2019c). In Latin America, Eastern and Southern Africa and Western and Central Europe and North America, PLHIV accessing ART were respectively 62%, 67% and 79% (UNAIDS, 2019c).

Challenges in access to ART lie in the adoption of WHO recommendations to "treat all". An increasing number of countries have updated their national guidelines to recommend treatment for all, and by July 2019, 93% of low-and middle-income countries had begun a Treat all policy (up from only 33% in 2016) (World Health Organization, 2019b).

However, implementation of these guidelines remains slow with 115 (84%) LMIC that have already fully performed the Treat All Policy and 5 (4%) LMIC that have carried out this policy in the larger part of treatment sites in 2018 (World Health Organization, 2019b).

Countries will be able to overcome implementation problems, including recurrent prescription stock-outs, barriers to the delivery of affordable medications and inadequate availability of second and third-line therapeutic regimens, which have been decreased on a regular basis (UNAIDS, 2014).

2.3.4. Retention in Care

Retention in Care can be described as when a person with HIV is effectively linked to services from the moment of initial involvement in care, eligibility determination, initiation on ART and lifelong retention in ART care. This keeps out people who died or were lost to follow-up in the cascade (World Health Organization & HIV/AIDS Programme, 2012).

Retention is essential to decreasing morbidity and mortality associated with HIV, the incidence of new infections, rates of hospitalization, development of ART resistance and improvement of overall health (Giordano, 2016; Mugavero et al., 2009; Tripathi et al., 2011).

Many people who receive HIV treatment drop out of care (World Health Organization & HIV/AIDS Programme, 2012). The WHO reports that the average retention rate was 81% at 12 months, 75% at 24 months, and 67% at 60 months after initiating ART (World Health Organization & HIV/AIDS Programme, 2012).

Challenges in estimating and enhancing retention in HIV Care include measurement issues; patient, provider and system concerns; and staff and resource issues (Giordano, 2016).

To calculate and describe retention, there is no single best way. Methods include counting missed visits (e.g. using an actual number or a minimum number of missed visits), adherence to appointments (proportion of scheduled visits that are maintained), persistence or constancy (minimum level of visits per period; e.g. attending at least 1 visit per 90 days), and care gaps (e.g. no 6-, 9-, or 12-month visits gaps).

At the patient level, challenges include (Giordano, 2016; World Health Organization & HIV/AIDS Programme, 2012) :

- Modifying the behavior of retention-adherence, close to changing the behavior of medication-adherence
- Enhancing confidence, including improving patient engagement with the health facility and eliminating the stigma associated with the need for HIV infection care.

- Elimination of systemic obstacles and resolution of unmet needs (e.g. transport, accommodation, childcare and financial needs)
- Decreasing substance dependence

Challenges at the practitioner and system levels include (Giordano, 2016; World Health Organization & HIV/AIDS Programme, 2012) :

- Improving communication with practitioner and decision making
- Developing processes for appointment scheduling (e.g, dealing with open-access systems)
- Increasing access to the health facility, for example, by extending the health facility's hours of operation
- Strengthening procedures to protect correct contact details
- Defragmenting the processes of health insurance and health services
- Reorganization of the provision of health services to HIV-infected patients in order to meet the needs of the population requiring care over decades
- Discussing the constraints of staffing and infrastructure

Financial and a number of health staff constraints limit health systems' ability to meet some of these challenges (Giordano, 2016; World Health Organization & HIV/AIDS Programme, 2012).

However, some studies have demonstrated that short conversations engaging patients in care can strengthen positive comportments, uncover obstacles to successful ongoing treatment, and promote access to services and resources as needs change over time (Giordano, 2016; Tripathi et al., 2011).

2.3.5. Viral Suppression

The ultimate aim of an HIV treatment programme is to virally suppress PLHIV, described as having less than 1000 HIV copies per milliliter of blood (World Health Organization, 2015). People who experience Viral Suppression respond well to HIV treatment (Cohen et al., 2014; Elul et al., 2013; Maman et al., 2015) and are unlikely to transmit HIV to others (Rodger et al., 2016).

Viral load tests (VLT) are important because they provide an early signal of adherence problems and/or failure of care, authorizing patients to move quickly to a substitute treatment as long as there is access to efficient second-line or third-line treatments. Delays in changing treatment risks permitting drug resistance to develop (World Health Organization, 2015).

To assess the effectiveness of ART in preventing transmission, VL suppression is utilized to evaluate the overall transmission capacity within a community (World Health Organization, 2015).

The WHO suggests that VLT should be done 6 and 12 months after the start of ART and every 12 months for patients who are stable on ART (World Health Organization, 2015).

UNAIDS has set targets to 90% of PLHIV on ART will have Viral Suppression by 2020. Globally in 2018, 53% of PLHIV on ART had Viral Suppression (UNAIDS, 2019c). The percentage of all PLHIV with a suppressed VL is lower worldwide (UNAIDS, 2014).

In many areas, VL is currently not regularly monitored. However, VL suppression in populations is a crucial predictor of the HIV programme outcomes (World Health Organization, 2015).

Concerted efforts are required to overcome challenges to boost access to technologies for viral load testing.

2.4. Factors influencing the HIV Care Cascade

Many factors influence each step of the HIV Care Cascade.

2.4.1. HIV Testing

Routine HIV screening is more effective in HIV status knowledge (Branson et al., 2006; International Advisory Panel on HIV Care Continuum Optimization, 2015). Men and adults with less than primary education were less likely than women and adults with secondary and above education to be diagnosed for HIV (Staveteig et al., 2017).

Less likely to seek HIV Testing were PLHIV who were part of key populations (Januraga et al., 2018; Koirala, Deuba, Nampaisan, Marrone, & Ekström, 2017) as well as young PLHIV (18–24 years of age) (Koirala et al., 2017).

2.4.2. Linkage and Retention in Care

PLHIV who belonged to key populations were less likely to be linked and retained in HIV Care (Januraga et al., 2018; Koirala, Deuba, Nampaisan, Marrone, & Ekström, 2017) as well as young PLHIV (18–24 years of age) (Koirala et al., 2017). The following factors have been identified as being associated with delayed Linkage to Care : mental illness, substance use, African, Caribbean or black rather than white ancestry, unemployment, lack of emotional support or stigmatization, lack of transportation and language barriers (Carter et al., 2016 ; Perelman et al., 2018).

2.4.3. Initiation of ART

PLHIV were more likely than those with low literacy to initiate HIV Care with high adherence to HIV Care and ART with strong HIV treatment literacy (Koirala et al., 2017).

Compared to older PLHIV (aged ≥ 25), adherence to ART was also weaker among younger persons (Koirala et al., 2017). Those who had co-infection with Tuberculosis were more likely to start ART (Koirala et al., 2017).

2.4.4. Viral Suppression

Younger persons (18-24 years old) had lower levels of care, treatment, ART adherence and Viral Suppression than other PLHIV (Cohen et al., 2014; Koirala et al., 2017; Nsanzimana et al., 2015).

More repeated monitoring of CD4 and viral load was correlated with greater levels of Viral Suppression (Cohen et al., 2014). Within 3 months, PLHIV linked to care experienced shorter periods for Viral Suppression versus others and PLHIV also experienced a shorter period for Viral Suppression with a greater number of period-updated care visits (Hall et al., 2013).

2.5. Cascades Definition

Two types of cascade analysis are available : cross-sectional cascades and longitudinal cascades.

A cross-sectional cascade : at a given point in time, a cross-sectional cascade measures indicators. Whether or not they are currently being treated, all PLHIV are included (World Health Organization, 2018). For national programmes, cross-sectional cascades are usually more useful because they estimate the 90-90-90 targets.

A longitudinal cascade also called a cohort cascade, measures indicators at several points in time. In longitudinal cascades, people are in cohorts and are tracked until a defined end point like the Viral Suppression is reached. Longitudinal cascades express the outcomes obtained by individuals over a given period of time, with a specific beginning and end (World Health Organization, 2018).

A denominator-denominator cascade is a cascade in which data are linked to the individual patient level through the steps (Haber et al., 2016).

Denominator-Numerator cascade is a cascade in which data are linked to the individual patient level within each step (Haber et al., 2016).

Population denominators : The denominator is the number of persons in a population, whether or not they are in contact with the Health-Care System. The number of PLHIV, for example, is generally used as a population denominator (World Health Organization, 2015).

Programme Denominators : The denominator is a number (such as the number of patients treated or the quantity of materials ordered) known to the Health System. A programme denominator is for example, the number of people HIV diagnosed (World Health Organization, 2015).

Single-source cascade is a cascade in which all data are derived from a single source (World Health Organization, 2018).

Multi-source cascade is a cascade in which data are from multiple sources (World Health Organization, 2018).

Table 1 presents the cross-sectional and longitudinal cascade indicators.

Table 1: Cross-sectional and longitudinal cascade indicators [adapted from (World Health Organization, 2018)]

Indicators	Cross-sectional cascade	Longitudinal cascade among people newly diagnosed
Indicator 1	Number of PLHIV (usually the estimated number of PLHIV)	Number of PLHIV in one calendar year
Indicator 2	Number and percentage of PLHIV diagnosed	Number of people newly diagnosed with HIV in one calendar year
Indicator 3	Number and percentage of PLHIV linked to care	Number and percentage of people newly HIV diagnosed linked to care within 12 months of diagnosis in one calendar year
Indicator 4	Number and percentage of PLHIV in care on ART	Number and percentage of people newly HIV diagnosed initiated ART within 12 months of diagnosis in one calendar year
Indicator 5	Number and percentage of PLHIV in care retained	Number and percentage of people newly HIV diagnosed retained in care within 12 months of diagnosis in one calendar year
Indicator 6	Number and percentage of PLHIV virally suppressed.	Number and percentage of people newly HIV diagnosed year virally suppressed within 12 months of diagnosis in one calendar year

2.6. HIV/AIDS Care Organization in Côte d'Ivoire

In this section, the Ivorian Health System is presented followed by a presentation of the Institutions engaged in HIV Control in Côte d'Ivoire.

2.6.1. Health System Organization

The Ivorian Health System is a pyramidal type with 3 levels and 2 sides. One side : manager and the other one : care provider. The health system is dominated by a predominantly public sector and a growing private sector, alongside which traditional medicine plays a relatively important role (Direction de l'Informatique et de l'Information sanitaire, 2019).

The Public Health sector for the care provider side of the Health System is organized according to a three-level health pyramid. The primary level includes Primary Health Care Services, which are Urban and Rural Health Centers, Specialized Urban Health Centers and Urban Health Units. This level also includes health programme activities. The secondary level is composed of the health facilities that are the referral health facilities for the primary level which are General hospitals and Regional Hospitals. The tertiary level is composed of the health facilities which are the referral health facilities for the secondary level : Teaching Hospitals, National Specialized Institutes, the Abidjan Institute of Cardiology, the Raoul Follereau Institute of Côte d'Ivoire, the National Institute of Public Hygiene, the National Institute of Public Health of Côte d'Ivoire, the Pasteur Institute of Côte d'Ivoire and the Emergency Medical Assistance Service (Direction de l'Informatique et de l'Information sanitaire, 2019).

The manager side of the Health System also includes 3 levels. The central level, with the Cabinet of the Ministry of Health (French acronym MSHP), the General Directorate and the attached services and directorates. The central level is responsible for policy definition, support and overall health coordination (Direction de l'Informatique et de l'Information sanitaire, 2019).

The Directorate of Information Technology and Health information is directly attached to the Cabinet of the Ministry of Health. It is responsible for the management and dissemination of health information, as well as the development of the health map. It is also responsible for the integration of new technologies in the health sector in Côte d'Ivoire (Direction de l'Informatique et de l'Information sanitaire, 2017).

The intermediate level encompasses 33 Regional Health Directorates whose mission is to support the Health Districts in the implementation of the Health Policy. Among the 33 Health Regions, we have the Health Region of Abidjan 1 and the Health Region of Abidjan 2.

The peripheral level is composed of 112 Departmental Health Directorates or Health Districts which coordinate the health activities according to their territorial scope and provide operational and logistical support to the health services. The Health District is the operational unit of the Health System. Other ministries, such as those in charge of Defence, Economy and Finance, Civil Service, Women Family and Children, National Education, Justice and Home Affairs are involved in the provision of health care through their health facilities (Direction de l'Informatique et de l'Information sanitaire, 2019).

The private health sector has developed gradually in recent years with the emergence of private health facilities of all categories (polyclinics, clinics, medical centres and practices, private pharmacies and private infirmaries). The faith-based private sector, associations and community-based organisations are also involved in the provision of care, especially at the primary level (Direction de l'Informatique et de l'Information sanitaire, 2019).

These health facilities both in the public and private sectors, provide all HIV-related services and referrals along the HIV Care Cascade. All Health Regions and Health Districts are provided with HIV Care sites but their access remain a concern because not all health facilities are offering HIV care.

2.6.2. Institutions Engaged in HIV Control

A National Program to fight AIDS, STIs and Tuberculosis, (under the french acronym (PNLS / IST / TUB) was created in 1992 (Programme National de Lutte contre le Sida, 2016).

A Ministry delegated to the Prime Minister in charge of the fight against AIDS was created in 2001. In 2004, a Ministry for the Fight against AIDS was created with the role of coordinating the fight against AIDS by taking into account the community component and mobilizing resources (Programme National de Lutte contre le Sida, 2016).

The Ministry of Health and Public Hygiene was then responsible for the medical care of PLHIV. In 2011, the two Ministries merged into the Ministry of Health and AIDS Control, with the french acronym MSLS. This ministry, MSLS no longer exists. The Ministry of Health and Public Hygiene is in charge of all health issues. In 2014, the National AIDS Control Programme (PNLS) was created, replacing the National AIDS Care Programme (PNPEC) (Programme National de Lutte contre le Sida, 2016).

The mission of the National AIDS Control Programme is to coordinate the health sector's response to AIDS and to contribute to the reduction of morbidity and mortality related to STIs and HIV/AIDS through promotional, preventive, curative and research activities (Programme National de Lutte contre le Sida, 2016).

The fight against HIV and STIs is based on a multisectoral and decentralised approach which aims to involve all stakeholders, whether they come from institutions and ministries, health and social professionals or the community and associative fabric, and this is at the national level.

In institutional terms, the political commitment against AIDS is based on the following 3 bodies (Programme National de Lutte contre le Sida, 2016) :

- The National AIDS Control Council (with the french acronym CNLS), created in 2004 and officially installed in 2005, with a political and strategic orientation role, meeting once a year.
- The Partners' Forum, chaired by the Minister of Health and the Fight against AIDS ;
- Decentralized Committees which must ensure the coordination of interventions in the fight against AIDS at the local level (Health Region, Departments, Municipalities, Villages).

Some health programmes contribute to the fight against HIV/AIDS. These include (Programme National de Lutte contre le Sida, 2016) :

- The National Tuberculosis Control Programme (PNLT) ;
- The National Programme for Mother and Child Health (PNSME) ;
- The National Programme for School and University Health (PNSSU)
- The National Nutrition Programme (PNN) ;
- The National Programme to fight against Viral Hepatitis (PNLHV) ;

In line with the international vision, Côte d'Ivoire has committed itself to an accelerated response with a view to taking out the HIV epidemic through the 90 90 90 targets by 2020 (Programme National de Lutte contre le Sida, 2019).

Côte d'Ivoire has adopted the "Test and Treat Policy" for all people tested positive for HIV for full implementation beginning in 2017. The "Test and Treat Policy" is the provision of ART to all PLHIV regardless of their CD4 count, which was previously used as a cut off to begin therapy (World Health Organization et al., 2015b). The "Treat All Policy" is a key strategy for the 90-90-90 targets.

2.7. Summary of the Literature Review

The HIV Care Cascade or the HIV Care Continuum, is a system used to assess how many people are living with HIV and how or whether they are receiving the care they need.

Viral Suppression for PLHIV is the final goal of an HIV treatment programme. For a PLHIV to attain an undetectable VL, they must have access to a continuum of services: HIV testing, linkage to HIV care, access to ART and retainment in care.

There has been a lot of progress at different steps of the HIV Care Cascade, however, significant gaps remain along the HIV Care Cascade in particular in sub-Saharan Africa countries. Around the world, the percentage of all PLHIV with a suppressed VL is lower. There is also a lack of data on the two steps of the HIV Care Cascade, namely Linkage to Care and Retention in Care. This research conducted will contribute to the development of data on the HIV Care Cascade, particularly in sub-Saharan Africa, and to a knowledge of the factors associated with Viral Suppression.

CHAPTER THREE – METHODS

3.1. Study Design

This study was a cross-sectional descriptive one using secondary data of the PLHIV (newly diagnosed and old) followed in the HIV Care Cascade in the Abidjan Health Region until December 2018.

3.2. Study Location

The Study Location was the Abidjan Health Region 1 and the Abidjan Health Region 2 in Côte d'Ivoire. For this study, the Abidjan Health Region 1 and the Abidjan Health Region 2 were combined to become the Abidjan Health Region. I chose Abidjan Health Region because it presents the highest HIV prevalence (3.4%) compared to other Regions (Direction de l'Informatique et de l'Information sanitaire, 2019). Any action in this Region could have an impact on the national HIV prevalence.

3.3. Population and Demographics

The District of Abidjan counted 4,395,243 people at the last census in 2014 (Institut National de la Statistique, Côte d'Ivoire, 2015). Since 2019, Côte d'Ivoire has had a new division of Health Regions that has changed the allocation of Health Regions and Health Districts. In 2018, the Abidjan Health Region 1 included 6 Health Districts namely Adjamé-Plateau-Attécoube, Yopougon-Est, Yopougon-Ouest, Dabou, Grand-Lahou and Jacqueville. The Abidjan Health Region 2 also included 6 Health Districts namely Cocody-Bingerville, Marcory-Treichville, Abobo-Est, Abobo-Ouest, Anyama and Koumassi-Port-Bouet-Vridi. Côte d'Ivoire is located in West Africa in the sub-equatorial zone with an area of 322,462 Km². It is bordered to the North by Burkina Faso and Mali, to the West by Liberia and Guinea, to the East by Ghana and to the South by the Gulf of Guinea.

Figure 1 presents a map of the Abidjan Health Region.

Figure 1 : Map of the Abidjan Health Region

3.4. Organization of the HIV Care

The organization of HIV Care in the Abidjan Health Region is the same as that which was presented for the country in section 2.6.2. In Côte d'Ivoire, there are 2,174 HIV Care sites. In the Abidjan Health Region 1 and in the Abidjan Health Region 2, there are 126 and 137 HIV Care sites respectively.

3.5. Data Source

The study used data from the SIGDEP2, French acronym for an Electronic Patient Record Management Information System that manages the individual data of PLHIV.

Data anonymized was obtained from the Directorate of Information Technology and Health Information, French acronym DIIS.

3.6. Study Population

The study population was the PLHIV (newly diagnosed and old) followed in the HIV Care Cascade in the Abidjan Health Region from 1991 to December 2018.

I present data for all PLHIV in the database and for the PLHIV newly diagnosed. Data from PLHIV newly diagnosed is rarely documented (World Health Organization, 2018).

For PLHIV newly diagnosed, I intentionally selected data from 2014 to 2018 to have a view of the 5 years before 2018.

3.6.1. Inclusion Criteria

All PLHIV followed in the HIV Care sites in Abidjan 1 and Abidjan 2 from 1991 to December 2018 with an Electronic Patient Record.

3.6.2. Exclusion Criteria

PLHIV followed in the HIV Care with half of the data missing and any HIV Care sites in the Abidjan Health Region that did not have data available on the SIGDEP2.

3.7. Description of Study Variables

The description of the study variables is presented in **Table 2a** and **Table 2b**.

Table 2a : Variables of the Study

Variable	Type of variable	Operational definition	Scale of measure
PLHIV diagnosed	Dependent	% of PLHIV who have been diagnosed in the reporting period	Ratio Numerator : Number of PLHIV in the HIV Care Cascade Denominator : Number of PLHIV in the Abidjan Health Region in 2018
Linkage to Care	Dependent	% of PLHIV who have been diagnosed and enrolled within 3 months in the reporting period or % of newly diagnosed people enrolled in HIV care	Ratio Numerator : Number of PLHIV enrolled in HIV Care within 3 months after diagnosis Denominator : Number of PLHIV enrolled in HIV care Or Numerator : Number of PLHIV newly diagnosed enrolled in HIV Care within the past 12 months. Denominator : Number of PLHIV newly diagnosed within the past 12 months.
PLHIV on ART	Dependent	% of PLHIV who have been diagnosed and on ART in the reporting period	Ratio Numerator : Number PLHIV on ART Denominator : Number of PLHIV in the Abidjan Health Region or Number of PLHIV newly diagnosed within the past 12 months.
Retention in Care	Dependent	% of PLHIV alive and on ART in 12, 24, 48 months	Ratio Numerator : Number of ART patients alive on ART Denominator : Number of patients initiating ART up to the reporting period (including PLHIV died since starting ART +those who stopped therapy + those who lost to follow-up) or Number of PLHIV newly diagnosed within the past 12 months.

Table 2b : Variables of the Study

Variable	Type of variable	Operational definition	Scale of measure
Viral Suppression	Dependent	% of PLHIV on ART with a suppressed VL in the 12 months	Ratio Numerator : Number of PLHIV on ART with a suppressed VL in the 12 months Denominator : Number of PLHIV on ART in the 12 months
Age	Independent	Age of PLHIV at time of study	**Numerical and after I categorised** 0-14 yrs 15-19 yrs 20-24 yrs 20-49 yrs >50 yrs
Sex	Independent	Gender	Binary Male Female
Marital status	Independent	PLHIV relationship status	Categorical Single Married Cohabiting Divorced/separated Widow/widower
Educational Status	Independent	Having formal education	Categorical No schooling Primary Secondary Tertiary
Employment	Independent	Employment status	Binary Employed Non employed
Pregnancy status	Independent	Condition within the female body of carrying a developing fetus	Binary Pregnant Non pregnant

3.8. Data Collection Techniques/Methods and Tools

I used data extraction Sheets to compile data for each step of the HIV Care Cascade. The information in the data extraction sheet is presented in **Table 3.**

Table 3 : Data extraction Sheet information for HIV Routine Data Abidjan Health Region

Variables	Operational definitions	Data type
District name	Data requested for in districts	Raw data
HIV Care site name	Name of the HIV care	Raw data
HIV-positive patient age	Age in years or months/ Date of birth	Raw data
HIV-positive patient gender	Male/female	Raw data
HIV-positive patient education level	Education categories in the data	Raw data
HIV-positive patient occupation	Occupational categories in the data	Raw data
HIV-positive patient marital status	Marital categories in the data	Raw data
HIV Testing date	Date on which testing was done	Raw data
Enrolment date for HIV care	Date on which a patient file or chart was opened	Raw data
Partner HIV status	HIV status of the partner (positive or not)	Raw data
Population Type	General or Key Population Key population: Groups who are more vulnerable to HIV due to particular high-risk habits, regardless of the type of epidemic or local context (World Health Organization, 2016a) General population: The whole population of individuals	Raw data
ART initiation date	Date on which the ART was taken for the first time	Raw data
ART status	In progress, discontinued, lost to follow-up	Raw data
Date of the last visit	Last date on which the HIV-positive patient came at the HIV Care site	Raw data
Viral load date	Date on which the viral load test was done	Raw data
Viral load number	Number of viral particles found after the test reported as copies of HIV in a milliliter of blood	Raw data

3.9. Data Management and Quality control : HIV Care Cascade database description

Table 4 describes the HIV database. This database contained 66,625 patients. After elimination of duplicates, 31,182 patients were recorded. I had 4,889 (28.8%) PLHIV from the Abidjan Health Region 1 and 12,405 (71.7%) from the Abidjan Health Region 2. Forty-nine out of 191 HIV Care sites at the Health Districts were included in this study (25.7%). Of these 49 sites, 37 (75.5%) were in the public sector, 7 (14.3%) were in the private sector, and 5 (10.2%) were faith-based.

From the database, the first documented diagnosis of HIV occurred in 1991 and the earliest ART initiation date documented was in 1999. In 2018, data on 8 out of 12 Health Districts in the Abidjan Health Region were presented in the database. Data for the Health Districts of Grand-Lahou, Jacqueville, Dabou and Anyama are absent. Apart from the "Gender" and "Age" variables, there was a lot of missing data in the other variables.

Table 4 : HIV Care database description

Region	Total Number of HIV Care sites	Number of HIV sites involved in the study	Number of HIV-positive patients identified
Abidjan 1			
Adjamé–Plateau-Attécoubé	25	1	649
Yopougon-Est	21	5	3,574
Yopougon-Ouest	27	7	4,678
Abidjan 2			
Abobo-Est	24	11	6,492
Abobo-Ouest	15	6	6,501
Cocody-Bingerville	20	12	4,885
Koumassi-Port Bouët-Vridi	35	6	4,396
Marcory-Treichville	24	1	7
Total	**191**	**49**	**31,182**

3.10. Data Analysis/Statistical Methods

For analysis, I used a cross-sectional cascade analysis for all PLHIV in the database and longitudinal cascade analysis for PLHIV newly diagnosed from 2014 to 2018.

Cross-sectional cascades are more useful for national cascades programmes because they have national estimates of the 90-90-90 targets (World Health Organization, 2018).

Longitudinal cascades are useful for showing the outcomes obtained by individuals over a given period of time (World Health Organization, 2018).

For the cross-sectional analysis, I presented 2 types of HIV Care Cascade, one with the denominator taking into account all PLHIV in the 8 Health Districts by the study and the other with the denominator being the total number of PLHIV diagnosed in the HIV Care Cascade (Centers for Disease Control and Prevention, 2019).

For the longitudinal cascade analysis, the denominator was PLHIV newly diagnosed (World Health Organization, 2018).

Proportions of PLHIV who know their HIV status, linked to care, on ART, retained in care, on ART with Viral Suppression were calculated.

Knowledge of HIV status : to estimate all PLHIV in the Abidjan Health Region , I used data from Spectrum Côte d'Ivoire for the 8 Health Districts involved in the study (UNAIDS, 2020). According to the Spectrum data in 2018, the number of PLHIV in the Health Districts concerned was 148,678 people with 60.5% being women (UNAIDS, 2020).

Linkage to Care : I considered PLHIV diagnosed with an enrolment date for HIV Care within 3 months of the HIV diagnosis because the majority of studies used a three-month delay as an indicator of successful Linkage to Care (Perelman et al., 2018; World Health Organization, 2015).

On ART : I considered only any documented date of ART in the HIV Care Cascade.

Retention in Care : I assessed this step by considering only PLHIV who are alive and on ART (World Health Organization, 2015). In our database, the death was not documented, so to find out if the patient is alive, I considered 2 variables : the ART status and the HIV Care site last visit in 2018. For the ART status, I only took those with the ART status noted in progress, at the beginning or modified in the HIV Care Cascade.

Viral Suppression : I considered any viral load < 1000 copies/ml (World Health Organization, 2015).

The search for socio-demographic factors associated with Viral Suppression was done in 2 stages. First, I did a univariate analysis using the Chi Square at 0.05 significance level.

Then, variables with a p value less than 0.05 were included in a logistic regression model. I calculated unadjusted and adjusted odds ratio.

I included in the analysis the variable « Linkage to Care within 3 months » (LTC_3 months) because some studies have shown that people who have access to care within 30 or 90 days have better health outcomes, including faster viral load suppression (Hall et al., 2016)**.**

I analysed the data using MS Excel 2016 and STATA Version 15.

3.11. Ethical Considerations

My study used secondary data. I requested for the data and obtained permission from the Directorate of Information Technology and Health Information to use data for the study. Data were anonymized before I got it and the anonymity was even more ensured by not presenting data by HIV Care sites and Health Districts. The confidentiality of data was ensured by using a password to have access to the computer where data were stored.

CHAPTER FOUR– MONITORING AND EVALUATION ISSUES OF THE STUDY

4.1. Description of the HIV Care Cascade in Côte d'Ivoire

PLHIV receiving HIV services in Côte d'Ivoire is done through the activities of the National AIDS Control Programme. The objectives on caring for PLHIV are : (Programme National de Lutte contre le Sida, 2016).

- To provide antiretroviral treatment
- To procure treatment and prevention of opportunistic infections
- To conduct biological monitoring and
- To provide complementary care (health promotion, lifestyle and food hygiene, psychosocial and spiritual care, etc.).

Different activities of the programme have led to an increase in : (Programme National de Lutte contre le Sida, 2016; UNAIDS, 2020)

- the number of PLHIV on ART from 158,002 in 2015 to 292,421 in 2018.
- the number of HIV Care sites from 768 in 2014 to 2,174 in 2019**.**

However, challenges remain to be met, such as (Programme National de Lutte contre le Sida, 2016):

- access to ART treatment,
- care for all PLHIV (adults, adolescents and children),
- monitoring and early diagnosis of children by performing PCR. Pediatric HIV Care is still a challenge.

Table 5 shows the different objectives to be achieved through the HIV Care Cascade according to 90 90 90 targets in Cote d'Ivoire.

Table 5: Different steps to be reached through the HIV Care Cascade according to 90 90 90 targets in Cote d'Ivoire (Programme National de Lutte contre le Sida, 2016)

90% PLHIV know their HIV status	**90% PLHIV diagnosed on ART**	**90% PLHIV on ART viral suppressed**
90% SW, MSM, DU, prisoners screened receive test result	95% PLHIV enrolled in care	Viral load available in 100% of health regions
90% migrants, truck drivers, people in uniform screened receive test result	100% SW, MSM, DU, prisoners diagnosed with HIV enrolled in care	Viral load supply ensured for 100% PLHIV on ART
10% general population screened, receive test result each year	100% PLHIV diagnosed enrolled in care receive biological check-up	95% of PLHIV on ART benefit care cascade ART adherence
30% women 15-49 years tested, receive results each year	90% PLHIV on ART kept in care 12 months after initiation of treatment	

To achieve the first and second ninety, the Ivorian national strategic plan focused on the at risk groups and to achieve the last ninety, they focused on the availabilty of viral load tests.

4.2. Type of Evaluation

This study is an evaluation of the outcomes of the HIV Care Cascade which are the 90 90 90 targets. The 5 steps of the HIV Care Cascade were evaluated.

4.3. Study Frameworks

Frameworks present a comprehensive overview of a programme's components and the sequence of the steps and procedures taken to achieve a programme's desired outcomes. It also helps to identify the interactions between each of a programme's components or variables, as well as other internal and external factors that could possibly affect the desired outcomes of the programme (Centers for Disease Control and Prevention, 2018).

4.3.1. Conceptual Framework

A Conceptual Framework is a diagram that describes and exemplifies the interactions between all relevant structural, organizational, individual, or other relevant variables that may affect the execution of the programme and the successful achievement of the objectives of the programme (Centers for Disease Control and Prevention, 2018).

Figure 2 shows the Conceptual Framework of the HIV Care Cascade. The HIV Care Cascade is influenced by both individual and health system factors. HIV testing services influence the knowledge of HIV status. HIV care, which concerns all aspects of HIV-related health services with ART availability, influences the linkage of care as well as to be put on ART.

Therapeutic adherence influences the Retention in Care. Access to viral load (VL) tests screening and therapeutic adherences influence Viral Suppression.

Population characteristics such as age, sex, education and risk groups influence each step of the HIV Care Cascade. HIV incidence and mortality are influenced by the HIV Care Cascade. This evaluation was not aimed at examining HIV incidence and mortality.

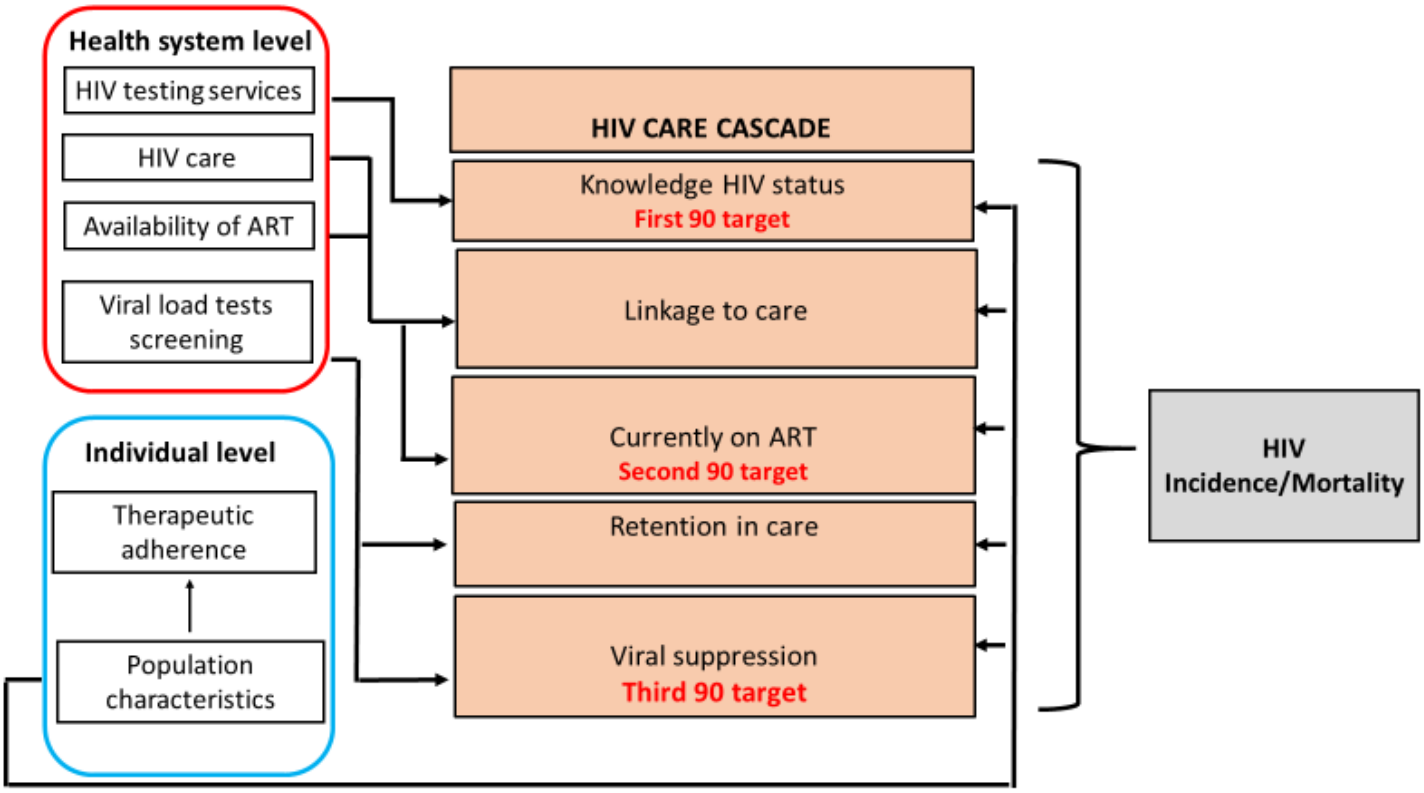

Figure 2 : Conceptual Framework of the HIV Care Cascade

4.3.2. Logic Model

A Logic Model is a graphical representation that shows the mutual relationships between a programme's resources, processes or activities, outputs and the outcomes/impacts of it. It describes the link between the activities of your programme and its expected effects, with an implicit "if-then" relationship between programme elements (Centers for Disease Control and Prevention, 2019b).

A Logic Model is presented in **Figure 3**.

Inputs are the resources invested by the health sector in the response to HIV Control and Management. They include Health Workforce, Infrastructures, Products, Governance and Financial Resources. Inputs are used to set up the activities or processes. Examples of processes are Testing, ART dispensing and Viral Load screening. The immediate results of the processes are outputs such as number of tests performed, number of ART dispensed and number of Viral Load tests performed. The outputs are expected to achieve outcomes and in the case of HIV, the outcomes are knowing HIV status, ART coverage and Viral Suppression.

In the Logic Model presented in Figure 3, the impact of the model was not not considered as it is not part of the objectives of the evaluation.

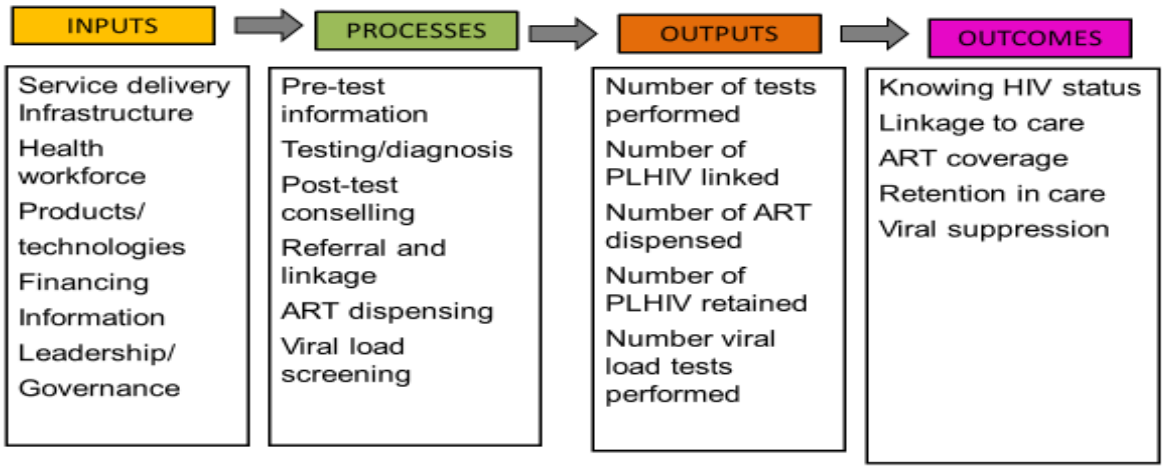

Figure 3 : Logic Model

4.4. Definition of Indicators

Table 6 presents indicators and scale of measurement for each indicator.

Table 6 : Study indicators and scale of measurement

Indicators	Scale of measure
PLHIV diagnosed	Ratio Numerator : Number of PLHIV in the HIV Care Cascade Denominator : Number of PLHIV in the Abidjan Health Region in 2018
Linkage to Care	Ratio Numerator : Number of PLHIV enrolled in HIV Care within 3 months after diagnosis Denominator : Number of PLHIV enrolled in HIV care Or Numerator : Number of PLHIV newly diagnosed enrolled in HIV Care within the past 12 months. Denominator : Number of PLHIV newly diagnosed within the past 12 months.
PLHIV on ART	Ratio Numerator : Number PLHIV on ART Denominator : Number of PLHIV in the Abidjan Health Region or Number of PLHIV newly diagnosed within the past 12 months.
Retention in Care	Ratio Numerator : Number of ART patients alive on ART Denominator : Number of patients initiating ART up to the reporting period (including PLHIV died since starting ART +those who stopped therapy + those who lost to follow-up) or Number of PLHIV newly diagnosed within the past 12 months.
Viral Suppression	Ratio Numerator : Number of PLHIV on ART who have a suppressed viral load in the 12 months Denominator : Number of PLHIV on ART in the 12 months

CHAPTER FIVE – RESULTS

5.1. Socio-demographic Characteristics of the PLHIV in the Abidjan Health Region

Table 7a and Table 7b show the socio-demographic Characteristics of PLHIV. Among patients, 29,813 (95.7%) were adults (> 15 years old) and 23,895 (76.6%) were females. The minimum age of PLHIV was 2 months and the maximum was 89 years old. Median age was 39.24 years old ± 12.29161 years old. Among adults, age group between 25 and 49 years old was the most represented 22,314 (71.6%).

Among adults with data available, 7,525 (54.1%) and 2,999 (21.5%) had a primary and tertiary school education respectively. PLHIV who were single 10,623 (39.3%), in cohabitation 7,851 (29%) and married 6,908 (25.5%) accounted for more than 90% of the PLHIV in the HIV Care Cascade. Among adults, 5,164 (73%) were employed, 29,944 (99.6%) were from the general population and 13,627 (78.9%) had an HIV-negative partner.

For those who were employed 2,677 (51.8%) worked in marketing services as traders. Among women with data available, 11,450 (94.1%) were not pregnant.

Table 7a: Socio-demographic Characteristics of the PLHIV, Abidjan (N = 31,182)

Characteristics	Number	Percentage (%)
Sex		
Male	7,287	23.4
Female	23,895	76.6
Age Group		
0-14	1350	4.3
15-19	497	1.6
20-24	1,125	3.6
25-49	22,314	71.6
>50	5,877	18.9
Educational status >15 yrs (N= 13,907)		
No schooling	1,733	12.5
Primary	7,525	54.1
Secondary	1,650	11.9
Tertiary	2,999	21.5
Marital status >15 yrs (N= 27,052)		
Single	10,623	39.3
Married	6,908	25.5
Cohabiting	7,851	29.0
Divorced/separated	250	0.9
Widowed	1,420	5.3

Table 7b : Socio-demographic Characteristics of PLHIV, Abidjan (N = 31,182)

Characteristics	Number	Percentage (%)
Occupation >15 yrs (N= 7,073)		
No employment	1,909	27.0
Employment	5,164	73.0
Population type (N= 30,069)		
General	24,944	99.6
Key population	125	0.4
Partner HIV Status >15 yrs (N= 17,261)		
Positive	3,634	21.1
Negative	13,627	78.9
Pregnancy status (N= 12,168)		
Pregnant	718	5.9
Not pregnant	11,450	94.1

5.2. Proportion of PLHIV with knowledge on their HIV status

In the HIV Care Cascade, 29,324 out of 31,182 PLHIV had their testing date clearly stated.

5.2.1. Cross sectional analysis of PLHIV with knowledge of their HIV Status

When the number of PLHIV (148,678) in the Abidjan Health Region was taken as a denominator, the proportion of PLHIV with knowledge of their HIV status from the HIV Care Cascade data was 31,182 (21%) (31,182/148,678) ; 95% CI [20.52 - 21.42].

5.2.2. Longitudinal cascade analysis of PLHIV newly diagnosed

However, using the longitudinal cascade analysis, in **Figure 4**, I observed that the number of PLHIV newly diagnosed increased each year approximately from 12 to 15%. From 2017 to 2018, there has been an increase in PLHIV newly diagnosed by more than 50%.

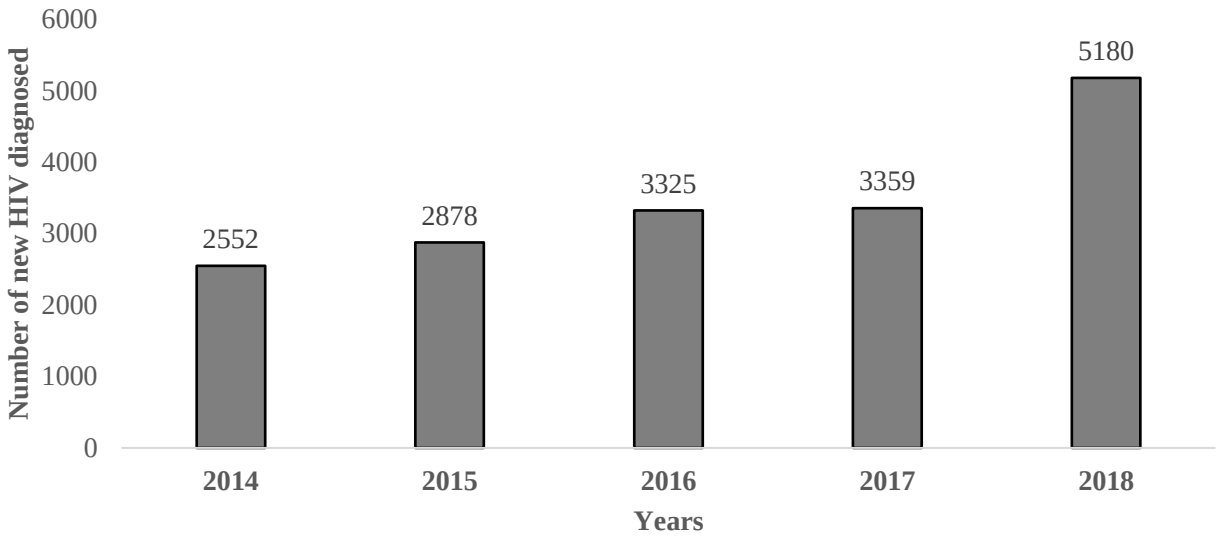

Figure 4 : Number of PLHIV newly diagnosed in the Abidjan Health Region from 2014 to 2018

5.3. Linkage to Care

The number of PLHIV linked to care within 3 months of the HIV diagnosis were 24,247 people out of 29,324 PLHIV with a testing date clearly stated.

5.3.1. Cross-sectional cascade analysis of PLHIV linked to care

When the number of PLHIV (148,678) in the Abidjan Health Region was taken as a denominator, the proportion of PLHIV linked to care was 29,324 (16.31%) (29,324/148,678) ; 95% CI [15.85 - 16.78]. Among PLHIV diagnosed with HIV from Care Cascade data, the proportion of PLHIV linked to care was 24,247 (82.7%) (24,247/29,324) ; 95% CI [82.22 - 83.18].

5.3.2. Longitudinal cascade analysis of PLHIV linked to care

In **Figure 5,** the proportion of PLHIV newly diagnosed and linked to HIV Care increased each year. The proportion of PLHIV newly diagnosed and linked to HIV Care from 2014 to 2018 was 15,839 (91.6%) (15,839/17,294) ; 95% CI [91.17 - 92.03].

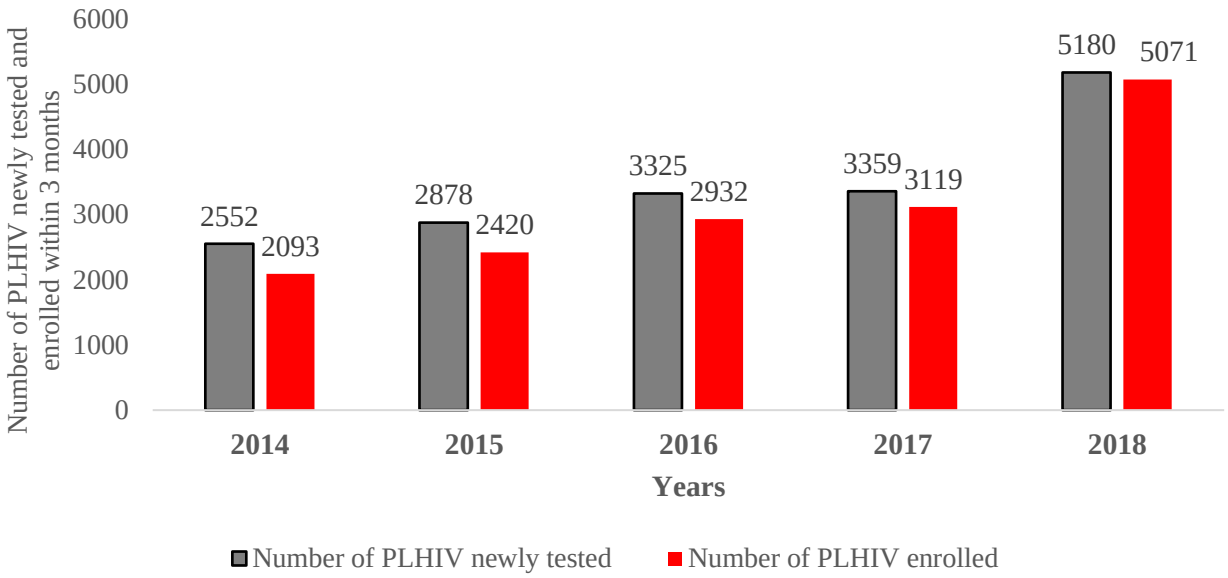

Figure 5 : Proportion of PLHIV newly diagnosed and linked to HIV Care from 2014 to 2018

5.4. ART initiation

The number of PLHIV linked to care within 3 months of the HIV diagnosis and on ART with a noted ART initiation date was 22,280 people.

5.4.1. Cross-sectional cascade analysis of ART initiation

When the number of PLHIV (148,678) in the Abidjan Health Region was taken as a denominator, the proportion of PLHIV on ART was 15% (22,280/148,678) ; 95% CI [14.53 - 15.47].

Among PLHIV diagnosed in the HIV Care Cascade data, the number of PLHIV linked to care within 3 months of the HIV diagnosis were 24,247 people. The proportion of PLHIV on ART was 22,280 (91.9%) (22,280/24,247) ; 95% CI [91.53 - 92.25].

5.4.2. Longitudinal cascade analysis of ART initiation

In **Figure 6,** the proportion of PLHIV newly diagnosed and who initiated ART in one calendar year increased. The proportion of PLHIV newly diagnosed and initiating ART from 2014 to 2018 was 12,931 (74.8%) (12,931/17,294) ; 95% CI [74.02 - 75.52].

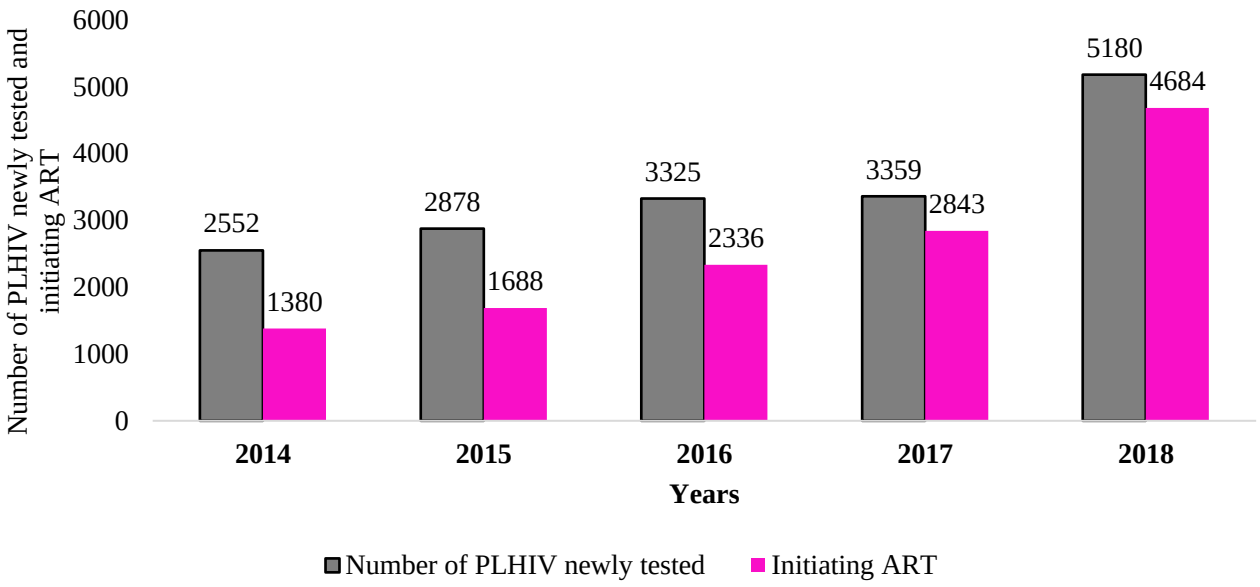

Figure 6 : Proportion of PLHIV newly diagnosed and on ART from 2014 to 2018

5.5. Retention in Care

The number of PLHIV on ART and alive was 20,708 people.

5.5.1. Cross-sectional cascade analysis of Retention in Care

When the number of PLHIV (148,678) in the Abidjan Health Region was taken as a denominator, the proportion of PLHIV retained in care was 13.9% (20,708/148,678) ; 95% CI [13.46 - 14.40].

Among PLHIV diagnosed in the HIV Care Cascade data, the number of PLHIV on ART with a noted ART initiation date was 22,280 people. The proportion of PLHIV retained in care was 20,708 (92.9%) (20,708/22,280) ; 95% CI [92.59, 93.29].

5.5.2. Longitudinal cascade analysis of Retention in Care

In **Figure 7,** the proportion of PLHIV newly diagnosed and retained in care within 12 months of the diagnosis increased. The proportion of PLHIV newly diagnosed and retained in care from 2014 to 2018 was 12,207 (70.6%) (12,207/17,294) ; 95% CI [69.79, 71.40].

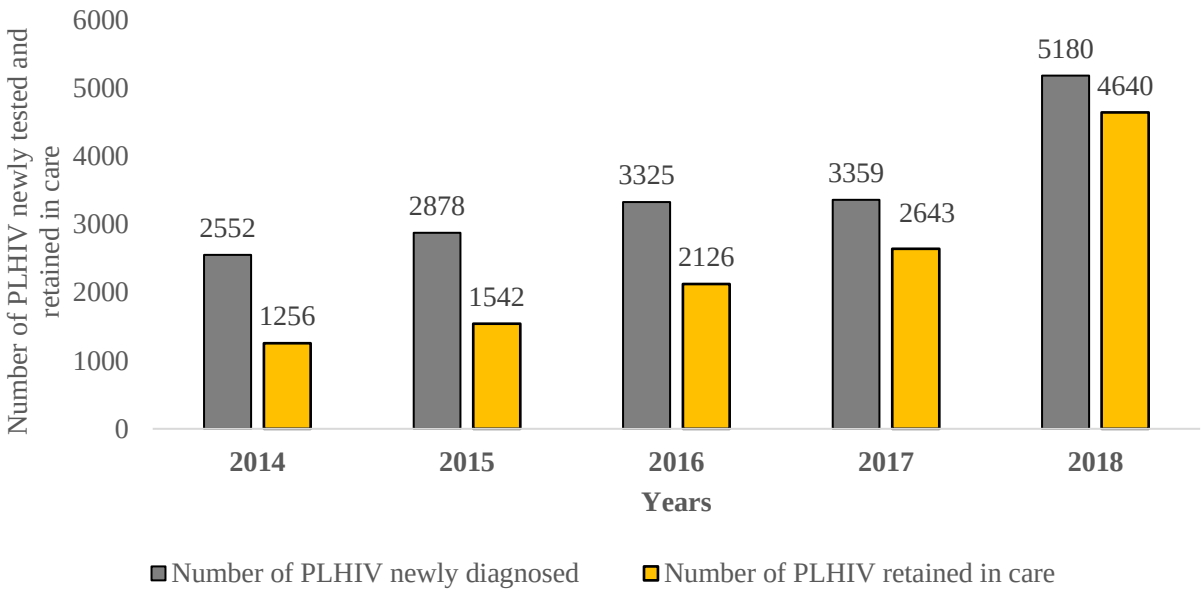

Figure 7 : Proportion of PLHIV newly diagnosed and retained in care from 2014 to 2018

5.6. Viral Suppression

The number of PLHIV on ART with a suppressed viral load (VL) was 11,944 people.

5.6.1. Cross-sectional cascade analysis of Viral Suppression

When the number of PLHIV (148,678) in the Abidjan Health Region was taken as a denominator, the proportion of PLHIV with VL suppression was 11,944 (8%) (11,944/148,678) ; 95% CI [7.54 - 8.52].

Among PLHIV diagnosed in the HIV Care Cascade data, the number of PLHIV on ART was 22,280 people. The proportion of PLHIV with VL suppression was 11,944 (53.6%) (11,944/22,280) ; 95% CI [52.72 - 54.50].

5.6.2. Longitudinal cascade analysis of Viral Suppression

In **Figure 8,** the proportion of PLHIV newly diagnosed and viral suppressed increased from 894 (35%) in 2014 to 1751 (52.3%) in 2017. In 2018, this proportion was the lowest, about 670 (12.9%). The proportion of PLHIV with viral load suppression was 5,932 (34.3%) (5,932/17,294) ; 95% CI [33.09, 35.51].

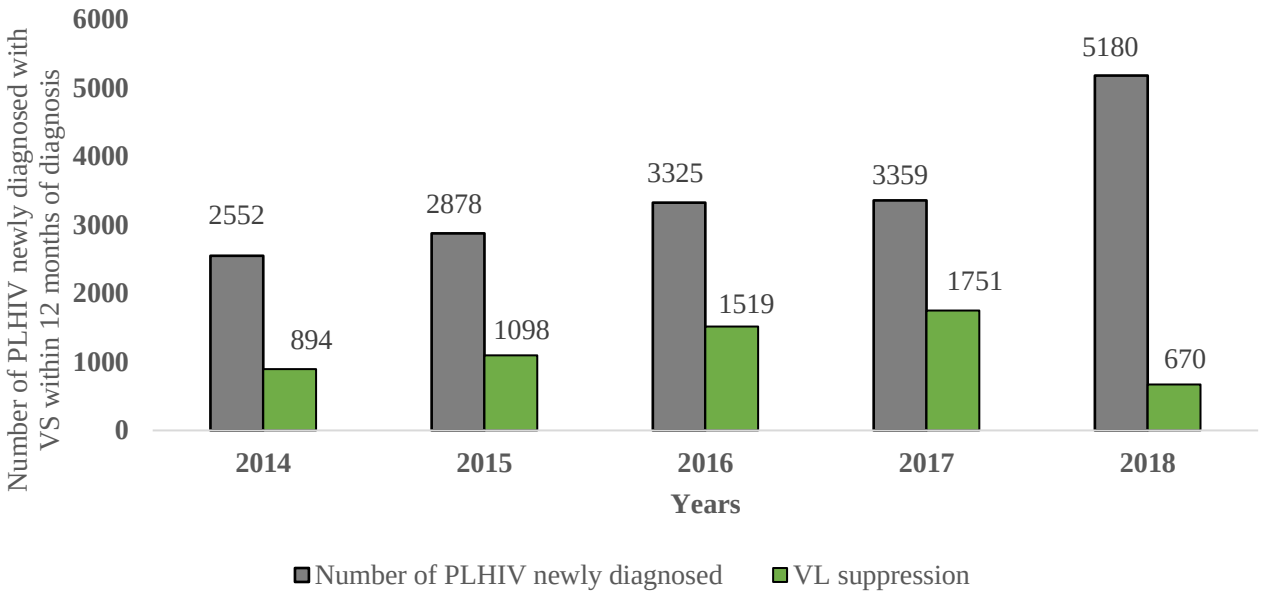

Figure 8 : Proportion of PLHIV newly diagnosed and viral suppressed from 2014 to 2018

5.7. Cross-sectional HIV Care Cascade among all PLHIV in the Abidjan Health Region

Among all PLHIV in the Abidjan Health Region in 2018, 31,182 (21%) were diagnosed, 124,247 (16 %) were linked to care, 22,280 (15%) initiated ART, 20,708 (14%) were retained in care and 11,944 (8%) achieved Viral Suppression (**Figure 9**).

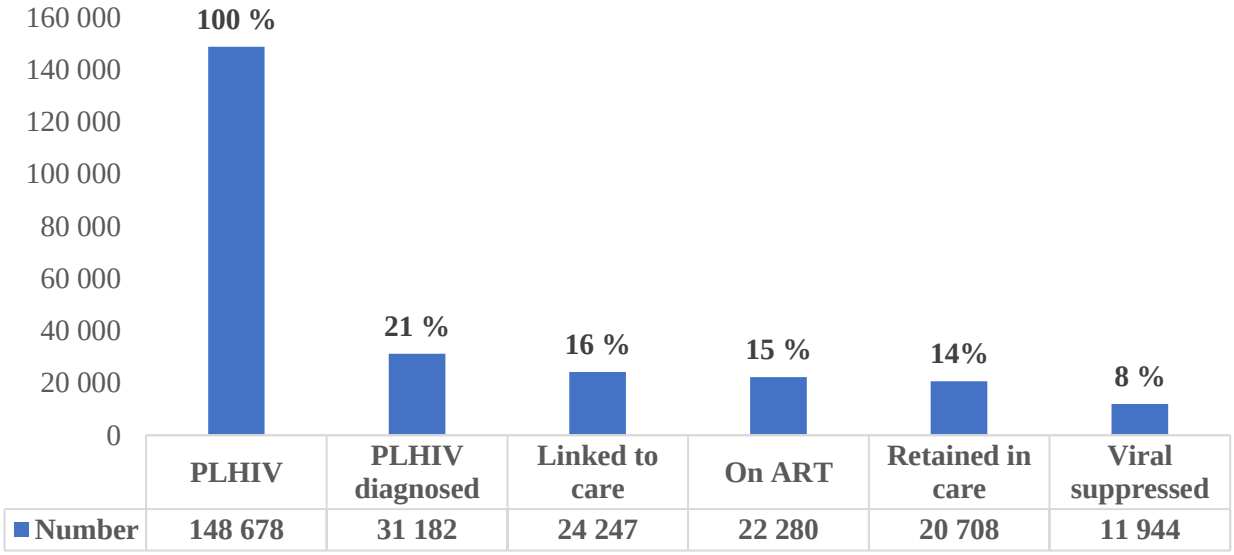

Figure 9 : Cross-sectional HIV Care Cascade, the Abidjan Health Region, 2018

5.8. Cross-sectional HIV Care Cascade among PLHIV diagnosed

Among PLHIV diagnosed in the HIV Care Cascade in 2018, 24,247 (83%) were linked to care, 22,280 (92%) of those linked to care were on ART, 20,708 (93%) of those on ART were retained in care and 11,944 (58%) of those on ART achieved Viral Suppression (**Figure 10**). Expressing these results in terms of progress towards achievement of the 90 90 90 targets, among PLHIV diagnosed in the Abidjan Health Region in 2018, 22,280 (76%) were on ART and 11,944 (53.6%) of those on ART achieved Viral Suppression.

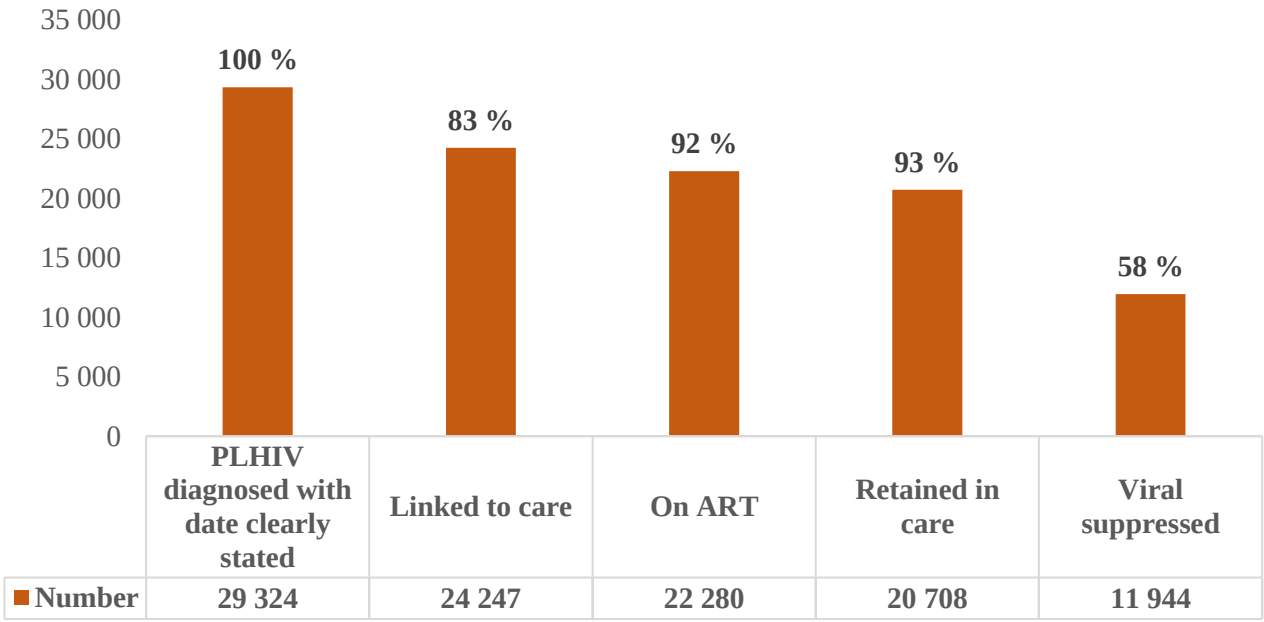

Figure 3 : Cross-sectional HIV Care Cascade among PLHIV diagnosed, the Abidjan Health Region, 2018

5.9. Longitudinal care cascade among PLHIV newly diagnosed

Among PLHIV newly diagnosed from 2014 to 2018 in the Abidjan Health Region, 15,839 (92%) were linked to care, 12,931 (75%) initiated ART, 12,207 (71%) were retained in care and 5,932 (34%) achieved Viral Suppression (**Figure 11**).

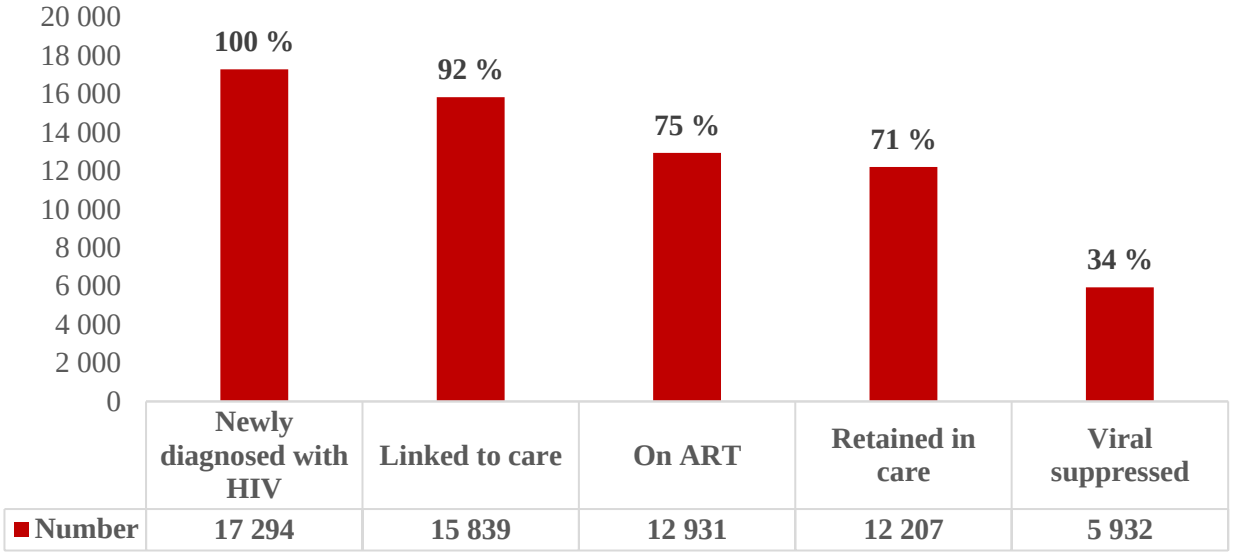

Figure 4 : Longitudinal HIV Care Cascade among PLHIV newly diagnosed, the Abidjan Health Region from 2014 to 2018

5.10. Factors Associated with Viral Suppression

In the HIV Care Cascade, PLHIV with viral load test were 19,043 regardless of the steps of the HIV Care Cascade.

5.10.1. Univariate analysis of Factors Associated with Viral Suppression

Table 8 shows associations between Viral Suppression and socio-demographics factors which were age group, educational level, marital status and Linkage to Care within 3 months of the HIV diagnosis. PLHIV between 25 and 49 years old and over 50 years old constituted 80% of the observation of Viral Suppression ($p< 0.001$). PLHIV with primary and tertiary school education constituted 71% of the observation of Viral Suppression ($p=0.005$). PLHIV who are single, married and cohabiting constituted 77% of observation of Viral Suppression. Viral Suppression was more observed among PLHIV linked in care within 3 months of HIV diagnosis ($p< 0.001$).

Table 8 : Associations between Viral Suppression and socio-demographics and Health System factors (N=19,043)

Independent variables	Viral suppressed (%)		Pearson Chi 2	P
	Yes	No		
Sex				
Male	3,371 (17.70)	740 (3.89)	0.1064	0.744
Female	12,277 (64.47)	2,655 (13.94)		
Age group (years)				
0-14	91 (0.48)	45 (0.24)		
15-19	76 (0.40)	49 (0.26)		
20-24	359 (1.89)	103 (0.54)	12.9321	**< 0.001*** **
25-49	11,646 (61.16)	2,655 (13.94)		
>50	3,474 (18.24)	543 (2.85)		
Educational status				
No schooling	439 (5.54)	107 (1.35)		
Primary	4,013 (50.66)	882 (11.13)		
Secondary	514 (6.49)	109 (1.38)	123.1250	**0.005** **
Tertiary	1,585 (20.01)	272 (3.43)		
Marital status				
Single	5,491 (31.84)	1,211 (7.02)		
Married	4,069 (23.59)	871 (5.05)		
Cohabiting	3,727 (21.67)	785 (4.55)	20.5682	**< 0.001*** **
Divorced/separated	129 (0.75)	32 (0.19)		
Widowed	810 (4.70)	112 (0.65)		
Occupation				
Employed	1,907 (62.44)	375 (12.28)		
Non employed	633 (20.73)	139 (4.55)	1.0187	0.313
Partner HIV status				
Positive	1,864 (17.04)	397 (3.63)	1.2479	0.264
Negative	7,064 (64.59)	1,612 (14.74)		
Population type				
General	13,985 (82.12)	3,023 (17.75)	5.5896	0.348
Key population	19 (0.11)	3 (0.02)		
Pregnancy status				
Pregnant	198 (2.28)	31 (0.36)	3.3599	0.067
Not pregnant	6, 899 (79.57)	1,542 (17.79)		
LTC_3 months				
Linked	12,745 (66.93)	2,665 (13.99)	20.0888	**< 0.001*** **
Not linked	2,903 (15.24)	729 (3.83)		

*** Highly statiscally significant ** Very statiscally significant * Statiscally significant

5.10.2. Multivariate analysis of Factors Associated with Viral Suppression

Table 9 presents in adjusted analysis that the age between 20 and 24 years old (AOR= 0.63 ; 95% CI [0.43 - 0.94]), between 25 and 49 years old (AOR= 0.71 ; 95% CI [0.60 - 0.84]), the marital status single (AOR= 0.84 ; 95% CI [0.72- 0.98]) and married (AOR= 0.84 ; 95% CI [0.71 - 0.99]) were more conducive to achieving Viral Suppression than the reference. PLHIV over 50 years old (AOR= 0.71 ; 95% CI [0.60 - 0.84]) were 1.4 times more likely to have Viral Suppression than the reference. PLHIV with tertiary school education were 1.5 times more likely to have Viral Suppression than the reference (AOR= 1.50 ; 95% CI [1.15 - 1.95]).

Table 9 : Binary logistic regression model of factors associated with Viral Suppression

Independent variables	Unadjusted logistic regression		Adjusted logistic regression	
	COR [95% CI]	**P-value**	**AOR [95% CI]**	**P-value**
Age group (years)				
0-14	1.00 [reference]		1.00 [reference]	
15-19	0.77 [0.46 - 1.27]	0.305		
20-24	1.72 [1.13 - 2.62]	**0.011***	0.63 [0.43 - 0.94]	**0.023***
25-49	2.17 [1.51 - 3.11]	**< 0.001*****	0.71 [0.60 - 0.84]	**< 0.001*****
>50	3.16 [2.19 - 4.57]	**< 0.001*****	1.4 [1.21 - 1.60]	**< 0.001*****
Educational status				
No schooling	1.00 [reference]		1.00 [reference]	
Primary	1.11 [0.89 - 1.39]	0.364	1.14 [0.90 - 1.45]	0.273
Secondary	1.15 [0.86 - 1.54]	0.356	1.24 [0.90 - 1.70]	0.184
Tertiary	1.42 [0.86 - 1.54]	**0.005****	1.50 [1.15 - 1.95]	**0.003****
Marital status				
Single	0.95 [0.86 - 1.05]	0.335	0.84 [0.72 - 0.98]	**0.026***
Married	0.98 [0.88 - 1.09]	0.728	0.84 [0.71 – 0.99]	**0.041***
Cohabiting	1.00 [reference]		1.00 [reference]	
Divorced/separated	0.84 [0.57 - 1.26]	0.409	0.69 [0.38 - 1.25]	0.224
Widowed	1.52 [1.23 - 1.88]	**< 0.001*****	1.08 [0.78 - 1.51]	0.646
LTC_3 months				
Linked	1.18 [1.08 - 1.29]	**< 0.001*****	1.10 [0.95 - 1.27]	0.197
Not Linked	1.00 [reference]		1.00 [reference]	

*** Highly statiscally significant ** Very statiscally significant * Statiscally significant

CHAPTER SIX – DISCUSSION

The objective of this study was to evaluate the HIV Care Cascade in the Abidjan Health Region in Côte d'Ivoire from routine programme data using cross-sectional and longitudinal cascade analysis. I found that in the HIV Care Cascade, 4 out of 5 PLHIV were women and 7 out of 10 PLHIV were between 25 and 49 years old. Among all PLHIV in the Abidjan Health Region, only 1 out of 5 PLHIV knew their HIV status, 3 out of 20 PLHIV were on ART and 2 out of 25 PLHIV had Viral Suppression. Among PLHIV diagnosed in the HIV Care Cascade, 4 out of 5 were linked to care, 9 out of 10 PLHIV linked to care were on ART, 9 out of 10 of those on ART were retained in care, and 3 out of 5 of those on ART had Viral Suppression. A PLHIV newly diagnosed in the Abidjan Health Region had a 90% chance to be linked to care within 3 months, a 75% chance to be on ART, a 70% chance to be retained in care and a 34% chance to have Viral Suppression after 12 months of diagnosis. Age over 20 years old, tertiary school education, single and married marital status were associated with Viral Suppression. This study made several important findings that can shed light on the HIV Care Cascade and the achievement of the 90-90-90 targets in the Abidjan Health Region.

6.1. The HIV Care Cascade

The socio-demographic profile of PLHIV diagnosed in the HIV Care Cascade indicates that young adult women are more affected by AIDS than men at the same age in Côte d'Ivoire as is the case in different developing countries around the world (UNAIDS, 2019c).

From 2014 to 2018 in the Abidjan Health Region, the proportion of PLHIV newly diagnosed, linked to care, on ART, retained in care and viral suppressed increased over time. This increase has also been observed in an other HIV Care Cascade study in Haiti (Auld et al., 2017). In this country, new HIV diagnoses, care enrolments and ART enrolments increased from 2002 to 2004 and from 2011 to 2013 by 1.2 to 1.5 times.

This was explained by the fact that there have been improvements in HIV Care through donor assistance. In Côte d'Ivoire the same conclusion can also be reached.

The WHO 2015 recommendation of test and treat policy which took effect in 2017 in Côte d'Ivoire could explain the 50% increase of PLHIV newly diagnosed from 2017 to 2018 observed in this study.

This study observed that within the HIV Care Cascade for PLHIV diagnosed and newly diagnosed, Linkage to Care (80 and 90%) and Retention in Care (70 and 90%) were effective which could indicate the performance of the programme being effective in linking people newly HIV diagnosed and their retention in the HIV care. Compared to other studies, the reported proportion of LTC and Retention in Care were approximatively similar. For instance, in Canada in 2013, in 19 European countries from 2006 to 2017, and in the USA in 2015 the majority of people diagnosed with HIV infection, approximately 82% to 85%, are linked to care within three months (Amanda Giacomazzo, 2019; Croxford et al., 2018). A WHO report in 2011 showed that in low and middle income countries the average Retention in Care was 81% at 12 months after ART initiation (World Health Organization, 2016b).

However compared to other studies, Linkage to Care found within this HIV Care Cascade (83% for PLHIV diagnosed and 92% for PLHIV newly diagnosed) was high. For instance, in Haiti from 2002 to 2015, and in the North West Province in South Africa between 2014 and 2016, Linkage to Care was 49% (Auld et al., 2017) and 58.4% (Lippman et al., 2019) respectively. In a review of the literature in Subsaharan Africa on provider-initiated testing and counselling programmes in the hospital setting, most of the studies documented a proportion of Linkage to Care range from 42% to 70% (Kranzer et al., 2012). In Northern Tanzania between 2008 to 2012, and in Nairobi (Kenya) from 2013 to 2015, 70% of PLHIV were linked to care within 3 months of their diagnosis (Reddy et al., 2016; van der Kop et al., 2016).

The difference might be because of the high burden of the HIV in most countries concerned and the overcrowding of their HIV services which diminishes their effectiveness in Linkage to Care (Lambdin et al., 2011; MacPherson et al., 2012; Wouters et al., 2008).

6.2. The 90 90 90 targets

The denominator used to calculate PLHIV at each step of the HIV Care Cascade influences the outcomes of the findings (World Health Organization, 2018). Nevertheless, whether one considers all PLHIV at the level of the Abidjan Health Region or only the number of PLHIV within each step of the HIV Care Cascade, the 90 90 90 targets have not been achieved in this study (UNAIDS, 2014).

The 90 90 90 targets found in the Abidjan Health Region were much lower than the national average which was 63% of PLHIV knew their status, 55% were on ART and 41% had Viral Suppression in 2018 (UNAIDS, 2019b). This can be explained by the fact that in this study only the HIV Care sites with data present in the SIGDEP2 were used.

Among PLHIV newly diagnosed in the HIV Care Cascade from 2014 to 2018 (17,294), the targets in the Abidjan Health Region remain below the ART coverage's target and the Viral Suppression's target which should have been 15,565 (90%) and 14,008 (81%) respectively instead of the 12,931 (75%) and 5,932 (34%) as observed.

When comparing the ART coverage among PLHIV newly diagnosed to other HIV Care Cascades, it is observed that it is higher compared, to that reported in Haiti 60% in 2015 (Auld et al., 2017), in the United States 37% in 2011 (Bradley et al., 2014), and among black people with diagnosed HIV 46.2% in 2010 (Whiteside et al., 2014). This difference could be explained by the fact that this HIV Care Cascade contains data from 2017, which saw a sharp increase in ART coverage among PLHIV in developing countries (UNAIDS, 2019c).

In the North West Province in South Africa in 2016 and in Oman in 2018, the ART coverage was higher than that reported in this study, 91.5% and 84.3% respectively (Elgalib et al., 2019; Lippman et al., 2019). In a country like Oman, this difference might be due to the country's constant supply of ART and the elevated rate of late diagnosis of HIV (Elgalib et al., 2019).

When comparing Viral Suppression among PLHIV diagnosed (58%) and PLHIV newly diagnosed (34%) to other HIV Care Cascades studies, it was noted that the Viral Suppression of 73.7% in Oman in 2018, of 72% in East Ehiopia in 2018, of 87% in Zimbabwe in 2017 and of 93% in Vietnam in 2016 was higher than that observed in the Abidjan Health Region in 2018 (J. H. Ali & Yirtaw, 2019; Elgalib et al., 2019; Rangarajan et al., 2016; Sithole et al., 2018). This difference might be due to the high level of ART adherence among PLHIV on ART in other HIV Care Cascades (Rangarajan et al., 2016) and the weakness of the biological and virological monitoring at the level of the Health Facilities in Côte d'Ivoire (Programme National de Lutte contre le Sida, 2016).

6.3. Factors associated with Viral Suppression

Viral Suppression is a measure of the effectiveness of treatment and the decrease in possible transmission (World Health Organization, 2015). In the Abidjan Health Region, those aged over 20 years old, tertiary school education, single and married marital status were associated with Viral Suppression. Some studies showed that people from 24 years old had good ART adherence (Cohen et al., 2014) and between 30 and 39 years old, they had a minimum of 92 days to achieve Viral Suppression (J. H. Ali & Yirtaw, 2019). This might be explained by the fact that over 20 years old, people are in a period of their life where they are more responsible and more attentive to their health over the years so they are more adherent to the treatment.

Being single may encourage the desire for Viral Suppression that may lead to the prospect of union as for being married may allow for the moral support of a partner during HIV Care (J. H. Ali & Yirtaw, 2019; Dessie et al., 2020).

Having a tertiary school education could increase awareness of treatment and illness, access to health care that promotes good adherence to treatment (Dessie et al., 2020).

In this study, gender was not associated with Viral Suppression. This finding is accordant with other studies that showed there was no difference in Viral Suppression proportions between men and women (J. H. Ali & Yirtaw, 2019; Floridia et al., 2008; Rangarajan et al., 2016).

6.4. Limitations of the Study

This study used secondary data and thus data on HIV stigmatization, social exclusion and discrimination were not available thus limiting the factors that could affect the HIV/AIDS cascade. However, the high rates of Linkage to Care and Retention in Care suggest that their effect did not have a large impact on outcomes.

This study was a single-source cascade. Some HIV Care sites did not have their data on SIGDEP2 so the lack of data from some of the HIV Care sites and also missing patient values may have affected the outcomes. However, the high number of PLHIV in this HIV Care Cascade, more than 30,000, might minimize the impact on outcomes. Other studies have indicated a large amount of missing and incomplete data, as is often the case when using data from routine programmes (Auld et al., 2017; World Health Organization, 2018). This fact did not call into question the validity of the study results.

Data for the Health Districts of Grand-Lahou, Jacqueville, Dabou and Anyama are absent in the database. Out of all the HIV Care sites present in the Abidjan Health Region 1 and Abidjan Health Region 2 (263 in total), the HIV Care sites from these 4 Health Districts represent about 72 (27.4%). Their non-inclusion will not significantly affect the results.

Despite the limitations of the study, it is the first study to our knowledge that presents, on the one hand, the outcomes of the HIV Care Cascade of PLHIV in the Abidjan Health Region in Côte d'Ivoire, and on the other hand, the progression of any PLHIV newly diagnosed at the different steps of HIV Care in 2018.

CHAPTER SEVEN – CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

The HIV Care Cascade is a helpful tool to identify and quantify gaps along the HIV Care Cascade, and to link programmes services to their outcomes such as the 90 90 90 targets. In the Abidjan Health Region, the HIV Care Cascade evaluation shows :

- Gaps in reaching all PLHIV to know their status and engage them in HIV Care (the gap was 69%).
- Among PLHIV diagnosed and newly diagnosed, the programme is effective in linkage and Retention in Care.
- Among PLHIV newly diagnosed, ART coverage and Viral Suppression are below the 90 90 90 targets to 75% and 34% respectively instead of 90% and 81%.
- PLHIV with the following socio-demographic characteristics : over 20 years old, single, married, tertiary school education are more likely to achieve Viral Suppression**.**

7.2.Recommendations

These following recommendations are essentially addressed to 2 organizations : The Directorate of Information Technology and Health Information and the National Aids Control Programme.

7.2.1. The Directorate of Information Technology and Health Information

The capacity to analyse the outcomes of the HIV Care Cascade is strongly determined by the availability and quality of data that go into the HIV Care Cascade. Efforts must be made to improve data quality in terms of validity, completeness, accuracy and representativeness. It is important to regularly assess data quality and provide feedback to those who enter data into the software.

All HIV Care sites in the Abidjan Health Region should be linked to the Electronic Patient Record Management Information System which will provide more complete and accurate data for all Health Districts in the Abidjan Health Region.

7.2.2. The National AIDS Control Programme

Linkage to Care and Retention in Care are calculated differently in various countries all around the world. I did not find any national criteria for these 2 variables. It is therefore important to establish and have national criteria so that comparisons can be made over time using the same methods. Data from the SIGDEP2 did not contain any patient death data. It is important to establish how to assess PLHIV who are alive along the HIV Care Cascade.

My Findings showed that the HIV Care Cascade needs to be improved by addressing the gaps in the ART coverage and the Viral Suppression. In the Abidjan Health Region, strategies that improve HIV diagnosis, ART coverage and Viral Suppression should be put in place. I recommend that before using strategies for improving ART coverage, it is crucial to evaluate the ART adherence among PLHIV diagnosed (World Health Organization, 2018).

My findings also showed that children and adolescents were underrepresented in the database. I recommend that interventions targeting children aged 0 to 14 years old and adolescents aged 15 to 19 years old living with HIV must be put in place to promote better HIV Care in these age groups.

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